<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>Wednesday, January 12  AAHS Program</td>
<td></td>
</tr>
<tr>
<td>6:30 - 7 am</td>
<td>Breakfast/Exhibits</td>
</tr>
<tr>
<td>7:8 am</td>
<td>Instructional Courses</td>
</tr>
<tr>
<td>8:10-9:30 am</td>
<td>Welcome &amp; Panel: Should I Have Surgery? Will Therapy Help? What is the Evidence?</td>
</tr>
<tr>
<td>9:30-10:30 am</td>
<td>Panel: New Technologies in Upper Extremity Medical &amp; Surgical Care - Current Perspectives</td>
</tr>
<tr>
<td>10:30 -10:50 am</td>
<td>Break/Exhibits</td>
</tr>
<tr>
<td>10:50 -11:30 am</td>
<td>Panel: Troublesome Fractures in the Hand</td>
</tr>
<tr>
<td>11:30 am-12 pm</td>
<td>Invited Guest Lecture - Stephen Sullivan, MD</td>
</tr>
<tr>
<td>12-1 pm</td>
<td>Panel: Cosmetic (Rejuvenation) Hand Surgery: Form vs. Function</td>
</tr>
<tr>
<td>5-6:30 pm</td>
<td>&quot;Margaritas with Mentors&quot; Reception</td>
</tr>
<tr>
<td>6:30-8:30 pm</td>
<td>Welcome Reception</td>
</tr>
<tr>
<td>Thursday, January 13  AAHS Program</td>
<td></td>
</tr>
<tr>
<td>6:30 - 7 am</td>
<td>Breakfast/Exhibits</td>
</tr>
<tr>
<td>7-8 am</td>
<td>Instructional Courses</td>
</tr>
<tr>
<td>8-8:15 am</td>
<td>Presidential Welcome</td>
</tr>
<tr>
<td>8:15-8:45 am</td>
<td>Obama in the OR</td>
</tr>
<tr>
<td>8:45-9:30 am</td>
<td>Panels A &amp; B</td>
</tr>
<tr>
<td>9:30-10:30 am</td>
<td>Scientific Paper Sessions A &amp; B</td>
</tr>
<tr>
<td>10:30 -10:55 am</td>
<td>Break/Exhibits</td>
</tr>
<tr>
<td>11-11:30 am</td>
<td>Presidential Address</td>
</tr>
<tr>
<td>11:40 am-12:30 pm</td>
<td>Invited Guest Lecture - Aron Ralston</td>
</tr>
<tr>
<td>12:30-1:30 pm</td>
<td>Lunch with Exhibits</td>
</tr>
<tr>
<td>Friday, January 14  AAHS &amp; ASPN Programs</td>
<td></td>
</tr>
<tr>
<td>6:30-7am</td>
<td>Breakfast/Exhibits</td>
</tr>
<tr>
<td>7-8 am</td>
<td>Instructional Courses</td>
</tr>
<tr>
<td>8-10:15 am</td>
<td>Welcome and Panel: Innovative Hand Surgery - An International Perspective</td>
</tr>
<tr>
<td>8:15-8:45 am</td>
<td>Welcome and Panel: Nerve Transfers</td>
</tr>
<tr>
<td>8:45-9:30 am</td>
<td>Debates [2]</td>
</tr>
<tr>
<td>9:30-10:30 am</td>
<td>Lecture: Nerve Surgery - An Historical Perspective</td>
</tr>
<tr>
<td>10:30 -11:10 am</td>
<td>Presidential Panel: Back to the Future - Current Advances and the Future of Nerve Surgery</td>
</tr>
<tr>
<td>10:15-11am</td>
<td>Break/Exhibits</td>
</tr>
<tr>
<td>10:30-11:45 am</td>
<td>Scientific Paper Sessions A &amp; B</td>
</tr>
<tr>
<td>10:30-11:45 am</td>
<td>Scientific Paper Session A</td>
</tr>
<tr>
<td>11:45am-1:15 pm</td>
<td>Joint Concurrent AAHS/ASPN Panels: Assessment and Management of the Mangled Hand</td>
</tr>
<tr>
<td>11:45am-1:15 pm</td>
<td>Joint Concurrent AAHS/ASPN Panels: Failed Nerve Decompression - Now What?</td>
</tr>
<tr>
<td>11:45am-1:15 pm</td>
<td>Danyo Lecture - Michael Hayton, BSc, MBChB, FRCS</td>
</tr>
<tr>
<td>1:30-5:50 pm</td>
<td>Comprehensive Hand Review Course</td>
</tr>
<tr>
<td>5-6 pm</td>
<td>Special Session: Scientific Posters</td>
</tr>
<tr>
<td>7-10 pm</td>
<td>Salsa Dinner Dance</td>
</tr>
</tbody>
</table>

**Legend**
- AAHS
- ASPN
- ASRM
- Combined
- Breaks with Exhibitors
### Saturday, January 15
**Combined Day / ASPN & ASRM Programs**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:30-8 am</td>
<td>AAHS/ASPN/ASRM-Breakfast/Exhibits</td>
</tr>
<tr>
<td>7-8 am</td>
<td>Instructional Courses</td>
</tr>
<tr>
<td>8:15-9:30 am</td>
<td>Presidents’ Welcome and Panel: Robotic Surgery</td>
</tr>
<tr>
<td>9:30-10 am</td>
<td>AAHS/ASPN/ASRM-Break/Exhibits</td>
</tr>
<tr>
<td>10-11 am</td>
<td>Joint Presidential Keynote Lecture - Bob Woodruff</td>
</tr>
<tr>
<td>11 am-12 pm</td>
<td>Joint Outstanding Papers</td>
</tr>
<tr>
<td>12-1 pm</td>
<td>Scientific Paper Session C and Lunch</td>
</tr>
<tr>
<td>12-5 pm</td>
<td>Master Series - Tricks, Tips, and Pearls: Insights from the Masters</td>
</tr>
<tr>
<td>5-6 pm</td>
<td>Special Session: Scientific Posters</td>
</tr>
<tr>
<td>6:30-8:30 pm</td>
<td>ASPN/ASRM Welcome Reception</td>
</tr>
</tbody>
</table>

### Sunday, January 16
**ASPN & ASRM Programs**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:30-8 am</td>
<td>Breakfast/Exhibits</td>
</tr>
<tr>
<td>7-8:15 am</td>
<td>Instructional Courses</td>
</tr>
<tr>
<td>8:15-9:30 am</td>
<td>Welcome and Panel: Lessons from the Global War on Terror - Unique Reconstructive Challenges</td>
</tr>
<tr>
<td>9:15-9:45 am</td>
<td>Break/Exhibits</td>
</tr>
<tr>
<td>9:45-10:45 am</td>
<td>Scientific Paper Session D</td>
</tr>
<tr>
<td>10:45-11:45 am</td>
<td>Concurrent Scientific Paper Sessions</td>
</tr>
<tr>
<td>10:45-11:45 am</td>
<td>ASPN/ASRM Panel: Facial Paralysis</td>
</tr>
<tr>
<td>11:45am-1:30 pm</td>
<td>Scientific Paper Session E and Lunch</td>
</tr>
<tr>
<td>1:15-2:45 pm</td>
<td>ASRT Update</td>
</tr>
<tr>
<td>4-5 pm</td>
<td>ASRM Cocktail Poster Reception/Exhibits</td>
</tr>
<tr>
<td>5-7 pm</td>
<td>Best Case/Best Save</td>
</tr>
</tbody>
</table>

### Monday, January 17
**ASRM Program**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:30-8 am</td>
<td>Breakfast/Exhibits</td>
</tr>
<tr>
<td>7-8 am</td>
<td>Break Out Panels</td>
</tr>
<tr>
<td>8-9 am</td>
<td>YMG Panel: Lessons Learned in Practice</td>
</tr>
<tr>
<td>9-10 am</td>
<td>Concurrent Scientific Paper Sessions</td>
</tr>
<tr>
<td>10-10:30 am</td>
<td>Break/Exhibits</td>
</tr>
<tr>
<td>10:30-11 am</td>
<td>Presidential Lecture: Peter Neligan, MD</td>
</tr>
<tr>
<td>11 am-12:30 pm</td>
<td>Concurrent Scientific Paper Sessions</td>
</tr>
<tr>
<td>12:30-1 pm</td>
<td>Lunch with Exhibitors</td>
</tr>
<tr>
<td>1-2 pm</td>
<td>Godina Lecture - James Higgins, MD</td>
</tr>
<tr>
<td>2:3-3:15 pm</td>
<td>Break Out Panels</td>
</tr>
<tr>
<td>6:30-8:30 pm</td>
<td>ASRM Social Event</td>
</tr>
</tbody>
</table>

### Tuesday, January 18
**ASRM Program**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:30-8 am</td>
<td>Breakfast/Exhibits</td>
</tr>
<tr>
<td>7-8 am</td>
<td>ASRM Business Meeting - ASRM Members Only</td>
</tr>
<tr>
<td>8-9:15 am</td>
<td>Break Out Panels</td>
</tr>
<tr>
<td>9:15-9:45 am</td>
<td>Break/Exhibits</td>
</tr>
<tr>
<td>9:45-10:45 am</td>
<td>Buncke Lecture - Julian J. Pribaz, MD</td>
</tr>
<tr>
<td>10:45-11:45 am</td>
<td>Concurrent Scientific Paper Sessions</td>
</tr>
<tr>
<td>11:45 am-12:45 pm</td>
<td>The Best “Back Up” Flap for Breast Reconstruction (When the DIEP Isn’t Enough)</td>
</tr>
<tr>
<td>12:45 pm</td>
<td>Closing Remarks</td>
</tr>
</tbody>
</table>
The 2011 meeting theme is that of “Collegiality”. With this as the goal, the program is centered on interactive participant educational activities covering the breadth of problems related to the hand and upper limb.

Along with the traditional opportunities to present new information in the form of free papers, there are over 20 Instructional Courses with faculty comprised of internationally renowned hand surgeons and occupational and physical therapists focusing on many contemporary clinical problems. The formats are case-based and feature best practices and patient safety, with analysis of outcomes.

Over the 3½ days, the meeting includes a number of panel discussions focusing on unsolved problems such as carpal instabilities, flexor tendon repair and reconstruction, and options of soft tissue coverage. In addition, these panels cover the efficacy of new technologies, robotic surgery, and therapy best practices.

Along with the Presidential address given by Dr. Lee Osterman, featured speakers include Aron Ralston, author and adventurer.

The program provides for ample time for collegial interchange of ideas and new concepts as well as a stimulating and educational 3½ days in Cancún.
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AAHS, ASPN, and ASRM fully comply with the requirements of the Americans with Disabilities Act (ADA) and will endeavor to address special needs, as time allows, to enhance your participation.
GENERAL ANNOUNCEMENTS

Meeting Service Hours (subject to change)

Tuesday, January 11  4:00pm – 7:00pm
Wednesday, January 12  6:30am – 3:00pm
Thursday, January 13  6:30am – 3:00pm
Friday, January 14  6:30am – 6:00pm
Saturday, January 15  6:00am – 6:00pm
Sunday, January 16  6:30am – 3:00pm
Monday, January 17  6:30am – 3:30pm
Tuesday, January 18  6:30am – 1:00pm

AAHS Poster Presentation Viewing Hours

The AAHS Poster Presentations will be placed in the Foyer Hallway from Wednesday, January 12 – Saturday, January 15. All presenters should have posters set up before 12:00 pm on Wednesday and taken down before 12:00 pm on Saturday.

ASPN Poster Presentation Viewing Hours

The ASPN Poster Presentations will be placed in the ASPN General Session Room from Friday, January 14 – Sunday, January 16.

Friday presenters should have posters set up before 10:00 am on Friday and taken down by 8:00 am on Saturday.

Saturday presenters should have posters set up before 10:00 am on Saturday and taken down by 8:00 am on Sunday.

ASPN will host two poster viewing receptions. The first reception will be Friday, January 14 with the second reception on Saturday, January 15. Both receptions will take place from 5:00-6:00 pm.

ASRM Poster Presentation Viewing Hours

The ASRM Poster Presentations will be placed in the Foyer Hallway from Saturday, January 15 – Tuesday, January 18. ASRM posters can be set up in the Foyer Hallway after 12:00 pm on Saturday, January 15. A poster viewing session will be held on Sunday, January 16 from 4:00-5:00 pm.

AAHS, ASPN, and ASRM will not be responsible for any posters that are not removed within the allotted times.

Commercial Exhibits

The commercial exhibits will be located in the Foyer Hallway. A variety of commercial exhibits are featured at the meeting, enabling the attendees to learn about the technological advances pertaining to upper extremity surgery, neurosurgery and reconstructive microsurgery, and to meet key suppliers. Please refer to the Exhibit Listing in this book.

Exhibit Hours

Thursday, January 13
6:30am-7:00am AAHS-Breakfast/Exhibits
10:30am-10:55am AAHS-Break/Exhibits
12:30pm-1:00pm AAHS-Lunch/Exhibits

Friday, January 14
6:30am-7:00am AAHS-Breakfast/Exhibits
10:15am-10:45am AAHS-Break/Exhibits

Saturday, January 15
6:30am-8:00am AAHS/ASPN/ASRM-Breakfast/Exhibits
9:30am-10:00am AAHS/ASPN/ASRM-Coffee/Exhibits
6:30pm-8:00pm ASPN/ASRM Welcome Reception

Sunday, January 16
6:30am-8:00am ASPN/ASRM-Breakfast/Exhibits
9:15am-9:45am ASPN/ASRM-Coffee/Exhibits
4:00pm-5:00pm ASRM-Cocktail Poster Reception/Exhibits

Monday, January 17
6:30am-8:00am ASRM-Breakfast/Exhibits
10:00am-10:30am ASRM-Coffee/Exhibits
12:30pm-1:00pm ASRM-Lunch/Exhibits
6:30pm-8:30pm ASRM Event Reception

Tuesday, January 18
6:30am-8:00am ASRM-Breakfast/Exhibits
9:15am-9:45am ASRM-Coffee/Exhibits

Internet Stations are located in the foyer.

Speaker Ready Room Hours

The Speaker Ready Room will be located in the Tulum Room.

Wednesday, January 12  6:00am – 5:00pm
Thursday, January 13  6:30am – 3:30pm
Friday, January 14  6:00am – 5:00pm
Saturday, January 15  6:00am – 3:00pm
Sunday, January 16  6:30am – 3:00pm
Monday, January 17  6:30am – 3:00pm
Tuesday, January 18  6:30am – 11:00am

Dress Code

We encourage meeting attendees to dress casually and comfortably. Jackets and ties are not required for any business or networking events. If you plan to be outdoors in the evening, a jacket may be preferred.
Message Board
A message board will be set up near Meeting Services in the Staircase Foyer Showroom. Please refer to the message board for meeting notices and general announcements.

Copyright
All of the proceedings of the annual meeting, including the presentations of scientific papers, are intended solely for the benefit of the membership of the American Association for Hand Surgery, American Society for Peripheral Nerve and American Society for Reconstructive Microsurgery. No statement or presentation made at the meeting is to be regarded as dedicated to the public domain. Any statement or presentation is to be regarded as limited publication only and all property rights in the material presented, including common law copyright, are expressly reserved to the speaker or to the American Association for Hand Surgery, American Society for Peripheral Nerve and American Society for Reconstructive Microsurgery. Any sound reproduction, transcript, or other use of material presented at the meeting without the permission of the speaker or the American Association for Hand Surgery, American Society for Peripheral Nerve and American Society for Reconstructive Microsurgery is prohibited to the full extent of common law copyright in such material.

THE USE OF CAMERAS OR PHOTOGRAPHIC EQUIPMENT IS NOT PERMITTED DURING PRESENTATIONS.
**Social Events**

Social events are offered to promote collaboration in a social environment, and to enhance your meeting experience. Many of the events are included in your registration fee, and we encourage you to purchase tickets for your guests for all networking events. We recommend that you purchase guest tickets in advance, as they will be available on a very limited basis at the meeting. Attendee name badge or a guest ticket is required for all social events.

**“Margaritas with Mentors” Reception**  
**Wednesday, January 12**  
5:00 – 6:00 pm  
1 ticket included in AAHS Registration

This late afternoon event was created for young hand surgeons and therapists (in practice five years or less) as well as those still in training to come and meet some of the seasoned AAHS members, including the President and other board members. It is a time to relax and discuss the growth and development of HAND, the official journal of AAHS. This is a time of enjoyment to make new friends with more seasoned folks and mingle. Also feel free to bring your partners and kids.

Ticket includes hosted beverages and light appetizers. Please see information in Welcome Reception for additional ticket availability.

**AAHS Welcome Reception**  
**Wednesday, January 12**  
6:30 – 8:30 pm  
1 ticket included in AAHS Registration

Reconnect and reflect with fellow meeting attendees at this causal gathering on the beach in Cancún. Ticket includes hosted beverages and light appetizers.

Additional adult tickets available at $50 each and tickets for children and young adults (5-17 years) available at $25 each. The ticket is for admission to both the “Margaritas with Mentors” Reception and the Welcome Reception.

**AAHS Salsa Dinner Dance**  
**Friday, January 14**  
7:00 – 10:00 pm  
1 ticket included in AAHS Registration

Salsa away the night with friends to one of the hottest bands in Cancun. After we congratulate our award recipients we’ll party with a celebratory dinner and dancing. Ticket includes dinner, hosted beverages, and musical entertainment. Tropical attire.

Additional adult tickets available at $125 each and tickets for children and young adults (5-20 years) available at $55 each.

**ASRM Young Microsurgeon’s Group/ New Member Reception**  
**Saturday, January 15**  
5:30 – 6:30 pm  
(Invitation only)

**ASPN/ASRM Welcome Reception**  
**Saturday, January 15**  
6:30 – 8:00 pm  
1 ticket included in ASPN and ASRM registration.

Additional adult tickets available at $50 each and tickets for children and young adults (5 - 17 years) available at $25 each and include one drink ticket.

Join fellow ASPN and ASRM meeting-goers at the Ritz-Carlton’s Beach Club for an authentic Mexican-style celebration. This casual, seaside reception will set the tone for the days of learning and networking ahead. Tickets include beverages, light hors d’oeuvres and regional entertainment. Shorts suggested, shoes optional, reception in sandy area.

**ASRM Posters & Exhibits Reception**  
**Sunday, January 16**  
4:00 – 5:00 pm  
**NEW EVENT!** View and discuss fellow attendees poster presentations while mingling amongst our organizations supporters. This reception takes place just before the popular Best Case/Best Save event so come early and join us for some networking, food and beverages.

**ASRM Social Event**  
**Monday, January 17**  
6:30 – 8:30 pm  
1 ticket included in ASRM registration.

Additional adult tickets available at $60 each and tickets for children and young adults (5 - 17 years) available at $30 each and include drink tickets.

Join us on the Ritz-Carlton’s expansive new beach and Caribe Grille Terrace for a night of delectable Caribbean-Mexican cuisine and lively music. Ticket includes heavy hors d’oeuvres, hosted beverages and live entertainment. Casual attire is suggested.

**ASRM Guest Fee**  
Have your guest join you for the ASRM social events, breakfasts, and lunches during the official dates of the ASRM Meeting (Saturday-Tuesday). Please see ASRM daily schedules for details. ASRM guests are not eligible to claim CME credit. Any attendee who plans to attend general sessions and claim CME credit must be a healthcare professional and register as a regular attendee. Cost $250 per ASRM Guest.
American Society of Plastic Surgeons  
Booth: TBD  
444 E. Algonquin Road  
Arlington Heights, IL 60005-4664  
phone 800-766-4955  
fax 847-228-7099  
memserv@plasticsurgery.org  
www.plasticsurgery.org  

The American Society of Plastic Surgeons is the largest organization of board-certified plastic surgeons in the world. Representing more than 7,000 physician members, the Society is recognized as a leading authority and information source on cosmetic and reconstructive plastic surgery. ASPS comprises more than 94 percent of all board-certified plastic surgeons in the United States. Founded in 1931, the Society represents physicians certified by The American Board of Plastic Surgery or The Royal College of Physicians and Surgeons of Canada.

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fax 610-404-2061  
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fax 502-425-7422  
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www.aptismedical.com  

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fax 386-462-6803
e-mail knorton@axogeninc.com
www.axogeninc.com
AxoGen® Inc. was founded in 2002 to focus on improving peripheral nerve repair. Peripheral nerves provide the pathway for both motor and sensory signals between the central nervous system and muscles or organs throughout the body. Injuries to nerves impact patients in many ways. A traumatic injury to an arm may result in a loss of strength, movement and muscle mass. The removal of the prostate and the cavernous nerves due to prostate cancer may result in erectile dysfunction and/or incontinence. An injury to the facial nerve can result in the patient losing the ability to smile. Every year, several hundred thousand people suffer traumatic injuries or have surgical procedures which may impact the function of their peripheral nerves. AxoGen is committed to supporting surgeons in improving the standard of care for these patients.

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G114
Philadelphia, PA 19107
phone 215-925-4579
fax 215-925-2386
e-mail lristine@handfoundation.org
The Hand Rehabilitation Foundation, established in 1975, is a 501(c)3 non profit corporation formed to promote research and education, and disseminate information to physicians and therapists who work with children and adults with hand disorders caused by injury, disease or present at birth.

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This open-access, online resource provides valuable information for healthcare providers treating complex peripheral nerve trauma. Presented are concepts of nerve anatomy and physiology (both normal and following injury), evaluation techniques, and management strategies. Surgical options include nerve decompression and nerve transfers, and are explained through text, illustrations, photographs and videos.
### AAHS

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Meeting</th>
<th>Dates</th>
<th>Location</th>
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<th>State</th>
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<td>2014</td>
<td>Annual Meeting</td>
<td>January 8-11, 2014</td>
<td>Grand Hyatt Kauai Resort and Spa</td>
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### ASPN

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### ASRM

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<td>Grand Hyatt Kauai Resort and Spa</td>
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<table>
<thead>
<tr>
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</thead>
<tbody>
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<td>President-Elect</td>
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<tr>
<td>Past Presidents</td>
<td>Scott Kozin, MD</td>
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<tr>
<td></td>
<td>Nicholas B. Vedder, MD, FACS</td>
</tr>
<tr>
<td>Senior Directors at Large</td>
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<td></td>
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<td></td>
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<tr>
<td>Affiliate Directors</td>
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<td>Gretchen Kaiser, OTD, MBA, OTR/L, CHT</td>
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<tr>
<td></td>
<td>Susan Michlovitz, PT, PhD, CHT</td>
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Please join us in thanking these AAHS committee and task force members for their work in 2010

<table>
<thead>
<tr>
<th>Committee</th>
<th>Chair</th>
<th>Members</th>
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<tr>
<td>Program Committee</td>
<td>Jesse B. Jupiter, MD</td>
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</tr>
<tr>
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<td>Peter Amadio, MD, Lynn Bassini, MD, OTR, CHT, Charles Eaton, MD, Gretchan Kaiser, OTD, MBA, OTR/L, CHT, N. Bradley Meland, MD, Miguel A. Pirela-Cruz, MD</td>
</tr>
<tr>
<td>Plastic Surgery Relations Task Force</td>
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<td>Neal Jones, MD, Donald Lalonde, MD, Steven L. Moran, MD, Nicholas B. Vedder, MD, FACS</td>
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<tr>
<td>Technology Committee</td>
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<td>H. Brent Bamberger, DO, Andrew Chen, MD, David Ring, MD, Rebecca von der Heyde, MS, OTR/L, CHT</td>
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<td>OTR/L, CHT, Chair, John Taras, MD, Chair, Georgette Fogg, OTR/L, CHT, Paula Galaviz, OTR, Maureen Hardy, PT, MS, CHT</td>
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<tr>
<td>Membership: Active Committee</td>
<td>Randipsingh Bindra, MD, FCRS</td>
<td>Chair, Brian Adams, MD, Kyle Bickel, MD, FACS, Kevin Chung, MD, Jeff Johnson, MD, Dean Sotereanos, MD</td>
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<tr>
<td>Membership: Affiliate Committee</td>
<td>Rebecca von der Heyde, MS, OTR/L, CHT</td>
<td>Chair, Sharon Dest, PT, CHT, Kris Valdes, OTD, CHT</td>
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<td>Susan Michlovitz, PT, PhD, CHT, Chair, Alejandro Badia, MD, Francisco Fernandes, MD, Sidney Jacoby, MD</td>
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<td>Chair, Jeffrey Budoff, MD, Gretchen Kaiser, OTD, MBA, OTR/L, CHT, Dean Sotereanos, MD, Scott Steinman, MD, Rebecca von der Heyde, MS, OTR/L, CHT</td>
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<tr>
<td>Technology Committee</td>
<td>Keith Brandt, MD</td>
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<tr>
<td>Program Committee</td>
<td>Jesse B. Jupiter, MD</td>
<td>Chair, Brian Adams, MD, David Bozentka, MD, James Chang, MD, Kevin Chung, MD, Warren Hammert, MD, Gretchen Kaiser, OTD, MBA, OTR/L, CHT, Susan Michlovitz, PT, PhD, CHT, Steven L. Moran, MD</td>
</tr>
</tbody>
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Michael R. Harrison, MD 1996
Dallas D. Raines 1997
John Texter, MD 1998
Vincent R. Hentz, MD 1999
Nancy Dickey, MD 2000
Michael Wood, MD 2001
Francisco Rosas 2002
Arnold-Peter Weiss, MD 2003
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Gavin Menzies 2005
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Allen Van Beek, MD 2008
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Richard Berger, MD 2010

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John W. Madden, MD 1979
Harold E. Kleinert, MD 1980
J. William Littler, MD 1981
Clifford C. Snyder, MD 1982
Robert A. Chase, MD 1983
Richard J. Smith, MD 1984
James M. Hunter, MD 1985
Bernard McC. O’Brien, MD 1986
Erle E. Peacock, Jr., MD 1988
Michael Jabelay, MD 1989
Robert M. McFarlane, MD 1990
James H. Dobyns, MD 1991
Adrian E. Flatt, MD 1992
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Pat Clyne 1995
David M. Evans, FRCS 1996
Eugene Nelson, MD 1997
Fritz Klein 1998
Janet L. Babb 1999
Frank E. Jones, MD 2000
Joseph Buckwalter, MD 2001
Linda Cendales, MD 2002
Arnold-Peter Weiss, MD 2003

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Jeff Lictman, MD, PhD 2006
Richard Kogan, MD 2007
Ramez Naam 2008
Daniel Gottlieb, PhD 2009
Stephen Sullivan, MD 2010
Evan Lyons, MD 2010

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Michael Jabaley, MD 2002
Maureen Hardy, PT, MS, CHT 2002
Sterling Mutz, MD 2002
Sue Michlovitz, PT, PhD, CHT 2003
Richard E. Brown, MD 2003
Nash Naam, MD 2004
Miguel Saldana, MD 2007

notes
Hand Surgery Endowment
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MBA CHT
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Julian Pribaz, MD
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AAHS CONTINUING MEDICAL EDUCATION

Educational Overview
The American Association for Hand Surgery Annual Meeting brings together health care professionals from North America and abroad for a three-day continuing education program featuring the best evidence of the practice of hand and upper extremity health care. The program is multifaceted and includes more than 20 instructional courses, numerous panel discussions and case-based programs, and free papers selected by a panel of experts. The learner will gain insight into both common and complex problems of the upper extremity, understand indications for surgery, therapy, outcomes of each, and potential complications of intervention.

Intended Audience
The program is intended for health care professionals involved in the assessment and management of a wide variety of common and complex conditions of the hand and upper limb.

Learning Objectives: Following completion of this activity, participants will be able to:
• Discuss clinical and basic scientific research on hand and upper extremity problems.
• Integrate principles of hand therapy with surgical management of hand and upper extremity problems.
• Evaluate surgical and nonsurgical principles of managing common hand and upper extremity problems.
• Compare the intellectual discourses through an integrated program with the related surgical societies (ASRM and ASPN) and resolve conflicts.
• Implement enhanced management of fractures, arthritis and congenital problems.
• Compare clinical and nonclinical hand therapy issues for a variety of hand problems and fractures.

Accreditation Statement and Designation
This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the American Society of Plastic Surgeons (ASPS) and the American Association for Hand Surgery (AAHS). The ASPS is accredited by the ACCME to provide continuing medical education for physicians.

The ASPS designates this educational activity for a maximum of 17.25 AMA PRA Category 1 Credits™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Disclaimer
The view expressed and the subject material presented in the course of any activities sponsored by the American Association for Hand Surgery including lectures, seminars, instructional courses, or otherwise, represent the personal views of the individual participants and do not represent the opinion of the American Association for Hand Surgery. The society assumes no responsibility for such views or materials, or implied, for the content of any Society sponsored presentations. Further, the Society hereby acknowledges that while its broad purpose is to promote the development and exchange of knowledge pertaining to the practice of microsurgery; it does so only in the context of a private forum without making any representation to the public whatsoever. Accordingly, the Society declares that its primary purpose is to benefit only its members, and responsibility for the Society for acts or omissions of Society members dealing with the public is hereby expressly disclaimed.
American Association for Hand Surgery
- 2011 Annual Meeting

PRESENTERS’ DISCLOSURES

Disclosure Policy and Disclosures
The American Society of Plastic Surgeons (ASPS) requires all instructors, planners, reviewers, managers and other individuals in a position to control or influence the content of an activity to disclose all relevant financial relationships or affiliations. All identified conflicts of interest must be resolved and the educational content thoroughly vetted by ASPS for fair balance, scientific objectivity and appropriateness of patient care recommendations. The ASPS also requires faculty/authors to disclose when off-label/unapproved uses of a product are discussed in a CME/CE activity or included in related materials.

All identified conflicts of interest have been resolved.

Disclosures of all Chairs, Speakers, Authors, Moderators, Reviewers, Committee Members and other appropriate individuals:

Brian Adams, MD – Consultant for Integra Life Sciences; Off-label discussion: total wrist implant system used as distal radius implant arthroplasty
Simone Archibald, MD – Employee [Chief Scientist] Integra LifeSciences
Alejandro Badia, MD – Advisor to Small Bone Innovations, Inc.
H. Brent Bamberger, DO – Consultant to Upex, LLC, Memedx; Advisor to Upex, LLC; Memedx; Stockholder in Upex, LLC and Memedx
Michael Bednar, MD – Consultant for DePuy
Andrew Bergeron, MD – Off-label discussion: Fluphenazine - a phenothiazine derivative used to inhibit fibroblast contraction in this study
Kyle Bickel, MD, FACS – Speaker for Auxilium Pharmaceuticals; consultant for Auxilium Pharmaceuticals; shareholder of Auxilium Pharmaceuticals
Randip Bindra, MD, FRCS – Speaker for Integra; consultant to Integra, Acumed; advisor to Am Surgical; recipient of support from Tepha, Inc.
Allen T. Bishop, MD – Off-label discussion: Collagen conduit filled with Collagen-GAG Matrix Conduit
Susan Blackmore, MS, OTR/L, CHT – Consultant to PolyGel
Philip Blazar, MD – Recipient of research support from Auxilium Pharmaceuticals
Jennifer Bond – Off-label discussion: Fluphenazine - a phenothiazine derivative used to inhibit fibroblast contraction in this study
David Bozentka, MD – Speaker for Medartis
Reuben Bueno Jr, MD – Off-label discussion: Botulinum toxin for treatment of pain and ulceration from Raynaud’s Phenomenon.
Tyson Cobb, MD – Speaker, Consultant to Integra Life Sciences; recipient of research support from Integra Life Sciences; Off-label discussion: Wright Medical Graft Jacket used as interposition material
Brian Cohen, PhD – Employee Auxilium
Stephen Coleman, MD – Shareholder Auxilium
Carisa Cooney - Off-label discussion: Botulinum toxin for treatment of pain and ulceration from Raynaud’s Phenomenon.
A. Lee Dellon, MD – Shareholder Sensory Management Systems.
David G. Dennison – Research support recipient Aircast (DJ); DePuy, a Johnson & Johnson Company
Peter Evans – Off-label discussion: arthrosurface metatarsal implant used for the capitates
Patricia F. Friedrich – Off-label discussion: Collagen conduit filled with Collagen-GAG Matrix Conduit
William Geissler, MD – Consultant for Acumed
Guilherme Giusti – Off-label discussion: Collagen conduit filled with Collagen-GAG Matrix Conduit
Josef Hadeed – Off-label discussion: Fluphenazine - a phenothiazine derivative used to inhibit fibroblast contraction in this study
Harry Hoyen – Off-label discussion: arthrosurface metatarsal implant used for the capitates
Asif Ilyas, MD – Speaker for Medartis; Consultant to Wright Medical, Integra; Recipient of research support for Wright Medical, Medartis
Christian Krarup, MD – Research support recipient Shire and Integra Life Sciences
Joo-Yup Lee – Off-label discussion: Collagen conduit filled with Collagen-GAG Matrix Conduit
Jon Lemke – Off-label discussion: Wright Medical Graft Jacket used as interposition material
Howard Levinson – Off-label discussion: Fluphenazine - a phenothiazine derivative used to inhibit fibroblast contraction in this study
Philippe Liverneaux, MD – Consultant to SBI
Gustavo Mantovani, MD – Royalties recipient SBI International
Christophe Mathoulin, MD – Inventor, receive royalties SBI International
Steven Moran, MD – Speaker for Ascension
Nash Naam, MD – Consultant Auxilium
Michael W. Neumeister, MD, FRCSC/FACS – Off-label discussion: Botulinum toxin for treatment of pain and ulceration from Raynaud’s Phenomenon.
Jorge Orbay, MD – Shareholder of Skeletal Dynamics
Clayton A. Peimer, MD – Consultant Auxilium
Jean Pillet, MD – Speaker for Pillet Hand Prostheses
David Ring, MD – Consultant Acumed and Tornier; Research Support Recipient Biomet and Stryker.
The following Chairs, Speakers, Authors, Moderators, Reviewers, Committee Members and other appropriate individuals reported they have no relevant financial relationships or affiliations to disclose:

- Joshua Abzug
- Christine N. Adham, BS
- Marco A. Aita, MD
- Yelena Akelina
- Takintope Akinbiyi, MSc
- Sahin Alagoz
- Murray Allen, MD
- Kai-Nan An
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- Carlos H. Fernandes, MD
- Diego L. Fernandez
- Lynn Festa, OTR/L, CHT
- Georgette Fogg, OTR/L, CHT
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- Jeffrey Friedrich, MD
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- Paula Galaviz, MS, OTR, CHT
- Thomas Gardner
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- Alexandru Georgescu, MD, PhD
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- Eric Hofmeister, MD
- Harry Hoyen
- Chung-Chen Hsu
Thomas Hughes, MD  
Thomas Hunt, III, MD  
Allan Ibsen  
Kyros Ipaktchi  
Neil Ford Jones, MD  
Sung No Jung  
Sanjeev Kakar  
Gretchen Kaiser, OTD, OTR/L, MBA, CHT  
Loree Kalliainen, MD  
Justin T. Kane, MD  
Julia Katarincic  
Joel Katz  
Susan Kean, BScPT, CHT  
Ayhan Kilic  
San Who Kim  
Hervey Kimball, MD  
Graham King  
J. Vincent Kish  
Andrew J. Kochevar, MD, MS  
Scott Kozin, MD  
Leo T. Kroonen, MD  
Yalcyn Kulahcy  
Ho Kwon  
Donald Lalonde, MD  
Janice Lalonde  
Leticia Lansing  
Martin LeBlanc, BSc, MD  
W. P. Andrew Lee, MD  
Joo-Yup Lee  
Jon Lemke, PhD  
L. Scott Levin, MD  
Howard Levinson  
C. Levis  
Yu Kit Li, BHSc  
Terry Light, MD  
Joan Lipa, MD  
Eric Kar-Wai Liu  
Kristina Liu, BA  
James Love  
John Lubahn, MD  
Goeran Lundborg  
Joy MacDermid, BScPT, PhD  
Susan Mackinnon  
Anna-Lena Makowski  
Steven Margles, MD  
Tambra Mark, OTD, OTR/L, CHT  
John Mathewson  
Paul McArthur  
Steven McCabe, MD  
Elizabeth McDade, PhD  
Lucas S. McDonald, MD  
Daniel McKee  
Sam McNally  
Deana Mercer  
Susan Michlozvitov, PT, PhD, CHT  
Randy Miller, MD  
M. Ather Mirza, MD  
Anuj Mishra  
V. Moonesamy  
Michael Morhart, MD, FRCS  
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Carol Morris  
Roberta Morris, OT, CHT  
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Kate Nellans  
Kathryn Nelson  
David Netcher, MD  
Michael Neumeister, MD, FRCS  
Mary Nordlie, MS, OTR/L, CHT  
Dung Nguyen, MD  
T. JoAnna Nguyen, MD  
Shelley Noland  
Christine Novak, PT, MS, PhD  
Jose Ortiz, MD  
A. Lee Osterman, MD, FACS  
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E. Anne Ouellette  
Kagan Ozer  
Carol Page, PT, DPT, CHT  
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Dima Raskolnikov  
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Todd A. Richards, MD, MBA  
Aldo Riesgo  
Birgitta Rosen, DMSc  
Jaiyoung Ryu, MD  
Sedipah Saber  
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Douglas Sammer, MD  
Julie Samora, MD, PhD  
Brinkeley Sandvall  
Luis Scheker, MD  
Wesley Schooler, MD  
Jesse Selber, MD  
Deirdre Seoighe  
Celalettin Sever  
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Alexander Y. Shin  
Paul G. Shupe, MD  
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Philip Stanley, MD  
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Peter Stern, MD  
Hans Suchy, MS  
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John Taras, MD  
Peter Taub  
Suni Thirkannad  
Achilles Thoma  
Jennifer Thompson, MPT, CHT  
J. Grant Thomson  
John Tidwell, MD  
Serdar Toker  
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Serhan Tuncer  
Tolga Turker  
Joseph Upton, MD  
Mark M. Urata, MD, DDS  
Fatih Uygun  
Kristin Valdes, OTD, OTR, CHT  
Philippe Valentti  
Josep Valls-Sole  
Allen Van Beek, MD  
Rebecca von der Heyde, PhD, OTR/L, CHT  
Kelli Webb  
Renata Weber, MD  
Lawrence Weiss, MD  
Jonathan Winograd, MD  
Terri Wolfe, OTR/L, CHT  
Avida Wolff, OTR, CHT  
Eric Wroten, MD  
Eduardo Zancolli, III, MD  
David Zelouf, MD  
Presents DISCLOSURES  
ASPS CME Committee/Education staff members and involved AAHS staff members have no relevant financial relationships or affiliations to disclose.
American Association for Hand Surgery

DAY-AT-A-GLANCE

Wednesday, January 12, 2011

6:30am – 5:00pm Speaker Ready Room Tulum
6:30am – 3:00pm Meeting Services Staircase Foyer
6:30am – 7:00am Continental Breakfast Fountain Courtyard

Specialty Day Program

7:00am – 8:00am AAHS Instructional Courses
101 Fingertip and Nailbed Injuries Salon I
102 Rheumatoid Hand Reconstructions Cancun
103 How to Make an Intraoperative Video Plaza II
104 Update on Kiebock’s Disease Cozumel
105 Dupuytren’s Disease Update Merida
106 Reconstruction of Post Traumatic Deformities of the Finger Plaza I

8:10am – 8:30am President and Program Chairs Welcome Salon II & III
8:30am – 9:30am Panel: Should I Have Surgery? Will Therapy Help? What is the Evidence? Salon II & III
9:30am – 10:30am Panel: New Technologies in Upper Extremity Medical and Surgical Care-Current Perspectives Salon II & III

10:30am – 10:50am Coffee Break Fountain Courtyard
10:50am – 11:30am Panel: Troublesome Fractures in the Hand Salon II & III
11:30am – 12:00pm Invited Guest Lecture Salon II & III
Stephen Sullivan, MD
12:00pm – 1:00pm Panel: Cosmetic (Rejuvenation) Hand Surgery: Form versus Function Salon II & III
5:00pm – 6:00pm “Margaritas with Mentors” Reception Beach Club
6:30pm – 8:30pm Welcome Reception Beach Club
101 Fingertip and Nailbed Injuries

Chair: Mark Belsky, MD

Instructors: Georgette Fogg, OTR/L CHT; Jennifer Green, MD; Eric S. Wroten, MD; Jeffrey Yao, MD

This course is designed to cover both basic and complex injuries to the fingertip. It is based around a series of clinical cases designed to address contemporary issues regarding fracture fixation, soft tissue coverage, nail bed injury and reconstructive problems post-injury. The faculty will highlight real and potential complications and treatment pearls to avoid later problems.

Objectives: Following this session, the participant will be able to:
1. Define injury patterns and decision-making options.
2. Describe indications and surgical options for soft tissue injury and loss.
3. Outline rehabilitation modalities.
4. Gauge the extent of disability, its quantification and rating.

102 Rheumatoid Hand Reconstructions

Chair: Asif Ilyas, MD

Instructors: Brian Adams, MD; Michael Baumholtz, MD; Marco Rizzo, MD; Peter Stern, MD

With the growth of successful anti-rheumatic medications, the surgical management of the rheumatoid hand has changed significantly. This course will focus on providing a brief primer on anti-rheumatic medications, a review of the best evidence practices for rheumatoid joint arthroplasty and arthrodesis, soft tissue reconstruction, and discussion of post-surgical rehabilitation of the rheumatoid hand.

Objectives: Following this session, the participant will be able to:
1. Describe the strengths and limitations of medical management.
2. Review indications and techniques for small joint implant arthroplasty, small joint arthrodesis, and rheumatoid tendon reconstruction.
3. Identify nuances in the rehabilitation of the rheumatoid hand.

103 How to Make an Intraoperative Video

Chair: Eric Hofmeister, MD

Instructors: Matthew Bernstein, MD; Matt Concannon, MD; Leo Kroonen, MD; Donald Lalonde, MD

This course is designed to teach the requirements to produce a high-quality, complete, professional-appearing intraoperative video. Topics include patient consent, following the laws associated with HIPPA, and patient safety during the making of the video. Additional topics include discussing all equipment and software requirements, editing, final cuts and productions, and implementing videos into your practice.

Objectives: Following this session, the participant will be able to:
1. Incorporate patient consent, HIPPA, and patient safety prior to and during the making of a video.
2. Illustrate the hardware and software requirements for making a video.
3. Produce a complete, professional-appearing intraoperative video.

104 Update on Kienböck’s Disease

Chair: Steve McCabe, MD

Instructors: Steven Moran, MD; Roberta Morris, OT, CHT; Stephanie Sweet, MD

Kienböck’s disorder remains an enigma both regarding etiology and optimum treatment. This course will highlight the best available evidence in staging, treatment options, outcomes, and complications. Faculty will cover rehabilitation after treatment and reconstructive procedures in detail. A series of clinical cases will challenge both the faculty and participants.

Objectives: Following this session, the participant will be able to:
1. Illustrate the radiographic staging of Kienböcks.
2. Identify the best evidence regarding outcome as well as complications.
3. Describe the indications and options of salvage procedures.
4. Discuss rehabilitation modalities and outcomes.

105 Dupuytren’s Disease Update

Chair: Jaiyoung Ryu, MD

Instructors: Kyle Bickel, MD, FACS; Philip Blazar, MD; Rod Hentz, MD; Eduardo Zancolli, MD

With the advent of non- and minimally-invasive treatments of Dupuytren’s disease, the indications for newer treatments versus traditional surgical approaches has become the subject of great scrutiny. This course will focus on the best available evidence regarding the outcomes of the different treatment modalities. Techniques, pitfalls, and pearls of treatment options will be highlighted as well as best practices of rehabilitation.

Objectives: Following this session, the participant will be able to:
1. Recognize the indications, techniques, and pitfalls of percutaneous fasciotomy, collagenase injections, and open partial fasciectomy.
2. Clarify the complications of each technique.
3. Tabulate rehabilitation algorithms and newer concepts.

106 Reconstruction of Post Traumatic Deformities of the Finger

Chair: Randip Bindra, MD, FRCS

Instructors: Sharon Andruskiwec, PT, CHT; Gunter Germann, MD, PhD; Douglas Sammer, MD; Tsu-Min Tsai, MD

Among the most vexing problems confronting the upper extremity surgeon and therapist involve posttraumatic deformities of the finger. These include tendon imbalance of the PIP joint; diaphyseal malunion and nonunion; and chronic instability. Non-operative as well as operative approaches, pitfalls and pearls of each, and best evidence of outcome will be addressed.

Objectives: Following this session, the participant will be able to:
1. Identify the pathomechanics of PIP deformities.
2. Summarize the indications, techniques, pitfalls and pearls of surgical treatments.
3. Identify non-operative and operative approaches to treatment.
8:10 – 8:30 am
President and Program Chairs Welcome

A. Lee Osterman, MD, FACS, AAHS President
Jesse Jupiter, MD, Program Chair
Susan Michlovitz, PT, PhD, CHT, Specialty Day Chair

8:30 – 9:30 am
Panel: Should I Have Surgery? Will Therapy Help? What is the Evidence?

Moderator: Mark Baratz, MD; Gretchen Kaiser, OTD, OTR/L, MBA, CHT
Panelists: Susan Blackmore, MS, OTR/L, CHT; Warren Hammert, MD, DDS; Steven McCabe, MD; Stephanie Sweet, MD

The moderators will present a series of common problems seen and treated by both disciplines with a surgeon and a therapist giving the best evidence why their chosen approach is preferable. Topics will include trigger thumb; trigger finger with PIP flexion posture; PIP flexion contracture; deQuervains; STT arthritis; mild to moderate CTS and others to be determined by the moderators. The program will present the treatment options for common problems.

Objectives: Following this panel, the participant will be able to:
1. Assess and evaluate the different approaches of experienced surgeons and therapists in treatment of common problems such as trigger thumb, STT arthritis, and PIP flexion contracture.
2. Discuss the advantages and disadvantages of non-operative versus operative treatment for various disorders of the hand.

9:30 – 10:30 am
Panel: New Technologies in Upper Extremity Medical and Surgical Care – Current Perspectives

Moderators: Brian Adams, MD; Gretchen Kaiser, OTD, OTR/L, MBA, CHT
Panelists: John Lubahn, MD; John Taras, MD; Rebecca von der Heyde, PhD, OTR/L, CHT; Jeffrey Yao, MD

New technologies continue to emerge, yet the evidence often lags clinical utilization. It is useful to offer insight into some technologies that are currently in use. The moderators will challenge the panel to explain the virtues or problems with newer technologies in use in the surgical and rehabilitation of problems of the hand and upper limb. Examples include: onabotulinum-toxina for tendon rehab; nerve glues; colloidal collagenase, implant hemiarthroplasty of the PIP joint for acute and subacute trauma; ultrasound for diagnosis and treatment.

Objectives: Following this panel, the participant will be able to:
1. Identify the indications and techniques for using new technologies and appreciate the advantages and disadvantages of these technologies in the management of a number of conditions of the upper limb.
2. Describe outcomes of these recent developments.

10:50 – 11:30 am
Panel: Troublesome Fractures in the Hand

Moderator: Jesse Jupiter, MD; Aviva Wolff, OTR, CHT
Debaters: Georgette Fogg, OTR/L, CHT; Peter Stern, MD; Peter Tang, MD; Jennifer Thompson, MPT, CHT

A number of contemporary issues exist regarding the management of fractures in the hand including the role of minimally invasive techniques, complex fractures with associated soft tissue injury, fractures of the base of the thumb, and intraarticular fractures of the metacarpals and phalanges. The faculty and participants will be challenged through a series of clinical cases.

Objectives: Following this panel, the participant will be able to:
1. Compare treatment modalities.
3. Describe the decision-making process for fractures associated with major soft tissue injury.

11:30 am – 12:00 pm
Invited Guest Lecture
(not offered for credit)

Stephen Sullivan, MD, MPH
Title: Surgical Experiences While In Haiti

12:00 – 1:00 pm
Panel: Cosmetic (Rejuvenation) Hand Surgery: Form versus Function

Moderator: Laurence Glickman, MD, FRCSC, FACS
Panelists: Cynthia Cooper, MA, OTR/L, CHT; Gunter Germann, MD, PhD; Randy Miller, MD; Jean Pillet, MD

An exciting new arena of hand care has centered around improving the aesthetic appearance of the hand. A number of technologies are being incorporated into practices, including fat or collagen injection, onabotulinum-toxina treatment, and laser skin treatments. The panel members will present their own experiences, indications and techniques of treatment, and the overall economics of these forms of treatment.

Objectives: Following this panel, the participant will be able to:
1. Report upon a relatively new field of reconstructive hand surgery.
2. Identify the indications, techniques, and complications of the approaches to hand rejuvenation procedures.
3. Consider patient perspectives as well as the economics of the procedures.

5:00 – 6:00 pm
“Margaritas with Mentors” Reception
See description on page 3.

6:30 – 8:30 pm
Welcome Reception
See description on page 3.
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<td>Obama in the OR: Andrew Gurman, MD</td>
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<td>8:45am – 9:30am</td>
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<td>9:30am – 10:30am</td>
<td>Scientific Paper Session A</td>
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<td>Coffee Break</td>
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<td>11:00am – 11:30am</td>
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<td>11:40am – 12:30pm</td>
<td>Invited Guest Lecture: Aron Ralston</td>
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<td>12:30pm – 1:30pm</td>
<td>Lunch With Exhibitors</td>
<td>Fountain Courtyard</td>
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</tbody>
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Instructors: Neal Chen, MD; Terri Wolfe, OTR/L, CHT; David Zelouf, MD

Chair:

109 Principles of Tendon Transfer

Chair: John Lubahn, MD

Instructors: Neal Chen, MD; Terri Wolfe, OTR/L, CHT; David Zelouf, MD

This course on tendon transfer will include basic principles of tendon transfer, such as application of basic physiology including the BLIX curve for appropriate tension of transfers to various techniques of tendon transfer. It will also include the indications for tendon transfer, contraindications and post-operative rehabilitation.

Objective: Following this session, the participant will be able to apply new suture techniques along with traditional principles of tendon transfer to serve their patients with neuromuscular deficits requiring reconstruction.

notes

110 Wide Awake Hand Surgery

Chair: Donald Lalonde, MD

Instructors: Sean Bidic, MD; Eric Hofmeister, MD; Susan Kean, BSc, PT, CHT

This course will demonstrate injection techniques for hand operations such as carpal tunnel, trapeziectomy, tendon repair, finger and hand fractures, and simple tendon transfers, making it easy for observers to reproduce the techniques. Videos of the principles of intraoperative adjustments in complex hand operations with active movement by the unseated patient before the skin is closed will illustrate the usefulness of the technique for many hand operations. Advantages of the surgeon as the sole anesthesia provider will be briefly outlined. New frontiers in hand therapy with hand therapists participating in wide awake hand surgery will be explained and concerns about adrenaline in the fingers will also be allayed.

Objectives: Following this session, the participant will be able to:
1. Inject local anesthetic and epinephrine in a tumescent fashion into the hand and forearm to delete the necessity for tourniquet and reduce or eliminate the need for sedation.
2. Make intraoperative adjustments in tendon and fracture surgery before closing the skin.
3. Educate their patients and communicate effectively with their therapists during the surgery.

111 Fractures of the Scaphoid: Pitfalls and Pearls

Chair: Stephanie Sweet, MD

Instructors: Paul Brach, MS, PT, CHT; Sanjay Desai, MD; William Geissler, MD; Hervey Kimball, MD; Peter Murray, MD

Based on a series of clinical cases illustrating contemporary issues, the panel will discuss indications for surgery, outcomes of non-operative versus operative treatment; stiffness post-fracture; vascular issues; and deformity post-fracture.

Objectives: Following this session, the participant will be able to:
1. Identify indications for non-operative treatment.
2. Compare the pitfalls and pearls of percutaneous screw fixation.
3. Describe the implications of vascular problems and fracture healing.

112 Fracture Dislocations about the Elbow

Chair: David Ring, MD

Instructors: Brent Bamberg, DO; Jose Ortiz, MD; Carol Page, PT, DPT, CHT; Jaiyoung Ryu, MD; Lawrence Weiss, MD

Fracture-dislocations about the elbow represent a constellation of injuries which present unique challenges for treatment. Careful assessment of the injury patterns will lead to improvements in overall patient outcomes. This course will address contemporary issues such as when to repair or replace radial head fractures; surgical approaches and techniques of fixation of coronoid fractures; indications for primary ligament repair; indications for adjuvant external fixation; rehabilitation; and assessment and management of complications.

Objectives: Following this session, the participant will be able to:
1. Recognize the various fracture-dislocation patterns from radiographs and imaging.
2. Define the best evidence of outcomes.
4. Describe the role of rehabilitation with an emphasis on modalities, timing, and complications.
8:00 – 8:15 am
Presidential Welcome
A. Lee Osterman, MD, FACS

8:15 – 8:45 am
Obama in the OR
Moderator: Mark Rekant, MD
Speaker: Andrew Gurman, MD

Dr. Andrew Gurman is an active AAHS member and the American Medical Association. He has been in the forefront in many aspects in current health care policy issues. Dr. Gurman will provide his perspectives on the current landscape of healthcare as well as the likely changes to come and how they may affect health care providers.

Objective: Following this panel, the participant will be able to summarize the details of the proposed changes in health care from the perspective of the AMA as well as the speaker, who is an active AAHS member.

8:45 – 9:30 am
Panel A: New Flaps for Hand Surgery
(New Workhorse Flaps for the Hand)
Moderator: James Chang, MD
Panelists: Allan Bishop, MD; Jeff Friedrich, MD; Paula Galaviz, MS, OTR, CHT; William Pederson, MD

The provision of soft tissue coverage to the injured hand and upper limb remains fundamental to the care of the complex injury. There continues to be interest and research in the development of new flaps to achieve these goals. This panel will present a number of local and remote flaps which have proven predictable, durable, and versatile. The pitfalls and pearls of technique and how these new flaps compare to alternatives will be expanded upon.

Objectives: Following this panel, the participant will be able to:
1. Compare the indications, techniques, and outcomes of a variety of newer design flaps for hand and upper limb coverage.
2. Identify benefits and weaknesses of soft tissue coverage versus delayed coverage.
3. Avoid negative rehabilitation issues specific to soft tissue injury and reconstruction.

8:45 – 9:30 am
Panel B: Flexor Tendon Injuries – Master Techniques
Moderator: David Zelouf, MD
Panelists: Donald Lalonde, MD; John Taras, MD; Rebecca von der Heyde, PhD, OTR/L, CHT

Based upon a series of operative techniques, the panel members will present their specific techniques for a number of difficult clinical problems. These will include pulley reconstruction, flexor digitorum avulsion, zone 2 tendon repair, wide awake tendon repair, and contemporary perspectives of rehabilitation after zone 2 tendon repair.

Objectives: Following this panel, the participant will be able to:
1. Describe the repair of flexor tendon injuries.
2. Identify the newer concepts of rehabilitation post-flexor tendon repair.

9:30 – 10:05 am
Concurrent Scientific Paper Session A1
Moderators: David Bozentka, MD; W.P. Andrew Lee, MD

9:30 am - 9:35 am
Functional Outcome of Collagenase Injections vs. Fasciectomy in treatment of Dupuytren’s Contracture
Institution where the work was prepared: Southern Illinois Hand Center, Effingham, IL, USA
Nash Naam, MD

9:35 am - 9:40 am
Long-Term Evaluation of Dupuytren’s Contracture Recurrence Following Treatment with Collagenase Clostridium Histolyticum (CORDLESS)
Institution where the work was prepared: Michigan State University, Marquette, MI, USA
Clayton A. Peimer, MD; Philip Blazar, MD; Stephen Coleman, MD; F. Thomas D. Kaplan, MD; Ted Smith, PhD; James Tursi, MD; Brian Cohen, PhD; Greg Kaufman, MD

9:40 am - 9:45 am
Fluphenazine Induces Inhibition of Fibroblast Migration and Contractility in Dupuytren’s Disease
Institution where the work was prepared: Duke University Medical Center, Durham, NC, USA
Josef G. Hadeed, MD; Angelica Selim, MD; Andrew Bergeron, MD; Jennifer E. Bond; Howard Levinson

9:45 am - 9:50 am
Discussion

9:50 am - 9:55 am
Simulated Osteotomy of the Trapezium Reduces Radial Subluxation and Improves Contact Pressure Distribution Across the Thumb Carpometacarpal Joint in Lateral Pinch
Institution where the work was prepared: University of New Mexico, Albuquerque, NM, USA
Deana Mercer; Tahseen A. Cheema, MD; Christina Salas; Leticia Lansing; Mahmoud Taha; James Love; Nathan Morrell, MD

9:55 am - 10:00 am
Arthroscopic Resection Arthroplasty for Treatment of Pantrapezial Arthritis
Institution where the work was prepared: Orthopaedic Specialists, Davenport, IA, USA
Tyson Cobb, MD; Patrick Sterbank, PA-C; Jon Lemke, PhD

10:00 am - 10:05 am
Comparison of Trapeziectomy and Trapeziectomy with Ligament Reconstruction and Tendon Interposition (LRTI): a Systematic Review
Institution where the work was prepared: Yu Kit Li, Hamilton, ON, Canada
Yu Kit Li, BHSc; Colin White; Achilles Thoma

10:05 am - 10:10 am
Discussion

10:10 am - 10:15 am
Institution where the work was prepared: McMaster University, Hamilton, ON, Canada
LM Dickson, MD; C. Levis; Achilles Thoma

Scientific Paper Session A1 continued
Scientific Paper Session A1 continued

10:15am - 10:20am
Is Main Operating Room Sterility Really Necessary in Carpal Tunnel Surgery?: A Multicenter Prospective Study of Minor Procedure Room Field Sterility Surgery
Institution where the work was prepared: Dalhousie University, Halifax, NS, Canada
Martin R. LeBlanc, BSc, MD; Donald H. Lalone, BSc, MSc, MD; A. Thomas, MD, MSc, FRCSC(C); Mike Bell, MD, FRCSC; Peter Chang, MD; Neil Wells, MD; Murray Allen, MD; Janice F. Lalone; Daniel McKee

10:20am - 10:25am
The Treatment of Kienböck’s Disease: Retrospective Analysis of 147 Patients in a Single Institution
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Chung-Chen Hsu; Jan Szatkowski, MD; Steven L. Moran, MD

10:25am - 10:30am Discussion

Concurrent Scientific Paper Session B1

Session B Moderators: Michael Neumeister, MD; Christine Novak, PT, MS, PhD

9:30am - 9:35am
Overcoming the Learning Curve: A Novel Approach to Teaching Zone II Flexor Tendon Repairs
Institution where the work was prepared: Stanford University, Stanford, CA, USA
A. Sina Bari, MD; Colin YL Woon; Brian C. Pridgen; James Chang, MD

9:35am - 9:40am
Surgical Knot Security for Common Suture Materials: A Biomechanical Study
Institution where the work was prepared: West Virginia University, Morgantown, WV, USA
John E. Tidwell, MD; J Vincent Kish; Julie Samora, MD, PhD; Joseph Prud’homme

9:40am - 9:45am
Experimental Model of Trigger Finger in a Human Cadaveric Hand
Institution where the work was prepared: Yale University School of Medicine, New Haven, CT, USA
Kristina J. Liu, BA; J. Grant Thomson

9:45am - 9:50am Discussion

9:50am - 9:55am
Isolated Lunotriquetral Ligament Tears Treated with Ulnar Shortening Osteotomy
Institution where the work was prepared: Ather Mirza MD, PC, Smithtown, NY, USA
M. Ather Mirza, MD; Mary Kate Reinhart, MS, CNP

9:55am - 10:00am
Results of Ulnar Shortening Osteotomy with a New Plate Compression System
Institution where the work was prepared: The University of Mississippi Medical Center, Jackson, MS, USA
Sonya M. Clark, DO; William Geissler, MD

10:00am - 10:05am A Retrospective Review of Perilunate, Lunate Dislocations and Fracture-Dislocations: What Factors Contribute to a Missed Injury?
Institution where the work was prepared: University of Minnesota, Minneapolis, MN, USA
Mary Elizabeth Tyler Rashid, MD; Deborah Bohn, MD; Cherrie Heinrich, MD; Thomas Varecka, MD; Loree Kallilainen

10:05am - 10:10am Discussion

10:10am - 10:15am
Botulinum Toxin Type A for Raynaud’s Phenomenon
Institution where the work was prepared: Southern Illinois University School of Medicine, Springfield, IL, USA
Kelli N. Webb, MD; Carisa M. Cooney; Reuben A. Bueno Jr, MD; Michael W. Neumeister, MD, FRCS/FACS

10:15am - 10:20am Treatment Strategy for Diffuse Venous Malformations of the Upper Extremity
Institution where the work was prepared: Boston Children’s Hospital, Boston, MA, USA
Andre Panossian, MD; Dean M. Anselmo, MD; Philip Stanley, MD; Obaid Chaudhry, MD; Cameron S. Francis, MD; Amir H. Taghinia; Joseph Upton, MD

10:20am - 10:25am Maximizing Outcomes in Rope Avulsion Thumb Injuries
Institution where the work was prepared: The Buncke Clinic, San Francisco, CA, USA
Gregory Nimalan Emmanuel; Darrell Brooks; Rudolf F. Buntic; Gregory M. Buncke; Bauback Safa; Brian Parrett

10:25am - 10:30am Discussion

10:30 – 10:55 am Coffee Break

11:00 – 11:30 am Presidential Address
Title: Collegiality: The Art of the Handshake
A. Lee Osterman, MD, FACS

11:40 am – 12:30 pm Invited Guest Lecture
(not offered for credit)

Aron Ralston – Adventurer and author of Between a Rock and a Hard Place
In 2003, pinned by a half-ton boulder for nearly a week in a remote canyon in southern Utah, Aron Ralston finally escaped by amputating his right forearm with a dull pocketknife. After applying a tourniquet, he hiked and rappelled for 5 hours through Blue John Canyon before searchers miraculously rescued him.

Ralston documented his life-altering experience and his remarkable will to survive in his best-selling book, Between a Rock and a Hard Place. His story has been adapted for the big screen by Oscar-winning director Danny Boyle, starring James Franco as Aron. The film, ‘127 Hours,’ was released in November 2010.

Since his amputation – and aided by radical prosthetic devices that he helped design – he has expanded his adventures to the world’s great peaks, deserts, and rivers. He is the only person to have solo climbed all 59 of Colorado’s 14,000-foot-high mountains in winter; the only person with a disability to have skied from the summit of Denali, North America’s tallest mountain; and in April 2009, he became the first amputee to row a raft through the Grand Canyon.

He speaks on the topics of persevering in adversity, drawing courage and strength from one’s deepest relationships, and appreciating even the “boulders” of life, as they are also our blessings.

12:30 – 1:30 pm Lunch with Exhibitors
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<tr>
<th>Time</th>
<th>Event</th>
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<tr>
<td>6:00am – 3:30pm</td>
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<td>Meeting Services</td>
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<td>6:30am – 7:00am</td>
<td>Continental Breakfast with Exhibitors</td>
<td>Fountain Courtyard</td>
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<td>7:00am – 8:00am</td>
<td>Instructional Courses</td>
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<td>113 Update on Congenital Deformities-Controversies</td>
<td>Salon II &amp; III</td>
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<td>114 Reconstruction of Malunion of the Distal Radius</td>
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<td>115 CMC Arthritis Open and Arthroscopic Treatment</td>
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<td>116 Complex Hand Fractures and Dislocations in Contact Athletes</td>
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<td>117 Reconstruction of the Burned Hand</td>
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<td>118 Challenges of Orthotic Selection</td>
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<td>8:00am – 8:10am</td>
<td>Welcome</td>
<td>Salon II &amp; III</td>
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<td>8:10am – 8:40am</td>
<td>Panel: Innovative Hand Surgery – An International Perspective</td>
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<td>Debate: Is the Negative Pressure Wound Dressing a Panacea Device of the Devil</td>
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<td>9:15am – 10:15am</td>
<td>Scientific Paper Session A</td>
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<td>Scientific Paper Session B</td>
<td>Plaza I &amp; II</td>
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<td>10:15am – 10:30am</td>
<td>Break with Exhibitors</td>
<td>Fountain Courtyard</td>
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<td>Scientific Paper Session B</td>
<td>Plaza I &amp; II</td>
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<td>11:00am – 11:45am</td>
<td>AAHS/ASPN Panel: Assessment and Management of the Mangled Hand</td>
<td>Salon II &amp; III</td>
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<td>11:45am – 12:30pm</td>
<td>Danyo Lecture: Medicine is Too Serious to Take Seriously</td>
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<td>Michael Hayton, BSc, MBChB, FRCS</td>
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<td>12:30pm – 1:30pm</td>
<td>Annual Business Meeting (AAHS Members Only)</td>
<td>Salon II &amp; III</td>
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<td>1:30pm – 5:50pm</td>
<td>Comprehensive Hand Surgery Review Course</td>
<td>Salon II &amp; III</td>
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<td>7:00pm – 10:00pm</td>
<td>Salsa Dinner Dance</td>
<td>Fountain Courtyard</td>
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Friday, January 14, 2011

6:30 – 7:00 am  Continental Breakfast

7:00 – 8:00 am  Instructional Courses
1 AMA PRA Category 1 Credit™

113 Update on Congenital Deformities - Controversies
Chair: Scott Kozin, MD
Instructors: William Cooney, MD; Neil Ford Jones, MD; Terry Light, MD
Based upon a series of clinical cases, this course will address some of the more difficult and controversial congenital deformities. The experts will be asked to not only provide their own experience, but also the best evidence in medical literature.

Objectives: Following this session, the participant will be able to:
1. Better diagnose and manage some challenging congenital anomalies.

114 Reconstruction of Malunion of the Distal Radius
Chair: David Bozentka, MD
Instructors: Philip Blazar, MD; Jesse Jupiter, MD; Andrew Koman, MD; Kristin Valdes, OTD, OTR, CHT
This course will focus on the indications for treatment, methods of pre-operative planning, and osteotomy techniques for both extra- and intra-articular malunions, types of bone graft, and post-operative rehabilitation.

Objectives: Following this session, the participant will be able to:
1. Identify the indications as well as surgical management of malunions following distal radius fractures.
2. Describe the types of bone graft or substitutes available.
3. Compare the volar versus dorsal surgical approach for creating the osteotomy.

115 CMC Arthritis Open and Arthroscopic Treatment
Chair: Mark Rekant, MD
Instructors: Alejandro Badia, MD; Tambra Marik, OTD, OTR/L, CHT; Eduardo Zancolli, MD
Arthritis at the base of the thumb is one of the most common problems seen and treated by hand surgeons and therapists. There continues to be discussion and debate about a variety of surgical and non-surgical options. This course will highlight the controversies extending from soft tissue procedures to implant arthroplasty to arthroscopic treatment, among others.

Objectives: Following this session, the participant will be able to:
1. Discuss a variety of surgical options and techniques as well as evidence-based outcomes.
2. Compare arthroscopic treatment with open surgery.

116 Complex Hand Fractures and Dislocations in Contact Athletes
Chair: Michael Hayton, BSc, MBChB, FRCS
Instructors: Steven Margles, MD; Chaitanya Mudgal, MD; Aviva Wolff, OTR, CHT
This course will provide an overview of complex fractures and dislocations in athletes.

Objectives: Following this session, the participant will be able to:
1. Outline common injuries in athletes.
2. Outline the clinical assessment of these injuries including investigations.
4. Describe differences in the athlete compared with the rest of the population.

117 Reconstruction of the Burned Hand
Chair: Keith Brandt, MD
Instructors: Ted Chapman, MIL USA, MEDCOM, CRDAMC; Michael Neumeister, MD; Roger Simpson, MD; Jonathan Winograd, MD
Based around a series of clinical cases, the panel will discuss both common and complex problems related to both deformity and soft tissue contracture.

Objectives: Following this session, the participant will be able to:
1. Identify digital deformities secondary to thermal burn.
2. Discuss the surgical indications, techniques, and risks of deformity correction.
3. Recognize the indications and options for soft tissue reconstructions post-burn.

118 Challenges of Orthotic Selection
Chair: Lynn Festa, OTR/L, CHT
Instructors: Jerry Coverdale, OT, CHT; Mark Rekant, MD; Mike Szekeres, OT, CHT; Rebecca von der Hyde, PhD, OTR/L, CHT
This course will review evidence-based orthotic selection for common diagnoses and procedures of the upper extremity. Advanced clinical reasoning for orthotic selection based on multiple factors, including anatomy, biomechanics, surgical procedures, and clinical research, will be addressed.

Objectives: Following this session, the participant will be able to:
1. Articulate rationale for orthotic selection based on anatomy, biomechanics, surgical procedures, and clinical research.
2. Identify evidence-based orthotics for multiple diagnoses.

8:00 – 8:10 am  Welcome

8:10 – 8:40 am  Panel: Innovative Hand Surgery – An International Perspective
Moderators: A. Lee Osterman, FACS; Aviva Wolff, OTR, CHT
Speakers: Carlos Fernandes, MD; Alexandru Georgescu, MD, PhD; Pak Cheong Ho, MBBS, FRCS; Eduardo Zancolli, MD
This panel will highlight the exciting and innovative surgical procedures developed by some of our colleagues throughout the world.

Objectives: Following this panel, the participant will be able to:
1. Better perceive the global nature of the profession.
2. Incorporate innovative approaches to basic and complex problems of the hand and wrist.
8:40 – 8:55 am
Debate: Is the Negative Pressure Wound Dressing a Panacea or Device of the Devil?
Moderator: Randip Bindra, MD, FRCS
Debaters: Andrew Koman, MD; Jonathan Winograd, MD
The negative pressure dressing has seen wide application. However, questions remain as to its optimal utilization. This debate will put in clear perspectives the pros and cons of this technology.

Objective: Following this debate the participants will identify the affirmative values and the negative aspects of the negative pressure wound dressing.

8:55 – 9:15 am
Debate: Locked Distal Radius Plate – Holy Grail or Fool’s Gold?
Moderator: Daniel Nagle, MD
Debaters: Michael Bednar, MD; Jorge Orbay, MD
The locking plate has become the choice of many for the treatment of unstable fractures of the distal radius. This debate will put into focus the benefits and the pitfalls of this technology based upon the best evidence available.

Objective: Following this debate, the participant will be able to list and assess the benefits and risk of the locking plate for the treatment of distal radius fractures.

9:15am – 10:15 am
Concurrent Scientific Paper Sessions A&B

Concurrent Scientific Paper Session A2
Session A Moderators: David Ring, MD; Jonathan Winograd, MD

9:15am - 9:20am
Effects of a Collagen Nerve Guide Tube in Patients with a Median or Ulnar Nerve Lesion
Institution where the work was prepared: Rigshospitalet, Copenhagen, Denmark
Christian Krarup, MD; Allan Ibsen; Michel Bockstyns, MD; Josep Valls-Sole; Joaquim Fores, MD; Xavier Navarro; Birgitta Rosen, DMSc; Goeran. Lundborg; S.J. Archibald, PhD

9:20am - 9:25am
Functional Outcomes of Nerve Defects Treated with Matched-Diameter Allograft vs. Cabled Autograft
Institution where the work was prepared: Columbia University, New York, NY, USA
Peter Tang, MD, MPH; Geoffrey Konopka; Ayhan Klic; Yelena Akelina; Ricky Regalbuto; Thomas Gardner

9:25am - 9:30am
New Clinical Perspectives on Processed Nerve Allografts: A Multicenter Retrospective Study of the Utilization and Outcomes in Peripheral Nerve Injury Repair
Institution where the work was prepared: The Buncke Clinic, San Francisco, CA, USA
Darrell Brooks

9:30am - 9:35am
Discussion

9:35am - 9:40am
Internal vs. External Fixation of Distal Radius Fractures: A Prospective Randomized Controlled Trial
Institution where the work was prepared: Hand and Upper Limb Center, University of Western Ontario, London, ON, Canada
Ruby Grewal; Joy MacDermid, BSc, PT, PhD; Graham King; Kenneth Faber

9:40am - 9:45am
Is It Necessary to Use Bone Graft Following Corrective Osteotomy of the Distal Radius?
Institution where the work was prepared: Denver Health Medical Center, Denver, CO, USA
Kagan Ozer; Ayhan Klic; Kyros Ipaktchi

9:45am - 9:50am
Outcomes of a Novel Approach to Intercarpal Arthrodesis
Institution where the work was prepared: University of Alberta, Edmonton, Canada
Lisa Korus, MD; Michael Morhart, MD, FRCSC

9:50am - 9:55am
Discussion

9:55am - 10:00am
Clinical Outcomes for Patients with Soft Tissue Sarcoma of the Hand
Institution where the work was prepared: Memorial Sloan-Kettering Cancer Center, New York, NY, USA
Edward A. Athanasian, MD; Mark E. Puhaindran; Carol Morris

10:00am - 10:05am
Reconstruction of Upper Extremity Postburn Contractures Using Thoracodorsal Artery Perforator Flaps
Institution where the work was prepared: GATA Haydarpaºa Training Hospital, Istanbul, Turkey
Fatih Uygur; Serhan Tuncer; Yalcýn Kulaqcý; Celalettin Sever; Sahin Alagöz

10:05am - 10:10am
Improving Resident Confidence with Hand Surgery Using A Fresh Tissue Dissection
Institution where the work was prepared: Keck School of Medicine of the University of Southern California, Los Angeles, CA, USA
Justin T. Kane, MD; Joseph N. Carey, MD; T. JoAnna Nguyen, MD; Alex Campbell, MD; Morad Askari, MD; Dung Nguyen, MD; Mark M. Urata, MD, DDS; Randy Sherman, MD; Wesley Schooler, MD

10:10am - 10:15am
Discussion

Concurrent Scientific Paper Session B2
Session B Moderators: Warren Hammert, MD; Gretchen Kaiser, OTD, OTR/L, MBA, CHT

9:15am - 9:20am
Early Growth Response Factor - 1 (EGR-1): Expression in a Rabbit Flexor Tendon Scar Model
Institution where the work was prepared: Southern Illinois University School of Medicine, Springfield, IL, USA
Brian Michael Derby, MD; Joel Reichensperger, BS; Hans Suchy, MS; Chris Chambers, PhD; Reuben Bueno, MD; Michael Neumeister, MD, FRCSC, FACS

9:20am - 9:25am
Mesenchymal Stem Cell Allograft with Screw Fixation for the Treatment of Scaphoid Non-Unions
Institution where the work was prepared: Naval Medical Center San Diego, San Diego, CA, USA
Dominic Gomez-Leonardelli, MD; Leo Kroonen, MD; Eric Hofmeister, MD

9:25am - 9:30am
Validation of the Michigan Hand Questionnaire in a Maritime Canadian Population
Institution where the work was prepared: Dalhousie University, Halifax, NS, Canada
Bryan Chung, MD, PhD; Steven Morris, MD

9:30am - 9:35am
Discussion

Scientific Paper Session B2 continued
Concurrent Scientific Paper Session A3

Moderators: Sue Michlovitz, PT, PhD, CHT; Renata Weber, MD

10:30am - 10:35am
Risk Factors for Complications after Locked Volar Plate Fixation of Distal Radius Fractures
Institution where the work was prepared: Massachusetts General Hospital, Boston, MA, USA
David C. Ring, MD, PhD; Roderick van Leerdam; Thierry Guitton; Christopher Got, MD; Julia Katarincic; Mazimillian Soong, MD

10:35am - 10:40am
A New Radiographic View To Detect Screw Penetration To The Dorsal Cortex of The Distal Radius After Volar Fixed-Angle Plating
Institution where the work was prepared: Denver Health Medical Center, Denver, CO, USA
Kagan Ozer; Serdar Toker

10:40am - 10:45am
Supination, Pain, and Strength are Important Determinants of Disability after Distal Radius Fracture
Institution where the work was prepared: Columbia University Medical Center, New York, NY, USA
Eric Swart, MD; Aldo Riesgo; Kate Nellans, MD; Dima Raskolnikov; Melvin P. Rosenwasser, MD

10:45am - 10:50am
Do Intercarpal Ligament Injuries Predict Outcomes After Distal Radius Fractures?
Institution where the work was prepared: Columbia University Medical Center, New York, NY, USA
Eric Swart, MD; Anthony Ding, MD; Peter Tang, MD, MPH

10:50am - 10:55am
Biomechanical Comparison of Three Fixation Techniques Used for Four-Corner Arthrodesis
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Jirachart Kraisarin, MD; David G. Dennison; Lawrence J Berglund; Kai-Nan An; Alexander Y. Shin

10:55am - 11:00am
Discussion

Concurrent Scientific Paper Session B3

Moderators: Joy MacDermid, BSc, PT, PhD; Peter Murray, MD

10:30am - 10:35am
Reduction and Association of the Scaphoid and Lunate (RASL) for Chronic Static Scapholunate Instability: Long-Term Follow-Up
Institution where the work was prepared: Columbia University Medical Center, New York, NY, USA
Neil J. White, MD, FRCS; Dima Raskolnikov; Scott A. Crow, MD; Eric Swart, MD; Melvin P. Rosenwasser, MD

10:40am - 10:45am
Improving Efficiency of Volar Plate Locking in the Treatment of Distal Radius Fracture
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Jeffrey C. Mears, MD; Mark G. Rohrbough, MD; Robert A. Fanton, MD

10:45am - 10:50am
Biomechanical Comparison of Three Fixation Techniques Used for Four-Corner Arthrodesis
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Jirachart Kraisarin, MD; David G. Dennison; Lawrence J Berglund; Kai-Nan An; Alexander Y. Shin

10:50am - 10:55am
Discussion

10:55am - 11:00am
End of Concurrent Scientific Paper Session B3
10:45am - 10:50am
Trapeziometacarpal Joint Reconstruction Using APL Tendon: Results After 5.5 Years
Institution where the work was prepared: University of Oklahoma and University of Mississippi, Oklahoma City, OK, and Jackson, MS, OK, USA
Andrew J. Kocher, MD, MS; Christine N. Adham, BS; Mehdi N. Adham, MD; Michael F. Angel, MD; Marcus D. Walkinshaw, MD

10:50am- 11:00am
Discussion

11:00 – 11:45 am
Joint Concurrent AAHS/ASPN Panel: Assessment and Management of the Mangled Hand
Moderator: Jesse Jupiter, MD
Panelists: Neil Ford Jones, MD; Rojan Gupta, MD; L. Scott Levin, MD; William Pederson, MD; Luis Scheker, MD

This panel will present perspectives on the assessment, management, and outcomes of complex “mangling” hand and upper extremity injuries. Indications for salvage versus amputation; management of combined skeletal and soft tissue loss; and early and late reconstruction on injured structures will be discussed.

Objective: Following this panel, the participant will be able to:
1. Assess complex “mangling” hand and upper extremity injuries in order to make careful decisions regarding overall management.
2. Identify the indications for emergency free tissue transfers.
3. Define the reconstruction of bone, tendon, and nerve loss.

11:45 am – 12:30 pm
Danoy Lecture
Moderator: A. Lee Osterman, MD, FACS
Michael Hayton, BSc, MBChB, FRCS
Title: Medicine is Too Serious to Take Seriously
Mike Hayton is a hand and wrist surgeon from Wrightington Hospital in England. The hospital was made famous by the pioneering work of Sir John Charnley in the 1960’s with the low friction hip arthroplasty and ultra clean air theatres.
Professor John Stanley was appointed in the 1970’s to provide an upper limb service to the vast amounts of patients that travelled to Wrightington. Over the next 30 years John steadily grew the unit to become the internationally acclaimed unit it is today and he now has 9 colleagues.
Mike was John’s fellow in 2001 to 2003. The two of them immediately hit it off with their similar personalities and humour, a love of hand surgery but above all friendship.
Mike was appointed in 2003 and for two years was blessed with having parallel sessions with John both in the OR and in clinic. The practice that John had developed was carefully handed over to Mike and his senior colleague Ian Trall. He is Honorary Senior Lecturer in the human bone cell research group at the University of Liverpool also at the University of Salford in Healthcare sciences
Mike has developed his own special interest in Sports injuries of the hand and wrist and is the hand surgeon to over 40 professional sporting teams and national sporting organisations. He had 11 patients compete in Beijing bringing home 6 medals.

12:30 – 1:30 pm
Annual Business Meeting (AAHS Members Only)
3:10 – 3:30 pm
Scaphoid Fractures and Non-Unions, Kienbock's Disease
Robert Goitz, MD
A review of the clinical features, diagnostic challenges, operative and non-operative treatment options, and a contemporary approach to the patient with acute scaphoid fracture or established non-union. The talk will also provide an overview to the diagnosis and treatment of Kienbock's disease.

3:30 – 3:50 pm  Break

3:50 – 4:10 pm
Carpal Instability, Wrist Arthritis
Jose Ortiz, MD
A review of the anatomy and mechanics of the wrist as it relates to carpal instability, including a review of the diagnostic and treatment of common patterns of instability. This talk will also review the management of common patterns of wrist arthritis which develop from long-standing carpal instability.

4:10 – 4:30 pm
Fractures of the Metacarpals and Phalanges
Jerome Chao, MD
Metacarpal and phalangeal fractures are among the most common injuries seen in the hand. A thorough review of the anatomy and biomechanics of these injuries will be provided. The treatment choices of closed management, percutaneous pinning, plate fixation, and intramedullary rodding will be reviewed along with their technical nuances.

4:30 – 4:50 pm
Flexor & Extensor Tendon Injuries
Loree Kalliainen, MD
This presentation will review the principles of the evaluation of the patient with an extensor or flexor tendon injury in the hand. The technical aspects of tendon repair will be discussed as well as the biomechanical rationale behind the development of the current post-operative rehabilitation protocols. The basic science of tendon healing will be outlined.

4:50 – 5:10 pm
Infections of the Hand
E. Gene Deune, MD
This lecture will involve a comprehensive review of infections of the hand with up-to-date information regarding the clinical features and treatment principles such that participants will feel more comfortable treating patients with these maladies.

5:10 – 5:30 pm
Congenital Hand Differences
Robert Havlik, MD
This talk will review the most common congenital hand differences of the upper extremity including the embryology, diagnosis, and treatment. Associated syndromes will be reviewed along with long-term outcomes, and associated complications.

5:30 – 5:50 pm
Tendonopathies and Dupuytren's Contracture
Miguel Pirela-Cruz, MD
Tendonopathies of the hand and wrist and Dupuytren’s contracture are among the most common problems seen in hand surgery. An overview of the pathophysiology of these conditions will be provided as well as specific non-operative and operative treatment recommendations.

7:00-10:00 pm
Salsa Dinner Dance
See description on page 3.
Educational Overview
This program provides an opportunity for surgeons, therapists, researchers, faculty and other healthcare professionals working in these complementary fields to share new discoveries and techniques. By learning from colleagues about cutting-edge technologies and patient-care options, participants will have a broader view of patient treatment and recovery.

Intended Audience
This educational activity is intended for healthcare professionals and researchers working in the fields of hand surgery, peripheral nerve and/or neural regeneration, and microneurovascular surgery and other complex reconstructions.

Learning Objectives: Following completion of this activity, participants will be able to:
- Discuss clinical and basic science research.
- Describe robotic applications in three fields: plastic surgery, nerve surgery and hand surgery.

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Michael Bednar, MD – Consultant for DePuy
Paul Cederna, MD – Off-label discussion: Surgisis is used as a container for transferred muscle
Tyson Cobb, MD – Speaker, Consultant to Integra Life Sciences; recipient of research support from Integra Life Sciences; Off-label discussion: Wright Medical Graft Jacket used as interposition material
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AAHS/ASPN/ASRM Combined Program

DAY-AT-A-GLANCE

Saturday, January 15, 2011

6:00am – 3:00pm Speaker Ready Room

6:30am – 6:00pm Meeting Services

6:30am – 8:00am AAHS/ASRM/ASPN Continental Breakfast

7:00am – 8:00am AAHS/ASPN/ASRM Instructional Courses

201 Controversies in the Management of Nerve Compression In the Upper Extremity

202 Reconstruction of Acute and Chronic Scapholunate Ligament Injuries—How I Treat

203 Cortical Plasticity and Changes with Nerve Injury

204 Adult Brachial Plexus Lesions

205 Monitoring Technologies for Flaps and Replants

206 Innovation in Free Flap Surgery

8:15am – 8:30am AAHS/ASPN/ASRM Presidents’ Welcome

8:30am – 9:30am AAHS/ASPN/ASRM Panel: Robotic Surgery

9:30am – 10:00am Coffee Break with Exhibitors

10:00am – 11:00am AAHS/ASPN/ASRM Joint Presidential Keynote Lecture Bob Woodruff

11:00am – 12:00pm AAHS/ASPN/ASRM Joint Outstanding Papers

Meeting Services Staircase Foyer

AAHS/ASPN/ASRM Continental Breakfast Fountain Courtyard

AAHS/ASPN/ASRM Instructional Courses Plaza I

Controversies in the Management of Nerve Compression In the Upper Extremity Plaza I

Reconstruction of Acute and Chronic Scapholunate Ligament Injuries—How I Treat Plaza II

Cortical Plasticity and Changes with Nerve Injury Cancun

Adult Brachial Plexus Lesions Merida

Monitoring Technologies for Flaps and Replants Cozumel

Innovation in Free Flap Surgery Salon I

AAHS/ASPN/ASRM Presidents’ Welcome Salon II & III

AAHS/ASPN/ASRM Panel: Robotic Surgery Salon II & III

Coffee Break with Exhibitors Fountain Courtyard

AAHS/ASPN/ASRM Joint Presidential Keynote Lecture Bob Woodruff Salon II & III

AAHS/ASPN/ASRM Joint Outstanding Papers Salon II & III
204 Adult Brachial Plexus Lesions
Chair: Allan Belzberg, MD
Instructors: Michael Dorsi, MD; Thomas Tung, MD; Justin Brown, MD
This course will review the relevant anatomy of the brachial plexus and how it is affected in trauma. We will review what factors play a role in spontaneous regeneration and how they can be used to predict prognosis as well as the various surgical options for the typical injuries seen by the nerve surgeon.
Objectives: Following this session, the participant will be able to:
1. Describe the variables related to prognosis
2. Plan for non-operative and operative care of a brachial plexus injury

205 Monitoring Technologies for Flaps and Replants
Chair: TBD
Instructors: Darrell Brooks, MD; Alex Keller, MD; Hakim Said, MD
Clinical monitoring for picking up a venous or arterial problem with a flap or replant is the standard against which newer technologies are evaluated. This session discusses the utility, advantages, and disadvantages of newer technologies including quantitative fluorometry, fluorescent imaging, tissue saturation, and flow couplers.
Objectives: Following this session, the participant will be able to:
1. Determine the pros and cons of newer technologies for monitoring.
2. Decide which monitoring technologies to implement in practice.

8:15 – 8:30 am
AAHS/ASPN/ASRM Presidents’ Welcome
A. Lee Osterman, MD, FACS, AAHS President
Paul S. Cederna, MD, ASPN President
Peter C. Neligan, MD, ASRM President
Bob Woodruff joined ABC News in 1996 and has covered major stories throughout the country and around the world. He was named co-anchor of ABC’s World News Tonight in December 2005. On January 29, 2006, while reporting on U.S. and Iraqi security forces, Woodruff was seriously injured by a roadside bomb that struck his vehicle near Taji, Iraq.

In February 2007, Woodruff and his wife Lee released *In an Instant: A Family’s Journey of Love, Courage, and Healing*, their personal memoir about Woodruff’s recovery after his attack in Iraq and the medical and family support that helped him heal.

In April 2008, Woodruff won a Peabody Award for “Wounds of War – The Long Road Home for Our Nations Veterans”, a series of reports that aired on ABC. He is also the recipient of the Daniel Pearl Award for Courage and Integrity in Journalism. He has received numerous awards and citations from organizations around the country for his work on behalf of the wounded veterans.

His overseas reporting of the fallout from September 11 was part of ABC News’ coverage recognized with the Alfred I. duPont Award and the George Foster Peabody Award, the two highest honors in broadcast journalism.

Before becoming a journalist, Woodruff was an attorney. But in 1989, while teaching law in Beijing, he was hired by CBS News to work as a translator during the Tiananmen Square uprising and a short time later he changed careers.

Woodruff is back at work reporting for ABC News shows on a variety of international and national stories with his “Bob Woodruff Reports” unit. Woodruff has a law degree from the University of Michigan Law School and a BA from Colgate University. He is married and has four children.
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ASPN CONTINUING MEDICAL EDUCATION

Educational Overview
This program will give participants an enhanced knowledge of the pathophysiology and the management of chronic pain, including the scope and application of surgical techniques used in treating different chronic pain syndromes and recurrent entrapment neuropathy.

Intended Audience
The American Society for Peripheral Nerve (ASPN) Annual Meeting is intended for surgeons, researchers and other healthcare professionals working in disciplines related to peripheral nerve and/or neural regeneration.

Learning Objectives: Following completion of this activity, participants will be able to:
• Describe and discuss the pathophysiology and the management of chronic pain.
• Analyze and discuss the different options of managing patients with recurrent entrapment neuropathy.
• Examine the emerging technologies in the management of nerve injuries.
• Explain and discuss new advances in understanding the concept of pain.
• Describe and discuss the evolving management of different pain syndromes.

Accreditation Statement and Designation
This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the American Society of Plastic Surgeons (ASPS) and the American Society for Peripheral Nerve (ASPN). The ASPS is accredited by the ACCME to provide continuing medical education for physicians.

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Disclosure Policy and Disclosures
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All identified conflicts of interest have been resolved.

Disclosures of all Chairs, Speakers, Authors, Moderators, Reviewers, Committee Members and other appropriate individuals:

Reuben Bueno Jr., MD – Off-label discussion: Botulinum toxin type A for chronic pain.
Nicole Castagno, BS – Off-label discussion: Surgisis is used as a container for transferred muscle.
Paul Cederna, MD – Off-label discussion: Surgisis is used as a container for transferred muscle.
Jerome Chao, MD – Research support recipient AxoGen Inc. Off-label discussion: Fibrin sealant is used to maintain an adequate seal between the nerve tube and graft/native stump.
Carisa Cooney – Off-label discussion: Botulinum toxin type A for chronic pain.
A. Lee Dellon, MD – Shareholder Sensory Management Systems.
Brent Egeland, MD – Off-label discussion: Surgisis is used as a container for transferred muscle.
Daniel Hayes, MD – Research support recipient Pfizer, Novartis, GlaxoSmithKline.
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Christopher Frost - Off-label discussion: Surgisis is used as a container for transferred muscle.
Jesse Jupiter, MD – Consultant to AO Foundation, Eidosmed, OHK; shareholder of OHK
Loree K. Kallainen, MD – Off-label discussion: Dexmетодомidine given IV intraoperatively. There is some early data that suggests it may decrease nerve irritability.
Johnson Lee, MD – Off-label discussion: Fibrin sealant is used to maintain an adequate seal between the nerve tube and graft/native stump.
Justine Mann, MD – Off-label discussion: Dexmетодомidine given IV intraoperatively. There is some early data that suggests it may decrease nerve irritability.
Rajiv Midha, MD, MsC – Research support recipient CIHR and Integra LifeSciences.
Michael W. Neumeister, MD – Off-label discussion: Botulinum toxin type A for chronic pain.
David Ring, MD – Consultant Acumed and Tornier; Research Support Recipient Biomet and Stryker.
Donya Rowe, MD – Off-label discussion: Fibrin sealant is used to maintain an adequate seal between the nerve tube and graft/native stump.
Vered Stearns, MD – Research support recipient Novartis and Pfizer.
Melanie Urbanchek, PhD – Off-label discussion: Surgisis is used as a container for transferred muscle.
Benjamin Wei, MD – Off-label discussion: Surgisis is used as a container for transferred muscle.
Kelli Webb, MD – Off-label discussion: Botulinum toxin type A for chronic pain.
Renata Weber, MD – Consultant Axogen.
Lynda Yang, MD – Sparton Corp.: Member of the Board of Directors FDA Consultant to the Neurological Devices Panel, to other panels of the Medical Devices Advisory Committee, and to the Center for Devices and Radiological Health.
Michael J Yaszemski, MD, PhD - Founder and equity holder. A preliminary patent has been filed and the technology has been licensed to BonWrx. No royalty payments of any type have been received.

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Carmen Viegege-Lankamp, MD, PhD
Erik T. Walbeein
Huan Wang, PhD
Aubrey A. Webb, MD
Kelli N. Webb, MD
Benjamin Wei, MD
B. J. Wilhelmi, MD
Anthony J. Windebank, MD
Sean F. Wolford, MD
Kimberly Wong, BSc
Albert Woo, MD
Matthew D. Wood, MD
Patrick M. Wood, MD, PhD
Jian-Guang Xu
Wen-Dong Xu, MD, PhD
Ji-Geng Yan, MD
Yu-Hui Yan, MD
Li Yao, MD, PhD
Lin-Ling Zhang, MD
Zhe Zhang, MS
Zijie Zhang, MD, PhD

ASPS CME Committee/Education staff members and involved ASPN staff members have no relevant financial relationships or affiliations to disclose
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>6:00am – 3:00pm</td>
<td>Speaker Ready Room</td>
<td>Tulum</td>
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<tr>
<td>6:30am – 6:00pm</td>
<td>Meeting Services</td>
<td>Staircase Foyer</td>
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<tr>
<td>6:30am – 7:00am</td>
<td>Continental Breakfast</td>
<td>Fountain Courtyard</td>
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<tr>
<td>7:00am – 8:00am</td>
<td>ASPN Instructional Courses</td>
<td>Salon I</td>
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<td></td>
<td>301 Evaluation and Treatment of Disproportionate Pain and Disability</td>
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<td>302 Obstetrical Brachial Plexus Palsy and Nerve Transfers</td>
<td>Directors</td>
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<td>303 Pediatric Peripheral Nerve Considerations</td>
<td>Cozumel</td>
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<tr>
<td>8:15am – 8:25am</td>
<td>ASPN President and Program Chair Welcome</td>
<td>Salon I</td>
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<tr>
<td>8:25am – 9:10am</td>
<td>Panel: Nerve Transfers</td>
<td>Salon I</td>
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<tr>
<td>9:10am – 9:30am</td>
<td>Lecture: Nerve Surgery – An Historical Perspective</td>
<td>Salon I</td>
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<td>David Kline, MD</td>
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<tr>
<td>10:15am – 10:30am</td>
<td>Coffee Break with Exhibitors</td>
<td>Fountain Courtyard</td>
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<tr>
<td>10:30am – 11:00am</td>
<td>Scientific Paper Session A</td>
<td>Salon I</td>
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<tr>
<td>11:00am – 11:45am</td>
<td>AAHS/ASPN Panel: Failed Nerve Decompression – Now What?</td>
<td>Salon II &amp; III</td>
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<td>AAHS/ASPN Panel: Assessment and Management of the Mangaled Hand</td>
<td>Salon I</td>
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<tr>
<td>11:45am – 1:15pm</td>
<td>Scientific Paper Session B &amp; Lunch</td>
<td>Salon I</td>
</tr>
<tr>
<td>5:00pm – 6:00pm</td>
<td>Special Session: Scientific Posters</td>
<td>Salon I</td>
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</tbody>
</table>
301 Evaluation and Treatment of Disproportionate Pain and Disability

Instructors: Marie-Noëlle Hérbet-Blouin, MD; David Ring, MD

Disproportionate pain and disability is common, difficult to treat, and stressful for health care providers. Biomedical paradigms such as causalgia, reflex sympathetic dystrophy, sympathetic maintained pain, and complex regional pain syndrome continue to morph and evolve, have nonspecific and unreliable diagnostic criteria, and seem to be promoted by a few strong advocates. Psychologists and psychiatrists seem to understand and treat disproportionate pain and disability better, but there is little collaboration between medical and psychological experts. This course will be an open moderated discussion of these issues that should leave you a little less perplexed.

Objective: Following this session, the participant will be able to discuss methods to help patients with disproportionate pain and disability.

302 Obstetrical Brachial Plexus Palsy and Nerve Transfers

Chair: Thomas Tung, MD

Instructors: Gregory Borschel, MD; Scott Kozin, MD

This course will focus on the role of nerve transfers either as primary or secondary management of obstetrical brachial plexus palsy. Indications will be reviewed and commonly performed and established nerve transfer procedures will be discussed. Case presentations will be included in this session.

Objectives: Following this session, the participant will be able to:
1. Recognize the need for nerve transfers.
2. Describe the indications for nerve transfers.
3. Evaluate commonly performed nerve transfers.

303 Pediatric Peripheral Nerve Considerations

Co-Instructors: Howard Clarke, MD, PhD; Lynda Yang, MD, PhD

This course will review the clinical management of peripheral nerve conditions, including brachial plexus palsy, in pediatric patients with a focus on anatomy and clinical management. Topics include patient assessment, including aspects of history, physical exam, and imaging modalities; selection of patients with nerve injury for operations; and nerve conditions that require emergency / urgent management.

Objective: Following this session, the participant will be able to discuss the clinical management of peripheral nerve conditions in pediatric patients.
10:15 – 10:30 am Coffee Break with Exhibitors

10:30 – 11:00 am Scientific Paper Session A

Throughout the program a series of basic and clinical research papers chosen by the Program Committee will be presented.

**Objective:** The participants will be exposed to ongoing research in the field of peripheral nerve surgery.

**Moderator:** Lynda Yang, MD, PhD

**Co-Moderator:** Allan Van Beek, MD

10:30am - 10:35am

**Impact of PEDOT on Regenerating Nerves**

Institution where the work was prepared: University of Michigan, Ann Arbor, MI, USA

Ziya Baghmanli, MD; Melanie G. Urbanchek, PhD; Benjamin Wei, MD; Bong S. Shin, PhD; H Khan; David C. Martin, PhD; William M. Kuzon, MD, PhD; Paul S. Cederna, MD

10:35am - 10:40am

**Skin Derived Precursor Cells (SKPs) Promote Return of Electrophysiological Function in the Rat Tibial Nerve Model of Adriamycin Induced Demyelination**

Institution where the work was prepared: University of Calgary, Calgary, AB, Canada

Joey Grochmal, MD; Sundeeep Dhalvi; Rajiv Midha, MD, MSc

10:40am - 10:45am

**Conductive Polymer Scaffolds for Repair of Rat Sciatic Nerve**

Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA

Huan Wang, MD, PhD; M. Brett Runge, PhD; Jing Rui, MD; Michael J. Yaszemski, MD, PhD; Anthony J. Windebank, MD; Robert J. Spinner, MD

10:45am - 10:50am

**Brief Electrical Stimulation (ES) Promotes Regeneration of Axons Through Chronically Denervated Distal Nerve Stump of Transected Peripheral Nerve**

Institution where the work was prepared: University of Alberta, Edmonton, Canada

Adil Ladak, MD, MSc; Vanessa Falk, BSc; Valerie Verge, PhD; Neil Tyreman; Tessa Gordon, PhD

10:50am - 10:55am

**Calcium Channel Blockers Reduce the Effects of Cigarette Smoking on Peripheral Nerve Ischemia/Reperfusion Injury**

Institution where the work was prepared: University of Kentucky Division of Plastic Surgery, Lexington, KY, USA

Brian Rinker, MD; Betsy F. Fink; Neil G. Barry; Joshua A. Fife; Maria E. Milan; Ashley R. Stoker; Peter T. Nelson

10:55am - 11:00am

Discussion

11:00 – 11:45 am

**Joint Concurrent AAHS/ASPN Panel: Failed Nerve Decompression – Now What?**

**Moderator:** Allen Van Beek, MD

**Invited Panelists:** Allan Belzberg, MD; Marie-Noëlle Hérbet-Blouin, MD; Tsu-Min Tsai, MD

This panel will unravel the possibilities of incorrect diagnosis, iatrogenic injury, true recurrence, and the use of diagnostic adjuncts when faced with a potential of recurrent compression of nerves.

**Objective:** Following this session, the participant will be able to:
1. Accurately assess nerve compression.
2. Determine when surgery or supportive care is necessary.

11:45 am – 1:15 pm

**Scientific Paper Session B and Lunch**

**Moderator:** Allan Belzberg, MD

**Co-Moderator:** Martijn Malessy, MD, PhD

11:45am - 11:50am

**Prospective Evaluation of Incidence of Carpal Tunnel Syndrome among Post-Menopausal Women Receiving Adjuvant Aromatase Inhibitor Therapy for Breast Cancer**

Institution where the work was prepared: Johns Hopkins University School of Medicine, Baltimore, MD, USA

Raghunandan Venkat, MD, MPH; Aditya Bardia, MD, MPH; Jon Giles, MD; David Flockhart, MD, PhD; Daniel F. Hayes, MD; Norah L. Henry, MD, PhD; Stacie Jeter; Anne Nguyen; Anna M. Storniolo, MD; Karineh Tarpinian; Zhe Zhang, MS; Vered Stearns, MD; Gedge Rosson, MD

11:50am - 11:55am

**Double Fascicular Nerve Transfer to the Biceps and Brachialis Muscles After Brachial Plexus Injury: Clinical Outcomes in a Series of 29 Cases**

Institution where the work was prepared: Washington University School of Medicine, St. Louis, MO, USA

Wilson Z. Ray, MD; Mitchell Pet, BS; Susan E. Mackinnon, MD

11:55am - 12:00pm

**Contralateral C7 Transfer in Treating A Child with Cerebral Palsy: A Case Report**

Institution where the work was prepared: Huashan Hospital, Shanghai, China

Wen-Dong Xu, MD, PhD; Jian-Guang Xu; Yu-Dong Gu

12:00pm - 12:07pm

**Discussion**

12:07 pm - 12:12 pm

**Enhancing Functional Recovery by Supplementing Acellularized Nerve Grafts with Motor and Sensory Schwann Cells**

Institution where the work was prepared: Washington University School of Medicine, St. Louis, MO, USA

Katherine Santosa; Nithya J. Jesuraj, BS; Matthew MacEwan; Amy Moore; Wilson Z. Ray, MD; Gregory H. Borschel; DA Hunter; Philip J. Johnson, PhD; Shelly Sakiyama-Elbert, BS, PhD; Susan Mackinnon

12:12 pm - 12:17 pm

**Discussion**

12:17 pm - 12:22 pm

**Scientific Paper Session A**
Throughout the program a series of basic and clinical research papers chosen by the Program Committee will be presented.

**Objective:** The participants will be exposed to ongoing research in the field of peripheral nerve surgery.

**Moderator:** Lynda Yang, MD, PhD

**Co-Moderator:** James Bain, MD

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**Impact of PEDOT on Regenerating Nerves**

Institution where the work was prepared: University of Michigan, Ann Arbor, MI, USA

Ziya Baghmanli, MD; Melanie G. Urbanchek, PhD; Benjamin Wei, MD; Bong S. Shin, PhD; H Khan; David C. Martin, PhD; William M. Kuzon, MD, PhD; Paul S. Cederna, MD

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Brian Rinker, MD; Betsy F. Fink; Neil G. Barry; Joshua A. Fife; Maria E. Milan; Ashley R. Stoker; Peter T. Nelson

10:55am - 11:00am

Discussion
12:12 pm - 12:17 pm
Ca2+-ATPase Regulation in Crushed Peripheral Nerves
Institution where the work was prepared: Medical College of Wisconsin, Milwaukee, WI, USA
Yu-Hui Yan, MD; Hani S Matloub; Lin-Ling Zhang; Micheal Agresti; James Sanger; Ji-Geng Yan

12:17 pm - 12:24 pm
Discussion

12:24 pm - 12:29 pm
3D Reconstruction Model of Epidermal Fibers: A Novel Approach for Assessment of Neuropathic Pain
Institution where the work was prepared: Erasmus MC Rotterdam, Rotterdam, Netherlands
Liron S. Duraku, MsC; Aram Hussaini; Lukas Falke; Tom J.H. Ruigrok; Erik T. Wallebergh

12:29 pm - 12:34 pm
Botulinum Toxin Type A for Chronic Pain
Institution where the work was prepared: Southern Illinois University School of Medicine, Springfield, IL, USA
Kelli N. Webb, MD; Carisa M. Cooney; Reuben A. Bueno Jr; Michael W Neumeister

12:34 pm - 12:39 pm
Effects of Chronic Implantation of a Novel Nerve Cuff on Peripheral Nerve
Institution where the work was prepared: University of Alberta, Edmonton, AB, Canada
Lisa Korus, MD; Liu Shi Gan, PhD; Kimberly Wong, BSc; Kathryn Todd, PhD; Jaret Olson, MD, FRCSC; Michael Morhart, MD, FRCSC; Arthur Prochazka, PhD

12:39 pm - 12:46 pm
Discussion

12:46 pm - 12:51 pm
Scaffold-Less Engineered Neural Conduit Promotes Regeneration and Functional Recovery after Peripheral Nerve Injury in Adult Rats
Institution where the work was prepared: University of Michigan, Ann Arbor, MI, USA
Aaron Adams, PhD; Tatiana Kostrominova, PhD; Lisa M. Larkin

12:51 pm - 12:56 pm
Does the Active Range of Motion in Patients with Obstetrical Brachial Plexus Palsy Diminish over Time? A Ten Year Analysis
Institution where the work was prepared: Hospital for Sick Children, Toronto, ON, Canada
Abdullah E. Kattan, MBBS, FRCS(C); Christine G. Curtis, BSc, PT; Gregory H. Borschel; Howard M. Clarke, MD, FRCSC

12:56 pm - 1:01 pm
Functional Outcome After the Hoffer Procedure
Institution where the work was prepared: University of Alberta, Edmonton, AB, Canada
Amera Murabit, MD; Kathleen O’Grady; Michael Morhart, MD, FRCSC; Jaret Olson, MD, FRCSC

1:01 pm - 1:06 pm
Restoration of Plantar Sensation after Complex Injuries of the Tibial Nerve with Distal Nerve Transfers of the Sural and Superficial Peroneal Nerves: A Cadaveric Feasibility Study
Institution where the work was prepared: Hospital Universitario A Coruna, A Coruna, Spain
Andres Rodríguez, MD, PhD; Bruno Gago, MD; Felipe Pineda, MD

1:06 pm - 1:15 pm
Discussion

5:00 – 6:00 pm
Special Session: Scientific Posters
Join your ASPN colleagues for a series of oral poster presentations. Presenters will describe their research and answer your questions. Refreshments will be served.
Moderators: Dimitri Anastakis, MD; Gregory Borschel, MD; Ida Fox, MD

Axonal Relationships of Human Cells Transplantation to Repair Nerve Defect in Nude Rats
Institution where the work was prepared: Miami Project to Cure Paralysis, Miami, FL, USA
Zijie Zhang, MD, PhD; James Guest, MD, PHD; Patrick M. Wood, PhD

The Use of Medical Self-Hypnosis for the Treatment of Perioperative Brachial Plexus Pain and Sleep Disturbance
Institution where the work was prepared: The Upper Extremity Institute, Blue Bell, PA, USA
Scott M. Fried, DO

Functional Recovery after Repair of an 8-cm Ulnar Nerve Defect with a Processed Nerve Allograft/Nerve Connector Composite Graft
Institution where the work was prepared: Certified Plastic Surgery of New York, Saratoga Springs, NY, USA
Johnson C. Lee, MD; Donya Rowe; Jerome D. Chao, MD

Re-examining Fibromyalgia and Neuropathic Chronic Pain Syndromes
Institution where the work was prepared: Hand and Microsurgery Center of El Paso, El Paso, TX, USA
Jose J. Monsivais, MD

Treatment of Peripheral Neuropathy In HIV Patients with Nerve Decompressions
Institution where the work was prepared: Gulf Breeze Hospital, Gulf Breeze, FL, USA
Sean F. Wolfert, MD; A. Lee Dellon, MD

Assessment of Nerve Regeneration after Entubulation within a Novel Extracellular Matrix-Based Conduit
Institution where the work was prepared: Indiana University School of Medicine, IN.
Harris S. Mir, MD; Zafar A Sayed, MD; William Arthur Wooden, MD; Karim Sadik, MD

The Development of an Intramuscular Microsphere Drug Delivery System: An In Vivo Safety Study
Institution where the work was prepared: The Hospital for Sick Children, Toronto, ON, Canada
Daniel Ennis; Matthew D. Wood, PhD; Tessa Gordon, PhD; Gregory H. Borschel, MD; The Hospital for Sick Children
American Society for Peripheral Nerve

DAY-AT-A-GLANCE
Saturday, January 15, 2011

6:00am – 3:00pm Speaker Ready Room Tulum

6:30am – 6:00pm Meeting Service Staircase Foyer

6:30am – 8:00am AAHS/ASRM/ASPN Continental Breakfast Fountain Courtyard

7:00am – 8:00am AAHS/ASRM/ASRM Instructional Courses

201 Controversies in the Management of Nerve Compression In the Upper Extremity Plaza I

202 Reconstruction of Acute and Chronic Scapholunate Ligament Injuries—How I Treat Plaza II

203 Cortical Plasticity and Changes with Nerve Injury Cancun

204 Adult Brachial Plexus Lesions Merida

205 Monitoring Technologies for Flaps and Replants Cozumel

206 Innovation in Free Flap Surgery Salon I

8:15am – 8:30am AAHS/ASPN/ASRM President’s Welcome Salon II & III

8:30am – 9:30am AAHS/ASPN/ASRM Panel: Robotic Surgery Salon II & III

9:30am – 10:00am Coffee Break with Exhibitors Fountain Courtyard

10:00am – 11:00am AAHS/ASPN/ASRM Joint Presidential Keynote Lecture Salon II & III
Bob Woodruff

11:00am – 12:00am AAHS/ASPN/ASRM Joint Outstanding Papers Salon II & III

12:00pm – 1:00pm ASPN Scientific Session C and Lunch Salon II & III

5:00pm – 6:00pm ASPN Special Session: Scientific Posters Foyer Hallways

6:30pm – 8:00pm ASPN/ASRM Welcome Reception Beach Club
201 Controversies in the Management of Nerve Compression in the Upper Extremity
Chair: Thomas Hughes, MD
Instructors: Tyson Cobb, MD; Neil Ford Jones, MD; John Lubahn, MD; Mary Nordlie, MS, OTR, CHT
A number of developments have occurred in the surgical management of peripheral nerve compression syndromes. This course will focus on the indications and role of minimally invasive nerve decompression as well as evaluating these procedures as compared to more traditional open surgical techniques.
Objectives: Following this session, the participant will be able to:
1. Describe the indications for endoscopic guided nerve decompression.
2. Compare the advantages and disadvantages of simple decompression versus transposition for cubital tunnel compression.
3. Gain insight into the controversy over radial tunnel compression.

202 Reconstruction of Acute and Chronic Scapholunate Ligament Injuries – How I Treat
Chair: Mark Rekant, MD
Instructors: Steven Moran, MD; Peter Stern, MD Jennifer Thompson, MPT, CHT
Based on a series of clinical cases, the panel will address best evidence for treatment of common fractures of the hand. The various methods of internal or external fixation versus splints or casts will be expanded upon.
Objectives: Following this session, the participant will be able to:
1. Compare treatment options for hand fractures.
2. Avoid complications of treatment and improve patient safety.

203 Cortical Plasticity and Changes with Nerve Injury
Chair: Dimitri Anastakis, MD
Instructors: Martijn Malessy, MD PhD
During this course, participants will be provided with an overview of the current understanding of cortical plasticity and of the CNS changes that occur following peripheral nerve injury (PNI). In addition, the cortical changes that occur in patients with PNI and chronic neurogenic pain will be discussed. Researchers speculate that certain patient specific cofactors that may contribute to whether or not a given nerve lesion is painful – this concept will also be presented and discussed.
Objective: Following this session, the participant will be able to:
1. Describe the CNS changes that occur following peripheral nerve injury.
2. Describe the cortical changes that occur in patients with PNI and chronic neurogenic pain.
3. List potential patient specific cofactors that may contribute to chronic neurogenic pain following PNI.

204 Adult Brachial Plexus Lesions
Chair: Allan Belzberg, MD
Instructors: Michael Dorsi, MD; Thomas Tung, MD; Justin Brown, MD
This course will review the relevant anatomy of the brachial plexus and how it is affected in trauma. We will review what factors play a role in spontaneous regeneration and how they can be used to predict prognosis as well as the various surgical options for the typical injuries seen by the nerve surgeon.
Objectives: Following this session, the participant will be able to:
1. Describe the variables related to prognosis.

205 Monitoring Technologies for Flaps and Replants
Chair: William Swartz, MD
Instructors: Darrell Brooks, MD; Alex Keller, MD; Hakim Said, MD
Clinical monitoring for picking up a venous or arterial problem with a flap or replant is the standard against which newer technologies are evaluated. This session discusses the utility, advantages, and disadvantages of newer technologies including quantitative fluorometry, fluorescent imaging, tissue saturation, and flow couplers.
Objectives: Following this session, the participant will be able to:
1. Determine the pros and cons of newer technologies for monitoring.
2. Decide which monitoring technologies to implement in practice.

206 Innovation in Free Flap Surgery
Chair: Geoff Gurtner, MD
Instructors: David Brown, MD; Paul Cederna MD
Scientific advancements in gene therapy and tissue engineering have unique applications in microsurgery and have the potential to revolutionize how we care for our patients. See how far we have come and where we still need to go.
Objectives: Following this session, the participant will be able to:
1. Demonstrate how free flaps can be modified as therapeutic delivery systems.
2. Explain how functional muscle flaps can be engineered.
8:30 – 9:30 am
AAHS/ASPN/ASRM Panel: Robotic Surgery
Moderator: Jesse Selber, MD
Panelists: Michael Bednar, MD; Philippe Liverneaux, MD; Sijo Parekattil, MD
This panel will introduce novel robotic applications in three fields: plastic surgery, nerve surgery and hand surgery. Detailed descriptions of the robotic operative procedures; the indications and rationale behind using the robot; videos of the procedures themselves; and patient outcomes will be presented. This international panel will present the state-of-the-art in robotic microsurgery.

Objectives: Following this panel, the participant will be able to:
1. Describe the basic robotic surgical platform.
2. Innumerate advantages of the robot in minimally invasive approaches.
3. Describe ways in which robotics can be applied to plastic surgery, nerve surgery and hand surgery.

9:30 – 10:00 am
Coffee Break with Exhibitors

10:00 – 11:00 am
Joint Presidential Keynote Lecture
(not for credit)

Featured Speaker: Bob Woodruff
(See page 37 for more information)

11:00 am – 12:00 pm
AAHS/ASPN/ASRM Joint Outstanding Papers Presentations

AAHS Outstanding Papers
Moderator: Jesse Jupiter, MD
11:00am - 11:07am
Age-Related Changes in the Stress Response of Rat Tendon Stem-Progenitor Cells
Institution where the work was prepared: Mount Sinai School of Medicine, New York, NY, USA
Takintope Akinbiyi, MSc; Peter J. Taub; Lili Xu, MD; Melissa Ramcharan, MS; Herb Sun, PhD

11:07am - 11:14am
Early Versus Late Motion Following Volar Plating of Distal Radius Fractures
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
David Dennison, MD; Charlene L. Blanchard; Bassem T Elhassan; Alexander Y Shin

11:14am - 11:20am
Discussion

ASPN Outstanding Papers
Moderator: David L. Brown, MD
11:20am - 11:27am
Biophysical Stimuli Induce Demyelination via an Integrin Dependent Mechanism
Institution where the work was prepared: University of California, Irvine, Irvine, CA, USA
Michael Y. Lin; Laura R. Frieboes; Maryam Forootan; Winnie Palispis; Ranjan Gupta

11:27am - 11:34am
Detecting Cortical Plasticity Following Median Nerve Injury and Repair in a Rat FMRI Survival Study
Institution where the work was prepared: Medical College of Wisconsin, Milwaukee, WI, USA
Patrick C. Hettinger, MD; Rupeng Li, MD; Ji-Geng Yan, MD, PhD; Younghoon Cho, MD, PhD; James Sanger, MD; Safwan Jaradeh, MD; Chris Pawela, PhD; James Hyde, PhD; Hani S. Matloub, MD

11:34am - 11:40am
Discussion

ASRM Outstanding Papers
Moderator: Joan E. Lipa, MD
11:40 am - 11:47 am
Trachea Allotransplantation to Treat Long-Segment Tracheal Defects. Outcome After Retrieval of Immunosuppressive Therapy
Institution where the work was prepared: KU Leuven University Hospitals, Leuven, Belgium
Jan Jeroen Vranckx, MD, PhD; Pierre Delaere, MD, PhD

11:47 am - 11:54 am
Perioperative Fluid Considerations to Minimize Early Postoperative Complications in Free Flap Breast Reconstruction
Institution where the work was prepared: University Health Network, Toronto, ON, Canada
Toni Zhong, MD; Ryan Neinstein, MD; Stefan O.P. Hofer, MD, PhD, FRCSI(C); Joan Lipa; Christine Massey, MSc; Stewart McCluskey, FRCP; Peter C. Neligan

11:54am- 12:00pm
Discussion

12:00 – 1:00 pm
Scientific Paper Session C and Lunch
Moderator: Christopher Coombs, MBBS (Hons)
Co-Moderator: Jonathan Winograd, MD

12:00 pm - 12:05 pm
What Retrospective Clinical Research Should Teach Us about Prospective Patient Care After Peripheral Nerve Gap Repair
Institution where the work was prepared: The Buncke Clinic, San Francisco, CA, USA
Darrell Brooks, MD

12:05 pm - 12:10 pm
Targeted Muscle Reinnervation of a Free Flap
Institution where the work was prepared: Southern Illinois University School of Medicine, Springfield, IL, USA
Margo Herron, MD
5:00 – 6:00 pm
Special Session: Scientific Posters
Join your ASPN Colleagues for a series of oral poster presentations. Presenters will describe their research and answer your questions
Moderators: Ronald Zuker, MD; Thomas Tung, MD
Sensory to Motor Nerve Transfer in a Free Muscle Flap for Plantar Foot Reconstruction: Analysis of Outcomes in A Clinical Case and Review of Literature
Institution where the work was prepared: Hospital Universitario A Coruna, A Coruna, Spain
Andres Rodriguez, MD, PhD

Anatomical Localization of Supraorbital Nerve Compression in Frontal Triggered Migraines
Institution where the work was prepared: Neuropax Clinic, Saint Louis, MO, USA
Michael A. Fallucco, MD; Robert R. Hagan

Selecting Denervation in the Lower Extremity: a Discussion of Learning Curve and Outcomes
Institution where the work was prepared: Regions Hospital, St. Paul, MN, USA
Justine Mann; Loree K Kalliainen

Ethyl-2-Cyanoacrylate Can Be Applied in Direct Contact with Regenerating Nerves in a Novel Nerve-Guide
Institution where the work was prepared: The Catholic University School of Medicine, Rome, Italy
Antonio Merollì, MD; Lorenzo Rocchi; Luigi Mingarelli; Alessandro Morini; Francesco Catalano

Stimulus Parameters Are Important For Intraoperative Neurophysiological Evaluation of the Brachial Plexus: A Case Study
Institution where the work was prepared: Sunnybrook HSC, Toronto, ON, Canada
David A. Houlden, PhD; Farhad Pirouzmand, MD

The Motor Nerve to the Masseter Muscle: an Anatomic and Histomorphometric Study to Facilitate its Use in Facial Reanimation
Institution where the work was prepared: The Hospital for Sick Children, Toronto, ON, Canada
Gregory H. Borschel, MD; David H. Kawamura, MD; Dan Hunter, RA; Rahul Kasukurthi; Albert Woo

A Comparison of Peripheral Nerve Interfaces Containing Either Cultured Myoblasts or Transferred Muscle
Institution where the work was prepared: University of Michigan, Ann Arbor, MI, USA
Melanie G. Urbanchek, MS, PhD; Benjamin Wei, MD; Ziya Baghmanli; Nicole L. Castagnino, BS; Christopher M. Frost, Student; Brent M. Egeland, MD; Paul S Cederna

Transplanting Schwann Cells Transfected with GDNF into Cold-Preserved Nerve Allografts
Institution where the work was prepared: Washington University School of Medicine, St. Louis, MO, USA
Katherine Santosa; Phillip Johnson; Matthew MacEwan; Wilson Z. Ray, MD; Michael Nicolson; Dan Hunter, RA; Susan E. Mackinnon; Washington University School of Medicine

6:30 - 8:00 pm
ASPN/ASRM Welcome Reception
See description on page 3.
## American Society for Peripheral Nerve

### Day-at-a-Glance
**Sunday, January 16, 2011**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>6:00am – 8:00am</td>
<td>Speaker Ready</td>
<td>Tulum</td>
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<tr>
<td>6:30am – 6:00pm</td>
<td>Meeting Services</td>
<td>Staircase Foyer</td>
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<tr>
<td>6:30am – 8:00am</td>
<td>Breakfast with Exhibitors</td>
<td>Fountain Courtyard</td>
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<tr>
<td>7:00am – 8:00am</td>
<td>Instructional Courses</td>
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<tr>
<td>304</td>
<td>Lower Extremity Nerve Decompression in the Patient with Diabetes</td>
<td>Cancun</td>
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<td>305</td>
<td>Reinnervating Muscle: From the Lab to the Clinic</td>
<td>Salon I</td>
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<tr>
<td>8:15am – 9:15am</td>
<td>Panel: Treatment of Migraine Headaches via Nerve Interventions</td>
<td>Salon I</td>
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<tr>
<td>9:15am – 9:30am</td>
<td>Break with Exhibits</td>
<td>Fountain Courtyard</td>
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<tr>
<td>9:30am – 10:45am</td>
<td>Scientific Paper Session D</td>
<td>Salon I</td>
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<tr>
<td>10:45am – 11:45am</td>
<td>ASPN/ASRM Panel: Facial Paralysis</td>
<td>Salon II &amp; III</td>
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<tr>
<td>11:45am – 12:45pm</td>
<td>Scientific Paper Session E &amp; Lunch</td>
<td>Salon I</td>
</tr>
<tr>
<td>12:45pm – 1:30pm</td>
<td>Annual Business Meeting (ASPN Members Only)</td>
<td>Salon I</td>
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Proceed. This course will investigate the detrimental consequences to determine whether surgery is required for axon regeneration to await signs of functional recovery and by limited techniques degeneration. Delays are frequently incurred by clinical practice commences to repair peripheral nerves that have suffered axon degeneration. Delays are frequently incurred by clinical practice to await signs of functional recovery and by limited techniques to determine whether surgery is required for axon regeneration to proceed. This course will investigate the detrimental consequences of prolonged delays between diagnosis of nerve injury requiring operative repair and the surgical repair. Instructors will present experimental findings from animal and human studies which demonstrate that brief electrical stimulation at the time of surgical repair accelerates axon regeneration and target reinervation and that stem cells that are directed to Schwann cell phenotypes can promote regeneration through chronically denervated distal nerve stumps.

Objectives: Following this session, the participant will be able to:
1. Describe the consequences of prolonged delays between diagnosis of nerve injury requiring operative repair and the surgical repair.
2. Make more informed judgments of the timing of surgical repair of peripheral nerve injuries.

8:15 – 9:15 am
Panel: Treatment of Migraine Headaches via Nerve Interventions
Moderator: Bahman Guyuron, MD
Invited Panelists: A. Lee Dellon, MD; Ivica Ducic, MD; Jeffrey Janis, MD
This panel will review the current state of the surgical treatment of migraine headaches. Panelists will discuss how to set up a migraine practice, the patient referral pattern, patient selection, surgical maneuvers, and factors contributing to the success and failure of the operation. Cases representing the common features of the conditions that can be successfully treated with these procedures, designed to deactivate the peripheral trigger mechanisms, will be discussed.

Objectives: Following this session, the participant will be able to:
1. Describe the current state of the surgical treatment of migraine headaches.
10:15am - 10:20am
Treatment of a Segmental Nerve Defect with Use of a Cabled Sural Nerve Autogenous Graft as a Novel Experimental Model in the Rat
Institution where the work was prepared: Columbia University Medical Center, New York, NY, USA
Ayhan Kilic; Geoffrey Konopka; Ricky Regalbuto; Yelena Akelina; Thomas Gardner; Peter Tang

10:20am - 10:25am
Discussion

10:25am - 10:30am
Profiling Muscle-Specific Microrna Expression After Peripheral Denervation and Re-Innervation in a Rat Model
Institution where the work was prepared: Chang Gung Memorial Hospital – Kaohsiung Medical Center, Kaohsiung, Taiwan
Ching-Hua Hsieh, MD; Seng-Feng Jeng, MD

10:30am - 10:35am
The Vein Supported with Muscle and Bone Marrow Stromal Cells Compared to the Nerve Autograft as a Natural Conduit for Bridging a 15mm Nerve Defect in Rats
Institution where the work was prepared: Erasmus MC, University Medical Center, Rotterdam, Netherlands
T.H.J. Nijhuis, MS; J.W. Neck van, PhD; E.T. Walbeehm, MD, PhD; J.H. Blok, PhD; S.E.R. Hovius, MD, PhD

10:35am - 10:40am
Traumatic Neuroma in Continuity Injury Model in Rodents
Institution where the work was prepared: University of Calgary, Calgary, AB, Canada
Jacob D. Alant, MBChB, MMed; Stephen W.P. Kemp, BSc, PhD; Kathleen J. Khu, MD; Ranjan Kumar; Aubrey A. Webb, PhD; Rajiv Midha, MD, MSc

10:40am - 10:45am
Discussion

10:45 – 12:45 pm
Scientific Paper Session E and Lunch
Moderator: Tessa Gordon, PhD
Co-Moderator: Ranjan Gupta, MD

11:45 - 12:00 pm
Reconstruction of Shoulder Function in Supraclavicular Brachial Plexus Injuries: A Comparative Study Between Nerve Transfers versus Nerve Grafting
Institution where the work was prepared: Chang Gung Memorial Hospital, Linkou, Taoyuan, Taiwan
Woo-Leon Lam, MD, FACS; David Chwei-Chin Chuaung, MD

11:55am - 12:00pm
Low-Pressure Headaches in Adult Patients with Traumatic Brachial Plexus Injury
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Marie-Noëlle Hébert-Blouin, MD; Bahram Mokri, MD; Alexander Y. Shin; Allen T. Bishop, MD; Robert J. Spinner, MD

12:00pm - 12:03pm
Discussion

12:03pm - 12:08pm
Innovative Techniques in Primary Brachial Plexus Reconstruction
Institution where the work was prepared: Texas Brachial Plexus Institute, Houston, TX, USA
Art Armenta; Edward Berzin

12:08pm - 12:13pm
Intraoperative Choice of Reconstructive Strategy in Obstetric Brachial Plexus Palsy
Institution where the work was prepared: Euregio Reconstructive Microsurgery Unit, Franziskushospital, Aachen, Germany
Jörg Bahm, MD

12:13pm - 12:18pm
The BMRC scale vs. Objective Elbow Flexion and Extension Strength Measurement
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Leili Shahgholi, fellow; Keith A. Bengtson; Allen T Bishop; Alexander Y Shin; Robert J. Spinner; Kenton R Kaufman

12:18pm - 12:21pm
Discussion

12:21pm - 12:26pm
Peripheral Nerve Compressions in the Lower Extremities Aggravating Restless-Legs-Symptoms - Selected RLS-Patients Profit by Surgical Nerve Decompression
Institution where the work was prepared: Caritas Krankenhaus Lebach/Arabella Klinik Munich, Lebach/Munich, Germany
Martin Raghunath, MD
Scientific Paper Session E and Lunch continued

12:31pm - 12:36pm
Sensory Recovery in the Upper Extremity Using Processed Acellular Human Nerve Allograft
Institution where the work was prepared: Albert Einstein College of Medicine, Bronx, NY, USA
Snezana Veljic, MD; Renata V. Weber, MD

12:36pm - 12:41pm
Abnormal Post-Operative Electrophysiological Findings after Carpal Tunnel Release: A One-year Follow-up
Institution where the work was prepared: The Catholic University, Rome, Italy
Antonio Merolli, MD; Mauro Lo Monaco; Maria Luisa Mereu; Mario Luigetti; Anna Modoni; Francesco Catalano

12:41pm - 12:44pm
Discussion

12:45 – 1:30 pm
Annual Business Meeting (ASPN Members Only)
<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
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<tbody>
<tr>
<td>President</td>
<td>Peter C. Neligan, MD</td>
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<tr>
<td>President-Elect</td>
<td>Keith E. Brandt, MD</td>
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<tr>
<td>Vice-President</td>
<td>Michael W. Neumeister, MD</td>
</tr>
<tr>
<td>Secretary</td>
<td>Gregory R.D. Evans, MD, FACS</td>
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<tr>
<td>Treasurer</td>
<td>Allen T. Bishop, MD</td>
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<tr>
<td>Immediate Past President</td>
<td>William A. Zamboni, MD</td>
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<tr>
<td>Senior Members-At-Large</td>
<td>Elisabeth K. Beahm, MD</td>
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<td>Raymond M. Dunn, MD</td>
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<tr>
<td>Junior Members-At-Large</td>
<td>Michel Saint-Cyr, MD, FRCS (C)</td>
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<td>Eduardo Rodriguez, DDS, MD</td>
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<tr>
<td>Historian</td>
<td>Lawrence J. Gottlieb, MD</td>
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</table>
Please join us in thanking the following ASRM committees who have helped make the 2010 year successful.

**Audit Committee**
David Chang, MD, Chair
Matthew Hanasono, MD
Brad Wilhelmi, MD

**Buncke Lectureship Committee**
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Yur-Ren Kuo, MD
Elliot Rose, MD
Joan E. Lipa, MD
Peter C. Neligan, MD

**Bylaws Committee**
E. Gene Deune, MD, Chair
Paul Cederna, MD
Robert Whitfield, MD

**Clinical Guidelines & Outcomes Committee**
James Higgins, MD, Chair
Peter Cordeiro, MD
Lee Pu, MD
Hakim Said, MD

**CPT/RUC Committee**
Paul Cederna, MD, Chair
Gregory Buncke, MD
Gabriel Kind, MD
Dan Nagle, MD
William C. Pederson, MD
Michael R. Zenn, MD
Raymond M. Dunn, MD, Ex-Officio

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Bernard Lee, MD, Chair
Melissa Crosby, MD
Stefan Hofer, MD
Marc Mureau, MD

**Electronic Communications Committee**
Michael Klebuc, MD, Chair
Matthew Concannon, MD
Howard Langstein, MD
Peter Murray, MD
Michael Miller, MD, Ex-Officio

**Endowment Committee**
L. Scott Levin, MD, FACS, Chair
Lawrence Colen, MD
Joseph Serletti, MD
Robert Walton, MD

**Finance Committee**
Keith E. Brandt, MD, Chair
Allen T. Bishop, MD
Peirong Yu, MD
Joseph M. Serletti, MD, FACS, Ex-Officio

**Godina Fellowship Selection Committee**
Keith E. Brandt, MD, Chair
Yur-Ren Kuo, MD
Peter C. Neligan, MD
Michael Zenn, MD

**Masters Series Symposium Committee**
Lawrence Gottlieb, MD

**Membership Committee**
Keith E. Brandt, MD, Chair
Donald Baumann, MD
Elisabeth Beahm, MD
Gabriel Kind, MD
Eduardo Rodriguez, MD, DDS
Michael Neumeister, MD, Ex-Officio

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Keith Brandt, MD, FACS
Gregory Buncke, MD
Peter Cordeiro, MD
Liza Wu, MD

**Nominating Committee**
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Melissa Crosby, MD
William Dzwierzynski, MD
Howard Langstein, MD
Hakim Said, MD
Program Committee
Joan E. Lipa, MD, Chair
Fred Duffy, MD
Jaco Festekjian, MD
Michael Klebuc, MD
Gordon Lee, MD
David Mathes, MD
Babak Mehrara, MD
Roman Skoracki, MD
Maria Siemionow, MD
Claire Temple, MD
Howard T. Wang, MD
Wei Z. Wang, MD
Charles E. Butler, MD, Ex-Officio

Technical Exhibits Committee
Randall Culp, MD, Chair
Eduardo Rodriguez, DDS, MD
Liza Wu, MD

Time & Place Committee
William Zamboni, MD, Chair
Lawrence B. Colen, MD
Neil Ford Jones, MD

Young Microsurgeons Group Committee
Robert Whitfield, MD, Chair
Melissa Crosby, MD
Scott Hansen, MD
Thomas Hayakawa, MD
John Hijjawi, MD
Mark Kiehn, MD
Otway Louie, MD
Vu Nguyen, MD
Gedge Rosson, MD
### ASRM HISTORICAL INFORMATION

**1983 Founding Council**

James B. Steichen, MD  
Berish Strauch, MD  
Julia K. Terzis, MD, PhD  
James R. Urbaniak, MD  
Allen L. Van Beek, MD

<table>
<thead>
<tr>
<th>Year</th>
<th>President</th>
<th>Annual Meeting Site</th>
<th>Founders/Godina Lecturers</th>
</tr>
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<tbody>
<tr>
<td>1985</td>
<td>Berish Strauch, MD</td>
<td>Las Vegas, NV</td>
<td>Harry J. Buncke, MD</td>
</tr>
<tr>
<td>1986</td>
<td>James R. Urbaniak, MD</td>
<td>New Orleans, LA</td>
<td>Harold E. Kleinert, MD</td>
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<tr>
<td>1987</td>
<td>Joseph E. Kutz, MD</td>
<td>San Antonio, TX</td>
<td>Robert D. Acland, MD</td>
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<tr>
<td>1988</td>
<td>H. Bruce Williams, MD</td>
<td>Baltimore, MD</td>
<td>Founders’ Lecturer</td>
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<tr>
<td>1989</td>
<td>James B. Steichen, MD</td>
<td>Seattle, WA</td>
<td>Berish Strauch, MD</td>
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<tr>
<td>1990</td>
<td>Allen L. Van Beek, MD</td>
<td>Toronto, Ontario, Canada</td>
<td>G. Ian Taylor, FRCS, FRACS</td>
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<tr>
<td>1991</td>
<td>Michael B. Wood, MD</td>
<td>Orlando, FL</td>
<td>Founders’ Lecturer</td>
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<tr>
<td>1992</td>
<td>Andrew J. Weiland, MD</td>
<td>Scottsdale, AZ</td>
<td>Andrew Lightbody</td>
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<td>1993</td>
<td>Graham Lister, MD</td>
<td>Kansas City, MO</td>
<td>Founders’ Lecturer</td>
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<tr>
<td>1994-95</td>
<td>Robert C. Russell, MD</td>
<td>Marco Island, FL</td>
<td>Algimantas Narakas, MD</td>
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<tr>
<td>1995-96</td>
<td>Ralph T. Manktelow, MD</td>
<td>Tucson, AZ</td>
<td>Founders’ Lecturer</td>
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<tr>
<td>1996-97</td>
<td>James A. Nunley, MD</td>
<td>Boca Raton, FL</td>
<td>Founders’ Lecturer</td>
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<tr>
<td>1997-98</td>
<td>William M. Swartz, MD</td>
<td>Scottsdale, AZ</td>
<td>Founders’ Lecturer</td>
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Godina Lecturer
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<tr>
<th>Year</th>
<th>President</th>
<th>Annual Meeting Site</th>
<th>Founders/Godina Lecturers</th>
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<tr>
<td>1998-99</td>
<td>David T. W. Chiu, MD</td>
<td>Waikoloa, HI</td>
<td>Julia K. Terzis, MD, PhD Founders’ Lecturer</td>
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<td>Phillip Blondeel, MD Godina Lecturer</td>
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<tr>
<td>1999-2000</td>
<td>Daniel Nagle, MD</td>
<td>Miami, FL</td>
<td>Allen Van Beek, MD Founders’ Lecturer</td>
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<td>Gregory R. D. Evans, MD Godina Lecturer</td>
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<td>2000-2001</td>
<td>Saleh M. Shenaq, MD</td>
<td>San Diego, CA</td>
<td>Wayne Morrison, MD, FRACS Founders’ Lecturer</td>
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<td>Roger Khouri, MD Godina Lecturer</td>
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<tr>
<td>2001-2002</td>
<td>Randy Sherman, MD</td>
<td>Cancun, Mexico</td>
<td>Robert Russell, MD Founders’ Lecturer</td>
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<td>William Zamboni, MD Godina Lecturer</td>
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<td>2002-2003</td>
<td>Julia K. Terzis, MD, PhD</td>
<td>Kauai, HI</td>
<td>Panayotis Soucacos, MD Founders’ Lecturer</td>
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<td>Raymond Dunn, MD Godina Lecturer</td>
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<td>2003-2004</td>
<td>Ronald M. Zuker, MD</td>
<td>Palm Springs, CA</td>
<td>Ralph Manktelow, MD Founders’ Lecturer</td>
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<td>Milomir Ninkovic, MD, PhD Godina Lecturer</td>
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<td>2004-2005</td>
<td>Robert L. Walton, MD, FACS</td>
<td>Fajardo, Puerto Rico</td>
<td>Isao Koshima, MD Founders’ Lecturer</td>
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<td>Michael Neumeister, MD, FRCSC, FACS Godina Lecturer</td>
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<td>G. Ian Taylor, MD, FACS Buncke Lecture</td>
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<td>2005-2006</td>
<td>William C. Pederson, MD</td>
<td>Tucson, AZ</td>
<td>David Chang, MD, FACS Godina Lecturer</td>
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<td>Fu Chan Wei, MD, FACS Buncke Lecture</td>
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<td>2006-2007</td>
<td>L. Scott Levin, MD, FACS</td>
<td>Rio Grande, Puerto Rico</td>
<td>Ming Huei Cheng, MD, MHA Godina Lecturer</td>
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<td>James Urbaniaik, MD Buncke Lecture</td>
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<td>2007-2008</td>
<td>Lawrence B. Colen, MD</td>
<td>Beverly Hills, CA</td>
<td>Peirong Yu, MD Godina Lecturer</td>
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<td>Berish Strauch, MD Buncke Lecture</td>
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<td>2008-2009</td>
<td>Neil F. Jones, MD</td>
<td>Maui, HI</td>
<td>Michael Sauerbier, MD Godina Lecturer</td>
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<td>Ralph Manktelow, MD Buncke Lecture</td>
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<tr>
<td>2009-2010</td>
<td>William A. Zamboni, MD</td>
<td>Boca Raton, FL</td>
<td>Yur Ren Kuo, MD, PhD Godina Lecturer</td>
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<tr>
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<td>Susumu Tamai, MD Buncke Lecture</td>
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ASRM CONTINUING MEDICAL EDUCATION

Educational Overview
After the completion of this program, participants will have an enhanced knowledge of the scope, practice and application of microsurgical techniques in breast, upper/lower extremity and head and neck reconstruction. Included will be specifics of patient and flap selection, inset techniques, and avoidance and management of complications.

Intended Audience
This educational activity is intended for surgeons and other healthcare professionals engaged in the practice of clinical reconstructive microneurovascular surgery and other complex reconstructions and/or involvement in research and teaching of microneurovascular surgery.

Learning Objectives: Following completion of this activity, participants will be able to:
• Discuss state-of-the-art techniques in microsurgery and complex reconstruction.
• Effectively implement interdisciplinary interaction and cooperative learning among colleagues in professional practice.
• Interact professionally with microsurgeons from various countries worldwide for the beneficial exchange of medical knowledge and surgical techniques.
• Analyze current reconstructive practices and evaluate professional effectiveness with respect to best practices and patient safety.
• Differentiate new knowledge and emerging techniques in complex reconstruction and translate into clinical practice.

Commercial Support
This activity is supported by educational grants from, The California Pacific Medical Center

and by an educational grant from Synovis, MCA.

Accreditation Statement and Designation
This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the American Society of Plastic Surgeons (ASPS) and the American Society for Reconstructive Microsurgery (ASRM). The ASPS is accredited by the ACCME to provide continuing medical education for physicians.

The ASPS designates this educational activity for a maximum of 23.5 AMA PRA Category 1 Credits™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Disclaimer
The view expressed and the subject material presented in the course of any activities sponsored by the American Society for Reconstructive Microsurgery including lectures, seminars, instructional courses, or otherwise, represent the personal views of the individual participants and do not represent the opinion of the American Society for Reconstructive Microsurgery. The society assumes no responsibility for such views or materials, or implied, for the content of any Society sponsored presentations. Further, the Society hereby acknowledges that while its broad purpose is to promote the development and exchange of knowledge pertaining to the practice of microsurgery; it does so only in the context of a private forum without making any representation to the public whatsoever. Accordingly, the Society declares that its primary purpose is to benefit only its members, and responsibility for the Society for acts or omissions of Society members dealing with the public is hereby expressly disclaimed dealing with the public is hereby expressly disclaimed.
All identified conflicts of interest have been resolved.
ASPS CME Committee/Education staff members and involved ASRM staff members have no relevant financial relationships or affiliations to disclose

notes
American Society for Reconstructive Microsurgery
DAY-AT-A-GLANCE
Saturday, January 15, 2011

6:00am – 3:00pm Speaker Ready Room Tulum
6:00am – 3:00pm Meeting Services Staircase Foyer
6:30am – 8:00am Breakfast with Exhibitors Fountain Courtyard
7:00am – 8:00am AAHS/ASPN/ASRM Instructional Courses
   201 Controversies in the Management of Nerve Compression in the Upper Extremity Plaza I
   202 Reconstruction of Acute and Chronic Scapholunate Ligament Injuries-How I Treat Plaza II
   203 Cortical Plasticity and Changes with Nerve Injury Cancun
   204 Adult Brachial Plexus Lesions Merida
   205 Monitoring Technologies for Flaps and Replants Cozumel
   206 Innovations in Free Flap Surgery Salon I
8:15am – 8:30am AAHS/ASPN/ASRM President’s Welcome Salon II & III
8:30am – 9:30am AAHS/ASPN/ASRM Panel: Robotic Surgery Salon II & III
9:30am – 10:00am Coffee Break with Exhibitors Fountain Courtyard
10:00am – 11:00am AAHS/ASPN/ASRM Joint Presidential Keynote Lecture Bob Woodruff Salon II & III
11:00am – 12:00pm AAHS/ASPN/ASRM Joint Outstanding Papers Salon II & III
12:00pm – 5:00pm ASRM Master Series in Microsurgery Salon II & III
12:30pm AAHS/ASRM Golf Tournament Hilton Course
5:30pm – 6:30pm ASRM Young Microsurgeons Group/ New Member Reception (Invitation Only) El Mexicano Café Terrace
6:30pm – 8:00pm ASPN/ASRM Welcome Reception Beach Club
201 Controversies in the Management of Nerve Compression in the Upper Extremity
Chair: Thomas Hughes, MD
Instructors: Tyson Cobb, MD; Neil Ford Jones, MD; John Lubahn, MD; Mary Nordlie, MS, OTR, CHT
A number of developments have occurred in the surgical management of peripheral nerve compression syndromes. This course will focus on the indications and role of minimally invasive nerve decompression as well as evaluating these procedures as compared to more traditional open surgical techniques.
Objectives: Following this session, the participant will be able to:
1. Describe the indications for endoscopic guided nerve decompression.
2. Compare the advantages and disadvantages of simple decompression versus transposition for cubital tunnel compression.
3. Gain insight into the controversy over radial tunnel compression.

202 Reconstruction of Acute and Chronic Scapholunate Ligament Injuries – How I Treat
Chair: Mark Rekant, MD
Instructors: Steven Moran, MD; Peter Stern, MD; Jennifer Thompson, MPT, CHT
Based on a series of clinical cases, the panel will address best evidence for treatment of common fractures of the hand. The various methods of internal or external fixation versus splints or casts will be expanded upon.
Objectives: Following this session, the participant will be able to:
1. Compare treatment options for hand fractures.
2. Avoid complications of treatment and improve patient safety.

203 Cortical Plasticity and Changes with Nerve Injury
Chair: Dimitri Anastakis, MD
Instructors: Martijn Maleyss, MD PhD
During this course, participants will be provided with an overview of the current understanding of cortical plasticity and of the CNS changes that occur following peripheral nerve injury (PNI). In addition, the cortical changes that occur in patients with PNI and chronic neurogenic pain will be discussed. Researchers speculate that certain patient specific cofactors that may contribute to whether or not a given nerve lesion is painful – this concept will also be presented and discussed.
Objective: Following this session, the participant will be able to:
1. Describe the CNS changes that occur following peripheral nerve injury.
2. Describe the cortical changes that occur in patients with PNI and chronic neurogenic pain.
3. List potential patient specific cofactors that may contribute to chronic neurogenic pain following PNI.
ASPN Outstanding Papers
Moderator: David L. Brown, MD
11:20 am - 11:27 am
Biophysical Stimuli Induce Demyelination via an Integrin Dependent Mechanism
Institution where the work was prepared: University of California, Irvine, Irvine, CA, USA
Michael Y. Lin; Laura R. Frieboes; Maryam Forootan; Winnie Palispis; Ranjan Gupta

11:27 am - 11:34 am
Detecting Cortical Plasticity Following Median Nerve Injury and Repair in a Rat FMRI Survival Study
Institution where the work was prepared: Medical College of Wisconsin, Milwaukee, WI, USA
Patrick C. Hettinger, MD; Rupeng Li, MD; Ji-Geng Yan, MD, PhD; Younghoon Cho, MD, PhD; James Sanger, MD; Safwan Jaradeh, MD; Chris Pawela, PhD; James Hyde, PhD; Hani S. Mattloub, MD

11:34 am - 11:40 am
Discussion

ASRM Outstanding Papers
Moderator: Joan E. Lipa, MD
11:40 am - 11:47 am
Trachea Allotransplantation to Treat Long-Segment Tracheal Defects. Outcome After Retrieval of Immunosuppressive Therapy
Institution where the work was prepared: KU Leuven University Hospitals, Leuven, Belgium
Jan Jeroen Vranckx, MD, PhD; Pierre Delaere, MD, PhD

11:47 am - 11:54 am
Perioperative Fluid Considerations to Minimize Early Postoperative Complications in Free Flap Breast Reconstruction
Institution where the work was prepared: University Health Network, Toronto, ON, Canada
Toni Zhang, MD; Ryan Neinstein, MD; Stefan O.P. Hofer, MD, PhD, FRCS(C); Joan Lipa; Christine Massey, MSc; Stewart McCluskey, FRCPC; Peter C. Neligan

11:54 am - 12:00 pm
Discussion
12:00 – 5:00 pm
Master Series in Microsurgery
Tips, Tricks and Pearls: Insights from the Masters
(Seperate Registration required)
This year the Masters Series will be a little bit different and with the title Tricks, Tips and Pearls: Insights from the Masters, a panel of Masters will offer insight into their respective specialties.

Chair: Lawrence J. Gottlieb, MD

SuperMicrosurgery
Instructor: Joon Pio Hong, MD

Hand/Upper Extremity Reconstruction
Instructor: James Higgins, MD

Pediatric Microsurgery
Instructor: Neil F. Jones, MD

Head and Neck Reconstruction
Instructor: Ming-Huei Cheng, MD

Reconstruction Using Tissue Engineering
Instructor: Gregory R. D. Evans, MD, FACS

Breast Reconstruction
Instructor: Keith Brandt, MD

Getting Started as an Academic Reconstruction Microsurgeon
Instructor: Liza Wu, MD

Reconstructive Microsurgery in (Solo) Private Practice
Instructor: Loren Schechter, MD

Objectives: Following this course, the participant will be able to:
1. Evaluate tips, tricks and pearls of microsurgery from the Masters.
2. Apply tips, tricks and pearls of how to get started as an academic reconstructive microsurgeon.
3. Identify tips, tricks and pearls of how to be a successful reconstructive microsurgeon in private practice.
4. Discuss tips, tricks and pearls of tissue engineering and its use in reconstructive surgery.

12:30 pm
Golf Tournament

5:30 – 6:30 pm
ASRM Young Microsurgeons Group/New Member Reception (Invitation Only)

6:30 – 8:00 pm
ASPN/ASRM Welcome Reception
American Society for Reconstructive Microsurgery

DAILY AT A GLANCE

Sunday, January 16, 2011

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<tr>
<th>Time</th>
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<td>6:00am – 3:00pm</td>
<td>Speaker Ready Room</td>
<td>Tulum</td>
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<td>Meeting Services</td>
<td>Staircase Foyer</td>
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<td>6:30am – 8:00am</td>
<td>Breakfast with Exhibitors</td>
<td>Fountain Courtyard</td>
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<tr>
<td>7:00am – 7:15am</td>
<td>ASRM Presidential/Program Chair Welcome: Peter C. Neligan, MD, Joan E. Lipa, MD</td>
<td>Salon II &amp; III</td>
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<tr>
<td>7:15am – 8:15am</td>
<td>Panel: Lessons From the Global War on Terror—Unique Reconstructive Challenges</td>
<td>Salon II &amp; III</td>
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<tr>
<td>8:15am – 9:15am</td>
<td>President’s Invited Lecturer: Roger Khouri, MD Beyond Microsurgery</td>
<td>Salon II &amp; III</td>
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<tr>
<td>9:15am – 9:30am</td>
<td>William G. Shaw Memorial</td>
<td>Salon II &amp; III</td>
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<td>9:30am – 9:50am</td>
<td>Coffee Break with Exhibitors</td>
<td>Fountain Courtyard</td>
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<tr>
<td>9:30am – 10:45am</td>
<td>Concurrent Scientific Paper Session: Nerve</td>
<td>Salon I</td>
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<tr>
<td>9:50am – 10:45am</td>
<td>Concurrent Scientific Paper Session: Breast</td>
<td>Salon II &amp; III</td>
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<td>10:45am – 11:45am</td>
<td>ASPN/ASRM Panel: Facial Paralysis</td>
<td>Salon II &amp; III</td>
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<tr>
<td>11:45am – 1:00pm</td>
<td>ASRM Break Out Panels</td>
<td>Merida</td>
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<td>1:15pm – 2:45pm</td>
<td>ASRT Update</td>
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<td>4:00pm – 5:00pm</td>
<td>Poster &amp; Exhibits Reception</td>
<td>Foyer Hallways</td>
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<tr>
<td>5:00pm – 7:00pm</td>
<td>Best Case/Best Save Programming</td>
<td>Salon II &amp; III</td>
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<tr>
<td>7:30pm</td>
<td>ASRM President’s Dinner (Invitation Only)</td>
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</table>
ASRM Concurrent Scientific Paper Sessions: Nerve, Breast I

Objective: The participants will be exposed to ongoing research in the field of peripheral nerve surgery and reconstructive microsurgery.

Nerve

Moderator: Linda Dvali, MD; Loree Kalliainen, MD; Robert Spinner, MD

9:30 am - 9:35 am
Modified Approach for Lateral Femoral Cutaneous Nerve Decompression in Patients with Meralgia Paresthetica
Institution where the work was prepared: Georgetown University Hospital, Washington, DC, USA
Ivica Ducic, MD, PhD; Matt Iorio, MD; John Felder, MD

9:35 am - 9:40 am
Tendon Transfer or Nerve Transfer for Elbow Flexion. What is the Evidence? A Systematic Review
Institution where the work was prepared: McMaster University, Hamilton, ON, Canada
Wendy Kar Yee Ng, MD; Sophocles Voineskos, MD; Achilles Thoma

9:40 am - 9:45 am
Contralateral C7 Transfer (CC7T) with Long-term Follow-up (at Least 4 years) at Chang Gung Memorial Hospital
Institution where the work was prepared: Chang Gung Memorial Hospital, Taoyuan, Taiwan
Shu-ying Chang, MD; David Chwei-Chin Chuang, MD

9:45 am - 9:50 am
Modified Latissimus Dorsi Muscle Transfer for External Rotation in Brachial Plexopathy
Institution where the work was prepared: University of Montreal, Montreal, QC, Canada
Dominique M. Tremblay, MD; Patrice Tetreault, MD, MSc; Andre Chollet, MD; Jenny C. Lin, MD, PhD

9:50 am - 9:55 am
Development of a Microsphere Drug Delivery System to Promote Nerve Regeneration After Peripheral Nerve Injury
Institution where the work was prepared: The Hospital for Sick Children, Toronto, ON, Canada
Matthew D. Wood, PhD; Howard Kim, MS; Alex Bilbily; Tessa Gordon; Molly Shoichet; Gregory H. Borschel

9:55 am - 10:00 am
Analysis of Spatiotemporal Expression of Regeneration-Associated Genes (RAGs) after Nerve Injury and During Regeneration
Institution where the work was prepared: Ochsner Clinic Foundation, New Orleans, LA, USA
Olawale Sulaiman, MD, PhD; Thomas D. Dreesen, PhD; Doan Nguyen, PhD

10:00 am - 10:05 am
Discussion

10:05 am - 10:10 am
Autologous, Bioengineered, Scaffold-free Nerve Conduit for Peripheral Nerve Repair
Institution where the work was prepared: University of Missouri - Columbia, Columbia, MO, USA
Bradley A. Hubbard; Francoise S. Marga, PhD; Thomas W. McEwan, MD; Gabor Forgacs, PhD; Stephen H. Colbert, MD
Breast I

Moderators: Robert Allen, MD, Howard Langstein, MD

9:50 am - 9:55 am
Hernia/Bulge Rates Similar Following Medial versus Lateral DIEA Branch Perforator Harvest in 615 Consecutive DIEP and MS TRAM Flaps
Institution where the work was prepared: The University of Texas M.D. Anderson Cancer Center, Houston, TX, USA
Patrick Garvey, MD; Seroos Salavati, BS; Charles E. Butler, MD

9:50 am - 9:55 am
Comparison of Outcomes Related to Various Abdominal Fascial Closure Techniques after Muscle Sparing TRAM Flap Breast Reconstruction
Institution where the work was prepared: Fox Chase Cancer Center, Philadelphia, PA, USA
Sameer A. Patel, MD; Lars Johan Sandberg, MD; Neal S. Topham, MD; Karthik Devarajan, MD

9:55 am - 10:00 am
Impact of Adjuvant Chemotherapy on Incidence of Donor Site Hernia and Bulges in Muscle Sparing TRAM Flap Breast Reconstruction
Institution where the work was prepared: Fox Chase Cancer Center, Philadelphia, PA, USA
Lars Johan Sandberg, MD; Sameer A. Patel, MD; Karthik Devarajan, MD; Neal S. Topham, MD

10:00 am - 10:05 am
Discussion

10:05 am - 10:10 am
Age and abdominal wall strength: assessing the aging abdominal wall after autologous breast reconstruction
Institution where the work was prepared: University of Pennsylvania Health System, Philadelphia, PA, USA
Jonas A. Nelson, MD; Joshua Fosnot, MD; Jesse C. Selber, MD, MPH; Joseph M. Serletti, MD

10:10 am - 10:15 am
Do 2 Free Flaps Put the Patient at More Risk?: Comparing Patient Characteristics and Complications in Unilateral and Bilateral Autologous Free Flap Breast Reconstruction
Institution where the work was prepared: Hospital of the University of Pennsylvania, Philadelphia, PA, USA
Ines C. Lin, MD; Joshua Fosnot; Jesse C. Selber, MD, MPH; Joseph Serletti, MD

10:15 am - 10:20 am
Outcomes and Complications of Breast Reconstruction Using SIEA Free Flaps, One Institutions Experience
Institution where the work was prepared: Health Sciences Center, Winnipeg, MB, Canada
Trevor Brooks, MD; Thomas E.J. Hayakawa, MD; L. Sigurdson, MD; Stephanie Olivier, MD; Edward Wayne Buchel, MD

10:20 am - 10:25 am
Discussion

10:25 am - 10:30 am
Should Tamoxifen Be Held Prior to Microsurgical Breast Reconstruction?
Institution where the work was prepared: MD Anderson Cancer Center, Houston, TX, USA
Brian Patrick Kelley, BS; Vicente Valero, MD; Min Yi, MD; Steven Kronowitz, MD

10:30 am - 10:35 am
The First Reported Use of the Transversus Abdominis Plane (TAP) block in DIEP Flap Reconstruction of the Breast – A Prospective Series of 20 Cases
Institution where the work was prepared: University Health Network, Toronto, ON, Canada
Toni Zhong, MD; Karen Wong, MD; Srinivas Coimbatore, MD; Stuart McCluskey, MD; Stefan Hoffer, MD

10:35 am - 10:40 am
Closer to an Understanding of Fate – The Role of Vascular Complications in Free Flap Breast Reconstruction
Institution where the work was prepared: The University of Pennsylvania Health System, Philadelphia, PA, USA
Joshua Fosnot, MD; Shareef Jandali, MD; David W. Low, MD; Stephen J. Kovach, MD; Liza C. Wu, MD; Joseph M. Serletti, MD

10:40 am - 10:45 am
Discussion
10:45 – 11:45 am
ASPN/ASRM Panel: Facial Paralysis
Moderator: Michael Klebuc, MD
Invited Panelists: Christopher Coombs, MBBS [Hons]; Eyal Gur, MD; Julia K. Terzis, MD, PhD; Ronald Zuker, MD
Facial reanimation surgery continues to evolve, particularly as the role of donor nerves expands. This panel joins the skills and expertise of our microsurgery and nerve societies to address the latest techniques for the treatment of complete and incomplete facial paralysis.
Objectives:
1. Identify possible nerve transfers for the plexus-injured patient, and rehabilitation strategies.
2. Identify the indications for using newer techniques of masseter-facial nerve coaptation.
3. Recognize when new adjuncts can complement functional reconstruction.

11:45 am – 1:00 pm
ASRM Break Out Panels
1.25 AMA PRA Category 1 Credits™

401 Face Transplant
Chair: David Mathes, MD
Instructors: Laurent Lantieri, MD; Maria Siemionow, MD
Face transplantation has become a reality with programs in multiple countries. However, ethical, logistical, immunosuppression, and infection issues add to the increased challenge for success of this transplant compared with other composite tissue transplants.
Objectives: Following this session, the participant will be able to:
1. Negotiate the logistics of setting up a face transplant program and the implications of failure of a face transplant.
2. Review specific considerations in protocols for tolerance for face transplant.
Patient safety: 0.25

402 Nerve Transfers, Targeted Reinervation, & Rehabilitation in Upper Extremities
Chair: Doug Ross, MD
Instructors: Gregory Dumanian, MD; Thomas Miller, MD
High-level upper extremity injuries, whether as a result of brachial plexus injury or amputation, leave the patient with profound impairment. Newer strategies exist to enhance the functional outcome, and these complex nerve surgeries have particular challenges in rehabilitation. This session combines surgical expertise with rehabilitation strategies.
Objectives: Following this session, the participant will be able to:
1. Identify possible nerve transfers for the plexus-injured patient, and key points in rehabilitation.
2. Examine the concept of targeted reinervation in high-level upper extremity amputations to improve the function of myoelectric prostheses.

403 Sarcoma & Limb Salvage Reconstruction
Chair: Steven Morris, MD
Instructors: E. Gene Deune, MD; Marco Innocenti, MD; Robert Whitfield, MD
Extremity coverage options and modalities for functional reconstruction have expanded over the past decade to solve challenging extremity defects resulting from either sarcoma surgery or trauma.
Objectives: Following this session, the participant will be able to:
1. Incorporate aesthetic and functional restoration in complex extremity defects.
2. Apply reconstructive options for upper and lower extremity salvage in practice.
3. Determine when a pedicled flap option may be preferable to a free flap option.

404 Fat Grafting and Engineering
Chair: Gregory Evans, MD, FACS
Instructors: Roger Khouri, MD; Maurice Nahabedian, MD
The science of fat grafting has advanced the safety and efficacy of transfer of fat both as an adjunct to reconstruction and with the potential to replace conventional free flap transfers. This session brings together experts to highlight these advances and improve safety and results in practice.
Objectives: Following this session, the participant will be able to:
1. Describe the issues surrounding the use of autologous stem cells in fat grafting.
2. Apply fat grafting as adjuncts to reconstructive techniques.
3. Apply strategies to improve fat graft survival.
4. Consider the role of tissue engineered adipose flaps in the future of reconstruction.
Patient safety: 0.5

1:15- 2:45 pm
ASRT Update
Presenter: David Mathes, MD
This presentation will discuss the latest and clinical updates and technical issues surrounding composite tissue transplantation. The session will feature a presentation focus on critical aspects and innovations in reconstructive transplantation, as well as updated from the current CTA programs in the United States.
Objectives: Following this session, the participant will be able to:
1. Review current research and technique related to composite tissue transplantation.
2. Describe the latest technical advances in hand and face transplantation for the both the donor and recipient operations.

2:45 – 4:00 pm Break in Programming

4:00 – 5:00 pm
Poster & Exhibits Reception
(see description on page 3)

5:00 – 7:00 pm
Best Case/Best Save
Submissions of microsurgical salvage cases performed during the last year will be presented and a panel of experts will critique the submitted cases. Attendees will vote for the Best Microsurgical Save and the Best Microsurgical Case of the year. Awards will be presented at the conclusion of the session.
Supported by an educational grant from Synovis, MCA.
# American Society for Reconstructive Microsurgery

## DAY-AT-A-GLANCE

### Monday, January 17, 2011

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<td>Breakfast with Exhibitors</td>
<td>Fountain Courtyard</td>
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<td>6:30am – 7:00am</td>
<td>Past Presidents Breakfast (Invitation Only)</td>
<td>Café Mexicana</td>
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<td>7:00am – 8:00am</td>
<td>ASRM Break Out Panels</td>
<td>Salon I</td>
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<td>405 Scalp Reconstruction</td>
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<td>406 Strategies for Microsurgery Practices</td>
<td>Plaza I</td>
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<td>407 Lymphedema Treatment</td>
<td>Plaza II</td>
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<td>408 Preoperative Imaging in Perforator Flap Reconstruction</td>
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<td>8:00am – 9:00am</td>
<td>PANEL: YMG Lessons Learned in Practice</td>
<td>Salon II &amp; III</td>
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<td>9:00am – 10:00am</td>
<td>Concurrent Scientific Paper Sessions</td>
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<td>Head &amp; Neck I</td>
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<td>Trunk and General Reconstruction</td>
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<td>10:00am – 10:30am</td>
<td>Coffee Break with Exhibitors</td>
<td>Fountain Courtyard</td>
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<td>10:30am – 11:00am</td>
<td>Presidential Lecture: Peter C. Neligan, MD</td>
<td>Salon II &amp; III</td>
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<td>11:00am – 11:40am</td>
<td>Concurrent Scientific Paper Sessions</td>
<td>Salon II &amp; III</td>
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<td>Extremity International Showcase</td>
<td>Salon I</td>
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<td>11:40am – 12:30pm</td>
<td>Concurrent Scientific Paper Sessions</td>
<td>Salon II &amp; III</td>
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<td>Breast II</td>
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<td></td>
<td>Translational Research</td>
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<td>12:30pm – 1:00pm</td>
<td>Lunch with Exhibitors</td>
<td>Fountain Courtyard</td>
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<td>1:00pm – 2:00pm</td>
<td>Godina Lecture: James Higgins, MD</td>
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<td>2:00pm – 3:15pm</td>
<td>Concurrent Break Out Panels</td>
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<td>409 Practical Local Flaps for Head and Neck Reconstruction</td>
<td>Cancun</td>
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<td>410 Impact of Health Care Reform on Microsurgery--Is there One?</td>
<td>Plaza I</td>
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<td>411 Hand Transplant Update</td>
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<td>412 Shaping in Breast Reconstruction</td>
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<td>5:30pm – 6:30pm</td>
<td>Godina Alumni Reunion (Invitation Only)</td>
<td>Lobby Bar Terrace</td>
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<tr>
<td>6:30pm – 8:30pm</td>
<td>ASRM Social Event</td>
<td>Café Carribe Terrace, Casitas</td>
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</table>
Monday, January 17, 2011

6:30 – 8:00 am  Continental Breakfast

7:00 – 8:00 am  Break Out Panels

1 AMA PRA Category 1 Credit™

405 Scalp Reconstruction
Chair: Lawrence Gottlieb, MD
Instructors: Stefan Hofer, MD; Eduardo Rodriguez, MD
Because of the hair-bearing nature of the scalp, the final aesthetics of the outcome can be challenging. As well, special considerations must be given if calvarial reconstruction is required or in the face of radiotherapy. Comprehensive scalp reconstruction including non flap, local flap, and free flap options with aesthetics in mind will be discussed.

Objectives: Following this session, the participant will be able to:
1. Incorporate aesthetic refinements for scalp reconstruction into their practice.
2. Determine the most appropriate reconstruction for complex wounds.
Patient safety: 0.25

406 Strategies for Microsurgery Practices
(not for credit)
Chair: Keith Brandt, MD
Instructors: Anu Bajaj, MD; Edward Buchel, MD; Jason Rosenberg, MD
When starting out in microsurgery practice and when enhancing an established practice in this current economic situation, it is possible to incorporate strategies to improve practice and surgical efficiency, be effective with coding to optimize reimbursement, and market effectively.

Objectives: Following this session, the participant will be able to:
1. Structure a private microsurgery practice that will be successful.
2. Determine appropriate patient selection, postoperative protocols, and reimbursement.
3. Demonstrate how to optimize operative room efficiency and team dynamics.
4. Apply tips for coding effectiveness.

407 Lymphedema Treatment
Chair: Jay Granzow, MD
Instructors: David Chang, MD; Ming Heui Cheng, MD; Isao Koshima, MD
Surgical treatment for the management of postmastectomy lymphedema may involve supramicrosurgery lymphaticovenous anastomoses or vascularized lymph node transfers. Patient and technique selection will be addressed, as well as evaluation of results. Postoperative therapy and insurance and coding issues will also be discussed.

Objectives: Following this session, the participant will be able to:
1. Discuss the outcome of microsurgery techniques for the treatment of lymphedema.
2. Determine appropriate patient selection, postoperative protocols, and reimbursement.
Patient safety: 0.25

408 Preoperative Imaging in Perforator Flap Reconstruction
Chair: Michel Saint-Cyr, MD
Instructors: David T. Greenspun, MD; Thomas Hayakawa, MD; Warren Rozen, MD
Flap planning is enhanced by available imaging modalities, and may have a role in the enhancement of patient outcomes. This session reviews the anatomy of perforasomes, and compares modalities of CT and MR imaging versus clinical assessment alone.

Objectives: Following this session, the participant will be able to:
1. Describe relevant perforator flap anatomy as it relates to imaging.
2. Analyze CT and MR angiography images to select perforators when planning a flap.
3. Decide which (or whether) to incorporate routine preoperative imaging in practice.
Patient safety: 0.5

8:00 – 9:00 am
YMG Panel: Lessons Learned in Practice
Moderator: Robert Ferguson, MD
Panelists: John Boehmier, MD; Neil Fine, MD; L. Scott Levin, MD, FACS; John LoGiudice, MD; Michael Neumeister, MD; Vu T. Nguyen, MD; Roman Skoracki, MD
Young Microsurgeons Group Members will present hand, lower extremity, breast, and head and neck cases and the lessons they learned from those cases. A ‘more senior’ Active Member will review each case providing “words of wisdom” acquired through their experience.

Objectives: Following this session, the participant will be able to:
2. Predict the challenges of starting in microsurgery practice and the role of mentorship and collaboration.
Patient safety: 0.5

9:00 – 10:00 am
Concurrent Scientific Paper Sessions: Head & Neck I, Trunk & General Reconstruction
Throughout this program a series of basic and clinical research papers chosen by the Program Committee will be presented.

Head & Neck I
Moderator: Roman Skoracki, MD & J. Trad Wadsworth, MD
9:00 am – 9:05 am
The Advantages of Bending the Reconstruction Plate in Defined Angles for Fibula Flap Mandibular Reconstruction
Institution where the work was prepared: Chang Gung Memorial Hospital, Taipei, Taiwan
Chung-Kan Tsao, MD; Ming-Huei Cheng, professor; Chwei-Chin Chuang, professor; Fu-Chan Wei, professor

9:05 am – 9:10 am
Advantages of Computer-Aided Offset Cuts in Free Fibula Mandibular Reconstruction
Institution where the work was prepared: New York University Langone Medical Center, New York, NY, USA
Nicholas T. Haddock, MD; Casian J. Monaco, MD; Katie Weimer, MS; David Hirsch, MD; Jamie P. Levine, MD; Pierre B. Saadeh, MD

9:10 am – 9:15 am
Institution where the work was prepared: Fox Chase Cancer Center, Philadelphia, PA, USA
Richard L. Agag, MD, MA; Sameer A. Patel, MD; O. Z. Lerman, MD; Neal S. Topham, MD
9:15 am - 9:20 am
Discussion

9:20 am - 9:25 am
Union and Bone Resorption of Free Fibular Flaps in Mandibular Reconstruction
Institution where the work was prepared: Div of Plastic Surgery, University Health Network, Toronto, Canada
Tulja M. Yla-Kotola, MD; PhD; Eric Bartlett; David Goldstein; Ralph Gilbert; Stefan Hofer, MD, PhD

9:25 am - 9:30 am
Immediate Bone Grafting and Plating of the Radial Osteocutaneous Free Flap Donor Site
Institution where the work was prepared: Memorial Sloan-Kettering Cancer Center, New York, NY, USA
Philip Joseph Torina, MD; Evan Matras, MD, MMSc; Edward A. Athenasian, MD; Peter Cordeiro, MD

9:30 am - 9:35 am
Stair-step flap for Secondary lower lip revision following lip and cheek composite defects reconstruction
Institution where the work was prepared: Chang Gung Memorial Hospital-Kaoshiung Medical Center, Kaosiuang, Taiwan
Yu-Ren Kuo, MD, PhD, FACs; Takashi Fujiwara; Chien-Chang Chen; Hsiang-Shun Shih; Seng-Feng Jeng

9:35 am - 9:40 am
Discussion

9:40 am - 9:45 am
Functioning free gracilis myocutaneous flap transfer provides a reliable single stage facial reconstruction and reanimation following tumor ablation
Institution where the work was prepared: Chang Gung Memorial Hospital, Taoyuan, Taiwan
ChihHung Lin, MD; Chih-Hung Lin, MD; Jiun Da Liao

9:45 am - 9:50 am
Anatomic Shortening of Orbicularis oculi and Orbicularis oris to improve results after smile reconstruction
Institution where the work was prepared: Instituto Novaplastia, Porto Alegre, Brazil
Marcos Jaeger, MD, PhD; Eduardo Grosmann, MD, PhD

9:50 am - 9:55 am
A new technique for total oral sphincter reconstruction
Institution where the work was prepared: University of Manitoba, Winnipeg, Canada
Matthew Choi, MD; G. Althubalti, MD; Sarvesh Logsetty, MD; Thomas Hayakawa, MD; L. Sigurdson, MD

9:55 am - 10:00 am
Discussion

Trunk & General Reconstruction
Moderator: Lawrence Colen, MD & Michael Miller, MD

9:00 am - 9:05 am
Ipsilateral Component Separation Improves Outcomes of VRAM Flap Donor Sites with Excessive Fascial Tension
Institution where the work was prepared: University of Texas MD Anderson Cancer Center, Houston, TX, USA
Donald Baumann, MD; Charles Butler, MD FACS

9:05 am - 9:10 am
Total Sacrectomy Reconstruction Using a VRAM Flow-Through Flap to a Double-Barreled Free Fibula Flap
Institution where the work was prepared: The University of Texas M.D. Anderson Cancer Center, Houston, TX, USA
Patrick B. Garvey, MD; Laurence D. Rhines, MD; Justin M. Sacks, MD

9:10 am - 9:15 am
Anterior Lumbar Spine Fusion Using a Expandable Titanium Cage Fixation and Intra-abdominal Donor Vessels, Overcoming the Challenges of Vascularized Fibula grafts to the Spine
Institution where the work was prepared: Long Island Plastic Surgical Group, Garden City, NY 11530, NY, USA
Thomas Davenport, MD; M. Agulnick; B. Cohen; T. Addona; J. Goncalves; D. Shin; M. Kilgo; Kristin Aliano, MD

9:15 am - 9:20 am
Discussion

9:20 am - 9:25 am
The Pudendal Canal of Alcock and the Microsurgeon
Institution where the work was prepared: Yale University, New Haven, CT, USA
Britt Colebunders, MD; Michael K. Matthew, MD; Niclas Broer, MD; John A. Persing, MD; A. Lee Dellon, MD, PHD

9:25 am - 9:30 am
500 Consecutive Cases of Live Donor Liver Transplantation with Microvascular Technique: a 14 Years Brazilian Experience
Institution where the work was prepared: University of Sao Paulo, Sao Paulo, Brazil
Hsiang Wei Teng; Paulo Chap Chap; Eduardo Carone; Vincenzo Pugliese; Eduardo Antunes Fonseca; João Seda

9:30 am - 9:35 am
Laparoscopic Transperitoneal Approach for Rectus Abdominis Muscle Harvest with Free Transfer
Institution where the work was prepared: Regions Hospital, St. Paul, MN, USA
Matthew Choi, MD; G. Althubaiti, MD; Sarvesh Logsetty, MD; Thomas Hayakawa, MD; L. Sigurdson, MD

9:35 am - 9:40 am
Discussion

9:40 am - 9:45 am
The Effect of Low Molecular Weight Heparin and Procedure Type on Re-Operative Hematoma
Institution where the work was prepared: Regions Hospital, St. Paul, MN, USA
Pamela Portschy, MD; George Dreszer MD; Chris Pannucci, MD; Nicholas Kim MD; Jennifer A. Swanson MD, MPH; Loree K. Kalliainen, MD

9:45 am - 9:50 am
Free Tissue Transfer in the Hypercoagulable Patient: A Review of 29 Free Flaps
Institution where the work was prepared: University of Pennsylvania, Philadelphia, PA, USA
Theresa T. Wang, MD; Joseph M. Serletti; David W. Low, MD; Stephen J. Kovach, MD; Liza C. Wu, MD

9:50 am - 9:55 am
A Prospective Evaluation of U-clips for Arterial Microvascular Anastomoses
Institution where the work was prepared: Scott & White Hospital, Temple, TX, USA
Janae Lynn Maher, MD; Raman Chaos Mahabir; Juhee Song
10:30 – 11:00 am
Presidential Lecture

Lecturer: Peter C. Neligan, MD, ASRM President

11:00 am – 11:40 am
Concurrent Scientific Paper Sessions: Extremity, International Showcase

Throughout this program a series of basic and clinical research papers chosen by the Program Committee will be presented.

Objective: The participants will be exposed to ongoing research in the field of peripheral nerve surgery and reconstructive microsurgery.

Extremity

Moderators: Raymond Dunn, MD & William Pederson, MD

11:00 am - 11:05 am
30 Year Follow-up of the First North American Lower Extremity Replant
Institution where the work was prepared: UCLA Medical Center, Plastic & Reconstructive Surger, Los Angeles, CA, USA
Ahmed Suliman, MD; Fernando A. Herrera; Eric I. Chang; Malcolm Lesavoy

11:05 am - 11:10 am
Results at One Year after Bilateral Trans-humeral Transplantation
Institution where the work was prepared: Clinica Cavadas, Valencia, Spain
Pedro C. Cavadas; Luis Landin

11:10 am - 11:15 am
Pediatric Microvascular Surgery at the Buncke Clinic: a Ten-year Experience (2000-2009)
Institution where the work was prepared: The Buncke Clinic, San Francisco, CA, USA
Yasser El-Sheikh, MD, FRCs(C); Richard Shaw, PhD; Bauback Safa, MD, FACS; Rudy Bunctic, MD, FACS; Greg Buncke, MD, FACS; Brooks Darrell, MD, FACS

11:15 am - 11:20 am
Discussion

11:20 am - 11:25 am
Experience with “Racing Stripe” Fasciocutaneous Free Flaps
Institution where the work was prepared: University of Texas, Houston, TX, USA
Emmanuel G. Mellissinos, MD; Erik Scott Marques, MD; Donald H. Parks, MD

11:25 am - 11:30 am
Timing Of Post-Traumatic Lower Extremity Free Flap Reconstruction: A Retrospective Review
Institution where the work was prepared: Louisiana State University, New Orleans, LA, USA
Anh Lee, MD; Heath Charvest, BS; Stephen Liaw, BS; M. Whitten Wise, MD; Charles L. Dupin, MD; Hugo St-Hilaire, MD, DDS

11:30 am - 11:35 am
Long Term Results and Costs of Free Flap Coverage & Ilizarov Bone Transport in Lower Limb Salvage
Institution where the work was prepared: The Buncke Clinic, San Francisco, CA, USA
Brian Parrett; Rudolf F. Buntic; Gregory M. Buncke; Darrell Brooks; Bauback Safa, MD; David Lowenberg

11:35 am - 11:40 am
Discussion

International Showcase

Moderators: Milomir Ninkovic, MD & Lars Steintraessner, MD

11:00 am - 11:05 am
Reconstruction of Composite Tibial Defects with Microvascular Osteomuscular Latissimus Dorsi Flap
Institution where the work was prepared: Department of Plastic Surgery, University of Helsinki, Helsinki, Finland
Erkki Tukiainen, MD, Psrof; Jaro Junnola, MD

11:05 am - 11:10 am
Thirteen DIFFERENT Types of FREE Flap Harvested FROM the Thigh for Microsurgical RECONSTRUCTION
Institution where the work was prepared: Tel Aviv Medical Center, Tel Aviv, Israel
Arik Zaretski, MD; F.C. Wei; Chih-Hung Lin; Ming-Huei Cheng; Christopher Glenn Wallace; Eyal Gur

11:10 am - 11:15 am
Reconstruction of High Ulnar Nerve Lesions by Distal Double Median to Ulnar Nerve By-pass
Institution where the work was prepared: C.T.O. Hospital, Torino, Italy
Bruno Battiston; Luigi Giulio Conforti; Pierluigi Tos

11:15 am - 11:20 am
Discussion

11:20 am - 11:25 am
Skeletal deformities in noma patients
Institution where the work was prepared: BG Trauma Center, Murnau, Germany
Goetz A. Giessler, MD, PhD; Andreas B. Schmidt, MD; Carl Peter Cornelius, DMD, MD, PhD

11:25 am - 11:30 am
Hemodynamic Differences in Blood Flow between Free Skin and Muscles Flaps: Prospective Study
Institution where the work was prepared: Hacettepe University, Ankara, Turkey
Serdar Nasir; Bahattin Baykal, MD; Selman Altuntas; Mustafa Asim Aydin, MD

11:30 am - 11:35 am
Mesenchymal Stem Cells Prolongation of Allotransplant Survival Is Correlated to T-cell Regulation in a Swine Hemi-facial Composite Tissue Allotransplantation Model
Institution where the work was prepared: Chang Gung Memorial Hospital-Kaohsiung Medical Center, Kaohsiung, Taiwan
Yur-Ren Kuo, MD, PhD; Chien-Chang Chen; Hsiang-Shun Shih; Chong-Wei Huang; Shigeru Goto; Fu-Chan Wei

11:35 am - 11:40 am
Discussion
Scientific Paper Sessions: Breast II, Translational Research

Throughout this program a series of basic and clinical research papers chosen by the Program Committee will be presented.

Objective: The participants will be exposed to ongoing research in the field of peripheral nerve surgery and reconstructive microsurgery.

Breast II
Moderators: Otway Louie, MD & Joseph Serletti, MD

11:40 am - 11:45 am
The Impact of Preoperative CT Angiography on Breast Reconstruction with Abdominal Perforator Flaps
Institution where the work was prepared: UNC. Chapel Hill, NC, USA
Winnie Tong, MD; Robert Dixon, MD; Eric G. Halvarson, MD

11:45 am - 11:50 am
Clinical Utility of CT Angiography in Pre-operative Perforator Selection in DIEP Free Flap Breast Reconstruction
Institution where the work was prepared: University of Washington, Seattle, WA, USA
Kari Keyes, MD; Hakim K. Said, MD; Otway Louie, MD; Peter Camillus NeIigan; David W. Mathes

11:50 am - 11:55 am
Cost Benefit of Preoperative Imaging in DIEP Flap Breast Reconstruction
Institution where the work was prepared: Stony Brook University Medical Center, Stony Brook, NY, USA
Oren Z. Lerman, MD; John P. Fischer; Brent DeGeorge; Joshua Fosnot; Richard Agag; Liza C. Wu; Joseph M. Serletti

11:55 am - 12:00 pm
Comparison of Intraoperative Perfusion Techniques to Predict Mastectomy Skin Flap Necrosis: Preliminary Results of a Prospective Clinical Trial
Institution where the work was prepared: Stony Brook University Medical Center, Stony Brook, NY, USA
Brett T. Phillips, MD; Steven T. Lanier, BA; BS; Nicole Connkling, BA, BS; Eric D. Wang, BS; Brian J. O’Hea, MD; Alexander B. Dagum, MD; Jason C. Ganz, MD; Sami U. Khan, MD; Duc T. Bui, MD

12:00 pm - 12:05 pm
Discussion

12:05 pm - 12:10 pm
Ten-Year Review of Microsurgical Breast Reconstruction after Unsatisfactory Implant Reconstruction
Institution where the work was prepared: New York University School of Medicine, New York, NY, USA
Steven M. Levine, MD; Mary E. Lester; Robert J. Allen, MD

12:10 pm - 12:15 pm
Impact of Prior Tissue Expander/Implant on Post-Mastectomy Free Flap Breast Reconstruction Outcomes
Institution where the work was prepared: University of California Los Angeles, Los Angeles, CA, USA
Chris K. Gold, MD; Aviva Olsvsky; John L. Clayton; Jason Roostaeian; Christopher Crisera; Jaco Festejkjan; Andrew Da Lio; Joan E. Lipa

12:15 pm - 12:20 pm
Deep Femoral Artery Perforator Flap: A New Perforator Flap in Breast Reconstruction
Institution where the work was prepared: Center for Microsurgical Breast Reconstruction, New York, NY, USA
Julie V. Vasile, MD; Joshua L. Levine, MD; Robert J. Allen

12:20 pm - 12:25 pm
Multi-factor Analysis of Risk for Complication Following Perforator Flap Breast Reconstruction: A Review of 240 Consecutive DIEP Breast Flaps
Institution where the work was prepared: Medical University of South Carolina, Charleston, SC, USA
John R. Barbour, MD; Jennifer A Dixon; Michael F Reynolds; Dennis K Schimpf; Patrick O’Neiill

12:25 pm - 12:30 pm
Discussion

Translational Research
Moderators: Justin Sacks, MD & William A. Zamboni, MD

11:40 am - 11:45 am
Adipose-derived stem cell modulated CD4+/CD25+ regulatory T-cell expression and prolonged allotransplant survival in a rodent hind-limb model
Institution where the work was prepared: Chang Gung Memorial Hospital-Kaohsiung Medical Center, Kaohsiung, Taiwan
Yur-Ren Kuo, MD, PhD; FACS; Chien-Chang Chen, MD; I-Tee Lee, MS; Shigeru Goto; Chun-Ting Wang, BS; Fu-Chan Wei

11:45 am - 11:50 am
The Regulatory Function of CD4-CD8- Double Negative T Cells Prolongs Mouse Hindlimb Osteomyocutaneous Flap Survival
Institution where the work was prepared: University of Pittsburgh Medical Center, Pittsburgh, PA, USA
Cheng-Hung Lin, MD; Timothy W. Ng; Dong Zhang; Gerald Brandacher; W.P. Andrew Lee; Xin Xiao Zheng

11:50 am - 11:55 am
Costimulatory Blockade Does Not Promote Peripheral Regulatory Mechanisms to Prolong Composite Tissue Allograft Survival in Non-Human Primates
Institution where the work was prepared: University of Maryland Medical Center, Baltimore, MD, USA
Gerhard S. Mundinger; Luke S. Jones, BS; Helen Hui-Chou; Amir H. Dorafshar, MD; Cinthia B. Drachenberg; Steven T. Shipley, DVM; Bernard Vakhvome, PhD; Agnes Azimzadeh, PhD; Richard N. Pierson, MD; Stephen T. Bartlett, MD; Eduardo D. Rodriguez, MD, DDS; Rolf N. Barth, MD

11:55 am - 12:00 pm
Chronic Rejection Responses are Distinct from Acute Rejection Responses in Non-Human Primate Models of Facial and Vascularized Fibula Composite Tissue Allograft Transplantation
Institution where the work was prepared: University of Maryland Medical Center, Baltimore, MD, USA
Gerhard S. Mundinger; Helen G. Hui-Chou; Raghava Munivenkatappa, MD; Cinthia B. Drachenberg; Steven T. Shipley, DVM; Luke S. Jones, BS; Amir H. Dorafshar, MD; Stephen T. Bartlett, MD; Rolf N. Barth, MD; Eduardo D. Rodriguez, MD, DDS

12:00 pm - 12:05 pm
Discussion

12:05 pm - 12:10 pm
Effectiveness of Topical Immunosuppressants in Prevention and Treatment of Rejection in Face Allograft Transplantation
Institution where the work was prepared: Cleveland Clinic, Cleveland, OH, USA
Bahar Bassiri Gharb, MD; Antonio Rampazzo, MD; Selman Altuntas, MD; Maria Madajka, PhD; Agata Matejuk, PhD; Maria Z. Siemionow, MD, PhD, DSc

12:10 pm - 12:15 pm
Early Detection of Complete Vascular Occlusion in a Pedicle Flap Model Using Quantitative Spectral Imaging
Institution where the work was prepared: University of California, Irvine, Orange, CA, USA
Michael R. Pharaon, MD; Thomas Scholz, MD; Scott Bogdanoff, BS; David Cuccia, PhD; Anthony J. Durkin, PhD; David B. Hoyt, MD; Gregory R. D. Evans, MD
Impact of Health Care Reform on Microsurgery – Is there One?

Chair: Scott Oates, MD
Instructors: Raj Ambay, MD; Malcolm Roth, MD

With the Health Care Reform bill signed into law in 2010, speculation as to how it will affect surgeons is the topic of conversations both in academic and private practice settings. Get the organized medicine perspective on its influence on your microsurgery practice, and learn what the implications on malpractice and coding may be.

Objective: Following this session, the participant will be able to determine the potential impact of health care reform on microsurgery practices.

Hand Transplant Update

Chair: W.P. Andrew Lee, MD
Instructors: Warren Briedenbach, MD; Achilles Thoma, MD

Successful hand transplantation has been carried out multiple times across the United States, and immunosuppression protocols continue to evolve. These treatments do not come without costs, which makes the topic of the economics of hand transplantation very timely in today’s climate.

Objectives: Following this session, the participant will be able to:
1. Outline donor and recipient operations and evaluate long-term function.
2. Update on immunosuppression protocols and strategies to decrease immunosuppression.
3. Evaluate the economics (and sustainability) of hand transplantation.

Shaping in Breast Reconstruction

Moderator: Elisabeth Beahm, MD
Instructors: Pierre Chevray, MD; Jian Farhadi, MD;

“How do they get such great results?” Learn how the experts make their breast reconstructions look like the aesthetic ideal.

Objectives: Following this session, the participant will be able to:
1. Describe the essentials of breast aesthetics to set the ideal for the reconstructive outcome.
2. Demonstrate how preoperative planning leads to easy shaping.
3. Be able to incorporate tips and tricks for shaping into breast reconstruction practice.
## American Society for Reconstructive Microsurgery

### DAY-AT-A-GLANCE

**Tuesday, January 18, 2011**

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<td>6:30am – 1:00pm</td>
<td>Meeting Services</td>
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<td>6:30am – 8:00am</td>
<td>Breakfast with Exhibitors</td>
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<td>8:00am – 9:15am</td>
<td>Concurrent Break Out Panels</td>
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<td>413  Laryngo-Tracheal Reconstruction</td>
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<td>414  Reviving the Failing Flap or When to Just Start Over</td>
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<td>415  Intraoperative Perforator Selection</td>
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<td>416  Abdominal Wall Reconstruction</td>
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<td>9:15am – 9:45am</td>
<td>Coffee Break with Exhibitors</td>
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<td>9:45am – 10:45am</td>
<td>Buncke Lecturer: Julian Pribaz, MD</td>
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<td>Will the “Brave New World” of Transplantation be the Answer to the Limitations of Reconstructive Surgery</td>
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<td>10:45am – 11:45am</td>
<td>Concurrent Scientific Paper Sessions</td>
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<td>Outcome Studies</td>
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<td>Head &amp; Neck II</td>
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<td>11:45am – 12:45pm</td>
<td>Panel: The Best “Back Up” Flap for Breast Reconstruction (When the DIEP Isn’t Enough)</td>
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<td>12:45pm</td>
<td>Closing Remarks</td>
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Tuesday, January 18, 2011

6:30 – 8:00 am   Continental Breakfast

7:00 – 8:00 am
ASRM Business Meeting (Members Only)

8:00 – 9:15 am
Break Out Panels

1.25 amA PRA Category 1 Credits™

413 Laryngo-Tracheal Reconstruction
Chair: Peirong Yu, MD
Instructors: Ralph Gilbert, MD; Jan Jeroen Vranckx, MD
The specialized structures and functions of the larynx and trachea make their reconstruction among the most challenging in head and neck reconstruction. Alternatives to tracheal reconstruction include tissue engineering approaches and transplantation, and this panel will highlight progress that has been made and successful outcomes to date.

Objectives: Following this panel, the participant will be able to:
1. Describe the anatomy and functional considerations in abdominal wall reconstruction.
2. Compare the limitations and progress in tracheal tissue engineering, reconstruction, and tracheal transplantation.

414 Reviving the Failing Flap or When to Just Start Over
Chair: J. Brian Boyd, MD
Instructors: Jaco Festekjian, MD; Matthew Hanasono, MD; Babak Mehrara, MD
Impending flap failure may not be obvious at first, and failing to act in a timely fashion can have disastrous consequences. Especially early on in independent practice, the decision to go back to the OR in the middle of the night and perform under the added pressure of “I don’t want to lose this flap” can be humbling. This break-out panel captures the experience of the experts.

Objectives: Following this session, the participant will be able to:
1. Design and carry out functioning free flap reconstruction of the partial laryngeal defect.
2. Compare the limitations and progress in tracheal tissue engineering, reconstruction, and tracheal transplantation.

415 Intraoperative Perforator Selection
Chair: Michael Zenn, MD
Instructors: Aldona Spiegel, MD; Claire Temple, MD
This session steps beyond pre-operative radiographic imaging in flap planning and looks at intraoperative strategies for decision-making in perforator selection, to see not only which perforator is the largest, but whether it will actually ‘get the job done’.

Objectives: Following this session, the participant will be able to:
1. Describe clinical assessment and algorithms for perforator selection.
2. Summarize the additional information that can be obtained from transit time flow-volume measurement and other modalities such as fluorescent imaging.

Patient safety: 0.5

416 Abdominal Wall Reconstruction
Chair: Charles E. Butler, MD
Instructors: Gregory Dumanian, MD; William Kuzon, MD
We are inundated with marketing of bioprosthetics – but when is it appropriate to use conventional prosthetics and how do we decide which bioprosthetic to use? Or when to use a flap reconstruction for a complex abdominal wall defect?

Objectives: Following this session, the participant will be able to:
1. Describe the anatomy and functional considerations in abdominal wall reconstruction.
2. Review the differences, roles, and long-term outcomes of prosthetics and bioprosthetics.
3. Be able to perform components separation with less morbidity, and understand when flap reconstruction is necessary.

Patient safety: 0.25
10:45 – 11:45 am
Concurrent Scientific Paper Sessions
Outcome Studies, Head & Neck II

A series of basic and clinical research papers chosen by the Program Committee will be presented.

Objective: The participants will be exposed to ongoing research in the field of peripheral nerve surgery and reconstructive microsurgery.

Outcome Studies
Moderators: Melissa Crosby, MD & Gordon Lee, MD

10:45 am - 10:50 am
The Importance of Hospital Case-Volume for Outcomes in Autologous Free-Tissue Breast Reconstruction
Institution where the work was prepared: Johns Hopkins University School of Medicine, Baltimore, MD, USA
Mazen I. Bedri, MD; Cassandra Villegas, MD; Gedge D. Rosson

10:50 am - 10:55 am
The volume-outcome relationship for immediate breast reconstruction
Institution where the work was prepared: University of California, Los Angeles, Los Angeles, CA, USA
Neil Tanna, MD, MBA; Jerome H. Liu, MD, MSHS; Jason Roostaeian, MD; John L. Clayton, MD, PhD; Christopher A. Crisera, MD

10:55 am - 11:00 am
The Transition from Pedicle TRAM to Perforator Flap – What is the Cost of Opportunity?
Institution where the work was prepared: UNC, Chapel Hill, NC, USA
Winnie Tong, MD; Andrea Bazakas, BS; C. Scott Hultman, MD, MBA; Eric G. Halvorson, MD

11:00 am - 11:05 am
Discussion

11:05 am - 11:10 am
The Effect of Surgery Start Time on Head and Neck Reconstruction Outcome
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Rimante Seselgyte, MD; Nho V. Tran; Uldis Bile, MD; Ricky P. Clay

11:10 am - 11:15 am
Economic Value of Plastic Surgery to the Hospital Bottom Line
Institution where the work was prepared: University of Pennsylvania, Philadelphia, PA, USA
Theresa Y. Wang, MD; Jonas Nelson, MD; Diane Carrigan, MBA; Joseph M. Serletti, MD

11:15 am - 11:20 am
Lag-Time to Publication in Microsurgery: A Comparison of Seven Peer-Reviewed Journals
Institution where the work was prepared: Stanford University, Stanford, CA, USA
David T. Lee, BS; Christina K. Chung, MD; Ahilia Kattan, BS; Gordon K. Lee, MD

11:20 am - 11:25 am
Discussion

11:25 am - 11:30 am
A Review of the National Trauma Data Bank Comparing Treatment Patterns of Traumatic Thumb Amputations Between University and Community Hospitals
Institution where the work was prepared: Texas A&M University, Scott & White Hospital, Temple, TX, USA
Christopher M. Shale, MD; James Tidwell, MD; Ryan P. Mulligan, BA; Daniel Jupiter, PhD; Raman C. Mahabir, MSc, MD

11:30 am - 11:35 am
The Relationship Between Health-Related Quality of Life and Time Since Breast Reconstruction in the Early Postoperative Period
Institution where the work was prepared: University Health Network, Toronto, ON, Canada
Toni Zhong, MD; Andrea L. Pusic; Stefan Hofer

11:35 am - 11:40 am
Functional, Psychological and Quality of Life Outcomes after Mandibular Reconstruction for Osteoradionecrosis with Osseocutaneous Free Flaps in Oral Cancer Patients: A Case-Control Study
Institution where the work was prepared: University Health Network, University of Toronto, Toronto, ON, Canada
Caroline E. Payne, MSc, FRCS, (plast); Ralph Gilbert, MD; Gerald Devins, MD; David Goldstein, MD; Jolie Ringash, MD; Kimberley Fernandes, MSc; Stefan O. P. Hofer, MD, PhD

11:40 am - 11:45 am
Discussion

Head & Neck II
Moderator: Lawrence Gottlieb, MD & Matthew Hanasono, MD

10:45 am - 10:50 am
Technical Challenges of Total Esophageal Reconstruction using a Supercharged Jejunal Flap
Institution where the work was prepared: University of Texas MD Anderson Cancer Center, Houston, TX, USA
Melissa Poh, MD; Jesse C. Selber, MD, MPH; Roman Skoracki, MD; Garrett L. Walsh, MD; Peirong Yu, MD

10:50 am - 10:55 am
An Extra Apron of Seromuscular Coat to Prevent Leakage at the Anastomotic Site between Cervical and Thoracic Esophagus
Institution where the work was prepared: China Medical University Hospital, Taichung, Thailand
Hung-chi Chen, MD, FACS; Yueh-bih Tang, MD, PhD; Shih-Heng Chen

10:55 am - 11:00 am
Reconstruction of Partial Glossectomy Defects: The Role of the FAMM flap
Institution where the work was prepared: Long Island Plastic Surgical Group, P.C., Garden City, NY, USA
Tommaso Addona, MD; John Layliev, MD; Douglas Frank, MD; Matthew S. Kilgo, MD; Thomas Davenport, MD

11:00 am - 11:05 am
Discussion

11:05 am - 11:10 am
Prefabrication of trachea for the reconstruction of hemilaryngectomy defects
Institution where the work was prepared: dept Plastic Surgery, KUL Leuven University Hospitals, Leuven, Belgium
Jan Jeroen Vranckx, MD, PhD; Pierre Delaere

11:10 am - 11:15 am
Transplantation of the Eyelids: Anatomical research and clinical cases
Institution where the work was prepared: Henri Mondor Hospital, CRETEIL, France
L. Lantieri; Jean Paul Meningaud; P. Grimbert; MD Benjoar; M. Hivelin, MD; R. Bosc
11:15 am - 11:20 am  
**Twenty Year Experience with Microsurgical Reconstruction of Hemifacial Atrophy and Linear Scleroderma**

Institution where the work was prepared: University of Wisconsin, Madison, WI, USA  
Daniel Schmid, MD; John W Siebert

11:20 am - 11:25 am  
Discussion

11:25 am - 11:30 am  
**Preoperative CT Angiography for Head and Neck Reconstruction with Anterolateral Thigh Flaps**

Institution where the work was prepared: The University of Texas M.D. Anderson Cancer Center, Houston, TX, USA  
Patrick Garvey, MD; Jesse Selber; John Madewell, MD; Luc Bidaut, PhD; Lei Feng, BS; Peirong Yu

11:30 am - 11:35 am  
**Microvascular Reconstruction Allows for Re-irradiation of Patients with Salvage Surgery for Recurrent Head and Neck Cancer**

Institution where the work was prepared: University of Texas, M. D. Anderson Cancer Center, Houston, TX, USA  
Ravit Yanko-Arzi, MD; David I. Rosenthal, MD; Randel S. Weber, MD, FACS; Roman J. Skoracki, MD, FRCSC, FACS; Peirong Yu, MD, FACS; Matthew M Hanasono

11:35 am - 11:40 am  
**Secondary pectoralis major musculocutaneous flap for reconstruction of recurrent oral cancers or other secondary defects**

Institution where the work was prepared: E-Da Hospital, Kaohsiung, Taiwan  
Shih-Heng Chen; Hung-chi Chen, MD, FACS; Yueh-bih Tang, MD, PhD

11:40 am - 11:45 am  
Discussion

11:45 am – 12:45 pm  
**The Best “Back Up” Flap for Breast Reconstruction (When the DIEP Isn’t Enough)**

**Moderator:** Steven Kronowitz, MD  
**Panelists:** Joshua Levine, MD; Gottfried Wechselberger, MD

The abdominal donor site for breast reconstruction is well-accepted as a first-line source of tissue for autogenous reconstruction. However, some candidates for reconstruction may appear “too thin” to undergo DIEP flap surgery to achieve a breast reconstruction of adequate volume to match either their contralateral breast or their expectations. This panel has experts giving their perspective on other flaps or solutions in order to manage this situation. Solutions debated will be secondary fat grafting, gracilis myocutaneous flap (TUG/TMG), GAP flap, and adding an implant to the flap reconstruction. Based on this discussion, participants will be encouraged to vote on what they feel is the best overall “back-up” flap when the DIEP isn’t enough.

**Objectives:** Following this session, the participant will be able to:
1. Determine the pros and cons of breast reconstructive alternatives in the thin patient.
2. Incorporate management of expectations into preoperative discussion with these patients.

**Patient safety:** 0.25

12:45 pm  
Closing Remarks
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American Association for Hand Surgery

AAHS Scientific Abstract Session A1

Functional Outcome of Collagenase Injections vs. Fasciectomy in treatment of Dupuytren’s Contracture

Institution where the work was prepared: Southern Illinois Hand Center, Effingham, IL, USA

Nash Naam, MD; Southern Illinois Hand Center and Southern Illinois University

There are several surgical options for treatment of Dupuytren’s contracture. Recently Collagenase has been approved for injection treatment of Dupuytren’s contracture. In this study we compare our results of treatment of Dupuytren’s contracture with Collagenase injections vs. fasciectomy.

Materials and Methods:

Retrospective review of 2 groups of patients was conducted. Group I which was treated with fasciectomy consisted of 16 patients in whom 22 digits were involved. The 10 males and 6 females averaged 67 years (range 39-84). The index finger was involved in one patient, long finger in 5, ring finger in 10 and little finger in 6. Deformities averaged 43˚ for MP joints and 47˚ for PIP joints. 3 patients needed check rein ligament releases.

Group II which was treated with Collagenase injections consisted of 12 patients in whom 14 digits were injected. There were 11 males and one female averaging 65 years (range 42-83). The index finger was involved in one patient, ring finger in 7 and little finger in 6. Thirteen MP and 2 PIP joints cords were injected. The average flexion deformity was 46˚ for MP and 30˚ for PIP joints. The indications for treatment (flexion deformity of MP or PIP ≥20˚) were the same in both groups.

Results:

In group I the average post operative follow up was 27 months compared to 20 month for group II. In group I the postoperative flexion deformity was 4˚ for MP joints and 8˚ for PIP joints. There was one complication; one patient developed transient numbness of the ring finger. For Group II the average post injection flexion deformity was 6˚ for the MP (range 0-25 degrees) and 5˚ (range 0-10) for the PIP joints. The patients who did not show significant improvements were patients who had previous surgery and one patient who had a long standing severe flexion deformity of the PIP joint. One patient developed swelling and axillary lymphadenopathy that resolved spontaneously.

Patients in Group I returned to normal activities after an average of 37 days compared to 2.5 days in group II (P<0.001). Patients were satisfied with their outcome in both groups. But patients in group II were more inclined to go through the procedure again if needed.

Conclusion:

Collagenase injections are very effective in treating Dupuytren’s contracture. Patient selection is of paramount importance. Patients who had previous surgery or long standing flexion deformity of the PIP joint may not fare as well.

Long-Term Evaluation of Dupuytren’s Contracture Recurrence Following Treatment with Collagenase Clostridium Histolyticum (CORDLESS)

Institution where the work was prepared: Michigan State University, Marquette, MI, USA

Clayton A. Peimer, MD; Philip Blazar, MD; Stephen Coleman, MD; F. Thomas D. Kaplan, MD; Ted Smith, PhD; James Tursi, MD; Brian Cohen, PhD; Greg Kaufman, MD; (1)Michigan State University, (2)Brigham and Women’s Hospital, (3)Hand & Upper Limb Clinic, (4)Indiana Hand Center, (5)Auxilium Pharmaceuticals

Hypothesis:

Collagenase clostridium histolyticum (CCH, XIAFLEX®) has demonstrated safety and efficacy as a non-surgical treatment for Dupuytren’s contracture. To determine the long term durability of response, contracture recurrence, and safety, subjects from five Phase III studies were offered enrollment in a Year 2-5, non-treatment follow-up study (CORDLESS).

Methods:

In the five Phase III studies, subjects with metacarpophalangeal (MP) or proximal interphalangeal (PIP) joint contractures of ≥20 and ≤100 degrees received 0.58mg CCH per treatment cycle. Each cycle consisted of injection, manipulation the following day, and 30 day follow-up. Patients received a maximum of 3 treatment cycles per joint depending on achievement of clinical success (defined as contracture reduction to ≤55 degrees full extension). Patients were observed annually with their reevaluation 2 years after initiation of Phase III studies. In joints that achieved primary clinical success, recurrence was defined as contracture increase by at least 20 degrees with a palpable cord, or if the joint had further medical or surgical treatment. Statistical analyses included nominal recurrence rates and a Kaplan-Meier (KM) analysis.

Results:

634 of 950 eligible subjects (66.7%) were evaluable in CORDLESS. Mean follow-up time from the first dose of CCH was 2.1 years. These 634 subjects represented 1065 treated joints (641 MP, 424 PIP). 619 joints (449 MP, 170 PIP) achieved clinical success in the earlier studies. 500 successfully treated joints (80.7%) demonstrated a durability of response at 2 years without recurrence. 119 joints (61 MP, 58 PIP) recurred resulting in a nominal 2-year recurrence rate of 19.3% (±1.6% SE) overall, 13.6% (±1.6%) for MP joints, and 34.1% (±3.6%) for PIP joints. The 2-year KM estimate recurrence rate was 24.1% (±2.0% overall), 17.6% (±2.1%) for MP joints, and 41.4% (±4.4%) for PIP joints. There were 13 (2.1%) successfully treated JOINTS corrected surgically out of 619 successfully treated joints. In the follow-up phase, only 30 AEs and 9 SAEs were reported, and none were considered related to CCH treatment (none occurred in a treated finger).

Conclusion:

The long term durability of response for all joints following CCH treatment was 80.7%, with a 19.3% overall nominal 2-year recurrence rate. Additionally, 97.7% of patients avoided surgical intervention for recurrence of a successfully treated joint during that time. These follow-up results after CCH treatment for patients with Dupuytren’s contracture are very encouraging and can be favorably compared to published surgical fasciotomy and fasciectomy results and are improved over available needle aponeurotomy results.
Simulated Osteotomy of the Trapezium Reduces Radial Subluxation and Improves Contact Pressure Distribution Across the Thumb
Carpometacarpal Joint in Lateral Pinch

Institution where the work was prepared: University of New Mexico, Albuquerque, NM, USA

Deana Mercer; Tahseen A. Cheema, MD; Christina Salas; Leticia Lansing; Mahmoud Taha; James Love; Nathan Morrell, MD

Introduction:
Joint laxity and radial subluxation of the metacarpal on the trapezium has been associated with arthritis of the carpometacarpal (CMC) joint of the thumb. Surgical treatment of early arthritis of the CMC joint includes ligament reconstruction or first metacarpal extension osteotomy to decrease joint laxity. To the best of our knowledge, no biomechanical study has analyzed joint subluxation and contact pressure distribution on the trapezium with open wedge osteotomy of the trapezium. We hypothesize that an opening wedge osteotomy of the trapezium reduces subluxation of the CMC joint and improves pressure distribution across the joint by changing the trapezial tilt. The purpose of this study is to assess the effect of trapezial osteotomy and wedge placement on pressure distribution and laxity at the CMC joint with the thumb in the position of lateral pinch.

Methods:
Ten fresh frozen cadaveric specimens were used. The flexor pollicis longus, abductor pollicis longus, adductor pollicus, abductor pollicus brevis and flexor pollicus brevis/opponents tendons were each loaded with 1.5 kg-force. Radial subluxation of the CMC joint was measured from anteroposterior c-arm images taken with the specimen in loaded and unloaded positions, before and after placement of a 15° wedge. Pressure distribution was measured with the Tekscan l-scan® pressure measurement system using the Quad sensor (Model #6900, Tekscan, Inc., South Boston, MA). The sensor was placed in the joint space between the trapezium and the first metacarpal for analysis. Pressure maps were taken of each specimen in a loaded and unloaded states. Results In 48 of the 50 trials, the simulated trapezial osteotomy reduced radial subluxation. Average reduction in subluxation was 49.0% [SD ±41%, After placement of the 15 degree wedge, the pressure distribution across the joint shifted medially. Pressure in the radial volar quadrant was reduced by 26.7%. Pressure increased in the ulnar volar region by 72.8%, and in the ulnar dorsal region by 96.2%. An increase in pressure in the ulnar region may indicate a tendency for the metacarpal to shift toward the medial aspect of the trapezium during lateral pinch after wedge placement.

Discussion and Conclusion:
With the thumb in lateral pinch position, the 15° opening wedge osteotomy of the trapezium reduces radial subluxation of the CMC joint and shifts pressure distribution across the joint. Trapezial osteotomy may stabilize the CMC joint and have a role in treatment of early arthritis of this joint when associated with laxity and mild subluxation.
**Arthroscopic Resection Arthroplasty for Treatment of Pantrapezial Arthrosis**

Institution where the work was prepared: Orthopaedic Specialists, Davenport, IA, USA

Tyson Cobb, MD; Patrick Sterbank, PA-C; Jon Lemke, PhD; (1)Orthopaedic Specialists, PC, (2)Genesis Medical Center

**Purpose:**
Arthroscopy of the carpometacarpal (CMC) and scaphotrapeziotrapezoid (STT) joints have been described for the purpose of diagnosing, staging, and treating CMC and STT pathology. This study evaluates the short-term outcome of arthroscopic resection arthroplasty of the CMC and STT joint for CMC and STT (pantrapezial) arthrosis.

**Methods:**
Thirty nine cases of arthroscopic resection arthroplasty of the CMC and STT joints were performed in thirty eight patients over a 3-year period. Four of these were excluded because they had less than one year of follow up. All patients underwent simultaneous arthroscopic resection arthroplasty of both the CMC and STT joints. Two or three mm of bone was resected arthroscopically from the proximal and distal aspects of the CMC and STT joints; Interposition material was placed in most cases. Preoperative data collected included 10 point self reported Pain Scale, DASH, range of motion, grip strength, key and chuck pinch, length of symptoms and treatment. Post operative data included the above plus patient satisfaction graded on a 0 to 5 scale. Data were collected at postoperative months 1, 3, 6 and 12.

**Results:**
There were a total of 35 procedures in 34 patients. Twenty three of 35 had graft jacket interposition. There were 27 females and 7 males. Average age was 63, (range 46 to 79). Preoperative length of symptoms averaged 48 months. Clinical follow up time averaged 388 Days. No patients required formal therapy postoperatively. Average time of post operative immobilization was less than 3 weeks. DASH score averaged 45 preoperatively, and 51, 30, 20, and 19 for the aforementioned postoperative intervals. Key pinch averaged 9 preoperatively, and 4, 8, 11, and 14 postoperatively. Grip strength averaged 39 pounds preoperatively, and 25, 36, 41, and 49 postoperatively. Pain improved from 7 (scale 0-10) preoperatively to 1 at 1 year follow-up. The patient satisfaction averaged 4 (0-5) at final follow-up.

**Conclusions:**
Short-term analysis suggests that arthroscopic arthroplasty for pantrapezial arthrosis provides satisfactory pain relief and return of strength and function. The patients progressively improve over time throughout the first year.

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**Comparison of Trapeziectomy and Trapeziectomy with Ligament Reconstruction and Tendon Interposition (LRTI): A Systematic Review**

Institution where the work was prepared: Yu Kit Li, Hamilton, ON, Canada

Yu Kit Li, BHSc; Colin White; Achilleas Thoma; McMaster University

**Purpose:**
Trapeziometacarpal osteoarthritis is a disabling condition of the hand that causes pain, stiffness, and weakness. Trapeziectomy with ligament reconstruction and tendon interposition (LRTI) is currently the most commonly used technique for operative treatment of this condition. Based on the evidence however, it is uncertain if the addition of LRTI to trapeziectomy confers any advantage. The aim of this study was to systematically review the literature and determine which procedure, trapeziectomy or trapeziectomy with LRTI, offers the best results to patients.

**Methods:**
A literature search was undertaken of the following electronic databases: Cochrane, AMED, EMBASE, HAPI, Healthstar, MEDLINE, TRIP, and Proceedings First (2002-2009). Studies were selected by two independent assessors if: (1) the study population included patients with trapeziometacarpal osteoarthritis and (2) the study was a controlled comparative study or systematic review comparing trapeziectomy and trapeziectomy with LRTI. Inter-rater variability was assessed. Included studies were assessed using the Assessment of Multiple Systematic Reviews tool and Jadad scale, and objective (ROM, grip strength, pinch strength, health cost, postoperative complications) and subjective (pain relief, hand function, overall satisfaction, and quality of life) outcomes were extracted. Statistical pooling and power analyses were performed with available data.

**Results:**
Two systematic reviews and four RCTs were identified and included in our review. Kappa for inter-rater agreement was 1.0. The maximum duration of follow-up was 5 years. The RCTs were well-matched in terms of age, gender, and hand dominance. There were no statistically significant differences between the two procedures in terms of postoperative grip strength (p=0.77), tip pinch strength (p=0.72), and key pinch strength (p=0.90). In addition, neither procedure demonstrated superiority in terms of postoperative pain VAS (p=0.34), DASH score (p=0.75), and number of adverse events (p=0.13). No studies reported health costs or quality of life.

**Conclusions:**
Neither procedure produced greater benefit in terms of objective and subjective outcomes. Moreover, there was enough power to be conclusive that there is no difference in tip pinch strength, key pinch strength, and adverse events between trapeziectomy and trapeziectomy with LRTI. Future studies should measure health costs and quality of life using formal economic evaluations and validated questionnaires, respectively. To definitively determine which procedure is better, a high quality RCT with longer follow-up is required.

Institution where the work was prepared: McMaster University, Hamilton, ON, Canada
LM Dickson, MD; C. Levis; Achilles Thoma; McMaster University

Introduction:
Increasing demands on the healthcare system and limited resources necessitates awareness of health economics. Many surgical procedures can be performed under local anesthetic and intuitively, the cost of performing appropriately selected hand procedures in this way would be less than in the main operating suite under general anesthesia. However, there are presently no cost-analysis studies comparing outcomes of treating hand fractures in the main operating suite to treatment in the minor procedures suite. The purpose of this study is to determine the cost-effectiveness of treating closed hand fractures in the minor procedure suite versus treatment in the main operating room. It will also assess the feasibility and complication rates of the two treatment modalities.

Methods:
This is a retrospective chart review of all hand fractures treated at our institution between 2005 and 2009. Treatment under local anesthetic in the minor procedures suite is compared with the control group consisting of those treated in the main operating room under a general anesthetic. The main outcome is the time from consult to normal range of motion.

Results:
The study sample consisted of 341 patients. 143 patients were excluded because of incomplete charting. Of the remaining patients 72 were in the control group and 54 in the treatment group. The mean age of the patients was 29.9 (SD= 15.6) in the control group and 35.4 (SD=19.9) in the treatment group. The mean time from consult to normal ROM was 40.5 days (SD=16.6) in the control group and 42.6 days (SD=13.4) in the treatment group. The mean time from consult to treatment was 81.5 hours (SD=114) in the control group and 65.3 (SD = 87.3) hours in the treatment group. The mean duration of hospitalization was 14.7 hours (SD=33.8) in the control group and 0 hours in the treatment group. The average cost of treatment was $2379 (CAD) in the control group and ($443 CAD) in the treatment group. The overall cost of treatment of the control group was $171,288 and $23,922 in the treatment group.

Conclusion:
There is no statistically significant difference in treatment outcomes such as time from consult to OR (p=0.983), consult to ROM (p=0.087). There was a significant difference in the duration of hospitalization and in the cost treatment in the two groups ($2379/patient vs. $443/patient). This study supports the safety and cost-benefit of treating appropriately selected patients under local anesthetic when compared to the gold standard of treatment under general anesthetic.

Is Main Operating Room Sterility Really Necessary in Carpal Tunnel Surgery? - A Multicenter Prospective Study of Minor Procedure Room Field Sterility Surgery

Institution where the work was prepared: Dalhousie University, Halifax, NS, Canada
Martin R. LeBlanc, BSc, MD1; Donald H. Lalonde, BSc, MSc, MD1; A. Thoma, MD, MSc, FRCS(C); Mike Bell, MD, FRCS(C); Peter Wells, MD1; Murray Allen, MD1; Janice F. Lalonde1; Daniel McKee1; [1]Dalhousie University, [2]St. Joseph’s Healthcare and McMaster University, [3]Ottawa University, [4]University of Saskatchewan, [5]University of British Columbia

Purpose:
More than 70% of Canadian carpal tunnel syndrome (CTS) operations are now performed outside of the main operating room with field sterility and surgeon administered pure local anaesthesia (2). Is main operating room sterility necessary to avoid infection for this operation? This study evaluates the infection rate in performing carpal tunnel surgery using field sterility in Canada.

Method:
This is a multicenter prospective study reporting the rate of infection in carpal tunnel surgery performed in the minor procedure room setting using field sterility. Field sterility means prepping of the hand with iodine or chlorhexidine, a single towel/drape with a hole in it, and a sterile tray with a modest supply of basic instruments and retractors. Sterile gloves and masks are used but the surgeons are not gowned. No prophylactic antibiotics are given.

Results:
A total of 1,504 consecutive CTS operative cases were collected prospectively from January 2008 to January 2010. Six superficial infections were reported and four of those patients received oral antibiotics. No deep postoperative wound infection was encountered and no patient required admission to hospital, incision and drainage, or intravenous antibiotics.

Conclusions:
A superficial infection rate of 0.4% and a deep infection rate of 0% following carpal tunnel surgery using field sterility confirm the low incidence of postoperative wound infection of this procedure using field sterility. This study supports the safety and low incidence of postoperative wound infection of performing carpal tunnel surgery using minor procedure field sterility without prophylactic antibiotics. Main operating room sterility comes with a fourfold cost in money even without an anaesthesiologist (2), and generates considerably more garbage. The higher monetary and environmental cost of main operating room sterility may not be justified on the basis of infection for carpal tunnel surgery.

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Purpose:
The treatment of Kienböck’s disease is still controversial. The purpose of this study was to retrospectively review of objective and subjective functional outcomes of surgical treatments for Kienböck disease.

Methods:
Between 1976 and 2001, a total series of 147 patients with Kienböck disease were treated surgically. The average age at the time of surgery was 36.1 years (13 to 75). The follow-up time in average was 42.5 months (6 to 348).

Clinical assessment included measurements of wrist range of motion (ROM), grip strength. Post-operative complications were noted. Patients were sent asked to answer both the Disability of Arm, Shoulder and Hand (DASH) questionnaire and the Patient-Rated Wrist Examination (PRWE). Radiographic evaluation included measurements of carpal height index and Stahl index. The patients were separated into groups by Lichtman classification. 2 patients in stage 1, 32 in stage 2, 51 in stage 3A, 49 in stage 3B, 9 in stage 4. 4 patients were unclassified. All outcomes variables were compared with the use of a paired t-test. The effects of different surgical procedure on active ROM, DASH, PRWE and radiographic index values were analyzed by one-way Analysis of Variance (ANOVA). A p-value of less than 0.05 was considered significant.

Results:
For patients with stage 2 disease, there was no benefit noted between procedures with regard to post-operative range of motion; however, grip strength was improved significantly when using a pedicled vascular bone graft (VBG). VBGs were also found to produce improved results when compared to radial shortening (RS) procedures.

In stage 3A, VBG procedures were found to produce better ROM when compared to patients undergoing RS and scaphocapitate (SC) fusions. In stage 3B, pedicle VBG and RS osteotomy maintained preoperative ROM; however ROM decreased in both the SC fusion and proximal row carpectomy (PRC) groups. Grip strength improved significantly in both the SC and PRC group. Overall, 17 patients (11.7 %) underwent revision procedures for complications. There were no significant differences noted in revision rates, DASH and PRWE scores between any of the procedures at any stage.

Conclusion:
In stage 2 and 3A, pedicile VBG could be a superior option than the other procedures due to better ROM or grip strength. In stage 3B, SC fusion and PRC provided better grip strength but poorer ROM. RS osteotomy and pedicle VBG were found to preserve acceptable ROM and grip strength even in cases of 3B disease.
Overcoming the Learning Curve: A Novel Approach to Teaching Zone II Flexor Tendon Repairs

Institution where the work was prepared: Stanford University, Stanford, CA, USA
A. Sina Bari, MD; Colin YL Woon; Brian C. Pridgen; James Chang; Stanford University

Background:
Repairs of Zone II flexor tendon injuries involve complex techniques that have benefited from many advances in recent years. These advances present new challenges, however, for teaching within the operating room. A focused tutorial incorporating a practical, hands-on model and standardization of repair technique may offer an effective low-risk, low-cost method for training future surgical residents.

Methods:
Plastic Surgery residents (n=14) were asked to perform their preferred Zone II flexor tendon repair using an inexpensive tabletop model before and after a focused tutorial. The tutorial reviewed primary literature and presented a standardized approach. Repairs were tested for load deformational behavior using a hydraulic tensiometer and high-resolution photography. Blinded pre- and post-tutorial repairs and questionnaires were analyzed to determine effectiveness of this teaching approach. Participants were retested at 6 months to evaluate persistence of results.

Results:
Post-tutorial repairs required higher loads to generate a 2mm gap (19N +/- 3.5 Pre vs. 44N +/- 3.6 Post; p<0.001) and ultimate breakage (29N +/- 3.9 Pre vs. 56N +/- 4.0 Post; p<0.001). Both objective measures, e.g. tendon purchase, and subjective measures, e.g. participant confidence, increased significantly. Subgroup analysis by level of training demonstrated significant improvement for both junior and senior residents. Retesting at 6 months revealed gains were maintained over time (2mm gap: 45N +/- 4.3; ultimate breakage: 52N +/- 5.3).

Conclusions:
We created a practical educational tool to teach Zone II flexor tendon repair outside of the time- and error-sensitive confines of the operating theatre. Our approach utilizes an inexpensive hands-on tabletop model, review of the primary literature, and standardization of the technique. Analysis of resident’s pre-tutorial repairs revealed common misconceptions in suture technique, strand count, and purchase. This may in part be due to the multitude of suggested repair techniques, difficulty in comparing data across multiple studies, and the steep learning curve involved in learning complex procedures. By introducing a novel hands-on teaching tool, we believe to have overcome some of these barriers.

Surgical Knot Security for Common Suture Materials: A Biomechanical Study

Institution where the work was prepared: West Virginia University, Morgantown, WV, USA
John E. Tidwell, MD; J Vincent Kish; Julie Samora, MD, PhD; Joseph Prud’homme; (1)West Virginia University, (2)Ohio State University

Purpose/Significance:
Currently, there is no consensus defining the number of throws required for adequate square knot security, defined simply as a knot that when tested to failure will fracture as opposed to untying by slippage. We proposed that a standard minimum of five knots will be required to confer knot security for flat square knots for all suture materials and sizes and that additional throws will be needed for Fiberwire.

Methods:
Using various monofilament, multi-filamentous, absorbable, and non-absorbable suture materials (Fiberwire, Monosof, Surgipro, Maxon, and Polysorb) across suture sizes (#5, #2, 0, 2-0, and 4-0) were tied uniformly and reproducibly ex-vivo by hand with different number of flat square knot throws (3, 4, 5, and 6). At each suture size and material, 20 knots were statically loaded in tension to failure using the loop method on a tensiometer measuring tensile strength at failure. Measured outcomes included whether the knot failed by fracture or slippage and the tensile strength at that knot failure.

Results:
For the tested materials (except Fiberwire) at least five flat square throws should be placed to confer knot security based on a binomial proportion score 95 % confidence intervals (CI) of 0.84 – 1.0 or at least four throws should be made based on a 95% CI of 0.76 – 0.99. Fiberwire requires six throws per knot for security based on a 95 % CI. As expected, knot tensile strength increased significantly with increasing suture size. The knot tensile strengths reached a plateau at the number of throws required for knot security.

Conclusions:
Unless a surgeon has specific knowledge based on experimental evidence that a different number of throws of squared knots is superior for a specific application; the default should be a minimum of four throws, with five conferring additional security in most situations. Fiberwire knots should be made with six throws.
Experimental Model of Trigger Finger in a Human Cadaveric Hand
Institution where the work was prepared: Yale University School of Medicine, New Haven, CT, USA
Kristina J. Liu, BA; J. Grant Thomson; Yale University School of Medicine

Purpose:
While it can be reasonably assumed that trigger digits occur as a result of a size mismatch in the pulley-tendon system, it is unclear whether locking, histological changes and/or nodule formation occur as a result of an intrinsically too-small pulley or an enlarged flexor digitorum profundus. According to a review of the literature to date, there has never been an anatomical hand model using non-preserved human tissue created for the study of trigger finger. Our purposes in this study were to 1) create a model of trigger digit, 2) examine the change in work of flexion as the force of pulley constriction is increased, 3) compare the work of flexion between non-triggering and triggering conditions, and 4) subject A2, A3 and A4 pulleys to the same conditions to examine whether triggering can be modeled at these locations.

Methods:
Using an Instron computer-integrated tensiometer, we studied the work of flexion in four fingers (thumb, index, middle and ring) from a fresh-frozen human cadaveric hand severed at the forearm level. Measurements of the load of flexion were taken as the A1, A2, A3 and A4 pulleys were incrementally constricted in order to induce triggering. Works of flexion were calculated and analyzed statistically for differences amongst trial conditions.

Results:
Using our experimental setup, triggering was successfully induced in all four digits through incremental constriction of the A1 pulley. The work of flexion in all digits after triggering in the A1 position all differed significantly from the work of finger flexion with non-constricted A1 pulleys. The same incremental pulley constriction was applied to the A2, A3 and A4 pulleys. Despite increasing the pulley constrictions to a maximum, no triggering occurred in any of these pulley systems in all four digits. As expected, the work of flexion increased as the constriction around the pulley systems increased, yet the work did not incrementally change as was seen in the A1 pulley system.

Conclusion:
This is the first time trigger finger has been experimentally induced in a human cadaveric hand. Our results demonstrate that the A1 pulley can trigger due to manual constriction of the pulley alone. The A1 pulley system also remains unique in maintaining the ability to trigger from pulley constriction in this experimental model. This opens the door to further questions regarding the unique anatomical aspects of the A1 pulley and their role in triggering that can be further discussed in the presentation.

Isolated Lunotriquetral Ligament Tears Treated with Ulnar Shortening Osteotomy
Institution where the work was prepared: Ather Mirza MD, PC, Smithtown, NY, USA
M. Ather Mirza, MD; Mary Kate Reinhart, MS, CNP

Hypothesis:
Isolated lunotriquetral ligament (LTL) tears can be treated successfully with ulnar shortening osteotomy (USO).

Methods:
72 consecutive patients (74 cases) were treated between October 1992 and February 2004 with USO for isolated LTL tears. Those who failed to respond to conservative management for ulnar sided wrist pain underwent diagnostic bone scan, arthrograms, and arthroscopy and were treated surgically with USO. The modified Gartland and Werley wrist grading system was used to assess outcome.

Results:
We are reporting on 41 patients (42 cases) average age 44.5 years (range, 19 to 68 y) with minimum follow-up 2 years (range, 2 to 5.3 y). All sustained traumatic injuries; a loaded dorsiflexed wrist was the precipitating injury in 21 cases (50%). Bone scans were positive in 18 patients (42.8%). Arthrograms indicative of LTL tears were positive in 37 patients (88.1%). Mean ulnar variance was 1.0 mm (range, -2 to 3.5) pre-operatively and became 0.4 mm (range, -5 to 3.5) post-operatively. Mean bone healing time was 18 weeks. There were no non-unions or complications. Postoperatively the modified Gartland and Werley wrist grading system revealed 20 excellent (47.6%), 15 good (35.7%), 7 fair (16.7%) and no poor outcomes.

Conclusion:
A loaded dorsiflexed wrist injury was the most common. Bone scans are helpful in ruling out ulnar impaction syndrome. Arthroscopy is the gold standard for detecting LTL tears. Regardless of preoperative ulnar variance, isolated LTL tears can be successfully treated by performing an USO.
A Retrospective Review of Perilunate, Lunate Dislocations and Fracture-Dislocations: What Factors Contribute to a Missed Injury?

Institution where the work was prepared: University of Minnesota, Minneapolis, MN, USA

Mary Elizabeth Tyler Rashid, MD; University of Minnesota; Deborah Bohn, MD; Park Nicollet Health Services/Tria Orthopaedic Center; Cherie Heinrich, MD; HealthPartners; Thomas Varecka, MD; University of Minnesota/ Hennepin County Medical Center; Loree Kalliainen; Regions Hospital

Purpose:
Certain wrist dislocations, such as perilunate dislocations, lunar dislocations and fracture-dislocations, are missed on initial exam (about 25% of the time) and it is unclear why. It could possibly be concomitant injuries that the patient incurs contribute to a missed injury or delay in diagnosis and treatment. The purpose of our study is to investigate the demographics, time to diagnosis and time to treatment of this particular injury pattern. Our hypothesis is that as the injury severity score (ISS) increases, that the number of missed wrist injuries (increased time to diagnosis and treatment) will increase.

Methods:
Patient charts were reviewed retrospectively over five years at three hospitals: two local Level 1 trauma centers and one community hospital in the Minneapolis/St-Paul area. Patients with the diagnosis of perilunate dislocation, lunar dislocation or fracture-dislocation were identified. Information extracted from the chart were as follows: age, time to diagnosis, time to reduction (either open or closed), time to operative management, injury severity score (ISS), laterality, handedness, gender, mechanism of injury, presence of associated acute median nerve compression.

Results:
46 patients were identified and 44 patients included in this study. Mean age was 30.4 year old with standard deviation of 11.4 years. 40 patients were male and 4 were female. 43% (19) patients suffered right side injury and other 57% (25) injuries were on the left. 38.6% (17) of patients presented with associate injuries. 29.5% patients received their care at community hospital. Those patients who were treated at community hospital were more likely to have delayed diagnosis than those treated at level one trauma center (p=0.05). Those patients who were treated at community hospital were also more likely to have delayed reduction than those treated at level one trauma center (p=0.007). Patient with associated injury were more likely to have a delayed reduction than those without associated injury (p=0.06). The associated injury did not appear to be associated with the time to diagnosis (p=0.13).

Conclusions:
Associated injury did not significantly impact on the delay to diagnosis and treatment of perilunate dislocations, lunar dislocations and fracture-dislocations. However, those patients who presented and were treated at community hospitals were more likely to have a missed injury initially.
Botulinum Toxin Type A for Raynaud’s Phenomenon
Institution where the work was prepared: Southern Illinois University School of Medicine, Springfield, IL, USA
Kelli N. Webb, MD; Carisa M. Cooney; Reuben A. Bueno Jr; Michael W. Neumeister; Southern Illinois University School of Medicine

Background:
Raynaud’s phenomenon is a common cause of ischemic digits, and may lead to severe pain and nonhealing ulcers. Although the exact pathophysiology is still unknown, Raynaud’s phenomenon is generally considered to be an imbalance between vasoconstrictors and vasodilators. There are multiple treatment options with varying levels of invasiveness and effectiveness. Botulinum toxin type A (Botox, Allergan Inc.) may be a novel therapeutic treatment option.

Methods:
This is a retrospective chart review of 29 patients treated with botulinum toxin type A for symptomatic relief of pain and ulceration from Raynaud’s phenomenon. Fifty to 100 units of botulinum toxin type A were injected into the palm around each involved neurovascular bundle. Data collection included subjective evaluation of pain relief by the patients, serial photography of wound healing, and objective data on tissue perfusion using a Doppler perfusion imager and Periscan image analysis software.

Results:
Between 2004-2010, twenty-nine patients were injected with botulinum toxin type A for symptomatic relief of Raynaud’s phenomenon. Twenty-three out of 29 patients (79%) reported pain-reduction after a single injection. Nineteen patients reported immediate relief; 4 reported more gradual pain reduction over 1-2 months. The average duration of pain relief was 20 months (range 1-59 months). Six patients had no or minimal pain relief. Tissue perfusion results demonstrated a marked change in blood flow (-48.15 to +425%) to the digits. Fifteen out of 17 patients (88%) with finger ulcers healed within 60 days.

Conclusions:
Although the mechanism is unknown, botulinum toxin type A may be a non-surgical treatment option for severe pain and ulcerations associated with Raynaud’s phenomenon.

Treatment Strategy for Diffuse Venous Malformations of the Upper Extremity
Institution where the work was prepared: Boston Children’s Hospital, Boston, MA, USA
Andre Panossian, MD1; Dean M. Anselmo, MD1; Philip Stanley, MD1; Obaid Chaudhry, MD1; Cameron S. Francis, MD1; Amir H. Taghinia2; Joseph Upton, MD2; (1)Children’s Hospital Los Angeles, (2)Children’s Hospital Boston and Harvard Medical School

Background:
Venous malformations (VM) of the upper limb are low-flow vascular lesions that often present complex management challenges. Present from birth, these masses can be discrete or rhizomal and diffuse. They are comprised of a dilated venous network that commonly plague patients with pain, thrombophlebitis, pathologic fractures, and disfigurement. Venous malformations may involve skin, muscle, bone, or joints and can produce trophic changes in the upper extremity. Unfortunately, there is no algorithm for identifying, diagnosing, and managing such complex lesions. We review our experience with diffuse upper extremity VM and present our anatomically-based, symptomatically-focused management algorithm.

Methods:
The authors executed a 20-year retrospective study of 37 patients who presented with diffuse upper limb VM. Patients with only upper limb VM were included. Other parameters gathered were age of onset, age of presentation, gender, anatomical location, signs and symptoms, radiological and histopathological studies, therapeutic intervention, and outcome.

Results:
All cases investigated demonstrated unilateral and widespread involvement of the entire upper limb, including skin, subcutaneous tissue, muscle and bone. There was a female to male preponderance of 1.5:1. Onset at birth, pain, and swelling were uniformly present. Reduced functional capacity of the upper extremity was present with increasing age in all adults. Pathological fractures occurred in 14% of patients (n=5). Symptomatic patients were managed with pressure garments, sclerotherapy, surgery, or a combination of all modalities. No patients required amputation and not all patients underwent surgical intervention. The majority of patients managed with sclerotherapy or surgery often underwent multiple sessions to manage symptomatic areas only. Postoperative complications were categorized as early or late, and included the following: hematoma (16%), epidermolysis (27%), painful neuromas (16%), digital contractures (35%), skin necrosis (5%), and wound dehiscence (8%).

Conclusion:
A uniform approach is crucial for the diagnosis and management of purely diffuse upper extremity VM. In addition, treatment of widespread upper limb VM focuses on recognition of symptomatic regions and anatomical location. Sclerotherapy, surgical resection, or a combination of both may be employed safely. The decision to pursue a particular line of treatment is best determined by a multidisciplinary team. Despite the lifelong course, extensive bulk, and excessive weight that may be associated with VM, patients often compensate well functionally.
Maximizing Outcomes in Rope Avulsion Thumb Injuries

Institution where the work was prepared: The Buncke Clinic, San Francisco, CA, USA

Gregory Nimalan Emmanuel; Darrell Brooks; Rudolf F. Buntic; Gregory M. Buncke; Bauback Safa; Brian Parrett; The Buncke Clinic

Introduction:

Rope avulsions represent a unique mechanism of injury combining avulsive, twisting and crushing forces. This causes significant damage to the length of the finger, including soft tissue, bone, tendons, blood vessels, and nerve. Current literature documents low survival rates for revascularized or replanted thumb rope avulsion injuries. We believe that results are better than documented and our goal was to review our outcomes and determine the best treatment for these injuries.

Methods:

We reviewed all rope avulsion thumb injuries at our center between 1983 and 2009. Charts were reviewed for injury mechanism, treatment rendered, survival of the replanted thumbs, need for secondary surgery, post-operative motion, and the reconstruction of non-replantable thumbs.

Results:

There were 105 avulsed thumbs in 105 patients (mean age, 39 years). The most common mechanisms of injury were “cowboy thumb” due to the roping of cattle, followed by horse training and water ski tow rope accidents. The most common level of avulsion was at the proximal phalanx level followed by the interphalan-geal joint. Mean follow-up was over one year.

Devascularized thumbs were revascularized or replanted in 85% of cases with an 86% survival rate. Vein grafts were employed for arterial reconstruction in 40% of cases and venous reconstruction in 20% of cases. Twenty percent of artery repairs used transposition of an adjacent finger artery. Mean length of stay was 6 days. Following successful revascularization or replantation, mean total active motion for the thumb was over 70 degrees. Eighty percent of patients returned to full time work and minimal patients needed secondary surgery.

Conclusions:

We present the largest series of rope avulsion injuries and contrary to the current literature, a majority of rope avulsion thumb injuries can be replanted or revascularized with high success rates. Vein grafts should be used liberally to allow removal of damaged vessels. Motion in the affected digits is often good and minimal secondary surgery is needed.
Effects of a Collagen Nerve Guide Tube in Patients with a Median or Ulnar Nerve Lesion

Institution where the work was prepared: Righospitalet, Copenhagen, Denmark

Christian Krarup, MD¹; Allan Ibsen¹; Michel Boeckstyns, MD²; Josep Valls-Sole³; Joaquim Fores, MD³; Xavier Navarro³; Birgitta Rosen, DMSc; Goeran Lundborg⁵; S.J. Archibald, PhD⁶; ¹Righospitalet, ²Gentofte Hospital, ³Hospital Clínico de Barcelona, ⁴Skåne University Hospital, ⁵Malmö University Hospital, ⁶Integra NeuroSciences

Recovery after section of peripheral nerve depends on the outgrowth of nerve fibers, reinnervation of target tissue and maturation of regenerated fibers. Since the clinical result is often poor, different treatment strategies including placement of nerve guides have been used. It was found that a collagen tube in monkey (Ann. Neurol. 2002;51:69-81) and a silicone tube in humans (J.Hand Surg.[Br.] 2004;29:100-7) support regeneration over short nerve gaps as well as direct suture or short nerve grafts. We have therefore studied the effect of a collagen tube (Integra Life Sciences Corp., NJ, USA) on short gap nerve regeneration in humans with the hypothesis that outcome would be as good in tube repair as in direct suture or short graft repair.

Methods:

In this randomized, blind, parallel group, international multi-center study two surgical procedures for repair of nerve lesions were compared. The study population consisted of patients who had complete traumatic nerve injuries to the median and/or ulnar nerves in the distal third of the forearm. The collagen nerve guide (NeuraGen™) was implanted in 22 of 43 patients and direct suture repair was used in the other 21 patients. A total of 32 patients completed the 2-year observation period. Evaluation included clinical symptoms including pain, a battery of sensory-motor-pain/discomfort hand-function tests - RosenScore (J Hand Surg 2000;25A:535-43) and electrophysiological studies.

Results:

Both groups of patients treated with NeuraGen and control suture had sensory loss in innervated digits. During early regeneration patients treated with NeuraGen had less pain than controls and at longer observation period there was no difference in complaints of pain. At completion there was no difference in median or ulnar motor and sensory function scores when NeuraGen and controls were compared, although both were reduced compared to non-lesioned subjects. Motor and sensory nerve conduction studies showed no statistical differences between groups in regard to amplitudes, latencies or conduction velocities of compound motor and sensory action potentials.

Conclusions:

Treatment of short gap lesions with a resorbable collagen nerve guide tube yielded as good results as direct suture or short graft repair considering most motor and sensory function parameters. At early regeneration periods, patients treated with NeuraGen complained of less pain than controls.

Significance:

The study indicates that repair with a nerve guide tube is a realistic alternative to conventional end-to-end or graft repair. Further development of the collagen tube may allow better repair over longer distances in the future.

Functional Outcomes of Nerve Defects Treated with Matched-Diameter Allograft vs. Cabled Autograft

Institution where the work was prepared: Columbia University, New York, NY, USA

Peter Tang, MD, MPH; Geoffrey Konopka; Ayhan Klic; Yelena Akelina; Ricky Regalbuto; Thomas Gardner; Columbia University Medical Center

There are many approaches in dealing with nerve defects. If a tensionless, primary repair cannot be achieved the next best option is autogenous nerve grafting. Disadvantages of an autograft include donor site morbidity, limited graft availability, and diameter mismatch which may necessitate cabling of the autografts to approximate the diameter of the injured nerve. Acellular nerve allograft is a new option for bridging nerve gaps that allows diameter matching to the injured nerve. The goal of this project was to assess the functional recovery of nerve defects treated with a matched-diameter acellular allograft versus cabled autogenous nerve graft.

Fifty-four Sprague-Dawley rats were divided into one of three experimental groups. All rats underwent an unilateral 10 mm sciatic nerve defect which was immediately repaired with a graft. Rats in Group A were repaired with an acellular nerve allograft processed by AxoGen Inc. Rats in Group B were repaired with three reversed sural nerve autografts cabled to match the nerve defect. Rats in Group C (control), were repaired with the excised segment of sciatic nerve in a reversed position. The animals were evaluated at the end of 12 weeks post surgery.

Outcomes Included:

Maximum isometric tetanic force of the tibialis anterior muscle, fibular anterior muscle weight, and compound muscle action potential of the gastrocnemius. Each measure was normalized to the contralateral leg. Statistical significance was evaluated using ANOVA testing. At 12 weeks, the average normalized maximum isometric tetanic force at evaluation was 52.0 +/- 2.9% for Group A, 47.5 +/- 1.6% for Group B, and 51.9 +/- 3.0% for Group C.(p>0.05)  The average normalized compound muscle action potential was 104.8 +/- 8.1% for Group A, 86.1 +/- 4.9% for Group B, and 90.9 +/- 4.3% for Group C.(p>0.05)  The average normalized tibialis anterior muscle weight was 52.0 +/- 2.0% for Group A, 47.5 +/- 1.6% for Group B, and 51.9 +/- 3.0% for Group C.(p>0.05) Matched diameter acellular nerve allograft demonstrated equal functional recovery at 12 weeks when compared to the control group (reversed autograft), and superior functional recovery to the cabled sural nerve autograft.

These results suggest that acellular nerve allografts may provide the optimal nerve graft for small nerve defects, but large defect sizes and longer recovery time periods should be investigated.
New Clinical Perspectives on Processed Nerve Allografts: A Multicenter Retrospective Study of the Utilization and Outcomes in Peripheral Nerve Injury Repair

Institution where the work was prepared: The Buncke Clinic, San Francisco, CA, USA

Darrell Brooks: The Buncke Clinic

Introduction:
Previously, the use of peripheral nerve allografts was restricted by tissue availability and the need to manage immune response. In 2007, an off-the-shelf processed nerve allograft (Avance® A xoGen, Inc) became widely available for the reconstruction of nerve discontinuities. While the availability of clinical outcomes data has been limited, surgeons seeking alternative repair options have used this product with increased frequency. As a result, a multicenter retrospective study to collect utilization and outcomes data of processed nerve allografts was initiated.

Methods:
This study reports the findings from the first multi-center retrospective clinical study of processed nerve allografts. Data was collected from 10 centers between November 2008 and April 2010. Centers, selected to represent a broad range of institutions, followed their own standards of care for treatment and follow-up. Standardized case report forms were used to collect data on the repair and recovery. Follow-up evaluations used a variety of measures for sensory and motor assessments including MRCC scales, 2-point discrimination, Semmes-Weinstein testing, range of motion, motor strength testing, muscle bulk, pain assessment, and patient assessment of improvement. Information on adverse experiences occurring intra/post-operatively were also collected.

Results:
A total of 60 subjects (42 males and 18 females) were enrolled to include 80 nerve repairs in the upper extremity-digital (47.9%), upper extremity-forearm/upper arm (43.8%), head/neck (5%), and lower extremity (3.8%). In the Utilization Population (UP), the average age was 38.4 years (18-86). The mean gap length was 27.3 mm (5-200). The median time to repair was 26 days (0-246). Mechanisms of injury included lacerations, blunt trauma, amputation/avulsion, gun shot wound, improvised explosive device, neuroma and oncologic resections.

Of the UP, 32 subjects with a total of 43 nerve repairs (24 sensory, 7 motor, 12 mixed) had sufficient follow-up. The mean gap length was 21.6 mm (7-50). Overall functional recovery was demonstrated in 88.4% of the cases. Sensory, motor, and mixed nerve repairs reported recovery at 91.7%, 85.7%, and 83.3% respectively with measures ranging from S3-S4 for sensory and M2-M5 for motor. Three revisions not related to the graft were required. There were no reported adverse events related to the nerve graft.

Conclusion:
Processed nerve allografts are a safe alternative for nerve reconstruction. Functional recovery was reported in 88.4% (p<0.0001) of all cases including sensory, mixed, and motor injuries. Continuation of this project will include further follow-up, more research centers, and subset analysis to provide additional evidence on the success rate of processed nerve allografts.

Internal versus External Fixation of Distal Radius Fractures: A Prospective Randomized Controlled Trial

Institution where the work was prepared: Hand and Upper Limb Center, University of Western Ontario, London, ON, Canada

Ruby Grewal; Joy MacDermid; Graham King; Kenneth Faber; University of Western Ontario

Hypothesis:
Few randomized trials have evaluated whether internal fixation offers superior outcomes to external fixation in the treatment of distal radius fractures (DRF). The purpose of this pragmatic RCT was to compare functional outcomes seen with ORIF to closed reduction, percutaneous pinning and external fixation (ExFix) in the treatment of DRF.

Methods:
52 patients with DRF failing closed reduction and casting were randomized to ORIF (n=26) or ExFix (n=26). For pragmatic reasons, the choice of internal fixation was left to the surgeon’s discretion (early recruitment: dorsal plates (n=8), later recruitment: volar locked plates (n=18)). Outcomes were measured at 6 weeks, 3, 6, and 12 months and included: the Patient Rated Wrist Evaluation (PRWE), range of motion and grip strength. Generalized linear modeling using repeated measures indicated that there were significant differences for fixation and time in PRWE scores (Figure 1). The overall mean advantage for ORIF on PRWE scores was 9.95 (p=0.04) (Figure 1), however the ExFix group had a higher mean baseline PRWE score, indicating that despite randomization, this group may have had a more severe initial injury. Although this study was not designed to differentiate between fixation method, a subgroup comparison identified significantly better PRWE scores with volar plates compared to both external fixation (p=0.01) and dorsal plating (p = 0.04) (Figure 2).

There were no significant differences for any measured impairment between the two groups. However, we did observe a trend towards greater grip strength (p=0.032), wrist extension (p=0.06) and supination (p=0.09) in the ORIF group at 3 months, and greater supination (p=0.07) and radial deviation (p=0.09) at 1 year. Of note, these differences were of little clinical significance (i.e. < 10 degrees).

The overall incidence of complications was similar, however tendonitis was seen more frequently with ORIF (23% vs. 0%, p = 0.04) and infections with ExFix (32% vs. 0%, p = 0.002).

Summary Points:
1. PRWE scores were significantly lower for patients treated with ORIF compared to ExFix with the best outcomes observed with volar locked plates.
2. These advantages are seen in the early post-operative period with overall scores equalizing at 1 year.
Is It Necessary to Use Bone Graft Following Corrective Osteotomy of the Distal Radius?

Institution where the work was prepared: Denver Health Medical Center, Denver, CO, USA
Kagan Ozer; Denver Health Center; Ayhan Kilic; Columbia University Medical Center; Kyros Ipaktchi; Denver Health Medical Center

Purpose:
Following corrective osteotomies of the distal radius, the use of bone graft gives additional structural stability and promotes bone healing. Previous studies on the use of bone grafts at the osteotomy site were published in an era where volar locking plates were not available. Volar locking plates provide excellent stability and support at the fracture site that the use of bone graft for structural stability may not be necessary. In this study, we tested the following hypothesis: There is no need to use bone graft provided that the contact on the volar cortex is maintained following opening wedge corrective osteotomy of the distal radius with volar locked plating.

Patients and Method:
Two groups of age-matched patients were identified with dorsally angled malunited extraarticular fractures of the distal radius who underwent opening wedge corrective osteotomy with volar locked plating. In group 1 (n=14), patients have refused to receive any form of synthetic graft, allograft or autograft. In group 2 (n=14) patients have agreed to have allograft (de-mineralised bone matrix chips) at the osteotomy site. No patients had a body mass index (BMI) above 35 and none of the patients had diabetes. Table 1 shows radiographic findings.

Results:
All patients in both groups had a complete radiographic union at the end of 6 months without hardware failure. Patients in-group 1 (without bone graft) had a longer time to union (11 weeks) compared to group 2 (7 weeks) (p<0.05). Return to work, maintenance of correction at the final follow-up, and DASH scores showed no statistical difference. One patient had an extensor pollicis longus rupture in-group 2 and treated with a tendon transfer.

Conclusion:
The use of allograft bone chips is not needed. This reduces the overall of the cost of the surgery, eradicates the disease transmission risk associated with the use of bone allograft chips, and eliminates the donor site morbidity seen after autogenous bone grafting.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>AP Inclination (°)</th>
<th>Dorsal Tilt (°)</th>
<th>Radial Height (mm)</th>
<th>Time to Union (weeks)</th>
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<tr>
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<td>Preop</td>
<td>Postop</td>
<td>Preop</td>
<td>Postop</td>
<td>Preop</td>
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<tr>
<td>Group 1</td>
<td>34</td>
<td>5°(-5/5)</td>
<td>12°(-8/-16)</td>
<td>-18°(-45/-15)</td>
<td>8°(0-15)</td>
</tr>
<tr>
<td>Group 2</td>
<td>37</td>
<td>3°(-7/8)</td>
<td>14°(-9/-20)</td>
<td>-20°(-35/-15)</td>
<td>7°(0-15)</td>
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Table 2

<table>
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<tr>
<th></th>
<th>Wrist Flex/Ext (°)</th>
<th>Wrist Radial/Ulnar Deviation (°)</th>
<th>Pronation/Supination (°)</th>
<th>DASH Score</th>
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<td></td>
<td>Preop</td>
<td>Postop</td>
<td>Preop</td>
<td>Postop</td>
</tr>
<tr>
<td>Group 1</td>
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<td>110°(100-175)</td>
<td>8°(7-12)</td>
<td>15°(12-20)</td>
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<tr>
<td>Group 2</td>
<td>55°(25-130)</td>
<td>115°(105-180)</td>
<td>10°(6-14)</td>
<td>18°(11-25)</td>
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</table>
Outcomes of a Novel Approach to Intercarpal Arthrodesis

Institution where the work was prepared: University of Alberta, Edmonton, Canada
Lisa Korus, MD; Michael Marhart, MD, FRCSC; University of Alberta

Purpose:
Four-corner fusion is generally indicated in cases of advanced degenerative arthritis of the wrist. It may also be indicated in patients with persistent and debilitating pain post scapholunate ligament repair or midcarpal instability. Four-corner fusion with exclusion of the hamate – essentially becoming a “two-corner, three-carpal arthrodesis” is now being performed at the University of Alberta. Proposed benefits of such a procedure include shorter operative times and a less involved operation which may translate to fewer complications. This study’s purpose was to review the results of this novel approach to intercarpal arthrodesis.

Methodology/Study Design:
All patients undergoing two-corner, three-carpal arthrodesis were included in the study. After obtaining ethics approval, patient charts were reviewed for demographics and pre-operative diagnoses. Physiotherapy records were reviewed for pain assessment, range of motion and grip strength. Follow-up radiographs were evaluated for evidence of fusion.

Results:
Eleven two-corner, three-carpal arthrodeses were performed over a two-year period at the University of Alberta (2008-2010). The average age of patients was 37 years old (range 21 – 56). Four patients were female and seven male. Indications for surgery were grade III SLAC (five), failed prior wrist ligament reconstructions (two), grade II SLAC with LT instability (two), SNAC (one) and SL and LT instability (one). Preliminary results showed an improvement in wrist pain as subjectively assessed by the patient. Grip strength was approximately 50% of that of the contralateral hand and flexion and extension 83% and 87% at an average of six months post-operatively. There was no evidence of failure union in follow-up radiographs of preliminary patients.

Conclusions:
Preliminary results demonstrate excellent range of motion in comparison to standard values for four-corner fusion and no incidence of non-union. Based on these preliminary results we conclude that two-corner, three-carpal arthrodesis is a safe and straightforward alternative to standard four-corner fusion.

Clinical Outcomes for Patients with Soft Tissue Sarcoma of the Hand

Institution where the work was prepared: Memorial Sloan-Kettering Cancer Center, New York, NY, USA
Edward A. Athanasian; Mark E. Puhaindran; Carol Morris; Memorial Sloan Kettering Cancer Center

Background:
In an earlier report from our center on surgical treatment for soft tissue sarcomas (STS) of the hand, the authors concluded that repeat resection or amputation improves outcomes. Since then, we have aggressively sought to achieve negative resection margins, using standard or modified amputations when needed, and doing repeat resections to negative margins when they were not achieved at initial surgery. We conducted this review to determine if this approach resulted in better outcomes.

Methods:
We performed a retrospective review of 53 patients with STS of the hand treated between 1996 and 2005. We assessed recurrence-free survival (RFS) and functional outcome of hand-preserving procedures, according to the Musculoskeletal Tumor Society system.

Results:
The median RFS was not reached. Of 53 patients, 6 (11%) had positive microscopic resection margins. Three underwent repeat resection to negative margins, while another 3 did not. All 3 patients with positive microscopic margins that were not re-excised developed local recurrence; 2 also developed distant metastases. Two of the 50 patients with negative margins developed distant metastases. All 5 patients who developed local and/or distant recurrence had deep tumors. The median MSTS score was 29 (interquartile range, 27–30). Patients with more extensive resections, such as double ray amputations, had lower MSTS scores.

Conclusion:
Suboptimal biopsies and positive resection margins are associated with local and distant recurrence in STS. Our results suggest that aggressive surgical treatment can result in better clinical outcomes, and underscore that care must be taken when planning biopsies of hand tumors.
Reconstruction of Upper Extremity Postburn Contractures Using Thoracodorsal Artery Perforator Flaps

Institution where the work was prepared: GATA Haydarpaşa Training Hospital, Istanbul, Turkey
Fatih Uygur¹; Serhan Tuncer²; Yalcın Kulahçyi; Celalettin Sever¹; Sahin Alagöz¹; (¹)GATA Haydarpaşa Eğitim hastanesi, (2)Gazi University, Faculty of Medicine, (3) Kocaeli Tıp fakültesi

Objective:

Full-thickness burns involving the upper extremity areas result in severe contractures. Functional impairment is inevitable if the affected areas are not managed properly. Proper treatment requires complete release and radical excision of the scar tissue, followed by reconstruction using durable tissue that will not contract during long-term follow-up.

Method:

Between 2004-2010, 13 patients with flexion contractures were in antecubital and axillar regions were reconstructed with pedicled thoracodorsal artery perforator flaps. 6 patients flexion contractures were in palmar region underwent reconstruction with a free thoracodorsal artery perforator flap. All of the patients were male, and their ages ranged from 20 to 23 years (mean, 21.1 years). The size and orientation of the skin islands were planned according to the defect size and orientation. In free flaps, anastomoses were performed to the radial artery and comitant vein with 10-0 nylon suture in an end-to-end manner in the anatomic snuffbox. In all cases, the donor site was closed primarily. The patients were followed up for 6 to 12 months (mean, 9.3 months).

Result:

All of the flaps used on the postburn contractures survived completely. Minimal transient venous congestion occurred in two pedicled flaps during the early postoperative period. A complete range of motion at the elbow joint was achieved in all patients by the end of the reconstruction period.

Conclusion:

This study revealed that the thoracodorsal artery perforator flap is a suitable alternative for postburn contractures.

Improving Resident Confidence with Hand Surgery Using A Fresh Tissue Dissection

Institution where the work was prepared: Keck School of Medicine of the University of Southern California, Los Angeles, CA, USA
Justin T. Kane, MD; Joseph N. Carey, MD; T. JoAnna Nguyen, MD; Alex Campbell, MD; Morad Askari, MD; Dung Nguyen, MD; Mark M. Urata, MD, DDS; Randy Sherman, MD; Wesley Schooler, MD; Keck School of Medicine of the University of Southern California

Purpose:

Teaching hand surgery has become increasingly difficult in an era of increasing work hours limitations and where “practicing on patients” is no longer tolerated. While these challenges have driven surgical educators to seek new modalities of surgical training, fresh cadaveric tissue dissection remains the standard to which any hand surgery simulation could be compared. We postulated that incorporating a required curriculum of hand dissections with emphasis on surgical technique and simulation would improve resident education, confidence, and ultimately, quality of surgical performance. We also postulated that by performing multiple different dissections we could evaluate which areas of hand surgery residents found to be more challenging than others.

Methods:

We designed a curriculum of required dissections in hand surgery. Twenty-one different dissections were planned in coordination with attending staff to emphasize surgical technique and anatomical concepts. The dissections were designed to allow residents to prepare for the designated procedures, and to perform them under the supervision of senior residents or staff. Residents were also given the opportunity to perform the procedures on their own. Fresh cadavers were obtained through coordination between the Pathology and Surgical Departments. Evaluation data were reported by participants on a confidence scale of 1-5, before and after each dissection.

Results:

A curriculum of fresh tissue dissections was created and implemented over a 3 month period. 42 dissections by n=9 residents were reported during 6 total dissection days. Data were evaluated for confidence pre and post dissection. For n=42 dissections, resident predissection confidence was 2.1±1.2 and post dissection was 4.5±0.9. Data were stratified by Junior (PGY4) and Senior (PGY6) level dissections. Mean Junior predissection confidence level was 1.8±0.98 and Senior was 2.2±1. Mean Junior postdissection level was 3.7±1.2 and Senior postdissection level was 4.8±0.39.

Conclusion:

Our results demonstrate that providing and requiring anatomic fresh tissue dissection and surgical simulation improved resident confidence with Hand surgery operations. We also found a difference between confidence at different levels of training, and that a gap existed between postdissection confidence levels between senior and junior residents. We believe that including and requiring fresh tissue dissection in Hand surgery training may provide an answer to improving surgical training in a decreased work hour environment. Additional evaluation is needed to establish evidence that patient outcomes and surgical quality can be improved.
Mesenchymal Stem Cell Allograft with Screw Fixation for the Treatment of Scaphoid Non-Unions

Thirteen (13) patients were treated surgically for scaphoid non-union using screw fixation supplemented with mesenchymal stem cell allograft by four hand surgeons between June 2008 and December 2009. Pre-operative, operative and post-operative clinic notes were reviewed with a minimum six month follow-up interval established. Radiographs were independently reviewed to identify fracture location and time to radiographic healing. Parameters including age, tobacco use, hand dominance, injury location, mechanism of injury, time from injury to surgery, surgical approach and time to union were recorded. Primary established endpoint was clinical/radiographic union. Failure was defined as non-union or need for additional surgery.

Results:
All patients in this study were males with an average age at time of presentation of 25.92 years. 53% (7/13) enrolled patients admitted to tobacco use, 23% (3/13) reported injury to dominant hand, 38% of fractures occurred at the proximal aspect of the scaphoid, 61% of fractures occurred at the scaphoid waist. Mechanism of injury included fall on outstretched hand in 84% (11/13), fight injury 7% (1/13) and martial arts training injury 7% (1/13).  Average time from injury to surgery was 13.2 months. One patient was lost to follow-up at 3 months and one patient was excluded from study computations due to inadequate follow-up. Overall union rate was 72.7% with three non-unions identified (non-union rate 27.3%). One non-union had an unidentified scapholunate ligament injury and one required significant correction of a humpback deformity. Two non-unions eventually required scaphoidectomy with fusion while the other non-union required a revision utilizing autograft. One patient with a healed scaphoid nonunion sustained a re-injury to his previously injured hand and required a manipulation under anesthesia.

Conclusion:
Use of mesenchymal stem cells with allograft bone graft may offer a potential alternative to autograft for the treatment of scaphoid non-unions. Further research is needed to more closely define indications for its use.

AAHS Scientific Abstract Session B2

Early Growth Response Factor - 1 (EGR-1): Expression in a Rabbit Flexor Tendon Scar Model

Background:
Despite extensive progress in scar research, hand surgeons still rely primarily on early motion hand therapy protocols to combat morbidity of reduced motion after flexor tendon repair. To date, no study has generated a clinically available product to ensure reduction in peritendinous adhesions and smooth tendon glide. Various growth factors have been implicated in the scar process. Research focused on enhancing or inhibiting single factors has demonstrated that the central mechanism for scar control is unknown. A universal regulator, through which all fibrotic pathways must pass to elicit scar formation following tendon injury, and repair, has not yet been discovered. Early growth response factor-1 (EGR-1), a transcription factor associated with synthesis of a variety of key profibrotic growth factors and expression of extracellular matrix genes, holds promise as that primary mechanism of control.

Methods:
Thirty New Zealand white rabbit forepaws underwent laceration and repair of the middle digit flexor digitorum profundus equivalent in zone II. Sodium morrhuate (SM) or phosphate buffered saline (PBS) was applied to the repair during closure of the tendon sheath. Sodium morrhuate, a sclerosing agent, was hypothesized to assist in the development of a novel model of tendon scar formation. Tendons were harvested from operated and unoperated forepaws at increasing time intervals (1,3,7,14,28 days). Tissues were analyzed by immunohistochemistry (IHC) and Masson-Trichrome staining.

Results:
IHC indicates EGR-1 is expressed focally, at the site of tendon repair, along the epitenon of the tendon, and in the infiltrate of inflammatory cells in the surrounding sheath-scar matrix. Control, unoperated tendons appear to express EGR-1 at a baseline, intrinsic level along the epitenon. EGR-1 follows a bell-shaped trend of expression post-operatively, with maximal expression at post-operative day 7. Regarding their respective impact on scar-matrix production, SM and PBS demonstrate no statistically significant difference.

Conclusions:
Findings demonstrate (1) EGR-1 expression is increased in the tendon wound environment, (2) EGR-1 is expressed predominantly along the epitenon and within the surrounding sheath-scar matrix after tendon injury, (3) normal, unwounded epitenon has a low, baseline level of EGR-1 expression, and (4) SM does not augment scar matrix production more than PBS. The ideal tendon scar model has not yet been generated.

Future research focused on modulation of EGR-1 expression could lead to novel treatments for preventing adhesion formation following flexor tendon repair. These applications could impact all medical disciplines with interest in manipulation of pathologic scar progression.

Mesenchymal Stem Cell Allograft with Screw Fixation for the Treatment of Scaphoid Non-Unions

Thirteen (13) patients were treated surgically for scaphoid non-union using screw fixation supplemented with mesenchymal stem cell allograft by four hand surgeons between June 2008 and December 2009. Pre-operative, operative and post-operative clinic notes were reviewed with a minimum six month follow-up interval established. Radiographs were independently reviewed to identify fracture location and time to radiographic healing. Parameters including age, tobacco use, hand dominance, injury location, mechanism of injury, time from injury to surgery, surgical approach and time to union were recorded. Primary established endpoint was clinical/radiographic union. Failure was defined as non-union or need for additional surgery.

Results:
All patients in this study were males with an average age at time of presentation of 25.92 years. 53% (7/13) enrolled patients admitted to tobacco use, 23% (3/13) reported injury to dominant hand, 38% of fractures occurred at the proximal aspect of the scaphoid, 61% of fractures occurred at the scaphoid waist. Mechanism of injury included fall on outstretched hand in 84% (11/13), fight injury 7% (1/13) and martial arts training injury 7% (1/13). Average time from injury to surgery was 13.2 months. One patient was lost to follow-up at 3 months and one patient was excluded from study computations due to inadequate follow-up. Overall union rate was 72.7% with three non-unions identified (non-union rate 27.3%). One non-union had an unidentified scapholunate ligament injury and one required significant correction of a humpback deformity. Two non-unions eventually required scaphoidectomy with fusion while the other non-union required a revision utilizing autograft. One patient with a healed scaphoid nonunion sustained a re-injury to his previously injured hand and required a manipulation under anesthesia.

Conclusion:
Use of mesenchymal stem cells with allograft bone graft may offer a potential alternative to autograft for the treatment of scaphoid non-unions. Further research is needed to more closely define indications for its use.
Reduction and Association of the Scaphoid and Lunate (RASL) for Chronic Static Scapholunate Instability: Long-Term Follow-Up

Institution where the work was prepared: Columbia University Medical Center, New York, NY, USA

Neil J. White, MD, PhD; Dima Raskolnikov; Scott A. Crow, MD; Eric Swart, MD; Melvin P. Rosenwasser, MD; (1)Columbia University Medical Center, 2)University of California, Los Angeles

Hypothesis:
In patients with chronic scapholunate dissociation, we hypothesize that the reduction and association of the scaphoid and lunate (RASL) is an effective and safe procedure to improve function and alleviate pain in the injured wrist. The purpose of this study is to report long-term follow-up in patients undergoing the RASL procedure over the past 20 years.

Methods:
Between December 1991 and September of 2008, the senior author has performed 35 RASL procedures for chronic scapholunate dissociation without capitulate arthritis. This reconstruction involves reduction of the rotational deformity and diastasis between the scaphoid and lunate. Maintenance of rotation is accomplished with a cannulated, headless, smooth-shafted screw directed from the scaphoid to the lunate along the anatomic axis of rotation between the two bones. For the purposes of this study, patients were evaluated by visual analog pain scale (VAS), standardized patient based questionnaires (DASH, SF-36), physical examination and radiographs.

Results:
Thirty-one patients were available for questionnaires and 22 available for questionnaires and physical examination. Five patients were lost to follow-up. The average age at the time of surgery was 50.0 years (range 31 – 67). The average time to final follow-up was 6.4 years (range 1.4 – 18.0). The mean DASH score was 17.0 (SD 20.3, range 0 to 51), the mean VAS was 0.50 out of 10 (SD 1.3, range 0-5) at rest and 1.60 (SD 2.0, range 0-7.3) with moderate activity. The mean SF-36 physical component score was 48.5, while the mental component score was 53.8. Range of motion was well preserved with 80% of the flexion extension arc being maintained in those available for physical examination. Grip and pinch strength were also comparable to the contralateral side. X-rays at an average of 24 months postoperative show significant decreases in both scapholunate gap (p < 0.001) and scapholunate angle (p < 0.001) as compared to preoperative films.

Discussion:
The RASL procedure is a safe and effective procedure for the treatment of chronic scapholunate dissociation. It re-aligns the scaphoid and lunate, restores function, reduces pain and appears to be robust over time, although capitulate arthritis is an absolute contraindication to this procedure. The RASL procedure is our option for the treatment of chronic static scapholunate instability.
Biomechanical Comparison of Three Fixation Techniques Used for Four-Corner Arthrodesis
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA

Jirachart Kraisarin, MD; David G. Dennison; Lawrence J Berglund; Kai-Nan An; Alexander Y Shin; (1)Chang Mai University, (2)Mayo Clinic

Introduction:
Four-corner arthrodesis is a common salvage procedure for the arthritic wrist. Clinical results vary in the literature and suggest that the fixation technique may be related to nonunion while no biomechanical comparisons have been reported that evaluate the differences between Kirschner wire, dorsal circular plate (DCP), and locked dorsal circular plate (LDCP) fixation. We examined the displacement between the lunate and capitate with the hypothesis that these 3 different types of fixation would have significantly different amounts of displacement within a cadaveric four-corner arthrodesis model.

Methods:
Eighteen fresh-frozen wrists (9 pairs) were randomly allocated to the 3 groups of fixation techniques. Following simulated arthrodesis, a magnet and transducer were secured to the radial side of the lunate and capitate to measure displacement. The wrists were then cyclically loaded to either implant failure or displacement > 1 mm with a maximum range of 60° of flexion and 60° of extension and a torque limit of 100N-cm to demonstrate fatigability.

Results:
There was significantly less lunocapitate displacement in the LDCP group compared to the DCP and K wire groups (p=0.018 and 0.006). There were no failures in the LDCP. One wrist in the K-wire group and 2 wrists in the DCP group also were without failure.

Conclusion:
In our four-corner arthrodesis model, wrists with the locked dorsal circular plate were significantly more stable than those with K-wires or the dorsal circular plate. Our results are limited only to the biomechanical behavior of these fixation techniques.

Four Corner Arthrodesis Using Dorsal Circular Plate with Center Restricted Fusion and Scaphoid One-piece Graft : 20 Patients Series
Institution where the work was prepared: Sao Paulo Hand Center - Beneficencia Portuguesa de Sao Paulo, Sao Paulo - SP, Brazil

Gustavo Mantovani, MD; Christophe Mathoulin, Prof, MD; Walter Y. Fukushima, MD; Marcio A. Aita, MD; Alvano Baik Cho; Evan Argintar, MD;
(1)“ Beneficencia Portuguesa de Sao Paulo “ Hospital, (2)Institut de la Main - Clinique Jouvenet, (3)Faculdade de Medicina do ABC, (4)Georgetown University

Objective:
20 patients underwent four corner arthrodesis using a dorsal circular plate. With a center restricted fusion area filled with one piece of cancellous bone graft from the scaphoid, we achieved a lower rate of non-union compared to previous series published.

Method:
From July 2006 to March 2008, twenty patients underwent four-corner fusion to treat Scaphoid Nonunion and Scaphoid Lunare Dissociation Advanced Collapse (SNAC, SLAC). Patients were evaluated by wrist range of motion, grip strength, and Disability of Arm Shoulder and Hand score.

Result:
With mean follow-up was 20.2 months, we found improvement in all clinical parameters after surgery. There was a 95% fusion rate. There was one case (5%) of nonunion and pain and 2 cases (10%) of persistent pain, which did not compromise activities of daily life. The remaining 85% of patients were considered to have good clinical results.

Conclusion:
Four-corner fusion using a dorsal circular plate appears to have a high degree of success when using the specific technical principles presented.

Long Term Psychological Sequelae after Severe Hand Trauma
Institution where the work was prepared: Stanford University School of Medicine, Stanford, CA, USA

Todd A. Richards, MD, MBA; Don Garvert, M5; Elizabeth McDade, PhD; Eve Carlson, PhD; Catherine Curtin, MD; (1)Stanford University, (2)VA Palo Alto Health Care System

Purpose:
Several studies have shown that upper extremity trauma has significant psychological effects in the acute period. This study assessed the long term physical and psychological sequelae after upper limb trauma. This study also evaluated the interrelationship of hand function, pain, psychological symptoms and social support.

Methods:
Cross sectional survey design of patients who had emergency hand surgery at a Level I trauma center. The hand functional measure was the Quick Disabilities of the Arm, Shoulder and Hand (qDASH). Psychological measures included the Center for Epidemiologic Studies Depression Scale (CES-D) to assess depression symptoms, the Screen for Posttraumatic Stress Symptoms (SPITSS) to assess posttraumatic stress disorder (PTSD) symptoms, the Medical Outcomes Study (MOS) Social Support Survey Form to assess social support, Social Constraints Survey to assess interpersonal stressors, and Perceived Stress Scale (PSS) to assess perceived stress.

Results:
The participants averaged 465 days since their emergent hand surgery. The overall qDASH score was 27 with a large standard deviation (25.0). The mean scores for the depression and PTSD measures were in the clinically significant range and 29% of respondents had both depression and PTSD. High pain scores on the QDASH were strongly correlated with poor psychological functioning.

Conclusions:
More than one third of the patients were in the clinical range for depression and/or PTSD symptoms at the time of assessment, which was on average 1.3 years after the injury. Reported hand injury disability was found to be strongly related to pain, depression, and PTSD symptoms. This study shows that the effects of hand trauma can persist long after the injury has healed. Hand surgeons need to aggressively treat pain and psychological distress in the acute period to mitigate long term sequelae.
Radial Nerve Lacerations Associated with Humeral Fractures
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Bassem T. Elhassan, MD; Tamir Prilish; Mayo Clinic

Background:
Early detection of nerve laceration in patients with radial nerve palsy associated with humeral fracture is of clinical significance. The purpose of this study was to find prognostic factors that significantly associate with nerve transection in the setting of humeral fracture and radial nerve palsy.

Materials and Methods:
Ninety-one consecutive patients who were treated for radial nerve palsies associated with humeral fractures were identified. Medical records and imaging studies were reviewed and analyzed to determine patients' and fractures' characteristics, treatment strategies, and operative findings. Seventeen lacerated nerves were found in sixty-nine surgical explorations. Eighteen patients who were treated conservatively with good recovery were assumed to have intact nerves. Four patients who were lost to follow-up were excluded from the study. The Fisher exact statistical test was used to identify significant correlations between the occurrence of nerve laceration and different fracture’s and patient’s characteristics. Sensitivity, specificity and positive and negative predictive values were calculated for each factor found significant.

Results:
High energy mechanism of trauma, open fractures, and comminuted fractures were found to significantly correlate with the occurrence of radial nerve laceration (p=0.034, p=0.001, and p=0.02 respectively). The sensitivity and specificity of those factors were 94.1% and 31.4%, 53% and 91.4%, and 64.2% and 74.2% respectively, and the positive and negative predictive values were 96.6% and 25%, 88.8% and 60%, and 90.7% and 34.6% respectively. No significant correlation was found between nerve laceration and the age or gender of the patients, the location of the fracture in the humerus, and the presence of associated injuries.

Summary:
In this study, open fractures, comminuted fractures and high energy mechanism of injury significantly correlated with the occurrence of nerve laceration, while, interestingly, the location of the fracture in the humerus did not. According to our analysis, nerve lacerations can almost certainly be ruled out if the mechanism of injury was of low energy trauma, and they are also less likely to occur if the fracture was not comminuted or open. A lacerated radial nerve is likely to be found in 1 out of every 4 cases associated with high energy trauma, and in more than 50% of patients with open fractures. We believe this new data can improve decision making and treatment outcomes in the setting of radial nerve palsies associated with humeral fractures.

The Intermetacarpal Angle: A Useful Screening Test for Carpometacarpal Fracture-Dislocations
Institution where the work was prepared: Naval Medical Center San Diego, San Diego, CA, USA
Lucas S. McDonald, MD; Paul G. Shupe, MD; Nathan Hammel, MD; Leo T. Kroonen, MD; Naval Medical Center San Diego

Background:
The goal of this study was to determine the normal intermetacarpal angles (IMA) between the 2nd and 5th metacarpals, and between then 3rd and 5th metacarpals to establish an easy screening test to identify carpometacarpal fracture-dislocations. Although fracture-dislocations of the 4th and 5th carpometacarpal joints are not uncommon little is published about them. In a previous unpublished study, we found that 4/7 coronal split fractures of the hamate causing carpometacarpal fracture dislocations were missed by the initial treating physician.

Method:
After obtaining IRB approval, we identified a consecutive series of 100 patients with normal hand radiographs, as read by a board-certified radiologist. A series of 12 known carpometacarpal fracture-dislocations were also examined. 3 different observers including a fellowship-trained hand surgeon, a senior resident and a junior resident measured all radiographs on 2 separate occasions, separated by at least 2 weeks. Angles were measured on the lateral hand radiograph, and included the angle between the 2nd and 5th metacarpals (2-5 IMA) and between the 3rd and 5th metacarpals (3-5 IMA). The dorsal cortex of each metacarpal served as the reference line.

Results:
Intraobserver reliability ranged from 0.72 to 0.90 for the 2-5 IMA, and from 0.68 to 0.91 for the 3-5 IMA. Interobserver reliability varied from 0.79 to 0.90 for the 2-5 IMA, and was consistent at 0.84 for the 3-5 IMA. Amongst normals, the mean for the 2-5 IMA was 5.66 (SD 4.40) and for the 3-5 IMA was 5.71 (SD 4.26). A Mann Whitney U Rank Sum Test was used to compare normals versus abnormal, and found them to be statistically different (P<0.001). Based on box-plot analysis of normals and abnormals, a natural dividing line existed at 10 degrees. When using this value, the 2-5 IMA had a sensitivity of 91.7% and a specificity of 81.3%, while the 3-5 IMA demonstrated a sensitivity of 83.3% and a specificity of 84.0%.

Conclusion:
Both the 2-5 IMA and the 3-5 IMA are useful screening measurements on the lateral hand radiograph for detection of a carpometacarpal fracture-dislocation. Based on its improved sensitivity, we recommend using the 2-5 intermetacarpal angle to evaluate post-traumatic ulnar-sided hand pain. If the 2-5 IMA is > 10 degrees, a further workup including a CT scan should be considered.
AAHS Scientific Abstract Session A3

Risk Factors for Complications after Locked Volar Plate Fixation of Distal Radius Fractures

Institution where the work was prepared: Massachusetts General Hospital, Boston, MA, USA

David C. Ring, MD, PhD; Roderick van Leeuwen; Thierry Guitton; Christopher Got, MD; Julia Katarinic; Maximilian Soong, MD; (1)Massachusetts General Hospital, (2)Brown University, (3)Lahey Clinic

Purpose:
The purpose of this study is to identify risk factors for complications after volar locking plate fixation of distal radius fractures.

Methods:
Early post-operative complications were assessed in 594 patients with a fracture of the distal radius repaired with a volar locking plate and a minimum 1 month evaluation in the medical record. Later complications were assessed among 321 patients with a minimum 6 months evaluation. Patient demographics, fracture characteristics, and aspects of management were compared between patients with and without complications in bivariate analysis. Multivariable logistic regression analysis was applied to identify the factors that were independently associated with complications.

Results:
At an average of 10 months (range 1 to 52 months) after surgery 47 complications (7%) were documented in the medical record. Of these, 24 occurred within the first month (24 of 594 patients; 4%), including 8 intra-articular screws and 7 patients with loss of fixation. Twenty-three complications occurred later (23 of 321 patients, 7%), including 14 patients diagnosed with tendon irritation (1 rupture of the tendon of the flexor pollicis longus) and 5 patients that had subsequent operations to address dysfunction of the distal radioulnar joint (malunion, synostosis, and arthrofibrosis). Twenty-six of the 47 complications were attributed to the plate, of which 9 were considered major (tendon rupture and intra-articular screws, comprising 1.5% of all cases). In the logistic regression models Type C fractures, an injury mechanism other than a simple fall, an ipsilateral elbow injury, and a non-hand specialist were positive independent predictors of early complications, whereas high-volume surgeons and plates other than the Hand Innovations DVR were positive independent predictors of later complications.

Conclusion:
Volar locking plate fixation of distal radius fractures was associated with relatively few plate-related complications in our institutions. Factors indicating higher energy or complexity were predictive of early complications. The most common late complication was tendon irritation, which is less discrete and perhaps variably diagnosed.

A New Radiographic View To Detect Screw Penetration To The Dorsal Cortex Of The Distal Radius After Volar Fixed-Angle Plating

Institution where the work was prepared: Denver Health Medical Center, Denver, CO, USA

Kagan Ozer; Denver Health Center; Serdar Toker; Denver Health Medical Center

Purpose:
Extensor tendon irritation and attritional tendon ruptures are well-recognized complications secondary to dorsal screw penetration following volar plating of the distal radius. Lateral and oblique views of the wrist have limited ability to detect such penetration, particularly at the ulnar side of the Lister’s tubercle. We conducted an intraoperative fluoroscopic study to determine dorsal screw penetration in various positions of the wrist/forearm and compared the standard radiographic views (lateral, supination and pronation views) with dorsal tangential view of the wrist. Materials and

Method:
Standard lateral, oblique (in pronation and supination) and dorsal tangential views were obtained in 27 consecutive patients undergoing open reduction and internal fixation of a distal radius fracture using a volar plate. Dorsal tangential views of the wrist were obtained as follows: While the patient was lying supine on the operating table, the examiner held the wrist flexed at 75 degrees. Once the forearm was placed between the two ends of the mini C-arm in the transverse plane, a continuous sequence of images were obtained while C-arm was moved in transverse plane until Lister’s tubercle was seen in its full height. The optimal position of the hand and forearm showing the longest distance between the tip of the Lister’s tubercle and the bottom of the EPL groove (3rd dorsal compartment) defined the dorsal tangential view of the wrist. The number of penetrating screws detected in each dorsal compartment (2nd, 3rd, or 4th) was recorded in each view.

Results:
Of the 125 distal screws, 11 were determined to be penetrating the dorsal cortex intraoperatively. While lateral and oblique views were sufficient for identifying penetrations on the floors of the 2nd and 4th dorsal compartments, only 1 (of the 4) screw penetration was identified on the 3rd dorsal compartment in pronation view. In dorsal tangential view, however, 4 screws penetrating the dorsal cortex were identified.

Conclusion:
Screw penetration to the 3rd dorsal compartment was missed in standard views, but visualized in dorsal tangential view. We recommend the use of dorsal tangential view in addition to standard lateral and oblique views during volar plating of the distal radius.
Supination, Pain, and Strength are Important Determinants of Disability After Distal Radius Fracture

In patients with distal radius fractures, a multivariate regression model shows pain, grip strength and restoration of supination to be significant predictors of patient-rated disability.

Introduction:
Patients suffering from distal radius fractures often have variable outcomes, despite near-anatomic restoration of classically assessed radiographic parameters (volar tilt, ulnar variance, radial inclination). In these patients, the relationship between radiographic outcomes, objective exam-based parameters, and patient-perceived disability remains unclear.

Methods:
Our group maintains a prospective observational registry of patients undergoing operative fixation of distal radius fractures. Radiographic assessment is performed and physical exam parameters measured at each visit, and patient-based outcomes are quantified with the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire and pain visual analogue scale (VAS). A multi-variate linear regression model was constructed to evaluate the association of range of motion, grip strength, and VAS score to the DASH score.

Results:
Data from 162 patients at 566 total clinic visits were analyzed. Pain (p < .001), grip strength (p < .001), and supination (p = 0.02) were all significant predictors of the DASH, controlling for all other predictors. These three variables alone predict 47% of the DASH score. Flexion/extension, radial/ulnar deviation, and pronation had no significant correlation to DASH scores. In addition, time since surgery was also not a significant predictor of DASH score.

Discussion/Conclusion:
Pain, strength, and supination are important determinants of patient-rated outcomes after distal radius fractures. Restoration of supination depends specifically on the anatomy of the distal radial-ulnar joint (DRUJ), a factor not encompassed in the classical radiographic parameters assessed after distal radius fractures. Future assessments of outcomes after distal radius fracture may benefit from a system that takes DRUJ anatomy into account.

Do Intercarpal Ligament Injuries Predict Outcomes After Distal Radius Fractures?

Purpose:
Despite improvements in operative fixation of distal radius fractures, outcomes remain variable and difficult to predict. The advent of wrist arthroscopy as a diagnostic modality has demonstrated that intercarpal ligament injuries in patients with distal radius fractures are more common than were initially suspected. To date, no studies have evaluated the relationship between ligament injuries and long term patient-based outcomes. The purpose of this study was to examine whether the presence of these injuries, assessed directly by arthroscopy, correlated with both objective and subjective patient-based outcomes.

Methods:
Thirty six patients with distal radius fractures were enrolled in this prospective prognostic study. At the time of initial fracture surgery, patients were arthroscopically evaluated for injuries to the scapholunate interosseous ligament (SLIL), triangular fibrocartilaginous cartilage complex (TFCC), or articular surface cartilage damage. Four weeks, 12 weeks, 26 weeks, and 1 year after surgery, patients were assessed using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, pain visual analogue scale (VAS), as well as using objective physical exam parameters including range of motion and grip strength. DASH score at one year was the primary outcome. A multivariate linear regression model was then constructed to evaluate the effect of these ligament injuries on the DASH, pain, range of motion and grip strength.

Results:
44% of patients had SLIL injuries, 44% had TFCC injuries, and 25% had injuries to the articular cartilage. Controlling for AO fracture type, none of these injury factors were significant predictors of DASH scores at one year. None of them correlated with DASH, VAS scores, or physical exam parameters at any time point, and no subdivision or sub-analysis of injury types revealed any statistically significant relationships.

Conclusions:
Intercarpal ligament injuries and cartilage damage are common in patients with distal radius fractures. Despite adequate reduction based on radiographic parameters, outcomes continue to be variable and difficult to predict. In this study, the presence of an SLIL injury, TFCC injury, or damage to articular surface cartilage did not predict patient-based or objective outcomes at one year post-operatively.
Biomechanical Comparison of an Intramedullary Nail and a Volar Locking Plate in a Dorsally Comminuted Extra-Articular Distal Radius Fracture Model

Institution where the work was prepared: Nagoya City University, Nagoya, Japan

Naoya Takada, MD; Takanobu Otsuka; Nagoya City University

Purpose:
The purpose of this study was to compare the biomechanical properties of an intramedullary nail and a volar locking plate in a dorsally comminuted extra-articular distal radius fracture model under loading condition simulating the physiologic force that is experienced during early postoperative active motion of the wrist and fingers.

Methods:
In ten synthetic radius bones (Sawbone), a simulated dorsally comminuted extra-articular distal radius fracture was created. The fractures were stabilized with one of two implants. Group N (MICRONAIL, Wright Medical Technologies, N=5) and group P (Stellar, Japan Universal Technologies, N=5) were tested under axial compression load (250 N, 0.5 mm/min) and dorsal and volar bending load (50 N, 0.5 mm/min) with a Materials Testing System machine, and were analyzed with a motion analysis system. The compression stiffness and the shrinkage rate of the dorsal gap were compared.

Results:
No construct failed in this testing. The average compression stiffness of the group N and P were 304.01±78.04 N/mm and 139.70±39.21 N/mm respectively. The average shrinkage rate of the dorsal gap of the group N and P were 11.58±4.13 % and 21.71±1.43 % respectively. Group N had significantly greater stiffness and resistance to fracture gap motion compared with the group P under axial loading condition (p<0.01). There is no significant difference of stiffness in two groups under dorsal and volar bending load (p=0.83, p=0.14).

Conclusions:
In this model of dorsally comminuted extra-articular distal radius fracture, both implants provided adequate stability under 250 N axial compression load and 50 N dorsal and volar bending load simulating the physiologic force that is experienced during early postoperative active motion of the wrist and fingers. The results of this study suggest that an intramedullary nail provides better stiffness and stability than a volar locking plate for the treatment of dorsally comminuted extra-articular distal radius fractures.
AAHS Scientific Abstract Session B3


Institution where the work was prepared: Miami International Hand Surgical Services, North Miami Beach, FL, USA

Eric Balaguer, MD; Kevin Delaney, MD; Anna-Lena Makowski; E. Anne Ouellette; (1)Plancher Orthopedics and Sports Medicine, (2)Ohio State University Medical Center, (3)Miami International Hand Surgical Services

Introduction:
Outcome of a biodegradable spacer used to relieve pain in patients with advanced thumb CMC osteoarthritis is evaluated.

Methods:
A chart review of 44 patients with Artelon spacer treatment for thumb CMC osteoarthritis was conducted. 18 CMC joints were evaluated in our practice for long term follow-up (average 204 weeks). Grip/pinch strength was measured, range of motion was noted and x-rays were taken.

Results:
We had the opportunity to examine 18 CMC joints treated with Artelon, 5 of which (27.7%) required removal of the Artelon implant due to pain. Tissue reaction occurred average 12 weeks after Artelon implantation. Revision surgery was performed average 44 weeks post initial surgery. Out of all patients examined, 13 patients had normal thumb ROM, Average pinch strength was 7 lbs for the affected hand 9 lbs for the unaffected contralateral hand. Average key grip was 9 lbs for the affected hand and 11 lbs for the unaffected contralateral hand. X-rays showed inflammatory changes in the proximal metacarpal in 8 of 14 patients.

Discussion:
27.7% of Artelon implants placed needed to be removed due to local tissue reaction and pain. Reaction to Artelon was relatively early with an average time of 12 weeks.
X-rays demonstrated significant amount of reaction in the proximal metacarpal joint most likely as a consequence of the reaction caused by the Artelon implant.

Long Term Follow-up After Partial Trapeziectomy for Trapeziometacarpal Joint Arthritis: What Happens to the Scapho-Trapezial Joint Over Time?

Institution where the work was prepared: Stanford University, Palo Alto, CA, USA

Shelley Suzanne Noland, BS, MD; Sepideh Saber; Vincent Hentz; Stanford University

Introduction:
There are many surgical options to treat trapeziometacarpal (TM) joint arthritis. As opposed to total trapeziectomy, partial trapeziectomy addresses the principle problem of TM arthritis without the potential risk of destabilizing the usually asymptomatic, but frequently radiographically abnormal scapho-trapezial (ST) joint. However, partial trapeziectomy has been criticized because of concern that over time, ST joint arthritis will develop, requiring additional surgery.

Hypothesis:
Partial trapeziectomy is a successful and durable treatment for TM joint arthritis, even in patients with radiographically abnormal but asymptomatic ST joints. Patients are not at increased risk for developing symptomatic ST joint arthritis, even many years after surgery.

Methods:
All patients who underwent a partial trapeziectomy by the senior surgeon from 1995-2005 were contacted. Sixteen patients (19 thumbs) were clinically evaluated. We measured grip strength, pinch strength, and evaluated standardized radiographs of the ST joint using a novel scoring system to classify arthritis (0=normal, 1=minimally narrow, 2=definitely narrow, 3=joint effaced, clearly arthritic). We performed ST joint manipulation and stress testing. Subjective data included the DASH questionnaire, an ST joint-specific questionnaire, and overall satisfaction. Seven additional patients were unable to travel but did complete mailed questionnaires.

Results:
The length of follow-up averaged 8 years (range 4-13). One joint required revision to total trapeziectomy for persistent pain. No patient had pain at the ST joint with direct palpation or stress testing. Radiographs of the ST joint demonstrated a mean score of 1 (range 0-3). Scores on the ST joint-specific questionnaire averaged 10 (range 0-100, 100 worst). Average DASH score was 16 (range 0-100, 100 worst). Mean grip strength was 63 lb on operated hand and 61 lb on non-operated hand. Mean pinch strength was 12 lb on both the operated and non-operated hands. Nineteen of twenty-one patients were very satisfied or extremely satisfied and two were not satisfied.

Summary:
The follow-up of this study is longer than most published series: satisfaction (90%) is equivalent to other published series. Partial trapeziectomy for TM joint arthritis provides long-lasting relief of symptoms, and maintains ST joint stability. The radiographic appearance of the ST joint changed over time but did not correlate with symptoms. Unless the patient has symptomatic ST arthritis, the ST joint may safely be retained.
Sensory Innervation of the Trapeziometacarpal Joint

Pranay M. Parikh, MD; S. Shar Hashemi, MD; Michael S. Murphy, MD; A. Lee Dellon, MD, PhD; (1)University of Mississippi Medical Center, (2)Johns Hopkins School of Medicine, Division of Plastic Surgery

Background:

Pain at the base of the thumb associated with trapeziometacarpal joint arthritides remains a commonly encountered problem in hand surgery. Although excision of the arthritic trapezium, with or without ligament reconstruction and tendon interposition, provides satisfactory relief from pain, the precise mechanism of the analgesia provided by these procedures remains unclear. The aim of this study is to identify potential afferent nociceptive pathways involved in the pain associated with trapeziometacarpal arthritis.

Methods:

Candidate nerves potentially contributing to trapeziometacarpal joint innervation were identified by literature review. Anatomic dissection of each candidate nerve to its terminal fibers was performed in nine fresh cadaver hands. Criteria for articular innervation included visual continuity of nerve fibers with the joint capsule under 3.2x loupe magnification, and histologic confirmation of peripheral nervous tissue in terminal fibers. Anatomic landmarks for each articular nerve were identified.

Results:

Five candidate nerves to the trapeziometacarpal joint were identified by literature review. Nine (100%) specimens demonstrated articular innervation from a deep branch of the lateral antebrachial cutaneous nerve, which penetrated the forearm fascia at a mean of 3.4cm proximal to the radial styloid and accompanied the radial artery to the anatomic snuffbox. Six of nine (67%) demonstrated articular contributions from fibers of the palmar cutaneous branch of the median nerve, which crossed the sheath of the flexor carpi radialis tendon at the proximal edge of the transverse carpal ligament. Two of nine (22%) demonstrated an articular contribution from the radial sensory nerve at the dorsal first web space. No articular contributions were observed in any specimens from the recurrent thenar branch of the median or the deep branch of the ulnar nerve.

Conclusions:

The trapeziometacarpal joint has a discrete, identifiable pattern of articular innervation with a constant contribution from the lateral antebrachial nerve and variable contributions from the palmar cutaneous branch of the median nerve and the radial sensory nerve. These nerves may be involved in the transmission of pain from trapeziometacarpal arthritis and represent potential targets for future work on therapeutic denervation of the painful thumb basal joint.

Trapeziometacarpal Joint Reconstruction Using APL Tendon: Results After 5.5 Years

Andrew J. Kochevar, MD, MS; Christine N. Adham, BS; Mehdi N. Adham, MD; Michael F. Angel, MD; Marcus D. Walkinshaw, MD; (1)University of Mississippi Medical Center, (2)University of Oklahoma Health Sciences Center

Purpose:

Long-term (66-month) clinical results of trapeziectomy and ligament reconstruction using the APL tendon in a modified Thompson technique, are not well known. Advantages of this technique include: retaining the FCR tendon as an important wrist stabilizer for pinch and grip, converting the APL tendon from a potential destabilizing to a stabilizing force, and avoidance of flexor surface incisions on the forearm. The goal of this study was to evaluate the results of this technique with an average 5.5-year follow-up for the primary treatment of advanced-stage basal joint arthritis (Eaton stages III and IV).

Methods:

The senior author has performed 210 thumb basal joint arthroplasties using a modified Thompson technique. This was an independent pilot study to evaluate long-term results. Twenty-five thumbs in 18 patients from a single surgeon’s practice were evaluated after ligament reconstruction arthroplasty for surgical treatment of advanced thumb basal joint arthritis. Treatment consisted of piecemeal excision of the entire trapezium, ligament reconstruction and interposition using the APL tendon, and 8 weeks of K-wire immobilization of the thumb metacarpal. Patients were seen, examined, and queried regarding their thumbs. Range of motion, lateral pinch, tip pinch, grip strength, and outcomes questionnaires including the Arthritis Impact Measurement Scales 2 Short Form (AIMS2-SF) were evaluated at an average of 66 months after surgery.

Results:

At 5.5 years follow-up, 17 of 18 patients (94%) experienced “excellent” or “good” relief of pain and were “very satisfied” with their operation(s). Given identical preoperative circumstances, 18/18 (100%) patients would choose to have the operation again. Range of motion evaluation showed 24 of 25 thumbs adducted fully into the plane of the palm and 24 of 25 opposed to the fifth metacarpal head. Comparisons between preoperative and 66-month postoperative strength measurements demonstrated an average 13.8% increase in grip strength, 11.8% increase in key pinch strength, and a 6.3% increase in tip pinch strength over preoperative values. Postoperative AIMS2-SF data demonstrated improvement in “Writing”, “Button shirt”, “Turn key/lock” and “Arthritis pain” categories compared with preoperative levels.

Conclusions:

The modified Thompson technique restored a stable, pain-free thumb that yielded excellent strength and motion five and one-half years after the procedure. Compared with techniques that harvest all or part of FCR tendon, the modified Thompson method retains the entire FCR tendon for continued wrist stability and decreases the effect of APL tendon abduction force at base of thumb metacarpal for greater joint stability.
AAHS Outstanding Paper Session
Age-Related Changes in the Stress Response of Rat Tendon Stem-Progenitor Cells

Institution where the work was prepared: Mount Sinai School of Medicine, New York, NY, USA
Takintope Akinbıyì, MSc; Peter J. Taub; Lili Xu, MD; Melissa Ramcharan, MS; Herb Sun, PhD; Mount Sinai School of Medicine

Background:
Tendons are vital connective tissue structures that allow muscles in one anatomical location to transmit forces to bones in another, such as the hand. As we age, the regenerative capabilities of tendons decrease leading to an increase risk of spontaneous rupture. One theory behind this phenomenon is that tendon-derived stem cells are less able to handle day-to-day physiological stresses and are therefore more prone to pathological tears and rupture. This is partially a result of the actions of degradative enzymes such as matrix metalloproteinases (MMPs) that function in the breakdown and remodeling of the tendon extra-cellular matrix. Cited2 (CBP/p300-Interacting-Transactivator-with-ED-rich-tail-2) is a transcription co-regulator that is known to inhibit the expression of MMP 13 and is essential for tendon remodeling and homeostasis. It therefore provides a novel approach to controlling tendon degradation due to MMPs. Characterization of the role of Cited2 in the age-related physiological stress response in tendon stem-progenitor (TSPCs) in a uniaxial cyclical stress model will help to provide insight into the development of clinical therapies to optimize the treatment of ruptured and lacerated tendons.

Method:
Young and aged (3-6 and 24-28 months old, respectively) male Sprague-Dawley rats were sacrificed using CO2 inhalation, and the Achilles and patellar tendons were harvested. Tendons from each animal were pooled together and tendon stem-progenitor cells (TSPCs) were isolated after digesting tendons in collagenase. Cells were cultured to passage 6, plated inside a custom designed well, and then placed in a custom device to provide uniaxial, cyclical stretching for one hour at 5% strain and 1Hz for 1 hour. Cells were harvested 1hr, 3hrs, and 6hrs after stretching for RNA extraction and quantitative PCR analysis. Controls were incubated in wells with no stretching.

Results and Discussion:
The relative expression of Cited2 (Fig. 1A) for TSPCs from young animals 1 hour post stretch (1.0±0.19) was higher than that in TSPCs from aged animals (0.61±0.12), p <0.05. MMP13, a collagenase, showed a similar trend (Fig. 1B) with the relative expression in aged animals (5.9±1.1) significantly higher than TSPCs from younger animals (1.0±0.19) p<0.05. With aging, there appears to be a reduction in Cited2 expression after mechanical stress leading to higher levels of MMP13. These findings help support the hypothesis that TSPCs from aged animals have an exaggerated response to physiological levels of stress immediately after the stress event and may help to explain the increase in tendon pathologies with age.

Early Versus Late Motion Following Volar Plating of Distal Radius Fractures

Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
David Dennison, MD; Charlene L. Blanchard; Bassem T. Elhassan; Alexander Y Shin; Mayo Clinic

Distal radius fractures are very common and the trend in fixation has included the use of locked volar plating. The amount of splinting that is required after surgery and the effect that splinting has upon the outcome of the wrist is not clear. Our aim was to compare the outcome (strength, motion and outcome scores) of patients treated with an early versus late motion protocol after volar plating.

Methods:
Thirty-three adult patients with distal radius fractures were prospectively and randomly enrolled into an early versus late motion study which included volar plating of a distal radius fracture. Early motion was defined as initiation of an active and passive motion protocol by 14 days after surgery and delayed motion was initiated at 5 weeks. Fractures were defined as intra-articular and extra-articular, and those with, and without, ulnar styloid fracture. Volar plating was completed through an FCR approach in all cases. Outcome measures (DASH/PRWE), motion (flexion-extension, radial-ulnar deviation, pronation-supination) and strength (appositional and oppositional pinch and grip) were measured through one year.

Results:
Wrist motion and DASH and PRWE scores were all significantly different at 6 weeks (p<0.05). There were no significant differences at any later time points up to one year.

Conclusion:
Following volar plating of distal radius fractures, early motion favored earlier return of wrist motion along with lower DASH and PRWE scores, but only at the 6 week point. All subsequent measurements revealed no significant difference in strength, motion or outcome score.
Optimization of Human Tendon Tissue Engineering: Peracetic Acid Treatment for Enhanced Reseeding of Acellularized Tendon Scaffolds

Institution where the work was prepared: Stanford University Medical Center, Palo Alto, CA, USA

Colin Woon, MD; Brian Pridgen, BS; Armin Kraus, MD; Hung Pham, BS; James Chang, MD; Stanford University Medical Center

Objective:
Tissue-engineered tendon scaffolds have the potential to improve the treatment of injuries leading to loss of more flexor tendon than can be addressed by autograft tissue. Flexor tendon tissue engineering combines scaffolds with recipient cells to create complete cell-tendon constructs. Allogeneic acellularized human flexor tendon has been shown to be a good natural scaffold. Cell-suspension reseeding successfully repopulates the scaffold surface. However, deep reseeding of the scaffold core is difficult as the tight tendon matrix restricts cell penetration.

Method:
Cadaveric human flexor tendons were harvested, acellularized treated with PAA in varying concentrations (2%, 5% and 10%) and for varying time periods (4 and 20 hours). The first group was analyzed for morphological differences in tendon microarchitecture. The second group was reseeded by incubation in a fibroblast cell suspension at 1 x 10^6 cells/ml and analyzed histologically and with DNA and cell proliferation assays. The last group underwent biomechanical studies without reseeding.

Result:
The optimal treatment protocol comprising of PAA at 5% concentration for 4 hours produced interfiber gapping and increased scaffold porosity, improving cell penetration and migration. Compared with controls, PAA treated scaffolds did not show reduced collagen or glycosaminoglycan content (p=0.37 and 0.72 respectively, T-test), ultimate tensile stress or elastic modulus (p=0.26 and 0.28 respectively, paired T-test). The treatment protocol was demonstrated to exhibit no cytotoxicity.

Conclusion:
Peracetic acid treatment of acellularized tendon scaffolds increases matrix porosity, leading to greater reseeding without noticeable biomechanical compromise. PAA-treatment may prove an important step in tissue engineering of human flexor tendon using natural scaffolds.

Flexor Tenosynovial Fistulas in the Palm

Institution where the work was prepared: Southern Illinois Hand Center, Effingham, IL, USA

Nash Naam, MD; Southern Illinois Hand Center and Southern Illinois University

Tenosynovial fistulas in the palm have not been, to our knowledge, reported in the literature. In this paper we report 15 patients who were treated for tenosynovial fistulas in the palm.

Materials and Methods:
Retrospective analysis of 15 patients who were treated for tenosynovial fistulas between 1996 and 2008 was conducted. There were 9 females and 6 males. Age averaged 42 years (range: 21 to 63). Index finger was involved in 5 patients, long finger in 7 and ring finger in 3. One patient had a fish fin injury of the palm; 6 had release of recurrent stenosing flexor tenosynovitis with use of steroid at the end of the surgery; one had pellet gun injury and the pellet was not removed for 3 weeks and 7 had deep lacerations of the distal palm that were repaired in the emergency department.

All patients presented with a sinus draining frothy clear fluid at the level of the distal palmer crease. There were no signs of infections. Cultures were negative including acid fast bacilli culture for Mycobacterium Mariner for the patient with the fish fin injury.

Conservative treatment was tried for an average of 6 weeks with no improvement. All patients required surgery for excision of the sinus tract with partial resection of the A1 pulley and soft tissue coverage with a transposition flap. Pathological examination of the sinus tracts revealed epithelialization with non specific chronic inflammation.

Results:
Post op follow up ranged from 6 to 148 months with an average of 59 months. All fistulas healed completely. Patients regained full ROM and normal grip and pinch strength compared to the contralateral side. One patient had transient tenderness of the scar for 3 months. There were no recurrences.

Conclusion:
Tenosynovial fistulas are rare in the palm. They may develop after an injury to the flexor tendonsheath or following the use of steroids after release of trigger finger. Surgical treatment with excision of the fistula and local flap coverage yield excellent results.
Rupture Rates in Hand Flexor Tendon Repair - A Potential Indicator Operation

Institution where the work was prepared: Department of Plastic Surgery, Royal Devon & Exeter Hospital, Exeter, Devon, United Kingdom

Nicole Breitenfeldt, PhD, MRCS1; V. Moonesamy, MRCS2; AMI Watts, FRCS, (Plast)2 (1)Northampton General Hospital, (2)Royal Devon & Exeter Hospital

Introduction:

Flexor tendon injuries of the hand are common. Rupture rates following primary repair are reported in the literature as 3-9% for finger/wrist flexors and 3-17% for FPL injuries. However, there are currently no internationally agreed standards for repair rupture rates. We performed an audit of process and outcome to determine the rupture rate in our department, identify any associated factors and assess the feasibility of repair rupture as a quality outcome measure.

Methods:

A retrospective analysis of hospital records, identified from our computerised operation logbook and physiotherapy database. All patients undergoing primary repair of a thumb, finger or wrist flexor tendon in our department over one year were included. The data collected included patient age, hand dominance, occupation, the zone and mechanism of injury, delay to repair, operative technique, seniority of surgeon and follow-up, including compliance with hand therapy.

Results:

70 patients were included with 113 flexor tendon injuries. Of these, six patients were known to have had an acute rupture following primary repair, all involving finger flexors (8.6% of patients, 5.3% of tendons). Factors associated with acute rupture were injury to the dominant hand, zone and mechanism of injury and lack of compliance with post-operative hand therapy.

Conclusions:

The rupture rate following flexor tendon repair in our department is similar to rates reported in the literature, although documentation was poor and needs to be improved. Primary flexor tendon repair rupture is a potential indicator operation for hand surgery but standards must be defined and agreed. Further work is required to establish factors associated with poor outcome and to identify potential mechanisms for improvement.

Scapholunate Dissociation - Biomechanical Tests of Three Various Scapholunate Ligament Suture Techniques

Institution where the work was prepared: University of Toledo, Toledo, OH, USA

Martin C. Skie; Despina E. Ciocanel; Daniel Gehling; Asher Smith; University of Toledo

Purpose:

Scapholunate interosseous injuries remain a challenging problem to even experienced hand and upper extremity surgeons. This study is designed to biomechanically compare the differences between pullout failure loads for three different techniques for scapholunate ligament repair.

Methods:

Nineteen fresh cadavers were used in this study. The intact scaphoid-scapholunate ligament-lunate complexes were mounted to a MTS machine and ligament loaded to failure to simulate a scapholunate dissociation. Ten specimens employed suture into the ligament and available soft tissue alone; another nine specimens employed suture-anchor fixation with suturing through the ligament; the third repair consisted of a suture anchor in the scaphoid and the suture passed through a bone tunnel in the dorsal lunate. The mechanical testing sequence consisted of preconditioning at low load (10 N) for 0.1 min before extension at 10 mm/min until failure occurred. For all 3 repairs we tested using the same extension rate of 10 mm/min until failure occurred.

Results:

The mean failure load for the intact ligaments was 144 N (SD 91 N). The mean failure loads for the direct repair was 36.15 N (SD 12.42 N), for the suture-anchor and ligament fixation was 38.20 N (SD 13.46 N) and for the suture anchor through bone –tunnel was 56.29 N (SD 15.78 N). Ligament failure was recorded for 77% (seven out of nine) suture-anchor fixations and suture failure for the other two suture-anchor fixations. Bone-tunnel failure was encountered in 30 % (3 out of 10) of the suture anchor through bone –tunnel fixations, suture failure for another 50% (5 out of 10) and anchor pulled-out failure for 20% (2 out of 10). We noticed a statistically significant difference between suture-anchor and suture anchor through bone-tunnel (p = 0.017) and between direct repair and suture anchor through bone-tunnel (p = 0.006).

Conclusions:

These biomechanical studies demonstrated that the suture anchor through bone-tunnel is statistically significant stronger fixation than the suture anchor repair through ligament.

Thumb Duplication: The Experience of a Pair of Congenital Hand Surgeons

Institution where the work was prepared: Alder Hey Children’s NHS Foundation Trust, Liverpool, United Kingdom

Claire K. Simpson, MBChB(Hons); Paul McArthur; Alder Hey Children’s NHS Foundation Trust

Introduction:

Thumb duplication is a relatively common congenital anomaly that routinely requires surgical reduction to improve function and appearance of the hand. The experience of two congenital hand surgeons at our institution was reviewed.

Materials and Methods:

101 patients with duplicate thumbs were identified from the Outpatient Database between March 1993 and April 2010. Of these, the notes of 89 patients were available for retrospective review to document associated medical conditions, surgical strategies and outcomes were verified.

Results:

Of the 89 patients, 5 had bilateral duplications, resulting in 94 duplicate thumbs. 91 thumbs have undergone surgical intervention. The average age of presentation to the outpatient clinic was 7 months [Range 2-58 months] with surgery being undertaken at an average of 14.7 months (Range 5 – 120 months). Thumbs were classified according to Wassel and Stelling where possible.

24/89 (27%) of patients required hospital review for associated medical complaints, ranging from genetic, cardio-vascular, congenital, developmental, musculo-skeletal, haematological and “other” conditions. However, no patients suffered from Fanconi’s anaemia.

15 thumbs have undergone revision surgery for a variety of reasons, the indications and outcomes of which are discussed. More recently, fewer patients have required further surgery following a change in practice.

Conclusion:

A change in philosophy of management of post-operative function and appearances has resulted in a reduced requirement of revision surgery.
Three-Dimensional Analysis of the Proximal Articulating Surfaces of the Lunate and Capitate

Institution where the work was prepared: Cleveland Combined Hand Fellowship, Cleveland, OH, USA

Shafic A. Sraj, MD; Cleveland Combined Hand Fellowship; Peter Evans; Cleveland Clinic; Harry Hoyen, MD; Metro Health Medical Center

The surfaces proximal articular surfaces of the capitate and lunate can be described by an ellipsoid geometry.

Methods:

We examined 24 sets of human carpal bone specimens and 41 CT scans of the wrist. The specimens were scanned using a three-dimensional digitizer (Surface Scans). The CT scans were traced both manually (2D CT scans) and digitally (3D CT scans). In both groups the proximal articulating surfaces of the lunate and capitate were sampled, and the surface data were processed using a non-linear regression model (Simplex Optimization). The 2D scans were processed using a graphic editing program (Adobe® Photoshop®) to manually obtain fit ellipsoids.

Results:

Best fit ellipsoids were successfully obtained using the surface scans with a small margin statistical error (error of 0.07-0.45 mm compared to a diameter of 6-15 mm). The perpendicular distance from the data point to the surface of the ellipsoid averaged 0.01-0.06 mm (range 0.00-0.18). The volume of the lunate ellipsoids was larger than the capitatorcounter-part (8 cc vs. 2 cc). The manual fitting of the 2D scans was satisfactory, but it produces relatively smaller ellipsoids compared with the surface data. We could not verify the results. The 3D CT scan data successfully produced fitting ellipsoids but the results lacked consistency.

Summary Points:

The proximal articulating surfaces of the lunate and capitate can be successfully described by an ellipsoidal surface. The lunate ellipsoids are significantly larger than those of the capitators. Those findings explain how proximal row carpectomies fail when they do so, and support the arguments toward preserving the lunocapitate joint when possible, and that capitator implant arthroplasty should match the surface of the lunate.

Laser Ablation of Abnormal Skin Pigmentation Post Syndactyly Release

Institution where the work was prepared: Alder Hey Children's Hospital, Liverpool, United Kingdom

Nicole Breitenfeldt; Kathryn E. Nelson, mRCS, MBChB, Hons; Anuj Mishra; Sam McNally; C. Gost; Paul McArthur; [1]Whiston Hospital, (2)Alder Hey Children's Hospital

Laser Ablation of Abnormal Skin Pigmentation Post Syndactyly Release Introduction and Aims Syndactyly is a relatively common problem in the hand affecting 1:2500 live births. Traditionally, release produces a shortage of skin frequently requiring a full thickness skin graft harvested from the groin. Long term follow up has reported problematic pigmentation in these grafts. In children the groin skin used is initially hairless and of a similar pigmentation. As puberty approaches, pigment deepens and hair growth increases. We present the use of laser therapy to reduce pigmentation in full thickness skin grafts taken from the groin for syndactyly reported problematic pigmentation in these grafts. In children the groin skin used is initially hairless and of a similar pigmentation. As puberty approaches, pigment deepens and hair growth increases. We present the use of laser therapy to reduce pigmentation in full thickness skin grafts taken from the groin for syndactyly release.

Material and Methods:

8 patients were included in the study. Q-switched Nd:YAG Laser(532nm) was used for depigmentation. Long pulsed Alexandrite Laser (755nm) was used for hair removal. Key

Results:

There was a good response to depigmentation at only 4 weeks. On average 4 treatments achieved depigmentation. No recurrence of pigment was seen at 1 year. Long pulsed Alexandrite Laser (755nm) was found to be painful when applied to the fingers and was therefore poorly tolerated by patients.

Conclusions:

Laser depigmentation appears promising treatment for this difficult problem but needs longer follow-up to establish chances of re-pigmentation. Alexandrite laser was poorly tolerated when used for this purpose on the fingers.

The Effect of Collagen Nerve Conduits Filled with Collagen-GAG Matrix on Peripheral Motor Nerve Regeneration in a Rat Model

Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA

Joo-Yup Lee, MD, PhD; Guilherme Giusti, MD; Patricia F. Friedrich, AAS; Allen T. Bhop, MD; Alexander Y. Shin, MD; Mayo Clinic

Hypothesis:

Absorbable conduit filled with collagen-glycosaminoglycan (GAG) matrix will result in improved motor recovery compared to collagen matrix filled conduits and collagen nerve tubes.

Methods:

Eighty-eight male Lewis rats were used and a unilateral 10 mm sciatic nerve defect was made. All rats were randomly divided into four experimental groups: group I was repaired with reversed autograft, group II received a commercially available empty collagen conduit (NeuraGen 1.5 mm; Integra LifeSciences), group III received a conduit filled with collagen matrix and group IV had a conduit filled with collagen-GAG matrix. At twelve weeks, nerve regeneration was evaluated using compound muscle action potential, maximum isometric tetanic force and wet muscle weight of the tibialis anterior, passive ankle plantar flexion angle and peroneal nerve histomorphometry.

Results:

The normalized maximum isometric tetanic force was 46.1±7.9 % in group I, 22.1±6.6 % in group II, 28.9±8.6 % in group III, 37.5±9.9 % in group IV. The normalized compound muscle action potential was 49.7±7.7 % in group I, 26.6±6.9 % in group II, 32.4±7.6 % in group III, 39.8±8.8 in group IV. Autograft showed significantly better motor recovery than other experimental groups (p<0.001). Conduit filled with collagen-GAG matrix demonstrated superior results compared to the empty conduit and conduit with collagen matrix in every experimental parameter.

Conclusion:

Autologous nerve grafting remains the gold standard in reconstruction for the segmental motor nerve defect. However, collagen conduits filled with collagen-GAG matrix demonstrated superior results with respect to isometric tetanic force generation compared to commercially available empty conduit or conduits filled with collagen matrix.
Variation in the Narcotic Prescription Patterns after Carpal Tunnel Surgery

Institution where the work was prepared: Regions Hospital, St. Paul, MN, USA

John William Mathewson, MD; Loree K. Kalliainen; Regions Hospital

Introduction:
Little has been done to explore optimal pain control after outpatient hand surgery and even less to explore variation in prescription patterns by individual physicians. Narcotics are not benign, and it is desirable to determine what constitutes a reasonable prescription size. Several studies by general surgeons have demonstrated the efficacy of postoperative nonsteroidal anti-inflammatory agents, but these findings have not been co-opted by hand surgeons, and narcotics are generally prescribed. Anecdotally, there is little consistency between surgeons in narcotic prescription practices. Our goals were to describe the average amount of narcotic tablets prescribed after uncomplicated carpal tunnel release (CTR) and to describe the variability between practitioners to allow us to begin to generate “Best Practice” Guidelines.

Methods:
A retrospective chart review of 30 consecutive uncomplicated CTRs for each of five hand surgeons was performed. Patients were excluded if they had a history of chronic pain or narcotic use, if they had recurrent CTS, if there was a history of severe extremity trauma, if the procedure was done as part of a Worker’s Compensation claim, or if there were intra- or postoperative complications. The perioperative pain control (type of block) and number and type of oral narcotic medications were recorded. The number of tablets prescribed was gathered from the electronic medical record.

Results:

<table>
<thead>
<tr>
<th>Surgeon</th>
<th>Mean Pt Age (yrs)</th>
<th>M:F</th>
<th>Mean # tablets (range)</th>
<th>#refills</th>
<th>Mean Pt Age (males)</th>
<th>Mean # tablets (males)</th>
<th>P-V-O-None *</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>53.3</td>
<td>6:24</td>
<td>11.5 (0-40)</td>
<td>2</td>
<td>63.3</td>
<td>18.3</td>
<td>1-14-4-11</td>
</tr>
<tr>
<td>B</td>
<td>53.4</td>
<td>6:24</td>
<td>6.6 (0-30)</td>
<td>0</td>
<td>54.0</td>
<td>10.0</td>
<td>2-13-0-15</td>
</tr>
<tr>
<td>C</td>
<td>57.2</td>
<td>7:23</td>
<td>9.0 (0-30)</td>
<td>0</td>
<td>62.8</td>
<td>15.7</td>
<td>2-11-0-17</td>
</tr>
<tr>
<td>D</td>
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<td>7:23</td>
<td>20.3 (0-40)</td>
<td>0</td>
<td>58.0</td>
<td>20.0</td>
<td>3-14-2-11</td>
</tr>
<tr>
<td>E</td>
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<td>7.1 (0-30)</td>
<td>0</td>
<td>59.0</td>
<td>11.0</td>
<td>1-8-3-18</td>
</tr>
</tbody>
</table>

*P-Percocet, V-Vicodin, O-Other , No- No Medication given

Conclusions:
This retrospective study documented the variation in narcotic prescription patterns among a group of hand surgeons for a relatively straightforward surgical procedure. Data suggest that surgeons vary fairly widely in how they prescribe narcotics for the treatment of pain after CTR, and that males are prescribed more pain medication than women by some surgeons. Further investigations will include surveys of patients to find out if they used all of their prescription medications and prescription pattern variability after more complex surgical procedures. Given the risks and costs associated with narcotics, coming to consensus regarding a reasonable narcotic prescription size could be a step in optimizing patient care and safety.
Volar Plate Capsulodesis for Treatment of the Thumb Metacarpophalangeal Joint Hyperextension Deformity with Basal Joint Arthritis: A Review of Fourteen Cases

Institution where the work was prepared: Columbia University College of Physicians and Surgeons, New York, NY, USA

Dima Raskolnikov; Neil J. White, MD, FRCS, (C); Ioannis C. Zouzias, MD; Eric Swart, MD; M. P. Rosenwasser, MD; (1)Columbia University Medical Center, (2) Columbia University Medical Center

**Introduction:**

Patients with advanced basal joint arthritis may suffer from a characteristic hyperextension deformity of their thumb metacarpophalangeal (MCP) joints. The purpose of this study is to provide long-term follow-up on a group of patients who were treated with a novel technique of thumb MCP joint capsulodesis as an adjunct to basal joint arthroplasty.

**Methods:**

We retrospectively evaluated 14 patients who had received basal joint interposition arthroplasty with concomitant MCP capsulodesis. Objective evaluation included thumb range of motion, grip strength and key pinch strength. Subjective evaluation included patient-based scores on the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, visual analog scale (VAS) pain scores, and a study-specific questionnaire.

**Results:**

At an average of 4.74 years after surgery (range, 2.2 – 11.5 years), average MCP hyperextension was 15.0°, with all but three patients hyperextending to less than 20°. Thirteen of 14 patients were able to oppose their thumbs against the distal end of the fifth metacarpal. Average grip and pinch strength were 23.4 kg and 3.5 kg, respectively. The average DASH score was 10.3. Patients reported minimal pain and were all satisfied with the procedure. No complications or revision procedures were reported.

**Discussion/Conclusion:**

Basal joint arthroplasty combined with the described volar plate step-cut technique for thumb MCP joint capsulodesis provides excellent long-term results for patients with basal joint arthritis and severe MCP hyperextension, although precise indications for the procedure remain poorly defined. This new procedure is safe and has a low complication profile.

Ulnar Artery Perforator Free Flap for Finger Resurfacing

Institution where the work was prepared: Uijongbu St. Mary’s Hospital, The Catholic University of Korea, Kumoh-dong, Uijongbu, South Korea

Sang Wha Kim, MD; Sung Na Jung; Won Il Sohn; Ho Kwon; Uijongbu St. Mary’s Hospital, College of Medicine, The Catholic University of Korea

**Purpose:**

Ulnar artery perforator free flap is a thin and pliable flap and a good alternative for finger resurfacing. An anatomical study concerning the location of the perforators to the ulnar artery perforator flap was done for the purpose of clinical application. 5 patients underwent finger resurfacing using ulnar artery perforator free flap.

**Methods:**

8 fresh cadavers were dissected, measuring the distance between the perforator of the ulnar artery perforator flap and the pisiform bone (Fig. 1). The location of the perforator was studied using this data. In all cases, two or more ulnar artery perforators were found within 40 ± 12 mm proximal to the pisiform bone.

Clinical application of this flap was applied on 5 patients with skin and soft tissue defects on hand caused by trauma and postoncologic defect (Fig. 2-4).

**Conclusion:**

The perforator to the ulnar artery perforator free flap was found to be located in a relatively consistent position. It was also comparatively easy to elevate and mobilize, and showed low donor site morbidity, similar to radial forearm free flap. Thin and pliable skin makes it very useful in finger resurfacing.
Factors Utilized by Applicants when Selecting a Hand Surgery Fellowship

Institution where the work was prepared: Thomas Jefferson University Hospital, Philadelphia, PA, USA
Joshua Abzug, MD; Ross Chafetz; A. Lee Osterman; Thomas Jefferson University Hospital

Hypothesis:
Choosing which hand fellowship to train at is one of the most important decisions a future hand surgeon makes. This study set out to determine which factors applicants utilize when choosing a fellowship.

Methods:
Interviewing applicants ranked, in order of importance, location of the fellowship, reputation, number of fellows, number of attendings the fellow rotates with, salary, intensity of call, pediatric hand rotation, shoulder & elbow rotation, significant microvascular experience, and research opportunities. Descriptive statistics and Fisher exact test were calculated.

Results:
All 65 applicants voluntarily complied. The highest ranked priority was reputation of the fellowship, ranked most important by 43% of applicants and 63% put it in the top 3. The next most important factor was the number of attendings the fellow rotated with. Nineteen percent ranked it first and 54% had it in the top 3. Subsequently, 19% of applicants placed a significant microvascular experience, a shoulder & elbow rotation, or location in the top 3. The least important factor was salary with 68% putting it last and 83% having it in the bottom 3. The next most common responses in the bottom 3 were research opportunities and call intensity each with 32%. No statistically significant difference existed between orthopaedic and plastic surgery applicants.

Summary Points:
It is important for hand fellowships to be knowledgeable about what topics are most and least important to applicants. Applicants responded that fellowship reputation and number of attendings they rotate with to be most important while salary, call intensity, and research opportunities are less important.
Distal Ulna Metaphyseal Subarticular Osteotomy for Ulnar Impaction Syndrome

Institution where the work was prepared: The Indiana Hand to Shoulder Center, Indianapolis, IN, USA

John Hildenbrand, MD; Jeff Greenberg, MD; The Indiana Hand to Shoulder Center

Introduction:
Ulnar impaction is due to excessive loading at the distal ulna usually in association with positive variance. Surgical treatment of this requires correction of ulnar variance by ulnar shortening. To avoid the morbidity associated with traditional techniques, Slade developed a technique utilizing an osteotomy at the subcondylar level. This paper presents a clinical series using this technique. Our hypothesis is that these patients will demonstrate good clinical outcomes validating the procedure’s usefulness.

Methods:
In this retrospective study, patients received LRTI (13 thumbs in 12 patients) or HDA (9 thumbs in 9 patients) according to attending surgeon’s preference, one exclusively performing LRTI and the other HDA. Patient perception was evaluated with a QuickDASH questionnaire and ten-point pain visual analog scale (VAS). Potential QuickDASH scores range 0-100, lower indicating better function. Clinical evaluation examined grip strength, tip pinch, and lateral pinch in kilograms force, and range of motion. Measurements were compared to the contralateral hand and published normals. Stressed and unstressed radiographs assessed metacarpal proximal and lateral migration and first web space. Chart review documented operative times.

Results:
LRTI and HDA scored similarly on QuickDASH (mean 18.0±10.7 vs. 17.7±19.0). Most reported excellent pain relief (mean VAS, 1.7±1.4 vs. 2.6±2.1). Average grip, tip pinch, and lateral pinch were also similar in both groups (grip=20.7±10.3 vs. 28.5±15.2 / tip=4.8±1.9 vs. 4.8±2.1 / lateral=6.0±2.1 vs. 6.4±2.6). None achieved statistical significance (Table 1). Our outcomes compared favorably with previous separate cohort studies for LRTI and HDA (Table 2).

Comparisons to contralateral hand and established normals showed LRTI and HDA were similar. All except two could oppose to little finger base. With stress, additional proximal migration was similar in both groups (21% LRTI vs. 31% HDA). Lateral migration averaged 5% LRTI, 1% HDA. Web space was preserved (49 degrees in both groups). LRTI took 54 minutes longer.

Conclusion:
Through multiple objective and subjective evaluations, the LRTI and HDA seemed equivalent. Both groups seemed to satisfy the principal goals of the surgery which were to provide a stable, mobile, pain-free thumb. Potential cost savings of performing the HDA over the LRTI may be realized from the significantly shorter operative time.

Distal Ulna Metaphyseal Subarticular Osteotomy for Ulnar Impaction Syndrome

Institution where the work was prepared: Baylor College of Medicine, Houston, TX, USA

Brian K. Sandvall, BS; Todd E. Cameron, DO; David T. Netscher, MD; Michael J. Epstein, MD; Kimberly Goldie Staines, OTR; CHT; Nancy J. Petersen, PhD; (1) Baylor College of Medicine. (2)Michael E. DeBakey Veterans Affairs Medical Center

Purpose:
Basal joint osteoarthritis of the thumb is a common problem. Several surgical treatment options exist, though some techniques are more complex than others. Previous studies have evaluated functional outcomes in separate cohorts but have not compared one method to the other. Our study compared the functional outcome of ligament reconstruction and tendon interposition (LRTI) suspension arthroplasty and hematoma distraction arthroplasty (HDA) by patient questionnaires, clinical measurements, and radiographic measurements to see if there is validity in exclusively using either LRTI or HDA.

Methods:
In this retrospective study, patients received LRTI (13 thumbs in 12 patients) or HDA (9 thumbs in 9 patients) according to attending surgeon’s preference, one exclusively performing LRTI and the other HDA. Patient perception was evaluated with a QuickDASH questionnaire and ten-point pain visual analog scale (VAS). Potential QuickDASH scores range 0-100, lower indicating better function. Clinical evaluation examined grip strength, tip pinch, and lateral pinch in kilograms force, and range of motion. Measurements were compared to the contralateral hand and published normals. Stressed and unstressed radiographs assessed metacarpal proximal and lateral migration and first web space. Chart review documented operative times.

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Conclusion:
Through multiple objective and subjective evaluations, the LRTI and HDA seemed equivalent. Both groups seemed to satisfy the principal goals of the surgery which were to provide a stable, mobile, pain-free thumb. Potential cost savings of performing the HDA over the LRTI may be realized from the significantly shorter operative time.
Ulnar Head Prosthesis: A Long term Review
Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Sanjeev Kakar, MD, MRCS, MBA; Presley Swann, MD; Kevin Perry, MD; Alexander Shin, MD; Steven Moran, MD; Mayo Clinic

Hypothesis:
Ulnar head endoprostheses restore stability and functionality to the upper limb after degenerative joint disease or resection arthroplasty of the distal radioulnar joint (DRUJ).

Methods:
A retrospective review was conducted analyzing the outcome of all ulnar head prosthesis implanted within our institution over a 10 year period. All patients presented complaining of pain and functional disability due to instability or arthrosis of the DRUJ. Standardized preoperative and postoperative assessments included a patient rated pain score, forearm range of motion, grip strength and Mayo Wrist Score. Preoperative and postoperative radiographs were examined to determine whether outcome could be based upon the type of sigmoid notch and the implant used. Statistical analyses used included survival curve, parametric and nonparametric t tests.

Results:
Ninety five patients were followed for an average of 53 months (range: 24 to 126 months). Eighty two percent of prostheses were uncemented and 18% cemented. Pain scores decreased by 57% with an associated improvement in Mayo Wrist scores after surgery. Average grip strength improved by 17% from preoperative measurements. There were no differences with respect to pre and postoperative pronation and supination (average 690 and 560 respectively). Eighty Avanta, 8 Ascension, 5 Aptis and 2 custom made implants were placed. Survival curve analysis demonstrated a 50% survival at 9 years and 78% at 5 years.

Conclusion:
After an average of 53 months, distal ulna arthroplasty restored stability and function to patients with DRUJ impingement or arthrosis. One third of patients, however, required additional surgical procedures after primary ulnar endoprosthesis placement.

Chronic Essex-Lopresti Injuries: Alternative Treatment Methods
Institution where the work was prepared: Allegheny General Hospital, Pittsburgh, PA, USA
Aaron I. Venouziou, MD; Dean G. Sotereanos, MD; Allegheny General Hospital

Background:
The Essex-Lopresti lesion results from an axial load to the forearm with injury to the radial head and disruption of the interosseous membrane and the distal radioulnar joint. Early recognition of this disorder usually results in predictable and satisfactory outcomes. However, when this disorder is unrecognized, late reconstruction is challenging and unpredictable. Currently, no technique has met general acceptance for the restoration of longitudinal stability of the forearm in chronic Essex-Lopresti injuries. The purpose of this study is to analyze the efficacy of an alternative treatment method for chronic Essex-Lopresti lesion by radial head replacement and ulnar shortening osteotomy.

Methods:
Seven patients (5 males, 2 females) have been treated in our institution for chronic Essex-Lopresti injuries between 2003 and 2009. The mean age was 42.5 years (range, 37-58) and the time interval from the initial injury to the final operative procedure was on average 8.8 months (range, 4-14). The mean follow up time was 26 months (range, 12-38). Five patients have had a staged approach, by initially replacing the radial head and subsequently the ulnar shortening osteotomy after wrist symptomatology developed. The other two patients underwent both procedures simultaneously. The ulnar variance before the final procedure was on average +8 mm (range, +6 - +12). Pain level, with the use of a visual analog scale (VAS), and wrist and elbow ROM were evaluated pre- and postoperatively. The Mayo Elbow Performance Score and Mayo Wrist Score were utilized to assess the functional outcome.

Results:
At the final follow up the mean pain level was reduced from 8.2 points pre-op to 3 points post-op (p<.05). The elbow arc of motion was increased on average from 79 pre-op to 119 degrees post-op. There was a significant improvement of forearm rotation from 76 pre-op to 138 degrees post-op, p<.05. The wrist arc of motion improved from 94 pre-op to 122 degrees post-op (p<.05). The final post-op mean Mayo Elbow Performance Score and Mayo Wrist Score was 49 and 82 points respectively. The post-operative ulnar variance was reduced from +8 mm to +3.5 mm. All patients were satisfied and there was no major complication although mild pain persisted in some patients.

Conclusion:
Implantation of a radial head prosthesis, in order to prevent proximal migration of the radius, and an additional ulnar shortening osteotomy, to level the position of the distal radioulnar joint, has resulted in improved outcomes in the case of chronic Essex-Lopresti injuries.
Corrective Osteotomy for Combined Intra- and Extra-Articular Distal Radius Malunion

Institution where the work was prepared: Massachusetts General Hospital, Boston, MA, USA

Geert Buijze, MD; Karl - Joseph Prommersberger, MD; Juan Del Pino, MD; Diego L. Fernandez; Jesse B. Jupiter, MD; (1)Massachusetts General Hospital, (2)Klinik fuer Handchirurgie - Rhoneklinikum, (3)Santa Cristina University Hospital, (4)Lindenhoff Hospital

Background:
Corrective osteotomy of a malunited distal radius fracture can effectively reduce pain and functional disability of the forearm and hand. However, due to technical difficulties and risk of iatrogenic complications there is reluctance to address the more complex malunions. This study evaluates the functional outcome of corrective osteotomy for combined intra- and extra-articular malunions of the distal radius using multiple validated outcome scores.

Methods:
Sixteen skeletally mature patients were evaluated at an average of forty-eight months after corrective osteotomy for a combined intra- and extra-articular malunion of the distal part of the radius. The indication for osteotomy in all patients was the combination of an extra-articular deformity (≥10º volar or dorsal angulation) and intra-articular incongruity of ≥2mm (maximum step-off or gap) as measured on lateral and posteroanterior radiographs, respectively. The average interval from the injury to the osteotomy was 11 months. The average maximum step-off or gap of the articular surface prior to surgery was 4.0 mm.

Results:
All sixteen patients healed uneventfully and the final articular incongruity averaged 0.4 mm. Three patients had a subsequent tenosynovitis of the extensor pollicis longus and one patient had a rupture of the index finger extensor, which was reconstructed with a tendon transfer. Three patients had mild and one had moderate osteoarthritis of the radiocarpal joint. Final range of motion and grip strength significantly improved (p<0.05), averaging 87% and 83% of the uninjured side, respectively. The rate of excellent or good results was 85% according to the rating system of Gartland and Werley, and 62% according to the Mayo modified wrist score. The mean DASH score was 15, which corresponds to mild perceived disability.

Conclusions:
The radiographic and functional outcomes of corrective osteotomy for combined intra- and extra-articular malunions are comparable to those of osteotomy for isolated intra- and extra-articular malunions. Corrective osteotomy for treatment of a malunited distal radius can improve wrist function, regardless of its type and complexity.

Level of Evidence:
Therapeutic study, level IV (case series)
American Society for Peripheral Nerve

ASPN Scientific Abstract Session A

Impact of PEDOT on Regenerating Nerves

Institution where the work was prepared: University of Michigan, Ann Arbor, MI, USA

Ziya Baghmanli, MD; Melanie G. Urbanchek, PhD; Benjamin Wei, MD; Bong S. Shim, PhD; H Khan; David C. Martin, PhD; William M. Kuzon, MD, PhD; Paul S. Cederna, MD; (1)University of Michigan, (2)University of Delaware

Objective:

3,4 polyethylenedioxythiphene (PEDOT) is a conductive polymer which is shown to “acutely” decrease biologically harmful impedance in our peripheral nerve interface (PNI). To establish a PNI, amputee nerve fibers must grow into the PNI. Until now, no studies have determined the long term effects of PEDOT on nerve regeneration and performance.

Methods:

A 5-group design (n=8) was used to adequately test peripheral nerve regeneration in the presence of PEDOT. A 15 mm rat peroneal nerve gap was reconstructed in: Sham (nerve exposure), Autograft, Decellularized nerve (DN), PEDOT polymerized DN (PEDOT), and No Graft (gap was not reconstructed) groups. A small intestinal submucosa (SIS) cuff was placed circumferentially around all nerve gap reconstructions for stability. After 90 days of recovery, nerve conduction (NC) and muscle contractile force were measured. Midgraft nerve specimens were histologically processed and scored using a modified version of the Clarke Nerve Rating Scale. (Murji, 2008)

Results:

NC velocity (m/s) in the PEDOT (19.8±2.8) was significantly faster than for Sham (13.4±2.7), Autograft (13.9±3.8), and DN (9.3±1.5) groups. Recovered muscle forces (mN) in the PEDOT (66.3±142.3) and DN (1204.0±1686.0) were weaker than Autograft (1591.7±520.2) and Sham (2471.7±1278.3) forces. Qualitative histologic examination of nerve samples in the PEDOT group revealed extensive nerve fiber regeneration (Fig 1). Nerve were rated in a best to worst order of: Sham>Autograft>DN>PEDOT>No Graft.

Conclusion:

Peripheral nerve regeneration occurs in the presence of PEDOT. The characteristic fast nerve conduction with decreases in muscle force and nerve rating for the PEDOT group are probably related to the polymer molecule’s conductive capabilities but also indicate mechanical obstruction of the DN conduit. Future studies will focus on polymerization processes which alter the physical properties of PEDOT.

Fig 1: Representative nerve histology of test groups with 100x magnification. Scale bar correspond to 50 µm.

Skin Derived Precursor Cells (SKPs) Promote Return of Electrophysiological Function in the Rat Tibial Nerve Model of Adriamycin Induced Demyelination

Institution where the work was prepared: University of Calgary, Calgary, AB, Canada

Joey Grochmal, MD; Sundeep Dhaliwal; Rajiv Midha, MD, MSc; University of Calgary

Introduction:

Skin derived precursor cells (SKPs) can mimic the phenotypic appearance of Schwann cells when predifferentiated in vitro (SKP-SCs), and are a reliable autologous source of Schwann cells that survive in considerable numbers when micro-injected into nerve grafts and denervated nerve. Our hypothesis is that SKP-SCs can produce morphologically and electrophysiologically functional myelin as they ensheath axons. We are testing this hypothesis in a model of focal demyelination of the rat tibial nerve.

Methods:

We unilaterally injected 500,000 GFP-L4 labelled SKP-SCs into the tibial nerves of 10 adult Lewis rats, while a second group of 10 received 500,000 GFP-L4 labelled Schwann cells in the same paradigm. A third group (n=10) received media alone. This was done one week after a demyelinating tibial nerve lesion was created using a 30ul injection of 12.5ug/ml Adriamycin (1). Baseline electrophysiology was performed on all animals prior to adriamycin injection, and all animals are being followed with nerve conduction studies and for compound muscle action potentials (CMAPs) every 3 days until 50 days post-initial injection. Animals from each group are being periodically sacrificed for morphological and immunohistochemical analysis, using anti-voltage gated sodium channel, anti-voltage gated potassium channel, as well as anti-CASPAR antibodies.

Results and conclusions:

Preliminary results indicate that the animals which received cell-injection therapy demonstrate an earlier return of CMAPs, suggesting quicker reversal of demyelination than the control group that had received media alone. We anticipate the SKP-SC group will continue this trend, on par with or better than the Schwann cell group. We also predict that SKP-SCs will participate in functional nodes of Ranvier formation, as demonstrated by confocal microscopy.

Conductive Polymer Scaffolds for Repair of Rat Sciatic Nerve

Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA

Huan Wang, MD, PhD; M. Brett Runge, PhD; Jing Rui, MD; Michael J. Yaszemski, MD, PhD; Anthony J. Windebank, MD; Robert J. Spinnor, MD; Mayo Clinic

Purposes:
Despite the permissive growth environment of the peripheral nervous system and the progress in microsurgical instrumentation and materials, functional recovery after surgical repair of injured peripheral nerves is often suboptimal. Brief electrical stimulation immediately following direct repair of severed peripheral nerve in rodents has led to accelerated axon outgrowth and better functional outcomes. When a nerve defect exists and is repaired by a graft or conduit, this brief stimulation might not suffice. The aim of our study is to develop a conductive polymer scaffold as a nerve conduit that can potentially receive and deliver electrical stimulation of any desired regimen.

Methods:
Electrically conductive polymer composites composed of polycaprolactone fumarate and polypyrrole (PCLF–PPy) have been developed for nerve regeneration applications. PCLF–PPy materials were synthesized with two different anions: naphthalene-2-sulfonic acid sodium salt (NSA) and dodecylbenzenesulfonic acid sodium salt (DBSA). Nerve conduits with 1.6 mm inner diameter and 12 mm length were fabricated from PCLF–PPy NSA dopant and PCLF–PPy DBSA dopant. Plain PCLF nerve conduits with the same diameters were also made to serve as control. These three types of conduits were implanted to repair a 1 cm defect of the left sciatic nerve in Lewis rats, with 8 animals in each group. Nerve conduction study, wet weight and cross-sectional area of tibialis anterior muscle and gastrocnemius muscle, as well as neuromorphometry at mid-portion of the nerve conduit were chosen to evaluate the extent of nerve regeneration.

Results:
The polymer composites were electrically conductive. They supported PC12 cell attachment and proliferation and DRG neurite extension in vitro without electrical stimulation. In vivo, compound muscle action potentials were recordable 8 weeks post-implantation. Latency of the nascent potential was 7.9±2.65 ms for plain PCLF group, 13.9±4.47 ms for PCLF–PPy NSA dopant group, and 13.2±2.55 ms for PCLF–PPy DBSA dopant group, respectively. Amplitude of the nascent potential was 0.1±0.002 mV for plain PCLF group, 0.1±0.001 mV for PCLF–PPy NSA dopant group, and 0.1±0.05 mV for PCLF–PPy DBSA dopant group, respectively. The study is ongoing which will be carried out to 16 weeks post-implantation. End-point nerve conduction study and muscle histology and neuromorphometry data will be obtained.

Conclusions:
Nerve conduits made of PCLF–PPy conductive polymer composites were biocompatible. They supported nerve regeneration across a 1 cm defect. Their capacity was comparable to non-conductive polymer controls when electrical stimulation was not applied. These polymer composites provide promising materials for future studies involving electrical stimulation.

Brief Electrical Stimulation (ES) Promotes Regeneration of Axons Through Chronically Denervated Distal Nerve Stump of Transected Peripheral Nerve

Institution where the work was prepared: University of Alberta, Edmonton, Canada

Adil Ladak, MD, MSc; Vanessa Falk, BSc; Valerie Verge, PhD; Neil Tyreman; Tessa Gordon, PhD; (1)University of Alberta, (2)University of Saskatchewan

Background:
Following peripheral nerve injury, axon regeneration into the distal nerve stump is supported by Schwann cells (SCs) in the stump. However, these denervated SCs progressively lose their capacity to support axon regeneration during the slow rate of axon regeneration of 1-3 mm/day, accounting in large part for the poor functional recovery observed so frequently in patients. We have demonstrated that brief electrical stimulation (ES) of the nerve proximal to the site of nerve repair, whether transection and surgical repair or release of nerve compression in carpal tunnel syndrome patients, accelerates axon outgrowth so that more neurons regenerate their axons into distal nerve stumps and reinnervate distal targets much quicker than when nerves are not stimulated at the time of surgery.

Objective:
In this study, we asked whether brief ES of surgically repaired transected peripheral nerve will enhance axon regeneration through chronically denervated distal nerve stumps in an animal model of chronic denervation of SCs.

Methods:
In Sprague Dawley rats, freshly cut common peroneal (CP) proximal nerve stumps were cross sutured to chronically denervated tibial (TIB) nerve stumps to promote regeneration after a 3 month period of chronic SC denervation. Four weeks following surgery, fluororuby fluorescent dye was applied to backlabel motor and sensory neurons that regenerated their axons 10 mm into chronically denervated CP nerve.

Results:
The mean number (±SE) of motoneurons that regenerated axons was significantly increased from 190 ± 32 to 290 ± 42 after 1 h ES at 20 Hz of the CP nerve (p<0.01), increasing from ~60% to 100% of the CP motoneuron pool.

Conclusion:
These experiments provide strong evidence that brief ES of axotomized nerves is sufficient to counteract deterioration of the chronically denervated nerve environment distal to nerve injury. Our previous reports that 1) ES elevates expression of brain derived neurotrophic factor (BDNF) after axotomy and 2) trkB functional antibodies block the ES effect of accelerating motoneuron regeneration argue that motoneuronal BDNF is pivotal to the positive ES effect on regeneration through chronically denervated nerve stumps.
Calcium Channel Blockers Reduce the Effects of Cigarette Smoking on Peripheral Nerve Ischemia/Reperfusion Injury

Brian Rinker, MD; Betsy F. Fink; Neil G. Barry; Joshua A. Fife; Maria E. Milan; Ashley R. Stoker; Peter T. Nelson; University of Kentucky

Introduction:
Cigarette smoking has been shown to impair the recovery of peripheral nerves from ischemia/reperfusion (I/R) injury. Calcium channel blockers are known to reverse many of the effects of nicotine. The purpose of this study is to assess the efficacy of calcium channel blockers in reducing the severity of I/R injury in animals subjected to cigarette smoke.

Methods:
40 male albino Wistar rats were divided into four groups. Animals in groups A, B, and C were exposed to cigarette smoke via controlled smoking chamber, 20 minutes daily for 14 days. All animals underwent a surgical procedure where one sciatic nerve was rendered ischemic by occluding the femoral vessels for three hours, followed by reperfusion. On days 14 through 28, animals in group B received verapamil (20mg/kg/day) by gavage. Animals in group C received nifedipine (10mg/kg/day). Walking track assessments were made on days 1, 15, 21, and 28, and the sciatic function index (SFI) was calculated. Five animals in each group were euthanized on day 21, the remainder on day 28. Nerve samples were assayed for malondialdehyde (MDA), a marker of I/R injury. Histological analysis was performed with light microscopy utilizing H/E, trichrome, LFB, and Garvy stains. A "nerve health score" was determined from the observed degree of inflammation, myelin disruption, and perineural edema. Urine cotinine concentrations were measured on days 1, 14 and 21.

Results:
Differences in urine cotinine levels between groups A, B, and C were not statistically significant. The mean SFI on study day 21 did not differ significantly between the three groups exposed to smoking. On day 28, the SFI in group A was -22.8±1.5, compared to -18.0±3.2 in the non-smoking group (p=0.03). The mean SFI in group B(nifedipine) was -19.5±1.6 and the mean SFI in group C(verapamil) was -20.2±1.5. Both of these values were significantly greater than group A (p=0.02 and p<0.04, respectively). Mean MDA concentration at day 28 in group A was 0.94±0.14, compared to 0.74±0.11 in the nonsmoking group (p=0.03), and the mean MDA in the nifedipine group was significantly greater than in group A (p=0.05). Upon histology, the nerve health score was not significantly different between groups exposed to cigarette smoke.

Conclusions:
Smoking was associated with a slower functional recovery following peripheral nerve I/R injury, but calcium channel blockers were shown to ameliorate these effects. Calcium channel blockers may be a useful adjunct for smokers recovering from nerve injury or nerve compression syndromes.
Prospsective Evaluation of Incidence of Carpal Tunnel Syndrome among Post-Menopausal Women Receiving Adjuvant Aromatase Inhibitor Therapy for Breast Cancer

Institution where the work was prepared: Johns Hopkins University School of Medicine, Baltimore, MD, USA
Raghunandan Venkat, MD, MPH; Aditya Bardia, MD, MPH; Jon Giles, MD; David Flockhart, MD, PhD; Daniel F. Hayes, MD; Norah L. Henry, MD, PhD; Stacie Jeter; Anne Nguyen; Anna M. Storniolo, MD; Karineh Tarpinian; Zhe Zhang, MS; Vered Stearns, MD; Gedge Rosson, MD; (1) Johns Hopkins University School of Medicine, (2) Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins, (3) Indiana University Melvin and Bren Simon Cancer Center, (4) University of Michigan

Introduction:
Aromatase inhibitors (AIs) are recommended as first line adjuvant hormonal therapy to postmenopausal women with hormone receptor (HR) positive breast cancer. AIs are commonly associated with bothersome musculoskeletal symptoms, however, the exact etiology leading the symptoms is unknown. A few studies have suggested that AIs are associated with an increased risk for tenosynovitis and carpal tunnel syndrome (CTS). However, the incidence and magnitude of CTS among women receiving AIs have not been prospectively examined.

Methods:
Postmenopausal women with stage 0-II HR-positive breast cancer who enrolled in the multi-center Exemestane and Letrozole Pharmacogenetics (ELPh) trial, underwent prospective evaluation of musculoskeletal symptoms. Women who met predefined thresholds were referred for a rheumatology consultation. Participants were also evaluated regarding clinical symptoms of CTS with a standard CTS questionnaire and quick DASH (disabilities of the arm, shoulder and hand) score, as well as evaluation with the 2-point discrimination (2PD test) at baseline, 3, and 6 months following initiation of the AI. The 2PD was ascertained by the Discriminator™, wherein the two-pronged end of the Discriminator™ was applied to the skin on the volar tip pulp of the index fingers of participants, and the threshold value (in mm) was determined as the shortest distance between these two prongs a woman was able to reliably differentiate correctly. We evaluated change in clinical symptoms and mean 2PD from baseline to 6 months following initiation of AI therapy.

Results:
A total of 30 women had results available for baseline and 6 month 2PD testing at our institution. The mean age was 60 +/- 9.0 years, 60% had stage I disease, and 37% received adjuvant chemotherapy. During the first 6 months of AI therapy, 40% of women (n=12) were referred to a rheumatologist for bothersome musculoskeletal symptoms. There was a significant worsening of the total CTS score (p=0.047), and mean 2PD (p=0.007), at end of 6 months as compared to baseline. Overall, 50% of patients (n=15) had worse CTS and quick DASH questionnaire scores at 6 months as compared to baseline.

Conclusion:
This prospective study suggests that a significant proportion of post-menopausal women receiving AI therapy develop worsening scores on the CTS questionnaire and changes in finger sensation suggestive of CTS, including bothersome symptoms that may require further diagnostic testing and evaluation. Additional studies are needed to confirm these findings, as well as elucidate the pathophysiology and predictive factors of AI induced CTS.

Double Fascicular Nerve Transfer to the Biceps and Brachialis Muscles After Brachial Plexus Injury: Clinical Outcomes in a Series of 29 Cases

Institution where the work was prepared: Washington University School of Medicine, St. Louis, MO, USA
Wilson Z. Ray, MD; Mitchell Pet, BS; Susan E. Mackinnon, MD; (1) Washington University School of Medicine, (2) Washington University

Purpose:
In this study, the authors evaluate the clinical outcomes of patients with brachial plexus injuries who underwent double fascicular transfer using fascicles from the median and ulnar nerves to reinnervate the biceps and brachialis muscles.

Methods:
A retrospective chart review of 29 patients with brachial plexus injuries treated with double fascicular transfer for restoration of elbow flexion. All patients underwent pre- and postoperative clinical evaluation using the MRC grading system.

Results:
The mean patient age was 37 years (range, 17-68 y) with a mean follow-up of 19 months ± 12 months (range, 8-68 months). At the most recent follow-up, all but one patient (97%) had regained some elbow flexion. Eight patients recovered grade M5, fifteen patients recovered grade M4, four patients recovered grade M3, and one patient recovered grade M1 strength. There was no evidence of functional deficit in the donor nerve distributions.

Conclusions:
Our results demonstrate the reliable restoration of M4-M5 elbow flexion following double fascicular transfer in patients with brachial plexus injuries.
Contralateral C7 Transfer in Treating A Child with Cerebral Palsy: A Case Report

Institution where the work was prepared: Huashan Hospital, Shanghai, China

Wen-Dong Xu, MD, PhD; Jian-Guang Xu; Yu-Dong Gu; (1)Huashan Hospital,Fudan University; (2)Fudan University

The purpose of this study was to report the primary results of applying contralateral C7 (CC7) transfer procedure in improving the function of upper extremity in a child with hemiplegic cerebral palsy. As only limited benefits had been acquired from previous rehabilitation trainings and occupational therapies, a four-year-old girl who sustained hemiplegic cerebral palsy and subsequent spasticity in the left upper extremity underwent a cross nerve transfer, in which the CC7 was transferred to the middle trunk of affected side (MTAS) with an interpositional graft of sural nerve through a subcutaneous tunnel. Quality of Upper Extremity Skills Test (QUEST) and Modified Ashworth Scale (MAS) were used for the evaluation of hand function and spasticity degrees preoperatively and at 6, 12, 18 and 24 months after surgery. Needle electromyography (EMG) study showed that compound muscle action potential (CMAP) could be recorded in the extensor carpi radialis muscle (ECRM) with a stimulation on the bottom of the neck where the graft nerve went through underneath at 1 year after surgery. Postoperative results showed a reduction in spasticity and an improvement in extension power of the elbow, the wrist, and the 2nd to 5th fingers. Scores in both QUEST and MAS tests have been significantly improved at final visit. In conclusion, primary clinical findings in this case indicated that the CC7-MTAS transfer not only released flexional spasticity but also strengthened extension power of the spastic upper extremity in children with hemiplegic cerebral palsy, thereafter improved the motor coordinate of the whole upper extremity.

Enhancing Functional Recovery by Supplementing Acellularized Nerve Grafts with Motor and Sensory Schwann Cells

Institution where the work was prepared: Washington University School of Medicine, St. Louis, MO, USA

Katherine Santosa; Nithya J. Jesuraj, BS; Matthew MacEwan; Amy Moore; Wilson Z. Ray, MD; Gregory H. Barschel; DA Hunter; Philip J. Johnson, PhD; Shelly Sakiyama-Elbert, BS, PhD; Susan Mackinnon; (1)Washington University School of Medicine, (2)Washington University, (3)The Hospital for Sick Children, (4) Washington University in St. Louis

Introduction:
There has been recent interest in the possibility of using sensory grafts for sensory reconstruction and motor for motor reconstruction of nerve gaps. However, due to limitations in availability of such autografts, this repair may not always be possible. The aim of our study was to investigate an alternative in which processed nerve grafts are re-seeded with motor or sensory Schwann cells (SCs). Given the results from our initial study that showed unique expression profiles of grafts injected with motor and sensory SCs and improved nerve regeneration on histomorphometry, we sought to determine if these findings would have any effect on functional recovery.

Methods:
Thirty Lewis rats were randomized into five groups (n=6 per group) corresponding to the type of graft that was used to repair a 14 mm nerve gap. Isografts and acellular processed nerve grafts served as positive and negative controls, respectively. The three experimental groups included processed nerve grafts supplemented with autologous SCs expanded from the sciatic nerve (mixed), femoral motor, and femoral sensory nerve branches. We measured maximum twitch and tetanic forces of the extensor digitorum longus (EDL) muscle at t=12 weeks to assess functional recovery of the injured limb.

Results:
Our data demonstrate that the supplementation of SCs into processed nerve grafts enhances functional recovery to a level comparable to that of an isograft (p<0.05). There was no statistical significance in the maximum twitch or tetanic forces between the positive control isograft and the three groups of processed nerve grafts supplemented with mixed, motor or sensory SCs. In addition, these four groups significantly outperformed the negative control group in both parameters.

Conclusions:
Although we previously demonstrated that the supplementation of SCs promotes nerve regeneration, it has become increasingly important to correlate these findings with functional recovery, arguably one of the most important outcome measures in translational research. The idea that limb function was restored with the nerve grafts re-seeded with mixed, motor and sensory SCs gives us great enthusiasm for the future use of this technique in the repair of short nerve gaps.
Ca2+-ATPase Regulation in Crushed Peripheral Nerves

Introduction:
Our previous study showed a direct correlation between calcium absorption and recovery of function after a crush injury to the peripheral nerve. Ca2+-ATPase is the most important uphill pump. The purpose of this study was to investigate the Ca2+-ATPase mRNA regulation to provide a useful information for further genetic therapy.

Materials and Methods:
24 Sprague-Dawley rats were divided into four groups of six rats each. The sciatic nerve was crushed by needle driver producing a 30-pound force. Animals were allowed to recover for either 2, 8, 12 or 24 weeks in each group.

Evaluation:
Electrophysiological study: After the respective recovery times, electrophysiological exams were performed prior to tissue harvesting. Compound Muscle Action Potentials (CMAPs) were recorded.
Tissue Ca2+ Staining: Injured site nerve and distal segment of the sciatic nerve were harvested. The nerve fibers were gently separated by tearing, and put in the Calcium Green-1 Aceatoxymethyl (AM) ester, then viewed under fluorescent conditions with a Zeiss Axio scope 40 microscope. The bright intensity measurements in Relative Fluorescent Units have been preset by this software. The CMAP recovery rates and calcium absorption rates were calculated.
RNA isolation and qPCR analyses of ATPase RNA: Total RNA was isolated using an RNAqueous-Micro Kit. The RNA was quantitated using a Qubit Fluorometer. qPCR: The qPCR reactions were performed using iQ SYBR Green I Supermix on a Bio-Rad iCYCLE iQ real time PCR instrument.

Results:
1. Calcium influx: After injury, calcium gradually entered the crush site and distal segment, peaking at 8 weeks.
2. Correlation between calcium absorption and CMAP: The CMAP recovery rate increase was accompanied by the calcium absorption rate increase. The r value was 0.81 by Pearson Correlation test. Correlation was statistically significant (P<0.05). Results of RNA and qPCR analyses of ATPase: The RNA calculation 2-\{ΔΔCt\} for 2, 8, 12 and 24 weeks respectively were: Crush site: 4.3, 5.3, 55 and 0.2; Distal site: 2.4, 8.0, 5.7 and 3.2; Proximal site: 1.5, 2.6, 48 and 2.4. (less than 1 is a decrease). Ca2+-ATPase up-regulations peaked at 12 weeks.

Conclusions:
1. The absorption of calcium has a direct correlation with electrophysiological recovery.
2. Calcium accumulation peak was at 8 weeks after crush injury. 3. Ca2+-ATPase up-regulations peak at 12 weeks, which is too late for calcium absorption in the natural pathway. Medical agents or genetic therapy to accelerate calcium absorption would improve nerve regeneration.

3D Reconstruction Model of Epidermal Fibers: A Novel Approach for Assessment of Neuropathic Pain

Introduction:
Peripheral nerve fibers involved in nociception are small thinly myelinated (A-delta) and unmyelinated (C) fibers, containing several neuropeptides such as calcitonin gene-related peptide (CGRP), substance P (SP), and isolectin-4 (IB4). These fibres are located in the outermost layer of the skin, epidermis. They are important for interpretation of noxious stimuli like heat, cold and pain, termed nociception. Evaluation of skin intra-epidermal nerve fiber density (IENF) is a common used clinical diagnostic tool for assessing neuropathic diseases in patients. However, there is limited knowledge about IENF of specific different nociceptors in skin after peripheral nerve injury especially in relation to subsequent neuropathic pain.

Methods:
In 6 rats, the sole of the foot of the hindpaws was excised and stained according to the necessary protocols for CGRP, SP, IB4 and PGP 9.5 (a pan-neuronal marker). Subsequently, 3D IENF reconstructions of nociceptors expressing CGRP, SP, IB4, and PGP9.5 (marker for detecting all fibers) were created of the entire sole of the foot. This 3D model provides an overview of the epidermal fiber distribution in the rostro-caudal and ventro-dorsal axis. This enables us to map and evaluate the IENF density within specific skin areas. Next, a neuropathic pain model, the ‘spared nerve injury’ (SNI), was applied to 2 rats, and the same area of the sole of the hindpaw was stained and 3D reconstructions were made. The animals were also assessed for neuropathic pain by using von Frey hairs and for temperature intolerance.

Results:
The 3D reconstructions demonstrate the fibre densities of the entire sole of the rats hindpaw. Initial results in the SNI rats (n=3) show a decreased fibre density in the tibial nerve area. At 5 weeks there is a significant increase in fibres, but from collateral sprouting. At 10 weeks, the tibial nerve area is almost repopulated by nerve fibres, but these fibres are all from collateral sprouting. The assessment of neuropathic pain demonstrates a significant increase in pain at 5 weeks, when there is a concomitant increase in nerve fibres.

Conclusion:
We developed a novel technique that enables us to make 3D reconstructions of specific nociceptive fibers in the skin. This valuable tool makes it possible to compare the innervation patterns of nociceptive fibers in much larger skin areas and will enable the evaluation of denervation and renervation processes taking place after peripheral nerve injuries.
Botulinum Toxin Type A for Chronic Pain

Institution where the work was prepared: Southern Illinois University School of Medicine, Springfield, IL, USA

Kelli N. Webb, MD; Carisa M. Cooney; Reuben A. Bueno Jr; Michael W Neumeister; Southern Illinois University School of Medicine

Purpose:
More than 65 million Americans suffer from chronic pain, placing a tremendous burden on patients and their families, as well as the country’s health care system and workforce. Chronic pain costs the United States an estimated $61-100 billion annually. For many patients, current pharmaceutical treatments are ineffective, addictive, and produce unfavorable systemic side effects. Although Clostridium botulinum toxin was historically associated with food poisoning, today it is frequently used for cosmetic treatments and symptomatic relief for a variety of conditions. The purpose of this study is to determine if botulinum toxin type A is an effective treatment for chronic pain.

Methods:
After IRB approval, a retrospective review was performed on all patients who received injection of botulinum toxin type A for chronic pain between June 2005 to November 2009. Patients were mailed an explanatory letter and invited to participate in the study via a telephone interview. Data was statistically analyzed using independent t test and chi-square test.

Results:
Thirty-three patients, 7 male and 24 female (mean age: 54 years, range: 37-80 years), were injected with botulinum toxin type A for various chronic pain conditions during the review period. Response rate for study participation was 72% (24 patients) with an average follow-up of 3 years (range: 1-5 years). Seventy-nine percent of patients enjoyed pain relief after a single injection of botulinum toxin type A for chronic pain conditions including musculoskeletal pain, neuroma, tendonitis, scar pain, arthritis, and reflex sympathetic dystrophy. Fourteen patients reported immediate pain relief, while 5 patients experienced more gradual onset of pain relief (up to 3 weeks). The average duration of pain relief was 28 months (range 1-55 months) and 58% of the chronic pain patients required no further medical treatments including discontinuation of all pain medications. Nine patients reported increased productivity at work or improved daily activities. Patients who responded well to botulinum toxin had shorter durations of chronic pain prior to injection (1 year vs. 5 years, p=0.02).

Conclusion:
Our results show that botulinum toxin type A may be an effective treatment option for patients with chronic pain. Response may be inversely related to the duration of chronic pain preceding treatment.

Effects of Chronic Implantation of a Novel Nerve Cuff on Peripheral Nerve

Institution where the work was prepared: University of Alberta, Edmonton, AB, Canada

Lisa Korus, MD; Liu Shi Gan, PhD; Kimberly Wong, BSc; Kathryn Todd, PhD; Jaret Olson, MD, FRCSC; Michael Morhart, MD, FRCSC; Arthur Prochazka, PhD; University of Alberta

Purpose:
Functional electrical stimulation has been employed in spinal cord injury to aid in regaining limb movement. The “Stimulus Router System” is a design that takes advantage of a lead implanted in a subcutaneous position that can capture current between two surface electrodes. The lead is in turn connected to the target nerve via a nerve cuff. Such cuffs, however, have potential to cause neural damage over time, especially when not sized properly. In an attempt to better control nerve cuff diameter and potentially reduce adverse neural changes, a novel cuff was developed. This design allows for custom sizing by the surgeon according to the diameter of the nerve. We sought to determine the effects of chronic implantation with this novel cuff design.

Methodology/Design:
Seven rabbits were implanted with the novel cuff design on their common peroneal and posterior tibial nerves. Leads were tunneled to subcutaneous positions on the rabbits’ dorsum. The contralateral side of the animal was subjected to a sham operation. External electrical stimulation was applied at 0, 1, 3 and 7 months and muscle activation thresholds were recorded. At 7 months nerves were harvested and analyzed histologically for gross morphology, connective and encapsulation tissue. Myelination, axonal structure and density, as well as the expression of proteoglycans associated with nerve compression (chondroitin sulfate proteoglycan or CSPG) was assessed through immunohistochemistry.

Results:
Stimulation thresholds were lowest at implantation and highest at 1 month post-operatively. Subsequent stimulations at 3 and 7 months saw decreasing thresholds, however thresholds never returned to levels seen at implantation. A Mallory trichrome stain found large amounts of connective tissue surrounding nerves that had been implanted with the novel cuff and a non-significant trend for increase in area, although no gross change in morphology. Staining for neurofilament-H showed decreased axonal density in cuff nerves (p=0.022), however no changes in longitudinal continuity. There was no significant difference in the expression of myelin as assessed by myelin basic protein (p=0.864) nor in the expression of CSPG (p=0.393).

Conclusions:
Although changes were seen such as increased connective tissue, larger nerve area and decreased axonal density, likely as a result of edema, there was no evidence to suggest that implantation with the novel design resulted in any significant nerve damage as assessed by gross morphological changes, changes in axonal continuity and myelination or through the expression of a proteoglycan associated with nerve compression.
Peripheral nerve traumas often necessitate replacement of damaged nerves to rescue targeted muscles from atrophy. While autologous nerve grafts are currently the gold standard, they present limitations due to availability and donor site morbidity. An engineered neural conduit could provide an alternative for repairing damaged nerve and restoring nerve function to target tissues.

The present study evaluated the repair capabilities of a scaffold-less three-dimensional (3-D) engineered neural conduit (ENC) in an adult sciatic nerve transection in a rat model. These ENCs were fabricated from primary fibroblast and E-15 neural cells from Fisher F344 rats. The fibroblasts have been shown to form an epineurium-like sheath, while the E-15 neural cells establish an internal network. A 10-mm non-critical nerve transection in the tibial nerve 5 mm from the medial and lateral gastrocnemius muscles was performed and repaired using either an ENC, engineered fibroblast conduit (EFC), or autograft.

Three months after peripheral nerve repair, results revealed substantial recovery in the ENC and EFC experiments, suggesting our engineered conduits are successful at bridging the 1 cm injury site. Contractile properties were measured in the medial gastrocnemius muscle while nerve conduction velocities (NCV) were measured in the lateral gastrocnemius muscles. In contralateral controls, no surgical intervention, the NCV was at 60 m/s (+/- 3.11 SEM), specific force was at 26.93 N/cm^2 (+/- 1.14 SEM) and medial gastrocnemius muscle mass was at 439.3 mg (+/- 1.38 SEM). In the autograft, our surgical control, the NCV was 58 m/s (+/- 1.41 SEM), specific force was 27.21 N/cm^2 (+/- 0.64 SEM) and medial gastrocnemius muscle mass was 277 mg (+/- 2.7 SEM). The ENC exhibited regeneration of 90% of NCV, 43% of gastrocnemius muscle mass, and 60% of specific force when compared to the autograft control group. The EFC exhibited 88% of NCV, 44% of gastrocnemius muscle mass, and 66% of specific force compared to the autograft control group. Histological analysis of the EFC and ENC revealed nerve regeneration as indicated by the presence of nerve (NCAM), Schwann cells (S100), structure (H&E), and myelinated axons (toluidine blue). The gradient of nerve regeneration, highest at the proximal site, was observed histologically.

In conclusion, scaffold-less three-dimensional engineered neural conduits promote partial neuronal regeneration in a 10-mm tibial nerve repair in adult rats. Increased repair time and further optimization of inner structure could make the ENC a viable clinical alternative for tissue repair avoiding the availability and site morbidity of autografts.

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**Does The Active Range of Motion in Patients with Obstetrical Brachial Plexus Palsy Diminish over Time? A Ten Year Analysis**

Institution where the work was prepared: Hospital for Sick Children, Toronto, ON, Canada

Abdullah E. Kattan, MBBS, FRCS(C); Christine G. Curtis, BSc, PT; Gregory H. Borschel; Howard M. Clarke, MD, PhD, FRCS(C); Hospital for Sick Children

**Objective:**

It has been our experience, and by personal report that of others, that children with obstetrical brachial plexus palsy tend to lose some of the active range of motion they originally achieved over the ensuing years. This initial improvement could have been the result of spontaneous recovery, physiotherapy, primary reconstruction, secondary reconstruction or any combination of these. There is very limited data reporting on long-term changes in these patients. The purpose of this study was document whether this diminution of active movement over time occurs.

**Method:**

A retrospective analysis of prospectively collected data from patients seen in our obstetrical brachial plexus clinic was performed. From an initial cohort of 745 consecutive patients first evaluated between 1991 and 2000, 139 patients with at least 10 year complete follow-up data were included in the study. Patients were divided into two groups, the first group (n= 42) included patients managed non-operatively. The second group (n= 97) included patients who underwent any form of primary or secondary brachial plexus reconstruction. Fifteen distinct joint motions were assessed using the Active Movement Scale (AMS). Data from examinations at 2, 4 to 6 and 9 to 11 years of follow-up were used to analyze any changes over time and examine any changes within each group.

**Result:**

There is initial improvement of ARM scores over the initial 4 to 6 years of childhood in both the operated and non-operated groups. The overall ARM scores were maintained when patients were evaluated at the 9 to 11 year follow-up with no significant loss of movement.

**Conclusion:**

Even longer follow up into the late teenage years will be required in order to reliably evaluate whether there is any loss of active range of motion over time in patients with obstetrical brachial plexus palsy.
Functionality After the Hoffer Procedure

Institution where the work was prepared: University of Alberta, Edmonton, AB, Canada
Amera Murabit, MD; Kathleen O’Grady; Michael Morhart, MD, FRCS; Jaret Olson, MD, FRCS; (1)University of Alberta, (2)Glenrose Rehabilitation Hospital

Purpose:
Children with obstetrical brachial plexus injury often develop an internal rotation and adduction contracture about the shoulder as a secondary deformity. This is due to the incomplete recovery of deltoid and rotator cuff muscles and results in an inability to externally rotate and abduct the shoulder. The Hoffer procedure is evaluated for its potential benefit in improving shoulder abduction and external rotation and its impact on activities of daily living.

Methods:
This study is a retrospective review of patients treated in our Brachial Plexus Injury Clinic who underwent tendon transfer procedures about the shoulder. Epidemiological data was collected and analyzed regarding the patient, their injury and their surgery. Age at time of surgery, surgical complications and other surgical procedures are catalogued. Pre-operative and post-operative active movement and active ROM are measured and recorded using the Mallet and Active Movement Scale (AMS). Clinical and statistical significance was examined.

Results:
This study included 20 patients: 18 underwent the Hoffer procedure; 2 had a L’Episcopo procedure. 11 of the patients were male, 9 female. Deformity was right-sided in 12 patients, and left-sided in 8. Average age at time of surgery was 6.35 years old (range 3-15 years old). Thirteen patients had primary brachial plexus reconstructive surgery, 7 patients had not; and 4 patients had concomitant wrist extension tendon transfer procedures. All patients had full or almost full passive ROM pre-operatively. Average follow-up period was 25.45 months (range 6-96 months).

Average differences in pre-Hoffer and post-Hoffer Mallet scale scores are: Active Abduction = 1.20*; External Rotation = 1.35*; Hand-to-Neck = 1.25*; Hand-to-Back = 0.75*; Hand-to-Mouth = 0.65*; Aggregate score = 4.60*

Average differences in relevant pre-Hoffer and post-Hoffer AMS scores are: Shoulder Abduction = 2.10*; Shoulder External Rotation = 4.25*; Shoulder Internal Rotation = 0.80*. All patients maintained full ROM passively, thus no functional loss was experienced.

All these results are shown to be very highly statistically (* p < 0.001) and clinically significant. Better pre-operative shoulder flexion and shoulder internal rotation yielded better post-operative results. Younger patients (≤6 years) yielded better results.

Conclusions:
The Hoffer procedure provides clinically and statistically significant improvement in external rotation and abduction while preserving functional internal rotation range in the child with obstetrical brachial plexus palsy and secondary shoulder deformity.

Restoration of Plantar Sensation after Complex Injuries of the Tibial Nerve with Distal Nerve Transfers of the Sural and Superficial Peroneal Nerves: A Cadaveric Feasibility Study

Institution where the work was prepared: Hospital Universitario A Coruna, A Coruna, Spain
Andres Rodriguez, MD, PhD; Bruno Gago, MD; Felipe Pineda, MD; Hospital Universitario A Coruna

Background:
The results of nerve reconstruction in the lower extremity usually yield to worse outcomes in comparison with upper extremity nerve injuries due to the long distances of nerve regeneration. Moreover additional challenge must be faced if long nerve gaps are encountered or in the case of established compartment syndrome. To consider the clinical application of the concept of distal nerve transfer for restoration of plantar sensation in long gaps of tibial nerve or in established compartment syndrome, this study aimed to determine detailed anatomic data about the suitability of transferring the sural nerve in combination with the superficial peroneal nerve to the tibial nerve at the level of the tarsal tunnel for restoration of plantar sensation.

Methods:
An anatomic study was performed in 8 fresh above-knee amputated limbs. It focused on the detailed anatomy of the course of the sural and superficial peroneal nerve from its emergence proximally at the knee level to the foot. Two different regions were described for each nerve, suprafascial and subfascial. The maximum length of dissection and the length of the nerve in each region were measured. In all dissections, we assessed the feasibility of directly transferring the sural and superficial peroneal nerves to the tibial nerve at the level of the tarsal tunnel.

Results:
The average maximum length of dissection for the sural nerve and superficial peroneal nerve was 37.15 cm (SD + 2.95 cm) and 37.7 cm (SD + 4.1 cm) respectively. The average length of the course of the nerves subfascially was 20.63 cm (SD + 2.4 cm) and 16.5 cm (SD + 0.9 cm) suprafascially for the sural nerve and 19.55 cm (SD + 2 cm) subfascially and 18.17 cm (SD + 2.7 cm) for the superficial peroneal nerve. The emerging of the nerve from subfascial course to suprafascial course was defined as the pivot point for its transfer to the tibial nerve. Both the sural nerve and the peroneal superficial nerve reached comfortably the tibial nerve at the level of the tarsal tunnel allowing direct coaptation.

Conclusion:
Distal nerve transfers using the sural nerve in combination with the superficial peroneal nerve are a reliable procedure and a potential alternative to the use of nerve grafts in reconstruction of long gaps of the tibial nerve. In addition selective patients with compartment syndrome may benefit also from this transfer to restore plantar sensation.

Epidemiological data was collected and analyzed regarding the patient, their injury and their surgery. Age at time of surgery, surgical complications and other surgical procedures are catalogued. Pre-operative and post-operative active movement and active ROM are measured and recorded using the Mallet scale and Active Movement Scale (AMS). Clinical and statistical significance was examined.
What Retrospective Clinical Research Should Teach Us about Prospective Patient Care After Peripheral Nerve Gap Repair

Introduction:
Peripheral nerve injuries can result in devastating sensory and motor disabilities. While recent advancements have provided additional treatment options for nerve injury, evaluation of outcomes is often challenging. Data from prospective randomized clinical studies is limited, mainly due to challenges such as the small patient populations, obtaining consent, inadequate controls, and long follow-up times. Clinicians therefore rely heavily on personal experience and retrospective reports. We discuss our findings of post-operative management of nerve injuries reported from multi-surgeon retrospective studies.

Materials and Methods:
Our review included our experiences from participation in a multi-center retrospective study on processed allografts (RANGER, AxoGen, Inc), and a literature search for comparable large, retrospective studies. Each study evaluated safety, efficacy, and adverse events associated with the treatment modality, the level of patient follow-up and correlated the type of repair with the level of recovery.

Results:
We evaluated our experience along with another large multi-surgeon retrospective study that evaluated outcomes with bovine collagen conduits (Wangensteen and Kalliainen 2009). The studies were similar in design: large patient population and nerve injuries treated. Each study had a noteworthy number of subjects who were either lost to follow-up (21-30%) or whose medical records provided insufficient information to evaluate efficacy (up to 25%). Operative records provided consistent information on repair procedures. However, variability regarding post-operative care, timing, and uniformity of measures was observed across the sites and surgeons. Evaluation methods utilized in each study ranged from 1-8 different methods for obtaining quantitative measures and subjective accounts. This did not adversely affect the ability to assess response to treatments, as meaning functional improvements was reported in 43% of the collagen conduits and 88% of the processed nerve allografts. However it did have some affect on the ability to assess more granular levels of treatment effect.

Conclusion:
In general, peripheral nerve injuries and expected outcomes are often treated as an enigma. Personal experience and retrospective studies provide valuable data when prospective randomized studies are not available or technically feasible. From our research we have learned that post-operative management of peripheral nerve injuries can be highly variable. It is critical to maintain consistent and adequate records. A standardized assessment algorithm containing the appropriate battery of measures and an increase in regular patient follow-up should be consistently implemented. A well designed and executed peripheral nerve injury registry is needed to expand our knowledge of treatments and better set expectation for patients, surgeons, therapists and researchers.

Targeted Muscle Reinnervation of a Free Flap

Targeted muscle reinnervation has been shown to allow improved upper extremity function in patients who have had above-the-elbow amputations. The reinnervated muscle receives signals from the brachial plexus and serves as a bioamplifier for the peripheral nerves. The amplified signals are sensed by a myoelectric prosthesis and provide more coordinated movement of the prosthesis, because it is receiving input from the brachial plexus.

We report a case of a patient who was treated with targeted reinnervation of a free flap transferred from the contralateral side. The patient had a shoulder disarticulation secondary to severe electrical burn injury. He also sustained full-thickness burns of the chest wall including the majority of the pectoralis major muscle and the pectoralis minor muscle. Because the pectoralis major muscle, which is usually used for targeted reinnervation, was not available, a serratus muscle free flap was transferred from the contralateral side. Cut ends of the median, ulnar, and musculocutaneous nerves were sutured to branches of the long thoracic nerve innervating the transferred serratus muscle. EMG studies demonstrate successful firing of the serratus muscle when the patient thinks about movements of his left upper extremity which has been amputated.

To our knowledge, this case represents the first clinical report of targeted muscle reinnervation of a free flap. The reinnervated free flap will allow the patient to be fitted for a more functional prosthesis because the brain will be communicating with the custom-built prosthesis, resulting in more fluid and directed motion of the extremity prosthesis.
Functional Recovery of Rat Sciatic Nerve Defect Following Repair with a Tissue Engineered Bone Marrow Stromal Cell Epineural Construct

Institution where the work was prepared: Cleveland Clinic Foundation, Cleveland, OH, USA

Amanda Mendiola, MD; Maria Madajka, PhD; Grzegorz Brzezicki, MD; Arkadiusz Jundzill, MD; James Gatherwright, MD; Joanna Cwykiel; Maria Siemionow; Cleveland Clinic Foundation

Objective:
To engineer a bone marrow stromal cell (BMSC) epineural construct for nerve repair by combining the neurotrophic effects of the epineural sheath with BMSCs in vitro prior to implantation for enhancement of nerve regeneration.

Methods:
10 stromal cell epineural constructs (SCEC) were created by filling an empty isogenic epineural sheaths with 3x10^6 isogenic BMSC and cultured in media for 10 days. In two experimental groups a 2 cm sciatic nerve defect was repaired in Lewis rats. Group 1: Repair with the engineered SCEC. Group 2: Autograft repair. Animals were evaluated at 6 and 12 weeks. Nerve regeneration was assessed using pin prick (PP), toe spread (TS), SSEP, and histomorphometry. The SSEP results were calculated as percentages of the unoperated side. Muscle denervation atrophy was evaluated by gastrocnemius muscle index (GMI).

Results:
The SCEC group showed better PP with full sensory recovery at 6 weeks while the autograft repair had a score 2.5 at 6 and 2.83 at 12 weeks. At 6 weeks SCEC and autograft repairs had TS score of 1 and 0.83 respectively and both groups increased at 12 weeks with a score of 2.4 and 1.67. At 6 weeks, the GMI was similar between the SCEC and autograft (0.22, 0.24). At 12 weeks, the SCEC had a better GMI of 0.55 versus 0.43 in the autograft. The average P1 latency for SCEC was 21.62ms or 130.94% of the unoperated side. The autograft revealed shorter latency at 17.93ms or 109.9% at 6 weeks. At 12 weeks both latencies were comparable at 19.33ms or 112.46% and 19.44ms or 115.45% for SCEC and autograft. The SCEC group had the longest N2 latency at 6 weeks 28.17ms or 112.46% and 19.44ms or 115.45% for SCEC and autograft. At 12 weeks, the SCEC had the lowest amplitudes at 6 weeks (22.99%) but improved the most and had the highest at 12 weeks compared to the autograft (82.48%, 71.8%). The autograft group showed higher mean fiber diameters (3.75µm vs 3.5 µm), higher axonal density (298.22 vs 283.3 axons/ 10000 µm²) and greater myelin thickness (0.96 vs 0.76 µm) on histomorphometry at 12 weeks.

Conclusion:
This preliminary report confirmed that our novel nerve repair technique with ex vivo engineered epineural construct supported with BMSC showed comparable functional outcome and histomorphometric results to an autograft repair with significant improvement over 12 weeks period.

Chronic Post-operative Breast Pain: Danger Zones for Nerve Injuries

Institution where the work was prepared: Georgetown University Hospital, Washington, DC, USA

Ivica Ducic, MD, PhD; Matt Iorio; Laura Seiboth; Georgetown University Hospital

Introduction:
Chronic post-operative breast pain is the number one complaint by patients seen in a general practice setting, and is reported by 50% of women who visit surgical clinics for breast symptoms (breast pain and nodularity). Breast pain can interfere greatly with sexual activity (reported at 48% of patients), physical activity (36%), social activity (13%), and working or school (6%).

Patients and Methods:
Fifty-seven consecutive patients presented to a single surgeon with post-operative breast pain. A retrospective review of this study population was conducted to assess the most commonly injured nerves, with respect to their anatomic location (zones of injury), type of nerve injury, and their association with specific breast and chest wall procedures. Ten separate anatomical cadaver dissections were used to correlate the anatomic zone of injury with the specific type of breast procedure, in an effort to designate the specific nerves that are at greatest risk in each procedure.

Results:
Study patients underwent breast reconstruction (38), reduction (2), mastopexy (2), augmentation (4) and radiation (11). We defined five zones of the breast that are vulnerable to nerve injury: superior, medial, inferior, lateral, and central/nipple-areola complex (NAC). The lateral zone of the breast was the most commonly injured in studied patients (80%), followed by the inferior (10%), medial (5%), central/NAC (4%), and superior (1%) zones.

The largest subset of patients had intercostal (2-7) nerve injury resulting in neuroma due to mechanical nerve trauma or compressive scar entrapment (42/57 = 74%). These patients had localized pain within the surgical scar or within the radius of mechanical sharp tissue dissection. Patients with traction-stretch neuropathy (4/57 = 7%) had localized pain from blunt rather than sharp tissue dissection (i.e. blunt augmentation pocket dissection). Radiation induced chronic breast/chest neuropathy (1/57 = 1.9%) patients had diffuse, non-localized nerve pain, while no chemotherapy alone induced nerve injuries were observed. Neuroma patients received involved nerve excision, while the two other groups (26%) of patients were non-operatively treated.
Partial Tibial Nerve Transfer to the Tibialis Anterior Motor Branch for the Treatment of Peroneal Nerve Injury

Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA

Jennifer Lindsay Giuffre, MD; Allen T. Bishop; Robert J. Spinner; Bruce A. Levy; Alexander Y. Shin; Mayo Clinic

Hypothesis:

Tendon transfers and ankle-foot orthotics traditionally have been the standard treatment for foot drop with satisfactory patient outcomes. The purpose of this study is to evaluate patient outcomes following traumatic peroneal nerve ruptures treated with an alternative treatment option: a partial nerve transfer from the tibial nerve to the motor branch of tibialis anterior.

Methods:

All patients treated with nerve transfers for traumatic peroneal nerve injury were reviewed. Patient demographics, mechanism of injury and time to surgery were recorded. Peri-operative motor grading by the British Medical Research Council was obtained. Patients completed questionnaires regarding disability and satisfaction.

Results:

Eleven male patients underwent tibial nerve to deep peroneal nerve transfers an average 5.8 months post-injury. Four patients (36%) had successful restoration of grade 3+ ankle-dorsiflexion, one patient (9%) regained grade 2, two patients (18%) regained grade 1 and four patients (36%) did not regain muscle activity. Clinically apparent motor recovery occurred an average of 7.6 months post-operatively. Reinnervation was demonstrated electromyographically an average of 9.1 months post-operatively. Most patients (78%) could ambulate and participate in activities. Although 67% of patients did not wear an AFO, only 33% of patients did not limp. The donor deficits included weak toe flexion (22%) and reduced calf circumference (67%). Overall, 67% of patients were satisfied and 78% would recommend surgery.

Conclusion:

Traumatic peroneal nerve ruptures may preclude nerve grafting secondary to the length of nerve injury thereby leaving few treatment options. Although the traditional treatment of foot drop has been tendon transfers and ankle-foot orthotics, partial nerve transfers of an uninjured nerve to the motor branch of a denervated muscle may be a treatment option for foot drop. Our study indicates that in traumatic avulsive peroneal nerve injuries, nerve transfers to the deep peroneal nerve give disappointing results. Only 36% of patients achieved M3 or greater motor recovery, while the remaining patients regained minimal to no motion and risked the added morbidity of the procedure itself.

Influence of Conductive Polymers on Neuroma Formation at Three and Six Months

Institution where the work was prepared: University of Michigan, Ann Arbor, MI, USA

Benjamin Wei, MD; Melanie G. Urbanchek, PhD; Ziya Baghmanli, MD; Bong S. Shim, PhD; David C. Martin, PhD; William M. Kuzon, MD, PhD; Paul S. Cederna, MD; (1)University of Michigan, (2)University of Delaware

Objective:

Our goal is to develop a long-term peripheral nerve interface (PNI) with motor and sensory capabilities for closed-loop neural control of an artificial limb. Our PNI uses the highly conductive polymer poly(3,4-ethylenedioxythiophene) (PEDOT) to improve conductivity, reduce impedance, and limit biofouling (Egeland 2009). PNIs are often compromised by neuromas, which can be painful and a source of signal interference. Our null hypothesis is that neuroma formation is unaffected by the presence of PEDOT at three and six months.

Methods:

In a rat model, peroneal nerves were divided, and the proximal stump was coapted to a scaffolding of 10mm acellularized small intestinal submucosa (SIS). PEDOT was polymerized on these scaffolds for two of the experimental groups. The first, Dry PEDOT, was chemically deposited resulting in a firm, brittle compound. The second, Wet PEDOT, was electrochemically deposited resulting in a soft, gel polymer. The study groups (n=8 per group) are as follows: Sham, Primary Repair, Divided Nerve, SIS alone, and SIS with Dry PEDOT, and SIS with Wet PEDOT. Tactile sensation was evaluated with von Frey filament stimulation at the operative site on POD 90 and 180. Statistical significance was determined by Kruskal-Wallis analysis with multiple comparisons as the model was significant. Final evaluations on POD 180 will also include histomorphometric analysis.

Results:

Lower von Frey thresholds reflect higher sensitivity (Chaplan 1994), implying more pain due to neuroma formation within the PNI. At 90 days, the Sham group was less sensitive than the Divided Nerve group. Addition of Dry PEDOT to the SIS scaffold increased the sensitivity of the operative site compared to the SIS scaffold alone (0.013 ± 0.017 vs. 0.22 ± 0.33, p < 0.05). However, sensitivity for the Wet PEDOT group was not increased at 90 or 180 days (power = 0.61, α = 0.1). At 180 days, the divided nerve group continued to show increased tactile sensitivity but the differences in the PEDOT groups were no longer statistically significant (Table 1).

Conclusions:

By distinguishing the Divided Nerve group from the Sham group, the von Frey system quantitatively stratifies subjects with and without neuromas in both the acute and chronic phases. The tactile sensitivity from Wet PEDOT was statistically no different than the SIS scaffolding alone at both three and six months, perhaps due to its more pliable mechanical characteristics.
Modified Approach for Lateral Femoral Cutaneous Nerve Decompression in Patients with Meralgia Paresthetica

Institution where the work was prepared: Georgetown University Hospital, Washington, DC, USA
Ivica Ducic, MD, PhD; Matt Iorio; John Felder, MD; Georgetown University Hospital

Introduction:
Meralgia paresthetica is syndrome of pain and paresthesias in the distribution of the lateral femoral cutaneous nerve (LFCN) in the thigh. Commonly affecting the obese or diabetic population, as well as those prone to work related repetitive nerve injury from pressure across the anterior superior iliac spine and inguinal ligament, initial treatment should include symptomatic management and elimination of any provoking factors. For symptoms persisting beyond three months, surgical decompression is known to ameliorate symptoms. Current surgical approaches do not adequately account for the anatomic variability of the LFCN, as widely described in the literature. We address this issue with a new and safer surgical approach based on our experience of 93 LFCN decompressions or branch neuroma excisions, in order to improve surgical outcomes and patient morbidity.

Technique:
Anatomic variability affecting the relationship of the LFCN and the ASIS and/or the inguinal ligament places the nerve at high risk of injury if decompression is focused at the site of entrapment, as radial incisions through the ligament at this site may damage the nerve. Our modified approach defines a technique of distal identification and retrograde decompression of the LFCN to ensure complete visualization of the nerve during dissection through the points of entrapment.

Conclusion:
If the distal approach we propose is adopted, and the nerve is first identified in an area where it is not actively compressed, dissection can proceed towards the point of maximal compression without accidental injury to the nerve, thereby improving patient safety and maximizing surgical results and symptom relief.

Tendon Transfer or Nerve Transfer for Elbow Flexion. What is the Evidence? A Systematic Review

Institution where the work was prepared: McMaster University, Hamilton, ON, Canada
Wendy Kar Yee Ng, MD; Sophocles Voineskos, MD; Achilles Thoma; McMaster University

Purpose:
Both tendon transfers and nerve transfers have been reported as techniques to restore elbow flexion after upper extremity nerve injury. The purpose of this presentation is to assess the literature to determine if there is any superiority of nerve transfers over tendon transfers.

Methods:
The following electronic databases were assessed for relevant articles by two independent reviewers: Medline, Cochrane, Embase and CINAHL. Articles were selected using specific inclusion criteria. Methodological quality of observational and non-randomized studies was assessed using the MINORS scale, and a predetermined score 10 or greater was considered to indicate a high quality study. We independently extracted data for the following clinical outcomes: range of motion, strength, quality of life, cost and complications.

Results:
In total, 417 articles were identified. Forty-eight articles were assessed as relevant and included in the final analysis. Our kappa agreement was 0.96. Forty-five of these 48 studies were retrospective and 3 were prospective. Three non-randomized articles and only 1 comparative study was deemed as high quality using the MINORS scale.

From the articles where data were available, mean range of motion was 133.3 degrees for 3 nerve transfer patients compared to 111.5 degrees for 106 tendon transfer patients. In addition, 52.2% of 67 nerve transfer patients could actively flex more than 90 degrees compared to 100% of 7 patients who underwent triceps to biceps transfer.

With respect to strength, 78.4% of 1101 nerve transfer patients had strength of M3 or greater vs. 88.2% of 34 tendon transfer patients. Furthermore, mean strength was 2.2 kg for 62 nerve transfer patients vs. 3.3 kg for 7 tendon transfer patients.

Finally, 0.74% (4/451) of nerve transfer patients compared to 8.41% (9/107) of tendon transfer patients had significant complications after operation, such as the need for re-operation or secondary operations.

Conclusions:
There is weak evidence that tendon transfer may be superior to nerve transfer with respect to strength, as measured by kilograms and by the MRC grading scale. There is weak evidence that significant complications are less often associated with nerve transfer compared to tendon transfer.

To better determine the overall superiority of either nerve transfers or tendon transfers, methodologically sound randomized controlled trials in defined populations with standardized techniques, and follow-up with unbiased independent outcome assessments, are needed.
Contralateral C7 Transfer (CC7T) with Long-term Follow-up (at Least 4 years) at Chang Gung Memorial Hospital

Institution where the work was prepared: Chang Gung Memorial Hospital, Taoyuan, Taiwan
Shu-ying Chang; David Chwei-Chin Chuang; Chang Gung Memorial Hospital

Background:
Contralateral C7 (CC7) transfer for brachial plexus injuries can benefit finger-like sensation but remains a controversial technique due to a wide variation in motor results. We reported our 20-year experiences of using CC7 transfer for different etiologies, versatility, sequelae, and results after at least 4 years follow-up.

Patients and Methods:
145 patients for different conditions were treated by CC7 transfer (1989 to 2006). 103 patients were collected after exclusion criteria. They all were performed by a single surgeon and had at least 4 years follow-up. Vascularized ulnar nerve graft (VUNG) either with pedicle or free fashion was utilized in all for CC7 elongation. The graft either passed through chest or neck. In cross-neck passing, it was passed either through subcutaneous or prevertebral tunnel. The VUNG was either transferred to the median nerve (one target) in 55 patients, or to the median and musculocutaneous nerves (two targets) in 24 patients. In another 25 patients, the CC7 transfer was one of stage procedures which was followed by functioning muscle transplantation for finger flexion.

Results:
Finger flexion strength M³3 was considered as success in function. Success rate in CC7 transfer to the median nerve alone was 55.4%; in CC7 transfer to the musculocutaneous and median nerve was 39.10%. However, success rate in CC7 transfer followed by functioning muscle transplantation is higher with 75%.

Conclusion:
CC7 is still a good resource for motor and sensory restoration in severe brachial plexus root injury and severe spastic hand patients. CC7 transfer to the musculocutaneous and median nerves followed by functioning muscle transplantation for deep finger flexors replacement can provide a comparable and quick outcome for elbow and finger flexion.
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Conclusion
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Modified Latissimus Dorsi Muscle Transfer for External Rotation in Brachial Plexopathy

Institution where the work was prepared: University of Montreal, Montreal, QC, Canada
Dominique M. Tremblay, MD; Patrice Tetreault, MD, MSc; Andre Chollet, MD; Jenny C. Lin, MD, PhD; University of Montreal

Purpose:
Loss of external rotation due to brachial plexus injury is functionally debilitating and few secondary procedures exist to correct this deficiency. The Latissimus dorsi has been used as a tendon transfer to restore external rotation in rotator cuff tear patients. In some reports, however, patients with this transfer do not regain active external rotation past 0°, and experience no increase in force. We hypothesize that this is due to the biomechanically disadvantaged line of pull of the latissimus dorsi muscle.

Methods:
Using a cadaveric biomechanical model with the arm at 0° of abduction, we determined the forces necessary to go from 0° to 40° of external rotation using two different lines of pull. The first was in the natural line of pull of the latissimus dorsi muscle, with the insertion transferred to the greater tuberosity of the humerus, representing the traditional tendon transfer. The second line of pull tested was that of the infraspinatus muscle, with the same insertion site.

Results:
On average, 40% greater force was necessary to move the cadaveric upper limb into external rotation using the original line of pull of the latissimus muscle. Reorienting the line of pull to the axis of the infraspinatus allowed more degrees of external rotation with the application of less force. These findings were statistically significant. One brachial plexus patient with no active external rotation consented to a modified latissimus dorsi muscle transfer reorienting the muscle’s line of pull to that of the infraspinatus muscle. Clinical results will be presented.

Conclusion:
This biomechanic cadaveric study showed that reorienting the latissimus dorsi muscle’s line of pull into that of the infraspinatus muscle decreases the force necessary for external rotation, suggesting that clinical results can be improved with this muscle transfer by modifying the origin and insertion of the muscle.
Development of a Microsphere Drug Delivery System to Promote Nerve Regeneration After Peripheral Nerve Injury

Institution where the work was prepared: The Hospital for Sick Children, Toronto, ON, Canada

Matthew D. Wood, PhD; Howard Kim, MS; Alex Biblly; Tessa Gordon; Molly Shoichet; Gregory H. Borschel; (1)The Hospital for Sick Children, (2)University of Toronto

Purpose:
The majority of bioengineering strategies to promote peripheral nerve regeneration after injury have focused on therapies to bridge large nerve defects. Fewer therapies are being developed to treat other nerve injuries, such as nerve transection. Repair of nerve transections generally have acceptable clinical outcomes unless the injury has persisted untreated for months. In these cases, the proximal nerve has undergone chronic axotomy due to long periods without attachment to the distal nerve stump resulting in motor axons that require increased amounts of growth factors to encourage them to regenerate. Glial-derived neurotrophic factor (GDNF) has previously been shown to promote motor nerve regeneration following chronic nerve axotomy. However, bioengineering strategies to provide sustained local release at the injury site are lacking. Therefore, the design of a controlled drug delivery system for nerves following chronic axotomy repair could be beneficial in promoting axon regeneration.

Methods:
We constructed polyactide-glycolic acid (PLGA) microspheres capable of extended GDNF release. In vitro protein release assays (ELISA) and cellular biological activity assays were performed to optimize the microsphere size, encapsulation efficiency of GDNF within the microspheres, and the time course of GDNF release. An in vivo drug delivery system was developed by placing the microspheres within a carrier fibrin gel (1st layer) that was surrounded by a layer of Tisseel glue (2nd layer) to localize the delivery system to a nerve injury coaptation. The drug delivery system was evaluated over 2 months to determine microsphere location within the layers and fibrin degradation.

Results:
Microspheres containing biologically active GDNF were constructed that can encapsulate and retain at least 65% of the initial GDNF loaded into the microspheres. Furthermore, GDNF released from the microspheres was biologically active for at least 7 days with cumulative GDNF release over time. The in vivo drug delivery system demonstrated that microspheres placed within a fibrin gel stay localized to the nerve following implantation. Additionally, the two-layer fibrin gel system degraded over the course of 2 months when implanted next to a nerve injury coaptation.

Conclusions:
Microspheres can delivery biologically active GDNF for an extended period and can be incorporated into a drug delivery system for localized delivery to a nerve injury site. Overall, the ability of the delivery system to provide GDNF to a nerve injury site may promote improved nerve regeneration and functional outcomes following chronic nerve axotomy.

Analysis of Spatiotemporal Expression of Regeneration-Associated Genes (RAGs) after Nerve Injury and During Regeneration

Institution where the work was prepared: Ochsner Clinic Foundation, New Orleans, LA, USA

Olawale Sulaiman, MD, PhD; Thomas D. Dreesen, PhD; Doan Nguyen, PhD; (1)Ochsner Clinic Foundation, (2)Louisiana State University Health Science Center

Introduction:
Injured peripheral nerves have the potential to regenerate but often functional recovery is suboptimal even after excellent microsurgical repair. Previous studies from our and other laboratories have demonstrated that chronic Schwann cell (SC) denervation, chronic neuronal axotomy and misdirection of regenerating axons are key factors that impair functional regeneration of injured axons. The chronically denervated SCs and chronically axotomised injured neurons lose their expression of regeneration-associated genes (RAGs) as reinnervation of injured target is delayed either as a result of delayed repair or regeneration over long distance to denervated targets. However, the spatiotemporal expression and loss of RAGs in the SCs of injured neurons stump and what happens to SC expression of RAGs during regeneration after immediate or delayed repair is not well understood. The effects of cytokines and neurotrophins on the pattern of expression are also not well understood.

Purpose of study:
To determine the spatiotemporal expression of RAGs in the distal nerve stump after acute and chronic nerve injuries as well as during nerve regeneration after immediate and delayed repair. We are also exploring the effect(s) of transforming growth factor-β and forskolin on the expression of RAGs after chronic nerve injury and during regeneration.

Methodology/design:
Rat model of sciatic nerve injury and repair will be used. In the control experiments, the Sciatic nerve will be cut and at 0 day, 4, 8, 12 weeks, two 1 cm long pieces of the distal nerve stumps are harvested for analysis of expression of RAGs in the 2 nerve segments using immunohistochemistry and gene array. In experimental group I, the TIB branch will be cut and either i) immediately repaired or ii) repaired after 2 months delay and regeneration into the distal nerve stumps is allowed for 6 weeks. In our experimental group II, same surgeries as in exp group I are performed but we apply either 0.5µM forskolin, or 1ng/ml of TGF-β or forskolin and TGF-β at the suture site. Same tissues are harvested as in the control groups.

Expected results: We expect an upregulation of RAGs in the distal nerve stumps immediately after injury up to 4 weeks and then a gradual decline; reinnervation of freshly cut distal nerve stump should upregulate RAGs but not after 2 month delay. Application of TGF-β and forskolin should induce the expression of RAGs as seen in freshly injured nerve and during regeneration into fresh cut distal nerve stumps.
Background:

Autologous nerve is the gold standard for bridging gaps in nerve repair, but has several drawbacks including the limited number of donor nerves and harvest site morbidity. Synthetic or autologous guidance tubes have failed to reach autograft quality regeneration except for sensory nerves with small gaps (<3cm). Synthetic and autologous tubes’ failure has been linked to low density of supporting cells, such as Schwann cells (SC), and the lack of longitudinally-oriented structural features. As a result, tissue engineering has emerged as a promising alternative.

Method:

A bioengineered nerve conduit was created using a novel tissue engineering technology, namely bioprinting. Constructs were composed of SC and bone marrow stem cells (BMSC) were added for their adherence qualities and implications in chronic pain treatment. No scaffold was used. Cylindrical “bio-ink” units are stacked according to a computer script. The construct matures for 10 days post-printing to allow for fusion of the discrete cylindrical units (Figure 1).

Results:

The pilot study is in the data collection period. Preliminary results of the nerve construct in rat sciatic nerve repair show an average of 3700 axons distal to the nerve repair (40% of the proximal nerve axons). There does appear to be a trend toward superior regeneration compared to collagen tube alone. The finalized data will be presented.

Conclusions:

This study presents a novel bioengineering method for creation of a scaffold-less nerve repair. This bioengineered tube has the advantages of high SC density and longitudinally-oriented structural features. The pilot study data is being finalized and further study is underway to better quantify the rate of regeneration. We hypothesize that this novel nerve conduit may obviate the need for autologus grafting in the future.

Two Methods for Modeling Aberrant Kinematics in Upper Extremity Nerve Compression Syndromes

Institution where the work was prepared: Washington University School of Medicine, St. Louis, MO, USA

William E. Janes:1; Rachel E. Meltzer:2; Jack R. Engsberg:2; Justin M. Brown, MD:2; (1)Washington University, (2)Washington University School of Medicine

Upper extremity nerve compression (UENC) syndromes share the hallmark features of pain and reduced function (1-2). Carpal tunnel syndrome (CTS) alone accounts for more days of lost work in the U.S. than any other condition (3-4). Work-related upper extremity disorders (WRUED) as a whole account for 1/3 of workers’ compensation costs in US private industry (5). Pathological kinematics, including cervicothoracic and scapular alterations, contribute to the development of WRUEDs, including subacromial conflict, glenohumeral instability and neurovascular impingement (6-10). These same postures have been associated with a number of nerve compression entities, including thoracic outlet syndrome (11-13) and CTS (14-15).

The relationship between kinematics and neuropathy has been studied more extensively in the lower extremity. Aberrant posture and compensatory proximal muscle activity in lower extremity neuropathy patients have been attributed to decreased afferent input to the spinal cord (16-17). Tourniquet ischemia, ice bath, and Lidocaine (18-20) have been utilized as models of lower extremity peripheral neuropathy. Here, two deafferentation methods are tested as models of UENC. Thorax, neck, and shoulder kinematics of patients with UENC are compared to the those of healthy subjects before and after temporary deafferentation via either tourniquet ischemia or lidocaine injection. We hypothesize that: 1) Both interventions change proximal posture and dynamics; 2) Kinematic changes resulting from deafferentation resemble those seen in persons with UENC. Additionally, we examine differences in the kinematics resulting from each intervention to determine whether either method is a better model of UENC.

Five UENC patients and ten controls performed a series of standardized movements. A video motion capture system collected 3D kinematic data. Controls were tested before and after intervention on the non-dominant upper extremity. Intervention for five controls consisted of a tourniquet applied at mid-humeral level inducing median, ulnar, and radial nerve block. Intervention for the remaining five controls consisted of 2CC 1% Lidocaine injected at the carpal tunnel resulting in localized median nerve block. Analysis is ongoing. Preliminary results indicate that both interventions resulted in kinematic changes, including increased cervicothoracic flexion and altered scapula orientation. We expect to detect similarities in post-intervention and UENC kinematics. We will also examine differences between the two models. The nociceptive experience of the mid-humeral tourniquet may influence kinematics beyond what can be explained by deafferentation alone. Should localized deafferentation of the median nerve via Lidocaine prove an effective model, more global deafferentation via tourniquet - and the associated pain response - may prove unwarranted.
MicroRNAs (miRNAs) are a class of highly conserved, non-coding RNAs involved in posttranscriptional gene regulation. The muscle-specific miRNAs miR-1, miR-133a, and miR-133b are expressed in skeletal muscles and have been shown to contribute to muscle growth and differentiation. This study was designed to profile the expression of muscle-specific miRNAs and to identify the regulated genes in the innervated skeletal muscle after denervation and re-innervation.

Methods:
The expression of muscle-specific miRNAs of the soleus muscle of the rats were analyzed with quantitative real-time PCR at 1 week, 1 month, 2 months, and 4 months after sciatic nerve denervation and re-innervation. In addition, a combined approach using computational prediction by the miRanda website and the Agilent Whole Rat Genome 4x44k oligo microarray experiment was performed to investigate the potential target genes of these three miRNAs in the denervated and re-innervated muscles.

Results:
The results revealed that the expression of miR-1 and miR-133 increased by ~2-fold at 4 months both after denervation and re-innervation; on the other hand, the expression of miR-206 was significantly increased to ~3-fold 1 month later only following re-innervation but not following denervation, and lasted at least for 4 months. The expression pattern of miR-206 was different from that of miR-1 and miR-133a. The combined approach with the target-prediction networks and whole rat genome oligo microarray experiments yielded a dozen potential targets of these muscle-specific miRNAs in the denervated and re-innervated muscles. Among these, 2 genes (Hnrpu and Npy) and 1 gene (Ptprd) were potentially regulated both in the denervated and re-innervated muscle by miR-1 and miR-133a, respectively. There were six potential target genes (Hnrpu, Lsamp, MGC108776, Meif2, Npy, and Ppfibp2) of the up-regulated miR-206 in the re-innervation muscle. Among these, 3 genes (Hnrpu, Npy, and MGC108776) were potentially regulated by both miR-1 and miR-206.

Conclusion:
This study has profiled the expression of muscle-specific miRNAs and identified their potential target genes in the soleus muscles following sciatic nerve denervation and re-innervation. Among those potential target genes, because the Meif2 transcription factor was reported to promote the transformation of type II fast glycolytic fibers into type I slow oxidative fibers, the up-regulation of miR-206 with decreased expression of the Meif2 transcript in the 4 months re-innervated muscle, which presented type II fiber predominance four months after nerve micro-anastomosis, might also indicate the role of miR-206 in determining the fiber type after peripheral nerve regeneration.
The Vein Supported with Muscle and Bone Marrow Stromal Cells Compared to the Nerve Autograft as a Natural Conduit for Bridging a 15mm Nerve Defect in Rats

T.H.J. Nijhuis, ms; J.W. Neck van, PhD; E.T. Waltebeehm, MD, PhD; J.H. Blok, PhD; S.E.R. Hovius, MD, PhD; Erasmus MC, University Medical Center

Introduction:
The aim of nerve repair is to encourage the axons to reach the distal side of the lesion and to re-innervate the end organ after trauma. The primary choice of treatment for peripheral nerve laceration is end-to-end repair. However, if the nerve defect is too large for primary repair, a graft is required to bridge the defect. We investigated the use of a vein as a natural conduit in a rodent model. Our model used a vein which was filled with a small piece of fresh muscle to keep the intima open and with Bone Marrow Stromal Cells (BMSC) as supportive cellular therapy.

Methods:
In three experimental groups of 20 rats each, a nerve defect of 15 mm was bridged with either a nerve autograft (group I), a vein filled with muscle (group II), or a vein filled with muscle and BMSC (group III).

Toe spread and pin prick were used to evaluate motor and sensory function at 1, 3, 6 and 12 weeks. Compound muscle action potentials (CMAPs) and the gastrocnemius muscle index (GMI) were recorded at 6 and 12 weeks to assess conduction properties and denervation atrophy, respectively.

Results:
Twelve weeks after grafting all animals responded with a toe spread and pin prick reaction; however, significant differences were found between the autograft and both vein graft groups at 12 weeks, with superior performance in the autograft group. Six weeks after grafting, no difference was found in the GMI and CMAP measurements. At twelve weeks, group I demonstrated a significant increase in GMI and significantly better CMAP results compared to group II and group III.

Discussion:
Our modified grafting technique combining vein and muscle with supportive cellular therapy proved to enable nerve regeneration. However, the autograft resulted in better functional regeneration as demonstrated by all evaluation techniques used. This suggests that the potential clinical application of a vein graft with additional cellular therapy should be further investigated. More specifically, to elucidate the beneficial effect of the BMSC alone, a different model would need to be used.

We conclude from this model, young healthy rats with a 15 mm nerve defect, that the nerve autograft remains the preferred grafting technique when compared to the BMSC filled vein graft supported with muscle.

Traumatic Neuroma in Continuity Injury Model in Rodents

Jacob D. Alant, MBChB, MMed; Stephen W.P. Kemp, BSc, PhD; Kathleen J. Khu, MD; Ranjan Kumar; Aubrey A. Webb, PhD; Rajiv Midha, MD, MSc; University of Calgary

Background:
Peripheral nerve injuries most challenging to manage clinically are often mixed Sunderland grade 3 and 4 lesions giving rise to neuroma in continuity (NIC), whose spontaneous functional recovery is limited or absent. Histological characteristics of traumatic NIC include aberrant intra- and extra-fascicular axonal regeneration and fibrosis. To our knowledge a clinically relevant rodent model of NIC has not been developed. Such a model would be useful to develop intervention strategies to improve patient outcomes.

Methods:
Various injury techniques were tested on freshly harvested Lewis rat sciatic nerves ex vivo, and examined histologically before inflicting more refined injuries in vivo. The optimal experimental injuries combined a 50g traction force applied with a spring scale hooked around the sciatic nerve, and a focal 3 second firm crush using a malleus nipper. Nerves were harvested at 0, 5, 13, 21 and 65 days, and processed for longitudinal 8 micron cryostat sectioning, H&E, laminin, neurofilament, GFAP and Masson’s trichrome staining. Skilled locomotion (tapered beam, ladder rung) and flat plane locomotion for ground reaction force (GRF) analysis were performed serially up to 9 weeks with the experimental (n=6) and simple (control) crush injuries (n=5) by blinded animal behavior experts.

Results:
Disruption of the endoneurium and perineurium with aberrant intra- and extranucleal axonal regeneration and progressive fibrosis was consistently demonstrated histologically in 17 of 17 nerves with experimental injuries. At 8 weeks, experimental animals displayed a significantly greater slip ratio in both skilled locomotor assessments as compared to nerve crush animals (p<.01). GRF’s of the crush-injured animals showed earlier improvement compared to the experimental animals (4 vs. 6 weeks), whose overall GRF pattern failed to recover as well as the crush group at 9 weeks.

Conclusion:
We have demonstrated histological features and poor functional recovery consistent with NIC formation in a rodent model. The injury mechanism employed combines traction and compression forces akin to the physical forces at play in clinical nerve injuries. This model may serve as a tool to help diagnose this injury earlier and to develop intervention strategies to improve patient outcomes.
Dorsal Root Implantation Promotes Axonal Regeneration by Spinal Cord Neurons Following Ventral Root Avulsion Injury

Introduction:

Following lumbosacral ventral root avulsion (VRA), ventral root reimplantation (VRI) is neuroprotective and promotes axonal regeneration and functional reinnervation. If the ventral roots are retracted or if injury extends distally along the root, direct replantation into the spinal cord may not be feasible and a nerve graft would be required. Dorsal root avulsion or transection often accompanies VRA and is considered irreparable. We propose that a lesioned dorsal root may be a source for a comparable donor for elbow flexion, as well as concomitant identification of C6 as another intra-plexal source for neurotization.

Methods:

Left L5-S2 VRA and L6 dorsal rhizotomy was performed on 18 female Sprague-Dawley rats. The animals were evenly divided to undergo implantation of a 1 cm segment of the L6 ventral (VRI; n=9) or L6 dorsal (DRI; n=9) root into the lateral funiculus of the spinal cord at the L6/S1 level. The distal ends of the implanted root segments were ligated. After seven weeks, the implanted roots were embedded in plastic and stained with Toluidine blue. The myelinated fibers in the implanted root segments were quantified and the nerve fiber and axon diameters, myelin thickness, and area of the implanted roots were measured. The G-ratio (axon diameter/nerve fiber diameter) was calculated. Statistical analysis included t-test or Mann-Whitney ranks sum test when appropriate.

Results:

DRI had significantly larger cross-sectional areas than VRI (22608 ± 5577 vs 15585 ± 7199 µm²; p=0.049) and contained more axons (2337 ± 405 vs 1054 ± 511; p=0.001). The axonal density was significantly greater in DRI (1072 ± 231 vs 716 ± 295 axons/100 µm²; p=0.015). There was no difference between groups for axon diameter (1.97 ± 0.81 vs 2.05 ± 0.91 µm; p=0.217), myelin thickness (0.60 ± 0.19 vs 0.59 ± 0.16 µm; p=0.690), or G-ratio (0.61 ± 0.07 vs 0.61 ± 0.08; p=0.9).

Conclusions:

Following VRA, intraspinal implantation of lesioned dorsal or ventral root segments promotes axonal regeneration by spinal cord neurons. The extent of regeneration is superior following dorsal root implantation. These findings support the use of dorsal root as nerve grafts to reconnect avulsed ventral roots to the spinal cord. Future studies will compare the neuroprotective effect of DRI versus VRI and determine whether functional reinnervation occurs when a segment of the dorsal root is used as a graft between the avulsed ventral root and spinal cord.
We present our experience with intraoperative decision making and long term outcomes. Literature reports on center experiences and related operative strategy, but a rotational dysbalance of the glenohumeral joint is a frequent (secondary) problem.

Including basic hand function. In upper lesions, a fair balance between elbow flexion and extension and an active abduction until the horizontal line are possible, of performed grafts and/or nerve transfers, and the individual postoperative nerve regeneration and patient rehabilitation. Total lesions show less favorable results.

The clinical outcome clearly depends on the extent and severity of the initial lesion (upper vs. total), the histological quality of root stumps, the type and number grading system. Our results, although limited in sample size, indicate that nerve allografts are a useful adjunct in the reconstruction of the brachial plexus, however, there have been cases where the availability of donor nerves in patients have been insufficient to completely reconstruct the brachial plexus or for future reconstructions. We present the results of 3 consecutive primary brachial plexus explorations where nerve allografts were utilized to reconstruct the brachial plexus in conjunction with the sural nerve. Nerve allografts have been widely used in hand and urologic reconstructions, but these are the first reported cases of using nerve allografts for brachial plexus reconstructions.

All patients presented with complete or partial paralysis of the upper extremity due to OBPP, ranging in age from 3-6 months, and all demonstrated defects of deltoid and biceps function at time of surgery. According to national and international accepted standards, these patients underwent primary brachial plexus exploration and nerve grafting. All patients had exploration, neurolysis and intraoperative nerve conduction studies. Two patients had resection of neuromas to the upper and/or middle trunks with primary nerve grafting utilizing the sural nerve and nerve allografts, and one patient was found to have conduction through the neuroma, and had neurolysis with side to side jump allografts. Follow up was done at 3, 6, 9, and 12 month intervals with the inception of physical therapy in all patients 2 weeks following surgery. Therapy was continued 2 times per week for the year of follow-up and continues to present.

The results showed that all patients recovered at least 3 muscle grades of function in the deltoid and biceps muscle groups, as measured with the British muscle recovered deltoid or biceps function by 3-6 months of age. Previous studies and literature prove that nerve auto grafts (sural nerve grafts) are the ideal choice in reconstructing the brachial plexus, however, there have been cases where the availability of donor nerves in patients have been insufficient to completely reconstruct the brachial plexus or for future reconstructions. We present the results of 3 consecutive primary brachial plexus explorations where nerve allografts were utilized to reconstruct the brachial plexus in conjunction with the sural nerve. Nerve allografts have been widely used in hand and urologic reconstructions, but these are the first reported cases of using nerve allografts for brachial plexus reconstructions.

Primary brachial plexus exploration and nerve grafting has been the standard of care for obstetrical brachial plexus palsy (OBPP) patients who have not recovered diotald or biceps function by 3-6 months of age. Previous studies and literature prove that nerve auto grafts (sural nerve grafts) are the ideal choice in reconstructing the brachial plexus, however, there have been cases where the availability of donor nerves in patients have been insufficient to completely reconstruct the brachial plexus or for future reconstructions. We present the results of 3 consecutive primary brachial plexus explorations where nerve allografts were utilized to reconstruct the brachial plexus in conjunction with the sural nerve. Nerve allografts have been widely used in hand and urologic reconstructions, but these are the first reported cases of using nerve allografts for brachial plexus reconstructions.

In this retrospective study, 15% (22/145) of patients with traumatic brachial plexus injury suffered from a new-onset headache after their injury, a third of these (7/22) having characteristics of low-pressure headache. These headaches, likely secondary to a CSF leak associated with the brachial plexus injury, occur in a significant proportion of patient and have been under-recognized.

Innovative Techniques in Primary Brachial Plexus Reconstruction

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Intraoperative Choice of Reconstructive Strategy in Obstetric Brachial Plexus Palsy

Early reconstructive surgery of severe obstetric brachial plexus palsy (obpp) includes supraclavicular exposure of the lesion followed by neuroma excision and intra- and extraplexic reconstruction using free sural nerve grafts and nerve transfers. We present our strategy and clinical results, focussing on intraoperative decision arguments.

Material and Methods:
Between 2000 and 2010, out of 1100 patients examined in our Institution, 155 obpp reconstructions were performed, including 40 in total lesions. Intraoperative tools included electrical stimulation and neurohistopathology on proximal and distal nerve stumps. Postoperative assessment included regular measurement of active and passive range of motion, and occasional foto and video documentation.

Results:
The clinical outcome clearly depends on the extend and severity of the initial lesion (upper vs. total), the histological quality of root stumps, the type and number of performed grafts and/or nerve transfers, and the individual postoperative nerve regeneration and patient rehabilitation. Total lesions show less favorable results, including basic hand function. In upper lesions, a fair balance between elbow flexion and extension and an active abduction until the horizontal line are possible, but a rotational dybance of the glenohumeral joint is a frequent (secondary) problem.

Discussion:
We present our experience with intraoperative decision making and long term outcomes. Literature reports on center experiences and related operative strategy, we therefore discuss our choice based on available clinical and scientific arguments, focussing on intraoperative neuropathology, the choice and performance of nerve transfers, the place of extraplexic donors and the long term clinical outcome.
The BMRC Scale vs. Objective Elbow Flexion and Extension Strength Measurement

Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA
Leili Shahgholi, fellow; Keith A. Bengtson; Allen T Bishop; Alexander Y Shin; Robert J. Spinner; Kenton R Kaufman; Mayo Clinic

Objective:
To critically evaluate manual muscle strength testing using the British Medical Research Council (BMRC) grading scales. Manual muscle strength is typically assessed using the 0-to-5 scale developed by the British Medical Research Council in 1946. Although widely used, little analysis of its validity is available. There are some papers which compare quantitative strength testing to manual muscle testing in the lower limb but no study has been performed on the upper extremity. Therefore, this study was undertaken to compare quantitative elbow flexion and extension versus manual muscle testing.

Design:
Retrospective cohort setting

Participants:
92 subjects aged 8-65 with brachial plexus injury were tested for elbow flexion strength. 84 of these subjects were tested for elbow extension strength.

Method:
Elbow flexion and extension strength was evaluated with both the traditional manual test method and quantitative elbow flexion and extension strength measured with either a hand held dynamometer and or an instrumented load cell. All data was converted to normal percentile using an existing database of unimpaired subjects tested with the same instrumentation. In 2/3 of subjects, comparison was done with their own uninjured side. Analyzing data was made using Wilcoxon / Kruskal-Wallis (rank –sum) and Dunn method.

Results:
Patients who were graded normal strength for elbow flexion, i.e. “5”, by manual muscle testing had less than 42% (median) of normal strength. Grade “4” was less than 16% of normal and grade 3 was less than 6 %, grade 2 about 0.5% and grade 1 and 0 were both 0%. In comparing MMT and QST, half of patients who were graded as having normal strength had less than 62% of normal strength when tested quantitatively. Grade “4” was less than 32% of normal, grade 3 was less than 9.9%, grade 2 about 1.2% and grade 1 and 0 were both 0%. There were significant differences in strength measured quantitatively between subjects who received a grade 4 or 5 (P =0.05) but there was no significant differences in grades 0, 1, 2 and 3.

Conclusion:
Traditional routine manual muscle test is misleading. When a patient is assumed to have good force production, even when graded at grade 5, there may actually be a major weakness that needs serious consideration. These strength deficits should be carefully considered with providing patient care.

Corneal Neurotization: A Novel Technique for the Anesthetic Cornea

Institution where the work was prepared: Eastern Virginia Medical School, Norfolk, VA, USA
Julia K. Terzis, MD, PhD; Marylou M. Dryer; Bruce I. Bodner; Eastern Virginia Medical School

Purpose:
This report describes and evaluates the efficacy of a novel procedure, direct corneal neurotization using contralateral, supraorbital, and supratrochlear nerves in patients with unilateral facial palsy and anesthetic cornea.

Methods:
The charts of 6 patients were thoroughly reviewed. Evaluated outcome parameters included corneal sensibility, improvement in best-corrected visual acuity, blink reflex, donor deficit, synesthesia, long-term corneal health, several psychosocial measures, and overall patient satisfaction.

Results:
The mean age at time of surgery in our study was 41.7 +/- 9.07 years. Average time from denervation to surgery was 7.00 +/- 8.56 years with an average follow-up time of 16.3 +/- 2.42 years. After surgery, all 6 eyes showed improvement of corneal sensibility, visual acuity, and corneal health and remained free of ulcers without adjunctive surgical treatment. Average time to sensibility was 2.80 +/- 2.17 years, and average corneal sensibility improved from 2.00 +/- 4.47 mm before surgery to 27.8 +/- 22.6 mm after corneal neurotization (P < 0.016).

Conclusions:
Direct neurotization of the cornea using the contralateral, supraorbital, and supratrochlear branches of the ophthalmic division of the trigeminal nerve seems to be an effective method for restoration of corneal sensibility in patients with unilateral facial palsy and anesthetic cornea. This procedure preserves ocular anatomy and cosmesis while restoring function by improving corneal health and visual acuity and by reestablishing the blink reflex.
Peripheral Nerve Compressions in the Lower Extremities Aggravating Restless-Legs-Symptoms - Selected RLS-Patients Profit by Surgical Nerve Decompression

Institution where the work was prepared: Caritas Krankenhaus Lebach/Arabella Klinik Munich, Lebach/Munich, Germany

Martin Raghunath, MD; Arabella Klinik, Munich

Introduction:
The pathophysiology of Restless-Legs-Syndrom (RLS) is not completely understood. Central nervous reasons like dopamine neurotransmission as well as spinal cord hyperexcitability and a lack of flexor-reflex inhibition are discussed. Considering the afferent part of the reflex peripheral nerves could play a role by triggering the reflex. This paper investigates the role of peripheral nerve compression in the lower extremities as a trigger of restless-legs-symptoms.

Method:
30 patients (20 female, 10 male, age average 66.8 years) were identified to have combined symptomatic nerve compressions in the lower extremities by careful consideration of the symptoms (character, localization), by clinical examination of the anatomical sites of potential nerve compression (tenderness, Tinel-sign) and quantitative sensory testing (pressure specified sensory device, PSSD TM). 28 patients were diagnosed by neurologists, 1 by polysomnography (ENT), 1 by a generalist to have RLS Syndorm and all were taking specific drugs. 40 decompression surgeries have been performed because 10 patients returned after successful surgery to have the contralateral side done. Decompressed nerves have been common peroneal nerve (40), superficial peroneal nerve (30), deep peroneal nerve (40), tibial nerve with calcaneal and plantar branches (40). The surgery was performed according to the description given by Dellon. In 4 patients additionally a metatarsalgia was treated. The severeness of the RLS (IRLS score), pain level (visual analogue scale), the required drugs have been evaluated pre- and postoperative, the patients rated postoperatively the improvement. The follow up time was 3 months to 2 years, average 10 months.

Results:
9 from 10 patients with bilateral surgery rated the improvement >75%, 1 rated 60%. Of the 20 patients with unilateral surgery rated 53% an improvement of >75%, 23% an improvement of >50%. The reduction of the IRLS score was corresponding to these ratings. 3 patients did not show any improvement (after 7, 8, 10 months). The average pain was assessed by VAS preoperatively 7,9 and 2,3 postoperative, 84% of the patients were able to reduce the specific drugs.

Discussion:
There is a subgroup of RLS patients, whose symptoms are aggravated by peripheral nerve compressions. They can be identified by the Dellon’s approach to diagnose and treat combined nerve compressions in the leg. After surgical decompression the patients can reduce the specific drugs and have less pain.

The high level of pain in this group of patients may be an additional indicator to identify patients with nerve compressions.

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Sensory Recovery in the Upper Extremity Using Processed Acellular Human Nerve Allograft

Institution where the work was prepared: Albert Einstein College of Medicine, Bronx, NY, USA

Snezana Vejic, MD; Renata V. Weber; Albert Einstein College of Medicine/Montefiore Medical Center

Hypothesis:
A processed acellular human nerve allograft may be used to reconstruct peripheral nerve gap injuries instead of a conduit or autologous nerve graft without increasing morbidity. Because of its construct, we anticipate comparable results to autograft and superior results to simple conduits.

Methods:
From March 2008 to July 2010, 15 patients were reconstructed with processed human nerve allograft. 2 patients never followed-up, thus a total of 13 patients with 23 nerve defects were evaluated. Three patients were repaired acutely (4 sensory nerves) and 13 patients had delayed repair (19 nerves: 14 sensory, 5 mixed motor). The 22 sensory nerve repairs were digital, while 1 was palmar cutaneous. Mixed nerve injuries were to the median nerve (3), ulnar nerve (1) and radial nerve (1) in the distal upper arm or forearm. Standard assessments were used for the sensory nerve assessments.

Result:
The mean age was 34.1 years (15-53). Mean nerve graft length was 19.6 mm (10-50 mm), mean diameter was 3.1 mm (1-5 mm) and follow-up time ranged between 1 to 27 months post-op. The 4 patients (2 sensory, 2 mix motor nerves) with less than 6 months follow up showed appropriate advancing Tinel sign. Of the 9 patients with 6 months or more of follow up (21 sensory, 3 mixed motor), 6 had sensory recovery with 2 point discrimination average of 4.5 [3mm to 8mm] and ten-ten test average 7.3/10 (5/10 to 9/10). The 3 patients with poor or no recovery (2 sensory, 1 mixed motor), upon re-exploration and repair had internal neuromas proximal to the original repair. After a second reconstruction, they still had less than expected recovery. There was no appreciable difference in sensory recovery between acute and delayed repair or between sensory versus mixed motor in the sensory recovery.

Conclusion:
All subjects recovered well with no signs of tissue rejection or infection. Early clinical outcomes show favorable results with good to excellent recovery of sensation and support the use of processed acellular human nerve allografts for nerve reconstruction. The 3 patients with initial poor results continued to exhibit poor sensory recovery after a second reconstruction, suggesting more extensive injury proximal to the repair thus possible outliers. Additional prospective clinical studies comparing outcomes to autologous nerve grafts are warranted.
Abnormal Post-operative Electrophysiological Findings after Carpal Tunnel Release: a One-year Follow-up

Institution where the work was prepared: The Catholic University, Rome, Italy

Antonio Meroli, MD; Mauro Lo Monaco; Maria Luisa Mereu; Mario Luigetti; Anna Modoni; Francesco Catalano; The Catholic University

Introduction:
Recurrence of carpal tunnel syndrome (CTS) after carpal tunnel release is a rare event, however practitioners may address again the patients to the surgeon if pain of any kind occurs after treatment. Clinical evaluation alone may not distinguish between recurrences and other pathologies so electrophysiological evaluation is seek for diagnostic purposes.

Objectives:
The electrophysiological outcome after carpal tunnel release has been the subject of a limited number of studies, so our objective was to evaluate, during a one-year period, what changes occurred in the electrophysiological parameters and to compare them with the clinical outcome.

Patients and Methods:
Eleven patients which received open-surgery in a consecutive series (no patient was excluded), were studied by measuring electrophysiological parameters at 1-month pre-operatively and, then, at 1-, 3-, 6-, 9- and 12-months post-operatively. Sensory nerve conduction velocity of median (digit 1-wrist and digit 3-wrist) and radial (digit 1-wrist) nerves, as well as distal motor latency of median nerve, were measured. Furthermore, the shift between the latency of median and radial sensory nerve action-potentials (double peak shift; recorded following thumb stimulation) was investigated as a parameter which is independent from possible inter-individual variations in nerve conduction velocity. Data from healthy subjects were used as baseline reference.

Results:
All the patients were followed-up to 3 months; nine to 6 months; six to 9 months and four completed the whole 12 months follow-up period. At 3 months, all patients experienced a distinctive remission in clinical signs and this was maintained afterwards; however, nerve conduction parameters did not returned to normality in most of them. More in details: median sensory nerve conduction remained slow in 10/11 patients at 3 months and in 3/4 patients at 12 months; distal motor latency remained prolonged in 5/11 patients at 3 months and in 1/4 at 12 months; the shift between the latency of median and radial sensory nerve action-potentials did not disappear in any patient at 12 months.

Conclusions:
Despite surgical treatment let the electrophysiological parameters to improve towards physiological values, normality was hardly reached; this sort of “electrophysiological scar” was particularly evident when the “double peak shift” was considered. These results let us to propose that abnormal post-operative electrophysiological findings, in the long term, should not substantiate the diagnosis of a poor outcome or of a recurrence as long as there is the clinical picture of remission.
Detecting Cortical Plasticity Following Median Nerve Injury and Repair in a Rat fMRI Survival Study

Institution where the work was prepared: Medical College of Wisconsin, Milwaukee, WI, USA

Patrick C. Hettinger, MD; Rupeng Li, MD; Ji-Geng Yan, MD, PhD; Younghoon Cho, MD, PhD; James Sanger, MD; Safwan Jaradeh, MD; Chris Pawela, PhD; James Hyde, PhD; Hani S. Matloub, MD; Medical College of Wisconsin

Introduction:
The purpose of this study is to observe the cortical plasticity associated with peripheral nerve injury and repair in a rodent fMRI survival model. Previous non-survival fMRI rodent models of nerve injury and repair required large numbers of animals, with groups randomly selected for a single imaging session at a specific time-point. These studies averaged the results of BOLD activation at each time-point and generalized them to the population. In doing so, previous designs did not account for animal-to-animal variability or the individuality of cortical reorganization inherent in nerve repair.

Materials and Methods:
14 male Sprague-Dawley rats, weighing 250-300 g, were divided into two groups of seven. All animals were first subjected to grip strength and Von Frey monofilament sensory testing of the right forepaw to achieve baseline measurements. All animals were then taken to the operating suite, where group 1 rats underwent a control operation, consisting of implantable electrode placement on the right median nerve. Group 2 rats underwent median nerve transaction and repair along with implantable electrode placement 5 mm distal to the repair site. Both groups then underwent fMRI during direct median nerve stimulation immediately following surgery. The groups were allowed to recover, and were then subjected to grip strength testing, sensory testing, and fMRI two weeks, four weeks, and eight weeks post-operatively.

Results:
There were no fatalities or infectious complications throughout this study. Group 2 rats showed statistically significant weakness and diminished sensation at two weeks and four weeks following nerve injury and repair. Grip strength and sensation returned to baseline at eight weeks, with no statistically significant difference when compared to the control group. In the nerve repair group, cortical activation (measured in voxels) during direct median nerve stimulation averaged 50, 175, 256, and 564 at time zero, two weeks, four weeks, and eight weeks, respectively. Repeated measures ANOVA shows a significant correlation between cortical activation and both functional studies at two weeks, four weeks, and eight weeks following nerve injury and repair. Grip strength and sensory testing returned to baseline at eight weeks, with no statistically significant difference when compared to the control group.

Discussion:
In this study, we have demonstrated a BOLD fMRI survival model to follow cortical plasticity after nerve injury and repair. Furthermore, the correlation between BOLD cortical activation and more traditional methods of peripheral nerve evaluation validates fMRI as a marker of functional outcome following nerve repair. This finding is important as future therapies can be directed more proximally in the neuraxis to the level of the cortex to improve outcomes following peripheral nerve operations.
Axonal Relationships of HUMAN CELLS Transplantation to Repair Nerve Defect IN Nude Rats

Institution where the work was prepared: Miami Project to Cure Paralysis, Miami, FL, USA
Zijie Zhang, MD, PhD; James Guest, MD, PhD; Patrick M. Wood, PhD; (1)Miami Project to Cure Paralysis, (2)University of Miami School of Medicine

We selected the sciatic nerve injury model to test whether chitosan guidance channel seeded Schwann cells (SC) or olfactory ensheathing cells (OECs) facilitated axonal regeneration and myelination of axons. Both human xenografts and rodent syngeneic grafts were studied. Chitosan channels are both biocompatible and biodegradable. Both SC and OECs have been studied in CNS transplantation models. While OECs do not normally form myelin in the olfactory pathway it has been reported that they can do so after transplantation into areas of myelin depletion in the CNS.

Methods:
Purified populations of lentivirally GFP-transfected SC and OECs were prepared respectively. The cells, admixed with Matrigel, were seeded into 1.2 mm chitosan channels to span a 7 mm nerve gap in nude and Fischer rats. After 4 weeks the rats were perfused and the tissues within the channels studied immunohistochemically using anti-GFP anti-neurofilament (NF), and anti-Po.

Results:
The survival and myelination of the transplanted cells have been confirmed by triple immuno-labeling techniques. Based on the number of detectable GFP+ve cells survival of syngeneic transplants was superior to that of xenografts for both SC and OECs. GFP positive SC formed Po+ve myelin around NF+ve axons whereas GFP +ve OECs formed only perineurial-like sheets around fascicles of axons.

Conclusions:
Chitosan tube filled with matrigel/media could induce axonal regeneration. Regenerated cable had good vascularity & morphology. Transplanted OEG, like SC, could survive and form myelin sheath with regenerating axons in immuno-deficient rodent model of PNS. Allograft better then xenograft and SC better than OEG.

The Use of Medical Self-Hypnosis for the Treatment of Perioperative Brachial Plexus Pain and Sleep Disturbance

Institution where the work was prepared: The Upper Extremity Institute, Blue Bell, PA, USA
Scott M. Fried, DO; Upper Extremity Institute

The purpose of this study is to evaluate the effectiveness of medical self-hypnosis to treat intractable pain and sleep dysfunction in operative and perioperative patients with documented brachial plexus injury.

Brachial Plexus Injury may be accompanied by chronic, debilitating, pain, especially in the lateral neck, shoulder, and arm. Mackinnon, Dellon, Hunter and Schwartzman have associated many pain syndromes with documented Brachial Plexus injury. Associated symptoms may include chronic pain, altered sensations, poor motor coordination, vascular instability and severely limited endurance for overhead activity. Many are not surgical candidates and close to 50% of patients who undergo surgery are left with disabling symptoms. Post - operative sleep disturbance and heightened sympathetic pain are of great concern and often hamper the rapidity of recovery and effectiveness of surgical interventions.

Those whose pain and sleep cannot be controlled often slow and falter in recovery from surgery and become chronic pain patients, with a physiologic cause for their pain, often without an operative solution.

Medical Self-Hypnosis is an established treatment modality which is effective in decreasing the need for anesthesia and post procedure pain medication as well as improving recovery time in patients who undergo surgery and radiology procedures (Lang, Esdaile). Its effectiveness for the treatment of chronic nerve pain and sleep disturbance is well established. This study addresses its specific effectiveness in the treatment of upper extremity orthopaedic pain, which has not previously been scientifically established.

The present retrospective study evaluated 25 patients with documented clinical and electrophysiological evidence of brachial plexus injury. Twelve sessions of self-hypnosis were added to standard medical treatment to aid in decreased need for pain medication and improvement in sleep.

Results suggested the patients’ benefit significantly from the utilization of medical self-hypnosis. All patients in our study reported the techniques were helpful. Most reported an improved ability to manage the pain, less emotional discomfort, and enhanced functional ability. A significant percentage of unemployed patients returned to work or school.

These results validate our hypothesis that the pain of upper extremity brachial plexus nerve injury, as well as quality of perioperative experience for those operative patients, can be effectively improved by the addition of self-hypnosis pain management techniques to standard protocols.
Introduction:
The nerve autograft’s status as the “gold standard” for nerve gap reconstruction is well established in literature, however other scientific solutions are needed when autografts are unavailable due to the nature of the injuries or lack of patient consent. Here we present the use of a processed nerve allograft in conjunction with nerve tubes to effectively treat an 80 mm nerve defect in an acute trauma patient.

Materials and Methods:
A 10 year old male involved in an all-terrain vehicle accident presented with a 80x80 mm soft tissue avulsion injury across the right antecubital fossa and acute sensory deficits in the ring and little finger. Local cubital tunnel exploration revealed an ulnar nerve defect measuring 80 mm after nerve transposition into anatomical position. The patient’s guardians declined to consent to harvesting an autograft due to the creation of a nerve deficit. Instead a composite graft was generated using a single 5x70 mm long processed nerve allograft (Avance®, AxoGen, Inc) with a 6x10 mm nerve tube (AxoGuard® Nerve Connector, AxoGen Inc.) secured to each end with 8-0 nylon. Total graft length was 8cm. The ulnar nerve stumps were trimmed until bleeding epineurium was present and the composite graft was implanted into the nerve gap with the proximal and distal stumps placed a few millimeters into the corresponding nerve tubes of the graft. This was secured with 8-0 nylon and fibrin glue sealant.

Results:
There were no intraoperative complications. At 9 month follow-up, the patient had tinel’s sign at 360mm and no evidence of clawing. Physical exam revealed full range of motion and return of protective sensibility along the ulnar nerve distribution. Both patient and guardians are extremely satisfied with the outcome of the repair.

Conclusion:
The variable nature of traumatic injury requires surgeons to creatively assess their armamentarium of treatment options when addressing peripheral nerve injuries. In this case, an off-the-shelf processed allograft was used to provide nerve architecture to the graft and nerve connectors served as coaptation aides to alleviate tension and promote neurotropism. This type of neural composite graft has allowed return of function for an injury that would have otherwise been none. While this approach to nerve injury’s is not widely recommended, our experience does show promise in cases where an alternative to the traditional autograft is desired and warrants further consideration and research.

Re-examining Fibromyalgia and Neuropathic Chronic Pain Syndromes

Jose J. Monsivais, MD; Hand and Microsurgery Center of El Paso, El Paso, TX, USA

A gold standard for the diagnosis of fibromyalgia does not exist. The intent of creating this diagnosis was to prevent patients (a group of individuals with multiple symptoms and apparently very few findings) from being untreated and marginalized by the healthcare system. Unfortunately, this has also provided grounds for secondary gains by patients and tertiary gains by the healthcare system and industry that further compounds the problem and creates confusion. An additional problem is the difficulty in developing a behavior compatible with the condition under study, over time they appear to adapt and improve rather than succumb to the symptoms.

Almost twenty years ago, I investigated the mechanism for the development of referred pain in entrapment neuropathies. Research in both the animal model and the clinical arena showed increased levels of spontaneous electromyographic activity in a specific group of muscles in the upper and lower extremities. I was also able to produce mirror image spontaneous electromyographic activity in the contralateral homonymous group of muscles both in the animal model and then confirmed in human patients.

Over the years, many patients with the diagnosis of fibromyalgia were referred to me by primary care doctors. During electromyographic studies, they exhibited the same muscle activity as in neuropathic conditions involving the ulnar or median nerves in the upper extremity and tibial, sciatic, and peroneal in the lower extremity. The same observation was made at nerve root level. The muscles which show abnormal spontaneous electromyographic activity create a pattern that is strikingly similar to the tender point map described by the American Rheumatology Association.

Concurrent psychosocial symptoms were common and I studied the psychological profile of chronic pain patients for an average of 10 years and noticed the overwhelmingly strong association with affective disorders in the presence of neuropathic pain. There is also a strong association with sleep disorders and high BMI and deconditioning. Patients with osteoarthritis and rheumatoid arthritis can also develop this conglomerate of neuromuscular pain, but not uniformly in all patients, especially in the absence of psychosocial symptoms.

In summary, I hypothesize fibromyalgia represents a neuropathic condition combined with participation of the proprioceptive system and affective disorders with maladaptive behavior, deconditioning, and sleep disturbances. Genetic, environmental, and endocrine influences may also play a role. The same treatment that is used for neuropathic pain conditions is also useful in fibromyalgia.
Assessment of Nerve Regeneration after Entubulation within a Novel Extracellular Matrix-Based Conduit

Haaris S. Mir, MD; Zafar A Sayed; William Arthur Woodson; Karim Sadik, MD; Indiana University School of Medicine

Conduits offer an off-the-shelf option for repairing peripheral nerve discontinuities by allowing approximation of nerve stumps. Entubulation to allow a 1-2mm gap provides advantages over direct repair by alleviating tension, minimizing scar, and reducing risk of neuroma. Historically, conduits have been comprised of cross-linked collagen or synthetics that degrade over time. Although clinical studies using these materials have shown successful results in gaps less than 5mm, extracellular matrices offer advantages by supporting the body’s regeneration process. Extracellular matrix from porcine small intestinal submucosa (SIS) retains signaling molecules2 and provides scaffolding for bringing capillary ingrowth into the repair site3. It has been frequently utilized clinically and is now available as a nerve conduit [AxoGen AxoGuard® Nerve Connector]. The study assessed regeneration through a SIS conduit compared to a cross-linked type-1 bovine collagen conduit [Integra NeuraGen® Nerve Guide]. Rat sciatic nerve was transected and approximated within 1cm devices (n=5 per group). Animals were sacrificed at 4 weeks. Cross-sections distal to the repair site were stained for anti-neurofilament, and axon density was quantified using BIOQUANT software.

Statistical analysis was performed using a Grubbs’ test to detect statistical outliers followed by a t-test. Longitudinal sections through the repair site were collected and reviewed by an independent pathologist. Quantitative comparison distally revealed that axon density was significantly greater in the SIS group compared to the collagen group (p=0.0062; 4200 ± 1400 versus 1300 ± 580 axons / µm²). Qualitative comparison of regeneration through the device revealed distinct differences and reviewed by an independent pathologist. Quantitative comparison distally revealed that axon density was significantly greater in the SIS group compared to the collagen group (p=0.0062; 4200 ± 1400 versus 1300 ± 580 axons / µm²). Qualitative comparison of regeneration through the device revealed distinct differences between the groups. In SIS conduits, regeneration was robust and axon fibers were densely packed into organized fascicular structures. In contrast, axons within collagen conduits appeared as a disorganized meshwork. More specifically, 4 out of 5 animals within the collagen group had >10% of the axons contained within fascicular bundles, whereas 4 out of 5 of the SIS group had surpassed this level. The SIS conduit was incorporated into the epineurium, creating a vascularized tissue ensheathing the regenerating nerve, whereas the collagen conduit did not incorporate. The regeneration though the SIS conduit may be attributed to the presence of signaling molecules (i.e., FGF2, TGF-beta, and VEGF) and its ability to create a nutrient-rich environment at the repair site. In summary, the SIS conduit was incorporated into the epineurium, creating a vascularized tissue ensheathing the regenerating nerve, whereas the collagen conduit did not incorporate. The regeneration though the SIS conduit may be attributed to the presence of signaling molecules (i.e., FGF2, TGF-beta, and VEGF) and its ability to create a nutrient-rich environment at the repair site. In summary, the SIS conduit was incorporated into the epineurium, creating a vascularized tissue ensheathing the regenerating nerve, whereas the collagen conduit did not incorporate. The regeneration though the SIS conduit may be attributed to the presence of signaling molecules (i.e., FGF2, TGF-beta, and VEGF) and its ability to create a nutrient-rich environment at the repair site.

This study presented was sponsored by AxoGen, Inc. and performed at an independent laboratory.
Sensory to Motor Nerve Transfer in a Free Muscle Flap for Plantar Foot Reconstruction: Analysis of Outcomes in A Clinical Case and Review of Literature

Institution where the work was prepared: Hospital Universitario A Coruna, A Coruna, Spain
Andres Rodriguez, MD, PhD; Hospital Universitario A Coruna

Background:
Experimental studies have shown that sensory nerves can regenerate and penetrate into the trimmed muscle surface and grow into the overlying grafted skin after sensory to motor nerve transfer. In the clinical setting this is relevant in reconstruction of defects located in the plantar surface of the foot where muscle flap with skin graft is still the best reconstructive option for some microsurgeons. We present the favorable outcomes of reconstruction of a extensive defect in the foot using a free muscle flap with sensory to motor nerve transfers using a fascicle of the tibial nerve as the neurotizer.

Methods:
A 35-year-old male sustained a degloving injury in the left foot with amputation of the 4th and 5th rays, necrosis of the entire plantar surface but the forefoot with exposure of the calcaneus bone and avulsion of the dorsal skin. After serial debridement reconstruction was performed by means of latissimus dorsi free muscle flap with STSG and sensory to motor nerve transfers using a fascicle of the tibial nerve as the neurotizer and the thoracodorsal nerve as the recipient nerve

Results:
Wound healing was uneventful and gait was started 1 month after surgery. Nerve regeneration inside the muscle was confirmed on a weekly basis through progression of the tinel sign. Complete sensory reinnervation of the muscle was achieved 3 months after surgery and deep sensation was completely recovered.

Conclusion:
Sensory to motor nerve transfers in muscle flaps may achieve effective muscle sensory reinnervation that upgrades the final reconstruction in plantar foot defects.

References:

Anatomical Localization of Supraorbital Nerve Compression in Frontal Triggered Migraines

Institution where the work was prepared: Neuropax Clinic, Saint Louis, MO, USA
Michael A. Fallucco, MD; Robert R. Hagan; Neuropax Clinic

Surgical deactivation of frontal migraine trigger points does not incorporate decompression of a fascial band at the supraorbital notch as part of the surgical procedure. To evaluate this primary compression site for the supraorbital nerve (SON), 60 cadaver supraorbital regions were dissected. The presence of a foramen (27%) and/or a notch (83%) for SON emergence was documented. When a notch was encountered, a fascial band overlying the SON was noted in 86%, or 43/50 of supraorbital regions.

A classification system was developed to categorize the four common fascial band variation patterns observed. Type I bands (51.2%, 22/43), or “simple,” refer to bands that are composed entirely of fascia with a single opening for supraorbital neurovascular passage (Fig 1A-C). Type II bands (30.2%, 13/43), or “partial bony,” refer to bands that are composed of bony spicules with intervening fascia that completes the bridge overlying the supraorbital neurovascular bundle (Fig 2A-C). Type III bands, or “septum,” are those fascial bands with a horizontal septum [Type IIIA, (9.3%, 4/43) Fig 3A-B], or a vertical septum [Type IIIB, (9.3%, 4/43) Fig 4A-B] which allows for a double passageway for the supraorbital neurovascular bundles.

This study verifies the presence of a primary compression site for the SON that is proximal to the glabellar myofascial complex. Knowledge of this potential compression site and its possible anatomical variations will enable surgeons to perform a more complete SON decompression for migraine amelioration.

Figure 1A-C. Type I Supraorbital Fascial Bands
Figure 2A-C. Type II Supraorbital Fascial Bands
Selective Denervation in the Lower Extremity: a Discussion of Learning Curve and Outcomes

Institution where the work was prepared: Regions Hospital, St. Paul, MN, USA

Justine Mann; Loree K Kalliainen; Regions Hospital

Expanding one’s practice can be challenging. Though excision of neuromas to relieve pain has been documented in the literature for decades, selective denervation of the lower extremity for chronic pain unresponsive to conservative measures has only recently been described. Given compelling presentations and publications about selective denervation, the senior author chose to offer this procedure to patients at her institution. Building a patient base involved getting referrals from Orthopaedic colleagues. Discussions with patients included the fact that this was an expansion of accepted practices yet was a relatively novel procedure. The value of a robust informed consent process cannot be underestimated. This presentation will review an effective process for expanding a surgeon’s practice, review the learning curve associated with selective denervation, and discuss successes and complications in the first year of providing this service.

Fourteen patients had selective denervation in the lower extremity over eleven months. All were referred by Orthopaedic Surgeons. All failed nonoperative therapies [narcotics, neurontin, PT, pool therapy, TENS, and compressive wraps]. All patients rated their pain at at least 5/10. Physical exam suggested which nerves were involved, and nerve blocks were performed. If the pain decreased by 5 points, surgery was discussed. Patient demographics: 9F:5M, age ranged from 27-78 years, 8/14 patients had undergone a knee replacement, 6 had nerve pain related to trauma or placement of hardware. Time between the initial orthopaedic procedure and selective denervation ranged from 4 months to 25 years. The operative procedure was done as described in the literature. Postoperatively, pain decreased to 0-2/10 in 78% of the patients. Revision surgery was required in 21%. Two patients developed seromas, one had a late partial wound dehiscence. A history of trauma appears to be associated with a less-optimal result; but the numbers of patients are too small to make definitive statements.

Selective denervation is efficacious for patients who have failed multiple other treatments for pain and who have responded to local nerve blocks. Patient selection, as in many procedures, is likely a key to success. Orthopedic surgeons should be educated about this option for their patients, and selective denervation should be a part of training for plastic surgery residents. The learning curve is relatively straightforward for surgeons who are familiar with peripheral neuroanatomy.

Ethyl-2-Cyanoacrylate Can Be Applied in Direct Contact with Regenerating Nerves in a Novel Nerve-Guide

Institution where the work was prepared: The Catholic University School of Medicine, Rome, Italy

Antonio Meroli, MD; Lorenzo Rocchi; Luigi Mingarelli; Alessandro Morini; Francesco Catalano; The Catholic University

Introduction:

Stitch suture is still the most recommended method to hold a nerve-guide in place. However, stitch suture is a well known cause of local inflammatory response. Glues of several kinds have been proposed as an alternative but they are not easy to apply in a real surgical setting. In this study, Authors analyzed histologically the nerve-glue interface in a novel poly-methyl-metacrylate nerve-guide termed “NeuroBox”, which is double-halved, not-degradable and rigid, and allows the use of cyanoacrylic glues.

Materials and Methods:

Wistar rats were used as animal model. In group 1, animals were implanted a NeuroBox to promote the regeneration of an experimentally produced 4 mm gap in the sciatic nerve. In group 2, the gap was left without repair (“sham-operated” group). Group 3 was assembled by harvesting 10 contralateral intact nerves to document the normal anatomy. Semi-thin sections for visible light microscopy and ultra-thin sections for Transmission Electron Microscopy were analyzed.

Results:

Application of ethyl-2-cyanoacrylate directly to the epineurium produced no significative insult to the underlining nerve fibers nor impaired nerve regeneration. In particular, no alterations were found in the morphology of axons and Schwann’s cells. No regeneration occurred in the “sham-operated” group.

Discussion:

As a group of rapidly polymerizing adhesives, cyanoacrylates have found surgical applications as skin-wound sutures as well as hemostatic and embolizing agents. In more recent literature, promising results have been reported with cyanoacrylate molecules in nerve surgery. Authors found that ethyl-2-cyanoacrylate was easily applied in the peculiar contruct of the NeuroBox and nerve regeneration was not affected by the presence of the acrylic glue all around the epineural sheath of the gluing regions. The peculiar geometry of the NeuroBox allowed the surgical application of the glue in a very small quantity and this, maybe, minimized the fibroblastic response.
Stimulus Parameters Are Important For Intraoperative Neurophysiological Evaluation of the Brachial Plexus: A Case Study

Institution where the work was prepared: Sunnybrook HSC, Toronto, ON, Canada

David A. Houlden, PhD; Farhad Pirouzmand, MD; Sunnybrook HSC

Background:
The stimulus parameters for intraoperative neurophysiological evaluation of the brachial plexus are not well described. The pitfall of using a uniform stimulus intensity for different neurophysiological tests is demonstrated.

Patient Characteristics:
Brachial plexus exploration was performed on a 38 year old man who suffered a C6-T1 avulsion (and possible C5 avulsion) from a motorcycle accident 8 months previously. Prior to surgery, he had no motor function or sensation in the left arm or hand but was able to elevate his left shoulder and retract the scapula.

Neurophysiological Methods:
After the brachial plexus was exposed, neurophysiological studies were performed to assess the functional continuity between the C5 spinal nerve and spinal cord. To estimate the stimulus intensity necessary for evaluating the C5 spinal nerve, a normal nerve (phrenic) was stimulated (200 microsecond pulse duration) with a bipolar hook electrode. The stimulus intensity was gradually increased until there was a visible left hemidiaphragm contraction. The stimulus intensity necessary for this contraction was then used to stimulate the proximal upper trunk. Recordings were obtained from electrodes over the cervical paraspinous muscles (for evoked myogenic muscle potentials - EMAPs), the contralateral scalp (for somatosensory evoked potentials – SSEPs) and the axillary nerve (for nerve action potentials - NAPs).

Results:
The stimulus intensity necessary for visible hemidiaphragm contraction after phrenic nerve stimulation was 3 milliamps (mA). The same stimulus (3 mA) applied to the upper trunk failed to produce EMAPs or SSEPs, indicating spinal nerve avulsion. Importantly, when the stimulus intensity was increased to 7 mA, both SSEPs and EMAPs were present, confirming no avulsion (so the results obtained at 3 mA were erroneous). The 7 mA stimulus intensity failed to produce an axillary NAP after upper trunk stimulation, confirming a post-ganglionic injury.

Conclusions:
The stimulus intensity necessary for hemidiaphragm contraction after phrenic nerve stimulation was inadequate for upper trunk SSEP and EMAP studies. To avoid erroneous interpretation, the stimulus intensity for SSEP and EMAP studies should be at least twice that necessary for visible muscle twitch.

The Motor Nerve to the Masseter Muscle: An Anatomic and Histomorphometric Study to Facilitate its Use in Facial Reanimation

Institution where the work was prepared: The Hospital for Sick Children, Toronto, ON, Canada

Gregory H. Borschel, MD; David H. Kawamura, MD; Dan Hunter, RA; Rahul Kasukurthi; Albert Woo; (1)The Hospital for Sick Children / University of Toronto, (2) Washington University in St. Louis, (3)Washington University School of Medicine, (4)Washington University

Introduction:
The motor nerve to the masseter muscle has been previously used for facial reanimation. It has supplied motor input for free muscle flaps and has been used as a nerve transfer to the distal stump of the injured facial nerve. However, many surgeons have been reluctant to use this versatile source of axons, citing the difficulty of locating it intraoperatively. In this study we wanted to develop a reliable method of locating this nerve. We also wanted to determine the number of myelinated fibers contained within this nerve.

Methods:
We examined 8 fresh cadaveric hemifaces. We defined the anatomy of the nerve to the masseter in particular its relationship to common surgical landmarks such as the auricular tragus and the zygomatic arch. We also defined its intramuscular anatomy and performed a histomorphometric analysis.

Results:
The anatomy of the motor nerve to the masseter was highly consistent: it was located 3.16 ± 0.30 cm anterior to the tragus at a level 1.08 ± 0.18 cm inferior to the zygomatic arch. The nerve was found at a depth of 1.48 ± 0.19 cm deep to the superficial muscular aponeurotic system (SMAS) at this point. Relative to the zygomatic arch, the nerve formed an angle of 50 ± 7.6 degrees as it coursed distally into the masseter muscle. The distance from the arch to the first branch of the motor nerve to the masseter was 1.33 ± 0.20 cm. The histomorphometric analysis demonstrated that the motor nerve to the masseter contained an average of 2775 myelinated fibers.

Conclusion:
Successful intraoperative location of the motor nerve to the masseter is facilitated by knowledge of its anatomy relative to standard surgical landmarks. A consistent and convenient starting point for dissection of this nerve is found 3 cm anterior to the tragus and 1 cm inferior to the zygomatic arch. The nerve contains over 2700 myelinated fibers, demonstrating its usefulness as a source of motor innervation for facial reanimation.
A Comparison of Peripheral Nerve Interfaces Containing Either Cultured Myoblasts or Transferred Muscle

Institution where the work was prepared: University of Michigan, Ann Arbor, MI, USA

Melanie G. Urbanchek; Benjamin Wei, MD; Ziya Baghmanic; Nicole L. Castagno, BS; Christopher M. Frost, Student; Brent M. Egeland, MD; Paul S Cederna; University of Michigan

Purpose:
We propose to ultimately enable amputees to use their own peripheral nerves to drive mechanized prosthetic limbs. A regenerated peripheral nerve interface (PNI) is our ideal inter-connect between divided nerves and electrode wiring to a neuro-processor which controls the prosthesis. Our PNI contains cultured myoblasts or transferred muscle which are neurotized with divided nerves of the amputees proximal stump. Single layer Surgisis™ (SIS) is formed into a container around the PNI. Electrodes are also included in the standard PNI.

Methods:
Using a rat amputation model, we compare the vitality and function of PNI formed with either cultured myoblasts (Myoblast) or freely transferred soleus muscle (MTransfer). For the Myoblast Group (n=6), satellite cells are harvested from isogeneic rat skeletal muscle, maintained in culture until the cells are actively contracting (~14 days) and PNI implantation occurs. For the MTransfer group (n=9), the soleus muscle from the contralateral leg is harvested, trimmed and immediately grafted into the PNI. PNs are implanted lateral and parallel to the rat femur; the peroneal nerve is divided and the proximal end is tacked inside the PNI in contact with the myoblasts or transferred muscle. Electrodes are not implanted in this study, PNI remain in situ for up to 18 months when electrodiagnosis and PNI histology are performed.

Results:
PNI muscle fibers of the MTransfer group were 10% larger than those of the Myoblast group (Fig 1). Peroneal nerve electrodiagnostic results show the MTransfers had better scores than the Myoblast group for compound muscle action potential (CMAP) amplitude and latency (Table 1). MTransfers performed as well as the Control Group on tests of CMAP latency, CMAP area, CMAP duration and CMAP velocity. Neuromuscular junction (NMJ) staining on PNI muscle fibers indicates extensive reinnervation in the MTransfer PNI while the Myoblast group PNI show few NMJ.

Conclusion:
Free muscle transfer provides a sustainable source of skeletal muscle fibers inside the PNI. Neurotization by divided peripheral nerves leads to NMJ formation. Nerve signals are readily recorded from PNI containing transferred muscle.

The views expressed in this work are those of the authors and do not necessarily reflect official Army policy. This work was supported by the Department of Defense Multidisciplinary University Research Initiative (MURI) program administered by the Army Research Office under grant W911NF0610218.

Table 1: Electrophysiological results for CMAP amplitude, CMAP area, CMAP duration and CMAP velocity.

<table>
<thead>
<tr>
<th>Group</th>
<th>CMAP Amplitude (mV)</th>
<th>CMAP Area (mm²)</th>
<th>CMAP Duration (ms)</th>
<th>CMAP Velocity (cm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.47 ± 0.13</td>
<td>4.32 ± 0.16</td>
<td>3.4 ± 0.2</td>
<td>12.3 ± 0.5</td>
</tr>
<tr>
<td>Myoblast</td>
<td>1.62 ± 0.18</td>
<td>4.78 ± 0.22</td>
<td>3.6 ± 0.3</td>
<td>12.7 ± 0.6</td>
</tr>
<tr>
<td>MTransfer</td>
<td>1.75 ± 0.20</td>
<td>5.13 ± 0.25</td>
<td>3.8 ± 0.4</td>
<td>13.1 ± 0.7</td>
</tr>
</tbody>
</table>

* Different from Control
* Different from Myoblast Group

sTransplanting Schwann Cells Transfected with GDNF into Cold-Preserved Nerve Allografts

Institution where the work was prepared: Washington University School of Medicine, St. Louis, MO, USA

Katherine Santosa; Philip Johnson; Matthew MacEwan; Wilson Z. Ray, MD; Michael Nicolson; Dan Hunter, RA; Susan E. Mackinnon; Washington University School of Medicine

Introduction:
Studies have demonstrated the importance of endogenous neurotrophic factors such as glial-derived neurotrophic factor (GDNF) on nerve regeneration not only in the CNS, but also in the PNS. Moreover, there has been recent interest in delivering exogenous GDNF to various sites in hopes of promoting further regeneration following a nerve injury and repair. Given that Schwann cells (SCs) play a significant role in regeneration in part due to their ability to secrete neurotrophic factors such as GDNF, it appears that autologous SCs could be used as a mechanism for the delivery of GDNF. The purpose of this study was to determine if the re-seeding of processed nerve allografts with GDNF transfected SCs would lead to enhanced nerve regeneration and ultimately, functional recovery.

Methods:
Seventy Lewis rats were randomized into five groups (n=14 per group) corresponding to the type of graft that was used to repair a 14 mm nerve gap. Isografts served as positive controls and cold-preserved nerve allografts as negative controls. The remaining three experimental groups consisted of processed nerve allografts injected with: (1) autologous SCs without any exposure to the GDNF vector; (2) autologous SCs exposed to the GDNF vector but not transfected; and (3) autologous SCs transfected with the GDNF vector. Of the 14 animals per group, eight underwent histomorphometric analysis and six for functional testing.

Results:
Preliminary data demonstrates that acellular processed nerve allografts injected with autologous SCs with and without exposure to the GDNF vector promotes peripheral nerve regeneration and functional recovery. In addition, although we initially hypothesized that the injection of the genetically modified GDNF transfected SCs would enhance regeneration even further, we have discovered that some animals in this study group developed neuromas, which has impeded axonal regeneration through the affected area. Additional analysis is underway to determine the cause and effect of these neuromas in the group that received grafts injected with GDNF transfected SCs.

Conclusion:
Due to the lack of expendable autogenous material and the known limitations in nerve gap length repairs of processed allografts, it has become increasingly important to utilize the regenerative properties of SCs and additional support provided by neurotrophic factors like GDNF to promote peripheral nerve regeneration and improve functional recovery. With a better understanding of the effect of supplementing nerve allografts with SCs and neurotrophic factors, we hope to provide comparable alternatives to the gold standard autograft in nerve gap repairs.

Free muscle transfer provides a sustainable source of skeletal muscle fibers inside the PNI. Neurotization by divided peripheral nerves leads to NMJ formation. Nerve signals are readily recorded from PNI containing transferred muscle.

The views expressed in this work are those of the authors and do not necessarily reflect official Army policy. This work was supported by the Department of Defense Multidisciplinary University Research Initiative (MURI) program administered by the Army Research Office under grant W911NF0610218.
American Society for Reconstructive Microsurgery

ASRM Scientific Abstract Session: Nerve

Modified Approach for Lateral Femoral Cutaneous Nerve Decompression in Patients with Meralgia Paresthetica

Ivica Ducic, MD, PhD; Matt Iorio; John Felder, MD; Georgetown University Hospital

Introduction:
Meralgia paresthetica is syndrome of pain and paresthesias in the distribution of the lateral femoral cutaneous nerve (LFCN) in the thigh. Commonly affecting the obese or diabetic population, as well as those prone to work related repetitive nerve injury from pressure across the anterior superior iliac spine and inguinal ligament, initial treatment should include symptomatic management and elimination of any provoking factors. For symptoms persisting beyond three months, surgical decompression is known to ameliorate symptoms. Current surgical approaches do not adequately account for the anatomic variability of the LFCN, as widely described in the literature. We address this issue with a new and safer surgical approach based on our experience of 93 LFCN decompressions or branch neuroma excisions, in order to improve surgical outcomes and patient morbidity.

Technique:
Anatomic variability affecting the relationship of the LFCN and the ASIS and/or the inguinal ligament places the nerve at high risk of injury if decompression is focused at the site of entrapment, as radial incisions through the ligament at this site may damage the nerve. Our modified approach defines a technique of distal identification and retrograde decompression of the LFCN to ensure complete visualization of the nerve during dissection through the points of entrapment.

Conclusion:
If the distal approach we propose is adopted, and the nerve is first identified in an area where it is not actively compressed, dissection can proceed towards the point of maximal compression without accidental injury to the nerve, thereby improving patient safety and maximizing surgical results and symptom relief.

Tendon Transfer or Nerve Transfer for Elbow Flexion. What is the Evidence? A Systematic Review

Wendy Kar Yee Ng, MD; Sophocles Voineskos, MD; Achilles Thoma; McMaster University

Purpose:
Both tendon transfers and nerve transfers have been reported as techniques to restore elbow flexion after upper extremity nerve injury. The purpose of this presentation is to assess the literature to determine if there is any superiority of nerve transfers over tendon transfers.

Methods: The following electronic databases were assessed for relevant articles by two independent reviewers: Medline, Cochrane, Embase and CINAHL. Articles were selected using specific inclusion criteria. Methodological quality of observational and non-randomized studies was assessed using the MINORs scale, and a predetermined score 10 or greater was considered to indicate a high quality study. We independently extracted data for the following clinical outcomes: range of motion, strength, quality of life, cost and complications.

Results:
In total, 417 articles were identified. Forty-eight articles were assessed as relevant and included in the final analysis. Our kappa agreement was 0.96. Forty-five of these 48 studies were retrospective and 3 were prospective. Three non-randomized articles and only 1 comparative study was deemed as high quality using the MINORs scale.

From the articles where data were available, mean range of motion was 133.3 degrees for 3 nerve transfer patients compared to 111.5 degrees for 106 tendon transfer patients. In addition, 52.2% of 67 nerve transfer patients could actively flex more than 90 degrees compared to 100% of 7 patients who underwent triceps to biceps transfer.

With respect to strength, 78.4% of 1101 nerve transfer patients had strength of M3 or greater vs. 88.2% of 34 tendon transfer patients. Furthermore, mean strength was 2.2 kg for 62 nerve transfer patients vs. 3.3 kg for 7 tendon transfer patients.

Finally, 0.74% (4/451) of nerve transfer patients compared to 8.41% (9/107) of tendon transfer patients had significant complications after operation, such as the need for re-operation or secondary operations.

Conclusions:
There is weak evidence that tendon transfer may be superior to nerve transfer with respect to strength, as measured by kilograms and by the MRC grading scale. There is weak evidence that significant complications are less often associated with nerve transfer compared to tendon transfer.

To better determine the overall superiority of either nerve transfers or tendon transfers, methodologically sound randomized controlled trials in defined populations with standardized techniques, and follow-up with unbiased independent outcome assessments, are needed.
Contralateral C7 Transfer (CC7T) with Long-term Follow-up (at Least 4 years) at Chang Gung Memorial Hospital
Institution where the work was prepared: Chang Gung Memorial Hospital, Taoyuan, Taiwan
Shu-ying Chang; David Chwei-Chin Chuang; Chang Gung Memorial Hospital

Background:
Contralateral C7 (CC7) transfer for brachial plexus injuries can benefit finger-like sensation but remains a controversial technique due to a wide variation in motor results. We reported our 20-year experiences of using CC7 transfer for different etiologies, versatility, sequelae, and results after at least 4 years follow-up.

Patients and Methods:
145 patients for different conditions were treated by CC7 transfer (1989 to 2006). 103 patients were collected after exclusion criteria. They all were performed by a single surgeon and had at least 4 years follow-up. Vascularized ulnar nerve graft (VUNG) either with pedicle or free fashion was utilized in all for CC7 elongation. The graft either passed through chest or neck. In cross-neck passing, it was passed either through subcutaneous or prevertebral tunnel. The VUNG was either transferred to the median nerve (one target) in 55 patients, or to the median and musculocutaneous nerves (two targets) in 24 patients. In another 25 patients, the CC7 transfer was one of stage procedures which was followed by functioning muscle transplantation for finger flexion.

Results:
Finger flexion strength M³3 was considered as success in function. Success rate in CC7 transfer to the median nerve alone was 55.4%; in CC7 transfer to the musculocutaneous and median nerve was 39.10%. However, success rate in CC7 transfer followed by functioning muscle transplantation is higher with 75%.

Conclusion
CC7 is still a good resource for motor and sensory restoration in severe brachial plexus root injury and severe spastic hand patients. CC7 transfer to the musculocutaneous and median nerves followed by functioning muscle transplantation for deep finger flexors replacement can provide a comparable and quick outcome for elbow and finger flexion.

Modified Latissimus Dorsi Muscle Transfer for External Rotation in Brachial Plexopathy
Institution where the work was prepared: University of Montreal, Montreal, QC, Canada
Dominique M. Tremblay, MD; Patrice Tetreault, MD, MSc; Andre Chollet, MD; Jenny C. Lin, MD, PhD; University of Montreal

Purpose:
Loss of external rotation due to brachial plexus injury is functionally debilitating and few secondary procedures exist to correct this deficiency. The Latissimus dorsi has been used as a tendon transfer to restore external rotation in rotator cuff tear patients. In some reports, however, patients with this transfer do not regain active external rotation past 0°, and experience no increase in force. We hypothesize that this is due to the biomechanically disadvantaged line of pull of the latissimus dorsi muscle.

Methods:
Using a cadaveric biomechanical model with the arm at 0° of abduction, we determined the forces necessary to go from 0° to 40° of external rotation using two different lines of pull. The first was in the natural line of pull of the latissimus dorsi muscle, with the insertion transferred to the greater tuberosity of the humerus, representing the traditional tendon transfer. The second line of pull tested was that of the infraspinatus muscle, with the same insertion site.

Results:
On average, 40% greater force was necessary to move the cadaveric upper limb into external rotation using the original line of pull of the latissimus muscle. Reorienting the line of pull to the axis of the infraspinatus allowed more degrees of external rotation with the application of less force. These findings were statistically significant. One brachial plexus patient with no active external rotation consented to a modified latissimus dorsi muscle transfer reorienting the muscle’s line of pull to that of the infraspinatus muscle. Clinical results will be presented.

Conclusion:
This biomechanic cadaveric study showed that reorienting the latissimus dorsi muscle’s line of pull into that of the infraspinatus muscle decreases the force necessary for external rotation, suggesting that clinical results can be improved with this muscle transfer by modifying the origin and insertion of the muscle.
Development of a Microsphere Drug Delivery System to Promote Nerve Regeneration After Peripheral Nerve Injury

Institution where the work was prepared: The Hospital for Sick Children, Toronto, ON, Canada

Matthew D. Wood, PhD1; Howard Kim, MS2; Alex Bibbly2; Tessa Gordon2; Molly Shoichet2; Gregory H. Borschel1; (1)The Hospital for Sick Children, (2)University of Toronto

Purpose:
The majority of bioengineering strategies to promote peripheral nerve regeneration after injury have focused on therapies to bridge large nerve defects. Fewer therapies are being developed to treat other nerve injuries, such as nerve transaction. Repair of nerve transactions generally have acceptable clinical outcomes unless the injury has persisted untreated for months. In these cases, the proximal nerve has undergone chronic axotomy due to long periods without attachment to the distal nerve stump resulting in motor axons that require increased amounts of growth factors to encourage them to regenerate. Glial-derived neurotrophic factor (GDNF) has previously been shown to promote motor nerve regeneration following chronic nerve axotomy. However, bioengineering strategies to provide sustained local release at the injury site are lacking. Therefore, the design of a controlled drug delivery system for nerves following chronic axotomy repair could be beneficial in promoting axon regeneration.

Methods:
We constructed polylactide-glycolic acid (PLGA) microspheres capable of extended GDNF release. In vitro protein release assays (ELISA) and cellular biological activity assays were performed to optimize the microsphere size, encapsulation efficiency of GDNF within the microspheres, and the time course of GDNF release. An in vivo drug delivery system was developed by placing the microspheres within a carrier fibrin gel (1st layer) that was surrounded by a layer of Tisseel glue (2nd layer) to localize the delivery system to a nerve injury coaptation. The drug delivery system was evaluated over 2 months to determine microsphere location within the layers and fibrin degradation.

Results:
Microspheres containing biologically active GDNF were constructed that can encapsulate and retain at least 65% of the initial GDNF loaded into the microspheres. Furthermore, GDNF released from the microspheres was biologically active for at least 7 days with cumulative GDNF release over time. The in vivo drug delivery system demonstrated that microspheres placed within a fibrin gel stay localized to the nerve following implantation. Additionally, the two-layer fibrin gel system degraded over the course of 2 months when implanted next to a nerve injury coaptation.

Conclusions:
Microspheres can deliver biologically active GDNF for an extended period and can be incorporated into a drug delivery system for localized delivery to a nerve injury site. Overall, the ability of the delivery system to provide GDNF to a nerve injury site may promote improved nerve regeneration and functional outcomes following chronic nerve axotomy.

Analysis of Spatiotemporal Expression of Regeneration-Associated Genes (RAGs) after Nerve Injury and During Regeneration

Institution where the work was prepared: Ochsner Clinic Foundation, New Orleans, LA, USA

Olawale Sulaiman, MD, PhD1; Thomas D. Dreesen, PhD1; Doan Nguyen, PhD2; (1)Ochsner Clinic Foundation, (2)Louisiana State University Health Science Center

Introduction:
Injured peripheral nerves have the potential to regenerate but often functional recovery is suboptimal even after excellent microsurgical repair. Previous studies from our and other laboratories have demonstrated that chronic Schwann cell (SC) denervation, chronic neuronal axotomy and misdirection of regenerating axons are key factors that impair functional regeneration of injured axons. The chronically denervated SCs and chronically axotomised injured neurons lose their expression of regeneration-associated genes (RAGs) as reinnervation of injured target is delayed either as a result of delayed repair or regeneration over long distance to denervated targets. However, the spatiotemporal expression and loss of RAGs during regeneration after immediate or delayed repair is not well understood. The effects of cytokines and neurotrophins on the pattern of expression are also not well understood.

Purpose of study:
To determine the spatiotemporal expression of RAGs in the distal nerve stump after acute and chronic nerve injuries as well as during nerve regeneration after immediate and delayed repair. We are also exploring the effect(s) of transforming growth factor-β and forskolin on the expression of RAGs after chronic nerve injury and during regeneration.

Methodology/design:
Rat model of sciatic nerve injury and repair will be used. In the control experiments, the Sciatic nerve will be cut and at 0 day, 4, 8, 12 weeks, two 1 cm long pieces of the distal nerve stumps are harvested for analysis of expression of RAGs in the 2 nerve segments using immunohistochemistry and gene array. In experimental group I, the TIB branch will be cut and either i) immediately repaired or ii) repaired after 2 months delay and regeneration into the distal nerve stumps is allowed for 6 weeks. In our experimental group II, same surgeries as in exp group I are performed but we apply either 0.5µM forskolin, or 1ng/ml of TGF-β or forskolin and TGF-β at the suture site. Same tissues are harvested as in the control groups.

Expected results: We expect an upregulation of RAGs in the distal nerve stumps immediately after injury up to 4 weeks and then a gradual decline; reinnervation of freshly cut distal nerve stump should upregulate RAGs but not after 2 month delay. Application of TGF-β and forskolin should induce the expression of RAGs as seen in freshly injured nerve and during regeneration into fresh cut distal nerve stumps.
**Autologous, Bioengineered, Scaffold-free Nerve Conduit for Peripheral Nerve Repair**

Institution where the work was prepared: University of Missouri - Columbia, Columbia, MO, USA

Bradley A. Hubbard; Francose S. Marga, PhD; Thomas W. McEwan, MD; Gabor Forgacs, PhD; Stephen H. Colbert, MD; (1)University of Missouri, (2)University of Missouri-Columbia, (3)University of Columbia

**Background:**

Autologous nerve is the gold standard for bridging gaps in nerve repair, but has several drawbacks including the limited number of donor nerves and harvest site morbidity. Synthetic or autologous guidance tubes have failed to reach autograft quality regeneration except for sensory nerves with small gaps (<3cm). Synthetic and autologous tubes’ failure has been linked to low density of supporting cells, such as Schwann cells (SC), and the lack of longitudinally-oriented structural features. As a result, tissue engineering has emerged as a promising alternative.

**Method:**

A bioengineered nerve conduit was created using a novel tissue engineering technology, namely bioprinting. Constructs were composed of SC and bone marrow stem cells (BMSC) were added for their adherence qualities and implications in chronic pain treatment. No scaffold was used. Cylindrical “bio-ink” units are stacked according to a computer script. The construct matures for 10 days post-printing to allow for fusion of the discrete cylindrical units (Figure 1).

**Results:**

The pilot study is in the data collection period. Preliminary results of the nerve construct in rat sciatic nerve repair show an average of 3700 axons distal to the nerve repair (40% of the proximal nerve axons). There does appear to be a trend toward superior regeneration compared to collagen tube alone. The finalized data will be presented.

**Conclusions:**

This study presents a novel bioengineering method for creation of a scaffold-less nerve repair. This bioengineered tube has the advantages of high SC density and longitudinally-oriented structural features. The pilot study data is being finalized and further study is underway to better quantify the rate of regeneration. We hypothesize that this novel nerve conduit may obviate the need for autologous grafting in the future.

**Two Methods for Modeling Aberrant Kinematics in Upper Extremity Nerve Compression Syndromes**

Institution where the work was prepared: Washington University School of Medicine, St. Louis, MO, USA

William E. Janes; Rachel E. Meltzer; Jack R. Engberg; Justin M. Brown, MD; (1)Washington University, (2)Washington University School of Medicine

Upper extremity nerve compression (UENC) syndromes share the hallmark features of pain and reduced function (1-2). Carpal tunnel syndrome (CTS) alone accounts for more days of lost work in the U.S. than any other condition (3-4). Work-related upper extremity disorders (WRUED) as a whole account for 1/3 of workers’ compensation costs in US private industry (5).

Pathological kinematics, including cervicothoracic and scapular alterations, contribute to the development of WRUEDs, including subacromial conflict, glenohumeral instability and neurovascular impingement (6-10). These same postures have been associated with a number of nerve compression entities, including thoracic outlet syndrome (11-13) and CTS (14-15).

The relationship between kinematics and neuropathy has been studied more extensively in the lower extremity. Aberrant posture and compensatory proximal muscle activity in lower extremity neuropathy patients have been attributed to decreased afferent input to the spinal cord (16-17). Tourniquet ischemia, ice bath, and Lidocaine (18-20) have been utilized as models of lower extremity peripheral neuropathy.

Here, two deafferentation methods are tested as models of UENC. Thorax, neck, and shoulder kinematics of patients with UENC are compared to the those of healthy subjects before and after temporary deafferentation via either tourniquet ischemia or lidocaine injection. We hypothesize that: 1) Both interventions change proximal posture and dynamics; 2) Kinematic changes resulting from deafferentation resemble those seen in persons with UENC. Additionally, we examine differences in the kinematics resulting from each intervention to determine whether either method is a better model of UENC.

Five UENC patients and ten controls performed a series of standardized movements. A video motion capture system collected 3D kinematic data. Controls were tested before and after intervention on the non-dominant upper extremity. Intervention for five controls consisted of a tourniquet applied at mid-humeral level inducing median, ulnar, and radial nerve block. Intervention for the remaining five controls consisted of 2CC 1% Lidocaine injected at the carpal tunnel resulting in localized median nerve block.

Analysis is ongoing. Preliminary results indicate that both interventions resulted in kinematic changes, including increased cervicothoracic flexion and altered scapula orientation. We expect to detect similarities in post-intervention and UENC kinematics. We will also examine differences between the two models. The nociceptive experience of the mid-humeral tourniquet may influence kinematics beyond what can be explained by deafferentation alone. Should localized deafferentation of the median nerve via Lidocaine prove an effective model, more global deafferentation via tourniquet - and the associated pain response - may prove unwarranted.
Peripheral nerve injuries can lead to a disabling loss of motor, sensory, and autonomic functions. The rat sciatic nerve 10-mm gap model is commonly used to investigate new strategies to improve functional recovery with segmental nerve defects; however, there is a lack of standardization, which makes comparison of studies difficult.

The present study aims to improve the standard surgical method with a control model that minimizes the number of animals required for obtaining valid results and simulates a current treatment for human peripheral nerve injury. Thirty-seven Sprague-Dawley rats, weighing an average of 328 gm, were utilized in this study. In the anatomical arm of this study, the hind legs of 19 cadaver rats were dissected under magnification for measurement of the sciatic and sural nerves at standardized points. In the surgical arm of this study, a unilateral 10-mm sciatic nerve defect was treated with three cables of ipsilateral sural nerve in 18 rats. The animals were evaluated at the end of 12 weeks.

Outcomes included: maximum isometric tetanic force of the tibialis anterior muscle, tibialis anterior muscle weight, and compound muscle action potentials of the gastrocnemius. Each measure was normalized to the contralateral leg. Histomorphometric outcomes included: axon density and myelin thickness distal to the nerve graft. The average sciatic nerve length from the piriformis muscle to trifurcation was 19.8 (SEM: 2.8) mm. The average sural nerve length from trifurcation to the penetration of the deep fascia of the posterior ankle was 34.8 (SEM: 1.1) mm. The average normalized compound muscle action potential was 86.1(SEM: 3.9)%.

Histomorphometric analysis revealed an average axon density of 12,828 (SEM: 2,974) axons/mm2 and a myelin thickness of 0.53 (SEM: 0.06) µm.

Our results support good functional and histomorphological recovery of the sciatic nerve after treatment. This nerve cabling technique is a viable control group treatment that uses a single entry exposure, incurs minimal morbidity, and maintains preservation of muscle attachment. We conclude that this rat model can be used in various experimental trials for diverse aspects of surgery in the field of peripheral nerve regeneration.

**Profiling Muscle-Specific Microrna Expression After Peripheral Denervation and Re-Innervation in a Rat Model**

Institution where the work was prepared: Chang Gung Memorial Hospital – Kaohsiung Medical Center, Kaohsiung, Taiwan

Ching-Hua Hsieh, MD; Chang Gung Memorial Hospital in Kaohsiung; Seng-Feng Jeng, MD; Chang Gung Memorial Hospital - Kaohsiung Medical Center, Chang Gung University

**Purpose:**

MicroRNAs (miRNAs) are a class of highly conserved, non-coding RNAs involved in posttranscriptional gene regulation. The muscle-specific miRNAs miR-1, miR-133a, and miR- are expressed in skeletal muscles and have been shown to contribute to muscle growth and differentiation. This study was designed to profile the expression of muscle-specific miRNAs and to identify the regulated genes in the innervated skeletal muscle after denervation and re-innervation.

**Methods:**

The expression of muscle-specific miRNAs of the soleus muscle of the rats were analyzed with quantitative real-time PCR at 1 week, 1 month, 2 months, and 4 months after sciatic nerve denervation and re-innervation. In addition, a combined approach including computational prediction by the miRanda website and the Agilent Whole Rat Genome 4×44k oligo microarray experiment was performed to investigate the potential target genes of these three miRNAs in the denervated and re-innervated muscles.

**Results:**

The results revealed that the expression of miR-1 and miR-133 increased by ~2-fold at 4 months both after denervation and re-innervation; on the other hand, the expression of miR-206 was significantly increased to ~3-fold 1 month later only following re-innervation but not following denervation, and lasted at least for 4 months. The expression pattern of miR-206 was different from that of miR-1 and miR-133a. The combined approach with the target-prediction networks and whole rat genome oligo microarray experiments yielded a dozen potential targets of these muscle-specific miRNAs in the denervated and re-innervated muscles. Among these, 2 genes (Hnrpu and Npy) and 1 gene (Ptprd) were potentially regulated both in the denervated and re-innervated muscle by miR-1 and miR-133a, respectively. There were six potential target genes (Hnrpu, Lsamp, MGC108776, Mef2, Npy, and Ppfibp2) of the up-regulated miR-206 in the re-innervation muscle. Among these, 3 (Hnrpu, Npy, and MGC108776) were potentially regulated by both miR-1 and miR-206.

**Conclusion:**

This study has profiled the expression of muscle-specific miRNAs and identified their potential target genes in the soleus muscles following sciatic nerve denervation and re-innervation. Among those potential target genes, because the MeF2 transcription factor was reported to promote the transformation of type II fast, glycolytic fibers into type I slow, oxidative fibers, the up-regulation of miR-206 with decreased expression of the MeF2 transcript in the 4 months re-innervated muscle, which presented type II fiber predominance four months after nerve micro-anastomosis, might also indicate the role of miR-206 in determining the fiber type after peripheral nerve regeneration.
The Vein Supported with Muscle and Bone Marrow Stromal Cells Compared to the Nerve Autograft as a Natural Conduit for Bridging a 15mm Nerve Defect in Rats

Introduction:
The aim of nerve repair is to encourage the axons to reach the distal side of the lesion and to re-innervate the end organ after trauma. The primary choice of treatment for peripheral nerve laceration is end-to-end repair. However, if the nerve defect is too large for primary repair, a graft is required to bridge the defect. We investigated the use of a vein as a natural conduit in a rodent model. Our model used a vein which was filled with a small piece of fresh muscle to keep the intima open and with Bone Marrow Stromal Cells (BMSC) as supportive cellular therapy.

Methods:
In three experimental groups of 20 rats each, a nerve defect of 15 mm was bridged with either a nerve autograft (group I), a vein filled with muscle (group II), or a vein filled with muscle and BMSC (group III). Toe spread and pin prick were used to evaluate motor and sensory function at 1, 3, 6 and 12 weeks. Compound muscle action potentials (CMAPs) and the gastrocnemius muscle index (GMI) were recorded at 6 and 12 weeks to assess conduction properties and denervation atrophy, respectively.

Results:
Twelve weeks after grafting all animals responded with a toe spread and pin prick reaction; however, significant differences were found between the autograft and both vein graft groups at 12 weeks, with superior performance in the autograft group. Six weeks after grafting, no difference was found in the GMI and CMAP measurements. At twelve weeks, group I demonstrated a significant increase in GMI and significantly better CMAP results compared to group II and group III.

Discussion:
Our modified grafting technique combining vein and muscle with supportive cellular therapy proved to enable nerve regeneration. However, the autograft resulted in better functional regeneration as demonstrated by all evaluation techniques used. This suggests that the potential clinical application of a vein graft with additional cellular therapy should be further investigated. More specifically, to elucidate the beneficial effect of the BMSC alone, a different model would need to be used.

We conclude from this model, young healthy rats with a 15 mm nerve defect, that the nerve autograft remains the preferred grafting technique when compared to the BMSC filled vein graft supported with muscle.

Traumatic Neuroma in Continuity Injury Model in Rodents

Introduction:
Peripheral nerve injuries most challenging to manage clinically are often mixed Sunderland grade 3 and 4 lesions giving rise to neuroma in continuity (NIC), whose spontaneous functional recovery is limited or absent. Histological characteristics of traumatic NIC include aberrant intra- and extra-fascicular axonal regeneration and fibrosis. To our knowledge a clinically relevant rodent model of NIC has not been developed. Such a model would be useful to develop intervention strategies to improve patient outcomes.

Methods:
Various injury techniques were tested on freshly harvested Lewis rat sciatic nerves ex vivo, and examined histologically before inflicting more refined injuries in vivo. The optimal experimental injuries combined a 50g traction force applied with a spring scale hooked around the sciatic nerve, and a focal 3 second firm crush using a malleus nipper. Nerves were harvested at 0, 5, 13, 21 and 65 days, and processed for longitudinal 8 micron cryostat sectioning, H&E, laminin, neurofilament, GFAP and Masson’s trichrome staining. Skilled locomotion (tapered beam, ladder rung) and flat plane locomotion for ground reaction force (GRF) analysis were performed serially up to 9 weeks with the experimental (n=6) and simple (control) crush injuries (n=5) by blinded animal behavior experts.

Results:
Disruption of the endoneurium and perineurium with aberrant intra- and extrafascicular axonal regeneration and progressive fibrosis was consistently demonstrated histologically in 17 of 17 nerves with experimental injuries. At 8 weeks, experimental animals displayed a significantly greater slip ratio in both skilled locomotor assessments as compared to nerve crush animals (p<.01). GRF’s of the crush-injured animals showed earlier improvement compared to the experimental animals (4 vs. 6 weeks), whose overall GRF pattern failed to recover as well as the crush group at 9 weeks.

Conclusion:
We have demonstrated histological features and poor functional recovery consistent with NIC formation in a rodent model. The injury mechanism employed combines traction and compression forces akin to the physical forces at play in clinical nerve injuries. This model may serve as a tool to help diagnose this injury earlier and to develop intervention strategies to improve patient outcomes.
ASRM Scientific Abstract Session: Breast

Hernia/Bulge Rates Similar Following Medial versus Lateral DIEA Branch Perforator Harvest in 615 Consecutive DIEP and MS FTRAM Flaps

Patrick Garvey, MD; Seroos Salavati, BS; Charles E. Butler; (1)MD Anderson Cancer Center, (2)The University of Texas M.D. Anderson Cancer Center

Background:

Prior studies of deep inferior epigastric artery (DIEP) and muscle-sparing free transverse rectus abdominis musculocutaneous (MS FTRAM) flaps for breast reconstruction suggest that damage to the intercostal nerves during flap harvest compromises abdominal wall integrity. Since the intercostal nerves are involved with the lateral, but not the medial, branch of the deep inferior epigastric artery (DIEA), some suggest harvesting medial branch perforator flaps to minimize abdominal morbidity. However, as yet, no clinical study has clearly demonstrated that medial branch perforator flap harvest reduces abdominal complications. We hypothesized that medial branch perforator flap donor sites would develop fewer abdominal wall bulges/hernias than lateral branch donor sites.

Methods:

We retrospectively studied 800 consecutive DIEP and MS FTRAM breast reconstructions performed at The University of Texas MD Anderson Cancer Center between 2000 and 2010. We included only patients for whom it could be clearly determined which perforator(s) (medial vs. lateral row) were harvested. We examined the relationship between patient and treatment factors—particularly the medial vs. lateral branch of DIEA harvested—and abdominal donor site outcomes. Donor site hernia and bulge were determined by careful physical examination on a regimented follow-up schedule, with or without a CT scan and/or operative findings on repair.

Results:

We included 615 patients, 289 (47%) medial branch and 326 (53%) lateral branch flaps. Mean patient follow-up was 31 months. Patient demographics, timing of reconstruction, number of perforators harvested, distribution of DIEP versus MS FTRAM harvest, percentage of unilateral versus bilateral harvest, and percentage of mesh closures were similar between the two flap groups. Fewer medial branch donor sites (40.8%) had undergone prior abdominal surgery compared to the lateral branch donor sites (51.2%, P=0.001). More of the medial branch donor sites (4.5%) had pre-existing hernias compared to the lateral branch donor sites (0.3%, P=0.003). Overall, a total of 28 (4.6%) donor sites developed a bulge/hernia. The medial and lateral branch donor sites had similar rates of abdominal bulge/hernia (3.5% vs. 5.5%, respectively; p=0.9).

Conclusions:

This is the largest study to directly compare donor site morbidity of medial vs. lateral row perforator harvest, and the overall incidence of bulge/hernia was low for both groups. Despite the lateral branch group having a higher incidence of previous abdominal surgery, we found no significant difference in hernia/bulge rates between the two groups. Therefore, perforator selection should not be based on medial vs. lateral location in an attempt to reduce donor site hernia/bulge.

Comparison of Outcomes Related to Various Abdominal Fascial Closure Techniques after Muscle Sparing TRAM Flap Breast Reconstruction

Sameer A. Patel, MD; Lars Johan Sandberg, MD; Neal S. Topham, MD; Karthik Devarajan; (1)Fox Chase Cancer Center, (2)The Methodist Hospital

Background:

Different techniques of abdominal wall fascial closure after muscle sparing TRAM flap or DIEP flap breast reconstruction exist. These include primary closure alone, primary closure with use of underlay biologic mesh, and primary closure with use of underlay synthetic mesh. The effect of closure technique on hernia and bulge formation remains unclear.

Methods:

A retrospective review comparing the use of primary closure, primary closure with biologic mesh underlay, and primary closure with synthetic mesh underlay was performed. Fischer's exact test was used to verify significance defined as p<0.05.

Results:

155 patients underwent either a muscle sparing TRAM or DIEP flap for breast reconstruction. Twenty three patients had primary closure, This group had 0 hernias and 2 (8.7%) bulges. Mesh closures were all done using an underlay technique with primary closure over the mesh. Biologic mesh was used in 72 patients. This group had 3 (4.2%) hernias and 7 (9.7%) bulges. Synthetic mesh was used in 60 patients. This group had 2 (3.3%) hernias and 2 (3.3%) bulges. Surgical site infection requiring removal of a synthetic mesh only occurred in 1 patient (1.7%).

Conclusions:

No significant difference was demonstrated in this study between primary closure, primary closure with underlay biologic mesh, or primary closure with underlay synthetic mesh in terms of abdominal wall hernias and bulges. In this cost-sensitive medical environment, primary closure alone should be considered when feasible. However, intraoperative surgeon judgement should be exercised in determining the most appropriate fascial wall closure in these patients.
Impact of Adjuvant Chemotherapy on Incidence of Donor Site Hernia and Bulges in Muscle Sparing TRAM Flap Breast Reconstruction

Institution where the work was prepared: Fox Chase Cancer Center, Philadelphia, PA, USA

Lars Johan Sandberg, MD; Sameer A. Patel, MD; Karthik Devarajan; Neal S. Topham, MD; (1)The Methodist Hospital, (2)Fox Chase Cancer Center

Background:
Free tissue transfer from the abdominal donor site has become an increasingly popular method for post-mastectomy reconstruction of the breast. Often performed for invasive cancer, these patients may require treatment with various adjuvant chemotherapy protocols. Although very effective from an oncologic perspective, the detrimental effects of postoperative chemotherapy on healing and the resulting clinical impact on patient outcome remains somewhat unclear in terms of abdominal bulges and hernias resulting from free tissue transfer from the abdominal donor site.

Methods:
In this retrospective study of 155 patients and 206 flaps, we sought as our primary endpoint the development of abdominal bulges and hernias related to adjuvant chemotherapy.

Results:
155 patients had a muscle sparing or DIEP flap for breast reconstruction. Closure was performed with primary closure alone or with primary closure with reinforcement with underlay mesh. The overall incidence of hernia was 3.2% and of bulges was 7.1%. The chemotherapy group (n=49) had an 8.2% hernia rate, compared to 1.0% in the non-chemotherapy group (n=104), but no significance was found p=0.27. Bulges occurred in 6.1% in the chemotherapy group compared to a marginally higher incidence of 7.7% in the non-chemotherapy group. This difference was also not significant.

Conclusions:
In this retrospective review a trend towards increased rates of hernia formation (eight-fold) was demonstrated in patients receiving adjuvant chemotherapy after breast reconstruction with a muscle sparing TRAM or DIEP flap as compared to those not receiving adjuvant chemotherapy. This trend is likely due to the impact of chemotherapy on healing of the fascial tissue. Further analysis through randomized prospective studies would help to clarify these preliminary findings.

Age And Abdominal Wall Strength: Assessing The Aging Abdominal Wall After Autologous Breast Reconstruction

Institution where the work was prepared: University of Pennsylvania Health System, Philadelphia, PA, USA

Jonas A. Nelson, MD; Joshua Fosnot, MD; Jesse C. Seiber, MD, MPH; Joseph M. Serletti, MD; (1)University of Pennsylvania School of Medicine, (2)University of Texas MD Anderson Cancer Center

Background:
Free tissue transfer is safe in advanced age, yet the average age at breast reconstruction is skewed toward a younger patient population. The purpose of our study was to better understand the effects of autologous reconstruction on the aging abdomen, in an effort to better counsel older patients who may consider autologous reconstruction.

Methods:
This study was part of a prospective study assessing 3 measures of abdominal strength (upper and lower abdominal strength, and a functional independence measure) following free flap breast reconstruction using abdominal tissue. Several psychometric variables were also assessed. All enrolled women who underwent DIEP or msfTRAM procedures between 11/2006 and 3/2010, with preoperative and long term follow up (>120 days) data were included in this analysis. Data was examined in patients >60 years old as compared to patients <60 for both unilateral and bilateral reconstructions.

Results:
145 patients were included in analysis, with a mean age at reconstruction of 52.0 (7.3) and 50.3 (9.1) for unilateral and bilateral patients, respectively. Eleven of 69 unilateral reconstruction and 13 of 76 bilateral reconstruction patients were >60 years old. For unilateral reconstructions, no significant differences were noted between age groups comparing absolute scores for the upper abdomen, lower abdomen, or the functional independence measure at either time point. When examining scores over time within the cohorts, a slight decrease in upper abdominal strength was noted in the younger cohort (p=0.01). Analyses revealed no differences in satisfaction with abdominal function, as both groups reported being very satisfied. Bilateral analyses also revealed no differences in absolute abdominal function scores between the two groups. Examining upper abdominal strength over time within groups, slight score decreases were noted for both <60 years (p<0.001) and >60 years (p=0.04). No differences were observed comparing the overall degree of change at late follow up. Several differences were noted on analysis of patient satisfaction, as patients >60 were slightly more satisfied with their abdominal strength compared to patients <60 (p=0.05). Similarly, this cohort was more satisfied with sensation (p=0.03) and scar (p=0.008) of the breast reconstruction. Finally, rates of hernia or bulge were not different for either bilateral (p=1.0) or unilateral (p=0.42) reconstruction cohorts.

Conclusions:
Autologous breast reconstruction with abdominal tissue can safely be performed in patients over the age of 60, with little to no difference in postoperative abdominal function as compared to younger patients. Such patients may be more satisfied with their surgical outcomes.
Outcomes and Complications of Breast Reconstruction Using SIEA Free Flaps, One Institutions Experience

Institution where the work was prepared: Health Sciences Center, Winnipeg, MB, Canada

Trevor Brooks, MD; Thomas E.J. Hayakawa, MD; L. Sigurdson, MD; Stephanie Olivier, MD; Edward Wayne Buchel, MD; (1)UNIVERSITY OF MANITOBA, (2)University of Manitoba

Introduction:
The SIEA free flap for breast reconstruction was first described in 1991. Since then it has been praised for its preservation of the abdominal wall fascia, yet criticized for the large increase in complication rates. With the smaller caliber and shorter pedicle length many people do not consider the SIEA to be a first line option for breast reconstruction. We present a large case series with results that lends support to considering each patient a potential candidate for an SIEA flap.

Material and Methods:
A four year retrospective chart review was undertaken to evaluate SIEA breast reconstruction at a single institution. Patient demographics, etiology of breast defect, operative information and post operative complications were determined.

Results:
From 2005-2009 121 SIEA flaps were performed on 100 patients for breast reconstruction with charts available for follow-up. Patient ages varied from 28-70 years of age (mean 50.3). The mean BMI was 29.76 (range 19.56 – 47.02). Take back rate was 13.7%, and flap failure rate was 3.3% with all flap losses due to arterial occlusion. 68% underwent immediate reconstruction. 53% of patients had previous surgery on their abdomen, with an average of 1.51 procedures per patient. 31% of patients underwent radiation either pre- or post-operatively. Fat necrosis was noted in 12%. Abdominal complications included 38% seroma rate, 14% delayed wound healing and 1pre-operative laparotomy incisional hernia noticed post-operatively.

Summary:
We report one of the largest case series to date on the topic of breast reconstruction with SIEA free flaps. Prior abdominal surgery was not an absolute contraindication to SIEA breast reconstruction. We did report a 38.71% seroma rate; however none of these patients required surgical drainage. Our most recent data for have shown a 1.6% failure rate for DIEP flaps in our institution, and a failure rate of 3.3% in SIEA. This difference is mostly attributable to the shorter pedicle length and decreased vessel size of the SIEA flap. SIEA fat necrosis rates in our study were also comparable to published DIEP rates.

Conclusion:
Overall the SIEA can be considered a first line choice for breast reconstruction. Failure rate can be decreased by only utilizing pedicles of appropriate length and vessel diameter. Its ease of harvest and the supra-fascial dissection are its main advantages over the DIEP flap.
Should Tamoxifen Be Held Prior to Microsurgical Breast Reconstruction?

Institution where the work was prepared: MD Anderson Cancer Center, Houston, TX, USA

Brian Patrick Kelley, BS; Vicente Valero, MD; Min Yi, MD; Steven Kronowitz; MD Anderson Cancer Center

Introduction:
Breast cancer patients who express the estrogen receptor on the tumor cells are usually treated with adjuvant tamoxifen citrate (tamoxifen) therapy. Tamoxifen has been associated with increased rates of thromboembolic events that have prompted concerns that it may increase the risk of failure of microvascular breast reconstruction. Some centers have implemented protocols to hold tamoxifen at the time of microvascular breast reconstruction.

Materials and Methods:
Between 2000 and 2010, 577 patients underwent delayed microvascular breast reconstruction treated at MD Anderson Cancer Center. We compared complication rates with regard to the tamoxifen status (elimination half life of N-desmethyl tamoxifen (active metabolite) approximately 14 days) at the time of microsurgical breast reconstruction.

Results:
Patients groups included: never on tamoxifen (343 patients), tamoxifen > 28 days from surgery (55 patients), and tamoxifen within 28 days from surgery (179 patients). Univariate analysis did not identify any statistically significant difference in overall (P = 0.3), immediate (P = 0.6), or follow-up (P = 0.3) complications in the tamoxifen groups. On multivariate analysis, tamoxifen use was not an independent risk factor the occurrence of complications. Flap thrombosis occurred in 2.0%, never on tamoxifen; 0%, tamoxifen > 28 days from surgery; 1.7%, tamoxifen within 28 days from surgery. Immediate flap loss occurred in 0.3%, never on tamoxifen; 1.8, tamoxifen > 28 days from surgery; 1.7%, tamoxifen within 28 days from surgery. Immediate pulmonary embolus occurred in 0%, never on tamoxifen; 1.8, tamoxifen > 28 days from surgery; 0%, tamoxifen within 28 days from surgery. Delayed pulmonary embolus occurred in 0%, never on tamoxifen; 0%, tamoxifen > 28 days from surgery; 0.6%, tamoxifen within 28 days from surgery.

Conclusion:
Prior or active tamoxifen use at the time of microsurgical breast reconstruction does not appear to increase thromboembolic complications and probably does not need to be held prior to microvascular breast reconstruction.

The First Reported Use of the Transversus Abdominis Plane (TAP) block in DIEP Flap Reconstruction of the Breast – A Prospective Series of 20 Cases

Institution where the work was prepared: university Health Network, Toronto, ON, Canada

Toni Zhong, MD; Karen Wong; Srinivas Coimbatore; Stuart McCluskey; Stefan Hofer; University Health Network

Background:
This is the first reported use of the Transversus Abdominis Plane (TAP) block for post-operative pain control at the donor sites for free muscle-sparing TRAM and DIEP flaps. The TAP block is a newly developed peripheral nerve block of the T6 – L1 intercostal nerves of the anterior abdominal wall.

Patients and Methods:
The study group consisted of a prospective group of 20 consecutive patients undergoing free DIEP or MS-TRAM flap breast reconstruction at University Health Network, Toronto, Canada. The control group consisted of 40 retrospectively selected patients matched to the study group by timing and laterality of surgery. Postoperatively, both groups had an on-demand only patient-controlled anaesthesia (PCA) system for the first 2 postoperative days. The primary outcome measured was amount of PCA narcotics used in the first 48 hours. Secondary outcomes included total amount of narcotics during hospital stay, pain scores, sedation, nausea and vomiting, and other milestones of surgical recovery.

Intraoperatively, all TAP blocks were inserted by the primary surgeon under direct vision using a 3cm incision at the Lumbar Triangle of Petit. (Figure 1) A multi-orifice epidural catheter was introduced into the TAP plane. Bupivacaine (0.25% with epinephrine) was injected into the TAP catheters, beginning with the first bolus of 10mL in the post-anesthetic care unit, and subsequently 10mL injection every 12 hours. The catheters were removed on postoperative day 3 morning.

Results:
There were no complications associated with the use of the TAP block indwelling catheter. Primary outcome analysis revealed that the mean dosage of PCA hydromorphone used in the TAP block group was significantly lower at 2.4 (+/-1.9) mg compared to the historic group of 9.2 (+/- 5.8) mg in the first 48 hours (p = 0.02).

Conclusion:
Our analysis of the first 20 consecutive, prospective patients revealed that when the TAP catheter is inserted under direct vision through the Triangle of Petit to intermittently deliver local anaesthetic to block the nerves of the anterior abdominal wall, post-operative IV narcotic use is significantly reduced by four-fold when compared to the matched controls.

Figure 1. Anatomical landmarks defining the Lumbar Triangle of Petit, an access point for performing TAP block.

The landmarks are:
- Anterior border – external oblique muscle
- Posterior border – latissimus dorsi muscle
- Roof – internal oblique muscle
- Floor – transversus abdominis muscle

Closer to an Understanding of Fate – The Role of Vascular Complications in Free Flap Breast Reconstruction

Institution where the work was prepared: The University of Pennsylvania Health System, Philadelphia, PA, USA
Joshua Fosnot, MD; Shareef Jandali, MD; David W. Low, MD; Stephen J. Kovach; Liza C. Wu; Joseph M. Serletti; (1)University of Pennsylvania Health System, (2) University of Pennsylvania

Background:
Flap loss in autologous breast reconstruction is devastating and almost invariably a result of a vascular complication; yet, not all complications portend the same fate. The purpose of this study was to determine if an intraoperative complication increases the risk of a subsequent postoperative vascular problem and to determine if specific interventions including anticoagulation are associated with risk modification.

Methods:
This was a retrospective review of all free flaps performed between 2005 and 2010 at Penn for breast reconstruction. Details of intra and postoperative vascular thromboses as well as technical difficulties were recorded by scrutinizing medical records. Statistical methods included Chi-square, Fischer exact and multiple regression analyses. Flaps with a routine intraoperative course were compared to those with an intraoperative complication.

Results:
Overall, 1173 free flaps were performed in 804 patients. In regression analysis, an intraoperative vascular complication was found to be the only independent predictor of a subsequent delayed vascular complication (OR 2.92, CI 1.19 – 7.16, p = 0.02). Interestingly, an intraoperative arterial thrombosis was not associated with a subsequent delayed arterial thrombosis (1.1 vs. 2.6%, p = 0.37); however, intraoperative technical difficulties were associated with an increased risk of delayed arterial thrombosis (1.0 vs. 4.2%, p = 0.05) and partial flap loss (0.6 vs. 4.2%, p = 0.02). No specific types of technical difficulties were implicated in these findings. There was no association between intraoperative arterial thrombosis (1.1 vs. 2.6%, p = 0.37) or technical variation (1.1 vs. 2.8%, p = 0.21) and delayed venous thrombosis. There was a trend toward a higher delayed venous thrombosis rate in the setting of an intraoperative venous thrombosis (1.1 vs. 16.7%, p = 0.07). Neither intraoperative arterial or venous thromboses were associated with flap loss as isolated variables; however, in aggregate, there was a higher rate of complete flap loss in flaps when any intraoperative vascular complication occurred (0.9 vs. 3.5%, p = 0.04). Neither the use of heparin nor aspirin were associated with decreased rates of postoperative vascular complications.

Conclusions:
In free flap breast reconstruction, when a vascular problem is encountered in the operating room, there is increased risk of a subsequent postoperative vascular complication as well as flap loss. Post operative vascular complications do not appear to be overtly affected by specific surgical intervention nor choice of anticoagulation in the setting of a preceding intraoperative problem. Intraoperative technical difficulties, aside from thrombosis, are associated with delayed complications.
ASRM Scientific Abstract Session: Head & Neck I

The Advantages of Bending the Reconstruction Plate in Defined Angles for Fibula Flap Mandibular Reconstruction

Institution where the work was prepared: Chang Gung Memorial Hospital, Taipei, Taiwan

Chung-Kan Tsao; Ming-Huei Cheng, professor; Chwei-Chin Chuang, professor; Fu-Chan Wei, professor; Chang-Gung Memorial Hospital

Purpose:
Shaping of the mandibular reconstruction plate (MRP) to match the contour of long mandibular defects after tumor ablation can be a difficult task. Contouring the fibula graft by means of computer-aided design and modeling procedures has been published in the literature recently. However, this process is costly and not easily adaptable to surgical treatment deviating from the planned one. It is also time consuming to inset the fibula segments under a smoothly curved MRP, which often requires repeat bone burning for an accurate fit. Further disadvantages are the difficult bone fixation which lacks rigidity, inadequate bony contact with subsequent potential for non-union, the resulting deadspace between the straight fibula segments and the curved plate, the more prominent and palpable metalwork, and ultimately the higher potential for plate exposure.

Our unit is pleased to share the positive experience gained with bending the MRP in defined angles which simplifies the design, inset, and fixation of the fibula segments and addresses these issues. A detailed description of the surgical technique and the outcome will be discussed.

Materials and Methods:
This procedure has been carried out on eleven patients undergoing free fibula reconstruction for segmental mandibular defects at the Chang Gung Memorial Hospital over the past three years. All patients had segmental mandibular defects longer than 7 cm. Two fibula segments for mandibular reconstruction were used in three and three segments in eight out of eleven patients.

Results:
All flaps survived. There was no plate loosening, fracture or exposure during the follow-up period. Adequate bony union and mandibular contour were observed by orthopantogram. An improved facial contour and symmetry were observed in comparison to patients who had a conventionally curved MRP.

Conclusion:
The MRP bent at defined angles to emulate pre-morbid symmetry can simplify the inset of fibula segments. This is a highly useful method to re-establish adequate occlusion and facial contour when reconstructing long segmental mandibular defects.

Advantages of Computer-Aided Offset Cuts in Free Fibula Mandibular Reconstruction

Institution where the work was prepared: New York University Langone Medical Center, New York, NY, USA

Nicholas T. Haddock, MD; Casian J. Monaco; Katie Weimer, MS; David Hirsch; Jamie P. Levine, MD; Pierre B. Saadeh; [1]New York University Langone Medical Center, [2]Medical Modeling Inc

Introduction:
The free fibula flap is the standard of care in mandibular reconstruction; however, procedural nuances continue to optimize results. More accurate and efficient osteotomies for graft insertion can be envisioned which address the difficulty in obtaining a perfect match between the cut ends of the fibula and mandible and the subsequent sacrifice of maximal bone contact. We propose a method of complementary offset osteotomies. The angled cuts were virtually planned using 3D computed tomography images. Optimal offset cuts maximized surface area contact and facilitated intraoperative repositioning when additional bone margins were needed.

Methods:
Using previously described protocols, 3D virtual reconstructions of the facial skeleton and fibula (average, series of 5) were used to simulate osteotomies at 45°, 60°, 75° and 90° to the long axis of the fibula. Complementary osteotomies were then simulated at the mandibular body just distal to the first molar in simulated free fibula reconstructions. Total area of apposing surfaces was calculated using computer-aided design. The results from the 45°, 60° and 75° cuts were compared to the conventional 90° cut. Resin-based mandibular osteotomy guides and a complementary fibula jig were computer-aided manufactured. A representative clinical case will be presented.

Results:
The total surface area of apposing fibula and mandible surfaces in a conventional 90° cut was 104 mm². This increased to 105 mm² with a 75° cut (1% increase), 115 mm² with a 60° (10% increase) cut and 133 mm² with a 45° cut (28% increase). 45° cuts also allowed for adequate bony contact in the setting of additional margin requirements up to 1cm. Complementary 45° cuts provided excellent bone-to-bone contact in a free fibula reconstruction using resin guides and a jig. This angle also facilitated access of the saw to the distal mandible.

Conclusion:
Virtual surgical planning is an increasingly recognized technology for optimizing surgical outcomes and minimizing operative time. We present a technical refinement that takes advantage of the precision complementary osteotomies that this technology affords. By creating offset cuts, we can maximize bony contact and maintain adequate contact should additional margins be required. Moreover, since mandibular involvement by cancer usually begins at the lingual cortex, angled osteotomies automatically provide additional margins at this surface.

Institution where the work was prepared: Fox Chase Cancer Center, Philadelphia, PA, USA
Richard L. Agag, MD, MA; Sameer A. Patel, MD; O. Z. Lerman, MD; Neal S. Topham, MD; Fox Chase Cancer Center

Purpose:
Free fibula reconstructions are the gold standard for reconstruction of large composite defects of the mandible. However, the surgical procedures are both challenging and time consuming. Newer techniques involving preoperative virtual surgical planning and the fabrication of stereolithographic models and osteotomy guides provide a more precise and efficient method for performing such cases. The impact of this technique on operative time, ischemia time, and overall cost was analyzed and compared to older techniques.

Methods:
A retrospective chart review was performed on all patients who underwent mandibular reconstruction with free fibular flaps from August of 2002 through September of 2009 at Fox Chase Cancer Center. The records of fifty patients were identified and reviewed. Patients were divided into three groups. Group A included flaps that were constructed on the back table, group B included flaps that were osteotomized in situ but without the use of the osteotomy guide and group C included flaps that were performed in situ using the osteotomy guide. Ischemia times and total operative times were compared for all groups. A cost analysis was also performed looking at the total cost of the osteotomy guide plus computer generated preoperative reconstruction with the hourly operative costs at our institution.

Results:
Ischemia times for groups A and B decreased from 172 minutes for group A to 84 minutes to group B (p<0.05). There were no differences for ischemia time for groups B and groups C (84 and 75 minutes respectively). Total OR times for groups A and groups B did not differ significantly (708 and 677 minutes respectively) however total operative times between groups B and C decreased from 677 minutes to 554 minutes (P<0.05). The osteotomy guide and CT reconstruction of the fibula flap with pre-bent reconstruction plate costs were $6750. The average additional 2 hours and 3 minutes of operative time costs were $4,082. This includes operative room, anesthesia technician, and anesthesia costs.

Conclusions:
Use of preoperative planning with computer-generated images as well as the use of the osteotomy guide not only makes the procedure more exact but also decreases total operative time. This results in an improved surgical outcome and decreased anesthesia time for the patient. Although there appears to be no cost savings for the institution at this time, we feel that increased use of this model will lead to further decreases in operative time and eventual cost savings.

Union and Bone Resorption of Free Fibular Flaps in Mandibular Reconstruction

Institution where the work was prepared: Div of Plastic Surgery, University Health Network, Toronto, Canada
Tuija M. Yla-Kotola, MD, PhD; Eric Bartlett; David Goldstein; Ralph Gilbert; Stefan Hofer, MD, PhD; University Health Network

The purpose of this study is to evaluate union rates and bone resorption after free fibular flap reconstruction for mandibular reconstruction and to study which factors contribute to the union of the neomandible.

Methods:
112 patients who required composite resection and reconstruction with a fibular flap between 2000-2009 were included into the study. Prospective database was used to collect clinical data for patients' age, gender, indication for surgery and history of radiotherapy as well as the surgical data for location and size of the defect, number and type of osteotomies required and type of the plates used.

We assessed the CT scan images taken after the reconstruction and approximately one year postoperatively to evaluate union (n=60) and bone resorption (n=24) of the neomandible. Bone measurements were done using axial, coronal or sagittal CT images which were reconstructed every 2mm in a standard bone filter and analyzed by two independent investigators. Vertical height and thickness of both the mandible and the fibular graft in each osteotomized segment was measured manually using the software provided by the workstation. Statistical analysis was done to compare immediate and late postoperative measurements and to find out which factors influenced the union of the neomandible.

Results:
Most patients had squamous cell carcinoma, the mean age was 54 years (14 to 88y), and one-third received radiotherapy. Major complications occurred in 15 patients out of 112 consisting of re-exploration of the anastomosis or partial and total flap failures. Preliminary CT-results show that two-third of the flaps healed well, however, there was radiologically non union in 20 % of the neomandibles in one year’s follow-up. We could find statistically significant bone resorption both in native mandible (p=0.017) and in the anterior part of the fibular graft (p=0.039). Interestingly, bone resorption was noted only in vertical height measurements, and there was no change in bone thickness. Radiotherapy had no effect on either bone resorption or union in our study.

Conclusion:
Union of the neomandibles was generally favourable after the reconstruction with a free fibular flap but there was statistically significant reduction in mandibular and fibular graft height in follow-up.
Immediate Bone Grafting and Plating of the Radial Osteocutaneous Free Flap Donor Site

Institution where the work was prepared: Memorial Sloan-Kettering Cancer Center, New York, NY, USA
Philip Joseph Torina, MD; Evan Mattos, MD, MMSc; Edward A. Athanasian, MD; Peter Cordeiro, MD; Memorial Sloan-Kettering Cancer Center

Background:
The primary shortcoming of the osteocutaneous radial forearm flap (ORFF) in head and neck reconstruction is the high incidence of fracture at the donor site. Although several prophylactic measures are reported, combined plating with iliac crest bone graft (ICBG) of the donor site has not been previously described. Outcomes and rationale for this method of radius reconstruction are described.

Methods:
Retrospective review of a prospectively maintained database identified twenty-three consecutive patients who underwent head and neck reconstruction using an ORFF. Flap features, method of donor site reconstruction and complications were evaluated.

Results:
The initial 7 patients from the series had no intervention at the radius donor site. The next 7 patients had ICBG only, whereas the final 9 patients had both plating and ICBG placed at the donor site. The mean cross sectional diameter and length of radius bone harvested was 30% by 7 cm, 33% by 8 cm, and 53% by 9 cm for the three groups respectively. Fracture rates for the three groups were 29%, 14%, and 0%. There were no iliac crest donor site complications.

Conclusion:
Plating combined with ICBG is a safe and effective method for radius donor site reconstruction. This technique maximizes both early and late strength of the radius while allowing for harvest of greater segments of bone. Decreased donor site morbidity combined with more bone available for use in oromandibular reconstruction may tip the risk-benefit scale in favor of widespread ORFF use.

Stair-step flap for secondary lower lip revision following lip and cheek composite defects reconstruction

Institution where the work was prepared: Chang Gung Memorial Hospital-Kaohsiung Medical Center, Kaohsiung, Taiwan
Yur-Ren Kuo, MD, PhD, FACS; Takashi Fujiwara; Chien-Chang Chen; Hsiang-Shun Shih; Seng-Feng Jeng; Chang Gung Memorial Hospital- Kaohsiung Medical Center, Chang Gung University

Background:
Free flap reconstruction is a common procedure for through-and-through lip and cheek complex defects after cancer ablation. However, oral incompetence with unacceptable bulky flap appearance invariably occurs and needs secondary revisionary procedure. We present our method to improve the oral competence and cosmetic appearance by stair-step technique of flap revision.

Methods:
Fourteen patients, the mean age was 52.0 years (range, 31-73 years), who had undergone flap folding reconstruction of the lip and cheek complex defect resulting in oral incontinence were involved in this study. The indication of this procedure are too much bulk and protruding deformity of the originated flap associated with circular contracture, downward and notching deformity of the lower lip, and insufficient alveololabial sulcus, resulting in oral incontinence and unacceptable ugly appearance. The average upper and lower lip defects were 15.0% (range, 5%-25%) and 38.2% (range, 25%-90%), respectively. The average size of the outer cheek defects is 48.5 cm² (range, 12.6 cm²-117.8 cm²), and of the inner lining, 37.2 cm² (range, 15.7 cm²-62.8 cm²). Thirteen patients had been treated with an anterolateral thigh flap and 1 with a fibular osteocutaneous flap incorporating the soleus muscle in the initial surgery. This revisionary stair-step technique was combined with simultaneous liposuction of the bulky flap in all cases.

Results:
Adequate oral continence and good contour was achieved in 12 patients. The remaining 2 patients whose original lower lip defects was 90% and 70%, still had mild drooling. The remaining 2 patients still had mild drooling, which managed successfully with a second stair-step flap. One patient developed microstomia required an enlargement of mouth opening with a free radial forearm flap.

Conclusions:
Lower lip defects less than 50% can be reconstructed successfully with our method. Adequate oral competence, enough alveololabial sulcus, and acceptable contour can be obtained. This approach is a valuable tool for secondary lower lip revision following full-thickness lip and cheek reconstruction.
Functioning free gracilis myocutaneous flap transfer provides a reliable single stage facial reconstruction and reanimation following tumor ablation

Institution where the work was prepared: Chang Gung Memorial Hospital, Taoyuan, Taiwan
Chihhung Lin, MD; Chih-Hung Lin, MD; Jiu Da Liao; (1)Chang Gung Memorial Hospital, (2)Chang Gung Memorial Hospital, Chang Gung University

Background:
Ablative oro/facial defects incorporating mimetic facial musculature/nerve cause hemifacial expressive dysfunction and considerable morbidity but are rarely reanimated immediately using free functioning gracilis myocutaneous flaps.

Methods:
Disrupted buccal branches provided recipient facial nerve for 24 gracilis re-innervation. Additional 15 free flaps were utilized for extensive composite defects. Smile outcome was graded according to Terzis’ criteria after two years recurrence-free follow-up. The influence of postoperative radiotherapy, integrity of oral commissure, and double free flaps were compared.

Results:
Eighteen patients completed two years’ recurrence-free follow-up; average smile outcome was Terzis Grade IV (mean 3.8). Resection/reconstruction of the modiolus (5/18 patients) tended to diminish outcome (Terzis Grade III, mean 3.0 versus Terzis Grade IV, mean 4.1), so as simultaneous two free flaps (3.56 versus 4.14). Postoperative radiotherapy (8/18 patients) had a more modest effect on outcome (Terzis Grade III; mean 3.3 versus Terzis Grade IV, mean 4.1).

Conclusion:
Reconstruction of oncologic defects including expressive facial musculature/nerve with gracilis FFMT can restore oral continence and facial expression primarily.

Anatomic Shortening of Orbicularis oculi and Orbicularis oris to improve results after smile reconstruction

Institution where the work was prepared: Instituto Novaplastia, Porto Alegre, Brazil
Marcos Jaeger, MD, PhD; Instituto Novaplastia; Eduardo Grosman, MD, PhD; UFRGS University

Purpose:
Nowadays, free flap construction of the previously paralyzed smile has reached superb results. Nevertheless, the univectorial voluntary mouth corner elevation is still sometimes give the idea of a non-spontaneous smile. A genuine spontaneous smile is achieved by facial nerve command to the outer portion of the orbicularis oculi and orbicularis oris: the risorius - Duschene smile. The aim of the clinical study is to demonstrate the orbicularis oculi plication – P and the mouth corner orbicularis oris plication – PS to improve the aesthetic appearance of the rebuilt smile 1-4.

Method:
14 patients House- Brackmann (HB) V/VI underwent smile reconstruction with free flap (split gracilis muscle/ trigeminal nerve) or masticatory transposition (temporalis muscle) for the treatment of the unilateral facial paralysis in the period from July 2004 to January 2008. Five patients who obtained HB score of III were still demanding a more natural smiling. Age ranged from 16-59 years old (Mean, 39.5). P and P-S were carried out after 2-4 years of the initial operation. The distance between the nasogenian sulcus was documented before and after the operation. Findings were compared using SPSS 14.0 (Figure 1)

Results:
Distance to the nasogenian sulcus decreased significantly (P> 0.001) at smiling, but was not demonstrated by a new improvement in the HB score. Distance from the mouth corner decreased after the operation, assuring the impression of adequate facial balance. 3-day week physiotherapist program was crucial to maintain muscle balance. (Figure 2).

Conclusion:
The result obtained through the utilization of P and P-S improved the aesthetic result in all five patients presented here. This was attested by the shortening of distance between the nasogenian sulcus and the mouth corner. We believe that muscle plication may be a useful tool to better balance the smile after dynamic reconstruction.

References:

Figure 1: Left side unilateral facial paralysis.  Figure 2. Result obtained after 2 years.
A New Technique for Total Oral Sphincter Reconstruction

Institution where the work was prepared: University of Manitoba, Winnipeg, Canada

Matthew Choi, MD; G. Althubaiti, MD; Sarvesh Logsetty, MD; Thomas Hayakawa, MD; L. Sigurdson, MD; University of Manitoba

Purpose:
We describe our experience reconstructing a full-thickness near-total upper and lower lip perioral burn injury using a split-gracilis functional muscle free tissue transfer. To our knowledge this is the first report of this method of reconstruction.

Method:
A healthy young male sustained a severe facial perioral contact burn from an electrical wire, obliterating greater than 80% of the lower lip and 60% of the upper lip. After resuscitation and debridement, a functional gracilis free-tissue transfer was performed. Intrafascicular dissection of the obturator nerve was performed with intra-operative nerve stimulation to identify two separate fascicular groups innervating two separate muscle units of the gracilis. One neuromuscular unit was used to reconstruct the upper lip with neuroraphy to a buccal branch of the facial nerve; the other unit was used to reconstruct the lower lip with neuroraphy to the marginal mandibular branch. The muscle strips were left attached at both ends and reinforced to the modiolus bilaterally to complete the total sphincter reconstruction. The muscle was lined with FAMM flaps to reconstruct effective buccal sulci and create a wet vermillion, with skin grafting to form an outer dry vermillion. Following initial healing, we performed serial excision of the skin grafts with local advancements of mucosa and perioral skin.

Results:
The wounds healed without complication. Both gracilis strips showed signs of reinnervation within 3 months. Complete excision of the skin grafts was performed with 3 serial excisions under local anaesthetic. At 17 months followup, our patient has protective sensation, full sphincter closure, and excellent incorporation into perioral musculature allowing for lip elevation, depression, retraction, and eversion. He has normal speech including plosive sounds, and eats an unrestricted diet with standard utensils. We believe his cosmetic outcome is excellent.

Conclusions:
This is the first report of a split-gracilis free functional muscle transfer for the reconstruction of a near-total upper and lower lip defect. Dynamic reconstruction of a functioning oral sphincter can thus be performed in a single-stage with superior function and aesthetics.

Learning Objectives:
1. Describe the split-gracilis free functional muscle transfer for full sphincter reconstruction of near-total upper and lower lip defects.
Ipsilateral Component Separation Improves Outcomes of VRAM Flap Donor Sites with Excessive Fascial Tension

Introduction:
The Vertical Rectus Abdominis Musculocutaneous (VRAM) flap has numerous indications in pelvic, vaginal and perineal soft tissue reconstruction. However, there can be considerable donor site morbidity associated with the muscle and fascial harvest of a VRAM flap owing to excessive fascial closure tension including myofascial laxity, fascial dehiscence and incisional hernia. Ipsilateral component separation (CS) with release of the external oblique aponeurosis can be used to reduce tension and facilitate fascial closure. We hypothesize that component separation can be used to close VRAM donor site abdominal wall defects, in patients where primary fascial closure is impossible or would result in excessive fascial closure tension.

Methods:
We evaluated surgical outcomes of all consecutive patients who underwent CS with VRAM donor site closure for difficult fascial closures and compared them to a control group of standard, primary fascial closure (PFC) VRAM donor site closures without excessive fascial tension at M. D. Anderson Cancer Center between June 2006 and May 2009. The indication for use of ipsilateral CS with VRAM donor site closure was the inability to approximate the fascial edges together or fascial closure tension deemed by the attending surgeon to be excessive and at extremely high risk for postoperative failure. Primary outcome indicators included surgical outcomes at the donor site, particularly wound complications, myofascial laxity (bulge) and incisional hernia.

Results:
Seventy-four patients were included in the study; 15 CS and 59 PFC patients. Mean follow-up was 16 months (range 6-39 months). The incidence of early postoperative complications including, seroma, infection, skin dehiscence and fascial dehiscence: was higher in the PFC (39%) group compared to the CS (13%) group (p<0.05). There was a four-fold greater incidence of incisional hernia in the PFC (24%) group compared to the CS (6%) group. There was also a non-statistically significant trend towards a higher incidence of myofascial laxity (bulge) in the PFC (14%) group compared to the CS (6%) group.

Conclusion:
CS was effective in allowing closure of VRAM fascial donor sites that were otherwise impossible to re-approximate or resulted in excessive tension. CS closures resulted in fewer postoperative wound complications, hernias and bulges despite a more difficult closure. CS facilitates fascial closure of VRAM donor sites by reducing fascial closure tension and should be considered when fascial closure tension is excessive.

Total Sacrectomy Reconstruction Using a VRAM Flow-Through Flap to a Double-Barreled Free Fibula Flap

Introduction:
Total sacrectomy is an uncommon resection that creates a massive tissue defect and sacroiliac disjunction by uncoupling the lumbar spine from the pelvis. The traditional method of spino-pelvic stabilization included instrumentation and alloplastic bone grafts. This suboptimal strategy resulted in unacceptable rates of hardware failure and incomplete arthrodesis. Compared to bone grafts, vascularized bone flaps have been shown in other applications to provide superior arthrodesis. However, an optimal surgical technique for total sacrectomy reconstruction with vascularized bone flaps has not yet been clearly described. We studied the use of total sacrectomy reconstruction using a vertical rectus abdominis musculocutaneous (VRAM) flow-through flap anastomosed to a double-barreled free fibular flap.

Methods:
We retrospectively studied all consecutive total sacrectomy reconstructions performed at The University of Texas MD Anderson Cancer Center from 1995 to 2010. We analyzed relationships between surgical outcomes and patient, tumor, and treatment factors. We also compared surgical outcomes of reconstructions with free fibula flaps to those without free fibula flaps.

Results:
Of the 56 sacrectomies identified, only six patients had undergone total sacrectomy. Total sacrectomy reconstructions included the following: 3 (50%) tibia alloplastic grafts, 2 (33%) free fibula flaps, and 1 (13%) soft tissue–only reconstruction. Both free fibula flaps were completed in three separate stages: supine harvesting of a pedicled VRAM flap and preparation of a fibula flap (left in situ) (Stage 1); prone total sacrectomy completion, spino-pelvic instrumentation, and temporary insetting of the trans-sacral VRAM (Stage 2); and harvest, osteotomy, and fixation of the free fibula flap between the fifth lumbar vertebra and iliac sciatic notches, tarsal vein graft harvest, and fibula flap anastomosis to the VRAM flap in a flow-through fashion (Stage 3). Both free fibula reconstruction patients ambulated by discharge. One of the tibia allograft patients and the soft tissue–only reconstruction patient never progressed beyond using a wheelchair or walker for ambulation. One of the three tibia allograft patients developed unstable hardware fixation after three years.

Conclusions:
This study describes total sacrectomy reconstruction using a VRAM flow-through flap anastomosed to a double-barreled free fibula flap. Free flap lumbosacral reconstruction is challenging due to the absence of local recipient vessels. Anastomosing the free fibula to the VRAM flap vessels allows assessment of the recipient vessels during the first operative stage, satisfies the bone and soft tissue requirements of the total sacrectomy defect, and provides a durable, functionally optimized reconstruction for the total sacrectomy patient.
Anterior Lumbar Spine Fusion Using a Expandable Titanium Cage Fixation and Intra-abdominal Donor Vessels, Overcoming the Challenges of Vascularized Fibula grafts to the Spine

Institution where the work was prepared: Long Island Plastic Surgical Group, Garden City, NY 11530, NY, USA

Thomas Davenport, MD; M Agulnick; T Cohen; T Addona; J Goncalves; D Shin; M Kilgo; Kristin Aliano, MD; (1)Winthrop University Hospital, (2)Long Island Plastic Surgical Group PC

Reconstruction of bony defects in the surgical management of vertebral osteomyelitis can be a challenging endeavor. Goals of surgical management include adequate debridement, reconstitution of structural integrity, and delivery of antibiotics. Vascularized fibula grafts have been used to reconstruct these defects where cancellous bone grafts would not be adequate. Difficulty with fixation to the spine and performing an anastomosis deep in the wound with small vessels makes this surgery technically challenging. We present three cases of vascularized fibula grafts to the spine with titanium cage fixation and intra-abdominal donor vessels.

Three patients, two female and one male, failed conservative treatment for vertebral osteomyelitis. Intervention consisted of staged posterior irrigation & debridement (I&D) with segmental fixation, followed by a thoracoabdominal approach for thoracolumbar corpectomy. Reconstruction was performed with a custom, expandable titanium cage and free vascularized fibular graft placed within this cage. The fibular graft was anastomosed to intra-abdominal recipient vessels in all three cases. One patient to the jejunal arcade, one patient to accessory splenic vessels, and a third to the gastroepiploic vessels. All patients showed clinical improvement postoperatively, with no neurologic deficits. Fusion was confirmed on CT scan on all three patients and none of the patients had recurrent infections with follow up of 18, 12 and 2 months. There were no wound or gastrointestinal complications.

A free vascularized fibular strut graft within an expandable titanium cage is a novel technique for the surgical management of spinal osteomyelitis. This procedure can be made less technically challenging for the orthopedic surgeon and plastic surgeon with the use of an expandable spinal cage for fixation and the use of intra-abdominal vessels for anastomosis.

The Pudendal Canal of Alcock and the Microsurgeon

Institution where the work was prepared: Yale University, New Haven, CT, USA

Britt Colebunders, MD; Michael K. Matthew, MD; Niclas Broer; John A. Persing, MD; A. Lee Dellon, MD, PHD; (1)Yale University, (2)Johns Hopkins University

Purpose:

Microsurgery free flap harvest now occurs in relationship to the pudendal nerve, especially with the inferior gluteal artery perforator flap (IGAP). Reconstruction of the penis, perineum and vagina for tumor, trauma or transgender surgery also bring the microsurgeon into relationship with this critical nerve. It is the purpose of this presentation to describe the critical anatomical relationships of the pudendal nerve, and bring to light the historical origin of the description of the pudendal canal by Benjamin Alcock.

Methods:

Historical texts were identified that contained the original description of the pudendal canal by Benjamin Alcock in 1836. Cadaver dissections were done in 4 male and 1 female formalin-fixed specimens to understand better the complex relationships of the pudendal nerve and its branches, the rectal, perineal, and dorsal nerve to the penis (clitoris). Dissections were carried out using different approaches: posterior, anterior and a medial approach after sagittal hemisection of the pelvis.

Results:

Although credited with describing the canal that contains the pudendal nerve, Benjamin Alcock actually described the course of the pudendal artery, mentioning briefly that the pudendal nerve accompanies the artery during its course, without giving a detailed description of the anatomy of the nerve in relation to the canal.

The dissections identified 7 potential entrapment sites of the pudendal nerve: 1) proximal to the sacrotuberous ligament 2) between the sacrotuberous ligament and the sacrospinous ligament 3) at the entrance of Alcock’s canal 4) within the sheath of the obturator fascia (the pudendal canal described by Alcock) 5) at the exit of the Alcock’s canal 6) along the pathway beneath the corpora cavernosa 7) and at the pubic symphysis (Figure 1)

Conclusion:

Although Alcock’s canal is often referred to in pudendal nerve entrapment pathology, Benjamin Alcock gave little attention to the nerve in his original description. We identified 7 potential entrapment sites of the pudendal nerve, 3 of which were in relation to Alcock’s canal. This anatomical knowledge will benefit those microsurgeons operating in this region, as well as guide operative approaches to neurolyse or reconstruct the pudendal nerve.
The Effect of Low Molecular Weight Heparin and Procedure Type on Re-Operative Hematoma

Introduction:

Concerns related to postoperative hematoma formation influence use of enoxaparin after surgery. The PSEF-funded Venous Thromboembolism Prevention (VTEP) study was designed to evaluate the efficacy of post-operative enoxaparin for venous thromboembolism (VTE) prevention in plastic surgery patients. In preliminary analysis of the VTEP database, we evaluated rates of operative hematoma formation when post-operative enoxaparin is and is not used. Additionally, we examined the relationship between procedure type and hematoma formation in patients not receiving enoxaparin prophylaxis.

Methods:

The VTEP study network consists of five academic institutions. In June 2008, each implemented a clinical protocol for VTE prophylaxis, which included pre-operative risk stratification and post-operative enoxaparin. The control group did not receive enoxaparin. Chart reviews identified thromboembolic and bleeding complications for 60 days after surgery. We examined rates of post-operative hematoma, stratified by receipt of enoxaparin and procedure type.

Results:

We identified 997 historic control patients in the VTEP database. When compared to patients having non-breast surgery, breast reconstruction patients (4.3% vs. 1.4%, p=0.009) and breast reduction patients (11.6% vs. 1.4%, p<0.001) were significantly more likely to have re-operative hematomas.

Conclusion:

In patients not receiving enoxaparin, breast reduction and breast reconstruction surgery patients were at a significantly increased risk for re-operative hematomas. Post-operative enoxaparin did not increase overall re-operative hematoma rates even in patients undergoing breast reduction and breast reconstruction. The effectiveness of enoxaparin for VTE prevention remains to be determined.
Free Tissue Transfer in the Hypercoagulable Patient: A Review of 29 Free Flaps

Institution where the work was prepared: University of Pennsylvania, Philadelphia, PA, USA

Theresa Y. Wang, MD; Joseph M. Serletti; David W. Low, MD; Stephen J. Kovach; Liza C. Wu; University of Pennsylvania

Introduction:

Hypercoagulable states is a group of inherited or acquired conditions associated with a predisposition to thrombosis. Most hypercoagulable states alter the blood itself or affect the vasculature directly creating a detrimental environment for microsurgery. The inherent risk of thrombosis would deem these patients unsuitable candidates for free tissue reconstruction. We present our series of hypercoagulable patients who underwent free flap reconstruction.

Methods:

A review was conducted of all free flaps performed between January 1, 2005-December 31, 2009 by the division of plastic surgery in the University of Pennsylvania Health System. A total of 1556 flaps were performed. Nineteen (19) patients or 29 free flaps were identified to have a hypercoagulable disorder or previous hypercoagulable event requiring anticoagulation. Diagnosis included Factor V Leiden (2), Protein C deficiency (1), hyperhomocysteinemia (1), antiphospholipid antibody syndrome (1), prothrombin gene mutation (1). The group of patients with thrombotic events (some with more than one event) included deep vein thrombosis (9), pulmonary embolus (4), myocardial infarction before the age of 50 (1) and embolic stroke before the age of 50 (2).

Results:

Seventeen patients were females, 2 were males. Mean age was 52 years. The average BMI was 27.8 kg/m2 (18.4 to 34.7). A total of 29 free flap reconstructions were performed which included 26 breast (2 SIEA, 4 DIEP, 20 TRAM), 1 trunk (TRAM), extremity (ALT), and 1 head and neck (ALT). There were no intraoperative flap losses. However, 1 case had an intraoperative flap congestion which required an additional venous anastomosis for drainage. Postoperatively, unless there was an anticoagulation regimen recommended by the patient’s hematologist, most patients received the standard anticoagulation according to independent surgeon protocols customary for free flaps. There were 4 flap (13.8%) thromboses- 3 arterial and 1 venous, which required surgical exploration. These cases all occurred on postoperative day 3 or 4. Despite vein graft, mechanical and chemical thrombolysis and systemic anticoagulation, the salvage rate was zero.

Conclusion: Although hypercoagulability produces an unfavorable condition for microvascular reconstruction, successful free tissue transfer is very much possible in this population. Most importantly, prior to embarking on this endeavor, patients need to be cognizant of the increased risks of thrombosis and flap failure. Collaboration with a hematologist is essential. When a flap thrombosis occurs, this seems to happen later than the immediate postoperative 48 hours and into the delayed period. Even with reexploration, salvage rates have not been promising.

A Prospective Evaluation of U-clips for Arterial Microvascular Anastomoses

Institution where the work was prepared: Scott & White Hospital, Temple, TX, USA

Janae Lynn Maher, MD; Raman Chaos Mahabir; Juhee Song; Texas A&M - Scott & White Hospital

Background:

Longer ischemia and operative times are associated with increased complications in microsurgery. The nitinol U-clip (Medtronic, Inc.; Minneapolis, MN) is a new penetrating clip applied in an interrupted fashion that eliminates knot tying and decreases operative time. This technology holds the potential for rapid, reproducible sutureless microvascular anastomoses. In addition, the surgical technique is very similar to conventional suture microanastomosis, resulting in decreased learning curves and suitability to training programs. The purpose of this study was to perform the first large clinical trial of this new technology for arterial microsurgical anastomosis.

Methods:

The study was a prospective clinical trial of nitinol U-clips for 25 arterial microsurgical anastomoses. Standard microsurgical techniques and instruments were used. The primary outcome was free flap survival. The secondary outcomes were ischemia time (this included inset of the flap when necessary), OR time, number of clips used, and recipient / donor site complications. Significant donor site / recipient site complications were defined as complication requiring re-operation. Data was collected on patient demographics, wound etiology and recipient site characteristics. Descriptive statistics were used. Minimum follow-up was three months.

Results:

There was a 100% success rate (25/25). Mean patient age was 57. The most common etiology of the defect was cancer resection (91%) and 48% of the recipient vessels had been irradiated prior to surgery. Mean ischemia time was 30 minutes (range 12 min to 54 min), and mean OR time was 7.4 hours. On average, 7 U-clips were used per arterial anastomosis. At 3-month follow up there was a 100% flap survival rate with no significant recipient site or donor site complications.

Conclusion:

This prospective clinical trial suggests that the nitinol U-clip holds promise to provide rapid, reproducible arterial microvascular anastomoses. The potential role of this new and exciting device warrants further investigation.
Reconstruction of Composite Tibial Defects with Microvascular Osteomuscular Latissimus Dorsi Flap

Institution where the work was prepared: Tel Aviv Medical Center, Tel Aviv, Israel

Ari Zaretski, MD; F.C. Wei; Chih-Hung Lin; Christopher Glenn Wallace; Eyal Gur; (1)Sackler Faculty of Medicine, Tel-Aviv University, (2)Chang Gung Memorial Hospital

Introduction:
Microsurgical free tissue transfer has revolutionized plastic surgeons reconstruction armamentarium. It allows functions and esthetics to be preserved without compromising the principles of oncologic surgery. We present thirteen possible flaps that can be harvested from the anterior thigh, demonstrating its versatility.

Patients and Methods:
Between 1995 and 2005, 2992 flaps were harvested from the anterolateral/anteromedial thigh at the Chang Gung memorial hospital, Taiwan; 65 flaps were harvested at the Tel-Aviv medical center from 2006 to 2010. In this group of patients 13 types of flaps harvested from the anterolateral/anteromedial thigh were developed along the years in order to answer reconstructive needs. Most of the flaps (73.3%) were used for head and neck reconstruction, including defects of the tongue, buccal region, mandible, midface, scalp and through-and-through cheek defects. The majority were variations of the anterolateral thigh flap based on the descending branch of the circumflex femoral vessels, including: 1) cutaneous (harvested in a suprafascial manner), 2) super-thinned, 3) fasciocutaneous, 4) vascuized fascia lata, 5) component separation fasciocutaneous, 6) variable thickness fasciocutaneous 7) myocutaneous (including a segment of vastus lateralis muscle), 8) cutaneous chimeric, 9) composite chimeric (including a separate muscular segment), 10) elevating two independent cutaneous flaps from the same donor site, and 11) flow-through flaps. Additional flaps used were 12) the vastus lateralis free flap and 13) free-style harvest of cutaneous flaps from the anteromedial thigh. Furthermore, the same donor site allows a second free flap to be harvested at a later date by utilising a different vascular supply (eg. free-style harvest of a cutaneous flap from the anteromedial region having previously used the anterolateral thigh).

Results:
The complete flap success rate was 96%. Donor site complications were few (eg. wound dehiscence), and invariably resolved in the short term. The harvest of a second flap from the thigh area at another time was always possible.

Conclusion:
The anterolateral/anteromedial thigh provides unchallenged flexibility in the choice of flaps available from a single donor site. The patient’s position need not be changed intraoperatively, allowing a simultaneous two-team approach during tumor resection and flap harvest. In this report we describe two previously unreported types of flaps (number 5 and 6). The thigh is a workhorse donor site for harvesting soft tissue flaps.

Different Types of Free Flap Harvested From the Thigh for Microsurgical Reconstruction

Institution where the work was prepared: Tel Aviv Medical Center, Tel Aviv, Israel

Bruno Battiston; Luigi Giulio Conforti; Pietrogi Toz; University de Torino

Reconstruction of High Ulnar Nerve Lesions by Distal Double Median to Ulnar Nerve By-pass

Institution where the work was prepared: C T O Hospital, Torino, Italy

Bruno Battiston; Luigi Giulio Conforti; Pietrogi Toz; University de Torino

Isolated proximal ulnar nerve lesions (Medial Trunk or ulnar nerve at the exit from the plexus) often carry an unfavorable prognosis, due to insufficient sensory and intrinsic muscle recovery, even if correctly reconstructed. This paper presents a series of 7 clinical cases where restoration of ulnarily innervated intrinsic muscles of the hand and of skin sensibility was achieved by a distal connection of the anterior interosseous nerve and the superficial sensory palmar branch of the median nerve to the motor and sensory components of the ulnar nerve at the wrist. Follow-up was between 12 months and 3.5 years. Results were graded by the Hight-Zachary scale. In 6 cases we obtained good motor and sensory recovery, while in one case we obtained only return of protective sensation.
Skeletal Deformities in Noma Patients

Institution where the work was prepared: BG Trauma Center, Murnau, Germany
Goetz A. Giessler, MD, PhD; Andreas B. Schmidt, MD; Carl Peter Cornelius, DMD, MD, PhD; (1)BG Unfallklinik Murnau, (2)Ludwig Maximilian University Munich

Background:
Noma primarily strikes children in growing age. The few survivors not only suffer from three-dimensional defects of the facial soft tissues, but may also develop complex osseous defects of the viscerocranium, which derive from acute osteitis, chronic exposure or arrested growth of skull and mandible. For an integrated approach of reconstruction of soft tissue together with appropriate structural skeletal restoration one must be familiar with the most common skeletal changes in noma victims.

Methods:
Through treating various noma cases since 1998 we had the opportunity to gain increasing insight into the skeletal sequelae of this complex disease. More recently, radiographic and CT-scan imaging improved the understanding of skeletal deficiencies and dysplasias and the nature and extent of typical noma-associated extraarticular temporomandibular joint ankylosis. These skeletal features are related to typical selected clinical cases.

Results:
The most common skeletal change is coronoid hypertrophy, which in extreme cases presents as fusion between the mandibular ramus and the zygoma or even the skull base. Loss of the maxilla which can involve all structural pillars is common in typical anterolateral cases. If noma strikes in young childhood in these cases, a tear-drop-shape of the orbital floor is common. It is sometimes combined with an orbital level disparity. In central noma cases the premaxilla with varying extents of the hard palate vomer and nasomaxillary pillars can be missing. Noma-associated osseous viscerocranial defects in other parts of the face are described but are rare.

Conclusions:
Integrative noma reconstruction should include skeletal restoration to achieve optimal results. Before reconstruction, the plastic surgeon must know, which defects can be expected in typical noma-associated lesions. This is especially true, if preoperative radiographic imaging is of limited availabilty or quality. Careful surgical planning must include the release of any ankylosis which is almost exclusively extraarticular in noma patients.

Hemodynamic Differences in Blood Flow between Free Skin and Muscles Flaps: Prospective Study

Institution where the work was prepared: Hacettepe University, Ankara, Turkey
Serdar Nasir1; Bahattin Baykal, MD2; Selman Altuntas1; Mustafa Asim Aydin, MD; (1)Hacettepe University, (2)Suleyman demirel University, (3)Suleyman Demirel University

Free flap transfer induces blood flow changes in the flap pedicle and recipient artery. Short- and long- term hemodynamic changes in recipient and pedicle arteries were shown in free muscle flaps. It was demonstrated that the blood flow increased according to free muscle flap requirements, and these changes in blood flow did not depend on recipient artery flow. However, this result has some drawbacks when considering all free flap models. Different types of flaps were used in clinical practice, and every type caused different hemodynamics in recipient and pedicle arteries after flap transfer. This result may relate to differences in the free flap anatomy and physiology. Sympathetic innervations are rarer in muscle than skin, and blood flow is regulated by the metabolic needs of the muscle, not by sympathetic innervations. Thus hemodynamic changes in recipient and pedicle arteries for different types of flaps may create some alterations in the postoperative follow-up period. Our goal was to demonstrate short- and long-term hemodynamic changes of recipient and pedicle arteries of skin and muscle flap transfers.

We used Doppler ultrasound to evaluate postoperative hemodynamic changes in blood flow in skin (n=11) and muscle (n=4) flaps. The minimum velocities, resistance indexes, and diameters of the pedicle, the recipient, and control artery (the corresponding contralateral artery that served as a recipient vessel) were recorded intraoperatively and at 10 days, 1 month, 3 months, 6 months, and 12 months after surgery. The minimum velocities and blood flow in recipient and pedicle arteries in both groups increased after flap transfer. In control arteries, these values decreased over the follow-up period. The decrease of blood flow in recipient arteries for the skin flaps started at 10 days and in the muscle flap at 1 month. The decrease in minimum velocity was noted after 10 days and 1 month for skin and muscle flaps, respectively. Resistance indexes were higher in skin flaps (99±6) compared with muscle flaps (89±9). Also, recipient blood flow after flap transfer, independent from intraoperative values, changed according to flap size; muscle flaps that were larger than skin flaps caused significantly higher blood flow in recipient artery.

To the best of our knowledge, this is the first report that demonstrates a hemodynamic difference in different types of free flaps during the follow-up period. Recipient and pedicle blood flow were independent from intra-operative values and may change depending on flap size.
Mesenchymal Stem Cells Prolongation of Allotransplant Survival Is Correlated to T-cell Regulation in a Swine Hemi-facial Composite Tissue Allotransplantation Model

Institution where the work was prepared: Chang Gung Memorial Hospital-Kaohsiung Medical Center, Kaohsiung, Taiwan
Yur-Ren Kuo, MD, PhD; Chien-Chang Chen; Hsiang-Shun Shih; Chong-Wei Huang; Shigeru Goto; Fu-Chan Wei; Chang Gung Memorial Hospital-Kaohsiung Medical Center, Chang Gung University

Background:
Partial face composite tissue allo-transplantation (CTA) was recently achieved in a human subject. However, the side effects of long-term immunosuppressant and chronic rejection still need to be concerned. In our previous study, we have successfully created swine hemi-facial transplantation for pre-clinical studies. We also demonstrated bone marrow-derived mesenchymal stem cells (MSCs) could significant prolong CTA survival in a swine hind-limb model. This study investigated whether MSCs combined with short-term cyclosporine-A (CsA) therapy could be reproducible and prolong CTA survival in swine hemi-facial allotransplant model.

Materials and Methods:
Out-bred miniature swine underwent hemi-facial transplantation. The hemi-facial orthotopic transplant consisted of ear cartilage, auricular nerve, parotid gland and lymphoid tissue, muscle with surrounding hemi-facial skin paddle supplied by the carotid artery and external jugular vein transplanted to recipient swine.

Group-I (n=4) was the untreated control. Group-II (n=3) received MSCs alone (given on days -1, +1, +3, +7, +14, +21). Group-III (n=3) received CsA (10mg/kg/day, day 0→+28). Group-IV (n=5) received CsA (day 0→+28) and MSCs (day-1, +1, +3, +7, +14, +21). The transplanted face was observed daily for signs of rejection. Biopsy of donor tissues for histological analysis were obtained at specified predetermined time (day +14, +28, +42), or at the time of clinically evident rejection. The expressions of CD4+/CD25+ T cells were assessed using flow cytometry.

Results:
The hemi-facial allotransplant survival with MSCs alone revealed mild prolongation as compared to the controls. Allotransplant with CsA treatment exhibited delayed rejection (days 36 to 48; P<0.05). However, combination of MSCs-CsA treatment demonstrated significant prolongation of allograft survival (days 38 to 71; P<0.05), although the allotransplant was still rejection finally. The MSCs-CsA group revealed the lowest degree of rejection in the allo-skin and interstitial layers. The CD4+/CD25+ regulatory-like T-cell expression in the circulating blood and allo-skin significantly increased in the MSC-CsA group. MSCs significantly suppressed T-cells proliferation in vitro.

Conclusion:
These results demonstrated MSCs significantly prolong allotransplant survival in different large animal study. The data indicated that the regulatory activity of MSCs on T cells might contribute to significant prolongation of CTA survival in the MSC-CsA treatment.
30 Year Follow-up of the First North American Lower Extremity Replant

Institution where the work was prepared: UCLA Medical Center, Plastic & Reconstructive Surgery, Los Angeles, CA, USA

Ahmed Suliman, MD; Fernando A. Herrera; Eric I. Chang; Malcolm Lesavoy; UCLA Medical Center

Background/Objective:
Lower extremity (LE) replantation continues to be controversial despite its description over 3 decades ago and increasing reports of successful outcomes. Current advancements in microsurgery and immunological suppression have paved the road for face and hand transplantation and with these innovative and pioneering efforts, long term follow-up will be key in assessing feasibility. Therefore of historic and clinical interest we report on the longest follow-up of the first LE replantation performed in the United States.

Case Report:
On 8/29/1977 a motorcycle accident resulted in the traumatic amputation of the leg at the mid-distal tibia and fibula of a 17 yo male. The proximal and distal boney segments were debrided and the tibia stabilized via rigid plate fixation. The Achilles tendon, foot extensors and flexors were repaired at their musculotendinous junctions. The posterior tibial artery, vena comitantes, and tibial nerve (thus preserving plantar sensibility) were repaired primarily. The anterior tibial artery was repaired with use of an interposition vein graft. Cold ischemia time was 7 hours, the patient received 8 units of blood and was discharged home 10 days later. At 6 months he was walking with crutches, at 9 months he was weight bearing and used a 3 inch shoe lift. At 11 months he had near normal gait. He had protective plantar sensation but was insensate in the distribution of the superficial, deep peroneal and sural nerves which were not repairable at the time of replantation. At 22 months he had near normal active flexion and extension of the ankle. At 3 yrs he underwent removal of hardware due to chronic drainage at the anterior aspect of his leg. At 6 years he had mild hypersensitivity along the plantar aspect of his foot but had no gait disturbances. He was able to hike, run, and swim without any limitations. At 17 years he had near normal function that did not limit his active lifestyle. At 30 years he continued to maintain an active lifestyle and was a grade I according to the Chen criteria of replanted lower limbs. On 3/16/2007 he died from complications related to epilepsy.

Conclusion:
We report a case of the 1st lower extremity replantation in the United States with the longest follow-up of 30 years. Past advancements in microsurgical techniques have paved the way for current and future technology which will allow patients the unique opportunity for successful anatomic, functional, psychological and social rehabilitation.

Results at One Year after Bilateral Trans-humeral Transplantation

Institution where the work was prepared: Clínica Cavadas, Valencia, Spain

Pedro C. Cavadas, MD; Luis Landin, MD; Clínica Cavadas

The clinical case of a male one year after transplantation of completely HLA-mismatched transhumeral bilateral upper extremities is reported. The patient received alemtuzumab as an induction, tacrolimus and MMF for maintenance, and steroids were introduced at 6 months for rejection. Posttransplant diabetes mellitus developed and is being treated. AROM of elbows is near-normal, quality of sensory recovery is S4, and after bilateral wrist arthodesis on postop month 10, finger flexion and extension is excellent and grip power is improving.
Experience with “Racing Stripe” Fasciocutaneous Free Flaps

Institution where the work was prepared: University of Texas, Houston, TX, USA
Emmanuel G. Melissinos, MD; Erik Scott Marques, MD; Donald H. Parks, MD; University of Texas Health Science Center

Introduction:
The value of the radial forearm and lateral arm free flaps as reconstructive tools has been solidly established. Their major disadvantage is donor site morbidity. The “racing stripe” modification, in which a large fascial component with a narrow strip of skin is harvested, minimizes the drawbacks of the traditional radial forearm and lateral arm free flaps while preserving their useful characteristics.

Materials and methods:
The course of the flap vessels is determined by Doppler and marked. A narrow skin paddle, 1-2.5 cm in width is designed with its axis centered on the position of the vessels. After incising through skin and subcutaneous fat, skin flaps are raised on both sides of the cutaneous strip, exposing the required amount of deep fascia. The periphery of the exposed fascia is incised and raised off muscles and tendons from both directions towards the flap vessels, dividing the muscular branches and elevating the fascia along the way. Unintended injury to the peritenons is not critical as primary closure of the donor wound is planned. In radial forearm flap cases, extreme care is taken to dissect and preserve all branches of the superficial radial nerve. The flap is transferred to the recipient site and the skin strip is positioned along the long axis of the defect. Sensory reinervation can be accomplished as described by others. The fascial borders of the flap are anchored along the perimeter of the defect and covered with split thickness skin. The donor site is closed primarily over a drain. The initial uneven, irregular appearance of the reconstructed area improves rapidly and matures into a satisfactory contour.

We have performed 422 radial forearm and 112 lateral arm “racing stripe” free flap transfers for reconstruction of distal tibial, ankle, foot, forearm, and hand and scalp wounds. There were no flap failures.

Conclusions:
The “racing stripe” radial forearm and lateral arm free flaps have provided us with a useful choice for simple, reliable reconstruction of small to medium size soft tissue defects. The inclusion of the skin stripe provides sturdy soft tissue coverage while minimizing donor site scarring and morbidity.
Timing of Post-Traumatic Lower Extremity Free Flap Reconstruction: a Retrospective Review

Institution where the work was prepared: Louisiana State University, New Orleans, LA, USA
Anh Lee, MD; Heath Charvest, BS; Stephen Liaw, BS; M. Whitten Wise, MD; Charles L. Dupin, MD; Hugo St-Hilaire, MD, DDS; Louisiana State University

Background:
High energy injuries to the lower extremity with composite tissue loss remain a challenge for the reconstructive surgeon. The complexity of those injuries which often include significant tissue loss with extensive zone of injury and vascular compromise has long been recognized. The traditional treatment philosophy still follows Godina’s findings from his original publication in the mid 80’s. He recommended coverage of Gustillo III b/c within 72 hours or 3 months post-surgery to minimize flap failure and infection. Recent literature also support the “earlier is better” concept. We, however, propose that an effective and stable reconstruction can be performed regardless of the time since the injury. The goal of this presentation is to review our recent experience in reconstruction of high energy injury of the lower extremity using free tissue transfer in a Level I trauma Center.

Methods:
An IRB approved retrospective review was performed. Our database was interrogated using CPT and ICD-9 codes designating free tissue transfer to the lower extremity in the years 2008 and 2009. Basic patient demographics, type of flaps and timing of reconstruction as well as adjunctive use of negative pressure dressing was recorded.

Results:
Charts reviewed totaled 141. Forty-eight of those that met inclusion criteria. The majority of injuries (73%) were Gustilo grade IIIb fractures. Mean injury to procedure time was 35.77 days (SD 55.47) while the mean post flap length of surgery stay was 13.63 days (SD 6.93). Comparing injury to procedure time (IPT) in the groups with wound vats (VAC®) and to those without (NWV), the mean IPT for VAC® was 41.92 days vs 15.5 days (NWV) with a p value of .09. There was one free flap failure that went onto amputation.

Conclusions:
We have shown that lower extremity reconstruction using free tissue transfer is feasible regardless of the time from the initial injury. Our data shows that successful reconstruction can be accomplished weeks and months out from the initial trauma. Adjunctive use of negative pressure wound therapy has allowed us to delay reconstruction from the acute critical period to a more subacute period. This allows complete stabilization and optimization of the polytrauma patient prior to reconstruction of a high energy composite defect of the lower extremity.

Long Term Results and Costs of Free Flap Coverage & Ilizarov Bone Transport in Lower Limb Salvage

Institution where the work was prepared: The Buncke Clinic, San Francisco, CA, USA
Brian Parrett; Rudolf F. Buntic; Gregory M. Buncke; Darrell Brooks; Bauback Safa, MD; David Lowenberg; The Buncke Clinic

Background:
It is a common teaching that patients with severe open tibial injuries with infection and bone loss are better served by amputation than complex limb salvage. Our preference is limb salvage with wide debridement, free muscle flap coverage, and Ilizarov bone transport. The purpose of this study was to evaluate the long term results and costs of this treatment modality as compared to current data related to amputation.

Methods:
A retrospective review was performed of all consecutive patients with lower extremity wounds with tibial defects who were recommended amputation and were instead treated with flap reconstruction and Ilizarov bone transport by a single surgeon. A criterion was at least 5 year follow-up. Outcomes assessed were flap complications, tibial union, infection, need for future surgeries, ambulation status, employment status, and need for chronic narcotic use. Patients were also surveyed regarding their satisfaction with their reconstruction. A cost analysis was also performed for this treatment modality and compared to published data on limb amputation.

Results:
Thirty six patients (mean age, 40 years) were included with 13 acute Gustilo grade 3B/C defects and 23 chronic tibial defects (infected nonunion with tibial osteomyelitis). Thirty seven muscle flaps were performed with one flap loss (2.7%). The mean tibial bone defect length was 9 cm, mean duration of bone transport was 10.6 months, and mean follow-up was 10 years (range, 5-18 years). The nonunion rate was 2.8%, malunion rate was 5.6%, and the infection rate was 8.3% (all cured with subsequent intervention). No patients underwent future amputations and 9 (25%) required re-operations. All patients progressed to bony union. Ninety-two percent of patients were ambulating without assistance, 79% of patients were working full time and 6% part-time, and only 5.6% required chronic narcotics. On long-term survey, all patients were happy with their decision to pursue limb salvage over amputation. On cost analysis, the mean cost per year and per lifetime per patient after limb salvage was significantly less than the published mean cost per year and lifetime for limb amputation patients.

Conclusion:
The long term results and costs of Ilizarov bone transport and free flap coverage strongly support complex limb salvage over limb amputation in this group of patients.
Purpose:
Perforator flaps based on the deep inferior epigastric artery (DIEA) are becoming popular for breast reconstruction. The anatomic variability of the DIEA has generated increasing interest in preoperative CT angiogram (CTA). There is little data comparing patients who have had CTA to those who haven’t. This study was undertaken to evaluate how preoperative CTA affected preoperative planning, operative time and outcome in our practice.

Methods:
We performed a retrospective study of patients who underwent abdominal free flap breast reconstruction at an academic center over a 4-year period, with preoperative CTA performed routinely after the first year. Operative time and outcomes were compared between procedures with and without preoperative CTA. The effect of preoperative CTA on surgical planning and rate of incidental findings was recorded.

Results:
From 2006-2010, 102 abdominal perforator flaps were performed in 69 patients; 51 patients had preoperative CTA and 18 did not. We excluded 3 patients who had unusually long operative times due to microanastomotic complications. Preoperative CTA changed preoperative planning in 30% of cases by localizing the side with best perforator anatomy in unilateral cases (N=11) or by identifying perforators with long intramuscular course (N=4). In the latter case, a muscle-sparing or contralateral flap was utilized. Preoperative plan based on CTA corresponded to operative procedure in 89% of cases. The sensitivity and positive predictive value of CTA to localize perforators were 79% and 92% respectively. In both unilateral and bilateral cases (Fig 1), operative time was reduced with CTA (unilateral: 496 min vs 636 min [p=0.02]; bilateral: 629 min vs 746 min [p=0.05]). A trend toward fewer complications requiring reoperation was observed with CTA (17% vs 34%, p=0.2). Rates of fat necrosis, partial flap necrosis and complete flap loss were comparable between those with CTA (12%, 5%, 1% respectively) and without CTA (9%, 4%, 0% respectively). Incidentalomas were found in 36% of patients (Table 1). Surgery was canceled in 1 patient due to metastatic disease.

Conclusions:
Preoperative CTA appears to reduce operative time by minimizing time spent identifying and dissecting individual perforators, allowing selection of the best side for unilateral reconstruction, and prompting conversion to a muscle-sparing flap when a long intramuscular course is identified. The use of CTA was associated with fewer complications requiring reoperation, but no significant effect on fat necrosis or flap necrosis was observed. The effect of a learning curve cannot be excluded, and is the chief limitation of this study.

Clinical Utility of CT Angiography in Pre-operative Perforator Selection in DIEP Free Flap Breast Reconstruction

Clinical Utility of CT Angiography in Pre-operative Perforator Selection in DIEP Free Flap Breast Reconstruction

Background:
CT angiography (CTA) has been shown in recent studies to have a high sensitivity and specificity for pre-operative planning in DIEP breast reconstruction and to reduce operative time. However, these studies have only documented the high degree of correlation between CTA and perforator location, but not their clinical significance. This study seeks to specifically evaluate the clinical utility of CTA in DIEP free flaps.

Methods:
This study includes 52 sequential DIEP free flap breast reconstruction cases in 37 patients. Pre-operative CTA of the deep inferior epigastric system was obtained in all cases with up to 3 dominant perforators marked by radiologist on 3-D skin-level reconstruction. Each scan was reviewed by the surgeon prior to the operation and the planned perforators were documented. Post-operatively, the perforators used were documented.

Results: Surgeons planned to use at least one marked perforator in 50/52 cases (96%). In 18/52 cases (35%) surgeons used perforators exactly as planned. In 38/52 cases (73%) perforators were used as planned with or without the addition of one or more extra perforators. The most common reason for the addition of perforators was, “additional perforator(s) easy to add (n=6)” followed by “planned perforator(s) insufficient (n=5)” and “anatomic reason (n=3).” In 22/52 cases (42%) at least one perforator was used that was neither marked by the radiologist nor surgeon pre-operatively. In 7/52 cases (14%) completely different perforators were used than that which was planned.

In terms of surgeon correlation with the radiologist we noted that in 14/52 cases (27%) the surgeon did not plan to use the perforator marked as the best by the radiologist. In fact, 1 in 10 of the perforators used were not even marked by the radiologist in the study.

Conclusion:
CTA mapping of perforators prior to DIEP flap surgery increases surgeon confidence and may reduces operative time; however, this study shows that there are still a significant number of changes made based on clinical judgment. Over two-thirds of the time, variations are made from the pre-operative plan based on CTA. This study highlights the importance of surgeon review of CTA images. Caution is warranted in reliance on CTA mapping, and significant perforators should not be sacrificed until the anticipated perforator(s) have been exposed and evaluated.
Comparison of Intraoperative Perfusion Techniques to Predict Mastectomy Skin Flap Necrosis: Preliminary Results of a Prospective Clinical Trial

Institution where the work was prepared: Stony Brook University Medical Center, Stony Brook, NY, USA

Brett T. Phillips, MD; Steven T. Lanier, BA; BS; Nicole Conkling, BA, BS; Eric D. Wang, BS; Brian J. O’Hea, MD; Alexander B. Dogum, MD; Jason C. Ganz, MD; Sami U. Khan, MD; Duc T. Bui, MD; Stony Brook University Medical Center

Background:
Intraoperative vascular imaging can potentially aid surgeon assessment of mastectomy skin flap (MSF) perfusion to predict areas of necrosis. No head to head study has compared alternative imaging modalities for this purpose. We hypothesized that: 1) Laser-Assisted Indocyanine Green (Novadaq SPY System, ICG) and Fluorescein Dye Angiography (FDA) are more sensitive methods of predicting mastectomy skin flap necrosis than clinical assessment, and 2) ICG is a more specific predictive tool than FDA.

Methods:
A prospective pilot study of 50 immediate breast reconstructions with tissue expander/implant or autologous flap is underway. MSFs are evaluated intraoperatively via clinical assessment, ICG, and FDA following expander placement or flap inset. Predicted areas of necrosis by each method are marked on the patient’s skin, traced onto a transparent film, and photodocumented. Clinical assessment guides excision. Patients are followed weekly and areas of actual necrosis are directly compared to areas predicted by the 3 intraoperative methods.

Results:
Complete data is collected for 27 immediate breast reconstructions (17 patients), with a mean follow-up of 8.4 weeks (Range: 2-16). Mean patient age is 50.1 (Range: 23-76) and mean BMI is 28.7 (+/- 12.8). Four cases of necrosis occurred (14.8%). ICG and FDA correctly predicted the occurrence of necrosis in 3 of 4 cases, representing a sensitivity of 75%. However, ICG and FDA over-predicted the areas of necrosis by an average of 68.6% (+/- 4.9%) and 82.2% (+/- 4.2%) respectively in these 4 cases. Of the 23 breasts in which necrosis did not occur, ICG predicted no necrosis in 11 for a specificity of 47.8%, while FDA predicted no necrosis in 7 for a specificity of 30.4%. Based on these numbers, the positive predictive values (PPV) of ICG and FDA are 20% and 15.8%, respectively, while the negative predictive values (NPV) of ICG and FDA are 91.7% and 87.5%, respectively. Quantitative intra-operative analysis (SpyQ) of areas that ultimately became necrotic showed perfusion ranging from 31-40% of baseline, though percentages in this range were also observed in MSF areas that did not ultimately become necrotic.

Conclusions:
ICG and FDA showed equal sensitivity, and predicted 3 cases of necrosis not predicted clinically. Early results show a trend towards over prediction of both the incidence and area of necrosis by both ICG and FDA as evidenced by the low specificity of both modalities and high percent area over-prediction. Further work is needed to refine and evaluate the utility of SpyQ.
Impact of Prior Tissue Expander/Implant on Post-Mastectomy Free Flap Breast Reconstruction Outcomes

Institution where the work was prepared: University of California Los Angeles, Los Angeles, CA, USA

Chris K. Gold, MD; Aviva Olsavsky; John L. Clayton; Jason Roostaeian; Christopher Crisera; Jaco Festekjian; Andrew Da Lio; Joan E. Lipa; University of California Los Angeles

Background:
One of the most common techniques for post-mastectomy breast reconstruction is expander-implant reconstruction. However, there is a high incidence of capsular contracture and long-term unsatisfactory results, particularly when adjuvant radiotherapy has been administered, which may require revision surgery or replacement of the prosthetic device with autologous tissue. While free flap breast reconstruction surgery has been widely accepted, there is no study to date assessing the outcomes in this patient population. The aim of this study is to determine if previous expander or implant surgery has an impact on outcomes and complications in free flap post-mastectomy breast reconstruction.

Methods:
A retrospective review (demographic data, operative and postoperative results) of patients undergoing free flap breast reconstruction from July 1, 2005 – October 31, 2008 was performed. The Prior Prosthesis Group consisted of those patients who underwent a free flap either as planned or salvage surgery to replace an expander or implant reconstruction. A matched number of patients who underwent free flap breast reconstruction as their only reconstructive procedure were randomly selected as the De Novo Group.

Results:
A total of 94 women who underwent 128 flaps were studied. The most common indication for removal of a prosthetic device was capsular contracture (59.6%). The Prior Prosthesis Group had a lower BMI (p = 0.001) and was more likely to have an alternate type of free flap other than a DIEP or TRAM. Scarring around the recipient vessels was more frequently identified (p = 0.001) in the Prior Prosthesis Group at 25% vs. 2.9% in the De Novo Group. This was not affected by prior radiotherapy on multivariate analysis. Also, major complications were more common (Adjusted OR 4.3; 95% CI 1.2 -15.4) in the Prior Prosthesis Group. No difference was noted in flap loss rates, operative take back, and operative time. The majority of mastectomy skin was preserved in less than half of the Prior Prosthesis Group reconstructions when the device was replaced with a flap.

Conclusion:
Free flap breast reconstruction following explantation or for planned replacement of a tissue expander can be safely performed with success rates equal to De Novo free flap breast reconstruction. However, the surgeon is more likely to encounter scarring around recipient vessels - adding to complexity of surgery - and major complications. Furthermore, a larger skin paddle may be required. This information will improve preoperative patient education and expectations, and will assist in surgical planning.
**Deep Femoral Artery Perforator Flap: A New Perforator Flap in Breast Reconstruction**

Institution where the work was prepared: Center for Microsurgical Breast Reconstruction, New York, NY, USA

Julie V. Vasile, MD; Stamford Hospital; Joshua L. Levine, MD; New York Eye and Ear Infirmary; Robert J. Allen; Medical University of South Carolina

The deep femoral artery perforator (DFAP) flap is a new perforator flap for breast reconstruction that allows harvest of tissue from the lower buttock and lateral posterior thigh with similar territory to an in-the-crease IGAP flap, but based on a different perforator. When a DFAP is present in this territory, it is usually the largest vessel supplying this area and is septocutaneous, which can facilitate dissection in comparison with an IGAP. The purpose of this paper is to present our surgical knowledge and experience with this new flap for breast reconstruction.

Preoperative MRA of the abdomen, buttck, and upper thigh were performed. The largest perforators in the saddle bag fat deposit area of the buttck were identified. The best perforator was chosen based on the largest vessel in a lateral position to preserve the cushioning fat on the ischial tuberosity, and an inferior position to optimize the scar. In the office, handheld Doppler confirmed perforator locations, and flaps were designed around the perforators.

Intraoperatively, the DFAP was identified at the lateral border of the gluteus maximus muscle. The fascia on the lateral thigh was then incised, and the pedicle was dissected down the septum between the gluteus maximus muscle and posterior thigh until adequate vessel caliber was reached for anastomosis. 4 patients underwent 5 DFAP and 3 IGAP flaps for bilateral breast reconstruction.

The DFAP supplied sufficient tissue to match the mastectomy specimens, as seen in Table 1. In our series, all 5 DFAPs that were identified in the desired location were septocutaneous. The DFAP pedicle averaged 5-6 cm, which is shorter than the average 8-10 cm IGAP pedicle, but there were no technical difficulties with microanastomosis to the internal mammary artery and vein or the internal mammary perforators.

In patients who are not candidates for an abdominal perforator flap breast reconstruction, flaps utilizing the saddle bag fat deposit may be an excellent option. The DFAP is an additional option for harvesting this tissue, and can be advantageous in comparison to the IGAP due to the frequent septocutaneous course and more lateral and inferior location. Preoperative MRA can assist with accurate flap design by permitting precise perforator location and vessel origin.

**Table 1. Mastectomy Weights compared with DFAP Flap Weights.**

<table>
<thead>
<tr>
<th>Patients</th>
<th>Mastectomy Weight (g)</th>
<th>DFAP Flap weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>1</td>
<td>n/a</td>
<td>320</td>
</tr>
<tr>
<td>2</td>
<td>206</td>
<td>456</td>
</tr>
<tr>
<td>3</td>
<td>210</td>
<td>306</td>
</tr>
<tr>
<td>4</td>
<td>484</td>
<td>475</td>
</tr>
</tbody>
</table>

**Multifactor Analysis of Risk for Complication Following Perforator Flap Breast Reconstruction: A Review of 240 Consecutive DIEP Breast Flaps**

Institution where the work was prepared: Medical University of South Carolina, Charleston, SC, USA

John R. Barbour, MD; Jennifer A Dixon; Michael F Reynolds; Dennis K Schimpf; Patrick J O’Neill; Medical University of South Carolina

**Introduction:**

Microvascular free-tissue transfer is an ideal option in autologous breast reconstruction, as it can often provide an excellent aesthetic outcome, the texture is comparable to the native breast, and complications such as contracture are avoided. However, this technique imparts complications inherent to microsurgical tissue transfer. Thrombus of vessels and wound healing issues are a risk. Moreover, breast cancer patients are hypercoagulable and may be at risk of heparin-induced thrombocytopenia (HIT) due to prior heparin exposure, increasing the risk of thrombosis and flap failure. The purpose of this study was to evaluate the risk factors for complications after deep inferior epigastric perforator (DIEP) flap breast reconstruction.

**Methods:**

A retrospective analysis of 143 consecutive women undergoing perforator-flap breast reconstruction (240 flaps) was performed at a single institution. Patient demographics, timing of reconstruction, smoking status, radiotherapy, flap weight, operative details, and post-operative findings were recorded. A prospective cohort of patients underwent anti-heparin antibody (PF-4) assay pre-operatively to identify patients at risk of HIT.

**Results:**

Twenty-five patients underwent re-operation for venous thrombosis or compressive hematoma (25/148, 20%). Factors increasing risk of thrombosis were smoking (28% vs. 10%), radiation (76% vs. 36%), progressive thrombocytopenia (43% decrease vs. 27%), and decreasing hemoglobin level (38% vs. 21%). Seventy-one flaps experienced wound healing difficulty (71/240, 29%), ranging from wound separation to tissue necrosis, however only six patients experienced total loss (6/240, 2.5%). Factors correlating to wound complications were elevated BMI (32.1 vs. 28.4), smoking (19% vs. 12%), immediate reconstruction (35% vs. 21%), and diabetes (12% vs. 3%). Multivariate analysis showed no impact of age, bilateral reconstruction, hypertension, active cancer at time of reconstruction, flap weight, nor venous coupler diameter. All prospectively screened patients demonstrated negative PF-4 levels, however two patients (14%) later developed PF-4 positivity and symptoms of HIT. Both patients underwent re-operation for thrombosis. Additionally, platelet counts on 22 patients dropped >40% and correlated to patients undergoing re-operation (43% vs. 8%).

**Conclusions:**

This study confirmed previous reports that smoking, radiation, obesity and diabetes increased complication rates following free flap breast reconstruction. Interestingly, this study is the first to suggest timing of reconstruction and thrombocytopenia post-operatively may be additional indicators of increased risk. While PF-4 screening was unsuccessful in determining patients at risk, HIT may still play a role in poor outcomes. In those patients, earlier detection, and appropriate management of HIT are essential for avoiding thrombosis. Patient selection and education are critical in obtaining optimal outcomes.

Institution where the work was prepared: Chang Gung Memorial Hospital-Kaohsiung Medical Center, Kaohsiung, Taiwan

Yur-Ren Kuo, MD, PhD, FACS; Chien-Chang Chen, MD; I-Te Lee, MS; Shigeru Goto; Chun-Ting Wang, BS; Fu-Chan Wei; Chang Gung Memorial Hospital- Kaohsiung Medical Center, Chang Gung University

Background:
This study investigated whether adipose-derived stem cells (ADSCs) combined with short-term immunosuppressant therapy could prolong composite tissue allotransplant (CTA) survival and correlated to induce T-cell regulation in a rodent hind-limb model. Materials and Methods: Orthotopic hind-limb transplants from Brown-Norway (RT1n) to Lewis (RT1 I) rats were performed (day 0). ADSC were propagated from the donor adipose-tissue and subculture. The phenotype and cell differentiation ability were tested. Group 1 (control group) did not receive any treatment. Groups 2 received cyclosporine-A (CsA 10 mg•kg–1•day–1) on days 0-20 following CTA. Group 3 received anti-lymphocyte serum (ALS 0.5ml i.p.;-4, +1), and CsA (days 0–20) following CTA. Group 4 received CsA (days 0–20), ALS (0.5ml i.p.;-4, +1), and ADSCs (2x106cells/ time, i.v. on days 7, 14, and 21). Flow cytometry analysis was performed. Tissue samples were biopsied to analyze the histological changes.

Results:
Allotransplant survival was significantly prolonged (>100 days) in ADSC-ALS-CsA group when compared with the other groups (P<0.001). The H&E staining performed on the allo-skin and muscle biopsy samples exhibited lowest degree of rejection and minimal mononuclear cell infiltration in the donor skin or muscle tissue as compared to that in controls. The RT1n-positive donor cells in recipient circulatory blood revealed higher expression at 4-6 weeks post-CTA, but skewing decrease in 150 days post-CTA. Immunohistochemical staining revealed the percentage of CD25+ T-cells expression revealed a trend of increase in early 4-6 weeks post-CTA in ADSC-ALS-CsA group as compared to other group but skewing decrease.

Conclusion:
Treatment with ASDCs in combination with transient immunosuppression significantly prolongs allograft survival and induction of tolerance associated with increasing the regulatory T cells expression. However, this model indicated the ADSC induction of T-cells regulation in early stage post-transplant.

The Regulatory Function of CD4’CD8’ Double Negative T Cells Prolongs Mouse Hindlimb Osteomyocutaneous Flap Survival

Institution where the work was prepared: University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Cheng-Hung Lin, MD; Timothy W. Ng; Dong Zhang; Gerald Brandacher; W.P. Andrew Lee; Xin Xiao Zheng; University of Pittsburgh Medical Center

Background:
The loss of a face or limb is a devastating defect that is difficult to address with conventional methods. However, composite tissue allotransplantation (CTA), heterogeneous grafts containing bone, muscle, nerve, and skin, can restore appearance, function and dignity to the patient. But, CTA requires immunosuppressive drugs, which can have severe side effects.

Immunoregulatory cells may wean patients off immunosuppressants. In our previous report, peripheral CD4+ T cells were converted into CD4-CD8- double negative (DN) T cells, which regulate allo- and auto- immune responses. DN T cells therapy alone significantly prolongs islet allograft survival.

Methods:
In this study, we tested the combination of DN T cells (5 x 106) and a low dose immunosuppressant, rapamycin (0.6 mg/kg/day for 28 days), in a complete MHC mismatched, mouse skin transplant model. Moreover, the treatment was also tested in a mouse hindlimb osteomyocutaneous flap (DBA/2 to C57BL/6). Antilymphocyte serum (ALS) and/or interleukin-2 fusion protein (IL-2) was also used in the different groups with DN T cells and rapamycin.

Results:
Low dose rapamycin and DN T cells have a synergistic effect on decreasing both CD4+ and CD8+ T cell proliferation and increasing apoptosis. Moreover, the combination treatment significantly extended skin graft survival (mean survival time 28 days). Interestingly, the addition of lymphoablative conditioning or cytokine immunomodulation to rapamycin and DN T cells extended skin graft survival beyond 60 days. Preliminary results from mouse hindlimb osteomyocutaneous flaps resemble the skin graft data. Mixed chimerism was found in the group with ALS, rapamycin, IL-2 and DN T cells at day 30.

Summary:
1. Using a novel cellular induction method, highly potent, antigen specific, immunosuppressive DN cells were produced in vitro.
2. DN cells prevent acute rejection in skin grafts and prolong hindlimb osteomyocutaneous flap survival in the mouse.
3. Our novel surgical model is the first application of DN T cells in composite tissue allotransplantation.
Costimulatory Blockade Does Not Promote Peripheral Regulatory Mechanisms to Prolong Composite Tissue Allograft Survival in Non-Human Primates

Introduction:
Costimulatory blockade is a promising therapy to provide effective immunosuppression without the associated toxicities of standard immunosuppression. Experimental and clinical studies have supported the development of regulatory mechanisms via costimulatory blockade that can facilitate long-term allograft survival. We investigated the ability of costimulatory blockade provided by a selective CD28 antagonist to promote long-term CTA survival via augmented regulatory cell populations.

Methods:
Mismatched Cynomolgus macaques received either facial (n=3) or fibula (n=2) CTAs with immunosuppression provided by 28 days of anti-CD28 costimulatory blocking antibody (sc28AT, 2 mg/kg IV once 4 weeks) combined with low-dose maintenance tacrolimus (FK goal level 20-30ng/ml). Facial CTA recipients that demonstrated rejection-free survival (average 310d) while on immunosuppression. FK levels did not significantly differ between groups (p=0.47). CTA skin was lost on POD 14 in one fibular transplant recipient due to venous congestion. The skin in the remaining animals survived to POD 180 without evidence of acute rejection. Both demonstrated radiologic evidence of bone union by POD 90; however, evidence of chronic transplant vasculopathy and alloimmune injury were present at necropsy (average group survival 186d). Regulatory cell populations did not increase post-operatively in either fibula or facial CTAs treated with anti-CD28 (average increase 0.09%, range -1.9 to 1.2%, p-value >0.05). Despite similar dosing of anti-CD28 in CTA and solid organ allograft models, trough levels of anti-CD28 were lower in CTA experiments (p=0.03).

Conclusions:
Costimulatory blockade did not upregulate regulatory cell populations and failed to prolong rejection-free CTA survival. These divergent results as compared to solid organ allograft models could be secondary to unique immunological differences between transplanted tissues or drug trough levels. Further investigation of the immunosuppressive requirements of CTA may demonstrate a benefit with higher levels of anti-CD28 therapy.

Chronic Rejection Responses are Distinct from Acute Rejection Responses in Non-Human Primate Models of Facial and Vascularized Fibula Composite Tissue Allograft Survival

Introduction:
Though acute rejection episodes have been well characterized in human composite tissue allotransplantation (CTA), documentation of chronic rejection responses is more recent and without clear understanding of predisposing mechanisms. We evaluated the development of chronic rejection in two non-human primate models of CTA.

Methods:
Heterotopic CTAs containing skin, muscle, and vascularized bone were performed in mismatched Cynomolgus macaques. Model 1 consisted of a composite oromandibular facial segment transplanted heterotopically to the recipient groin. Immunosuppressive regimens, inclusion of vascularized bone marrow (VBM), and average survival in Model 1 were as follows: 1) High-dose Tacrolimus (FK) (n=6, 116d), 2) FK + mycophenolate mofetil (MMF) no VBM (n=3, 112d), 3) FK + MMF+VBM (n=4, 310d), 4) FK converted to rapamycin + VBM (n=3, 379d), and 5) FK + anti-CD28 costimulatory blockade (n=3, 67d). Model 2 consisted of a composite fibular allograft transplanted to a recipient radial bone defect. Immunosuppression consisted of FK (n=3, 191d) or FK + anti-CD28 costimulatory blockade (n=2, 186d). Grafts were inspected daily and biopsied at scheduled intervals. Immunohistochemistry was performed on necropsy graft sections with appropriate positive and negative controls. Primary IHC antibodies included CD3 (1:200), CD20 (1:200), CD68 (1:100), IL-2 (1:200), Jagged (1:50), Notch 1 (1:50), Notch 3 (1:50), and Notch 4 (1:50). Stained slides were independently read and graded by a transplant pathologist.

Results:
In Model 1, all grafts in Groups 2, 4, and 5 were lost secondary to acute rejection. No grafts in Group 3 were lost to acute rejection while on immunosuppression. Nonetheless, Group 3 demonstrated transplant arteriopathy and chronic alloimmune injury after immunosuppression was withdrawn. Chronic rejection was characterized by increased overall sclerosis/fibrosis, arterial wall thickening, and neointimal proliferation with luminal narrowing. Notch 1, Notch 3, Notch 4, and Jagged (notch ligand) expression in vessel walls was high in areas of chronic rejection but absent in grafts either with acute rejection or without any rejection responses. In Model 2, both animals under FK + anti-CD28 costimulatory blockade demonstrated transplant arteriopathy and arterial narrowing due to neointimal proliferation.

Conclusions:
Transplant arteriopathy and chronic alloimmune injury were present in all facial allografts containing VBM after discontinuation of immunosuppression. Chronic rejection demonstrated a unique association with Notch expression as assessed by IHC. Chronic rejection was also evident in all fibula transplants receiving anti-CD28 costimulatory blockade. These data support a unique immunologic pathway for chronic rejection responses associated with Notch expression that is distinct from acute rejection.
Effectiveness of Topical Immunosuppressants in Prevention and Treatment of Rejection in Face Allotransplantation

Institution where the work was prepared: Cleveland Clinic, Cleveland, OH, USA

Michael R. Pharaon, MD; Antonio Rambazzo, MD; Selman Altuntas, MD; Maria Madajka, PhD; Agata Matejuk, PhD; Maria Z. Siemionow, MD, PhD, DSc; Cleveland Clinic

Background:
Employment of topical immunosuppressants has been anecdotally reported for treatment of rejection in composite tissue allotransplantation. The aim of the present study was to evaluate the effectiveness of topical Clobetasol-0.05% and Tacrolimus-0.1% in prevention and treatment of rejection in a face transplant model.

Methods:
Sixty-four hemiface allotransplants, between ACI (RT1a) donors to Lewis (RT1l) recipients, were performed in 8 groups: groups 1 and 2 represented controls receiving no treatment (1), or only systemic treatment with Cyclosporin-A and anti-αβ-TCR Antibody for 7 days (2). Groups 3 and 4 were treated with topical immunosuppressants (Clobetasol-0.05% (3) or Tacrolimus-0.1% (4)) only. Groups 5 to 8 received 7 days systemic immunosuppression, followed on day 8 (groups 5, 6) or at the first sign of rejection by topical treatment (groups 7, 8).

Skin biopsies and blood samples were taken at days 7, 21, 35, 63, 100 and at euthanasia when lymphoid organs were also harvested. Flow Cytometry analysis was performed to monitor rejection and chimerism (CD3, CD4, CD8, CD45, CD11, CD25, γδ-TCR, αβ-TCR, ACI). Skin samples and lymphoid organs were stained with H&E. The inflammatory infiltrate was characterized by immunostaining for CD3, CD4, CD8, CD45 and CD25.

Results:
Topical treatment increased the survival of the allograft in all groups. Maximal survival was obtained in Clobetasol treated animals following induction with CSA/TCR (groups 5, 7); in these groups, the animals reached the 100 days end point, free of rejection. However a high incidence of complications related to the application of steroids was evidenced. FACS analysis showed systemic depletion of lymphocytic populations and increase of CD11+ cells. Spleen and thymus were atrophic. Tacrolimus proved effective to prolong the life of the transplant up to 75 days. The lymphocytic populations were preserved and no local or systemic complications were observed. An increase of CD4+/CD25+ cells was registered in group 6.

Conclusions:
In our hemi-face transplantation model topical treatment with Clobetasol although effective in treating rejection is associated with systemic absorption and high local complication rate, therefore should be employed with caution. Topical Tacrolimus could represent a useful adjunct to systemic therapies prolonging allograft survival without systemic effects.

Early Detection of Complete Vascular Occlusion in a Pedicle Flap Model Using Quantitative Spectral Imaging

Institution where the work was prepared: University of California, Irvine, CA, USA

Michael R. Pharaon, MD; Thomas Scholz, MD; Scott Bogdanoff, BS; David Cuccia, PhD; Anthony J. Durkin, PhD; David B. Hoyt, MD; Gregory R. D. Evans, MD; (1)University of California, Irvine; (2)Beckman Laser Institute Photonic Incubator

Introduction:
Vascular occlusion after tissue transfer is a devastating complication that can lead to complete flap loss. Spatial frequency domain imaging (SFDI) is a wide-field imaging technology which employs patterned near infrared light (650-1000nm) to quantify optical properties of tissues. We employed this new non-contact, non-invasive imaging device which monitors oxygenated and deoxygenated hemoglobin, total hemoglobin and tissue saturation within a rodent pedicle flap model to detect vascular occlusion.

Methods:
Pedicle fasciocutaneous flaps on Wistar Rats (400-500 grams) were created and underwent continuous imaging using SFDI prior to and after selective vascular occlusion. Three flaps groups, (control, selective arterial occlusion and selective venous occlusion), as well as a fourth group comprised of native skin between the flaps were measured. The bilateral flaps were imaged at baseline for 10 minutes, followed by selective complete vascular occlusion, and imaging. The percent change (%Δ) from baseline was measured after selective vascular occlusion.

Results:
Baseline measurements showed stable results for oxygenated hemoglobin (HbO2), deoxygenated hemoglobin (Hb), total hemoglobin (HbT), and tissue saturation (StO2). There were no statistical differences for each of the above parameters between the control flap group, the selective arterial occlusion flap group, and the selective venous occlusion flap group prior selective vascular occlusion: HbO2 (p = 0.2017), Hb (p = 0.3148), HbT (p = 0.2718), and StO2 (p = 0.0777).

In the selective arterial occlusion flap group %ΔHb was statistically different from the control flap group, (p = 0.0218), %ΔHbO2 after selective arterial ligation had a trend towards a difference (p = 0.0888), while both %ΔHb (p = 0.5198) and %ΔStO2 (p = 0.4220) showed no statistical difference from the control flap group. The selective venous occlusion flap group demonstrated changes from baseline values after selective venous occlusion that were statistically different compared to control: %ΔHbO2 (p = 0.0029), and %ΔHb, %ΔHbT, & %ΔStO2 (p < 0.0001).

Conclusion:
SFDI provides two-dimensional, spatially resolved maps of tissue HbO2, Hb, HbT and StO2. Results presented here indicate that this can be used to quantify and detect physiological changes that occur after arterial and venous occlusion in a rodent tissue transfer flap model. This portable, non-contact, non-invasive device may have a high clinical applicability in monitoring post-operative patients.
Pharmacologic Pre-conditioning with Hydrogen Sulfide Confers Protection from Ischemia-Reperfusion Injury via Activation of The JAK-STAT Pathway

Institution where the work was prepared: Weill Cornell Medical College, New York, NY, USA

Natalia Jimenez; Alyssa J. Reiffel, MD; Peter W. Henderson, MD, MBA; Yoann H. Milet, BA; Jason A. Spector, MD; New York Presbyterian Hospital, Weill-Cornell Medical Center

Introduction:
Although it is well known that hydrogen sulfide (HS) provides significant protection against ischemia-reperfusion injury (IRI), the mechanism by which this protection is afforded remains poorly understood. It has been shown that mechanical preconditioning confers protection against IRI through activation of the JAK-STAT signaling pathway, which is known to modulate multiple downstream genes including apoptotic and cell-cycling genes. We hypothesize this critical cell survival pathway would be similarly activated by treatment with HS in the setting of IRI.

Methods:
Murine myotubes were treated with either 0 or 10 µM HS and allowed to equilibrate for 20min. They were then exposed to anoxia for 3hrs followed by normoxia (21% O₂) for 0.5, 5, 15, or 30min. A western blot analysis was performed using monoclonal phosphorylated STAT-1 (tyr701) and STAT-3 (tyr705) antibodies. Band intensities were quantified. Additionally, 12 C57/BL6 mice were divided into 4 groups and treated with IV saline (control), 40µg/g AG-490 (a JAK2 inhibitor that prevents STAT-3 phosphorylation), 10µM HS, or both HS and AG-490. 20min after injection, all mice underwent 3hrs of tourniquet-induced hindlimb ischemia followed by 3hrs of reperfusion. The gastrocnemius and soleus muscles were harvested, sectioned, and an injury score (IS) was assigned to each specimen. Statistical analysis was performed using student t-tests.

Results:
STAT-3 phosphorylation was significantly increased in HS-treated myotubes subjected to IR compared with non-treated cells after 30 seconds (124%, p=0.010) and 5min (155%, p=0.021) of simulated reperfusion. In addition, there was a trend towards an increase in STAT-1 phosphorylation at 30 seconds-15min of reperfusion, although this did not reach statistical significance. The injury scores of AG-490-treated mice were similar to those of controls (1.40 vs.1.58, p=0.071), while mice treated with 10µM HS alone demonstrated a significantly lower IS (0.42) compared to non-treated controls (p<0.001). Finally, mice treated with both AG-490 and HS demonstrated significantly greater IS than those of mice treated with HS alone (1.56 vs. 0.42, p<0.001).

Conclusion:
In the setting IRI, phosphorylation of STAT-1/3 is increased in the presence of HS. Additionally, the protective effect of HS in IRI is lost when JAK is inhibited. This suggests that, similar to mechanical pre-conditioning, pharmacologic pre-conditioning with HS confers protection through activation of the JAK-STAT pathway. Given that phosphorylation of JAK-STAT is known to activate downstream cell survival pathways, these data provide crucial insights into the mechanism by which HS confers protection against IRI.

Gene Modification of Muscle Flaps Using Novel Recombinant Adeno-Associated Viral Vectors

Institution where the work was prepared: The Ohio State University, Columbus, OH, USA

Ergun Kocak, MD, MS; Katherine H. Carruthers; Michael J. Miller, MD; Matthew J. During, MD, D, Sc; (1)The Ohio State University Medical Center, (2)The Ohio State University

Background:
Widespread application of gene therapy has been limited by several factors with one of the most important being that systemic gene therapy methods do not allow for specific targeting of tissues. Methods aimed at improving the specificity of target tissues are needed to achieve clinically applicable gene therapy treatment regimens. Recent reports in the plastic surgical literature have described the delivery of genes into muscle flaps for local production of gene products. These studies have relied on time consuming methods that use ex vivo perfusion of isolated tissues that are subsequently transferred as microvascular free flaps. We set out to develop a method for gene modification of flap tissues that would yield sustainable and robust production of gene products but would be less time consuming and technically less demanding than existing protocols.

Methods:
The viral vector used for gene delivery in these experiments is a novel adeno-associated virus (AAV) serotype that differs from classical serotypes and is unique to our laboratory. Specifically, we used a recombinant serotype, termed rAAVvec2, which was derived using a PCR shuffling technique from novel non-human primate viral isolates. We have shown that recombinant rAAVvec2 not only has a marked increase in yields enabling very high titer production, but also has a significant improvement in tissue tropism compared to the more classical AAV serotypes (AAV1-9). The rAAVvec2 vector was used to deliver the gene for green fluorescence protein (GFP). The tissues that were gene modified were pedicled pectoralis muscle flaps in wild-type C57BL/6 male mice ranging 30-35 grams in weight. Gene therapy was delivered by direct injection of muscle flaps using an insulin syringe and needle. Tissues were collected and processed at 4-5 weeks post injection of viral vector and histologically examined with both direct fluorescence microscopy and immunofluorescent staining techniques.

Results:
Direct injection of muscle flaps was carried out reliably and reproducibly in our experiments and added minimal additional time to the flap procedures. Analysis of the injected muscle flap tissues demonstrated GFP protein production that was observed histologically by both direct fluorescence microscopy and immunofluorescent staining. In contrast, GFP was not detected in tissues that were not directly injected with vector, indicating that the infection of tissues stayed local to the flap.

Conclusions:
Using novel recombinant adeno-associated viral vectors, we have developed a method for gene delivery into muscle flaps that is minimally time consuming and applicable to pedicled flap transfers.
The Importance of Hospital Case-Volume for Outcomes in Autologous Free-Tissue Breast Reconstruction

Mazen I. Bedri, MD; Cassandra Villegas, MD; Gedge D. Rosson; Johns Hopkins University School of Medicine

Objective: To determine if increased hospital volume is associated with improved short-term clinical and economic outcomes for patients undergoing breast reconstruction using autologous free-tissue transfer.

Background: Literature in several surgical subspecialties demonstrates that high-volume centers and surgeons often realize improved outcomes with respect to more complex procedures. Public data on breast reconstruction using free-tissue transfer has recently become available, allowing for a more directed analysis and comparison of outcomes across institutions.

Methods: Analysis of hospital discharge data from all nonfederal acute care hospitals in Maryland (via the Health Services Cost Review Commission database) identified all patients who underwent breast reconstruction using autologous free-tissue transfer from October 1, 2008 through December 31, 2009. Hospitals were categorized as either low-volume centers (LVCs, 1 to 30 cases) or high-volume centers (HVCs, >30 cases) based on the aggregate number of patient admissions to perform free-TRAM, DIEP, SIEA, and GAP flaps over the time period. Multiple regression analysis was used to study the relation between hospital case-volume and outcomes including in-hospital complication rates, length of stay, and total hospital charges.

Results: Among 374 hospital admissions for breast reconstruction using free-tissue transfer, 79% were accounted for by the two HVCs, with the remaining 21% distributed over the 19 other hospitals. HVCs were more likely to use DIEPs or GAPs, while LVCs demonstrated preference for DIEPs and free TRAMs. HVCs had lower in-hospital complication rates than LVCs (24.8% vs 43.8%, p<0.001), and were 60% less likely to have complications after adjustment for case-mix and patient characteristics (OR=0.40, p<0.001). Among specific categories of complications, there was a significant difference in the rate of bleeding complications between HVCs and LVCs (11.3% vs 30.1%, p<0.001). Patients at HVCs also had shorter lengths of stay than those at LVCs (3.7 days vs 4.4 days, p<0.001), and were 77% less likely to have prolonged stays after adjustment (OR=0.23, p<0.001). No differences were found in total hospital charges across institutions.

Conclusion: Increased hospital case-volume is associated with decreased complication rates and length of stay for patients undergoing autologous free-tissue breast reconstruction, and with decreased hospital charges for patients undergoing DIEPs, in the state of Maryland.

The Volume-Outcome Relationship for Immediate Breast Reconstruction

Mazen I. Bedri, MD; Cassandra Villegas, MD; Gedge D. Rosson; Johns Hopkins University School of Medicine

Objective: To determine if increased hospital volume is associated with improved short-term clinical and economic outcomes for patients undergoing breast reconstruction using autologous free-tissue transfer.

Background: Literature in several surgical subspecialties demonstrates that high-volume centers and surgeons often realize improved outcomes with respect to more complex procedures. Public data on breast reconstruction using free-tissue transfer has recently become available, allowing for a more directed analysis and comparison of outcomes across institutions.

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The Importance of Hospital Case-Volume for Outcomes in Autologous Free-Tissue Breast Reconstruction

Mazen I. Bedri, MD; Cassandra Villegas, MD; Gedge D. Rosson; Johns Hopkins University School of Medicine

Objective: To determine if increased hospital volume is associated with improved short-term clinical and economic outcomes for patients undergoing breast reconstruction using autologous free-tissue transfer.

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Conclusion: Increased hospital case-volume is associated with decreased complication rates and length of stay for patients undergoing autologous free-tissue breast reconstruction, and with decreased hospital charges for patients undergoing DIEPs, in the state of Maryland.
The Transition from Pedicle TRAM to Perforator Flap – What is the Cost of Opportunity?

Institution where the work was prepared: UNC, Chapel Hill, NC, USA

Winnie Tong, MD; Andrea Bazakas, BS; C. Scott Hultman, MD, MBA; Eric G. Halvorson, MD; University of North Carolina

Purpose:
While pedicled transverse rectus abdominus myocutaneous (pTRAM) flaps have historically been the flap of choice for autologous breast reconstruction, perforator flaps have gained popularity with the hope of reducing donor site morbidity. To date, comparative data on pTRAM and perforator flaps have been limited in the literature. This study evaluates how the transition from pTRAM to perforator flaps at an academic center has affected outcome and reimbursement.

Methods:
In 2006, our practice transitioned to almost exclusively perforator flaps for breast reconstruction. This study retrospectively compares pTRAM flaps performed from 2002-2006 (Group 1) to perforator flaps from 2006-2010 (Group 2). Operative time, length of hospital stay, complications and reimbursement were compared between the two groups.

Results:
We performed 93 pTRAM flaps in 69 patients in Group 1 and 102 perforator flaps in 69 patients in Group 2. Operative time was shorter in Group 1 for unilateral breast reconstruction (399 minutes vs 543 minutes, p = 0.0001), but not statistically different for bilateral cases (547 minutes versus 658 minutes, p=0.1). Patients had comparable length of hospital stay (6.2 vs 5.8 days, p=0.2). Fat necrosis requiring reoperation was more frequent in Group 1 (23.7% vs 5.9%, p=0.0004). Fat necrosis occurred in 0% of superficial inferior epigastric artery flaps (N=7), 8.6% of muscle sparing TRAMs (N=35) and 12.7% of deep inferior epigastric perforator flaps (N=55). The number of perforators used did not affect the fat necrosis rate. There was a trend toward higher partial flap necrosis (20% vs 12%, p= 0.2), abdominal bulge (21% vs 9.7%, p=0.3) and abdominal hernia (8.8% vs 1.6%, p=0.2) but fewer hematomas (1.5% vs 10%, p=0.06) in Group 1 vs Group 2. Mean charge per case for Group 1 was $9943 ($24.08 per minute) vs $9356 ($15.70 per minute) for the primary surgeon in Group 2. Mean revenue per case for Group 1 was $3594 ($8.70 per minute) vs $4857 ($8.15 per minute) for the primary surgeon in Group 2.

Conclusions:
Perforator flaps appear to be as profitable as pTRAM flaps for breast reconstruction but demonstrated lower morbidity. The transition from pTRAM to perforator flaps can be done successfully with fellowship trained microsurgeons, an already established breast reconstruction practice, and support from leadership and hospital staff. We believe that the development of a perforator flap practice represents an opportunity cost in optimizing patient care, and should be an option available to patients seeking autologous breast reconstruction.

The Effect of Surgery Start Time on Head and Neck Reconstruction Outcome

Institution where the work was prepared: Mayo Clinic, Rochester, MN, USA

Rimante Seselgyte, MD; Nho V. Tran; Uldis Bite, MD; Ricky P. Clay; (1)Vilnius University, (2)Mayo Clinic

Objective:
To study the effect of surgery start time on outcome of head and neck reconstruction.

Methods:
This retrospective Mayo Clinic Rochester IRB approved study consisted of 537 patients with 630 consecutive free (91%) and pedicle (9%) flaps over 18 years. Eighty-six patients underwent multiple free or pedicled flap reconstructions. Patient characteristics including age, sex, reconstruction start time, major complications and salvage options were obtained by chart review.

Results:
An increased rate of complications was observed if operation start time was delayed. Operations starting after 9 AM had significantly increased complications compared to cases starting before 9 AM with an odds ratio 1.72 (95% CI 1.16 - 2.56), p=0.007. Flap loss was only 1.13 times and recipient site complications were 1.54 times higher for cases after 9 AM. However, overall complication rate was 18.5% for before 9 AM vs. 28.1% for the later start group. Logistic regression revealed increasing complication risk by 9% with every subsequent hour, but this result was not significant (p=0.08). One-hundred-fifty-six cases (24.8%) required take-back surgeries. Partial flap failure, wound and vascular complications were three most common causes for additional surgery.

Conclusion:
Late head and neck surgery start time contributes to increased overall complications leading to re operations.
Economic Value of Plastic Surgery to the Hospital Bottom Line

Institution where the work was prepared: University of Pennsylvania, Philadelphia, PA, USA
Theresa Y. Wang, MD1; Jonas Nelson, MD2; Diane Corrigan, MBA3; Joseph M. Serletti, MD4; (1)University of Pennsylvania, (2)Hospital of University of Pennsylvania

Purpose:
With the current economic downturn and healthcare reform in the United States, it is critical for plastic surgeons to be aware of not only our clinical contributions but also our financial value to healthcare systems. We frequently assist with reconstruction in cancer extirpation, trauma, wound dehiscence and provide expertise for complex soft tissue problems. Are we appropriately valued and given credit, both operative and financial, for our important role? We aim to evaluate surgeon productivity, collaborative cases with other specialties and financial contributions made to our hospital by the division of plastic surgery.

Methods:
We reviewed all original articles published between January 2008 and December 2008 in four plastic surgery journals and three scientific journals – Microsurgery, Plastic and Reconstructive Surgery (PRS), Annals of Plastic Surgery (APS), Journal of Plastic and Reconstructive Aesthetic Surgery (JPRAS), Science, Nature, and Cell. Dates of article submission, acceptance, online publication, and print publication were recorded. Statistical methods included one-way analysis of variance (ANOVA) and student t-tests with significance set at p<0.05.

Results:
Average RVU for all surgical specialties was 94,595 (25,205 to 183,415), plastic surgery division was 54,288. Average RVU per surgeon for the health system was 12,149 (4,001 to 15,590), for plastic surgery it was 14,272 and the division was ranked 4th highest among all surgical services. The mean number of RVUs per case was 24.5 among all services, for plastic surgery, it was 31.2. The average revenue for primary inpatient admissions per RVU was $304.26 for all surgical services while plastic surgery was $113.49 per RVU. Total joint operative cases with plastic surgery and other surgical specialties was 574 or 33% of all cases logged by the division.

Conclusion:
Plastic surgery contribute significantly to the bottom line in performing many joint cases and salvaging complications that reduce patient morbidity and mortality for the hospital. Our division logs a high volume of cases and outperforms in surgeon productivity than most other surgical services. However, it lags behind the average in reimbursements for inpatient admissions. The aim is to provide more leverage to negotiate contracts with managed care companies for better reimbursement rates as well as within our health system for more resources given our higher productivity. In this current economic environment, it is crucial for plastic surgeons to be fully cognizant of our positive influence and economic impact to the hospital margin.

Lag-Time to Publication in Microsurgery: A Comparison of Seven Peer-Reviewed Journals

Institution where the work was prepared: Stanford University, Stanford, CA, USA
David T. Lee, BS; Christina K. Chung, MD; Ahlia Kattan, BS; Gordon K. Lee, MD; Stanford University

Background:
Microsurgeons depend on peer-reviewed journals for the latest scientific evidence to guide the care of reconstructive patients. However, there appears to be substantial delays during the publication process; lag-time between article submission, acceptance, and publication may interfere with the timely distribution of primary literature. The purpose of this study is to document and compare publication lag-times in plastic surgery and other scientific journals.

Methods:
We reviewed all original articles published between January 2008 and December 2008 in four plastic surgery journals and three scientific journals – Microsurgery, Plastic and Reconstructive Surgery (PRS), Annals of Plastic Surgery (APS), Journal of Plastic and Reconstructive Aesthetic Surgery (JPRAS), Science, Nature, and Cell. Dates of article submission, acceptance, online publication, and print publication were recorded. Statistical methods included one-way analysis of variance (ANOVA) and student t-tests with significance set at p<0.05.

Results:
Of the 1,439 original articles reviewed, 108 (7.5%) were from Microsurgery, 457 (31.8%) from PRS, 204 (14.2%) from APS, 207 (14.4%) from JPRAS, 68 (4.7%) from Science, 142 (9.9%) from Nature, and 353 (24.6%) from Cell. Of the total articles reviewed, 1374 (95.3%) had dates of submission, 1372 (95.3%) had dates of acceptance, and 669 (46.0%) had dates of online publication available for analysis. Dates of online publication were available for five journals: Microsurgery, JPRAS, Cell, Nature, and Science.

Articles published in plastic surgery journals had a mean submission-to-print lag-time of 463.4 days, which was significantly longer than other scientific journals (201.3 days, p<0.001). Articles in Microsurgery had a mean submission-to-acceptance lag-time of 68.8 days, which was significantly lower than PRS, JPRAS, Cell, and Nature (f(6, 1365)=77.66, p<0.001). Microsurgery had a mean acceptance-to-print lag-time of 150.1 days, the least of all plastic surgery journals (f(6, 1365)=284.19, p<0.001). Microsurgery also had a mean acceptance-to-online lag-time of 117.0 days, the most of all five journals analyzed (f(4,655)=48.27, p<0.001).

Conclusion:
Plastic surgery journals have prolonged lag-times between manuscript submission and print publication. Of the plastic surgery journals, Microsurgery had one of the shortest lag-times from manuscript submission to acceptance and the shortest lag-time from acceptance to print, suggesting an efficient peer-review system, fast editorial decisions, and an efficient printing process. In the current digital age, we suggest timely online publication after manuscript acceptance to decrease unnecessary lag-time. Plastic surgery journals should consider streamlining the peer-review process and reducing lag-time to publication in order to provide information in a timely fashion to its readers.
A Review of the National Trauma Data Bank Comparing Treatment Patterns of Traumatic Thumb Amputations Between University and Community Hospitals

Institution where the work was prepared: Texas A&M University, Scott & White Hospital, Temple, TX, USA
Christopher M. Shale, MD; James Tidwell, MD; Ryan P. Mulligan, BA; Daniel Jupiter, PhD; Raman C. Mahabir, MSc, MD; (1)Texas A&M University, Scott & White Hospital, (2)Texas A&M Health Sciences Center, (3)Texas A&M University Scott and White Hospital

Background:
The thumb constitutes roughly 40% of hand function. Traumatic thumb amputations are a common problem with significant associated cost to patients, hospitals, and society each year. The purpose of this study was to review the nationwide practice patterns for trauma centers and compare university and community practice settings.

Methods:
The design was a retrospective chart review of International Classification of Disease, Ninth Revision, diagnosis and procedure codes from the National Trauma Data Bank (NTDB) between the years 2002 and 2006. This included data on more than 2.7 million reported traumas. We compared community and university (teaching) hospitals on the basis of: attempt of replantation, time to replant, and success rate. For the purpose of this study, a success was defined as a replant that left the hospital with the replanted part in place. The limitations of the NTDB required us to define the time to replant to mean the time from arrival in the trauma bay to time in the OR.

Results:
Over the five-year period, there were 1,731 traumatic thumb amputations. There were a total of 318 (18.4%) attempted replants and with an overall success rate of 88.0%. The overall average time to replantation was 6.9 hours. Community hospitals treated 618 patients, or 35.7% of the patients with thumb amputations. They attempted 109 (17.6%) thumb replantations with a success rate of 85.3%. University hospitals treated 933 patients or 53.9% of patients with thumb amputations and attempted 192 (20.6%) thumb replantations with a success rate of 90.6%. The majority of thumb amputations occurred at work (63%) and were caused by some form of heavy machinery or hand held tool.

Conclusions:
Traumatic amputations are predominantly caused by accidents at work with machinery and hand tools. Practice patterns were similar between the two practice settings with slightly higher rates of attempted replant and success in the University setting.

The Relationship Between Health-Related Quality of Life and Time Since Breast Reconstruction in the Early Postoperative Period

Institution where the work was prepared: University Health Network, Toronto, ON, Canada
Toni Zhong, MD; Andrea L. Pusic; Stefan Hofer; (1)University Health Network, (2)Memorial Sloan-Kettering Cancer Center

Background:
Despite the growing literature on improvement in health-related quality of life (HR-QoL) following breast reconstruction, no studies have examined the early temporal relationship between HR-QoL changes and time since breast reconstruction. The primary objective of the study was to prospectively determine the relationship between patient-reported HR-QoL and time since breast reconstruction in the early postoperative period.

Methods:
All consecutive patients undergoing breast reconstruction at University Health Network between September 2009 and March 2010 were included in our study. They were asked to complete the BREAST-Q and Hospital Anxiety & Depression Scale (HADS) at baseline prior to their surgery, and at 3 weeks and 3 months following surgery. All subscales of the BREAST-Q were scored on a 0 to 100-point scale with higher score indicating greater satisfaction or function. Two-sided paired t-tests were used to compare change scores for the various psychosocial subscales between baseline and postoperative time-points.

Results:
A total of 46 out of 48 patients completed the questionnaires and the responder rate was 96%. 39 (85%) patients underwent the free MS-TRAM or DIEP flap procedure, and 7 patients (15%) underwent the two-stage tissue expander/implant reconstruction.

BREAST-Q
At 3 weeks following reconstruction, 3 out of the 5 subscales including satisfaction with breast, sexual well-being, and psychosocial well-being scores significantly improved from their preoperative scores (all p-values were <0.05). While the other 2 subscales such as physical well-being with respect to the chest and abdomen significantly dropped immediately following reconstruction at week 3, by the third postoperative month both scores significantly improved (p-values <0.05). (Figure 1)

HADS
To further validate the BREAST-Q, both depression and anxiety change scores on HADS were found to be negatively correlated the physical well-being change scores on the BREAST-Q between baseline and week 3 (p<0.01). Anxiety scores were found to be significantly lower at week 3 (p=0.000) than prior to reconstruction.

Conclusions:
We found a significant improvement in patient satisfaction, psychosocial well-being, and sexual well-being as early as 3 weeks following reconstruction. In addition, patient-reported well-being score with respect to the chest and abdominal donor site improved significantly between the first and third postoperative months.

Figure 1. BREAST-Q subscale scores at baseline, week 3 and month 3 following breast reconstruction
Functional, Psychological and Quality of Life Outcomes after Mandibular Reconstruction for Osteoradionecrosis with Osseocutaneous Free Flaps in Oral Cancer Patients: A Case-Control Study

Institution where the work was prepared: University Health Network, University of Toronto, Toronto, ON, Canada

Caroline E. Payne, MSc, FRCS, (plast); Ralph Gilbert, MD; Gerald Devins, MD; David Goldstein, MD; Jolie Ringash, MD; Kimberley Fernandes, MSc; Stefan O. P. Hofer, MD, PhD; University Health Network

Background:
Mandibular osteoradionecrosis (ORN) as a complication of radiotherapy often requires microvascular reconstruction for severe cases. There is a need to understand the long-term outcomes.

Purpose: Functional, psychological and disease-specific Quality-of-Life (QOL) outcomes in oral cancer patients were compared following conservative vs. surgical treatment with microvascular reconstruction.

Methods:
A case-control study designed to include irradiated oral cancer patients (1999-2009).

Case groups:
ORN group-1 - Patients with ORN - excision/radiation treated primary tumour, managed with resection and osseocutaneous microvascular reconstruction.
ORN group-3 – Patients with ORN - radiation treated primary tumour, received conservative management.

Control groups:
No ORN group-2 - Surgical excision of primary tumour with mandibular reconstruction and radiation.
No ORN group-4 – Oral tumour treated exclusively with radiation

Groups matched for age, sex and time since irradiation.

Measures:
Psychological wellbeing and emotional distress were evaluated by the CES-D, Affect Balance and Atkinson Life Happiness Rating Scales. Individual items tapped treatment-related concerns (whether patients felt “back-to-normal” and their fears of cancer recurrence). QOL was evaluated using EORTC-HN37.

Results: Comparison of 4 groups using multivariate analysis of covariance, controlling for empirically identified covariates, saw a lower psycho-social QOL in Cases (p=0.27) than Controls, with residual symptoms correlating significantly with pain/swallowing/sensations/speech QOL scores.

Case groups:
ORN group-1 reported more difficulty with speech and social eating than group-3 after accounting for current symptom burden. ORN group-3 reported lower subjective wellbeing scores (p=0.12) after controlling for general health than group-1.

Control groups:
No inter-group difference in emotional wellbeing, despite a more invasive surgical intervention in group-2 (p=0.53). Control group-4 (radiation only) reported significantly decreased concerns about “back-to-normal” compared to Cases (p=0.03 when comparing to group-1 and p-value = 0.01 when comparing to group-3).

Case/control:
Multivariate analysis of ‘Wellbeing’ outcome indicated a significant difference between groups-1 & 2, with group-1 reporting highest Wellbeing (Atkinson-life-Happiness, Affect Balance, and CES-D scales) and group-2 the lowest.

For the multivariate ‘Concern and Fear’ outcome, significant differences were evident between Groups-1&4, 3&4, and 2&3, with group-3 reporting the highest level of fear and concern, followed by group-1, group-2, and group-4.

Conclusions:
Mandibular reconstruction in ORN is an effective treatment with QOL preservation. Surgically managed ORN patients reported significant difficulties with speech and social eating, whereas conservatively-managed ORN patients reported more depressive symptoms and concerns about getting “back-to-normal” and more “fears-of-recurrence”. These are important implications for pre-operative counseling and selecting the appropriate treatment when faced with ORN in oral cancer patients.
Technical Challenges of Total Esophageal Reconstruction using a Supercharged Jejunal Flap

Institution where the work was prepared: University of Texas MD Anderson Cancer Center, Houston, TX, USA

Melissa Poh, MD; Jesse C. Selber, MD, MPH; Roman Skaracki, MD; Garrett L. Walsh, MD; Peirong Yu, MD; University of Texas MD Anderson Cancer Center

Background:
Total esophageal reconstruction is a technically demanding and complex procedure. A gastric pull-up is the first choice, but when this fails, or when the stomach is unavailable, either a colonic interposition or a supercharged jejunal flap (SCJF) is used to reestablish alimentary tract continuity. The SCJF has become our preferred method due to its availability, superior motility and low leak rate.

Methods:
We performed a retrospective review of 52 patients who underwent a SCJF for total esophageal reconstruction between March 2000 and September 2009 at a single institution. Patient characteristics, technical details and outcomes were analyzed.

Results:
Thirty-seven male and 15 female patients were included with a mean age of 55 (28-74) years. An immediate reconstruction was performed in 35 (67%) patients and delayed in 17 patients. For immediate reconstruction, the most common reason for utilizing a SCJF was the unavailability of the stomach (66%) due to tumor involvement, radiation, and previous gastric surgery. A failed gastric pull-up (53%) was the most common indication for SCJF in delayed reconstruction. The jejunal conduit was passed through a subternal route in 31 (60%) patients and a retrocardiac route in 20 patients. Most common recipient arteries were the internal mammary and transverse cervical. Most common recipient veins were the internal mammary and internal jugular. The overall success rate was 94% with 3 flap failures. Two flaps were returned to the operating room; one for bleeding and one for arterial thrombosis. Both flaps were salvaged. A total of 33 patients experienced one or more complications with abdominal wound infection and pulmonary complications being the two most frequent. Six (12%) patients demonstrated a subclinical, radiographic leak-all of which healed spontaneously. Seven (14%) patients developed an esophagocutaneous fistula: 4 healed spontaneously, 2 required surgical repair and 1 patient died. Five (10%) patients developed an anastomotic stricture: 3 were treated with endoscopic dilatations and 2 were managed surgically. Mean length of hospital stay was 21.5±14.0 days with a mean intensive care unit stay of 9.0±11.7 days. Mean time to first oral intake was 25.5±20.5 days. Forty-four (90%) patients were able to achieve a regular diet and 39 (80%) patients discontinued their tube feeds.

Conclusion:
The present study is the largest series of supercharged jejunal flaps for total esophageal reconstruction to date. This technically challenging operation requires a multidisciplinary approach and careful planning, yet can be successfully performed with good long-term function and acceptable morbidity. An algorithm delineating the operative strategy is presented.

Reconstruction of Partial Glossectomy Defects: The Role of the FAMM flap

Institution where the work was prepared: Long Island Plastic Surgical Group, P.C., Garden City, NY, USA

Tommaso Addona, MD; John Layliev, MD; Douglas Frank, MD; Matthew S. Kilgo, MD; Thomas Davenport, MD; (1)Long Island Jewish Medical Center, (2)LJMC

Background:
Management of primary tongue carcinoma can range from partial glossectomy to total glossectomy for advanced disease. In terms of reconstruction, primary closure, secondary intention, or skin grafts are adequate for many early stage tumor defects. Hemiglossectomy and total glossectomy defects require free tissue transfer or regional pedicled flaps. The facial artery myomucosal (FAMM) flap has been used to reconstruct various intraoral and nasal defects. We present the use of the FAMM flap for tongue reconstruction of defects to improve function and decrease morbidity, compared to free tissue transfer. Seven patients with a mean age of 63 years (range 51 to 84) underwent excision of squamous cell carcinomas of the tongue and floor of mouth. Tumor stages ranged from T1N0 to T1N1. All resections included a partial glossectomy. The tongue defects ranged in size from 2.7 x 1.5 x 0.4 cm to as large as 8 x 4 x 2 cm. A FAMM flap was utilized to reconstruct the tongue defects of all patients. Patients were evaluated postoperatively for speech and swallowing competence. All flaps had complete survival. Mean length of stay was 5 days (range 2-9). Mean operative time for the reconstructive portion of surgery was 1 hour and 43 minutes. Patients were followed for 6 months. All patients tolerated a regular diet and had excellent subjective speech and normal swallow as documented by modified barium swallow studies; only one patient required short term speech therapy. In conclusion, the FAMM flap is a reliable flap for the reconstruction of intraoral defects. We believe it has utility for the reconstruction of small to medium size defects involving the tongue and floor of mouth. Traditional primary closure or skin graft reconstruction may be inadequate, resulting in tongue tethersing and poor functional outcome. Free flap reconstruction for some medium sized defects may be more than is required. We feel the FAMM represents a superb reconstructive alternative in these circumstances. Our technique and data is the first to explore the utility of this flap and early functional data suggests its efficacy.
Prefabrication of trachea for the reconstruction of hemilaryngectomy defects

Institution where the work was prepared: dept Plastic Surgery, KUL Leuven University Hospitals, Leuven, Belgium
Jan Jeroen Vranckx, MD, PhD; Pierre Delaere; KUL Leuven University Hospitals Gasthuisberg

Introduction:

Total laryngectomy is the procedure of choice in unilateral glottis cancer, since the reconstruction of a hemilarynx while sparing one vocal cord, is so complex. However, every attempt must be made to avoid total laryngectomy in unilateral cancer since the loss of speech and the need of a permanent tracheostomy drastically alters quality of life. We used a prefabricated tracheal segment in 85 patients to restore the hemilarynx in a 2-stage procedure.

Material & methods:

In 39 patients in first stage 4 trachea rings were wrapped in situ with a forearm fascia flap. After microsurgical anastomosis the flap was covered with goretex to prevent adhesion formation. After 14 days, the tumor was resected, the trachea opened horseshoe-shaped and remodeled to restore the hemilarynx. In 2 cases the procedure was aborted due to tumor recurrence. The operative sequence therefore was modified and hence the surgical procedure. In 46 subsequent patients the tumor was resected in 1st stage. The resulting hemilaryngeal defect was temporarily closed using a fasciocutaneous radial forearm flap while a radial forearm fascia flap in continuity served to wrap and prefabricate the trachea. After an oncologic safe 4 months, the hemilaryngeal defect was reconstructed by the vascularised trachea segment.

Results:

After the first operation the RFA restores the sphincter function of the larynx. Swallowing of solids and liquids is possible after 1 week and speaking is possible during finger occlusion of the temporary tracheostomy. After the second operation the tracheal patch and the vascularised forearm flap succeeded in restoration of the sphincteric and respiratory function.

Hand-free speech was possible after closure of the tracheostome 6 weeks after the definitive reconstruction. Voice sounds natural and moderately hoarse.

Conclusion:

The combined use of the tracheal autotransplant with the radial forearm flap approaches the desired optimal reconstructive morphology after repair of extended hemilaryngectomy defects and prevents a total laryngectomy in selected cases.

Transplantation of the Eyelids: Anatomical research and clinical cases

Institution where the work was prepared: Henri Mondor Hospital, CRETEIL, France
L. Lantieri; Jean Paul Meningaud; P. Grimbert, MD; Benjoar; M. Hivelin, MD; R. Bosc; CHU Henri Mondor Paris XII University

Background:

The goal of face transplant is to restore the fundamental muscular activity to the face and more specifically of the orbicularis oculi and/or of the orbicularis oris. Restauration of the orbicularis oris is established by the transplantation of the lower two third of the face as in all the cases of partial face transplant. To obtain transplantation of the upper part of the face including the eyelids we developed an original technique.

Methods:

A preclinical study of 17 fresh cadavers helped us to determine the approach of the upper face. By dissection through a combined coronal approach on the upper part and premasseter approach on the external part of the eyelids and conjonctival opening the lacrymal duct and the levator could be isolated allowing of the en bloc harvest. The authors carried out the harvest of two total face allotransplant in april 2009 and June 2010. The harvest included the total face along with the eyelids and the ears.

Results:

Both the preclinical study and the clinical results obtained with our patient confirmed that complete revascularization of a graft consisting of the total face along with the eyelids and the ears is possible from a single external carotid pedicle. All dissections were completed within six hours. Graft procurement for the clinical cases took eleven hours in the first case and six in the second. As in our partial transplants, we continue to harvest the soft tissues of the face “en bloc” to gain time and to prevent tissue injury. The manufacture of a resin mask that covers the entire face gave indisputably excellent results. All the nerves and eyelids structures were easily reattached. Both patient had extrinsic movement of the eyelids at 8 days

Conclusions:

A composite tissue allotransplantation of the total face along including the eyelids is technically feasible. The flap used gave reliable vascular results and could be obtained in a standardized ways. It contained all the perioral muscles, the facial nerves (VII, V1, V2 and V3), the eyelids structures and the major salivary glands.
Romberg’s Disease and Linear Scleroderma (Coup de Sabre) are progressive, usually unilateral facial atrophies of unknown etiology. The gold standard treatment for these patients is microsurgical reconstruction following the “burning out” of the facial atrophy and stable contour for two years. In our experience, patients treated early in their disease course have immediate and sustained correction of the deformity, with slowing or in most cases cessation of the disease process upon microsurgical transfer. No disease process has recurred to date even in cases with severe progressive disease. Equally impressive is the apparent improvement of underlying skeletal growth in young children with severe disease who in previous experience would have gone on to have much more severe skeletal deformities. We report our experience with 130 patients involving 133 free tissue transfers with a minimum of 1 year follow up who were treated from July of 1989 to July 2009.

All cases had severe atrophy. There were 62 males and 68 females in the series. Distribution of disease was coup de sabre in 79 patients whereas 102 patients had a hemifacial distribution, typical of Romberg’s. 128 patients had unilateral disease and 2 patients had bilateral atrophy without systemic collagen vascular disease such as lupus erythematosis. The average age of onset of disease was 12.5 years. The average duration of atrophy was 6.3 years. Average age at operation was 29.2 years with a range from 4 to 69 years. Follow up ranged from 1 to 20 years. Complications included hematoma in 9 patients, one partial flap loss, 1 patient with partial facial skin slough treated with local wound care, and cellulitis in 1 patient. One flap was lost at two weeks following surgery when the patient began smoking heavily. Flap revisions performed at 6 months following free tissue transfer consisting of tissue rearrangement, debulking procedures and resuspension were completed in nearly all patients and is now a standard for optimal results. Minimal autologous fat transfers were used as an adjunct for small corrections or in the periorbita. Recurrence of facial atrophy was not seen.

All patients rated improvement as excellent with follow-up as long as 20 years. Microsurgical correction of Romberg’s disease and linear scleroderma produces long-lasting, sustained results, and may slow progression of the disease by transfer of healthy tissue to affected areas. Stable long-term results were found even in patients with active disease.

Preoperative CT Angiography for Head and Neck Reconstruction with Anterolateral Thigh Flaps

Institution where the work was prepared: The University of Texas M.D. Anderson Cancer Center, Houston, TX, USA

Patrick Garvey, MD; Jesse Selber; John Madewell, MD; Luc Bidaut, PhD; Lei Feng, BS; Peirong Yu; MD Anderson Cancer Center

Background:
The free anterolateral thigh (ALT) flap is one of the most versatile options for soft-tissue reconstruction of head and neck defects. During ALT flap harvest, inadequate or absent perforators may necessitate modification of the flap design, exploration of the contralateral thigh, or additional flap harvest. Computed tomographic angiography (CTA) may facilitate perforator mapping and optimize flap design. We performed this pilot study to determine the predictive power of CTA in ALT flap planning and execution.

Methods:
We studied a prospective cohort of 16 consecutive patients who received preoperative CTA mapping of the lateral circumflex femoral artery (LCFA) and subsequently underwent ALT flap reconstructions for complex head and neck defects at MD Anderson Cancer Center. We compared perforator location, origin, size, and course between CTA and intraoperative findings and analyzed the relationship of patient characteristics, CTA images, and intraoperative factors to flap design and surgical outcomes.

Results:
Among the 16 ALT flaps, 40 of 54 perforators identified intraoperatively were visible on CTA, resulting in 74% sensitivity. Intraoperative perforator location was an average of 0.35 cm from the CTA-predicted location. CTA locations were more accurate for proximal than for distal perforators. CTA accurately predicted the vessel of origin for a perforator in 92.5% of cases. The overall accuracy of CTA in predicting whether a perforator took a septocutaneous or an intramuscular course was 77.5%. The accuracy of predicting a perforator’s course also decreased from proximal to distal. Overall, CTA was able to accurately classify perforator size as small, medium, or large in 67.5% of cases. Preoperative CTA resulted in surgeons modifying the operative plan in 56% of cases. All flaps were successfully elevated and survived.

Conclusions:
CTA identified proximal perforators better than distal ones and larger perforators better than smaller ones. CTA accurately predicted the location and origin of visible perforators and less accurately predicted their course and size. Most importantly, the information provided by CTA influenced surgeons to modify their reconstructive strategy in over half of the cases, resulting in a higher level of recipient site and defect specificity in this challenging cohort of patients. We speculate that CTA mapping of the LCFA will reduce complication and functional morbidity rates, particularly when two reliable skin islands are needed for the reconstruction. Until such an outcomes study can be completed, our study represents the largest reported series of CTA mapping for ALT reconstruction of head and neck defects.
Secondary Pectoralis Major Musculocutaneous Flap for Reconstruction of Recurrent Oral Cancers or Other Secondary Defects

Institution where the work was prepared: E-Da Hospital, Kaohsiung, Taiwan

Shih-Heng Chen; National Taiwan University Hospital; Hung-chi Chen, MD, FACS; E-Da Hospital; Yueh-bih Tang, MD, PhD; National Taiwan University Hospital

Background:

Oral cancers have good prognosis if they are treated early. For primary reconstruction, wide excision followed by reconstruction with free flaps is popular when the tumor is large. Adjuvant therapy including radiation therapy and chemotherapy are provided after surgery depending on the pathological findings. However, when in recurrent cases the recipient vessels may not be readily found especially after radiotherapy. Therefore for a recurrent case regional flaps such as pectoralis major (PM) and deltopectoral flap (DP) are often employed for reconstruction after excision of recurrent cancers. It is a current practice to preserve the deltopectoral flap when a PM flap is used. However, we propose that the lateral thoracic vessels should also be preserved when PM is used for the first time. Then a deltopectoral flap when a PM flap is used. However, we propose that the lateral thoracic vessels should also be preserved when PM is used for the first time. Then a deltopectoral flap can be used whenever there is another defect requiring reconstruction.

Methods:

Postoperative re-irradiation following salvage surgery for recurrent head and neck cancer may improve survival yet is usually avoided due to concern for major complications. Our hypothesis was that microvascular free flap reconstruction following salvage resection helps to minimize complications associated with re-irradiation by replacing previously irradiated tissues with non-irradiated tissues.

Results:

Early (within 6 weeks of surgery) complications occurred in 34% of subjects compared to 29% in the control group (p=0.97). Late complications occurred in 35% of subjects, surgical site complications included fistula (10%), wound dehiscence (7%), osteoradionecrosis (7%), dysphagia (6%), and hardware exposure (6%). By comparison, late complications occurred in 18% of the control group (p=0.02), with the occurrence of surgical site wound dehiscence in (3%), dysphagia (5%), osteoradionecrosis (4%), and fistula (1%). Late re-irradiation-associated toxicities included skin fibrosis (20%), mucosal atrophy (6%), dysphagia (6%), brain necrosis (3%), and osteoradionecrosis (14%).

Pathologic margins were positive in 32% of subjects compared to 15% of controls (p=0.01), and 50% of subjects had perineural invasion compared to 30% of controls (p=0.01). At a mean follow-up time of 23±18 months, 28 patients (41%) have no evidence of disease, 13 (19%) are alive with disease 26 (38%) dead of disease, and 1 (1%) is dead of other causes. In the control group, at a mean follow-up time of 25±22 months, 55 patients (43%) have no evidence of disease, 16 (12%) are alive with disease, 41 (32%) are dead of disease, 9 (7%) are dead of other causes, and 2 (2%) had perioperative deaths.

Conclusions:

Although late complications were more frequent following re-irradiation, most were manageable and none were fatal. Replacement of previously irradiated tissues with non-irradiated free flaps may enable more patients to undergo re-irradiation for improved oncologic outcomes in advanced recurrent cancers. Our data suggests that re-irradiation may help patients with poor prognostic factors such as positive margins and perineural invasion achieve disease-free survival at a rate equivalent to patients without these factors.
Correlating SPY Imaging (ICG Fluorescence Angiography) with Flap Outcomes

Institution where the work was prepared: University of Manitoba, Winnipeg, Canada

David S. McDonald, MD, PhD; Thomas Hayakawa; Edward Buchel; Leif Sigurdson; Michael G. Sowa, PHD; Jeri Friesen; (1)University of Manitoba, (2)National Research Council of Canada

Background:
The elevation and transfer of skin flaps is essential in reconstructive surgery. Clinical prediction of flap viability at the time of elevation can be inaccurate and lead to reconstructive failure. A common example is that of mastectomy skin flap necrosis in the setting of immediate breast reconstruction. The purpose of this study was to determine the prognostic value of indocyanine green (ICG) fluorescence angiography in predicting flap necrosis in a rat model.

Methods:
Reverse McFarlane skin flaps were raised on the dorsa of 9 rats. ICG imaging was performed postoperatively (t= 0, 1, and 2 h). Digital color photos were then acquired at 72 h to determine clinical outcomes. Next, ICG images were compared to the clinical images to determine the accuracy of ICG in predicting necrosis. Statistical analysis included nonparametric receiver operating characteristic (ROC) curve analysis of the data. The area under the curve (AUC) was used as an indicator of the ability of normalized accumulated ICG fluorescence intensity to predict flap outcome.

Results:
At 0, 1 and 2 h after raising the flap, fluorescence intensities of less than 19%, 27% and 40% respectively of the intensity observed in surrounding normal tissue predicted tissue necrosis with a 95% specificity. The sensitivity increased from 68% (CI, 46-90%) at time 0 to 87% (CI, 76-98%) and 85% (CI, 73-97%) at 1 and 2 h, respectively. Inter-animal variations were significant: at a specificity of 95%, the area of the flap that ICG imaging inaccurately predicted to be viable (i.e. area predicted viable that ultimately failed) ranged from 0.41 to 17.44%, with an average of 6.13%. Conversely, areas inaccurately predicted to become necrotic ranged from 0.19 to 17.44%, with an average of 5.65%.

Conclusions:
In the reverse McFarlane flap model, an ICG fluorescence intensity of < 27% at 1 h postoperatively correlates with tissue necrosis with 95% specificity and 87% sensitivity, suggesting that ICG may be a reasonable objective predictor of necrosis. Timing of imaging appears to be important. Additionally, the significant inter-rat variability observed in the accuracy of ICG imaging suggests the potential for similar variability in accuracy when applying this technology in a clinical setting.

Use of Doxorubicin Chemotherapy Immunosuppressive Side Effects for Composite Tissue Allotransplantation

Institution where the work was prepared: University of Maryland School of Medicine, Baltimore, MD, USA

Helen G. Hu-Chou, MD; J. Bryce Olenczak, BA; Cinthia B. Drachenberg, MD; Luke S. Jones, BS; Eduardo D. Rodriguez, MD, DDS; (1)R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine, (2)University of Maryland School of Medicine

Purpose:
Bone cancers present reconstructive challenges as oncologic resection creates large continuity defects of bone and surrounding soft tissues. Since adjuvant and neoadjuvant chemotherapy is often required after tumor resection, the immunosuppressive side effects of doxorubicin could be utilized to allow immediate reconstruction with a composite tissue allograft (CTA) that would provide for exact replacement of tissues and avoid limb loss. We aim to use a short course of doxorubicin to achieve a novel method of immunosuppression in a rat model undergoing CTA to create an immunological environment for allograft survival without rejection.

Methods:
The IACUC approved protocol consisted of three experimental groups with of 5 animals in each. Groups 2 and 3 consisted of 5 Brown Norway rats as allograft donors and Lewis rats as transplant recipients. A separate control group underwent autotransplant alone. A 4 x 5 cm abdominal wall CTA was harvested based off the superficial inferior epigastric vessels. End-to-end microsurgical anastomosis were performed. Group 3 animals were administered 2.5 mg/Kg of doxorubicin intravenously during surgery, then 1.25mg/Kg on POD 2, 10 and 15. Survival of the CTA was assessed by physical examination and histological analysis. Complete blood counts were performed at endpoint.

Results:
Allotransplant without treatment showed rejection by day three, with diffuse erythema and edema. Complete rejection with necrosis occurred by day seven. This correlated with histologic findings of rejection including apoptotic halo cells, lymphocytic infiltration and subdermal edema. By day 10, there was complete loss of tissue architecture and bacterial infiltration. Allotransplant rats treated with doxorubicin had normal grafts through day 10 clinically and histologically. The CBC results of Group 3 showed a pancytopenia consistent with the immunosuppressive effects of doxorubicin treatment. Kaplan-meier survival analysis showed a statistically significant difference, with increased CTA survival time to endpoint with doxorubicin treatment, from a mean of 8.8 days in Group 2 to 16.4 days in Group 3.

Conclusions:
Allotransplant flaps without treatment showed complete clinical and histological signs of rejection by day 3 with complete rejection by a mean of 8.8 days. The normal clinical and histologic findings of the allotransplant group which received doxorubicin showed delay of allograft rejection with an 86% increased CTA survival time. The CBC values at endpoint revealed the marked pancytopenia attributable to the doxorubicin doses. This shows the feasibility of the immunosuppression caused by chemotherapy to delay and prevent rejection of a composite tissue allograft.
Tissue Oximetry Monitoring in Microsurgical Breast Reconstruction Decreases Flap Loss and Improves Rate of Flap Salvage

Institution where the work was prepared: Beth Israel Deaconess Medical Center/ Harvard Medical School, Boston, MA, USA

Michael S. Curtis, MD; Samuel J. Lin; Minh-Doan Nguyen, MD, PhD; Chen Chen; Salih Colakoglu; Adam M. Tobias; Bernard T. Lee;

Background:
Since the inception of microvascular free tissue transfer, flap monitoring has been based on clinical signs. Color, capillary refill, and handheld Doppler have been used for monitoring in the post-operative period; however, subjective clinical examination may delay recognition of flap compromise. Tissue oximeter (ViOptix, Fremont CA) monitoring offers an objective method for detecting vascular compromise with the measurement of tissue oxygen saturation and real-time flap perfusion.

Methods:
We reviewed 614 consecutive microsurgical flaps for breast reconstruction from 2004 to 2010. Our first 380 patients underwent clinical flap post-operative monitoring. Starting in June 2008, we used tissue oximetry as an adjunct on 234 consecutive patients. Flap re-exploration, flap loss, salvage rate, fat necrosis, and characteristics of vascular compromise were analyzed.

Results:
There were 26 (6.8%) instances of flap re-exploration and 11 (2.9%) flap losses prior to use of tissue oximetry. After tissue oximetry was used, there were 16 (6.8%) instances of flap re-exploration and 1 flap loss. The rate of flap re-exploration was not statistically significant between groups, but the difference between the flap failure rates is significant (p = 0.025). The flap salvage rate was previously 57.7%, but after tissue oximetry monitoring was 93.75% (p = 0.015).

Conclusions:
The use of tissue oximetry has decreased our flap loss rate and improved the flap salvage rate in microsurgical breast reconstruction. This device is a useful adjunct in flap monitoring during the post-operative period as it may help decrease flap loss by detecting impending vascular compromise before it becomes clinically evident.

Reversed Innervatd Supercharged Lattissimus Dorsi Flap + 6 other flaps for Complex Abdominal wall Reconstruction

Institution where the work was prepared: Bombay Hospital & Medical Research Centre, BOMBAY, India

Ashok Gupta, MS, MCh; Bombay Hospital & Medical Research Centre

Successful rehabilitation following polytrauma with life threatening septicemia and extensive loss of the anterior abdominal wall, anterior wall of the urinary bladder, pubic symphysis and pubic ramus, phallus, scrotum, testes and upper half of thigh soft tissue (right and left) has been achieved using seven different major flaps (Supercharged three in one symbiotic and two in one symbiotic) in patient to achieve restoration of life and member with 20 years of follow up assessment and Electron Microscopy to confirm the innervation of the supercharged innervated inferiorly based lat dorsi flap

Two Radial Forearm flaps + two vascularised fibula grafts, two gracilis and one Inferiorly based Lat. Dorsi Supercharged innervated were used on three diff. occasions. Five of the seven were micro-neuro-vascular flaps while the remaining two were extracorporeal transfers. The total per operative surgical duration has been 70 hours and final rehabilitation has taken 18 months.

A comprehensive rehabilitation with restoration of life and member has been achieved following life threatening trauma with extensive loss of soft tissue in the lower abdominal wall + genito-urinary areas using a combination of seven major flaps. He has eventually come out from the deathbed to a near normal life in to the society, replete with his self-confidence. This patient is an ample example of perseverance and judicious use of techniques in a near fatal clinical situation. Perhaps, this may be put on record as the only patient with a maximum numbers of major flaps being patronized.

All these flaps either alone or in combinations were carried out under Regional Anesthesia i.e. Continuous Epidural block + Brachial block, facilitating positioning of the patient while undertaking an extra-corporeal tissue transfer. Lat. dorsi muscle flap could also be dissected under thoracic epidural block along with infiltration of local anesthesia in the axilla for dissection of the neuro-vascular pedicle. He was discharged from the hospital after physical, functional and emotional rehabilitation including abdominal wall and phalloplasty.
The Use of Free Vascularized Fibula Grafts in the Spinal Stabilization of Pediatric Patients
Institution where the work was prepared: Dalhousie University, Halifax, NS, Canada
Kevin A. Calder, BSc, MD; Kenneth L Wilson, Dalhousie University

Purpose:
To objectively assess the structural stability and viability of free vascularized fibula grafts in pediatric patients for the treatment of progressive kyphoscoliosis deformities of the spine.

Method:
Anterior free vascularized fibula graft surgery was performed in eight pediatric patients at the Izaak Walton Killam Children’s Hospital between 1998 and 2005. All patients had severe kyphoscoliosis having failed spinal instrumentation. Plain film radiography in the PA and lateral planes was used to quantify the spinal deformity pre-operatively. Post-operative spinal angles of the residual kyphoscoliosis were measured and followed for a minimum of two years to assess long-term operative success. Bone scintigraphy was performed to assess graft viability at long-term follow up and 3-dimensional CT scan was obtained to assess graft stability and fusion.

Results:
Mean patient age at surgery was 12.8 years. The degree of kyphosis at time of surgery measured greater than 90° in all patients with the apex at the mid-thoracic spine. Amelioration of the kyphotic deformity was evident post-operatively in all cases. Long-term follow up averaged 5.5 years and showed persistent stability of spinal angles. Computed tomography showed bony incorporation at both ends of the fibula grafts in all cases. Bone scintigraphy revealed that the fibula grafts had good uptake and were all viable.

Conclusions:
Free vascularized fibula grafts are an effective treatment for the stabilization of kyphoscoliosis in the pediatric spine. The use of free vascularized fibula grafts provides a viable and long term solution to progressive kyphoscoliosis of the spine.

Learning Objectives:
At the end of this presentation, the learner will be able to identify the usefulness, durability, and long term outcomes of free vascularized fibula grafts in the management of progressive kyphoscoliosis in the pediatric patient.

Abdominal Wall Transplantation: The Microsurgical Approach
Institution where the work was prepared: Cleveland Clinic, Cleveland, OH, USA
Jason Prigozen, MD; Risal Djohan, MD; Robert Lohman; Steven Bernard; Maria Siemionow; Cleveland Clinic

Composite tissue allotransplantation has become an accepted technique for certain reconstructive goals. A newer idea, that of abdominal wall as a composite tissue for transplantation, has entered the literature via transplant surgeons in the USA and Italy. Fifteen transplants have been performed worldwide, with only the 3 done in Italy involving microvascular surgery techniques. We are in preparation for our first patient to receive an abdominal wall transplantation concurrent with his small intestine transplantation. With this aim, the literature has been reviewed for technical aspects of the surgery. These, however, are lacking.

With this dilemma the microsurgical reconstruction team at our institution collaborated with the intestinal transplant surgeons to develop a technical plan for accomplishing procurement and transplantation of a composite abdominal wall flap based on microsurgical anastomotic techniques. Four fresh cadavers were dissected in order to develop the plan from an anatomical basis. Once this was accomplished the 2 teams joined together for logistical planning of the transplantation. With this accomplished, we then performed a “dry run” harvest in order to refine our ideas and timing.

We will present the relevant technical data, surgical planning and cadaveric dissections achieved in our pursuit.
Predicting Pharyngocutaneous Fistula Following Larynx and Pharynx Reconstruction

Institution where the work was prepared: Medical University of South Carolina, Charleston, SC, USA

Steven M. Andreoli, MD; Jessica L. Gulkung, MD; J. Kenneth Byrd, MD; Jared M. Intapahan, MD; Joshua D. Homig, MD; Judith M. Skoner, MD; Medical University of South Carolina

Objectives/Hypothesis:
Fever and leukocytosis are common following head and neck cancer extirpation and defect reconstruction involving the pharynx. These aberrations are frequently attributed to atelectasis, but other factors may contribute. Patients undergoing such procedures are often smokers presenting with prolonged dysphagia, weight loss, and secondary malnutrition. Many have a history of surgery, radiation, chemotherapy, or a combination of interventions. These variables contribute to poor wound healing and may portend the formation of pharyngocutaneous fistula. The study intends to determine postoperative predictors of pharyngocutaneous fistula following laryngectomy and laryngopharyngectomy defect reconstruction.

Study Design:
A retrospective chart review identified all patients undergoing laryngectomy with partial or total pharyngectomy at an academic tertiary care medical center from July 2004 to June 2010. Data collected included patient demographics, oncologic site and stage, ablative and reconstructive surgery performed, postoperative temperatures and leukocyte counts, nutritional status, and pharyngocutaneous fistula status. Data was analyzed using a stepwise logistical regression.

Results:
79 patients undergoing laryngectomy with partial or complete pharyngectomy for squamous cell carcinoma of the larynx, hypopharynx, or tongue base were identified. Primary pharyngeal reconstruction via a traditional running Connell suture was performed in 43 patients. Eight patients were reconstructed using a pedicled pectoralis major myocutaneous flap. The remaining 28 patients underwent reconstruction via fasciocutaneous microvascular free tissue transfer, with donor sites including radial forearm, anterolateral thigh, scapula, and deep inferior epigastric perforator. Thirteen patients underwent total laryngopharyngectomy requiring circumferential pharyngeal reconstruction. A history of prior radiotherapy or chemoradiation was identified in 19 and 32 patients, respectively. Pharyngocutaneous fistula developed in 22 patients (25.3%). Fever (>100.4°F) and low grade fever (>99.0°F) were identified in 15% and 64% of patients, respectively. Stepwise logistical regression for all patients identified predictors of fistula formation to be maximum temperature within the first 24 postoperative hours (p=0.027) and maximum temperature in the ICU (p=0.017). Analysis of only patients with free flap reconstructions yielded similar results (p=0.012 and p=0.05). Tumor stage, prior radiation or chemoradiation, preserved posterior pharyngeal mucosal strip, thyroid stimulating hormone, albumin, and prealbumin did not predict fistula formation.

Conclusions:
Pharyngocutaneous fistula is a dreaded complication following complex pharyngeal reconstruction. This is the first evidence to support predictors of pharyngocutaneous fistula formation in patients with microvascular reconstruction, which is consistent with prior evidence in patients undergoing primary laryngectomy closure. Prompt identification of salivary fistula may expedite local wound care or operative revision to avoid more serious secondary complications.

Use of Vasopressors in Microvascular Reconstruction of Head Neck Defects

Institution where the work was prepared: University of Florida College of Medicine - Jacksonville, Jacksonville, FL, USA

Rui P. Fernandes, MD, DMD; Nate Eberle, MD, DMD; Phillip Pirgousis; University of Florida College of Medicine Jacksonville

Objective:
To evaluate the effect of intraoperative administration of vasopressors on the outcomes of microvascular tissue transfer in head and neck surgery.

Study Design and Setting:
Retrospective chart review of the last 100 consecutive free tissue transfers performed by one senior surgeon in a teaching tertiary care center from 2007-2009.

Results:
100 free tissue transfers were performed on 99 patients. The overall flap survival rate was 95%(95/100). A total 83.8 %(83) of patients received, either ephedrine, phenylephrine, dopamine or a combination of the three intraoperatively with ephedrine and phenylephrine being the most commonly used, 42%(35/83). Isolated use of ephedrine made up 33.7%(28/83) of the patients while 24%(20/83) received only phenylephrine and one patient received all three vasopressors. Of the five flaps that failed, 4 were exposed to both ephedrine and phenylephrine and one to all three vasopressors. There was a 30% (25/83) incidence of complications consisting of minor wound dehiscence, seromas, and hematomas in patients receiving vasopressors. In the subset of patients not receiving vasopressors, 29%(5/17) had similar complications. The most common reason for flap failure was venous thrombosis (4 flaps) followed by arterial thrombosis (1 flap).

Conclusion:
Our overall flap success rate was 95%. This rate is consistent with the reported success rates in the literature from high output centers. In light of the fact that 83% of our flaps were exposed to intraoperative vasopressors our study does not show a deleterious effect of the use of intraoperative vasopressors in microvascular tissue transfer for head and neck reconstruction. We found the use of intraoperative vasopressors to be more prevalent than previously thought, a fact that is likely to be the same in other centers.
Accelerating the Learning Curve: Free Fibula Contouring using Virtual Surgery and Stereolithography-Guided Osteotomy for Mandibular Reconstruction

Anuja K. Antony, MD, MPH1; Wei F. Chen, MD2; Antonio Kolokythas, DDS3; Katie Weimer4; Mimos N. Cohen, MD, FACS5; (1)University of Illinois at Chicago, (2)Medical Modeling Inc

Background:
Fibular osteotomy remains a challenging aspect of mandibular microsurgical reconstruction, largely dependent on surgeon experience, intraoperative judgment, and technical speed. Virtual surgical planning and stereolithographic modeling allowing for: reduction in the learning curve associated with neomandible contouring, enhanced levels of accuracy, and acceleration of a time-consuming intraoperative step. We describe our early, favorable experience and illustrate the technique with a video of the virtual planning session and intraoperative osteotomies.

Technique:
Using Materialise software to render the patient’s 3D CT virtually, optimization of cutting planes and fibular segment positioning was carried out in a trial-and-error fashion. After the virtual design is finalized, stereolithographic models of the neomandible (Medical Modeling Inc) and cutting guides were created, and a 3.0 mm plate was pre-bent based on the template. Intraoperative mandibular resection and fibular osteotomies were conducted using the cutting guides. After plate fixation, microvascular anastomoses and flap inset were performed.

Patient and Methods:
This ongoing prospective study has accrued five patients who underwent composite resection of the mandible and free fibula osteocutaneous reconstruction, between December 2009 to June 2010. Age ranges from 18 to 63 (mean 44.8y), with 2 females and 3 males. Follow-up ranges from 6 to 27 weeks. Outcomes assessed included technical accuracy (CT image overlay), potential for healing (bone-to-bone, bone-to-plate contact), aesthetic contour and functional outcomes. The functional and aesthetic outcomes were assessed by dental occlusion, postoperative imaging (panorex and CT), and clinical examination.

Result:
All patients achieved negative margins with cutting guide-directed resection. Use of cutting guides for mandibular and fibular osteotomies eliminated the need for intraoperative measurement, and provided faithful duplication of preoperative virtual surgical planning. The resulting fibular segments yielded excellent apposition. Minimal adjustments were needed in insetting. Flap survival was 100%. There were no wound complications. All patients have maintained preoperative occlusion and a symmetric mandibular contour on both panorex study, 3D CT, and clinical examination. The accuracy of the reconstructed contour was confirmed using image superimposition with the native mandible and virtual plan.

Conclusion:
Preoperative virtual surgical planning combined with stereolithographic model-guided osteotomy offers significant advantages over conventional techniques. In particular, this technique offers potential for enhanced aesthetic outcomes, improved bony contact, and decreased intraoperative time. Fibular osteotomy is greatly accelerated since the need for intraoperative free-hand contouring is eliminated and plate bending is converted to a preoperative event. This translates into considerable saving of intraoperative time and accelerates the learning curve process, manifesting virtual experience (afford investment) with efficiency gains in the operating room.

Bilateral Autologous Breast Reconstruction with Deep Inferior Epigastric Artery Perforator Flaps: Review of a Single Surgeon’s Experience

Raghunandan Venkat, MD; Johnson Lee; Ariel Rad; Gedge D. Rosson; Johns Hopkins University School of Medicine

Objectives:
Of options for autologous breast reconstruction, the DIEP flap best meets requirements for bilateral reconstruction in selected patients. There is a high degree of variability in the reported incidence of fat necrosis and abdominal wall complications, particularly in bilateral reconstructions. We sought to describe pre-operative conditioning, surgical approach, and outcomes in bilateral DIEP patients.

Methods:
We retrospectively reviewed 54 consecutive patients who underwent 108 DIEP flap reconstructions performed by a single surgeon over a 2.5 year period. Mean age and BMI were 52 years and 27.8, respectively. 43% of patients (n = 23) had immediate, 27% (n = 15) delayed, or 15% (n = 8) staged reconstructions with temporary tissue expansion. 15% of patients (n = 8) had combined immediate unilateral reconstruction for prophylaxis and contralateral delayed reconstruction. Most patients underwent rigorous physical therapy aimed at core strengthening. Surgical maneuvers aimed to preserve motar nerves. Reinforcement with acellular dermal matrix was performed where deemed appropriate. Mean follow-up was 46 weeks (range 4 to 120).

Results:
There was 100% flap survival. Unplanned re-operation rate was 7.6% (n = 4). Indications for re-operation included thrombosis (n = 2), infected tissue expanders in attempted staged patients (n = 2), and partial mastectomy flap necrosis requiring debridement (n = 1) – one patient had 2 of the 4 unplanned re-operations. 26% of patients (n = 14) had minor complications including non-operative infection, minor wound dehiscence, and donor site seroma. 2.7% of patients had significant late complications of abdominal wall bulge (n = 1 patient or 1.8%) and fat necrosis > 20% of volume (n = 1 flap or 0.9%). 20% of attempted staged patients required tissue expander explantation due to infection; these patients had delayed reconstruction over a mean interval of 74 weeks after mastectomy. 80% of staged patients had successful tissue expansion over mean interval to DIEP flaps of 27 +/- 20 weeks.

Conclusions:
This study demonstrates the efficacy of the DIEP flap for bilateral autologous breast reconstruction in the immediate, staged, and delayed settings. While there was 20% failure rate of tissue expansion, this did not compromise oncologic treatment nor final reconstruction outcome. Furthermore, bulge rate is markedly decreased versus historic controls due to maneuvers designed to enhance and preserve rectus abdominus integrity. While long-term prospective studies are warranted, we recommend physical therapy preconditioning, preservation of motor nerves innervating the rectus abdominus, and consideration of abdominal wall reinforcement.
Versatility of the Vein Graft in Fingertip Replantations

Institution where the work was prepared: Gi-Doo Kwon, Incheon, South Korea

Gi-Doo Kwon, MD; Byung-Moon Ahn; Sungmin General Hospital

Purpose:
In this retrospective study, we evaluate the survival rate, complications, functional, and cosmetic outcomes of fingertip replantations with and without vein grafting.

Materials and Methods: A total of 215 fingertip replantations in 199 consecutive patients with amputations at or distal to the distal interphalangeal joint of the finger or thumb were identified for the study during the period between January 2005 and June 2009 in our institute. Among these patients, direct vessel repairs were performed in 172 replantations while vein grafts were used for either arterial or venous repair or both in 43 amputated fingertips. There were 158 male and 41 female patients, with ages ranging between 2- and 72-years-old (mean: 42 years).

Results:
In the 172 cases of fingertip replantations without vein grafting, the overall survival rate was 89.5% (154 out of 172 cases). In the 43 cases with vein grafting, 37 fingertips survived with a survival rate of 86%. There was no statistically significant difference between the survival rates of these two groups (P = 0.534). No statistically significant differences were noted between the two groups in range of motion (t-test), cold intolerance rate, nail deformity rate, and pulp atrophy rate (Fisher’s exact test) (all P > 0.05).

Conclusion:
The vein grafting technique is a valuable tool for the optimal achievement of functional outcomes and appearance. This retrospective study demonstrates that the survival rate of fingertip replantations is not compromised by vein grafting.

Secondary Revisions and Refinements of Free Perforator Flaps for Lower Extremity Reconstruction

Institution where the work was prepared: R Adams Cowley Shock Trauma Center, University of Maryland, Baltimore, MD, USA

Helen G. Hui-Chou, MD; Jay Sulek, BA; Rachel Bluebond-Langner, MD; Eduardo D. Rodriguez, MD, DDS;
R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine

Background:
The aim of lower extremity reconstruction has focused on early wound coverage and functional recovery, but rarely aesthetics. Though free muscle flaps provide durable coverage, they require skin graft coverage and result in muscle atrophy which may limit future revisions. Perforator based flap reconstructions can be easily elevated to allow for both orthopaedic and contouring procedures. We reviewed the role of secondary procedures in achieving improved functional and aesthetic results following perforator flap reconstruction of lower extremity defects.

Methods:
A retrospective review identified 70 patients treated at R Adams Cowley Shock Trauma Center with 73 free perforator flaps for coverage of lower extremity wounds from 2002 – 2009. Data collected included age, gender, mechanism of injury, location of soft tissue defect, size of flap, composition of flap, and number and type of subsequent procedures including orthopaedic revisions after free tissue coverage, flap debulking, complex tissue rearrangement, tissue expanders, and liposuction.

Results:
Seventy patients were identified who underwent reconstruction with a perforator flap: 65 with an anterolateral thigh (ALT) flap and 5 with a superficial circumflex iliac artery (SCIA) flap. Flap type included 26 fasciocutaneous (37%), 24 adipocutaneous (34%), 20 musculocutaneous (29%), and 2 free muscle flaps (3%). The success rate for all free tissue transfers was 93% (n=68). The 7% (n=5) flap failure rate included four total flap losses and one delayed infection. The overall limb survival rate was 91% (n=68). Twenty-seven of the seventy patients (38%) underwent 40 orthopaedic-related secondary procedures in which the free flap was elevated. The most common reasons for the orthopaedics interventions after free flap reconstruction were tibial non-union requiring bone grafting (n=17) and osteomyelitis (n=11). No flaps were lost after secondary orthopaedic revisions. Nineteen patients (27%) underwent 32 refinement procedures of the reconstructed limb. Fifteen patients were refined with suction-assisted lipectomy (46.8%), 21 with complex tissue rearrangement including sharp debulking (65.6%), and one with tissue expanders (3.1%).

Conclusions:
Limb salvage remains the primary goal of lower extremity reconstruction. Free perforator flaps are an efficient and reliable means of reconstructing Gustilo grade IIIB lower extremity defects. This flap type allows for repeated revisions for orthopaedic complications commonly associated with lower extremity injuries and reconstruction. Following convalescence and functional recovery, appearance becomes increasingly important with regards to quality of life. The ability to safely manipulate ALT and SCIA flaps to perform secondary revisions allows for superior functional and aesthetic outcomes in lower limb salvage.
Local Transfer of Fasciocutaneous Flaps to Cover Wounds in Anterior Tibial, Ankle and Foot Areas

Institution where the work was prepared: University of Louisville, Louisville, KY, USA
Jiyao Zou, MD; David Seligson, MD; University of Louisville

Introduction:
There is limited soft tissue coverage in the anterior tibia, ankle and foot areas. A wound in these areas often has bone exposure and needs a fasciocutaneous flap. Local transfer of a fasciocutaneous flap can be done without using a microscope. There are 3 major arteries in the leg and plenty of soft tissue coverage on the posterior aspect of the leg. Therefore, it is feasible to transfer a fasciocutaneous flap locally to cover wounds in the anterior tibia, ankle and foot areas.

Methods:
Anatomy studies were done to examine the branches and perforators of the anterior tibial, posterior tibial and peroneal arteries. Nutrient arteries to sural nerve and saphenous nerve were also examined. Possibilities for local transfer of different fasciocutaneous flaps to cover wounds in the anterior tibia, ankle and foot areas were explored. Clinical examples were given.

Results:
A fasciocutaneous flap in the leg can be designed based on a major artery, a branch or a perforator. A fascia or skin pedicle can also be used. Based on our detailed microsurgical anatomy study, different kinds of fasciocutaneous flaps on the posterior leg can be used to cover a wound in the anterior tibia, foot and ankle areas. The donor site wound with good soft tissue coverage can be closed by direct suture or with a skin graft.

Discussion/Conclusion:
- Multiple sources of blood supply to the leg and abundant soft tissue coverage in the posterior leg make the local transfer of a fasciocutaneous flap possible.
- Local transfer of a fasciocutaneous flap can be done without using delicate microsurgical technique.
- Detailed microsurgical study on the leg gives us versatility in designing a fasciocutaneous flap for local transfer.

How to Manage the Size Discrepancy between the Oropharynx and Thoracic Esophagus in Reconstruction of Pharyngo-esophagus using Intestinal Flaps

Institution where the work was prepared: E-Da Hospital, Kaohsiung, Taiwan
Hung-chi Chen, MD, FACS; E-Da Hospital; Yueh-bih Tang, MD, PhD; National Taiwan University Hospital; Shih-Heng Chen; National Taiwan University Hospital

Background:
Size discrepancy during reconstruction of pharyngoesophagus is a difficult problem. If this is not properly treated, the following complication may occur: (1) leakage. If age early the soaking of carotid artery in the saliva can be a high risk to the patient¡'s life. If it occurs later after localization of tissue, the patient may have late stricture of esophagus due to chronic inflammation. (2) partial necrosis of the esophageal wall (3) wound infection (4) delayed adjuvant therapy (radiation therapy and/or chemotherapy), resulting in poor tumor control.

Patients and Methods:
In the past 25 years, three methods had been developed in treating the severe size discrepancy between the oropharynx and thoracic esophagus using intestinal flaps. (a) using cecum-ascending colon sement in an antiperistaltic direction, with the ascending colon anastomosed to the oropharynx and cecum anastomosed to the thoracic esophagus in end-to-side fashion. (b) colo-ileal flap with ascending colon anastomosed to the oropharynx and ileum anastomosed to thoracic esophagus. Myotomy was done for the ileocecal valve. (c) jejunum with two barrels, a small one sutured to the main segment to form a funnel. Retrospective study was carried out for 18 patients (10 in group a, 3 in group b, and 5 in group c). The function of swallowing and complications were recorded and analyzed.

Results:
In terms of swallowing, group c is the best, followed by group a and finally group b. There was no patients who developed leakage and stricture. In terms of easiness, group a is the simplest. In terms of donor site morbidity, group c is the best.

Conclusion:
Facing the problem of severe discrepancy between oropharynx and thoracic esophagus, the following suggestions are made: (1) if voice reconstruction is needed, choose method a (2) if voice reconstruction is not required, choose method c. Method b has neither the best swallowing function nor the best voice function. Therefore it is reserved for patients who do not need voice reconstruction, but jejunum is difficult to harvest due to previous adhesion.

Exploring the Myth of the Valve-less Internal Mammary Vein – a Cadaveric Study

Institution where the work was prepared: Royal Marsden Hospital, London, United Kingdom
Kelvin Ramsey, MBChirFRCSPlast; Simon Mackey; Royal Marsden Hospital

Establishing adequate venous outflow for free tissue transfer is a crucial part of any reconstruction. The internal mammary system has become the first choice for recipient vessels when performing breast reconstruction, and use of the cranial end of these vessels has been shown to be both safe and reliable. As our techniques become more advanced, however, the pedicle configuration becomes more complex and there may be multiple arteries or veins requiring additional recipient vessels. Usually, this involves drainage from a superficial vein, a branch of the main pedicle or from a stacked flap arrangement.

Multiple solutions for this have been sought, including the use of thoracodorsal, transverse cervical, thoracocostal or cephalic veins. Recently, the use of the caudal end of the divided internal mammary vein has been cited as an option for accessory venous drainage. This obviously requires blood flow in a retrograde fashion. All literature on this to date has stated that this is a safe technique based on the principle that there are no valves in the internal mammary vein. It will be shown that this is in fact not the case.

The internal mammary veins of over 30 cadavers were dissected and valves at multiple sites were found in multiple veins. An explanation of the techniques used to find these valves will be given, along with the exact details of the valve positions. In particular, the positions of the valves are correlated with venous side branches, providing an explanation for retrograde drainage despite the presence of valves.

The assumption of a valve-less internal mammary vein, accepted both in the anatomical and reconstructive literature is in fact incorrect. The ramifications of these valves will be explained, to assist decision making when additional venous drainage is required.
Tissue Compatibility and Recellularization of Decellularized Rat Tracheal Matrix

Mengqing Zang, MD1; Qixu Zhang, MD2; Peirong Yu1; (1)Plastic Surgery Hospital, Peking Union Medical College, (2)University of Texas MD Anderson Cancer Center

Objective:
Long circumferential tracheal replacement remains a major clinical problem owing to lack of effective reconstructive techniques. Tissue engineering has prompted exploration into tracheal substitutes that may provide replacement options. Decellularized tracheal matrix has been shown as a promising scaffold in tracheal tissue engineering. The aims of this study were to evaluate host responses to decellularized rat tracheal matrix and to examine recellularization of the tracheal matrix for tracheal tissue engineering.

Methods:
Brown Norway (BN) and Lewis rat tracheae were decellularized with detergent-enzymatic treatment, which achieved complete histological elimination of antigens. To evaluate host response, various tracheal grafts were implanted subcutaneously in Lewis recipients and observed for 4 weeks. They were then harvested for gross inspection, histological and immunohistochemical analysis. In group I, fresh tracheas from BN (allograft) and Lewis (isograft) rats were implanted to serve as controls. In group II, decellularized tracheal matrices from BN rats (decellularized allograft) and Lewis rats (decellularized isograft) were implanted. In group III, decellularized allografts were seeded with syngeneic bone marrow mesenchymal stem cells on the outer surface and with freshly isolated tracheal epithelial cells on the luminal surface using a static seeding technique before implantation.

Results:
In group I, all allografts showed total epithelial loss and luminal occlusion by fibrotic tissue. Isografts preserved lumen patency with intact epithelial cell lining. Cartilages were intact in both allografts and isografts. In group II, the density and distribution of macrophage, CD4+ and CD8+ lymphocytes in decellularized allografts were similar to that of the decellularized isografts, indicating decellularized allografts did not induce significant immunorejection. Inflammatory cell density in decellularized isografts was similar to that of the isografts, suggesting that decellularized grafts did not cause significant non-specific inflammatory reaction. However, all decellularized grafts showed granulation tissue ingrowth in the lumen due to the lack of epithelial lining and calcification of the cartilaginous matrix. In group III, tracheal lumens remained patent with complete epithelial lining and development of ciliated cells. However, calcification in the cartilaginous matrices was similar to group II with no cell repopulation or new cartilage formation.

Conclusions:
Decellularized tracheal matrix showed good tissue compatibility and supported epithelial cell lining. However, efficient stem cell population of cartilaginous matrix was not achieved by present static seeding technique and dynamic seeding may be necessary.

Salvaging Intrisic Venous Congestion in DIEP Flap

Rodney K. Chan, MD1; Allen Liu2; Julian Pribaz, MD; Stephani Caterson; (1)Brigham and United States Institution of Surgical Research, (2)Harvard Medical School, Brigham and Women's Hospital

Intrinsic venous congestion is seen when a DIEP flap exhibits signs of venous congestion but lacks evidence of anastomotic failure. This is a difficult problem and is observed when (1) an inadequate perforating vein is selected or (2) a dominant superficial venous system exists without adequate superficial to deep venous channels. Various methods of microsurgical venous augmentation have been described though the authors surmise that this might be a temporary problem that deserves a simpler, temporary solution.

We report a case of intrinsic venous congestion in DIEP flap breast reconstruction which resolved following application of a temporary venous drainage cannula into the superficial inferior epigastric vein.

55-year-old female with a history of left breast cancer elected to undergo left mastectomy with immediate DIEP flap reconstruction. A single medial row perforator was selected for perfusion of the right hemiabdominal flap, and the left internal mammary artery and vein served as the recipient vessels. A large superficial inferior epigastric vein (SIEV) noted in pre-operative imaging was preserved and clipped during the dissection of the flap. On post-operative day one, the DIEP flap was congested. On exploration, both the arterial and venous anastomoses were patent though the previously clipped SIEV was noted to be dilated. Removal of the clip on the SIEV resulted in brisk venous efflux and improvement of flap color. Reclipping of the SIEV resulted in rapid return of venous congestion. The deep inferior epigastric vein alone was inadequate in providing venous drainage from the flap. To secure additional venous outflow, a 16G angiocath was inserted and secured into the SIEV with resolution of her congestion following several drainages within 24 hours. Her flap remains healthy and viable at 1 year follow up with no evidence of fat necrosis.

We report the successful salvage of a case of venous congestion in a DIEP flap using a temporary venous cannula. This case suggests that the intrinsic venous inadequacy equilibrates quickly and an expeditious and temporary solution can be an effective treatment.
Reconstruction of The Buccal Mucosa Using Two Ulnar Artery Forearm Free Flaps from a Single Donor Site for Oral Submucous Fibrosis

Institution where the work was prepared: Chang Gung Memorial Hospital, LinKou, Taiwan

Wee-Leon Lam, MD, FRCS; Jung-Ju Huang, MD; Chung-Kai Tsao, MD; Jerry Wu, MD; Hwang-Kai Kao, MD; Ming-Huei Cheng, MD, FACS; Chang Gung Memorial Hospital, LinKou

Introduction:
Oral submucous fibrosis (OSF) is a chronic collagen disorder that affects the buccal mucosa, resulting in a potentially severe trismus with associated speech and nutritional problems. The use of free tissue transfer, particularly with the use of bilateral radial forearm flaps, has proved effective in bilateral buccal reconstruction following trismus release. Initial dissatisfaction with the sacrifice of both radial arteries, however, has led to the technique of harvesting two independent flaps from a single radial forearm. More recently, the ulnar forearm free flap (UFFF) has gained increasing popularity due to its potentially more concealable donor site while combining all the advantages of a forearm flap. Further refinements in our unit have allowed increased versatility of its use and we report our experience of harvesting two small ulnar forearm flaps from a single donor site in the management of OSF.

Methods:
From 2008-2009, a total of sixteen UFFF from eight donor sites were harvested for post-release reconstruction of OSF. All patients underwent release of fibrotic tissues with accompanying myotomy and coronoidotomy if necessary. Outcome assessments were measured in terms of interincisal distance (IID) improvement and patient satisfaction.

Results:
All flaps survived, giving a success rate of 100%. The mean flap size was 3.9 x 7.3 cm, with a mean pedicle length of 5.6 cm after division of the artery to accompany each flap. The mean ischemic time for each flap was 95 minutes. Previous mapping results of septocutaneous perforators at mean distances of 2.9, 5.8 and 9.3 cm from the proximal wrist crease allowed easy harvest and predictability in skin paddle design with desired pedicle lengths. Pre-operative IID averaged 9.8mm (range: 2-18mm). The immediate post-operative IID was 29.8mm and 31.6mm at a mean follow-up of 8 months, representing an overall improvement of 21.8mm. One flap required a vein graft while the others could be directly anastomosed to the facial vessels. Four donor sites required skin grafting, although an overall high satisfaction rate was reported due to the more hidden nature of the ulnar forearm.

Conclusion:
The UFFF is an excellent option for small, shallow head and neck defects such as for resurfacing purposes following release of OSF, with various advantages including ease of harvest and minimal donor morbidity. To date, this is the first report of harvesting two small independent UFFFs from a single donor site to resurface bilateral buccal defects.

The Neck is an Ideal Recipient Site for Composite Tissue Allotransplantation in the Mouse

Institution where the work was prepared: University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Cheng-Hung Lin, MD; Rober Sucher; Yu-Chung Shih; Chih-Hung Lin; Gerald Brandacher; W.P. Andrew Lee; (1)University of Pittsburgh Medical Center, (2)Chang Gung Memorial Hospital, Chang Gung University

Background:
The mouse has its indispensable position in transplantation research. However, because of its much smaller size, the mouse has proven to be a technically difficult and physiologically fragile model. Only a few studies use mice models in composite tissue allotransplantation (CTA) study. The purpose of this study was to report a reproducible and reliable mouse model for future CTA studies.

Materials and Methods:
Forty DBA/2 hindlimb osteomucocutaneous flaps were transplanted to right cervical region of C57BL/6 mice using a non-suture cuff technique. The donor iliac artery and femoral vein were mounted with polyimide cuffs (inner diameter: 0.404 mm, wall thickness: 0.025 mm), then anastomosed to recipient common carotid artery and external jugular vein. Immunosuppressant drugs were used postoperatively.

Results:
The mortality rate was 12.5% (5/40); all resulted from postoperative graft bleeding. But only one arterial insufficiency was encountered after transplantation. The overall success rate was 85.0%. The mean operation time was 2 hours. Long-term allograft survival (> 100 days) can be achieved under specific immunosuppres- sant regimen.

Conclusion:
There are several advantages of this model. Long and sizable vessels with a thicker wall are suitable for anastomosis utilizing cuff technique. A high-flow common carotid artery keeps anastomosis patent, and diastolic suction of the heart reduces the risk of venous stasis and thrombus formation. Finally, less destruction in heterotopic hindlimb transplantation lowers the associated mortality and morbidity in this fragile model.
Breast reconstruction utilizing the transverse rectus myocutaneous (TRAM) flap is the most common method of autologous breast reconstruction performed today. It provides a natural breast mound with minimal morbidity and high patient satisfaction. However, the TRAM flap does not always provide enough volume to match the contralateral breast or achieve patient desires. This situation may be encountered in patients with limited abdominal donor site tissue, especially when TRAM flap harvesting is restricted to the hemi-abdomen. Options for reconstructing this tissue deficiency include implants or additional flaps. Fat grafting, however, offers a less invasive alternative in keeping with the original intent of autologous reconstruction. This technique has been reported to address contour deformities but has not been described for TRAM flap augmentation.

We retrospectively identified 21 patients from 2007 to 2009 who underwent fat injection to address volume deficiency or contour deformities in their TRAM flap reconstructed breasts. Of these, 9 patients underwent a total of 11 episodes of fat grafting specifically for TRAM flap augmentation in 10 breasts (6 deep inferior epigastric perforator flaps and 4 muscle-sparing TRAM flaps). One patient had bilateral TRAM flap augmentation. One patient required 3 separate episodes of fat grafting. The average amount of purified fat injected into each TRAM flap was 87cc with a range of 60 to 115cc. 5 of the 9 patients received radiation therapy prior to TRAM flap reconstruction.

Patient follow-up averaged 227 days (range 3 months to 2 years). There were no complications after the 11 episodes of fat grafting. Specifically, no hematomas, cellulitis, or palpable masses were identified postoperatively. Likewise, there was no suspicion of tumor recurrence on clinical examination and no post-fat grafting biopsies performed. All patients were satisfied with their augmentation. Review of postoperative photographs demonstrated marked improvements in contour and improved symmetry after fat grafting with noticeable improvements in reconstructed breast volumes.

Our preliminary results demonstrate that fat grafting is an excellent option for improvement of breast contour deformities and volume discrepancies following TRAM flap breast reconstruction. This approach reliably facilitates refinement of autologous reconstruction and avoids the use of implants with minimal morbidity.

**A Ten Year Experience with the Use of Microsurgery In the Treatment of Oral Submucous Fibrosis**

Introduction:

Oral submucous fibrosis (OSF) is an insidious, chronic disease of increasing worldwide incidence, characterized by constricting oral collagen bands and resulting potential in a severe trismus with debilitating speech and dental hygiene problems. Although surgery is widely accepted for moderate to severe cases, there is general disappointment with the limitations of existing methods like skin grafts or local flaps, which has resulted in a high degree of recurrence or poor wound healing. Since 1999, a combined approach has been adopted at our institution, including radical release in conjunction with myotomy, coronoidotomy and followed by microsurgical reconstruction using free flaps. We present our ten year experience of this treatment philosophy and how continual refinements of reconstructive options have led to an evolution of techniques to maximize outcome and minimize donor morbidity.

Methods:

Between the period of 1999 to 2009, a total of 72 patients presented for treatment of OSF-related trismus with a mean age of 43 yrs (range 24 to 65). Diagnosis was confirmed via clinical examination and subsequent histological studies. Outcome assessments were measured in terms of improvement in the interincisal distances (IID) and restoration of diet/speech. The types of flap and their various modifications were traced to evaluate the evolution of free tissue transfer for OSF.

Results:

The mean pre-operative IID was 13mm and the immediate post-operative IID was 39mm. At a mean follow up of 22 months, an average IID of 29mm was recorded, demonstrating an improvement of 16mm. The different reconstructive options closely mirrored the evolution of the perforator flap concept, starting with the earliest option of bilateral radial forearm flaps, followed by the harvest of two chimeric forearm flaps on a single pedicle, then two forearm flaps with separate anastomoses at the recipient sites to minimize intra-oral dissections, and finally the most recent introduction with the harvest of two anterolateral thigh flaps from a single donor site in thinner patients.

Conclusion:

To date, our institution remains the only centre worldwide that carries out routine reconstructive microsurgery for this potentially pandemic condition, offering a reliable and effective method of restoring long-term oral competence in the treatment of OSF and also trismus from other causes. Accumulated experience over a ten-year period has allowed development of a variety of options that allows the surgeon to select the best reconstructive strategy for the right patient.
Secondary Microvascular Flap Debulking in the Face using a Microdebrider

Institution where the work was prepared: University of Wisconsin School of Medicine and Public Health, Madison, WI, USA
Ashish Y. Mahajan, MD; The Buncke Clinic; Thomas J. Sitzman, MD; University of Wisconsin School of Medicine and Public Health; Samuel O. Poore, MD, PhD; The Bernard O’Brien Institute of Microsurgery; John W. Stebert, MD; University of Wisconsin

Objective:
We present our preferred method of soft tissue debulking using a microdebrider after microvascular free tissue transfer to the face.

Method:
We reviewed our experience during the past three years using the microdebrider to debulk soft tissue in the face after autologous microvascular free tissue transfer, often for the treatment of facial asymmetry due to conditions such as hemifacial microsomia or atrophy.

Results:
In the care of over 52 patients during the past three years, we have found the microdebrider to be an excellent tool for soft tissue debulking in the face. We have applied the technique in both children and adults to debulk the parascapular flap and inframammary extended circumscapular flap, which are relatively soft, adipose tissues. The technique is less disruptive of the overlying skin and tissue. It has been especially helpful for final contouring of flap tissues “beyond the horizon of vision” with a facelift approach. Thus, transferred flaps can be contoured easily around the mouth in the facial midline without making incisions through the nasolabial fold or lips themselves. Operative times are significantly reduced compared to techniques employed during the previous decade by the senior author. The device is usually available at minimal cost in a surgery center where sinus or orthopedic surgery takes place, a friendly colleague may assist with training, and the technique is relatively quick to learn.

Conclusions:
We feel that the microdebrider is a useful tool in debulking free tissue in the face. The technique allows for variable amounts of resection, precise control, and minimal skin undermining. In the past, options for debulking a flap have included direct excision, liposuction, or curettage, depending on the density of the tissue and extent of debulking planned. The microdebrider has significantly reduced operative times without compromising results. The device has been widely adopted in orthopedic surgery and sinus surgery, plastic surgeons have begun to use it in the treatment of gynecomastia, and it may be useful in other regions of the body as well after free tissue transfer.

Creating Surgically Relevant de novo Tissue Engineered Constructs Using Biocompatible Biodegradable Polymers

Institution where the work was prepared: New York Presbyterian Hospital, Weill-Cornell Medical Center, New York, NY, USA
Alyssa J. Reiffel, MD1; Peter W. Henderson1; Allie M. Sohn1; Alice D. Harper1; Margaret Frey, PhD2; Jason A. Spector1; (1)New York Presbyterian Hospital, Weill-Cornell Medical Center, (2)Cornell University

Background:
Microvascular free tissue transfer (MFTT) is a mainstay of reconstructive surgery. While most patients have multiple candidate donor flaps available for transfer, a significant population lacks appropriate donor tissue. We previously reported a technique for fabricating constructs utilizing sucrose as a sacrificial fiber to form empty channels (a “capillary bed”) within a larger PDMS shell. Our objective is to modify this technique by substituting biocompatible, biodegradable polymers for non-biodegradable PDMS, thereby creating surgically relevant de novo constructs to use in place of autologous tissue for transfer.

Methods:
Various biodegradable polymers were compatibility-tested. From among these combinations, alginate and polylactic acid (PLA) were explored in depth. 2%, 3%, and 4% alginate solutions were mixed with 2% w/v calcium sulfate in a 2:1 ratio and injected into a mold traversed by PLA fibers. Once solidified, constructs were rinsed with calcium chloride solution and allowed to set overnight. The following day, the PLA was sacrificed with chloroform, leaving behind a channel through the hydrogel. Patency and continuity were evaluated by injecting blue dye via the center channel. Next, 4% alginate hydrogel films were Arg-Gly-Asp (RGD) modified. Both modified and unmodified films were seeded with green fluorescent protein (GFP)-tagged human umbilical vein endothelial cells (HUVECs) and imaged 4 days later. Finally, the construct was anastomosed to explanted rat aorta at either end and connected to a perfusion pump.

Results:
Characteristics such as polarity and solubility were evaluated when selecting polymers. Although several combinations were compatible, alginate and PLA were ultimately selected due to their complementary properties; low cost, and availability. While more viscous, 4% alginate was utilized due to the higher tensile strength it afforded the hydrogel. Constructs were created in a manner analogous to our sucrose/PDMS technique. Alginate was unaltered by exposure to chloroform, while PLA dissolved completely, leaving a patent continuous channel within the hydrogel, demonstrated by the flow of blue dye through the center channel. GFP-tagged HUVECs adhered more effectively to RGD-modified alginate films. Lastly, the construct was perfused via the pump without leakage from the anastomosis between the hydrogel and the vessel.

Conclusions:
Using our novel sacrificial technique, we have created surgically relevant de novo constructs and perfused them in a circuit including biologic vessels. Furthermore, we demonstrated that such constructs could be seeded with endothelial cells, theoretically allowing for long-term clot free blood flow. Customizable to any size or shape, we believe such constructs may revolutionize MFTT.
Free Toe Tissue Transfer using Infiltration Method of Local Anesthetic Agent

Institution where the work was prepared: Department of Plastic Surgery, Anam Hospital, Korea University, Seoul, South Korea

Seung Ha Park; Korea University Medical Center; Byung-il Lee, MD; Korea University Hospital

This study was designed to introduce free toe tissue transfer under local anesthesia. Four toe pulp tissues were transferred to reconstruct finger tip defects in four patients who were not suitable for general anesthesia. Four toe pulp tissues were transferred to reconstruct finger tip defects in four patients who were not suitable for general anesthesia. Two flaps taken from the lateral side of the great toe was used for reconstruction of the thumb pulp, and two flaps from the medial side of the second toe were used to resurface the index and the fifth finger. Surgical procedures followed the conventional free toe transfer technique, and pneumatic tourniquet was used intermittently. Flap size ranged from 2.0 x 2.0cm2 to 1.6 x 4.0cm2. 2% lidocaine hydrochloride (with 1:100,000 epinephrine) was used for venous anastomosis. All vessels were anastomosed within 2 cm proximal to the defect margin. Digital nerve was also anastomosed at the digital level as possible, using volar digital nerve or deep peroneal nerve. The entire procedure was carried out by one surgical team and all flaps were successfully taken without any complications. The average operation time was 1 hours 10 minutes. The amount of anesthetic agent used throughout the operation was roughly 4 mL on the toe, 8 mL on the finger, leading to 12 mL in total. In conclusion, free toe tissue transfer under local anesthesia could be a good alternative procedure for patients not suitable for general anesthesia, especially in pulp defect of the thumb and fingers.

Optimizing Filet-of-Leg Reconstruction of External Hemipelvectomy Defects

Institution where the work was prepared: Ohio State University, Columbus, OH, USA

James Herbert Boehmli, MD; Nabil Habash; Joel Mayerson; Ohio State University

For some patients requiring external hemipelvectomy for treatment of pelvic sarcomas, the posterior thigh flap is unavailable and a spare-parts closure can be accomplished with an ipsilateral filet-of-leg free flap. Traditionally this reconstruction is performed in one stage at the time of hemipelvectomy. Significant ischemia time of up to 6 hours is noted with this method which is suboptimal for a musculocutaneous flap. At our institution, three patients have undergone a two stage reconstruction with initial transfer of the filet-of-leg flap to the contralateral femoral vessels three days prior to tumor extirpation. The flap is temporarily closed on itself and is monitored in the intensive care unit. The second stage including hemipelvectomy is subsequently performed and the previously transferred flap is used to close the hemipelvectomy defect. The benefit of this approach is a significantly decreased average ischemia time of only 40 minutes. Our surgical approach since the first case has evolved to debulk the filet-of-leg flap by excising the muscles of the superficial posterior and portions of the deep posterior compartments. This allows for longer pedicle length and improved contour of the flap, particularly over the pubis. All three patients went on to heal well. One patient eventually succumbed to metastatic disease 6 months after hemipelvectomy. This series illustrates how filet-of-leg flap can be optimized and be performed safely, with minimal ischemia time, and provide excellent coverage of these large external hemipelvectomy defects.

Use of an Extracorporeal Membrane Oxygenation (ECMO) Circuit as a Bridge to Salvage a Major Upper Extremity Replant in a Critically Ill Patient

Institution where the work was prepared: Montefiore Medical Center, Bronx, NY, USA

Patrick J. Greaney, MD; Michael Cardisco, CCP; Daniel Rodriguez, CCP; Jordanna Newberger, CCP; Alan D. Legatt, MD, PhD; Evan Garfein, MD; Montefiore Medical Center

Purpose:

Selection of appropriate candidates for major upper extremity replantation of the upper extremity is complex and requires consideration of many patient and injury associated factors. Herein we describe the use of an extracorporeal membrane oxygenation (ECMO) circuit as a bridge for short term preservation of the extremity in a young patient with an acute, concomitant systemic illness. In the authors’ opinion, use of ECMO perfusion is a viable means of maintaining extremity perfusion over hours or days and may lead to broadened replant criteria in patients with associated injuries.

Case report:

A 19 year-old, right-hand dominant female presented after being ejected as an unrestrained rear seat passenger from a car. The patient sustained an amputation of the right upper extremity at the level of the proximal humerus. Although replantation was performed, the patient suffered a cardiac arrest postoperatively as a result of a transfusion reaction. Cardiopulmonary resuscitation was successful, however, with ongoing blood/capillary fluid loss from the extremity in the face of hemodynamic instability, the decision was made to clamp the reconstructed blood vessels supplying the replanted extremity.

Due to the age of the patient and since an identifiable cause for the arrest had been found and addressed, an ECMO circuit was deemed a possible means to preserve the extremity while the patient was stabilized. The extremity remained connected to the ECMO circuit for approximately 72 hours and was cooled to approximately thirty degrees Fahrenheit to decrease metabolic demand. Hand and finger viability, as determined by capillary refill, remained excellent during the duration.

Conclusions:

While achieving functional recovery in the replanted upper extremity can be challenging, the associated morbidity related to the loss of an extremity is significant. Every effort should be made to reattach the arm of a young patient, especially if restoration of function is possible. Nevertheless, replantation efforts should not jeopardize the chances of survival of the patient. In the case of patients who have significant concomitant injuries, replantation may have to be delayed until the patient is stable enough to undergo a lengthy procedure that is accompanied by major blood loss and a high transfusion requirement. This delay may extend beyond the time limit for replantation due to irreversible muscle and nerve ischemia. The use of extracorporeal circulation is possible in this situation and may provide a means to extend the time-window for replantation of the extremity in the setting of the unstable patient.
Perioperative Fluid Considerations to Minimize Early Postoperative Complications in Free Flap Breast Reconstruction

In total, 285 patients received 375 free flap reconstructions of the breast. A total of 63 patients (22%) had early post-operative complications including 52 surgical complications (13.9%) with 3 total flap losses in this series. Venous thromboembolism (DVT/PE) was the most common medical complication (1.4%). Univariate analysis revealed that total crystalloid infusion volume/kg for the first 24 hours was a significant independent risk factor for postoperative complications (p = 0.013). The final multivariate regression model showed that after controlling for the type of flap and effect of other covariates such as a cardiac risk factor, both BMI and volume of crystalloid infused/kg were all significantly related to postoperative complications(p = 0.0418 and 0.0102 respectively) (Table 1). Furthermore, we

<table>
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<th>95% Wald Confidence Limits</th>
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Table 1: Multivariate Analysis of Factors Associated with Postoperative Complications
found that a statistically significant quadratic relationship existed between the volume of perioperative fluid infusion and risk of complication (Figure 1).

Conclusions:
This is the first study to show that a modifiable variable such as perioperative fluid management is related to early post-operative complications in breast free flap reconstruction surgery.

Figure 1: Parabolic relationship is found between crystalloid infusion volume and complications when BMI is set to the median value of 26.24.
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January 13 – 15, 2012

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  Thursday, January 13, 2:30 PM to 3:30 PM

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