Annual Meeting
September 20 - 22, 2012
FINAL PROGRAM
Tampa Marriott Waterside Hotel & Marina
Tampa, Florida

Local Host: Douglas Letson, MD
MSTS President: Edward Y. Cheng, MD
THANK YOU

The Musculoskeletal Tumor Society
greatly appreciates your support of the 2012 MSTS Annual Meeting.
Your funding is vital and will advance the medical science
and care of patients with bone and soft tissue tumors.

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Cameras or video cameras may not be used in any portion of the meeting.
Educational Goals and Objectives

At the conclusion of this CME activity, the attendee should be able to:
1. Describe the progress in basic science research in musculoskeletal and connective tissue oncology
2. Identify new and emerging molecular targets to exploit in therapeutic strategies;
3. Cite the success rates of existing treatments for bone and soft tissue sarcomas;
4. Be familiar with the new and emerging technologies in the treatment of musculoskeletal tumors;
5. Describe advances in imaging and surgical management of connective tissue tumors;
6. Discuss the benefits of multidisciplinary input when formulating treatment plans;
7. Formulate a differential diagnosis for bone and soft tissue masses.

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Dear Colleagues and Guests:

Welcome to the MSTS Annual Meeting being held for the first time in sunny Tampa, Florida. The keen interest level in this year’s meeting is multi-institutional studies. Given the broad spectrum of expertise represented, we hope to challenge you by stimulating your learning about both familiar and perhaps not so familiar topics. We hope the environment will be ripe for the cross pollination of ideas and concepts that is so vital to spawning new discoveries.

Additional highlights include our Founders lecture by Jeffrey Eckardt who has keen insight and pioneers limb salvage surgery with segmental prosthesis. Don’t forget to use your skills to win a coveted iPad by entering the Stump the Professor contest and diagnosing the “unknown” cases. We will also have a special session on new technologies in the musculoskeletal tumor field and a session from the Moffitt Cancer Center sarcoma research laboratory.

We hope you will enjoy the centralized venue for our meeting in Tampa. While many of you have not been here before, undoubtedly you will enjoy the southern hospitality of our city. It’s especially true for Friday evening’s dinner at the most famous restaurant in Tampa, the Columbia Restaurant featuring the famous flamingo dancers.

Finally, we extend our thanks to all those who make this meeting possible. It would not be possible without the work of the Musculoskeletal Tumor Society and scholars who submitted their work, our excellent administrative team of Barbara Rapp and Jennifer Abner, and our generous sponsors.

Enjoy the meeting!

Sincerely,
Edward Y. Cheng, MD, MSTS President
Douglas Letson, MD, Program Chair
H. Thomas Temple, MD, Program Co-Chair
Francis J. Hornicek, MD, Program Co-Chair
Pietro Ruggieri, MD, Program Co-Chair
### MSTS Annual Meeting History

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Local Hosts &amp; Program Chairs:</th>
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<tbody>
<tr>
<td>1977</td>
<td>Boston, MA</td>
<td>Hugh G. Watts, Henry J. Mankin</td>
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<tr>
<td>1979</td>
<td>Houston, TX</td>
<td>John Murray</td>
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<td>1980</td>
<td>Gainesville, FL</td>
<td>William F. Enneking</td>
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<td>1981</td>
<td>Iowa City, IA</td>
<td>Michael Bonfiglio</td>
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<td>1982</td>
<td>New York, NY</td>
<td>Joseph M. Lane</td>
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<td>1983</td>
<td>Cleveland, OH</td>
<td>John T. Makley</td>
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<td>1984</td>
<td>Kansas City, KS</td>
<td>James R. Neff</td>
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<td>1985</td>
<td>San Francisco, CA</td>
<td>Theodore Boville, James R. Johnston</td>
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<td>1986</td>
<td>Bologna, Italy</td>
<td>Mario Campanacci (cancelled)</td>
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<td>1987</td>
<td>Toronto, ON</td>
<td>Fred Langer</td>
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<td>1988</td>
<td>Minneapolis, MN</td>
<td>Roby C. Thompson</td>
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<td>1989</td>
<td>Bologna, Italy</td>
<td>Mario Campanacci</td>
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<td>1990</td>
<td>Chicago, IL</td>
<td>Michael A. Simon</td>
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<td>1991</td>
<td>Buffalo, NY</td>
<td>Eugene R. Mindell</td>
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<td>1992</td>
<td>Boston, MA</td>
<td>Dempsey Springfield, Henry J. Mankin, Mark C. Gebhardt</td>
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<td>1993</td>
<td>Houston, TX</td>
<td>John Murray</td>
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<td>1995</td>
<td>Florence, Italy</td>
<td>Rudolfo Campana, Dempsey S. Springfield</td>
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<td>1996</td>
<td>Seattle, WA</td>
<td>Ernest U. Conrad</td>
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<td>1997</td>
<td>Cleveland, OH</td>
<td>John C. Makley</td>
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<td>1999</td>
<td>Denver, CO</td>
<td>Ross M. Wilkins, Stephen J. Withrow</td>
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<td>2000</td>
<td>Gainesville, FL</td>
<td>B. Hudson Berrey, William F. Enneking, Mark T. Scarborough</td>
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<td>2001</td>
<td>Baltimore, MD</td>
<td>Albert J. Aboulafia &amp; Alan M. Levine</td>
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<tr>
<td>2002</td>
<td>Toronto, ON, Canada</td>
<td>Robert S. Bell, Christopher P. Beauchamp, Norman S. Schachar, Robert E. Turcotte</td>
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<tr>
<td>2003</td>
<td>Chicago, IL</td>
<td>Terrance D. Peabody, Steven Gitelis, Robert Satcher</td>
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<td>2004</td>
<td>Long Beach, CA</td>
<td>Jeffrey J. Eckardt, Erik N. Zeegan, J. Dominic Femino, Lawrence R. Menendez, R. Lor Randall, J. Michael Kabo</td>
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<td>2005</td>
<td>Nashville, TN</td>
<td>Herbert S. Schwartz, Ginger E. Holt</td>
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<td>2006</td>
<td>Key West, FL</td>
<td>Mary I. O’Connor, William G. Ward</td>
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<td>2007</td>
<td>St. Louis, MO</td>
<td>Douglas McDonald, Timothy Damron, Kristy Weber</td>
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<td>2008</td>
<td>Phoenix, AZ</td>
<td>Christopher P. Beauchamp, Bruce A. Malin, Albert Aboulafia</td>
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<td>2009</td>
<td>Boston, MA</td>
<td>Edward Y. Cheng, J. Sybil Biermann</td>
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<td>2010</td>
<td>Philadelphia, PA</td>
<td>Richard D. Lackman, Albert J. Aboulafia</td>
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<td>2011</td>
<td>Chicago, IL</td>
<td>Edward Cheng, J. Sybil Biermann, Richard Gorlick, Poul Sorenson</td>
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</table>

### Future MSTS Meetings

**2013 Specialty Day**
McCormick Place, Chicago, IL  
*March 23, 2013*  
Program Chair: Michael P. Mott, MD;  
Co-Chair: Robert H. Quinn, MD

**2013 Annual Meeting:**  
Hyatt Regency, San Francisco, CA  
*October 3 - 5, 2013*  
Program Chair: Richard J. O’Donnell, MD;  
President: John H. Healey, MD
2012 MSTS Program at a Glance

Thursday, September 20, 2012

12:00 p.m. – 3:00 p.m.  Grand Salons F - J  Executive Committee Meeting
2:00 p.m. – 5:30 p.m.  Grand Salon Foyer  Registration
2:00 p.m. – 5:30 p.m.  Grand Salon Foyer  Technical Exhibit Set-up
2:00 p.m. – 5:30 p.m.  Grand Salons A - E  Poster Exhibit Set-up
5:00 p.m. – 7:00 p.m.  Patio  Welcome Reception

Friday, September 21, 2012

6:30 a.m. – 8:00 a.m.  Grand Salons A - E  Continental Breakfast
7:00 a.m. – 5:00 p.m.  Grand Salon Foyer  Registration
7:00 a.m. – 5:30 p.m.  Grand Salon Foyer/Salons A - E  Technical / Poster Exhibits
7:00 a.m. – 5:30 p.m.  Grand Salons F - J  Speaker Ready Desk
7:45 a.m. – 4:45 p.m.  Meeting Room 12  PA / ARNP / Allied Health Scientific Session
8:00 a.m. – 8:10 a.m.  Grand Salons F - J  Opening Remarks and Welcome, Douglas Letson, MD
8:10 a.m. – 10:00 a.m.  Grand Salons F - J  SESSION I – NAVIGATION/MARGINS/PELVIS/SOFT TISSUE SARCOMA
10:00 a.m. – 10:20 a.m.  Grand Salon Foyer/Salons A - E  Break – Technical / Poster Exhibits
10:20 a.m. – 12:00 p.m.  Grand Salons F - J  SESSION II – GENETICS/COMPLICATIONS
12:00 p.m. – 1:00 p.m.  Grand Salons A - E  Lunch
1:00 p.m. – 2:00 p.m.  Grand Salons F - J  NEW TECHNOLOGY SCIENTIFIC SESSION
2:00 p.m. – 3:00 p.m.  Grand Salons F - J  MOFFITT CANCER CENTER SCIENTIFIC SESSION
3:00 p.m. – 3:30 p.m.  Grand Salon Foyer/Salons A - E  Break - Technical / Poster Exhibits
3:30 p.m. – 5:30 p.m.  Grand Salons F - J  SESSION III – IMAGING/METASTATIC DISEASE/PEDIATRIC RECONSTRUCTION/RADIATION
7:00 p.m. – 11:00 p.m.  Columbia Restaurant  Dinner & Dancing

Saturday, September 22, 2012

6:00 a.m.  Fun Run
6:30 a.m. – 8:00 a.m.  Grand Salons A - E  Continental Breakfast
7:00 a.m. – 8:00 a.m.  Grand Salons F - J  Business Meeting (Open to all members)
7:00 a.m. – 12:30 p.m.  Grand Salon Foyer/Salons A - E  Technical / Poster Exhibits
7:00 a.m. – 12:30 p.m.  Grand Salons F - J  Speaker Ready Desk
7:00 a.m. – 5:00 p.m.  Grand Salon Foyer  Registration
8:00 a.m. – 9:30 a.m.  Grand Salons F - J  SESSION IV – YOUNG INVESTIGATORS
9:30 a.m. – 10:00 a.m.  Grand Salon Foyer/Salons A - E  Break – Technical / Poster Exhibits
10:00 a.m. – 11:00 a.m.  Grand Salons F - J  SESSION V – MULTI-INSTITUTIONAL
11:00 a.m. – 12:00 p.m.  Grand Salons F - J  FOUNDER'S LECTURE – Jeffrey J. Eckardt, MD
12:00 p.m. – 12:30 p.m.  Grand Salons F - J  Young Investigator Award
12:30 p.m.  Grand Salons F - J  Closing Statements
GENERAL INFORMATION

Meeting

Date: September 20 – 22, 2012

Venue: Tampa Marriott Waterside Hotel and Marina
700 S. Florida Avenue, Tampa, Florida, USA 33602 (813) 221-4900

Website: www.MSTS.org

Meeting Host: Douglas Letson, MD

Meeting Management: Jennifer M. Abner, CMP
Logistics, LLC
info@jenniferabnerlogistics.com

Registration

The MSTS Registration Desk is located in the Grand Salon Foyer of the Tampa Marriott Waterside Hotel.

Registration Fees:

- MSTS Member ......................................... $475
- Nonmember ........................................... $600
- Resident / Fellow / Nurse ....................... $275
- Friday Night Dinner Guest....................... $150

Registration fees include: scientific program materials, event transportation, Welcome Reception, Friday Dinner/Dance, two breakfasts, one lunch and all refreshment breaks.

CME

10.75 CME credits will be available for this meeting. Please see inside back cover.

Evaluation Forms

Please return evaluation forms to the MSTS Registration Desk (Grand Salon Foyer) by Saturday, September 22.

Certificate of Attendance

Certificates will be distributed at Registration to all registered attendees onsite at the 2012 MSTS Annual Meeting.
Presenter Information

A technician will be available onsite Friday and Saturday, September 21 - 22 in the Grand Salons F-J to accept materials for the oral presentations. Presenters are required to submit their presentation to the technician at least 3 hours prior to their presentation via USB drive. Please have abstract labeled with both title and session name.

IMPORTANT: The Speaker Ready Desk is NOT equipped with laptops and printers for review of presentations. The technician on staff will only accept presentations delivered via CD-ROM and USB drive.

Hours of Operation

Friday, September 21 .............. 7:00 a.m. – 5:30 p.m.
Saturday, September 22 ........... 7:00 a.m. – 12:30 p.m.

Scientific Poster Exhibition

The scientific poster exhibition will be held in the Grand Salons A - E. The poster session exhibition schedule is as follows:

Friday, September 21 .............. 7:00 a.m. – 5:30 p.m.
Saturday, September 22 ........... 7:00 a.m. – 12:30 p.m.

MSTS Technical Exhibits

The MSTS Tabletop Exhibition will be held in the Grand Salon Foyer during all breakfasts, morning and afternoon refreshment breaks and luncheons.

The exhibition will open at 7:00 a.m. on Friday, September 21, 2012.

The following companies are participating in the MSTS Exhibition: Acumed
Advanced Biologics
Bacterin
Baxter
Biomet
CarboFix Orthopedics, Inc.
Cura Surgical, Inc.
DePuy, A Johnson & Johnson Co.
Exactech, Inc.
Merete Medical, Inc.
Moffitt Cancer Center
Musculoskeletal Transplant Foundation
Skeletal Kinetics
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The Musculoskeletal Tumor Society
and The Orthopaedic Research and Education Foundation
Wish to thank the following:

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Jose E. Jaen, MD
James O. Johnston, MD
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L. Daniel Wurtz, MD

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Brian E. Brigman, MD
Edward Y. Cheng, MD
Felix H. Cheung, MD
Mr. and Mrs. Kenneth Chirba
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Richard J. O’Donnell, MD
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Francis R. Patterson, MD
Kevin A. Raskin, MD
Joshua C. Patt, MD
Dempsey S. Springfield, MD
Richard M. Terek, MD
Wakenda Tyler, MD
William G. Ward, MD
Kristy Weber, MD
Ronald P. Williams, MD, PhD
Henock T. Wolde-Semait, MD
L. Daniel Wurtz, MD

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Gary E. Friedlaender, MD
Mark C. Gebhardt, MD
John H. Healey, MD
Thomas A. Lange, MD
Alan M. Levine, MD †
George F. Muschler, MD
Mary I. O’Connor, MD
Regis J. O’Keefe, MD, PhD
Theodore W. Parsons III, MD, FACS
Randy N. Rosier, MD, PhD
Michael A. Simon, MD
Kimberly J. Templeton, MD
Kristy Weber, MD
Michael J. Yaszemski, MD, PhD

† = deceased
Thursday, September 20, 2012

12:00 p.m. - 3:00 p.m.  Executive Committee Meeting
2:00 p.m. - 5:30 p.m.  Registration
2:00 p.m. - 5:30 p.m.  Poster Exhibit Set-up
                      Technical Exhibit Set-up
5:00 p.m. - 7:00 p.m.  Welcome Reception
                      (Dinner on your own)

Friday, September 21, 2012

6:30 a.m. - 8:00 a.m. Continental Breakfast
7:00 a.m. - 5:30 a.m. Technical / Poster Exhibits
7:00 a.m. - 5:00 p.m. Registration
7:45 a.m. - 4:45 p.m. PA/ARNP/Allied Health Scientific Session
8:00 a.m. - 8:10 a.m. Welcome
                      Douglas Letson, MD

KEY:  Names in boldface = Presenter
See pages 167 - 176 for financial disclosure index.
♦ Indicates the FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an “off label” use).
• FDA information not available at the time of printing.  For full information, refer to inside back cover.
8:10 a.m. - 10:00 a.m.  
**SESSION I – Navigation/Margins/Pelvis/Soft Tissue Sarcoma**

**Moderators:** David Cheong, MD,  
Moffitt Cancer Center, Tampa, FL  
Francis Hornicek, MD, PhD,  
Massachusetts General Hospital, Boston, MA  
Brian E. Brigman, MD, PhD,  
Duke University, Durham, NC  
Ricardo Gonzalez, MD,  
Moffitt Cancer Center, Tampa, FL  
Carol D. Morris, MD,  
Memorial Sloan Kettering Cancer Center, New York, NY  
Edward Y. Cheng, MD,  
University of Minnesota, Minneapolis, MN

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8:10 a.m.  
**Paper #1**  
**p. 27**  
**COMPUTER ASSISTED NAVIGATION FOR BONE TUMOR RESECTION: EARLY EXPERIENCE IN A SINGLE INSTITUTION**  
*German L. Farfalli; Luis Aponte-Tinao, MD; Lucas Ritacco; Miguel Ayerza, MD; D. Luis Muscolo, MD*  
Orthopedics, Italian Hospital of Buenos Aires, Buenos Aires, Argentina

8:20 a.m.  
**Paper #2**  
**p. 28**  
♦ **COMPUTER ASSISTED LIMB SALVAGE RESECTION AND RECONSTRUCTION USING A HANDS-ON SCULPTOR ROBOT**  
*Paul Unwin, PhD1; Matjaz Jakopec, PhD1; Sudha Shunmungam, MEng1; Justin Cobb, MCh (Oxon) FRCS2*  
1Stanmore Implants Worldwide Ltd, Elstree, United Kingdom;  
2Orthopaedic Surgery, Imperial College London, Charing Cross Hospital, London, United Kingdom

8:30 a.m.  
**Paper #3**  
**p. 29**  
**NAVIGATION TO DOCUMENT BONE TUMOR RESECTIONS AND IMPROVE SURGICAL MARGINS**  
*Antoinette W. Lindberg, MD1; Jennifer S. Barr, MD2; Jed K. White2; Stephanie Punt3; Darin Davidson, MD1; Ernest U. Conrad, MD3*  
1Orthopaedics and Sports Medicine, University of Washington, Seattle, WA, USA;  
2Orthopedics and Sports Medicine, University of Mississippi, Jackson, MS, USA;  
3Orthopedics and Sports Medicine, Seattle Children’s Hospital, Seattle, WA, USA

8:40 a.m.  
**Paper #4**  
**p. 31**  
**BONE MARROW MARGINS IN RESECTION FOR SARCOMA OF BONE: ASSESSMENT OF INTRAOPERATIVE CONSULTATIVE PRACTICE WITH IMPLICATIONS FOR PROCESS IMPROVEMENT**  
*Megan E. Anderson, MD1; Kelsey Van Nostrand, BS1; Sara O. Vargas, MD2*  
1Orthopaedic Surgery, Children’s Hospital Boston, Boston, MA, USA;  
2Pathology, Children’s Hospital Boston, Boston, MA, USA

---

See pages 167 - 176 for financial disclosure index.
8:50 a.m.  p. 32  INFECTION IN PELVIC RESECTIONS FOR BONE TUMORS WITH OR WITHOUT RECONSTRUCTION
Pietro Ruggieri, MD, PhD; Andrea Angelini, MD; Elisa Pala, MD; Gabriele Drago, MD; Nicola Fabbri, MD; Douglas Letson, MD, PhD
1IV Department of Orthopaedics, Istituto Ortopedico Rizzoli, Bologna, Italy; 2Orthopedics, Moffitt Cancer Center, Tampa, FL, USA

9:00 a.m.  p. 33  HEMIPELVIC ALLOGRAFT RECONSTRUCTION: AN UPDATE TO THE MASSACHUSETTS GENERAL HOSPITAL EXPERIENCE
Zachary A. Child, MD; Joseph Schwab, MD; Mark Gebhardt, MD; Francis Hornicek, MD, PhD; Ernest U. Conrad, MD
1Orthopaedic Surgery, Massachusetts General Hospital, Boston, MA, USA; 2Orthopaedic Surgery, Beth Israel Deaconess, Boston, MA, USA

9:10 a.m.  p. 34  CHALLENGES OF ACETABULAR PELVIC RESECTION EXCEED NON ACETABULAR RESECTION
Stephanie Punt; Calvin L. Schlepp, BS; Jed K. White; Antoinette W. Lindberg, MD; Darin Davidson, MD; 1Orthopaedics and Sports Medicine, University of Washington, Seattle, WA, USA; 2Orthopedics and Sports Medicine, Seattle Children’s Hospital, Seattle, WA, USA

9:20 a.m.  p. 36  SKELETAL AND EXTRASKELETAL MESENCHYMAL CHONDROSARCOMA: A REVIEW OF 37 CASES
Satoshi Kawaguchi, MD; Israel Weiss, MD; Patrick P. Lin, MD; Winston W. Huh; Bryan S. Moon, MD; Robert L. Satcher, MD, PhD; Valerae O. Lewis, MD
1Orthopaedic Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA; 2Pathology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA; 3Pediaterics, The University of Texas MD Anderson Cancer Center, Houston, TX, USA

9:30 a.m.  p. 37  DEDDIFFERENTIATED CHONDROSARCOMA: A SINGLE-INSTITUTION REVIEW OF 41 CASES
Satoshi Kawaguchi, MD; Tao Sun; Patrick P. Lin, MD; Michael Deavers; Bryan S. Moon, MD; Robert L. Satcher, MD, PhD; Alberto G. Ayala; Valerae O. Lewis, MD
1Orthopaedic Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA; 2Pathology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA; 3Pathology, The Methodist Hospital, Houston, TX, USA

9:40 a.m.  p. 38  EPITHELIOID HEMANGIOMA OF THE SPINE: A CASE SERIES OF SIX PATIENTS AND REVIEW OF THE LITERATURE
Francis Hornicek, MD, PhD; Petur Nielsen, MD; Thomas Delaney, MD; Frank X. Pedlow, MD; Frederick Mansfield, MD; Carles Carrier; Spencer G. Dauer, BA; Joseph Schwab, MD
Orthopaedic Spine/Oncology, Massachusetts General Hospital, Boston, MA, USA

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<th>Time</th>
<th>Event</th>
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<tr>
<td>9:50 a.m.</td>
<td><strong>Paper #11</strong> AMPUTATION FOR EXTREMITY SOFT TISSUE SARCOMA DOES NOT INCREASE OVERALL SURVIVAL: A RETROSPECTIVE COHORT STUDY</td>
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<td></td>
<td>Vignesh K. Alamanda; Samuel N. Crosby; Kristin R. Archer; Yanna Song; Jennifer L. Halpern, MD; Herbert S. Schwartz, MD; Ginger E. Holt, MD</td>
</tr>
<tr>
<td></td>
<td>1Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, TN, USA;</td>
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<td>2Department of Biostatistics, Vanderbilt University Medical Center, Nashville, TN, USA</td>
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<td>10:00 a.m. - 10:20 a.m.</td>
<td><strong>Coffee Break Technical / Poster Exhibits</strong></td>
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<td>10:20 a.m. - 12:00 p.m.</td>
<td><strong>SESSION II – Genetics/Complications</strong></td>
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<td><strong>Moderators:</strong> R. Lor Randall, MD, FACS, Huntsman Cancer Institute, Salt Lake City, UT</td>
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<td>C. Parker Gibbs, MD, University of Florida, Gainesville, FL</td>
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<td>Albert J. Aboulafia, MD, FACS, MBA, Cancer Institute Sinai Hospital, Baltimore, MD</td>
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<td>Sheila A. Conway, MD, University of Miami, Miller School of Medicine, Miami, FL</td>
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<td>Nicola Fabbri, MD, Instituto Ortopedico Rizzoli, Bologna, Italy</td>
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<td>Hudson Berry, MD, University of Florida, Gainesville, FL</td>
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<td>10:20 a.m.</td>
<td><strong>Paper #12</strong> INHIBITION OF SYT-SSX ONCOPROTEIN BY ANTISENSE OLGODEOXYNUCLEOTIDES INHIBITS CELL VIABILITY IN SYNOVIAL SARCOMA</td>
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<td>Emily E. Carmody Soni, MD; Aykut Uren; Jeffery A. Toretsky</td>
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<td>1Orthopaedic Oncology, Medstar Georgetown Orthopaedic Institute, Washington, DC, USA;</td>
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<td>2Oncology, Georgetown University, Washington, DC, USA</td>
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<td>10:30 a.m.</td>
<td><strong>Paper #13</strong> EWS/FLI-RESPONSIVE GGAA-MICROSATELLITES EXHIBIT POLYMORPHIC DIFFERENCES BETWEEN EUROPEAN AND AFRICAN POPULATIONS</td>
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<td>Michael J. Monument, MD; R. Lor Randall, MD, FACS</td>
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<td>Stephen L. Lessnick, MD, PhD</td>
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<td>1Sarcoma Services; Department of Orthopaedic Surgery, Huntsman Cancer Institute; University of Utah, Salt Lake City, UT, USA;</td>
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<td>2Oncological Sciences, Huntsman Cancer Institute; University of Utah, Salt Lake City, UT, USA</td>
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See pages 167 - 176 for financial disclosure index.
10:40 a.m.  p. 43  
**Paper #14**

**A MOLECULAR SIGNATURE OF THE NEOPLASTIC PROPERTIES OF PTHRP IN GIANT CELL TUMOR OF BONE**

*Isabella Mak*¹; Robert E. Turcotte, MD, FRCSC²; Michelle Ghert, MD, FRCSC¹

¹Surgery, McMaster University, Hamilton, ON, Canada;  
²Orthopaedic Surgery, McGill University Health Centre, Montreal General Hospital, Quebec, QC, Canada

10:50 a.m.  p. 45  
**Paper #15**

**INTRONIC SINGLE NUCLEOTIDE POLYMORPHISM (SNP) OF CALM-1 GENE IS SIGNIFICANTLY ASSOCIATED WITH OSTEOARTHRITIS KNEE: A CASE CONTROL STUDY**

*Rajeshwar N. Srivastava, MD*¹; *Divya Sanghi, PhD Scholar*¹;  
*Saloni Raj, MBBS Scholar*²

¹Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India;  
²Orthopaedic Surgery, MS Ramaiah Medical College, Bangalore, India

11:00 a.m.  p. 46  
**Paper #16**

**ETHNICITY AND AGE DISPARITIES IN EWING SARCOMA OUTCOME**

*Bianca Koohbanani*¹; *Gang Han*¹; *Damon Reed, MD*¹; *Evita Henderson, MD*¹;  
*Ding Yi, MD*²; *Pietro Ruggieri, MD, PhD*³; *Marilyn M. Bui, MD, PhD*¹

¹Anatomic Pathology, Moffitt Cancer Center, Tampa, FL, USA;  
²Biostatistics Core, Moffitt Cancer Center, Tampa, FL, USA;  
³Sarcoma, Moffitt Cancer Center, Tampa, FL, USA;  
⁴Honors College and Project “Inspire” at Moffitt Cancer Center, University of South Florida, Tampa, FL, USA;  
⁵Pathology, Beijing JiShuiTan Hospital, Beijing, China;  
⁶Orthopaedics, Rizzoli Institute, Bologna, Italy

11:10 a.m.  p. 47  
**Paper #17**

**POST RADIATION BONE SARCOMA: A SINGLE INSTITUTIONAL EXPERIENCE ON 45 CASES**

*Pietro Ruggieri, MD, PhD*¹; *Elisa Pala, MD*¹; *Andreas F. Mavrogenis, MD*¹;  
*Andrea Angelini, MD*¹; *Carlo Romagnoli, MD*¹; *Douglas Letson, MD, PhD*²

¹IV Department of Orthopaedics, Istituto Ortopedico Rizzoli, Bologna, Italy;  
²Orthopedics, Moffitt Cancer Center, Tampa, FL, USA

11:20 a.m.  p. 48  
**Paper #18**

**HIGH FAILURE RATE OF INTERNAL FIXATION OF PATHOLOGIC FRACTURES OF THE FEMUR FOLLOWING SOFT TISSUE SARCOMA RESECTION AND RADIATION THERAPY**

*Amir Sternheim; Jasjit Lochab, MD; Patrick O’Donnell, MD, PhD; William Eward, MD; Anthony Griffin; Jay S. Wunder, MD; Peter C. Ferguson, MD, MSC, FRCSC*  
*Mount Sinai Hospital, Toronto, ON, Canada*

11:30 a.m.  p. 49  
**Paper #19**

**SILVER NEGATIVE PRESSURE DRESSING WITH VACUUM-ASSISTED CLOSURE OF MASSIVE SOFT TISSUE LOSS INVOLVING THE PELVIS AND EXTREMITIES**

*Herrick J. Siegel, MD; Brad Culotta, MD*  
*Orthopaedic Surgery, UAB, Birmingham, AL, USA*

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• FDA information not available at the time of printing. For full information, refer to inside back cover.
Friday, September 21, 2012

11:40 a.m.  p. 50 ♦ HUMAN ACELLULAR DERMAL MATRIX WRAPPING OF COMPLEX KNEE RECONSTRUCTIONS MINIMIZES DEEP INFECTIONS AND ALLOWS FOR EXCELLENT RANGE OF MOTION WITH PROLONGED IMMOBILIZATION

David King, MD; Robert Whitfield, MD; Eric L. Barker, BS; John C. Neilson; Donald A. Hackbarth, MD

1Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA; 2Plastic and Reconstructive Surgery, Medical College of Wisconsin, Milwaukee, WI, USA

11:50 a.m.  p. 51 ABDUCTOR DEFICIENCY TREATED WITH A GLUTEUS MAXIMUS ROTATIONAL FLAP

Herrick J. Siegel, MD; Justin Duke, MD

Orthopaedic Surgery, UAB, Birmingham, AL, USA

12:00 p.m. - 1:00 p.m.  Lunch

1:00 p.m. - 2:00 p.m. NEW TECHNOLOGY SCIENTIFIC SESSION

Notes p. 52

Moderator: Douglas Letson, MD,
Moffitt Cancer Center, Tampa, FL

1:00 p.m.  RADIONOMICS

Robert Gillies, PhD

Chair, Department of Cancer Imaging and Metabolism
Vice-Chair, Department of Radiology
Co-Director, Experimental Therapeutics Program
Moffitt Cancer Center, Tampa, FL

1:20 p.m.  Discussion

1:30 p.m.  NAVIGATION

Edward Y. Cheng, MD

University of Minnesota, Minneapolis, MN

1:50 p.m.  Discussion

See pages 167 - 176 for financial disclosure index.
2:00 p.m. - 3:00 p.m.
MOFFITT CANCER CENTER SCIENTIFIC SESSION
Moderators: Francis Hornicek MD, PhD
Massachusetts General Hospital, Boston, MA
Douglas Letson, MD
Executive Vice President & Physician-in-Chief
Moffitt Cancer Center, Tampa, FL

2:00 p.m.  SARCOMA VACCINE
Anthony Conley, MD
Assistant Member Moffitt Cancer Center,
Sarcoma Program Medical Oncology, Tampa, FL

2:10 p.m.  SARCOMA MOLECULAR ONCOLOGY
W. Jackson Pledger, PhD
Deputy Center Director, Moffitt Cancer Center, Tampa, FL

2:20 p.m.  SARCOMA PROTEOMICS
Soner Altiok, MD
Associate Member, Anatomic Pathology, Moffitt Cancer Center, Tampa, FL

2:30 p.m.  LIMB INFUSION
Rick Gonzalez, MD
Associate Member, Moffitt Cancer Center, Tampa, FL

2:40 p.m.  TOTAL CANCER CARE
Damon Reed, MD
Associate Member, Moffitt Cancer Center,
Sarcoma Program Medical Oncology, Tampa, FL

2:50 p.m.  Discussion

3:00 p.m. - 3:30 p.m.  Coffee Break Technical / Poster Exhibits

♦ Indicates the FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an “off label” use).
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<th>Time</th>
<th>Session</th>
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<tr>
<td>3:30 p.m.</td>
<td>SESSION III – Imaging/Metastatic Disease/Pediatric Reconstruction/Radiation</td>
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<td>3:30 p.m.</td>
<td>NOVEL METHODS TO DETECT PRIMARY OSTEOSARCOMA GROWTH IN A MURINE MODEL</td>
<td>p. 54</td>
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<td>Herbert S. Schwartz, MD</td>
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<td>; Heather Cole; Jiro Ichikawa, MD; Jeffry Nyman, PhD;</td>
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<td>THREE-DIMENSIONAL (3D) BIOLUMINESCENCE CT IMAGING OF ORTHOTOPIC OSTEOSARCOMA MOUSE MODELS</td>
<td>p. 55</td>
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<td>Chandhanarat Chandhanayingyong, MD; Saqib Nizami; Won Seok Song, MD;</td>
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<td>Alexander Klose, PhD; Yared Tekabe, PhD; Francis Y. Lee, MD, PhD</td>
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<td>2Department of Radiology, Columbia University, New York, NY, USA</td>
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<td>3:50 p.m.</td>
<td>WHOLE BODY MAGNETIC RESONANCE IMAGING IN COMPARISON TO WHOLE BODY BONE SCINTIGRAPHY FOR THE DETECTION OF METASTASES IN PATIENTS WITH PRIMARY BONE TUMOURS</td>
<td>p. 56</td>
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<td>Elizabeth Gillott, MRCS, MBBS; Stephen Ng Man Sun, MBBS MRCS; Jonathan R. Perera; Michelle Calleja; Philippa Tyler; Sajid Butt; Asif Saifuddin; Rob Pollock; John Skinner; Will Aston; Tim W. Briggs</td>
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<td>London Sarcoma Service, Royal National Orthopaedic Hospital, Stanmore, United Kingdom</td>
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<td>4:00 p.m.</td>
<td>SURGICAL TREATMENT OF ACETABULAR INSUFFICIENCY IN MUSCULOSKELETAL ONCOLOGY</td>
<td>p. 58</td>
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<td>Francis Patterson, MD; Kathleen S. Beebe, MD; John Hwang, MD;</td>
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<td>Joseph Benevenia, MD</td>
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<td>Orthopaedics, UMDNJ, Newark, NJ, USA</td>
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DURABILITY OF CEPHALOMEDULLARY NAIL FIXATION FOR TREATMENT OF METASTATIC PERITROCHANTERIC FEMORAL LESIONS

David Chafey, MD; Valerie O. Lewis, MD; Bryan S. Moon; Robert L. Satcher, MD, PhD; Patrick P. Lin, MD
Orthopedic Surgery, MD Anderson, Houston, TX, USA

A COMPARISON OF PEDIATRIC ALLOGRAFT AND IMPLANT LIMB SALVAGE

Antoinette W. Lindberg, MD; Stephanie Punt; Jed K. White; Viviana Bompadre, PhD; Darin Davidson, MD; Ernest U. Conrad, MD
1Orthopaedics and Sports Medicine, University of Washington, Seattle, WA, USA; 2Orthopaedics and Sports Medicine, Seattle Children’s Hospital, Seattle, WA, USA

A DUAL-CENTER REVIEW OF COMPRESSION OSTEONTEGRATION FOR FIXATION OF MASSIVE ENDOPROSTHETICS: 2-9 YEAR FOLLOW-UP

George T. Calvert, MD; Judd E. Cummings, MD; Kevin B. Jones, MD; L. Daniel Wurtz, MD; R. Lor Randall, MD, FACS
1Orthopaedic Surgery, Huntsman Cancer Institute and Primary Children’s Medical Center, University of Utah, Salt Lake City, UT, USA; 2Orthopaedic Surgery, Indiana University, Indianapolis, IN, USA; 3Orthopaedic Surgery, Orthopaedic Surgical Oncology of Arizona, Phoenix, AZ, USA

THE USE OF ADDITIVE LAYER MANUFACTURING FOR THE FABRICATION OF LIMB SALVAGE IMPLANTS

Paul Unwin, PhD; Kirti Wagjiani, BSc; Sudha Shunmungam, MEng; Abtin Eshraghi, MEng
Stanmore Implants Worldwide Ltd, Elstree, United Kingdom

RADIOGRAPHIC ANALYSIS OF CEMENTED LARGE SEGMENT ENDOPROSTHESSES FOR DISTAL FEMORAL TUMOR RESECTION: EVALUATION FOR ASEPTIC LOOSENING

Jeff Toreson, MD; Mustafa Al Sultan, MD; Robert E. Turcotte, MD, FRCSC
1Orthopedic Surgery, McGill University, Montreal, QC, Canada; 2Department of Radiology, McGill University Health Centre, Montreal, QC, Canada

EFFECT OF SIMULATED WEIGHT BEARING ON MICROMOTION AND PULLOUT OF UNCEMENTED FEMORAL STEMS

Jennifer S. Barr, MD; Antoinette W. Lindberg, MD; Jed K. White; Randal Ching, PhD; Darin Davidson, MD; Ernest U. Conrad, MD
1Orthopedics and Sports Medicine, University of Mississippi, Jackson, MS, USA; 2Orthopaedics and Sports Medicine, University of Washington, Seattle, WA, USA; 3Mechanical Engineering, University of Washington, Seattle, WA, USA; 4Orthopedics and Sports Medicine, Seattle Children’s Hospital, Seattle, WA, USA

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Friday, September 21, 2012

5:10 p.m.  p. 70  TOTAL HUMERAL ENDOPROSTHETIC REPLACEMENT FOLLOWING EXCISION OF MALIGNANT BONE TUMORS
Suhel Kotwal, MD; Bryan S. Moon, MD; Robert L. Satcher, MD, PhD;
Patrick P. Lin, MD; Valerae O. Lewis, MD
Orthopedic Oncology, MD Anderson Cancer Center, Houston, TX, USA

5:20 p.m.  p. 71  RADIOMICS OF SARCOMA-COMPUTER AIDED IMAGE ANALYSIS AND CHARACTERIZATION OF TUMOR HETEROGENEITY
Meera Raghavan, MD; Mu Zhao; Lawrence Hall; Dmitry Goldgof;
Robert Gatenby
1Department of Radiology, H. Lee Moffitt Cancer and Research Center, Tampa, FL, USA;
2Department of Computer Science and Engineering, University of South Florida, Tampa, FL, USA

7:00 p.m. - 11:00 p.m.  Dinner & Dancing

See pages 167 - 176 for financial disclosure index.
### Saturday, September 22, 2012

<table>
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<td>6:00 a.m.</td>
<td>Fun Run</td>
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<td>6:30 a.m. - 8:00 a.m.</td>
<td>Continental Breakfast</td>
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<td>7:00 a.m. - 12:30 p.m.</td>
<td>Technical / Poster Exhibits</td>
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<td>7:00 a.m. - 5:00 p.m.</td>
<td>Registration</td>
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#### 8:00 a.m. - 9:30 a.m.

**SESSION IV – Young Investigators**  
**Moderators:**  
- H. Thomas Temple, MD  
  University of Miami, Miller School of Medicine, Miami, FL  
- Theodore W. Parsons III, MD, FACS  
  Henry Ford Medical Group, Detroit, MI  
- Pietro Ruggieri, MD, PhD  
  Instituto Ortopedico Rizzoli, Bologna, Italy  
- Ernest U. Conrad, MD  
  Seattle Children's Hospital, Seattle, WA

**8:00 a.m.**  
*Paper #34*  
**SUCCESSFUL PROSTHETIC REHABILITATION FOLLOWING HIP DISARTICULATION OR HEMI-PELVECTOMY: THE MAYO CLINIC EXPERIENCE**  
*Michael Kralovec, MD*¹; *Karen Andrews, MD*²; *Matthew Houdek*¹; *Courtney Sherman, MD*¹; *Thomas Shives, MD*²; *Peter Rose*¹; *Franklin Sim, MD*¹  
¹Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN, USA  
²Department of Physical Medicine and Rehabilitation, Mayo Clinic, Rochester, MN, USA

**8:10 a.m.**  
*Paper #35*  
**RISK FACTORS FOR LOCAL RECURRENCE FOLLOWING RESECTION OF SUPERFICIAL SOFT TISSUE SARCOMAS: A REVIEW OF 467 PATIENTS**  
*William C. Eward, MD, DVM*¹; *Anthony Griffin*²; *Patrick O’Donnell, MD, PhD*³; *Peter Chung, MD*²; *Charles Catton, MD*²; *Brian O’Sullivan, MD*²; *Jay S. Wunder, MD*²; *Peter C. Ferguson, MD, MSC, FRSCC²  
¹Orthopaedic Surgery, Duke University Medical Center, Durham, NC, USA  
²Orthopaedic Surgery, University of Toronto, Toronto, ON, Canada  
³Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA

**8:20 a.m.**  
*Paper #36*  
**CHICK EMBRYO EXTRACT (CEE) AND EPIGENETIC REGULATION OF OSTEOSARCOMA STEM CELLS**  
*Xiaodong Mu, PhD*; *Bolat Sultankilov*; *Riddhima Agarwal*; *Johnny Huard, PhD*;  
*Kurt R. Weiss, MD*  
Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, PA, USA

**8:30 a.m.**  
*Paper #37*  
**OSTEOSARCOMA STEM CELL-TARGETED THERAPY WITH RETINAL**  
*Xiaodong Mu, PhD*; *Damel Mektepbayeva*; *Adel Mahjoub*; *Johnny Huard, PhD*;  
*Kurt R. Weiss, MD*  
Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, PA, USA

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• FDA information not available at the time of printing. For full information, refer to inside back cover.*
8:40 a.m.  p. 77  THE EFFECT OF THE SETTING OF A POSITIVE MARGIN ON LOCAL RECURRENT FOR EXTREMIT Y SOFT TISSUE SARCOMA  
*Patrick O’Donnell, MD, PhD*¹; *Anthony Griffin*³; *William Eward, MD*²; *Amir Sternheim, MD*³; *Brian O’Sullivan, MD*⁴; *Peter Chung, MD*¹;  
*Charles Catton, MD*⁴; *Peter C. Ferguson, MD, MSC, FR CSC*³; *Jay S. Wunder, MD*³  
¹Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA;  
²Orthopaedic Surgery, Duke University, Durham, NC, USA;  
³Orthopaedic Surgery, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada;  
⁴Radiation Oncology, Princess Margaret Hospital, Toronto, ON, Canada

8:50 a.m.  p. 78  A META-ANALYSIS OF OSTEOSARCOMA OUTCOMES IN THE MODERN MEDICAL ERA  
*Daniel C. Allison, MD, MBA, FACS*; *Scott C. Carney*; *Elke R. Ahlmann, MD*; *Alex C. Fedenko, MD*; *Sant C. Chawla, MD*; *Andrew C. Hendifar, MD*;  
*Constance C. Angeles*; *Lawrence R. Menendez, MD, FACS*  
Department of Orthopedics, University of Southern California, Los Angeles, CA, USA

9:00 a.m.  p. 79  THE HISTOLOGICAL EFFECT OF NEO-ADJUVANT CHEMOTHERAPY AT THE INTERFACE OF SARCOMAS AND THE ADJACENT SOFT TISSUES - PSEUDOCAPSULE FORMATION  
*Patrick O’Donnell, MD, PhD*¹; *Carlos Manivel, MD*³; *Denis Clohisy, MD*²  
¹Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA;  
²Orthopaedic Surgery, University of Minnesota, Minneapolis, MN, USA;  
³Surgical Pathology, University of Minnesota, Minneapolis, MN, USA

9:10 a.m.  p. 81  IS RECONSTRUCTION OF THE PROXIMAL RADIUS NECESSARY? RESECTION ALONE FOR TUMOURS OF THE PROXIMAL RADIUS - A SERIES OF SEVEN CASES  
*William C. Eward, MD, DVM*⁴; *Patrick O’Donnell, MD, PhD*²; *Amir Sternheim*³; *Anthony Griffin*³; *Jay S. Wunder, MD*³; *Peter C. Ferguson, MD, MSC, FR CSC*³  
¹Duke University Medical Center, Durham, NC, USA;  
²Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA;  
³Orthopaedic Surgery, University of Toronto, Toronto, ON, Canada

9:20 a.m.  p. 83  HOW LONG AND HOW FREQUENTLY SHOULD WE FOLLOW PATIENTS WITH SOFT TISSUE SARCOMAS?  
*Chigusa Sawamura*¹; *Seiichi Matsumoto*²; *Takashi Shimoji*²; *Keisuke Ae*²; *Atsushi Okawa*¹  
¹Orthopaedics, Tokyo Medical and Dental University, Tokyo, Japan;  
²Orthopaedics, Cancer Institute Hospital of Japanese Foundation for Cancer Research, Tokyo, Japan

9:30 a.m. - 10:00 a.m.  Coffee Break Technical / Poster Exhibits  

See pages 167 - 176 for financial disclosure index.
SESSION V – Multi-Institutional
Moderators: Mark C. Gebhardt, MD
Beth Israel Deaconess Medical Center, Boston, MA
Philipp T. Funovics, MD
Medical University of Vienna, Vienna, Austria

10:00 a.m. - 11:00 a.m.

WELL DIFFERENTIATED LIPOSARCOMAS / ATYPICAL LIPOMATOUS TUMORS OF THE EXTREMITIES
David Cheong, MD1; Marilyn M. Bui, MD, PhD1; Ricardo J. Gonzalez, MD1;
Curtis Buchanan1; Elisa Pala, MD2; Carlo Romagnoli, MD2; Douglas Letson, MD, PhD1;
Pietro Ruggieri, MD, PhD2
1Sarcoma, Moffitt Cancer Center, Tampa, FL, USA;
2Musculoskeletal Oncology, Rizzoli Institute, Bologna, Italy

CT-BASED STRUCTURAL RIGIDITY ANALYSIS IMPROVES SPECIFICITY AND POSITIVE PREDICTIVE VALUE OVER MIRELS CLASSIC RECOMMENDATIONS FOR FEMORAL METASTATIC LESIONS: A MULTI-INSTITUTIONAL MSTS SPONSORED STUDY
Timothy A. Damron, MD1; Carlos Brown, BS1; Ara Nazarian2; Vahid Entezari2;
Edward Cheng3; Megan E. Anderson, MD2; Richard M. Terek, MD3;
Albert Aboulafia4; Felix Cheung5; Lor Randall5; Robert E. Turcotte, MD, FRCSC7;
Patrick P. Lin, MD8; Mark Gebhardt, MD8; Brian Snyder9
1Department of Orthopedics, SUNY Upstate Medical University, East Syracuse, NY, USA;
2Department of Orthopedics, Harvard Medical School and Beth Israel Deaconess Biomechanics Laboratory, Boston, MA, USA;
3Department of Orthopedics, Brown University, Providence, RI, USA;
4Department of Orthopedics, University of Minnesota, Minneapolis, MN, USA;
5Department of Orthopedics, Sinai Hospital of Baltimore, Baltimore, MD, USA;
6Department of Orthopedic Oncology, University of Texas M.D. Anderson Cancer Center, Houston, TX, USA;
7Division of Orthopaedic Surgery, McGill University Medical School, Montreal, QC, Canada;
8Huntsman Cancer Institute, University of Utah School of Medicine, Salt Lake City, UT, USA;
9Department of Orthopedics, Marshall University, Huntington, WV, USA

COMPUTER NAVIGATION AND PRIMARY MALIGNANT BONE TUMORS REQUIRING HEMIPELVECTOMY
David Cheong, MD1; Weifeng Liu, MD1; Ricardo J. Gonzalez, MD1; Qing Zhang2;
Tao Wang3; Hairong Xu2; Douglas Letson, MD, PhD1; Xiaohui Niu2
1Sarcoma Program, Moffitt Cancer Center, Tampa, FL, USA;
2Orthopaedic Oncology, Beijing Ji Shui Tan Hospital Peking University, Beijing, China

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Saturday, September 22, 2012

10:30 a.m. p. 89  MALIGNANCY IN GIANT CELL TUMOR
Paper #46
Weifeng Liu, MD; David Cheong, MD; Qing Zhang; Lihua Gong; Hairong Xu;
Lin Hao; Yi Ding; Yuan Li; Marilyn M. Bui, MD, PhD;
Douglas Letson, MD, PhD; Xiaohui Niu
1Orthopaedic Oncology, Beijing Ji Shui Tan Hospital, Peking University, Beijing, China;
2Sarcoma Oncology Program, H. Lee Moffitt Cancer Center & Research Institute,
Tampa, FL, USA

10:40 a.m. p. 90  PROPHYLACTIC ANTIBIOTIC REGIMENS IN TUMOR SURGERY
(PARITY): UPDATE OF A MULTICENTER RANDOMIZED CLINICAL TRIAL
Paper #47
The PARITY Investigators
Center for Evidence-Based Orthopaedics, McMaster University, Hamilton, ON, Canada

10:50 a.m. p. 91  TREATMENT AND RESULTS IN 29 PATIENTS WITH DISTAL TIBIA
OSTEOSARCOMA TREATED WITH LIMB SALVAGE SURGERY
Paper #48
Elisa Pala, MD; Caterina N. Abati, MD; Andreas F. Mavrogenis, MD;
Pietro Ruggieri, MD, PhD; David Cheong, MD; Douglas Letson, MD, PhD
1IV Department of Orthopedics, Istituto Ortopedico Rizzoli, Bologna, Italy;
2Orthopedics, Moffitt Cancer Center, Tampa, FL, USA

11:00 a.m. - 12:00 p.m.  FOUNDER'S LECTURE
"Endoprostheses and Limb Sparing Surgery - A 35 Year Journey"
Jeffrey J. Eckardt, MD

12:00 p.m. - 12:10 p.m.  Young Investigator Award
Edward Y. Cheng, MD,
University of Minnesota, Minneapolis, MN

12:10 p.m. - 12:30 p.m.  Bone and Soft Tissue Unknowns
H. Thomas Temple, MD
University of Miami, Miller School of Medicine, Miami, FL

12:30 p.m.  Closing Statements
Douglas Letson, MD,
Moffitt Cancer Center, Tampa, FL

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SCIENTIFIC POSTER PRESENTATIONS

Poster #1  p. 93  ASSOCIATION OF VITAMIN D RECEPTOR (VDR) GENE POLYMORPHISM AND VITAMIN D STATUS IN KNEE OSTEOARTHRITIS

_Divya Sanghi, PhD Scholar¹; Rajeshwar N. Srivastava, MD¹;
Saloni Raj, MBBS Scholar²

¹Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India;
²Orthopaedic Surgery, MS Ramaiah Medical College, Bangalore, India

Poster #2  p. 94  ROLE OF VITAMIN D IN OSTEOARTHRITIS KNEE: A SIX-MONTH DOUBLE BLIND, RANDOMIZED, PLACEBO CONTROL TRIAL

_Divya Sanghi, PhD Scholar¹; Rajeshwar N. Srivastava, MD¹;
Saloni Raj, MBBS Scholar²

¹Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India;
²Orthopaedic Surgery, MS Ramaiah Medical College, Bangalore, India

Poster #3  p. 95  GENETIC POLYMORPHISM IN GDF-5 GENE AS RISK FACTOR FOR DEVELOPMENT AND PROGRESSION OF OSTEOARTHRITIS

_Rajeshwar N. Srivastava, MD; Abhishek Mishra, PhD Scholar;
Saloni Raj, MBBS Scholar

Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India

Poster #4  p. 96  TNF-β NCO1 POLYMORPHISM IN RELATION TO POSTOPERATIVE SEPSIS OUTCOME IN JOINT CARE SURGERY

_Kavita Baghel, PhD Scholar; Rajeshwar N. Srivastava, MD;
Saloni Raj, MBBS Scholar

Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India

Poster #5  p. 97  UTILITY OF MOLECULAR GENETIC MARKERS IN SARCOMA DIAGNOSTICS

_Michaela Leitnerová¹; Imrich Hikkel¹; Lucia Copáková²; Pavel Babál²

¹Department of Clinical Genetic, National Cancer Institute, Bratislava, Slovakia;
²Institute of Pathological Anatomy, Faculty of Medicine, Comenius University, Bratislava, Slovakia

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Scientific Poster Presentations

Poster #6  p. 98  FLAVOKAWAIN B INDUCES G2/M CELL-CYCLE ARREST AND APOPTOSIS IN HUMAN OSTEOSARCOMA CELLS
Tao Ji, MD; Carol Lin, MD; Eskander Ramez, MD; Yi Guo, MD;
Xiaolin Zi, MD; Bang Hoang, MD
1Department of Orthopaedic Surgery, UCI Medical Center, Orange, CA, USA;
2Department of Obstetrics and Gynecology, UCI Medical Center, Orange, CA, USA;
3Department of Urology, UCI Medical Center, Orange, CA, USA

Poster #7  p. 99  SPONTANEOUS REGRESSION OF SOLITARY OSTEOCHONDROMA OF THE DISTAL FEMUR. A CASE REPORT AND A LITERATURE REVIEW
Eduardo D. Abalo; Pablo D. Plater; Emilio C. Corinaldesi
CEMIC, Buenos Aires, Argentina

Poster #8  p. 100  GIANT CELL TUMOR OF THE TIBIA ARISING FROM PAGETIC BONE
Kurt R. Weiss, MD; Rao Uma, MD
1Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, PA, USA;
2Anatomic Pathology, University of Pittsburgh, Pittsburgh, PA, USA

Poster #9  p. 101  CHONDROBLASTOMA OF THE BONE: A REVIEW OF FUNCTIONAL OUTCOME AFTER OPERATIVE TREATMENT
Stephen Ng Man Sun, MRCS; Jake Jagliello, FRCS (Orth); Demos Neophytou;
Elizabeth Gillott, MRCS, MBBS; John Skinner; Rob Pollock; Will Aston; Tim W. Briggs
Bone Tumour Unit, Royal National Orthopaedic Hospital, Stanmore, United Kingdom

Poster #10  p. 102  THE USE OF INTRAOPERATIVE CT SCAN IN THE RESECTION OF SPINE OSTEOID OSTEOMAS AND OSTEOBLASTOMAS
Odion Binitie, MD; Camila De Mattos; Lauren Tomlinson, BS; John P. Dormans, MD
Orthopedics, Children’s Hospital of Philadelphia, Philadelphia, PA, USA

Poster #11  p. 103  ONCOLOGIC AND FUNCTIONAL OUTCOMES OF SURGICAL TREATMENT FOR GIANT CELL TUMOR OF THE DISTAL RADIUS
Robert W. Wysocki, MD; Emily E. Soni, MD; Walter W. Virkus, MD;
Mark T. Scarborough, MD; Sue E. Leurgans, PhD; Steven Gitelis, MD
1Orthopaedic Surgery, Rush University Medical Center, Chicago, IL, USA;
2Orthopaedic Surgery, University of Florida, Gainesville, FL, USA

Poster #12  p. 104  PRE-REFERRAL MRI USE IN MUSCULOSKELETAL ONCOLOGY PATIENTS IS NOT EXCESSIVE: A RETROSPECTIVE CASE SERIES
Christopher T. Martin, MD; Jose Morcuende, MD; Joseph A. Buckwalter, MD;
Benjamin J. Miller, MD
Orthopaedics and Rehabilitation, University of Iowa, Iowa City, IA, USA

Poster #13  p. 106  MRI IN SPINAL TRAUMA - A PREDICTOR OF NEUROLOGICAL RECOVERY?
Rajeshwar N. Srivastava, MD; Umesh Parasri
1Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India;
2Radiology, KG Medical College, CSM Medical University, Lucknow, India

See pages 167 - 176 for financial disclosure index.
Poster #14  p. 107  THE BONE CYTOLOGY AS EARLY DIAGNOSTIC METHOD IN BONE METASTASES

Javier Delgado¹, Pedro Valdivia¹, Matías Sepúlveda², Daniel Salgado³,
Juan Daniel Carpio⁴, Drina Omerovic⁴, María Teresa Poblete⁴, Cristian Carrasco⁴,
Maeva del Pozo⁴

¹Department of Orthopedic Surgery, Orthopaedic Surgical Oncology,
Valdivia Regional Hospital, Austral University of Chile, Valdivia, Chile;
²Department of Orthopedic Surgery, Valdivia Regional Hospital,
Austral University of Chile, Valdivia, Chile;
³Orthopaedic Resident, Austral University of Chile,
Valdivia Regional Hospital, Valdivia, Chile;
⁴Department of Pathology, Valdivia Regional Hospital,
Austral University of Chile, Valdivia, Chile

Poster #15  p. 108  THE BONE CYTOLOGY AS EARLY DIAGNOSTIC METHOD IN TUMORS OF THE SPINE

Javier Delgado¹, Pedro Valdivia¹, Matías Sepúlveda², Daniel Salgado³,
Juan Daniel Carpio⁴, Drina Omerovic⁴, María Teresa Poblete⁴, Cristian Carrasco⁴,
Tatiana Benavides⁴

¹Department of Orthopedic Surgery, Orthopaedic Surgical Oncology,
Valdivia Regional Hospital, Austral University of Chile, Valdivia, Chile;
²Department of Orthopedic Surgery, Valdivia Regional Hospital,
Austral University of Chile, Valdivia, Chile;
³Orthopaedic Resident, Austral University of Chile,
Valdivia Regional Hospital, Valdivia, Chile;
⁴Department of Pathology, Valdivia Regional Hospital,
Austral University of Chile, Valdivia, Chile

Poster #16  p. 109  THE BONE CYTOLOGY AS EARLY DIAGNOSTIC METHOD IN OSTEOSARCOMA

Javier Delgado¹; Pedro Valdivia¹; Matías Sepúlveda²; Daniel Salgado³;
Juan Daniel Carpio⁴, Drina Omerovic⁴, María Teresa Poblete⁴, Cristian Carrasco⁴,
Rubén Miranda⁴

¹Department of Orthopedic Surgery, Orthopaedic Surgical Oncology,
Valdivia Regional Hospital,
Austral University of Chile, Valdivia, Chile;
²Department of Orthopedic Surgery, Valdivia Regional Hospital,
Austral University of Chile, Valdivia, Chile;
³Orthopaedic Resident, Austral University of Chile,
Valdivia Regional Hospital, Valdivia, Chile;
⁴Department of Pathology, Valdivia Regional Hospital,
Austral University of Chile, Valdivia, Chile

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Poster #17 p. 110
DIGITAL BONE AND SOFT TISSUE TUMOR PATHOLOGY TEACHING LIBRARY: A NEW TOOL FOR SARCOMA PATHOLOGY TRAINING
Xiaohui Zhang, MD, PhD; Joseph Johnson, MS; Mark Lloyd, MS; Douglas Letson, MD, PhD; Marilyn M. Bui, MD, PhD
1Sarcoma, Moffitt Cancer Center, Tampa, FL, USA; 2ANALYTIC MICROSCOPY CORE, Moffitt Cancer Center, Tampa, FL, USA; 3Pathology, Moffitt Cancer Center, Tampa, FL, USA; 4Cell Pathology & Biology, University of South Florida, Tampa, FL, USA

Poster #18 p. 111
CORE NEEDLE BIOPSY OF MUSCULOSKELETAL LESIONS: ARE NON-DIAGNOSTIC RESULTS CLINICALLY USEFUL?
Manjiri M. Didolkar, MD, MS; Julia Rissmiller, MD; Megan E. Anderson, MD; Mary G. Hochman, MD; Mark C. Gebhardt, MD; Jeffrey D. Goldsmith, MD; Jim S. Wu, MD
1Radiology, Beth Israel Deaconess Medical Center, Boston, MA, USA; 2Orthopaedic Surgery, Beth Israel Deaconess Medical Center, Boston, MA, USA; 3Pathology, Beth Israel Deaconess Medical Center, Boston, MA, USA

Poster #19 p. 112
EWING’S SARCOMA OF THE FOOT: EXPERIENCES OF A UK BONE TUMOUR UNIT
Elizabeth Gillott, MRCS, MBBS; Steve Kahane, MRCs, BSc, MBBS; Will Aston; John Skinner; Rob Pollock; Steve Cannon; Tim W. Briggs
Bone Tumour Unit, Royal National Orthopaedic Hospital, Stanmore, Stanmore, United Kingdom

Poster #20 p. 113
LONG-TERM RESULTS OF INTRALESIONAL CURETTAGE AND CRYOSURGERY FOR TREATMENT OF LOW-GRADE CHONDROSARCOMA
Mort Meftah, MD; Patricia Schult; Robert M. Henshaw, MD
Orthopaedic Oncology, Georgetown, WHC, Washington, DC, USA

Poster #21 p. 115
PERIOSTEAL MESENCHYMAL CHONDROSARCOMA IN THE DISTAL TIBIA OF A FOUR YEAR OLD BOY
Dylan Nugent, MD; David Cheong, MD; Douglas Letson, MD, PhD; Jeffrey Keen, MD; Hector L. Monforte, MD; Alberto G. Ayala
1Orthopaedics, University of Florida College of Medicine Jacksonville, Jacksonville, FL, USA; 2Sarcoma, Moffitt Cancer Center, Tampa, FL, USA; 3Pathology, All Children’s Hospital, St. Petersburg, FL, USA; 4Pathology and Genomic Medicine, Methodist Hospital System, Houston, TX, USA; 5Orthopaedics and Sports Medicine, Flagler Orthopaedics and Sports Medicine, Palm Coast, FL, USA

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Poster #22 p. 117  PROGNOSTIC FACTORS OF HIGH-GRADE CHONDROSARCOMA - A SINGLE-CENTER EXPERIENCE WITH 175 PATIENTS
Philipp T. Funovics, MD; Martin Dominkus; Susanna Lang; Reinhard Windhager
1Department of Orthopaedics, Medical University of Vienna, Vienna, Austria;
2Department of Pathology, Medical University of Vienna, Vienna, Austria

Poster #23 p. 118  EXPRESSION OF MAPK/ERK PATHWAY IN PATIENTS WITH HIGH GRADE OSTEOSARCOMA
Wonseok Song, MD; Chandhanarat Chandhanayingyong, MD; Suc Hyeon Kweon, MD; Saqib Nizami; Yuhree Kim, MD; Jung Hyun Park, MD; Francis Young-In Lee
Orthopaedic Surgery, Columbia University, New York, NY, USA

Poster #24 p. 119  MICRO RNA IN CHONDROSARCOMA: A RAT MODEL
Heather Harrison, MD; Caroline Wolfe; Clifford Les, PhD; Gary Gibson; Michael Mott, MD; Theodore Parsons, MD
Orthopaedic Surgery, Henry Ford Health System, Detroit, MI, USA

Poster #25 p. 120  DELAYED DIAGNOSIS OF PRIMARY SACRAL TUMORS: INCIDENCE AND CONTRIBUTING FACTORS
Farbod Malek, MD; David McKeown; John H. Healey, MD; Patrick J. Boland, MD
Orthopaedic Service, Dept of Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, USA

Poster #26 p. 121 ♦ ELUTION OF CISPLATIN FROM COMMERCIALIY AVAILABLE BONE CEMENTS WITHOUT REDUCTION IN STRENGTH
Jill Meyer, PhD; Matthew Squire, MD, MS; Kevin MacDonald
1Civil Engineering & Mechanics, University of Wisconsin - Milwaukee, Milwaukee, WI, USA;
2Orthopedic Surgery, University of Wisconsin Hospital and Clinics, Madison, WI, USA;
3Orthopedic Surgery, Virginia Mason Medical Center, Seattle, WA, USA

Poster #27 p. 123  FRACTURE RISK ANALYSIS IN OSTEOCHONDROMA PATIENTS
Mathew Sunil Varre, Masters; J. C. Neilson, MD; Jill Meyer, PhD
1Civil Engineering & Mechanics, University of Wisconsin - Milwaukee, Milwaukee, WI, USA;
2Orthopedics, Medical College of Wisconsin, Milwaukee, WI, USA

Poster #28 p. 124  DIAGNOSTIC DELAY OF SOFT TISSUE SARCOMAS
Herrick J. Siegel, MD; Diego Herrera, MD
Orthopaedic Surgery, University of Alabama at Birmingham, Birmingham, AL, USA

Poster #29 p. 125  SYMPTOMATIC DEEP VENOUS THROMBOSIS FOLLOWING SOFT TISSUE MASS RESECTIONS
Herrick J. Siegel, MD; Jay Savage, MD
Orthopaedic Surgery, UAB, Birmingham, AL, USA

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**Poster #30**  p. 126  **EXTRASKELETAL MYXOID CHONDROSARCOMA: STUDY OF CLINICOPATHOLOGIC, IMMUNOHISTOCHEMICAL AND CYTOGENETIC FEATURES IN 20 PATIENTS**
Chandhanarat Chandhanayingyong, MD; Thana Siripisitsak; Kanapon Pradniwat; Sorranart Muangsomboon; Apichat Asavamongkolkul, MD; Fabrizio Remotti, Dr.; Francis Y. Lee, MD, PhD
1Center for Orthopaedic Research (COR), Department of Orthopaedic Surgery, Columbia University, New York, NY, USA; 2Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand; 3Department of Pathology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand; 4Department of Anatomic Pathology, Columbia University, New York, NY, USA

**Poster #31**  p. 127  **POST-RADIATION FRACTURES IN THE SETTING OF SOFT-TISSUE SARCOMA TREATMENT**
Ali Syed; Timothy A. Damron
Orthopaedic Surgery, SUNY Upstate Medical University, Syracuse, NY, USA

**Poster #32**  p. 128  **SOFT TISSUE EWINGS SARCOMA OF THE SCIATIC NERVE MIMICKING LUMBAR RADICULOPATHY: CASE REPORT AND LITERATURE REVIEW**
Kurt R. Weiss, MD; James D. Kang, MD; Jesse Even, MD; Liron Pantanowitz, MD
1Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, PA, USA; 2Anatomic Pathology, University of Pittsburgh, Pittsburgh, PA, USA

**Poster #33**  p. 129  **VALIDATION OF THE SF6D HEALTH STATE UTILITIES MEASURE IN A POPULATION OF LOWER EXTREMITY SARCOMA PATIENTS**
Kenneth R. Gundle, MD; Amy M. Cizik, MPH; Stephanie Punt; Jed K. White; Darin Davidson, MD; Ernest U. Conrad, MD
Department of Orthopaedics & Sports Medicine, University of Washington Medical Center, Seattle, WA, USA

**Poster #34**  p. 131  **SARCOMA EXCISION AND PATTERN OF SENSORY NERVE INJURY**
Neil Wickramasinghe; Daniel Porter
1Edinburgh University, Edinburgh, United Kingdom; 2Orthopaedics and Trauma, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

**Poster #35**  p. 132  **PROSPECTIVE STUDY OF PROTON REIRRADIATION FOR SOFT TISSUE SARCOMA: EARLY OUTCOMES AND MORBIDITY**
Abigail B. Milby, MD; Curtiland Deville, MD; Stefan Both; Zelig Tochner; James Metz; Kristi Varillo, MS; Richard D. Lackman, MD; John P. Plastaras, MD, PhD
Hospital of the University of Pennsylvania, Philadelphia, PA, USA

See pages 167 - 176 for financial disclosure index.
Poster #36  p. 134  EXPERIENCED OBSERVERS CAN DIFFERENTIATE BETWEEN LIPOMA AND WELL-DIFFERENTIATED LIPOSARCOMA USING ONLY MRI
Patrick O’Donnell, MD, PhD; Amir Sternheim, MD; William Eward, MD; Anthony Griffin; Lawrence White, MD; Jay S. Wunder, MD; Peter C. Ferguson, MD, MSC, FRCSC
1Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA; 2Orthopaedic Surgery, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada; 3Musculoskeletal Radiology, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada; 4Orthopaedic Surgery, Duke University, Durham, NC, USA

Poster #37  p. 135  EFFECT OF RADIATION THERAPY AND PERIOPERATIVE BLOOD TRANSFUSION ON RECURRENCE IN MYXOID LIPOSARCOMA PATIENTS
Dean Wang; Karen J. Fritchie; Amy S. Nowacki; Michael J. Joyce; Brian P. Rubin; Steven Lietman
1Orthopaedics/Pathology, Cleveland Clinic, Cleveland, OH, USA; 2Orthopaedics, UCLA, Los Angeles, CA, USA; 3Pathology, Mayo Clinic, Rochester, MN, USA

Poster #38  p. 137  LYMPHANGIOSARCOMA OF THE UPPER EXTREMITIY IN CHRONIC LYMPHEDEMA AFTER MASTECTOMY FOR BREAST CANCER: A CASE REPORT
Eduardo D. Abalo; Pablo D. Plater; Emilio C. Corinaldesi
CEMIC, Buenos Aires, Argentina

Poster #39  p. 138  INCREASE IN TUMOR SIZE ON MRI IS ASSOCIATED WITH GREATER PATHOLOGIC NECROSIS AND POOR SURVIVAL IN PATIENTS WITH SOFT TISSUE SARCOMA TREATED WITH NEOADJUVANT RADIOTHERAPY
Meena Bedi, MD; Jordan Kharofa; Jason Chang; Eduardo V. Zambrano; Keith Baynes; Alan P. Mautz; Melissa DuBois; David M. King; Donald A. Hackbart; John A. Charlson
1Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI, USA; 2Pathology, Medical College of Wisconsin, Milwaukee, WI, USA; 3Radiology, Medical College of Wisconsin, Milwaukee, WI, USA; 4Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA; 5Medical Oncology, Medical College of Wisconsin, Milwaukee, WI, USA

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Meena Bedi, MD; David King, MD; Robert Whitfield, MD; Donald A. Hackbarth, MD; John C. Neilson; John A. Charlson; Dian Wang, MD, PhD

1Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI, USA; 2Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA; 3Plastic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA; 4Medical Oncology, Medical College of Wisconsin, Milwaukee, WI, USA

Poster #41  p. 140  PROXIMAL MEDIAL THIGH TUMORS HAVE INCREASED RISK OF MAJOR ACUTE WOUND COMPLICATIONS IN PATIENTS WITH SOFT TISSUE SARCOMAS TREATED WITH NEOADJUVANT RADIATION FOLLOWED BY LIMB-SALVAGE SURGERY

Meena Bedi, MD; David King, MD; Robert Whitfield, MD; Donald A. Hackbarth, MD; John C. Neilson; John A. Charlson; Dian Wang, MD, PhD

1Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI, USA; 2Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA; 3Plastic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA; 4Medical Oncology, Medical College of Wisconsin, Milwaukee, WI, USA

Poster #42  p. 141  CAUSE AND EFFECT OF LOCAL RECURRENCE IN EXTREMITY SOFT TISSUE SARCOMA - ARE WE MAKING A DIFFERENCE?

Vignesh K. Alamanda; Samuel N. Crosby, MD; Kristin R. Archer, PhD; Yanna Song; Jennifer L. Halpern, MD; Herbert S. Schwartz, MD; Ginger E. Holt, MD

1Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, TN, USA; 2Department of Biostatistics, Vanderbilt University Medical Center, Nashville, TN, USA

Poster #43  p. 142  FAILURE TO CORRECTLY DIAGNOSE EXTREMITY SOFT TISSUE SARCOMAS - IS A LACK OF EDUCATION TO BLAME?

Vignesh K. Alamanda; Samuel N. Crosby, MD; Kristin R. Archer, PhD; Shannon Mathis; Herbert S. Schwartz, MD; Ginger E. Holt, MD

Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, TN, USA

Poster #44  p. 143  THE FINANCIAL BURDEN OF RE-EXCISING INCOMPLETELY EXCISED SARCOMAS - A COST ANALYSIS

Vignesh K. Alamanda; Kristin R. Archer, PhD; Shannon Mathis; Jesse Ehrenfeld; Jennifer L. Halpern, MD; Herbert S. Schwartz, MD; Ginger E. Holt, MD

1Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, TN, USA; 2Division of Multispecialty Adult Anesthesiology, Vanderbilt University Medical Center, Nashville, TN, USA

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Scientific Poster Presentations

Poster #45 p. 144  FACTORS, TREATMENT, AND OUTCOMES OF FUNGATING SOFT TISSUE SARCOMAS  
Steve C. Lin; Daniel C. Allison, MD, MBA, FACS; Elke R. Ahlmann, MD;  
Amy Williams; Lawrence R. Menendez, MD, FACS  
Department of Orthopedics, University of Southern California, Los Angeles, CA, USA

Poster #46 p. 145  DETECTION OF RECURRENT SARCOMA FOLLOWING RESECTION: MRI WITH A “TWIST”  
Laura M. Fayad, MD1; Filippo del Grande, MD3; Charles Mugera, MD3;  
Kristy L. Weber, MD2  
1Radiology, Orthopaedic Surgery & Oncology, Johns Hopkins University, Baltimore, MD, USA;  
2Orthopaedic Surgery, Johns Hopkins University, Baltimore, MD, USA;  
3Radiology, Johns Hopkins University, Baltimore, MD, USA

Poster #47 p. 146  A TALE OF TWO OUTCOMES: PALLIATIVE RESECTION OF SOFT TISSUE SARCOMAS IN PATIENTS WHO PRESENT WITH MULTIPLE LUNG METASTASES  
William C. Eward, MD, DVM1; Diana Marsilio2; Hesham Abdelbary2;  
Patrick O’Donnell, MD, PhD3; Amir Sternheim3; Anthony Griffin3;  
Jay S. Wunder, MD2; Peter C. Ferguson, MD, MSC, FRCS2  
1Orthopaedic Surgery, Duke University Medical Center, Durham, NC, USA;  
2Orthopaedic Surgery, University of Toronto, Toronto, ON, Canada;  
3Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA

Poster #48 p. 147  ANTIPROTOUSIO CAGE RECONSTRUCTION IN COMBINATION WITH DUAL MOBILITY TECHNOLOGY TO IMPROVE HIP STABILITY  
Herrick J. Siegel, MD; Graham Calvert, MD  
Orthopaedic Surgery, UAB, Birmingham, AL, USA

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Matthew T. Wallace, MD, MBA1; Robert M. Henshaw, MD2  
1Orthopaedic Surgery, George Washington University, Washington, DC, USA;  
2Musculoskeletal Oncology, Washington Cancer Institute, Washington, DC, USA

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Sergio Gutierrez, PhD2; Charles C. Nalley, MD1; Roger C. Gaskins, MD1;  
Brandon Santoni2  
1Department of Orthopaedic Surgery, University of South Florida, Tampa, FL, USA;  
2Phillip Spiegel Orthopaedic Research Laboratory, Foundation for Orthopaedic Research and Education, Tampa, FL, USA

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1Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA; 2Orthopaedic Surgery, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada; 3Orthopaedic Surgery, Duke University, Durham, NC, USA

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Karl Wieser, MD; Kourosh Modaressi, MD; Franziska Seeli, BScN; Bruno Fuchs, MD
Orthopedics, University Hospital Balgrist, Zurich, Switzerland

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Joseph Benevenia, MD; Kathleen S. Beebe, MD; Francis Patterson, MD;  
Mark Palma  
Orthopaedics, UMDNJ, Newark, NJ, USA

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Lisa Ercolano, MD; Tyson Christensen; Richard McGough, MD  
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Lisa Ercolano, MD; Matthew Colman; Mark Goodman  
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Wayne Chen; William G. Ward, MD  
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Suhel Kotwal, MD; Bryan S. Moon, MD; Robert L. Satcher, MD, PhD;  
Patrick P. Lin, MD; Valerae O. Lewis, MD  
Orthopedic Oncology, MD Anderson Cancer Center, Houston, TX, USA

**Poster #64**  p. 166  ANTIBIOTIC PROPHYLACTIC IN MEGA PROSTHESIS. ARE 24 HOURS ENOUGH TO PREVENT ACUTE INFECTIONS?
Marcos Galli Serra, MD; Walter M. Parizzia; Carlos M. Autorino;  
Emiliano Alvarez Salinas  
Hospital Universitario Austral, Pilar, Argentina

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See pages 167 - 176 for financial disclosure index.
Objective: The purpose of this study was report our early experience in preoperative planning, with image fusion, and tumor resection according to the desired plane using intraoperative navigation assistance.

Methods: From May 2010 to May 2012, sixty-nine patients were 3D reconstructed in a virtual platform and planned determining the osteotomy position according to oncology margins in a CT-MRI image fusion. Tumor resections were performed using a computer navigation system according to previously planned. We analyzed the technical problems (crashes), time for navigation procedure during surgery, accuracy of the registration technique and surgical margins.

Results: In four patients (5.7%) the navigation was not carried out due to technical problems. In two cases the crash was secondary to software problems, and in the remaining two cases the crash was secondary to hardware problems. Of the 65 cases where the navigation was performed, the mean registration error was 0.69 mm (range 0.3-1.4). The mean time for navigation procedures during surgery was 29 minutes (range 11-61). Histological examinations of all specimens showed a clear tumor margin in all patients.

Conclusions: Our findings suggest that preoperative planning and tumor resection guided by navigation is accurate and useful method for bone tumor surgery. In our study, the navigation could not be performed in 5.7% of series.

Level of Evidence Level IV, therapeutic study.
Objective: The use of computer assisted orthopaedic surgery (CAOS) and robotics is becoming more widely accepted in spinal and joint reconstruction surgery. However to date there has been limited progress in limb salvage surgery. High definition radiographic imaging and sophisticated computer modelling integrated with precision manufacturing enables highly accurate patient specific implants to be produced. Current practice is to then implant these precision-made devices using traditional surgical techniques but imprecise resection may lead to implant malposition and ultimately implant failure. Early clinical results of uni-condylar knee replacement implanted with the assistance of the Sculptor robot (Acrobot®) showed an increase in the precision and accuracy of the bone cuts and implant placement and resulting in enhanced functional performance (Cobb 2006). The aim of this study was to illustrate the first clinical use of an integrated process from radiographic assessment, through design and fabrication of the implant to robot assisted surgical excision and implantation.

Methods: The first limb sparing case was performed in December 2011. The patient suffered extensive bone loss of the distal femur and proximal tibia resulting from trauma. Using CT data, the bone cuts were planned pre-surgery. The common platform 3 dimensional implant model data was transferred to machining software linked to a computer controlled milling machine. The same common platform data was passed concurrently to the Sculptor surgical robot and the surgical milling path produced. At surgery, the radiological data was registered with that of the patient and the Sculptor robot used a digitising arm to monitor and track any movement of the patient in real time, whilst assisting the surgeon to perform precise cuts using active constraint technology to ensure that the position of the cutting burr on the robot arm remained within the planned milling path.

Results: The uncemented partial distal femoral and proximal tibial replacement fitted precisely. The patient rehabilitated rapidly and walked aided with a cane for 6 weeks. The patient now walks freely and unaided. Further limb sparing cases are being planned and will be presented.

Conclusions: Robotics in limb sparing is in its infancy and is considered to be an integral element in the development of the next generation of patient specific limb sparing implants.
NAVIGATION TO DOCUMENT BONE TUMOR RESECTIONS AND IMPROVE SURGICAL MARGINS
Antoinette W. Lindberg, MD; Jennifer S. Barr, MD; Jed K. White; Stephanie Punt; Darin Davidson, MD; Ernest U. Conrad, MD

Objective: Documentation and achievement of appropriate surgical margins and reconstructions during oncologic procedures remain challenging in orthopaedic oncology. Computer based systems have been successfully used in arthroplasty surgery to document intraoperative implant positioning. The adaptation of a navigation system for use in sarcoma surgery has the potential to improve the accuracy of surgical margins and allow for more accurate reconstructions after resection. This report summarizes our experience with a navigation system for the resection and reconstruction of osseous tumors. A navigation imaging model for future use is proposed.

Methods: We identified 35 osseous tumor patients as candidates for use of navigation based on tumor type, location, and proposed resection and reconstruction. 4 patients were adults and 31 were children. 9 pelvic and 26 extremity tumors were evaluated. Preop imaging was downloaded and reviewed on the oncology software. A prospective protocol required preop determination of the planned operative tumor margins (mm) which was documented on the preop CT imaging. Intraop navigation metrics included reconstructive metrics (length, rotation) and documentation of intraop osseous margins. Pathologic assessment and CT imaging was completed postop to confirm the accuracy of the final operative margins.

Results: Navigation was successfully used in the 37 patients with preop documentation of the planned tumor margins. Resection length and the adequacy of osseous margins were assessed both intraop and postop by navigation, intraop measurement and postop imaging and pathology. Predicted vs. postop osseous resection orientation had minimal variation (mean = 4.6mm) with navigation assistance and documentation (Table 1). Comparison of preop to postop margins showed significant variation (mean = 9.8mm).

<table>
<thead>
<tr>
<th>#</th>
<th>Loc</th>
<th>Resection Orientation (mm) from Landmark</th>
<th>Margins (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Preop</td>
<td>Postop</td>
</tr>
<tr>
<td>2</td>
<td>Pelvis</td>
<td>21.5</td>
<td>24.5</td>
</tr>
<tr>
<td>4</td>
<td>DH</td>
<td>106.2</td>
<td>101.9</td>
</tr>
<tr>
<td>8</td>
<td>DF</td>
<td>187.0</td>
<td>195.4</td>
</tr>
<tr>
<td>10</td>
<td>Tibia</td>
<td>41.9</td>
<td>45.9</td>
</tr>
<tr>
<td>13</td>
<td>PT</td>
<td>219.0</td>
<td>225.5</td>
</tr>
<tr>
<td>19</td>
<td>Pelvis</td>
<td>42.0</td>
<td>39.6</td>
</tr>
<tr>
<td>22</td>
<td>PH</td>
<td>175.0</td>
<td>165.9</td>
</tr>
<tr>
<td>23</td>
<td>PH</td>
<td>104.1</td>
<td>100.6</td>
</tr>
<tr>
<td>27</td>
<td>DF</td>
<td>48.0</td>
<td>46.0</td>
</tr>
<tr>
<td>29</td>
<td>DF</td>
<td>15.0</td>
<td>10.3</td>
</tr>
<tr>
<td>31</td>
<td>DF</td>
<td>14</td>
<td>236</td>
</tr>
<tr>
<td>33</td>
<td>PH</td>
<td>142</td>
<td>150</td>
</tr>
<tr>
<td>34</td>
<td>DF</td>
<td>2.9</td>
<td>3.0</td>
</tr>
<tr>
<td>39</td>
<td>DF</td>
<td>17</td>
<td>26</td>
</tr>
</tbody>
</table>

Table 1. Navigation metrics

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Conclusions: Our primary purpose for intraop navigation was improved calculation and documentation of osseous surgical margins. This current study was designed to assess the accuracy and feasibility of using intraop navigation for that purpose. Accuracy was evaluated by a comparison of preop vs. postop tumor resection length, orientation and associated tumor margins. The resection orientation comparison showed less variation (4.6mm) than the tumor margin comparison (9.8mm). Further evaluation of these margins and navigation techniques are recommended.

See pages 167 - 176 for financial disclosure index.
Objective: Complete resection with negative margins is critical for achieving local surgical control of primary sarcomas of bone. Intraoperative consultation, including frozen section of bone marrow at margins, is frequently used to aid in achieving this goal. This study assessed the diagnostic utility and practical impact of this procedure.

Methods: Pathology reports and operative notes were reviewed for patients with primary sarcomas of bone who underwent resection at Children’s Hospital Boston from 1997 to 2011 and had frozen section(s) performed on a bone marrow margin.

Results: 175 bone marrow margins from 130 patients (68 males, 62 females; mean age 13 years) were included in the study. Tumors included osteosarcoma (74%), Ewing sarcoma (20%) and rare other sarcomas. 169 (97%) of marrow margins were interpreted as negative intraoperatively. Among the remaining 6, 4 were interpreted as positive (all confirmed as positive on permanent sections) and 2 as suspicious (both determined to be negative on permanent sections). In 5 of these margins of histologic concern intraoperatively, the split gross specimen showed a close marrow margin that on its own would have triggered recutting of additional bone. In the remaining case, although the frozen section was read as "suspicious", no recut was performed because of the reassuring gross appearance of the split specimen. Thus, the frozen section diagnosis did not impact the surgical management in any case. Examination of the gross split specimen marrow margin resulted in a recut in 20 (11%) instances. All patients had negative bone marrow margins after full pathologic examination. 

Average distance from the tumor to the bone marrow margin (data available in 84% of cases) was 3.8 cm (median 3.5 cm; standard deviation 2.7 cm).

Conclusions: Intraoperative frozen section analysis of bone marrow margins did not impact intraoperative decisions in 175 of 175 bone sarcoma resections, and is therefore of little clinical utility in this setting. Omitting this frequently perfunctory practice may save operative time and cost, resulting in improved patient care. Examination of the split gross specimen appears to be an adequate adjunct to clinicoradiographic assessment to achieve negative margins in the current era of modern imaging and surgical techniques.
Objective: Purposes of this study were 1) to evaluate the incidence and outcome of infection after surgical resection (with or without reconstruction) for pelvic bone tumors, 2) to evaluate the effects on survival to infection of surgical reconstructions, site of tumor involvement and age at surgery, 3) to analyze the type of treatment of infection and its outcome.

Methods: From 1990 to 2010, 2228 patients with pelvic bone tumors were treated by surgical resection. The patients were followed at a mean of 6.6 years (range 1-20). Chondrosarcoma 135, Ewing’s sarcoma 29 and osteosarcoma 23 were the most common histotypes. According to Enneking’s classification, 57 patients had type I, 24 type II and 26 type III pelvic resection. Combined resections were performed in 29 cases (type I-II), 59 cases (type II-III), 18 cases (type I-II-III) and 15 cases (type I-IV). In 129 cases reconstruction was performed, in 99 there was no reconstruction. Special attention was given to deep infections, their treatment and outcome.

Results: Deep infections were observed in 38 cases (16.6%) at mean follow up of 11 months. There were 11 infections in 99 cases without reconstruction (11.1%) and 27 over 129 with reconstruction (20.9%). In 18 patients (47%) infection occurred within 4 weeks postoperatively, in 9 within 6 months and in 10 after 6 months. Most frequent bacteria causing infection were Stafilococcus (40%), Enterococcus and Escherichia Coli (31%), Pseudomonas Aeruginosa (9%). Actuarial survival to infection was 94%, 86% and 82% at 1 month, 1 and 10 years respectively. Surgical treatment consisted in one (47%) or more (28%) surgical debridements, combined with antibiotics therapy according to coltures. In 11 cases the implant was removed, while 5 cases (13.2%) had an external hemipelvectomy (one due to persistent infection and local recurrence). The incidence of infection in patients with reconstruction was statistically higher than in patients without reconstruction (p=0.0384). No statistical difference was found between periacetabular resections and others (p=0.1755). Average MSTS score (after treatment of infection) was 68.3%.

Conclusions: Favorable oncologic and functional outcome can be achieved in selected patients with pelvic bone tumors. Infection is a major complication that requires further surgery, but external hemipelvectomy is rarely needed. Reconstruction after resection is related with higher risk of infection.
HEMIPELVIC ALLOGRAFT RECONSTRUCTION: AN UPDATE TO THE MASSACHUSETTS GENERAL HOSPITAL EXPERIENCE

Zachary A. Child, MD; Joseph Schwab, MD; Mark Gebhardt, MD; Francis Hornicek, MD, PhD
1Orthopaedic Surgery, Massachusetts General Hospital, Boston, MA, USA; 2Orthopaedic Surgery, Beth Israel Deaconess, Boston, MA, USA

Objective: The Massachusetts General Hospital began transplanting cadaveric allografts in the 1970’s in an attempt to recreate perceived deficiencies of leaving extremities flail and favored the soft tissue attachments and ‘natural’ anatomic capacity of allografts. The early MGH experience brought to light notable complications such as a high rate of early infection, late fracture, and methods of graft preparation and storage to which end great progress has been made. The purpose of this retrospective case series is to examine the senior authors experience of massive pelvic allografts in reconstruction following internal hemipelvectomy. Comparison of the last 15 years of these procedures in comparison to the previous 15 years and with the use of allografts in the wider literature.

Methods: The allograft bank database was cross-referenced with the surgical database of the senior author (FJH) and the orthopaedic oncology service at the Massachusetts General Hospital from 1996 to March 2012. Forty hemipelvic allografts were transplanted following radical resection of pelvic tumors, most of them malignant. The patient medical records were examined with respect to the following demographics and variables: Diagnosis, age, histologic grade, site, stage, living/deceased, type of resection, blood loss, operative time, flap coverage, return to OR, documented infection (organism), resolution of infection, documented fracture, months since surgery, Oncologic outcome, adjunct treatment.

Results: Avg age= 43, R=26 L=14, Male=21 F=19, Diagnosis included OS 16, CS 12, Metastasis 5, Ewings 2, GCT 1, Osteochondroma 1. Avg f/u 33 mos, Overall rate of infection 17/40 (42%), Percent retained after infection 14/17 (82%), For those with minimum 5-year f/u retention was 14/15 (93%). predominant organism isolated in infection gram positive anaerobic enteric 9/16 (56%), Avg f/u was 32 mos, Longest f/u was 141 mos. The most common resection was a Type II+III(a/b) with variable degree of resection of the pubic rami. The average MSTS score was 57.4%.

Conclusions: The use of massive pelvic allograft in reconstruction of the pelvic ring following internal hemipelvectomy is fraught with complications. However, the ultimate success of these procedures in providing stability and integrity of the ring is considerable. The MSTS functional scores support the overall good functional outcomes obtained in these patients.
Objectives: Outcomes of acetabular and non-acetabular resection/reconstructions were compared for tumor recurrence and post-surgical complications.

Methods: 835 patients with a pelvic tumor presented to our Sarcoma Service from 1995-2011. Inclusion criteria included malignant tumors of the bony pelvis and an operative resection including part of the pelvic ring. 307 patients presented with a pelvic soft tissue tumor and 136 patients with a pelvic osseous malignant tumor. Resections were classified by the Enneking system (Figure I). Resections not affecting pelvic ring integrity and curettage procedures were excluded.

Results: 94 patients were identified with a pelvic osseous malignancy and treated with pelvic ring resection and reconstruction. 49 patients were treated with acetabular resections (Type II or combination). 45 patients were treated with non-acetabular resections (Type I or III). Both groups were similar in age, gender, and clinical follow up time and had similar rates of high grade tumors and tumor size. Average operative time, estimated blood loss, and hospital stay were greater for acetabular resections (Table I). Postop complications were similar in incidence, most commonly involving deep infections (31.0%). Amputations were unusual (6.4%) and usually carried out for local recurrence. Overall local tumor recurrence was 34.0% and mortality due to disease progression was 19% (Table II). Tumor resections involving the acetabulum had statistically higher surgical complication rates than nonacetabular resections (69.4% vs. 53.3%, p=0.0005). For acetabular resections the most common complications were deep infections (26.5%) (Table II). Functional outcomes showed lower rates of unassisted ambulation (55.1% vs. 68.9%, p=0.06) and a higher trend toward eventual limb loss (10.2% vs. 2.2%, p=0.07) for acetabular vs. nonacetabular resections. Incidence of tumor recurrence was similar (34.7% vs. 33.3%, p=0.55). Survival of patients with an acetabular vs. nonacetabular resection was higher overall for the nonacetabular group at 24 and 60 months (70.7% vs. 80.6%, 40.3% vs. 66.3%).

Conclusions: Comparison of acetabular to nonacetabular resections/reconstructions show similar risks of local recurrence and survival at final follow up but greater surgical complications and lower functional results. Postop complications, intra-op parameters, and amputation were greater in the acetabular resection group.
### Table 1. Comparison—Acetabular vs. Nonacetabular procedures

<table>
<thead>
<tr>
<th></th>
<th>Acetabular (Type II/Combinations), N=49</th>
<th>Nonacetabular (Types I and III), N=45</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High grade tumor</td>
<td>49.0% (24/49)</td>
<td>37.8% (17/45)</td>
<td>0.12</td>
</tr>
<tr>
<td>Tumor diameter</td>
<td>9.0cm</td>
<td>8.9cm</td>
<td>0.44</td>
</tr>
<tr>
<td>Average operative time</td>
<td>384 min.</td>
<td>234 min.</td>
<td>0.0002</td>
</tr>
<tr>
<td>Average blood loss</td>
<td>2434 mL</td>
<td>1114 mL</td>
<td>0.002</td>
</tr>
<tr>
<td>Average hospital stay</td>
<td>19.7 days</td>
<td>12.7 days</td>
<td>0.003</td>
</tr>
</tbody>
</table>

48 males, 46 females, average age at surgery: 43.7 years, mean follow up: 48.7 months

### Table II. Overall Complications

<table>
<thead>
<tr>
<th></th>
<th>Acetabular (Type II/Combination) N=49</th>
<th>Nonacetabular (Types I/III) N=45</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep infections</td>
<td>26.5% (9/34)</td>
<td>16.7% (4/24)</td>
<td>31.0% (18/58)</td>
</tr>
<tr>
<td>Wound revision</td>
<td>14.7% (5/34)</td>
<td>41.7% (10/24)</td>
<td>19.0% (11/58)</td>
</tr>
<tr>
<td>Graft fixation failure/fracture</td>
<td>14.7% (5/34)</td>
<td>16.7% (4/24)</td>
<td>22.4% (13/58)</td>
</tr>
<tr>
<td>Transient nerve palsies</td>
<td>5.9% (2/34)</td>
<td>---</td>
<td>5.2% (3/58)</td>
</tr>
<tr>
<td>Amputations</td>
<td>10.2% (5/49)</td>
<td>2.2% (1/45)</td>
<td>6.4% (6/94)</td>
</tr>
<tr>
<td>Local tumor recurrence</td>
<td>34.7%</td>
<td>33.3%</td>
<td>34.0%</td>
</tr>
</tbody>
</table>

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Objective: Mesenchymal chondrosarcoma (MSC) is a rare variant of chondrosarcoma. Because of the rarity of the disease, most studies contain only a small number of patients. Thus, its clinical features, prognostic variables, and role of adjuvant therapies in its treatment remain controversial.

Methods: We retrospectively reviewed the cases of MSC diagnosed and treated from 1965 to 2010. Thirty-seven cases were analyzed for demographics, treatments, oncologic outcomes and prognostic factors. Survival was estimated using the Kaplan-Meier plots and analyzed by using the log-rank test. The average follow-up period was 5.8 years (range from 1 month to 17.3 years).

Results: There were 17 women and 20 men. The mean age at diagnosis was 33 years (range from 11 to 65 years). Nineteen cases were skeletal and 18 cases were extraskeletal. Seventy-six percent of the tumors were located in the trunk. Seven patients presented with metastasis. Initial treatment of the primary tumor constituted tumor resection alone in 8, resection and chemotherapy in 13, resection and radiotherapy in 5, and a combination of resection, chemotherapy and radiation in 8. A total dose of external beam radiotherapy was 56 gray on average. During the course of treatment and follow-up, 22 patients developed metastatic disease and 7 patients developed local recurrence. Five- and 10-year overall survival was 51% and 37%, respectively. Five- and 10-year disease-free survival was 23% and 5%, respectively. By univariate analysis of all 37 patients, treatment without radiotherapy was significantly associated with poor recurrence-free survival (p=0.04). Age, gender, origin and site of the tumor, surgical margin and chemotherapy failed to show significant association with overall, disease-free, metastasis-free or recurrence-free survival. In analysis of the selected 30 patients who presented with only localized disease, age younger than 30 years was associated with decreased overall survival (p=0.04) and male gender was associated with decreased disease-free survival (p=0.03). In addition, treatment without radiotherapy was again significantly associated with poor recurrence-free survival (p=0.04).

Conclusions: This is the largest study analyzing the survival rates and prognostic variables of the patients with MSC. While the treatment of this rare tumor remains controversial, the present study reinforces the role of adjuvant radiotherapy for local tumor control.

See pages 167 - 176 for financial disclosure index.
**DEDIFFERENTIATED CHONDROSARCOMA: A SINGLE-INSTITUTION REVIEW OF 41 CASES**

*Satoshi Kawaguchi, MD*; *Tao Sun*; *Patrick P. Lin, MD*; *Michael Deavers*; *Bryan S. Moon, MD*; *Robert L. Satcher, MD, PhD*; *Alberto G. Ayala*; *Valerae O. Lewis, MD*  

*1Orthopaedic Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA; 2Pathology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA; 3Pathology, The Methodist Hospital, Houston, TX, USA*

**Objective:** Dedifferentiated chondrosarcoma (DDC) is a variant of chondrosarcoma characterized by two distinct histopathologic components. Currently, DDC remains a significant therapeutic challenge. In the present study, we evaluated treatment outcomes and prognostic variables of patients with DDC, focusing on impact of ifosfamide-based chemotherapy regimens on the oncologic outcome.

**Methods:** Forty-one cases of DDC diagnosed and treated at the author’s institution from 1986 to 2010 were analyzed for demographics, treatments, oncologic outcomes and prognostic variables. Survival was estimated using the Kaplan-Meier plots and analyzed by using the log-rank test. The average follow-up period was 26 months (range from 1 month to 23 years).

**Results:** There were 14 women and 27 men. The mean age at diagnosis was 58 years (range from 26 to 86 years). Seven patients were presented with metastasis. Surgical resection alone was performed in 11 patients, resection and chemotherapy in 26 patients, resection and radiotherapy in 2 patients, and a resection, chemotherapy and radiotherapy in 2 patients. Ifosfamide-based regimens were used in 16 patients. The median survival time was 11 months. Two- and 5-year disease-specific survival was 30% and 15%, respectively. Univariate analysis of all 41 patients revealed that pathologic fracture, positive margin, treatment without ifosfamide-based chemotherapy and presence of metastasis at diagnosis were significantly associated with poor survival (p<0.05). In contrast, age, gender, site of the tumor, and size of the tumor failed to show prognostic significance. Analysis of the 34 patients who presented with a localized disease again revealed pathologic fracture, positive margin, and treatment without ifosfamide-based chemotherapy as the variables associated with poor survival (p<0.05). Five-year disease-specific survival of those patients, who had been presented with a localized disease and treated with ifosfamide, was 33%. Among 28 patients who underwent chemotherapy, the 16 patients treated with ifosfamide-based regimens had a significant survival benefit compared to those 12 patients who were treated with other chemotherapy regimens (P=0.01).

**Conclusions:** We found that DDC still carried poor prognosis. However, it appears that ifosfamide-based adjuvant chemotherapy combined with margin-negative surgical resection provides the optimum oncologic outcome.
**Objective:** Epithelioid hemangioma (EH) of bone is a benign vascular tumor that can be locally aggressive. It rarely arises in the spine and the optimum management of EH of the vertebrae is not well delineated. This report describes our experience treating six patients with EH of the spine.

**Methods:** The Bone Sarcoma Registry at Massachusetts General Hospital was used to obtain a list of all patients diagnosed with epithelioid hemangioma of the spine. Medical records, radiographs and pathology reports were retrospectively reviewed in all cases. Only biopsy proven cases were included.

**Results:** The six patients included 5 males and 1 female who ranged in age from 20-58 years (with an average age of 40). The follow-up available for all five patients ranged from 6-115 (average 46.8) months. All patients presented with lytic vertebral body lesions. Five patients presented with pain secondary to their tumor and the tumor in the sixth patient was found incidentally during the work up for a herniated disc. Three patients required surgical management for instability secondary the destructive nature of their tumors, and two other patients required emergent decompression secondary to spinal cord compression by the tumor. The sixth patient was treated expectantly after biopsy confirmation. Three patients received postoperative radiation therapy as gross tumor remained after surgery. Three patients had gross total resections and did not receive post-operative radiation. Pre-operative embolization was utilized in 4 patients. One patient continued to have back pain after surgery and radiation and another continued to have ataxia after surgery and radiation. No tumor locally recurred or progressed.

**Conclusions:** Our data suggest that EH of the spine can be locally aggressive and lead to instability and cord compression. Surgery is required in such instances, however, observation should be considered in patients without instability or cord compression.
AMPUTATION FOR EXTREMITY SOFT TISSUE SARCOMA DOES NOT INCREASE OVERALL SURVIVAL: A RETROSPECTIVE COHORT STUDY
Vignesh K. Alamanda1; Samuel N. Crosby1; Kristin R. Archer1; Yanna Song2; Jennifer L. Halpern, MD1; Herbert S. Schwartz, MD1; Ginger E. Holt, MD1
1Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, TN, USA; 2Department of Biostatistics, Vanderbilt University Medical Center, Nashville, TN, USA

Objective: To determine if amputation increases survival when compared to limb salvage surgery in patients with a soft tissue sarcoma (STS) of the extremity when there is often a misconception among physicians and patients that ablative surgery eliminates local recurrence and increases overall survival.

Methods: This retrospective cohort study assessed 278 patients with STS and compared 18 patients who had undergone amputations for soft tissue sarcomas of the extremities to a comparative cohort of 260 patients who underwent limb salvage surgery during the same time period.

Results: Our limb salvage surgery (LSS) rate was 94% overall for soft tissue sarcomas with a median follow-up of 3.1 years. Patients undergoing amputations either had tumors that involved a critical neurovascular bundle (in particular nerve rather than vessel resection was more responsible for a decision towards ablation), or underlying bone or had neoplasms whose large size would require such an enormous resection that a functional limb would not remain. In comparing prognostic effects, mainly death due to sarcoma, distant metastasis and local recurrence, it was found that there was no statistically significant difference between patients undergoing amputation and those undergoing limb salvage surgery. (p > 0.05).

Conclusions: While amputations do not increase overall survival in soft tissue sarcomas of the extremity as compared to LSS, they are still a valuable option in a surgeon’s arsenal. In particular, amputations can provide improved local control and symptomatic treatment in patients who might not be candidates for limb salvage surgery.
INHIBITION OF SYT-SSX ONCOPROTEIN BY ANTISENSE OLIGODEOXYNUCLEOTIDES INHIBITS CELL VIABILITY IN SYNOVIAL SARcoma

Emily E. Carmody Soni, MD; Aykut Uren; Jeffrey A. Toretsky

1Orthopaedic Oncology, Medstar Georgetown Orthopaedic Institute, Washington, DC, USA; 2Oncology, Georgetown University, Washington, DC, USA

Objective: Synovial sarcoma has a characteristic translocation t(X;18) that results in a unique fusion protein, SYT-SSX in over 90% of cases. Little is known how this fusion protein contributes to the oncogenesis of synovia sarcoma. This novel, tumor-specific proteins provides a unique opportunity for the development of highly selective anticancer drugs that has yet to be exploited. Targeting of this protein may lead to further insight into its role in onogenesis, and may contribute to the development of tumor specific therapeutic agents.

Methods: Synovial sarcoma cell lines were previously established from primary tumor samples. Cell lines are maintained in DMEM supplemented with 15% FBS. Cell lines were subtyped by PCR using SSX1/SSX2 specific primers (Integrated DNA Technologies, Corallville, IA). Sequence analysis was performed (Genewiz, South Plainfield, NJ) to verify the coding sequence of SYT-SSX in our cell lines. Cell lines were treated with sequence-specific antisense oligodeoxynucleotides (ODN) against the SYT-SSX fusion protein. SYT-SSX protein levels were evaluated by western blot analysis. Cell viability was examined 72 hours after treatment.

Results: All cell lines were found to be of the SYT-SSX1 subtype and contain a specific deletion that results in the loss of Exon 8 from the expected coding sequence of the SYT-SSX protein. After treatment of the primary synovial sarcoma cell lines with antisense ODNs targeted against the SYT-SSX fusion protein, we saw a significant reduction in SYT-SSX protein levels in both the GUSS-1 and GUSS-3 cell lines, indicating a successful knock down of the target protein. In the GUSS-1 cell line we saw a 50% decrease in cell growth compared to untreated controls and in the GUSS-3 cell line we saw a 62% decrease in cell growth compared to untreated controls.

Conclusions: Successful knock down of the SYT-SSX fusion protein causes a significant decrease in cell viability in primary human synovial sarcoma cell lines, indicating that this fusion protein is imperative for tumor cell growth. Targeting this tumor specific protein provides a promising strategy for the development of uniquely effective, tumor-specific anticancer agents. Future work will focus on identification of specific protein sequence targets for the development of small molecules against these regions as tumor specific therapeutic agents.

See pages 167 - 176 for financial disclosure index.
EWS/FLI-RESPONSIVE GGAA-MICROSATELLITES EXHIBIT POLYMORPHIC DIFFERENCES BETWEEN EUROPEAN AND AFRICAN POPULATIONS

Michael J. Monument, MD¹; R. Lor Randall, MD, FACS¹; Stephen L. Lessnick, MD, PhD²
¹Sarcoma Services; Department of Orthopaedic Surgery, Huntsman Cancer Institute; University of Utah, Salt Lake City, UT, USA;
²Oncological Sciences, Huntsman Cancer Institute; University of Utah, Salt Lake City, UT, USA

Objective: To assess length-dependent polymorphisms of GGAA microsatellites within the promoter/enhancer region of direct EWS/FLI target genes in European and African populations. Given that European populations have a 10-fold greater incidence of Ewing sarcoma relative to African populations, and that EWS/FLI-mediated gene expression is positively correlated with an increasing number of GGAA-repeat motifs, our initial hypothesis was that subjects of European descent would have significantly larger GGAA-microsatellites.

Methods: The GGAA-microsatellites of 3 direct EWS/FLI targets (NR0B1, CAV1 and GSTM4), necessary for oncogenic transformation in Ewing sarcoma were sequenced from 100 healthy subjects of European and African descent. GGAA-microsatellites were assessed for the following characteristics: total number of GGAA repeats, number of repeat segments, longest consecutive GGAA repeat and total microsatellite length.

Results: The GGAA-microsatellites of all tested genes were polymorphic in both European and African populations. The NR0B1 GGAA-microsatellite was the most highly polymorphic, with the number of GGAA-repeats ranging from 16-60 and 14-72 in Europeans and Africans, respectively. While the characteristics of the CAV1 and GSTM4 microsatellites were similar across both populations, the NR0B1 microsatellite in African subjects was significantly larger, harboring more repeat motifs, a greater number of repeat segments, and longer consecutive repeats, than in European subjects.

Conclusions: These results are biologically intriguing as NR0B1 is the most highly enriched and regulated EWS/FLI bound gene required for oncogenic transformation in Ewing sarcoma. These data suggest that GGAA-microsatellite polymorphisms in the NR0B1 gene might influence disease susceptibility and prognosis in Ewing sarcoma in unanticipated ways.

<table>
<thead>
<tr>
<th>NR0B1, CAV1 and GSTM4 microsatellite characteristics</th>
<th>European</th>
<th>African</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NR0B1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsatellite length (bp)</td>
<td>97.9 +/- 46 (65-246)</td>
<td>129.8 +/- 62 (57-299)</td>
</tr>
<tr>
<td>Number of GGAA motifs</td>
<td>24.8 +/- 11 (16-44)</td>
<td>33.8 +/- 15 (14-72)</td>
</tr>
<tr>
<td>Longest consecutive repeat</td>
<td>10.9 +/- 1 (9-16)</td>
<td>12.0 +/- 2 (9-21)</td>
</tr>
<tr>
<td>Number of repeat segments</td>
<td>3.0 +/- 1 (2-7)</td>
<td>3.7 +/- 2 (1-9)</td>
</tr>
<tr>
<td><strong>CAV1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsatellite length (bp)</td>
<td>160.5 +/- 31 (138-190)</td>
<td>164.5 +/- 13 (134-194)</td>
</tr>
<tr>
<td>Number of GGAA motifs</td>
<td>23.2 +/- 2 (18-29)</td>
<td>24.1 +/- 2 (18-29)</td>
</tr>
<tr>
<td>Longest consecutive repeat</td>
<td>9.3 +/- 3 (6-10)</td>
<td>10.0 +/- 2 (6-10)</td>
</tr>
<tr>
<td>Number of repeat segments</td>
<td>3.8 +/- 0.4 (3-4)</td>
<td>3.8 +/- 0.4 (3-4)</td>
</tr>
<tr>
<td><strong>GSTM4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsatellite length (bp)</td>
<td>74 +/- 4 (60-89)</td>
<td>80 +/- 17 (55-189)</td>
</tr>
<tr>
<td>Number of GGAA motifs</td>
<td>19 +/- 1 (10-23)</td>
<td>19 +/- 2 (10-23)</td>
</tr>
<tr>
<td>Longest consecutive repeat</td>
<td>11 +/- 2 (9-15)</td>
<td>12 +/- 2 (9-15)</td>
</tr>
<tr>
<td>Number of repeat segments</td>
<td>2 +/- 0.2 (2-3)</td>
<td>2 +/- 0.6 (2-4)</td>
</tr>
</tbody>
</table>

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♦ Indicates the FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an “off label” use).
• FDA information not available at the time of printing. For full information, refer to inside back cover.
See pages 167 - 176 for financial disclosure index.
Objective: Giant Cell Tumor of Bone (GCT) is an aggressive skeletal tumor characterized by local bone destruction, high recurrence rates and metastatic potential. Developing an understanding of the biology of the tumour is important to subsequent creation of more effective therapeutic options. Previous work in our lab, including functional assays, has shown that neutralization of PTHrP in the cell environment inhibits cell proliferation and induces cell death in GCT stromal cells, indicating a role for PTHrP in cell propagation and survival. The objective of this study was to investigate the global gene and protein expression patterns of GCT cells in order to identify the underlying pathways and mechanisms of neoplastic proliferation provided by PTHrP in the bone microenvironment.

Methods: Primary stromal cell cultures from ten patients with GCT were used in this study. Cells were exposed to optimized concentrations of either PTHrP peptide (Pp), anti-PTHrP neutralizing antiserum (Pab) or IgG control, and were analyzed with both cDNA microarray and proteomic microarray assays in triplicate. Multiple bioinformatics tools were used to analyze changes in gene/protein expression and identify important gene ontologies and pathways common to this anti-PTHrP-induced regulatory gene network. Data was verified by real-time PCR for all 10 patient specimens.

Results: Hierarchical clustering and principal component analyses confirmed that counteraction of PTHrP in GCT stromal cells results in a clear-cut gene expression pattern distinct from all other treatment groups and the control cell line hFOB (Figure 1). PTHrP neutralization interferes with multiple cell survival and apoptosis signalling pathways by triggering both death receptors and cell cycle-mediated apoptosis, particularly via the caspase pathway, TRAIL pathway, JAK-STAT signaling pathway, and cyclin E/CDK2-associated G1/S cell cycle progression. Summary of the identified pathways are shown schematically in Figure 2.

Conclusions: These findings indicate that PTHrP neutralization exhibits anticancer potential by regulating cell cycle progression and apoptosis in bone tumor cells, with the corollary being that PTHrP is a pro-neoplastic factor that can be targeted in the treatment of bone tumors, GCT in particular.
See pages 167 - 176 for financial disclosure index.
INTRONIC SINGLE NUCLEOTIDE POLYMORPHISM (SNP) OF CALM-1 GENE IS SIGNIFICANTLY ASSOCIATED WITH OSTEOARTHRITIS KNEE: A CASE CONTROL STUDY

Rajeshwar N. Srivastava, MD; Divya Sanghi, PhD Scholar; Saloni Raj, MBBS Scholar

1Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India; 2Orthopaedic Surgery, MS Ramaiah Medical College, Bangalore, India

Objective: Though the pathology of osteoarthritis is well defined, the etiological factors are not fully characterized. Genetic exploration of genome has resulted in several susceptibility loci isolation confirming the genetic association of disease. The Japanese population has shown higher incidence of osteoarthritis in patients having intronic and core promoter SNP in CALM-1 gene. At the same, Caucasian and Greek population showed absence of any such predisposition in their population with the CALM-1 gene SNP. The objective of the study was to determine the association of CALM1 gene polymorphism with knee osteoarthritis.

Methods: We planned a case control study in patients of primary osteoarthritis knee with aims being to study the presence of CALM-1 gene SNP, correlation of its presence with osteoarthritis and its correlation with clinico-radiological stage of the disease. 120 cases and 120 controls were enrolled. Clinico-radiological features were noted and symptomatic clinical scoring was done. Genetic polymorphism in relation to intronic region of Calm-1 gene was studied by DNA extraction, PCR and RFLP method. Statistical analysis was done using Stata software.

Results: 39 (32.50%) cases and 18 (15%) controls showed the presence of SNP which was significant (P value = 0.0022). Among SNP positive cases and controls, 5 (8.7%) cases and none controls were heterozygosis for the occurrence of SNP. On regression of affecting variables against SNP, taking the presence of osteoarthritis as dependent variable, we calculated the adjusted odds ratio of all the significant variables.

Conclusions: CALM-1 gene intronic SNP (rs3213718) is present in Indian Population. The target SNP is significantly affecting the disease as the difference between cases and controls is highly significant (p value = .0022). Females are more predisposed for OA. Mean age of presentation in cases was 53.31 +/- 9.5 years. Age is a significant factor in causation of disease. However it is not influenced by existence of SNP. Between cases and controls, height, weight and BMI did not show any significant difference.
ETHNICITY AND AGE DISPARITIES IN EWING SARCOMA OUTCOME
Bianca Koohbanani; Gang Han; Damon Reed, MD; Evita Henderson, MD; Ding Yi, MD; Pietro Ruggieri, MD, PhD; Marilyn M. Bui, MD, PhD

1 Anatomic Pathology, Moffitt Cancer Center, Tampa, FL, USA; 2 Biostatistics Core, Moffitt Cancer Center, Tampa, FL, USA; 3 Sarcoma, Moffitt Cancer Center, Tampa, FL, USA; 4 Honors College and Project “Inspire “at Moffitt Cancer Center, University Of South Florida, Tampa, FL, USA; 5 Pathology, Beijing JiShuiTan Hospital, Beijing, China; 6 Orthopaedics, Rizzoli Institute, Bologna, Italy

Objective: Known prognostic factors of Ewing sarcoma (ES) include tumor stage and location. Previous literature regarding ethnicity and outcome in ES has been contradictory. Information is sparse in older ES patients (pts), especially those >40 years (yr) of age. This study is intended to investigate the outcomes of ES pts treated at a US oncology center with regards to ethnicity and age to explore other potential prognostic factors.

Methods: ES pts from Moffitt during 1987-2011 were studied retrospectively. Variables analyzed include ethnicity, age of diagnosis, gender, tumor location, tumor size, metastasis, treatments, date of death or date of last visit, and survival time. Kaplan-Meier’s product limit approach, log-rank test, and Cox regression models were used to determine the significance of prognostic factors. These data will be compared with international collaborators from China and Italy.

Results: A total of 135 ES pts were identified including 108 non-Hispanic white, 19 Hispanic, 5 Black, 2 Indian or Pakistani, and 2 of other decent. A total of 127 pts of either Hispanic, and/or non-Hispanic white ethnic background, were subjected to the statistical analysis, due to the small patient population of other ethnic groups. There were 15% Hispanic/Latino, 85% non-Hispanic/Latino, 27% <18 yr, and 21% >40 yr. Follow-up time ranged from 1-272 months (median at 41). Age was significantly associated with overall survival (OS) (p=0.01), whereby pts <18 yr had a higher probability of survival (5 year OS 61%) than pts >40 yr (5 year OS 37.6%). Other factors significantly associated with survival were tumor metastasis (p<0.0001) and stage (p=0.0062). Ethnicity was marginally statistically significant (associated with OS, p=0.065). Whereby ethnicity showed non-Hispanic/Latino white pts had a median survival of 63 months, and Hispanic/Latino patients 23 months, which was clinically significant.

Conclusions: In addition to previous well known factors, Hispanic ethnicity and age are independent poor prognostic factors for ES pts.

See pages 167 - 176 for financial disclosure index.
POST RADIATION BONE SARCOMA: A SINGLE INSTITUTIONAL EXPERIENCE ON 45 CASES
Pietro Ruggieri, MD, PhD; Elisa Pala, MD; Andreas F. Mavrogenis, MD; Andrea Angelini, MD; Carlo Romagnoli, MD; Douglas Letson, MD, PhD

1IV Department of Orthopaedics, Istituto Ortopedico Rizzoli, Bologna, Italy; 2Orthopedics, Moffitt Cancer Center, Tampa, FL, USA

Objective: Radio-induced sarcomas of bone is a rare entity. The incidence, latency from radiation therapy, treatment and survival have been difficult to evaluate. We report our experience about incidence, treatment and outcome of patients from a single Institution followed at long term. We retrospectively reviewed our experience to characterize prevalence, treatment, relapse and survivorship at long term follow up of this rare disease.

Methods: Forty-five patients were treated from 1980 to 2008 at our Institution for post radiation bone sarcomas. 18 male and 27 female with a mean age of 45 years (range: 14-78 years). Sites included: 13 femurs, 11 pelvis, 6 tibias, 4 clavicles, 4 scapulas, 2 spine, 2 humerus, 2 skulls and 1 sacrum. The mean radiation exposure dose for each patient was 33 Gy (range from 25 to 50 Gy) with a mean interval from radiation of 15.1 years (range 5-30 years). There were 33 secondary osteosarcomas and 12 secondary high grade spindle cell sarcomas. 38 pts had surgery: resection in 26 cases, amputation in 12 cases. Margin were wide in 30 cases, marginal in 5, intralesional in 3. All pts received chemotherapy, 38 pts received surgery and chemotherapy, 6 pts chemotherapy only and one patient underwent embolization. Statistical analysis with Kaplan Meier curves and Cox regression multivariate analysis were performed.

Results: At a mean follow up of 4 years, (range: 3 months-21 years) 19 patients were disease-free, 7 were alive with disease, 19 died with disease, 6 (13%) local recurrences were observed and 15 (33%) patients developed lung metastases. Kaplan Meier curves showed an overall survival of 48% at 5 and 10 years. At Cox regression multivariate analysis the prognostic influence of age, histology, size and site of tumour, types of treatment was evaluated. None of the variables had significant influence on prognosis of pts with post-radiation bone sarcomas.

Conclusions: Post radiation sarcoma were high grade osteosarcomas in the majority of cases. They used to have a poor prognosis, worse than classic osteosarcoma. With the association of neoadjuvant chemotherapy and surgery, about half of the patients survived at 10 years. On multivariate analysis, no variable significantly affected survival. Prognosis for patients with post-radiation sarcomas is still poor compared to primary sarcomas but it remarkably improved with combined chemotherapy and surgery.
HIGH FAILURE RATE OF INTERNAL FIXATION OF PATHOLOGIC FRACTURES OF THE FEMUR FOLLOWING SOFT TISSUE SARCOMA RESECTION AND RADIATION THERAPY

Amir Sternheim; Jasjit Lochab, MD; Patrick O’Donnell, MD, PhD; William Eward, MD; Anthony Griffin; Jay S. Wunder, MD; Peter C. Ferguson, MD, MSC, FRCSC
Mount Sinai Hospital, Toronto, ON, Canada

Objective: To determine the clinical outcomes of radiation-induced pathologic fractures of the femur treated with internal fixation in patients who had previously undergone wide resection of soft tissue sarcoma together with adjuvant radiation.

Methods: A retrospective database review identified 946 patients who underwent resection of soft tissue sarcoma in conjunction with radiation therapy from 1986 to 2006. Radiation-induced pathologic fractures developed in 61 (6.5%) patients of which 20 involved the femur (7 males, 13 females). Complications following internal fixation of radiation-induced femoral fractures due to non-union, hardware failure, secondary fracture or deep infection were identified.

Results: Mean age at index tumor surgery was 59 years. The mean time from index surgery to fracture was 71 months (range 2-195). Fourteen tumors were located in the anterior compartment, 5 posteriorly and 1 medially. Mean tumor diameter was 13.8cm. Eleven patients (55%) underwent periosteal stripping. Eight patients received 50 Gy and 12 received 66 Gy of radiation. The fracture pattern was transverse in 12 (60%) and short oblique in 8 (40%) patients. There were 11 diaphyseal fractures treated with an antegrade intramedullary nail, and 9 intertrochanteric and subtrochanteric fractures treated with an intramedullary nail or a sliding hip screw (6 and 3 respectively). No fixations were augmented with bone graft. 55% of fractures were fixed at community hospitals. The mean time to follow-up after fracture fixation was 73 months (minimum 12 months). The complication rate following fracture fixation was 90%. Ten (50%) patients had radiographic non-union at 12 months, 5 (25%) had hardware failure, 2 (10%) had infected non-unions and 1 (5%) developed a second radiation-associated femur fracture following initial fixation. Of those 18 patients with complications, 12 (67%) underwent subsequent revision surgery.

Conclusions: Internal fixation of pathologic fractures of the femur after radiation for sarcoma has an extremely high complication rate and requires special attention. These fractures are often fixed in community hospitals so general awareness of this issue is important. We advocate consideration of prosthetic replacement in treating these fractures primarily and further research into understanding radiation-induced fracture healing biology.
SILVER NEGATIVE PRESSURE DRESSING WITH VACUUM-ASSISTED CLOSURE OF MASSIVE SOFT TISSUE LOSS INVOLVING THE PELVIS AND EXTREMITIES

Herrick J. Siegel, MD; Brad Culotta, MD
Orthopaedic Surgery, UAB, Birmingham, AL, USA

Objective: Massive pelvic and extremity soft tissue loss remains a complex and cumbersome problem. Infection is often responsible for delayed healing, persistent drainage, pain, and other complications. Vacuum-assisted closure (VAC) technology has proven to be effective in the management of soft tissue loss. The use of a silver dressing in conjunction with the VAC may inhibit the colonization of drug resistant organisms and sustain early granulation leading to expedited healing. Silverlon™ is a highly concentrated negative pressure dressing that is a knitted fabric dressing that has been silver-plated by means of a proprietary autocatalytic chemical (reduction-oxidation) plating technique. This is the first study in the literature describing the use of a silver negative pressure dressing in combination with the wound VAC in the management of massive soft tissue defects involving the pelvis and/or extremities.

Methods: Between January 2003 and January 2010, 42 patients treated were treated for massive pelvic and/or extremity wounds (>20 cm) and were managed with the VAC device. The study group included 29 patients with sarcomas, 11 trauma patients, and 2 patients with chronic osteomyelitis and recurrent soft tissue abscesses. The patients were randomized prospectively between the Silverlon negative pressure dressing and wound VAC and the wound VAC alone group. Follow up ranged from 3 months to 1 year. Wounds were evaluated by the primary surgeon and home health care workers for outcome. Successful outcome defined as complete wound healing without infection. Statistical Complications associated with treatment were recorded. Surgical technique for wound VAC placement with and without Silverlon is described.

Results: Hospital stay (p<0.045), length of overall treatment (p<0.025), number of operative debridements (p<0.05) and success of wound closure without the need for soft tissue transposition (p<0.35) was found to be significantly less in the silver negative pressure dressing group compared to those with the VAC device alone. No local or systemic toxicity was observed from the silver impregnated dressing.

Conclusions: The adjunct use of a silver negative pressure appears to have several benefits and may be used safely in the management of massive soft tissue defects whenever wound VAC therapy is applicable.
HUMAN ACELLULAR DERMAL MATRIX WRAPPING OF COMPLEX KNEE RECONSTRUCTIONS MINIMIZES DEEP INFECTIONS AND ALLOWS FOR EXCELLENT RANGE OF MOTION WITH PROLONGED IMMOBILIZATION

David King, MD; Robert Whitfield, MD; Eric L. Barker, BS; John C. Neilson; Donald A. Hackbart, MD
1Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA;
2Plastic and Reconstructive Surgery, Medical College of Wisconsin, Milwaukee, WI, USA

Objective: Complex knee reconstructions are at increased risk of wound breakdown and deep infection. A compromised soft tissue envelope can result from previous surgery, infections, tumor, and chemotherapy or radiation therapy. To minimize the risk of deep infection in these complex knee reconstructions we have provided wrapping of the endoprosthetic with human acellular dermal matrix. We chose this biomaterial due to its ability to revascularize, decrease the inflammatory reaction around implants, resist infection if exposed, and for its inherent ability to stretch.

Methods: A retrospective chart review of the initial 17 consecutive patients who underwent human acellular dermal matrix wrapping of their knee reconstructions was performed. The heterogeneous population of complex primary tumor and revision knee reconstruction patients selected to have coverage of their prosthesis with human acellular dermal matrix were deemed to be at high risk for post-operative wound breakdown by the musculoskeletal oncologist and plastic surgeon. Outcome measures included deep infection, pre and post-operative range of motion (ROM), time of post-operative immobilization, and incidence of wound-healing problems.

Results: Three patients underwent coverage for primary reconstruction for tumor without prior reconstruction attempts. Fourteen patients underwent coverage for revision of a previous failed reconstructive surgery. Two patients were lost to follow-up. There were no deep infections. Eleven of fifteen patients were immobilized for > 3 weeks. Median pre-operative ROM for the revision patients was 90 degrees (average 85) (range 15 - 125). Median post-operative ROM was 100 degrees (average 104) (range 90 - 130). Three patients who underwent primary reconstruction for tumor had median post-op ROM of 125 degrees (average 120) (range 100-130).

Conclusions: Human acellular dermal matrix wrapping of complex knee reconstruction patients felt to be at high risk of wound dehiscence resulted in no deep infections. Despite prolonged knee immobilization to facilitate wound healing, patients were able to gain excellent range of motion. Human acellular dermal matrix wrapping of knee reconstructions may improve clinical outcomes in patients at high risk for wound failure and arthrofibrosis due to tumor or a compromised soft tissue envelope.
ABDUCTOR DEFICIENCY TREATED WITH A GLUTEUS MAXimus ROTATIONAL FLAP
Herrick J. Siegel, MD; Justin Duke, MD
Orthopaedic Surgery, UAB, Birmingham, AL, USA

Objective: Abductor weakness may lead to a trendelenburg gait and hip instability. Most commonly seen with revision total hip surgery, other potential etiologies are lumbar stenosis, infection and tumor resections. The treatment loss of the gluteus medius and minimus function is somewhat limited. Whiteside has described a technique whereby the gluteus maximus is transferred to the insertion of the medius and divided to be used a substitute for the anterior hip capsule and minimus.

Methods: The study includes 12 patients with abductor deficiency with severe trendelenburg gait and/or hip instability. The follow up ranged from 6 months to 2 years with mean of 15 months. The causes of abductor loss in this series included antiprotrusio cage reconstruction (7), tumor resections (4), and infections (2). Patients were allowed to immediately weightbear in an abduction brace for 8 weeks.

Results: There were no intraoperative complications associated with the muscle transfer. The average blood loss was 400 cc/ procedure with a range from 200 to 850 cc. Two of 12 patients received post op transfusions. One patient was taken back at 4 weeks post op for a persistent hematoma and one was treated with a wound VAC for partial dehiscence. At last follow up, 7 patients had no evidence of Trendelberg gait (no assistive devices), 2 had a subtle limp with mild discomfort (cane for ambulation), and 3 (including 2 previously infected patients) continued to have a severe limp with pain (walker/wheelchair). No post operative hip dislocations were noted.

Conclusions: The best functional results were seen in patient who had undergone revision total hip surgery and those with a history of infection had the worst results. Overall, 9 of 12 (75%) had good to excellent results at last follow up. The gluteus maximus muscle transfer is a viable option for abductor deficiency.
RADIONOMICS
Robert Gillies, PhD
Chair, Department of Cancer Imaging and Metabolism; Vice-Chair, Department of Radiology
Co-Director, Experimental Therapeutics Program; Moffitt Cancer Center, Tampa, FL

NAVIGATION
Edward Y. Cheng, MD
University of Minnesota, Minneapolis, MN

NOTES

See pages 167 - 176 for financial disclosure index.
SARCOMA VACCINE
Anthony Conley, MD
Assistant Member Moffitt Cancer Center, Sarcoma Program Medical Oncology, Tampa, FL

SARCOMA MOLECULAR ONCOLOGY
W. Jackson Pledger, PhD
Deputy Center Director, Moffitt Cancer Center, Tampa, FL

SARCOMA PROTEOMICS
Soner Altiok, MD
Associate Member, Anatomic Pathology, Moffitt Cancer Center, Tampa, FL

LIMB INFUSION
Rick Gonzalez, MD
Associate Member, Moffitt Cancer Center, Tampa, FL

TOTAL CANCER CARE
Damon Reed, MD
Associate Member, Moffitt Cancer Center, Sarcoma Program Medical Oncology, Tampa, FL

NOTES

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NOVEL METHODS TO DETECT PRIMARY OSTEOSARCOMA GROWTH IN A MURINE MODEL

Herbert S. Schwartz, MD; Heather Cole; Jiro Ichikawa, MD; Jeffry Nyman, PhD; Jonathan G. Schoenecker
Orthopaedic Surgery, Vanderbilt, Nashville, TN, USA

Objective: Aggressive osteosarcoma (OGS) characteristically manifests with rapid intra-osseous growth and pulmonary metastasis. The murine model is an excellent representation of the human condition as mice develop rapid growth of the ’primary’ tumor with subsequent lung metastasis. The current methods of quantifying primary tumor growth such as caliper measurement and traditional micro-computed tomography (μCT) are unreliable and fluorescent labeling requires manipulation of the cell and imaging equipment. Therefore, we set out to develop methodology that would allow for characterization of ‘primary’ tumor growth in the linear range of development.

Methods: In this study, we set out to validate additional tools of monitoring primary osteosarcoma growth by employing i) X-ray in vivo using a contralateral limb not injected with tumor as an internal control and ii) anisotropy based on μCT to quantify tumor progression. A total of 18 mice were used in the study.

Results: We found that radiographs allow for quantification of tumor growth represented by significantly (p<0.0001) enlarging radio-opaque area by 3 weeks. Additionally, radiographs proved more precise than indirect caliper measurements (intra-observer error ±6.64%; inter-observer error ±15.84%). Anisotropy, μCT measurement of tissue organization, was found to be significantly lower in tumor burdened femurs (2.488±0.91) compared to control (6.60±2.98) (p<0.0001) and was more reliable at detecting OGS than traditional μCT measures (BV/TV).

Conclusions: Here we demonstrate two novel techniques which can be employed to monitor primary murine OGS growth. The addition of serial X-ray evaluation to the murine model of OGS offers longitudinal quantification of in vivo ‘primary’ tumor growth without requiring genetic manipulation of the cell reducing cost and samples size of studies. Further, we determined that analysis of bone anisotropy by μCT is a more sensitive measure of primary tumor progression than traditional measures of uCT and is an ideal complement to histological techniques. These methods, combined with analysis of pulmonary metastasis, afford a complete assessment of osteosarcoma in the murine model.

See pages 167 - 176 for financial disclosure index.
Objective: To develop an osteosarcoma mouse model that mimics the natural history of invasion and metastasis. Secondly, we evaluate the diagnostic value of three-dimensional (3D) imaging of a tumor mass that is amendable to non-invasive detection of tumor growth and pulmonary metastases from co-registered x-ray computed topography (CT) combined with bioluminescence.

Methods: Luciferase expressing Osteosarcoma 143B cells were injected into the distal femur of ten nude mice. They were placed in a stereotactic frame. 2D x-ray and 3D high resolution images of bioluminescence were taken once a week for 8 weeks. Twenty mice with osteosarcoma at distal femurs were randomly assigned to treat with doxorubicin. Treatment outcomes were assessed by bioluminescence 3D CT.

Results: Ninety percent of mice showed tumor progression. Thirty percent of the animals developed pulmonary metastasis evidenced by bioluminescence imaged at 7-8 weeks after tumor injection. Mice treated with doxorubicin showed decreased tumor size compared with control group. The high resolution bioluminescence 3D CT reconstruction images were significantly superior to 2D imaging in terms of the clarity in visualization of tumor volume, the surrounding tissue invasiveness and earlier detection of pulmonary metastasis.

Conclusions: 3D CT - bioluminescence images provide reliable, real-time, and non-invasive observation of tumor progression and pulmonary metastases in living osteosarcoma xenograft. This procedure can be used to evaluate efficacy of new therapies.
WHOLE BODY MAGNETIC RESONANCE IMAGING IN COMPARISON TO WHOLE BODY BONE SCINTIGRAPHY FOR THE DETECTION OF METASTASES IN PATIENTS WITH PRIMARY BONE TUMOURS

Elizabeth Gillott, MRCS, MBBS; Stephen Ng Man Sun, MBBS MRCS; Jonathan R. Perera; Michelle Calleja; Philippa Tyler; Sajid Butt; Asif Saifuddin; Rob Pollock; John Skinner; Will Aston; Tim W. Briggs
London Sarcoma Service, Royal National Orthopaedic Hospital, Stanmore, United Kingdom

Objective: The aim of this prospective, double-blinded study was to compare Whole Body Magnetic Resonance Imaging (WBMRI) to Whole Body Bone Scintigraphy (WBBS) for the detection of metastases in patients with primary bone tumours. To determine whether WBMRI alone is a sound/reliable modality to detect bony metastases and determine disease stage in patients with osteosarcoma and Ewing’s Sarcoma.

Methods: 41 consecutive patients with a new diagnosis of osteosarcoma or Ewing’s Sarcoma were prospectively studied using WB-MRI and WB-BS between January 2008 and December 2011. The images were transferred to anonymised unpaired discs. All the WB-MRI and WB-BS images were reported in isolation by two separate radiologists using a double-blind technique. Each subject received a score representing radiological evidence of metastases (1 = no metastases, 2 = abnormality, not likely to be metastatic, 3 = abnormal appearance, probably metastases, 4 = definite metastases). Agreement was measured using the Kappa Statistic.

Results: WB-MRI detected cases of metastases that had not been seen on WB-BS, and of these the WB-MRI was able to detect multiple sites metastases where the WB-BS has been negative. WB-BS did indicate lesions that were found to be cases of hyperaemia. In addition MRI can pick up extraosseous soft tissue masses and other pathologies. The Kappa Correlation Coefficient showed moderate to substantial agreement.

Conclusions: WB-MRI proved as good as WB-BS in the detection of Primary lesion. Using WB-MRI, we were able to confirm or exclude a metastasis in areas of mild hyperemia seen on bone scanning. Though WB-BS may be superior to WB-MRI in the detection of rib and skull metastases. WBMRI identified more patients with metastases than Bone Scan whilst being more specific. It also exposed the patient to a lower radiation dose. It is our experience that WB-MRI offers a reliable alternative to WBBS and we now use it alongside WB-BS in order to detect metastases and therefore plan the clinical management of this patient group.
Metastases seen on WB-MRI but not seen on WB-BS

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SURGICAL TREATMENT OF ACETABULAR INSUFFICIENCY IN MUSCULOSKELETAL ONCOLOGY
Francis Patterson, MD; Kathleen S. Beebe, MD; John Hwang, MD; Joseph Benevenia, MD
Orthopaedics, UMDNJ, Newark, NJ, USA

Objective: The objective was to evaluate outcome, complications, and functional results following treatment of pelvic-acetabular insufficiency using acetabular cages, allograft prosthetic composite saddle prostheses and custom implants.

Methods: Patients that were included had acetabular reconstructions for primary and secondary musculoskeletal tumors and extensive bone loss from non-oncologic conditions. Cage-reconstructable (Standard): Patients required partial or complete resection of the acetabulum while preserving a portion of both the ilium and ischium. These were reconstructed with ilio-ischial flange type cages. Extensive bone loss (Complex): Patients were left with a portion of the ilium only without ischial support. These patients had saddle prosthesis, custom prostheses, or APCs.

Results: Thirty-four patients, with a mean age of 56, were included with 12 males and 22 females with an average follow-up time of 35 months. Ten patients had primary acetabular tumors, 21 secondary tumors, and three patients with non-oncologic acetabular insufficiencies. Twenty patients had defects treated using cages with ilio-ischial flanges, while the remaining 14 patients had complex defects treated with custom implants (n=3), the saddle prostheses (n=5), and APCs (n=7). Overall average MSTS score for patients was 20 (66%). Seventeen patients had complications including 5 dislocations, 5 infections, 4 DVT’s, 3 hematomas, 2 aseptic loosening, and one recurrence.

Conclusions: Treatment of acetabular deficiencies for large skeletal defects is challenging our results are similar to other studies showing complications in older patients with associated metastatic disease, and use of allografts.

See pages 167 - 176 for financial disclosure index.
DURABILITY OF CEPHALOMEDULLARY NAIL FIXATION FOR TREATMENT OF METASTATIC PERIITROCHANTERIC FEMORAL LESIONS

David Chafey, MD; Valerae O. Lewis, MD; Bryan S. Moon; Robert L. Satcher, MD, PhD; Patrick P. Lin, MD
Orthopedic Surgery, MD Anderson, Houston, TX, USA

Objective: The optimal approach to the stabilization of the proximal femur in patients with metastatic peritrochanteric femoral lesions is not well-established. This study reviewed the durability of CMN fixation of metastatic peritrochanteric femoral lesions and evaluated the causes for failure.

Methods: A retrospective chart review was conducted of patients treated with CMN for metastatic bone disease or myeloma from 1/1900 - 12/2009 at a single institution. 203 consecutive patients (208 nail procedures, 5 patients had bilateral fixation) with symptomatic bony metastasis isolated to the peritrochanteric region of the femur were identified. 59 patients (29%) presented with an acute displaced fracture and were admitted urgently. Mean age of patients was 59 years and the female:male ratio was 1:1. The most common primary disease associated with the indication for fixation was breast carcinoma (22%) followed by lung carcinoma (21%), renal cell carcinoma (18%), and multiple myeloma (9%). In addition to cephalomedullary nailing, 78 patients (39%) underwent curettage of metastatic deposit with cement augmentation. Failure was defined as implant breakage or loss of fixation requiring reoperation in order to restore the stability of the proximal femur.

Results: The median survival after surgical intervention was 8 mos (range 1 to 134). Fixation was maintained until last follow-up in 185 patients (91%). In the prophylactic nailing group, the failure rate was 10% (15/149), and in the fracture group the failure rate was 6% (3/59). 6/78 patients (8%) who initially underwent curettage/cement augmentation required revision due to disease progression. Median time to failure was 11 mos (range 3 to 15). Failure of fixation was attributed primarily to tumor progression in

54 y/o female with metastatic breast cancer and impending left femur fracture. Pre-op image (top left) and 1 month post-op (top right). Disease progression resulted in revision but hardware remained intact at 13 months (bottom left). Total femur endoprosthesis 1 month after revision (bottom right).
42% of cases and hardware failure or loss of fixation in 58% of cases. The failure rate was highest for renal cell carcinoma (6/36, 17%). The conversion rate to proximal or total femur endoprosthesis was 6%.

**Conclusions:** Failure rates are at or below 10% even if they are used to treat pathologic fractures. Although lung carcinoma was the second most common primary disease, we observed only 1 failure in this group, possibly related to poor patient survival. Curettage of metastatic deposits and concurrent cement augmentation may decelerate disease progression in certain diseases such as renal cell carcinoma.

See pages 167 - 176 for financial disclosure index.
A COMPARISON OF PEDIATRIC ALLOGRAFT AND IMPLANT LIMB SALVAGE
Antoinette W. Lindberg, MD1; Stephanie Punt1; Jed K. White1; Viviana Bompadre, PhD2; Darin Davidson, MD1; Ernest U. Conrad, MD2
1Orthopaedics and Sports Medicine, University of Washington, Seattle, WA, USA; 2Orthopedics and Sports Medicine, Seattle Children’s Hospital, Seattle, WA, USA

Objective: We compared pediatric limb salvage techniques identifying issues leading to surgical revision, complications, function, and failure. Outcome results were compared for allograft and oncologic implants for function and revision surgery.

Methods: 272 pediatric patients from 1991-2011 were evaluated for results of an osseous limb salvage procedure. Inclusion criteria were patient age (<18 years of age) and having an allograft or implant limb reconstruction. 29.7% (81/272) of patients were excluded for curettage, autogenous grafts, or resection without reconstruction. Reconstructions included 96 allografts and 113 oncology implants in 191 patients. 30.4% (58/191) patients were less than 12 years of age and 69.6% (133/191) patients were greater than 12 years of age. Average age at surgery was 13.8 years and average follow up was 6.1 years. Average follow was 5.5 years in the allograft group and 6.6 years in the implant group. Final function was evaluated by an activity monitor, or by MSTS criteria (good, excellent, fair, poor).

Results: The implant procedure involved the distal femur/proximal tibia in 79.6% (90/113) of implants and 61.5% (59/96) of allografts. Secondary procedures were required in 46.9% (53/113) of implants, occurring most commonly for aseptic loosening (15.0%; 17/113) and 56.2% (54/96) of the allografts. Allografts experienced 33.3% (32/96) minor revisions, 50.0% (48/96) major revisions, and 5.2% (5/96) failed. Allografts requiring a major revision occurred most commonly for a nonunion 19.8% (19/96). 8.3% (8/96) of allografts and 6.2% (7/113) of implants required removal for infection. Amputations were unusual for both groups and occurred most commonly for local tumor recurrence (7.7%). Both groups had comparable local tumor recurrences (7.3 vs. 8.8%) (Table I). Average MSTS score in both groups for function, support, and gait was “Good” (4/5). Leg length discrepancies in patients less than 12 years old were found in 8.8% (10/113) of implants and 10.4% (12/96) of allografts. 1.8% (2/113) of implants and 3.1% (3/96) of allografts had leg length discrepancies in patients over 12 years old (Table II).

Table I. Summary

<table>
<thead>
<tr>
<th></th>
<th>Allografts (N=96)</th>
<th>Implants (N=113)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distal Femur/Proximal Tibia</td>
<td>59/96 (61.5%)</td>
<td>90/113 (79.6%)</td>
</tr>
<tr>
<td>Any Second Surgery</td>
<td>54/96 (56.2%)</td>
<td>53/113 (46.9%)</td>
</tr>
<tr>
<td>Nonunion/Aseptic Loosening (Major Revision)</td>
<td>19/96 (19.8%)</td>
<td>17/113 (15.0%)</td>
</tr>
<tr>
<td>Deep Infection</td>
<td>8/96 (8.3%)</td>
<td>9/113 (8.0%)</td>
</tr>
<tr>
<td>Amputation (Failed)</td>
<td>5/96 (5.2%)</td>
<td>10/113 (8.8%)</td>
</tr>
<tr>
<td>Post-operative Tumor Recurrence</td>
<td>7/96 (7.3%)</td>
<td>9/113 (8.8%)</td>
</tr>
</tbody>
</table>

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Conclusions: Children are at higher risk for limb salvage failure with cemented implants. Both groups experience a high risk (46.9-56.2%) of second procedures but experienced good functional results (87.7%). Achieving growth in children under 10 years is partially successful. Tumor control was attained in 92% of patients.

Table II. Functional assessment and leg length summary

<table>
<thead>
<tr>
<th></th>
<th>Allografts (N=76/96)</th>
<th>Implants (N=86/113)</th>
<th>Overall (Allografts+Implants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unassisted</td>
<td>74/86 (86.0%)</td>
<td>68/76 (89.5%)</td>
<td>142/162 (87.7%)</td>
</tr>
<tr>
<td>Partial Support</td>
<td>16/86 (18.6%)</td>
<td>8/76 (10.5%)</td>
<td>24/162 (14.8%)</td>
</tr>
<tr>
<td>Leg Length Discrepancies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;12 years old</td>
<td>3.1% (3/96)</td>
<td>1.8% (2/113)</td>
<td></td>
</tr>
<tr>
<td>&lt;12 years old</td>
<td>10.4% (12/96)</td>
<td>8.8% (10/113)</td>
<td></td>
</tr>
<tr>
<td>Range (Average)</td>
<td>0.25-6.0cm (2.5cm)</td>
<td>1.5-10.0cm (3.3cm)</td>
<td></td>
</tr>
</tbody>
</table>
A DUAL-CENTER REVIEW OF COMPRESSIVE OSTEOREINTEGRATION FOR FIXATION OF MASSIVE ENDOPROSTHETICS: 2-9 YEAR FOLLOW-UP

George T. Calvert, MD; Judd E. Cummings, MD; Kevin B. Jones, MD; L. Daniel Wurtz, MD; R. Lor Randall, MD, FACS

1Orthopaedic Surgery, Huntsman Cancer Institute and Primary Children’s Medical Center, University of Utah, Salt Lake City, UT, USA;
2Orthopaedic Surgery, Indiana University, Indianapolis, IN, USA;
3Orthopaedic Surgery, Orthopaedic Surgical Oncology of Arizona, Phoenix, AZ, USA

Objective: Mechanical failure of massive endoprosthetics used in the reconstruction of major skeletal defects created by tumor resections remains a significant clinical problem. Fixation using compressive osteointegration was developed as an alternative to cemented and traditional press fit fixation in an effort to decrease mechanical failure rates. This study evaluates the use of this technology in a consecutive series of cases from two institutions.

Methods: The first 50 index cases utilizing compressive osteointegration fixation from two tertiary referral centers were retrospectively studied from a prospectively collected cohort. Clinical records and imaging studies were evaluated. Rates of re-operation, mechanical failure, and failure for any cause were calculated. Demographic, surgical, and oncologic factors which may influence failure rates were analyzed.

Results: Fifty consecutive cases utilizing compressive osteointegration for fixation of femoral, tibial, or humeral endoprostheses were reviewed. Minimum follow-up was 2 years with a mean of 66 months. Median age at the time of surgery was 14.5 years. Osteosarcoma was the most common diagnosis (39 cases) followed by Ewing sarcoma (3) and chondrosarcoma (3). There were 19 (38%) unplanned re-operations at an average of 11 months post-operatively. Planned re-operations for lengthening or closed manipulations were excluded. A total of 15 (30%) implants were removed for any reason (infection, arthrofibrosis, fracture, disease recurrence, and mechanical failure). Of these revisions, 7 (14%) were due to mechanical failure. Five of the seven mechanical failures occurred at less than 1 year (average 8.3 months), and none occurred beyond 17 months. Five of the seven mechanical failures were successfully revised to a new stem, one required amputation, and one was lost to follow-up. Age, operative site, chemotherapy use, and radiation use did not correlate with failure in this cohort.

Conclusions: Compressive osteointegration performed as well or better than tradition endoprosthetic fixation methods at early to mid-term follow-up. Most mechanical failures occurred in the first year after surgery, and most were successfully revised with another implant. Longer follow-up will be required to determine if this technique is ultimately superior to other forms of fixation.
Demographic, surgical, and oncologic factors of the patient cohort.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
<th>Any Re-operation</th>
<th>Any Revision</th>
<th>Mechanical Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Mean)</td>
<td>20.5</td>
<td>23.2</td>
<td>24.8</td>
<td>23.1</td>
</tr>
<tr>
<td>Male/Female</td>
<td>25/25</td>
<td>13/8</td>
<td>11/5</td>
<td>5/2</td>
</tr>
<tr>
<td>Diagnosis other than Osteosarcoma</td>
<td>13</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Resection Length</td>
<td>17.8</td>
<td>17.4</td>
<td>16.6</td>
<td>15.9</td>
</tr>
<tr>
<td>Derotation Pins (Y/N)</td>
<td>15/35</td>
<td>7/14</td>
<td>5/11</td>
<td>1/6</td>
</tr>
<tr>
<td>Resection Length</td>
<td>17.8</td>
<td>17.4</td>
<td>16.6</td>
<td>15.9</td>
</tr>
<tr>
<td>Diagnosis other than Osteosarcoma</td>
<td>13</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
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<td>13</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Resection Length</td>
<td>17.8</td>
<td>17.4</td>
<td>16.6</td>
<td>15.9</td>
</tr>
<tr>
<td>Derotation Pins (Y/N)</td>
<td>15/35</td>
<td>7/14</td>
<td>5/11</td>
<td>1/6</td>
</tr>
<tr>
<td>Compression Force 400/600/800</td>
<td>9/35/6</td>
<td>5/15/1</td>
<td>3/12/1</td>
<td>1/5/1</td>
</tr>
<tr>
<td>Compression Force 400/600/800</td>
<td>9/35/6</td>
<td>5/15/1</td>
<td>3/12/1</td>
<td>1/5/1</td>
</tr>
<tr>
<td>Compression Force 400/600/800</td>
<td>9/35/6</td>
<td>5/15/1</td>
<td>3/12/1</td>
<td>1/5/1</td>
</tr>
<tr>
<td>Spindle Size Custom/Small/Large</td>
<td>16/21/13</td>
<td>8/8/5</td>
<td>6/7/3</td>
<td>2/5/0</td>
</tr>
<tr>
<td>Spindle Size Custom/Small/Large</td>
<td>16/21/13</td>
<td>8/8/5</td>
<td>6/7/3</td>
<td>2/5/0</td>
</tr>
<tr>
<td>Time to Re-operation or Failure (Months)</td>
<td>N/A</td>
<td>10.8</td>
<td>12.4</td>
<td>8.3</td>
</tr>
<tr>
<td>Time to Re-operation or Failure (Months)</td>
<td>N/A</td>
<td>10.8</td>
<td>12.4</td>
<td>8.3</td>
</tr>
<tr>
<td>NED/DOD</td>
<td>44/6</td>
<td>19/2</td>
<td>14/2</td>
<td>6/1</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>45</td>
<td>19</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Radiation Therapy</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Kaplan-Meier curve of mechanical failures.

See pages 167 - 176 for financial disclosure index.
Objective: Additive Layer Manufacturing (ALM) is becoming an important fabrication technique for orthopaedic implants and is particularly suited for the demanding requirements of specialised implants such as those used in limb salvage. ALM has already proven its capability for producing small complex components for the aerospace industry. The ALM process uses a high-powered laser to selectively sinter fine powder such as a titanium alloy, in ultra-thin layers enabling complex free-form components to be built layer by layer. ALM is ideal for one off components, that can build rapidly forms and structures such as lattices that would be impossible using conventional subtractive manufacturing techniques currently used. This aim of this study was to describe the adoption of ALM into the design and fabrication process of titanium alloy limb salvage devices.

Methods: The first clinical application using selective laser sintering fabrication of a titanium alloy implant was undertaken in November 2010. A 62 year old male with a chondrosarcoma of periacetabulum required an extensive resection of the ilium and sacro-ilial joint saving only a small part of the superior public ramus. A 3 dimensional model was created from CT scans, from which the implant was designed. Key features of the implant design included extensive lattice structures at the SI joint and pubic ramus bone interfaces, transverse sacral bolts a large medialized acetabular socket and integral flanges anterior and posterior at the sacral joint. The 3D lattice structures were hydroxyapatite coated to encourage osseointegration.

Results: The pelvic device was implanted with the aid of navigation. Following an uneventful rehabilitation, the patient at 6 months was full weight bearing with a stick. At 18 months the patient remains active and radiographically there is the appearance of bony ingrowth into the lattice structure. To date, 7 scapular and 7 pelvic replacements have been implanted. The early use of this advanced manufacturing route for patient specific limb salvage implants been very encouraging as it enables the engineer to produce a more anatomical conforming implant with integral 3D lattice structures for bone and soft tissue integration.

Conclusions: It is anticipated that laser-based ALM will be key process in the development of the next generation of limb salvage implants.
RADIOPHGRAPHiC ANALYSiS oF CEMEnTED LARGE SEGMEnT EnDoPRoSTHESES FoR DiSTAL FEMoRAL TUMoR RESECTion: EV ALUATiON FoR ASEPTiC LooSEninG

Jeff Toreson, MD; Mustafa Al Sultan, MD; Robert E. Turcotte, MD, FRCSC

1Orthopedic Surgery, McGill University, Montreal, QC, Canada;
2Department of Radiology, McGill University Health Centre, Montreal, QC, Canada

Objective: Endoprosthetic replacement for distal femoral bone tumor resection has become a preferred method of reconstruction in the skeletally mature individual. Some authors have reported concern of high aseptic loosening in cemented components (6-32%). This has led to some using cementless implants. Previous work from our institution showed cement was not detrimental to long term success of distal femoral implants. Our technique involved reaming line-to-line and cementing without pressurization.

Methods: A retrospective review of radiographs of all distal femur (MRS and GMRS, Styker Orthopedics, Mahwah,NJ) from 1990 until 2010 was undertaken. All were from a single surgeon and all had the standard 127mm stem with cemented polyethylene tibial component. Radiographs were assessed by 2 independent reviewers and scored for radiolucencies (>1mm). Loosening was then graded on the following scale: 1. Not Loose (<50% lucency). 2. Possibly Loose (lucency 50-99%) 3. Probably Loose (100% Lucency - No position change) 4. Definite Loosening (migration/position change). We also recorded the final reamer/stem diameters, length of resection, tumour type, adjuvant treatment modalities, bushing exchange/revision surgery and infection.

Results: Series comprised 70 patients and no patients were lost to follow-up. Patient demographics are reported in table 1. The average radiographic follow up was 7.2 years (58% had f/u > 5 years). First, both reviewers scored all tibial components as “Not Loose”. Examiner A found 89% of femoral components to be “Not Loose” and 11 % percent (n=6) “Possibly Loose”. Examiner B found 96% of femoral components to be “Not Loose” and 4% (n=2) to be “Possibly Loose”. No components scored as Probably or Definitely Loose. The 2 distal femoral components reported be Examiner B to be “Possibly Loose” were also reported as such by Examiner A. No revision surgeries were done on any patients for either loosing or broken stem.

Conclusions: Albeit of small number, this series found no radiographic evidence of “Probable or Definite” loosening supporting previous works. Cementing a prosthesis with the best canal fit and with a very thin cement mantle appears to be a viable option.
Table One- Patient Demographics

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Age</td>
<td>41</td>
</tr>
<tr>
<td>% Primary Bone Sarcoma</td>
<td>89 (n=62)</td>
</tr>
<tr>
<td>% Receiving Post-operative Radiotherapy</td>
<td>4.3 (n=3)</td>
</tr>
<tr>
<td>% Receiving Post-Operative Chemotherapy</td>
<td>63 (n=44)</td>
</tr>
<tr>
<td>Average Length of Bone Resection (cm)</td>
<td>18 (range 11-30)</td>
</tr>
<tr>
<td>Average size of Final Reamer (mm)</td>
<td>13.7 (range 11-17)</td>
</tr>
<tr>
<td>Average Stem Size (mm)</td>
<td>13.5 (range 11-17)</td>
</tr>
<tr>
<td>Bushing Exchange (complete or pending)/ Patella Resurfacing %</td>
<td>17.1 (n=12)</td>
</tr>
<tr>
<td>Infection rate %</td>
<td>11.4% (n=8)**</td>
</tr>
<tr>
<td>% Antibiotic Cement Used *</td>
<td>85 (n=57)</td>
</tr>
</tbody>
</table>

* 1gm of Tobramycin per 40gm pack cement

** 2 infections after secondary procedure, Primary infection rate 8.6% (n=6)

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EFFECT OF SIMULATED WEIGHT BEARING ON MICROMOTION AND PULLOUT OF UNCEMENTED FEMORAL STEMS
Jennifer S. Barr, MD; Antoinette W. Lindberg, MD; Jed K. White; Randal Ching, PhD; Darin Davidson, MD; Ernest U. Conrad, MD
1Orthopedics and Sports Medicine, University of Mississippi, Jackson, MS, USA; 2Orthopaedics and Sports Medicine, University of Washington, Seattle, WA, USA; 3Mechanical Engineering, University of Washington, Seattle, WA, USA; 4Orthopedics and Sports Medicine, Seattle Children’s Hospital, Seattle, WA, USA

Objective: Published reports for oncologic total knees show revision rates of 20-30% at 10 years. Aseptic loosening is the primary cause of stem failure for cemented implants with improved results for uncemented stems. Our goal was to evaluate whether simulated early weight bearing may increase micromotion and reduce pullout strength of uncemented distal femoral stems.

Methods: 8-matched pairs of fresh human cadaveric femoral specimens were obtained from LifeNet Health Northwest. Each specimen was prepared with a 13cm distal femoral resection to accommodate the implant and the proximal end embedded in bone cement to facilitate testing. A straight fluted press-fit stem design was used with the same reaming steps and stem size on each side. The 8 pairs of femurs were randomly assigned to either the “cycled” or “uncycled” group with the cycled group receiving a 700N compressive load applied for 5000 cycles to simulate one week of early full weight bearing of a 71Kg adult in the postop period. This level of activity was taken from previous step counter data collected from postop limb salvage patients in our institution. Cyclical and pullout testing was performed on an MTS servohydraulic test system. During pullout testing, both peak force and the amount of force necessary to induce 150μm of micromotion were recorded. 150μm was chosen as the endpoint for micromotion—an accepted threshold of movement known to cause fibrous instead of osseous ingrowth.

Results: During cycling, we found insignificant levels of micromotion that trended lower after 5000 cycles of simulated weight bearing (Fig. 1). In comparisons of cycled vs. unceded groups, implants demonstrated no significant differences in pullout load to failure (p=0.3) (Fig. 2). Pullout occurred prior to the micromotion failure threshold (150μm) in 6/8 cycled implants. The remaining two cycled implants completely failed at 154μm (6842N) and 181μm (3111N) of micromotion.

Conclusions: The force required for uncemented implant pullout exceeded clinical expectations. Mean difference in peak micromotion between the first and last 50 cycles was 9μm. Implant pullout (failure) occurred concurrently with the previously established micromotion thresholds in the majority of specimens. Uncemented implant fixation with the straight fluted stem appears to tolerate early weight bearing loads in cadaveric specimens without significant micromotion or stem fixation failure.

Figure 1. Mean peak amplitude of implant micromotion for 5000 cycles of simulated weight-bearing
Figure 2. Mean cycled vs. uncycled failure loads (p = 0.3)

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TOTAL HUMERAL ENDOPROSTHETIC REPLACEMENT FOLLOWING EXCISION OF MALIGNANT BONE TUMORS

Suhel Kotwal, MD; Bryan S. Moon, MD; Robert L. Satcher, MD, PhD Patrick P. Lin, MD; Valerae O. Lewis, MD
Orthopedic Oncology, MD Anderson Cancer Center, Houston, TX, USA

Objective: Humerus is a common site for malignant musculoskeletal tumors. Advances in adjuvant therapies and reconstructive methods provide salvage of the upper limb with improved functional and oncological outcomes. Osteo-articular allografts, allo-prosthetic composites and endoprosthetic replacements following segmental resection of humerus are well described; however, reports of limb salvage with total humeral endoprosthetic replacement in extensive humeral tumors are sparse in literature. Our objective was to report functional and oncological outcomes of this procedure.

Methods: We undertook a retrospective study of 20 patients who underwent total humeral endoprosthetic replacement as limb salvage following excision of extensive malignant tumor of the humerus from 1990 to 2011. Eleven had primary malignant bone sarcoma, while 9 had metastatic disease. Fourteen patients were adults and 6 were pediatric with mean age of 40.9 years. Average follow-up was 42.8 months with maximum being 172 months. Functional and oncological outcomes were analyzed.

Results: Ten patients were still alive at the time of review, while 10 died of malignant disease. Mean estimated blood loss was 1077.5ml and duration of surgery was 299 minutes. Deep prosthetic infection was encountered in one patient requiring irrigation, debridement with retention of components, and mechanical loosening of ulnar component was identified in one patient, not requiring further surgery. Symptomatic subluxation of prosthetic humeral head was noted in 3 patients who proceeded to receive revision surgery. Mean active shoulder abduction was 12.5° and active flexion was 15°. Incompetence of abduction mechanism was the major determinant of poor active functional outcome. Mean elbow flexion was 106° with 30.5° flexion contracture in 10 patients with good and useful hand function. Implant survival at final follow-up was 85%. Average Musculoskeletal Tumor Society Score (MSTS) was 72%.

Conclusions: Total humeral endoprosthetic replacement can provide a reliable treatment option in indicated patients restoring mechanical stability and reasonable functional results of the upper limb without compromising patient survival, with low complication rate. In general, even in older patient population, this is a preferable elective alternative to a shoulder disarticulation.
RADIOMICS OF SARCOMA-COMPUTER AIDED IMAGE ANALYSIS AND CHARACTERIZATION OF TUMOR HETEROGENEITY

Meera Raghavan, MD; Mu Zhao; Lawrence Hall; Dmitry Goldgof; Robert Gatenby

1Department of Radiology, H. Lee Moffitt Cancer and Research Center, Tampa, FL, USA; 2Department of Computer Science and Engineering, University of South Florida, Tampa, FL, USA

Objective: Apply computer-aided, spatially-explicit image analysis to MRI examinations of soft tissue sarcomas (STS) in the extremities to quantify tumor heterogeneity and response to treatment.

Methods: Pathologically proven malignant extremity STS were identified through retrospective imaging review. Case selection was based on tumor location in an extremity without osseous involvement and size greater than 5 cm. MRI sequences used included axial nonfat suppressed T1, axial STIR and axial T1 fat suppressed post gadolinium enhancement. A total of 11 cases were identified (4 myxoid liposarcoma, 4 pleomorphic sarcoma, 3 synovial sarcoma). Baseline and post treatment MRIs were reviewed. Slices most representative of the tumor were identified across all three sequences and region of interest (ROI) drawn around the tumor as well as the area of enhancement. Based on imaging criteria such as size, presence of enhancement and necrosis, patients were classified as responders (5), non responders (5), and mixed responders (2). Utilizing fuzzy c-means clustering, a data clustering algorithm, the images were analyzed. Analysis was performed on the entire cross section through the tumor as well as the areas of enhancement. Two-dimensional color maps were generated from data points obtained from the clustering algorithm in three-dimensional space, based on pixel intensity values.

Results: Our analysis found that 3 distinct intratumoral “habitats” could be identified within all of the tumors although there was considerable inter-tumoral variation in their relative abundance. Tumor response could be quantified as a change in the percentage of each “habitat” in the cross sectional area of the tumor pre- and post-treatment.

Conclusions: Sophisticated image analysis can define distinct sub-regions (“habitats”) within each tumor based on combinations of imaging features from several MRI sequences and allows spatial variations within soft tissue sarcomas to be assessed and quantified. Initial investigation indicates this technique provides novel data for assessing response to therapy in malignant extremity STS. Characterization of tumor heterogeneity prior to initiation of treatment may have important therapeutic and prognostic implications.
SUCCESSFUL PROSTHETIC REHABILITATION FOLLOWING HIP DISARTICULATION OR HEMI-PELVECTOMY: THE MAYO CLINIC EXPERIENCE

Michael Kralovec, MD1; Karen Andrews, MD2; Matthew Houdek1; Courtney Sherman, MD1; Thomas Shives, MD1; Peter Rose1; Franklin Sim, MD1

1Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN, USA;
2Department of Physical Medicine and Rehabilitation, Mayo Clinic, Rochester, MN, USA

Objective: Prosthetic rehabilitation following hemipelvectomy and hip disarticulation surgeries has been considered by some to be a non-viable option. Subsequently, many patients are never fit with a prosthesis. The objective of the study was to evaluate the characteristics of successful prosthetic users, to determine what factors are predictive of successful prosthetic use, and to evaluate the functional impact of prosthetic use.

Methods: We reviewed our surgical database for patients who underwent hip disarticulation or hemipelvectomy between 2000 and 2010. We investigated patient demographics, characteristics hypothesized to predict unsuccessful prosthetic rehabilitation, and the usage profile of successful users.

Results: 43% of patients successfully used a prosthesis. The most common reason that a patient did not use a prosthesis was that they were not offered one. The only pre-operative factor that predicted unsuccessful prosthetic use was coronary artery disease. None of the characteristics investigated excluded a patient from being a successful prosthetic candidate, including advanced age, morbid obesity, depression, and arthritis. Successful prosthetic users ranged in age from 16-74 years old, and BMI from 18.4-36.1. They enjoyed long survival times with 89% alive at 60 months and 69% at 120 months. They wore their prosthesis for an average of 5.8 hours per day, and ambulated an average of 158 ft without resting. Most used a gait aid, with 50% able to ambulate with one or both hands free.

Conclusions: Successful prosthetic rehabilitation following hemipelvectomy and hip disarticulation is possible. High BMI, advanced age, depression, and other co-morbidities should not discourage prosthetic rehabilitation. Most patients that undergo successful prosthetic rehabilitation enjoy long periods of survival, wear their prosthesis for most of the day, and enjoy increased independence, functional mobility, and aesthetic restoration.

Level of Evidence: Therapeutic Level III

See pages 167 - 176 for financial disclosure index.
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- FDA information not available at the time of printing. *For full information, refer to inside back cover.*
Objective: Soft tissue sarcomas are most frequently located deep within fascial compartments of the extremities. Superficial soft tissue sarcomas are relatively less common. They may be managed differently than deep sarcomas because generous margins are often possible without sacrificing critical structures. Radiotherapy may be utilized less often because of these generous margins. However, small superficial soft tissue sarcomas are often not promptly recognized as such and may be frequently treated with inadequate oncologic excision prior to referral to a sarcoma centre. We sought to investigate the effect of these factors on local control.

Methods: We reviewed 467 patients with superficial soft tissue sarcoma with a minimum of 2 years’ follow-up from our prospectively maintained database at the University of Toronto/Mount Sinai Hospital between 1989 and 2009.

Results: Mean follow up was ten years. The most commonly represented tumours were undifferentiated pleomorphic sarcoma (UPS, 32 percent), leiomyosarcoma (16 percent), and dermatofibrosarcoma protuberans (DFSP, 12 percent). There were 131 (28 percent) grade 1/3 tumours, 133 (28.5 percent) grade 2/3 tumours, and 202 (43 percent) grade 3/3 tumours. 423 tumours (91 percent) were excised with negative margins while 39 (8.4 percent) were excised with microscopically positive margins and three (0.6 percent) were excised with grossly positive margins. There were 31 (6.8 percent) local recurrences. 55 patients (12.1 percent) developed distant metastatic disease following treatment. High grade was a risk factor for local recurrence (p=0.02). Having had an unplanned excision prior to referral to our center was a risk factor for local recurrence (p=0.03) and this scenario accounted for 17 of the 31 local recurrences (54.8 percent).

Conclusions: High tumour grade and previous unplanned oncologic resection are risk factors for local recurrence superficial soft tissue sarcomas.
Objective: Chick Embryo Extract (CEE) has been popularly used to fortify culture medium for the cultivation of some selected stem cells. Our previous studies have illustrated that CEE is necessary for the successful expansion highly regenerative muscle-derived stem cells (MDSCs). CEE was also found to have a DNA demethylation effect. Here we have investigated the effects of CEE in releasing the epigenetic repression of tumor suppressor genes and promoting the differentiation and apoptosis of osteosarcoma stem cells in culture.

Methods: 1. Osteosarcoma Cells: K7M2 and K12 are related murine osteosarcoma cell populations with differing metastatic potentials: K7M2 is violently metastatic to the lung but K12 is much less metastatic. Also, K7M2 cells were previously reported by our group to display much higher ALDH expression and activity than K12 cells. 2. CEE Treatment Of Cells: 0%, 2% and 4% of CEE in proliferation medium (10% FBS in DMEM) was used to culture K7M2 cells (reversibly permeabilized). Cells were incubated for 2 days before being fixed for observation or harvested for mRNA isolation. 3. Methylation-Specific PCR (MSP): MSP of tumor suppressor genes, including P16, P53, and E-cadherin, was conducted with EpiTect MSP Kit (Qiagen).

Results: 1- Highly metastatic K7M2 cells have more DNA methylation of tumor suppressor genes (i.e., P16, P53, and E-cadherin), compared with less metastatic K12 cells (Figure 1). 2- CEE promotes the demethylation of tumor suppressor genes (i.e., P16, P53, and E-cadherin) and activates their expression (Figure 1). 3- CEE represses proliferation and promotes the differentiation of K7M2 cells (Figure 2).

Conclusions: CEE may promote the transformation of cancer stem cells to normal, terminally-differentiated cells. This study may present a new mechanism to investigate tumour reversion by epigenetic reprogramming. Future studies will investigate candidate molecules contained within CEE that may be responsible for these observations.
OSTEOSARCOMA STEM CELL-TARGETED THERAPY WITH RETINAL
Xiaodong Mu, PhD; Damel Mektepbaev; Adel Mahjoub; Johnny Huard, PhD; Kurt R. Weiss, MD
Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, PA, USA

Objective: Retinoic acid has been shown to induce the differentiation and apoptosis of some cancer stem cells. Aldehyde dehydrogenase (ALDH) expression and activity are typically greater in cancer stem cells. Based on these observations, we investigated the effect of all-trans-retinal (a precursor of retinoic acid that can be transformed into retinoic acid by ALDH) on highly metastatic osteosarcoma cells.

Methods: 1. Osteosarcoma Cells: K7M2 and K12 are related murine OS cell populations with differing metastatic potentials: K7M2 is violently metastatic to the lungs but K12 is much less metastatic. K7M2 cells have been reported by our group to feature much higher ALDH expression and activity than K12 cells. 2. Retinal Treatment Of Cells: 1μl of 0, 1, or 5 mg/ml of all-trans retinal dissolved in ethanol was added to cells in proliferation medium (10% FBS in DMEM) and incubated for 2 days before the cells were fixed for observation or harvested for mRNA isolation. 3. Flow Cytometric Analysis Of ALDH Activity. The ALDH activity of cells was assessed using ALDEFLUOR Kit (STEMCELL Technologies) using the FL1 channel of a BD FACSAria Cell Sorting System and FACSDiva software (version 6.1.2) (Dickinson and Company). 4. Semi-quantitative RT-PCR for multiple growth and transcription factors important in osteosarcoma biology was performed after treatment with all-trans retinal.

Results: 1- Retinal treatment of K7M2 cells, which have higher ALDH activity than K12 cells, resulted in decreased proliferation and increased apoptosis. 2- Retinal treatment of K7M2 cells resulted in alterations of gene expression (i.e., Notch, Akt1, cMyc, BMP2, and Klotho) and morphology of K7M2 cells towards that of K12 cells (Figures 1 and 2). 3- Retinal treatment of K7M2 cells down-regulated expression of the ALDH gene and reduced the ALDH activity in K7M2 cells. 4- Retinal treatment of K12 cells, which possess lower in ALDH activity, had less effect compared with K7M2 cells.

Conclusions: Our results suggest that K7M2 cells, by virtue of their high ALDH activity, are particularly susceptible to the effects of retinal. Retinal treatment specifically promoted the apoptosis and differentiation of highly metastatic K7M2 cells. According to the fact that cancer stem cells also possess high ALDH activity, retinal may be used to specifically inhibit cancer stem cells, repress tumor development, and eliminate metastases.
THE EFFECT OF THE SETTING OF A POSITIVE MARGIN ON LOCAL RECURRENCE FOR EXTREMITY SOFT TISSUE SARCOMA

Patrick O’Donnell, MD, PhD; Anthony Griffin1; William C. Eward, MD, DVM2; Amir Sternheim, MD3; Brian O’Sullivan, MD4; Peter Chung, MD4; Charles Catton, MD4; Peter C. Ferguson, MD, MSC, FRCSC3; Jay S. Wunder, MD1

1Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA;
2Orthopaedic Surgery, Duke University, Durham, NC, USA;
3Orthopaedic Surgery, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada;
4Radiation Oncology, Princess Margaret Hospital, Toronto, ON, Canada

Objective: To evaluate the risk of local recurrence after extremity soft-tissue sarcoma (STS) resection with positive surgical margins, and the safety of sparing adjacent critical structures in this setting.

Methods: 257 patients with extremity STS and a positive resection margin were identified from a prospective database of 1,458 patients. Patients with positive margins were stratified into four groups, each representing a specific clinical scenario and thought to be associated with increasing risk: 1) low-grade liposarcoma; 2) positive margins planned preoperatively to preserve a critical structure (bone or major nerve or blood vessel); 3) positive margins on re-excision following a prior unplanned excision elsewhere; and 4) unplanned positive margins. The rate of local recurrence-free survival was calculated for all groups.

Results: 10-year local recurrence-free survival decreased incrementally from group 1 to group 4 (91.7% to 58.9%; p < 0.01). The rate of local recurrence-free survival following planned positive margins to preserve critical structures (85.4%; group 2) was significantly higher than after positive margins following prior incomplete excision (69.9%; group3) or unplanned positive margins (58.9%; group 4). In comparison, the 10-year local recurrence-free survival after sarcoma excision with negative margins was 90.2%.

Conclusions: These results show that the risk of local recurrence after resection of a STS with positive margins can be predicted based on the clinical context and supports this type of classification. In addition, salvage of critical structures including bone and major nerves and vessels directly adjacent to STS is relatively safe when planned ahead as part of multidisciplinary management. This information carries important decision-making implications for management of patients at risk of positive margin resection of a STS.
A META-ANALYSIS OF OSTEOSARCOMA OUTCOMES IN THE MODERN MEDICAL ERA
Daniel C. Allison, MD, MBA, FACS; Scott C. Carney; Elke R. Ahlmann, MD; Alex C. Fedenko, MD; Sant C. Chawla, MD; Andrew C. Hendifar, MD; Constance C. Angeles; Lawrence R. Menendez, MD, FACS
Department of Orthopedics, University of Southern California, Los Angeles, CA, USA

Objective: Four decades ago, specialized chemotherapy regimens turned osteosarcoma, once considered a uniformly fatal disease, into a disease in which a majority of patients survive. Though significant survival gains were made from the 1960’s to the 1980’s, further outcome improvements appear to have plateaued. This study aims to comprehensively review all significant, published data regarding osteosarcoma and outcome in the modern medical era in order to gauge treatment progress.

Methods: We performed a comprehensive and complete MEDLINE search, using only the search terms “osteosarcoma” and “survival.” Of 3,948 initial series found, 3,684 did not meet the study criteria, leaving a total of 264 series in the study. The data from these series was complied and evaluated according to overall survival, disease-free survival, recurrence, and limb salvage in relation to the decade of treatment.

Results: Published survival improved clinically and statistically significantly from 1960 to 1980 and then leveled, and in some measures decreased (Fig 1 & 2). Recurrence rates decreased into the 1970’s and then leveled. In contrast, published limb salvage rates have increased significantly every recent decade until the present.

Conclusions: Though significant gains have been made in the past, no improvement in published osteosarcoma survival has been seen since 1980, highlighting the importance of a new strategy in the systemic management of this still very lethal condition.

See pages 167 - 176 for financial disclosure index.
THE HISTOLOGICAL EFFECT OF NEO-ADJUVANT CHEMOThERAPY AT THE INTERFACE OF SARCOMAS AND THE ADJACENT SOFT TISSUES - PSEUDOCAPSULE FORMATION

Patrick O'Donnell, MD, PhD; Carlos Manivel, MD; Denis Clohisy, MD

1Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA; 2Orthopaedic Surgery, University of Minnesota, Minneapolis, MN, USA; 3Surgical Pathology, University of Minnesota, Minneapolis, MN, USA

Objective: To investigate the effect of neo-chemotherapy on the interface of soft tissue sarcomas and normal host tissue.

Methods: Histologic characteristics of the host tumor interface were studied in 75 soft tissue sarcomas (STS) after surgical resection. Twenty-eight resected STS were from patients treated with pre-operative chemotherapy and 47 resected STS controls were from patients receiving no neo-adjuvant therapy. Controls were matched for histologic subtype, depth, and size. No patients received radiation.

Results: The pseudocapsule was composed of two distinct layers, each with specific histological characteristics (Figure 1). The outer layer was composed of preexisting normal, compressed connective tissue, often including adipose tissue and skeletal muscle; this layer contained fibroblasts and frequent macrophages with abundant foamy cytoplasm or hemosiderin granules. The inner layer consisted primarily of hyalinized collagen and it was more prominent in regions of tumor regression. An identifiable pseudocapsule was more frequently observed in the group treated with chemotherapy and it was more frequently continuous and thicker in this group (p = 0.001). Neo-adjuvant chemotherapy decreased the number of tumors with malignant cells identified within and beyond the pseudocapsule (p = 0.07) (Figure 2).

Conclusions: The pseudocapsule in STS is composed of histologically distinct inner and outer layers and is identifiable in the majority of tumors. Neo-adju vant chemotherapy alters the host tumor interface in STS, changing the presence and composition of the pseudocapsule. These findings may provide an explanation for the proposed beneficial effect of chemotherapy in soft tissue sarcoma.
Figure 2
Fibrosarcoma after neo-adjuvant chemotherapy. Residual viable tumor cells in hyalinized inner layer show prominent degenerative changes.

See pages 167 - 176 for financial disclosure index.
IS RECONSTRUCTION OF THE PROXIMAL RADIUS NECESSARY? RESECTION ALONE FOR TUMOURS OF THE PROXIMAL RADIUS - A SERIES OF SEVEN CASES

William C. Eward, MD, DVM; Patrick O’Donnell, MD, PhD; Amir Sternheim; Anthony Griffin;
Jay S. Wunder, MD; Peter C. Ferguson, MD, MSC, FRCSC

Objective: Neoplastic conditions of the proximal radius are extremely uncommon. Unlike the situation of a comminuted fracture of the radial head, in which disruption of the structures that preserve radioulnar stability is likely to lead to proximal migration of the radius, these structures are unlikely to be disrupted during tumor resection. However the true incidence of proximal migration of the radius following oncologic resection, which may result in wrist pain and dysfunction, is unknown. Our objective is to determine the incidence of wrist pain and dysfunction in a small group of patients undergoing resection of bone tumors in the proximal radius.

Methods: We reviewed eighteen patients undergoing resection of proximal radial tumours from our prospectively maintained database at the University of Toronto/Mount Sinai Hospital between 1990 and 2012. Of these, we identified seven patients who underwent resection of the proximal radius without skeletal reconstruction. Preoperative and postoperative radiographs of the wrist and elbow were available for all seven patients.

Results: There were three patients with metastatic carcinoma, two patients with giant cell tumour, one patient with metastatic melanoma, and one patient with multiple myeloma. Mean resection length was 4.6 cm.

Overview of Patients Undergoing Proximal Radial Resection Without Reconstruction

<table>
<thead>
<tr>
<th>Patient</th>
<th>Diagnosis</th>
<th>Resection Length (cm)</th>
<th>Follow-up (months)</th>
<th>Shortening (mm)</th>
<th>Wrist Pain?</th>
<th>Associated Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GCT</td>
<td>4.8</td>
<td>70</td>
<td>5</td>
<td>No (Complained of instability)</td>
<td>Sauve-Kapandji</td>
</tr>
<tr>
<td>2</td>
<td>GCT</td>
<td>2</td>
<td>50</td>
<td>2</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>Metastatic Lung</td>
<td>7.7</td>
<td>6</td>
<td>0</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>Metastatic Lung</td>
<td>5.2</td>
<td>3</td>
<td>0</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>Metastatic Breast</td>
<td>6</td>
<td>7</td>
<td>0</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>Metastatic Melanoma</td>
<td>3.6</td>
<td>1</td>
<td>0</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>Multiple Myeloma</td>
<td>5.2</td>
<td>3</td>
<td>0</td>
<td>Yes (Mild; unclear etiology)</td>
<td>None</td>
</tr>
</tbody>
</table>

GCT = Giant Cell Tumour

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cm (range 2 to 7.7 cm). Of the two patients with benign disease, the mean time to follow-up was 60 months. Both of these patients developed postoperative radial shortening. Radial shortening was 2 mm in one patient at 50 months’ follow-up and was not associated with clinical symptoms. Radial shortening was 5 mm in another patient, was symptomatic, and was treated with a Sauve-Kapandji procedure which alleviated further symptoms. Of the patients being treated for metastatic disease and myeloma, mean survival time was 13.2 months (range 1 to 49 months). There was no radial shortening. One patient complained of mild wrist pain of unclear etiology.

**Conclusions:** We conclude that skeletal reconstruction of the proximal radius following resection for oncologic indications should be considered on a case-by-case basis. For patients with benign disease or primary tumors, proximal migration of the radius may occur without reconstruction and may lead to symptomatic ulnocarpal impingement. For patients with metastatic bone disease and a limited life expectancy, resection alone is likely sufficient.
HOW LONG AND HOW FREQUENTLY SHOULD WE FOLLOW PATIENTS WITH
SOFT TISSUE SARCOMAS?
Chigusa Sawamura1; Seiichi Matsumoto2; Takashi Shimoji2; Keisuke Ae2; Atsushi Okawa1
1Orthopaedics, Tokyo Medical and Dental University, Tokyo, Japan;
2Orthopaedics, Cancer Institute Hospital of Japanese Foundation for Cancer Research, Tokyo, Japan

Objective: Guidelines suggest that follow up for low-grade soft tissue sarcomas should be every 3-6 months for 2-3 years then annually and for high-grade sarcomas every 3-6 months for 2-3 years then every 6 months for the next 2 years then annually, although there are very limited evidence to support this strategies. We evaluated incidence of local recurrence and metastasis for different time periods to see the trend of events. We expected higher incidence of local recurrence and metastasis within the first 2 years.

Methods: Patients diagnosed with soft tissue sarcomas and who underwent surgical excision of tumor at Cancer Institute Hospital in Tokyo between 1978 to 2008 were retrospectively reviewed. Patients who had metastasis at diagnosis (M1) were excluded. Age, histologic diagnosis, FNCLCC grade, tumor location, size, adjuvant treatments were reviewed for each patient. Incidence of local recurrence and metastasis were calculated for every 2-year period and presented per 1000 person-years.

Results: 867 patients with a median age at diagnosis of 52-years were eligible for analysis. 32% of patients had low grade tumors (FNCLCC grade1) and 68% had high grade tumors (FNCLCC grade 2 or 3). 98 patients (11%) developed local recurrence at a median time of 18.8 months and 90% of patients who had local recurrence had them by within 7.1 years, 95% by 8.6 years and 99% by 20.5 years. 198 patients (23%) developed distant metastasis at median time of 11.8 months and 90% of patients who had metastasis developed them by 4.2 years, 95% by 7.3 years and 99% by 15.5 years. The rate of local recurrence was 39/1000 person-years and for metastasis was110/1000 person-years in first 2 years. These incidences were higher than those after 2 years although this trend was more evident for incidence of metastasis than of local recurrence. High grade tumors had higher incidence of local recurrence in first 2 years whereas low grade tumors recurred at a constant rate throughout the follow up period.

Conclusion: Since incidence rate of local recurrence and metastasis were higher at first 2 years for high grade tumors, it is reasonable to follow patients frequently during this period. Longer and less frequent follow up of the local site may be necessary for low grade tumors because they recurred at a constant rate. 95% of local recurrence and metastasis would be found if patients were followed up for a period of 9 years. Follow-up beyond 10 years does not yield a sufficient number of recurrences or metastases to warrant this further monitoring.
See pages 167 - 176 for financial disclosure index.
**Objective:** Well-differentiated liposarcoma and atypical lipomatous tumors are relatively common musculoskeletal tumors. The surgical management of this disease is commonly debated, and ranges from radical to intra-lesional procedures, but generally more conservative approaches are used. Tumor location and potential disability of the procedures play a role in definitive treatment. The collaborative efforts of two large musculoskeletal oncology centers are presented to better characterize these soft tissue sarcomas in the extremities.

**Methods:** A review of the medical records from 1993-2012 was performed at two participating institutions with IRB approval (The Rizzoli Institute, Italy, and Moffitt Cancer Center, USA). Cases were identified by tumor registry and database collections. Records were analyzed for pathology confirmed tissue specimens, and further divided based on tumor location (trunk and upper extremity, pelvis and lower extremity). Further clinical information was processed from the existing medical records.

**Results:** There were 195 tumors characterized as well-differentiated liposarcomas or atypical lipomas of the trunk and extremities. Of these 157(81%) were of the pelvis and lower extremities and 38(19%) were of the trunk and upper extremities. Patients were treated with intra-lesional, marginal and wide surgical resections. Ten (5%) patients received adjuvant radiotherapy. Analysis revealed 41(21%) locally recurrent. There were no cases of metastatic disease.

**Conclusions:** These data suggest that well-differentiated liposarcomas/atypical lipomatous have minimal metastatic potential; however local recurrence is of significant clinical concern. Although none of these patients developed distant metastases deaths did occur and many with recurrence suggesting that local recurrence may be associated with significant complications.
CT-BASED STRUCTURAL RIGIDITY ANALYSIS IMPROVES SPECIFICITY AND POSITIVE PREDICTIVE VALUE OVER MIRELS CLASSIC RECOMMENDATIONS FOR FEMORAL METASTATIC LESIONS: A MULTI-INSTITUTIONAL MSTS SPONSORED STUDY

Timothy A. Damron, MD; Carlos Brown, BS; Ara Nazarian; Vahid Entezari; Edward Cheng; Megan E. Anderson, MD; Richard M. Terek, MD; Albert Aboulafia; Felix Cheung; Lor Randall; Robert E. Turcotte, MD, FRCSC; Patrick P. Lin, MD; Mark Gebhardt, MD; Brian Snyder

1Department of Orthopedics, SUNY Upstate Medical University, East Syracuse, NY, USA; 2Department of Orthopedics, Harvard Medical School and Beth Israel Deaconess Biomechanics Laboratory, Boston, MA, USA; 3Department of Orthopedics, Brown University, Providence, RI, USA; 4Department of Orthopedics, University of Minnesota, Minneapolis, MN, USA; 5Department of Orthopedics, Sinai Hospital of Baltimore, Baltimore, MD, USA; 6Department of Orthopedic Oncology, University of Texas M.D. Anderson Cancer Center, Houston, TX, USA; 7Division of Orthopaedic Surgery, McGill University Medical School, Montreal, QC, Canada; 8Huntsman Cancer Institute, University of Utah School of Medicine, Salt Lake City, UT, USA; 9Department of Orthopedics, Marshall University, Huntington, WV, USA

Objective: For long bone involvement by metastases, plain radiographic techniques lack sensitivity, and Mirels criteria are sensitive but poorly specific. The purpose of this ongoing Musculoskeletal Tumor Society (MSTS) sponsored, multi-institutional prospective clinical study is to compare CT-based Structural Rigidity Analysis (CTRA) to physician-derived Mirels scoring for fracture risk prediction in femoral bone lesions.

Methods: To date, 136 patients with 161 lesions were enrolled. Patients underwent CTRA analysis and were assigned Mirels scores by the treating surgeon. A > 35% reduction in bending/torsional/axial rigidity at the lesion was considered at increased fracture risk. Of 136 patients, 32 (34/161 lesions) underwent prophylactic fixation, 59 patients had not completed 1 yr follow-up, and 13 dropped out. The remaining 39 lesions (32 pts) NOT prophylactically stabilized qualified for interim analysis, effectively excluding many patients felt clinically to be at highest fracture risk. Endpoints were (1) completion of 12-month follow-up without fracture (9 pts), (2) pathologic fracture through the lesion at risk (4 pts), or (3) death without fracture (19 pts). Mean age was 60.8 (23-88). The proximal femur or shaft was involved in all but 2 distal femur cases. Lytic lesions predominated (18) over mixed (17) and blastic (4) lesions. The most common primaries were breast (11), myeloma (6) and prostate (3).

Results: Each of the four fractures were correctly predicted by CTRA and Mirels scoring of 8 and 9 or above. Mirels score of 8 or above predicted fracture in 37/39 lesions. Mirels score of 9 or above predicted fracture in 26/39 lesions. CTRA predicted fracture in 16/39 cases. Sensitivity and negative predictive value were uniformly high, but specificity and positive predictive value were highest for CTRA when compared to Mirels 8 or 9 scores. (Table I)

Conclusions: CT-based structural rigidity analysis improves specificity and positive predictive value over Mirels using the classic cut-off of 9 points as the definition of an impending pathologic fracture. Hence, in this interim analysis, CTRA appears to be a valuable tool to predict fracture risk in patients with metastatic disease to the femur, but further accrual will strengthen the analysis.

See pages 167 - 176 for financial disclosure index.
Fracture Prediction Statistics Comparing Mirels to CTRA

<table>
<thead>
<tr>
<th></th>
<th>Mirels &gt; or = 8</th>
<th>Mirels &gt; or = 9</th>
<th>CTRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specificity</td>
<td>5.7%</td>
<td>37.1%</td>
<td>65.7%</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Positive Predictive Value (PPV)</td>
<td>10.8%</td>
<td>15.4%</td>
<td>25%</td>
</tr>
<tr>
<td>Negative Predictive Value (NPV)</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
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CTRA = CT-based Structural Rigidity Analysis (threshold of 35% reduction in torsional/axial/bending rigidity vs. contralateral or matched control femur)

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COMPUTER NAVIGATION AND PRIMARY MALIGNANT BONE TUMORS REQUIRING HEMIPELVECTOMY
David Cheong, MD; Weifeng Liu, MD; Ricardo J. Gonzalez, MD; Qing Zhang; Tao Wang; Hairong Xu; Douglas Letson, MD, PhD; Xiaohui Niu
1Sarcoma Program, Moffitt Cancer Center, Tampa, FL, USA; 2Orthopaedic Oncology, Beijing Jishui Tan Hospital Peking University, Beijing, China

Objective: Primary malignant bone tumors of the sacrum, pelvis and proximal appendicular skeleton at times require aggressive surgical management. The challenges of a hemipelvectomy have led to reports of positive margins as high as 40%. Computer Navigated surgical technology has allowed surgeons to technically improve both planning and execution of pelvic surgery. The authors present a collaborative effort of 44 pelvic surgical resections for primary malignancies of the pelvis and proximal appendicular skeleton using Computer Navigation in the planning and intraoperative resections.

Methods: Between 2007 and 2012, both institutions (JST Hospital Peking University, China, and Moffitt Cancer Center, USA) began using Computer Navigation techniques for planned resections of the hemipelvis. With IRB approval, a retrospective review of patient databases was performed searching for patients who underwent sacrum and pelvic resections and who had their surgeries performed with Computer Navigation techniques. Planned pelvic resections included both formal hemipelvectomy and internal hemipelvectomy with and without reconstruction. Use of both pre-operative imaging data (CT scans, MRI scans), and intra-operative imaging data (Arcadis Iso-C) sets were used to plan and actively navigate the surgical resections.

Results: During a retrospective review, 44 patients were identified as having undergone a hemipelvectomy. (Male 25, Female 19, average age 46.7(12-79)). Resections were performed for malignant primary tumors of bone. (Chondrosarcoma 16, Chordoma 17, Ewing 3, Osteosarcoma 3, and Malignant Spindle cell tumor 5). Patients were treated with formal hemipelvectomy and amputation (4), internal hemipelvectomy with (13) or without (27) reconstruction. Negative bone margins were obtained in 40/44 (91%) cases, with R1 (4), and R0 (40) resections. The average surgical time was recorded as 328.5 min (150min-575min). Complications included: 2 prosthesis dislocations requiring revision at 1 and 2 month postoperatively, 1 deep infection requiring revision at 19 months, 5 with superficial seroma requiring irrigation and debridement.

Conclusions: Computer Navigation techniques can be successfully used in hemipelvectomies. Early data suggests that Computer Navigation may add to the precision and accuracy of surgical resections in the osseous pelvis.

See pages 167 - 176 for financial disclosure index.
MALIGNANCY IN GIANT CELL TUMOR

Weifeng Liu, MD; David Cheong, MD; Qing Zhang; Lihua Gong; Hairong Xu; Lin Hao; Yi Ding; Yuan Li; Marilyn M. Bui, MD, PhD; Douglas Letson, MD, PhD; Xiaohui Niu

1Orthopaedic Oncology, Beijing Jishui Tan Hospital, Peking University, Beijing, China;
2Sarcoma Oncology Program, H. Lee Moffitt Cancer Center & Research Institute, Tampa, FL, USA

Objective: Malignancy in giant cell tumor (MGCT) is a confusing term that has been used to describe different type of giant cell rich tumor in the past. The malignant transformation was a relatively rare event. Primary malignancy was synchronous areas comprise high-grade sarcomatous region and benign giant cell tumor nevertheless secondary malignancy usually arising in lesions that have been treated previously with surgery or radiotherapy. The goals of this topic were to define the clinical outcome of MGCT of bone.

Methods: The authors retrospectively retrieved data from medical records and histology report of patients diagnosed giant cell tumor and treated by surgery at least one time between 1989 and 2009. 849 cases of GCT were diagnosed among our database which reported in our pathology department. From this group, primary MGCT (PMGCT) and secondary MGCT (SMGCT) were selected. Clinical, radiological, histological features, treatment and survival rate were analyzed in this study.

Results: 18 patients were diagnosed MGCT, about 2.1% of 849 cases. 5 primary and 13 secondary MGCTs. The lesion site mostly located epiphysis of extremities, 5 PMGCT contain: proximal femur (2 cases), proximal tibia (2 cases), distal tibia (1 case), 13 SMGCT contain: proximal humerus (1 case), shaft of humerus (1 case), distal humerus (1 case), distal femur (4 cases), proximal tibia (5 cases), proximal fibula (1 case). The average latent period was 57.5 months for spontaneous transformation, Comparison to benign GCT (P=0.000). 8 patients with lung metastasis (1 PMGCT and 7 SMGCT, P=0.378), 5 patients with SMGCT died for pulmonary metastasis. The clinical outcome was worse associated with SMGCT than PMGCT.

Conclusions: Malignancy in GCT of bone is confirmative high-grade sarcoma with poor prognosis. PMGCT often diagnosed benign GCT with almost the same clinicoradigraphic presentation, so the histologic examination seems to be particularly important. The character of SMGCT is more convenient to identify to prevent misdiagnosis. Campanacci classification, latent interval period between diagnosis of benign and malignant (>57.5 months), pulmonary metastasis were high risk factors in SMGCT.

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PROPHYLACTIC ANTIBIOTIC REGIMENS IN TUMOR SURGERY (PARITY): UPDATE OF A MULTICENTER RANDOMIZED CLINICAL TRIAL

The PARITY Investigators
Center for Evidence-Based Orthopaedics, McMaster University, Hamilton, ON, Canada

Objective: Deep infection following endoprosthetic reconstruction in tumor surgery is a devastating complication. There are currently no guidelines for antibiotic prophylaxis in tumor surgery and our recent survey confirmed that there is significant support among Orthopaedic Oncologists for a clinical trial aimed at establishing such guidelines. To this end, the Center for Evidence-Based Orthopaedics has begun the necessary preparations to complete such a trial.

Methods: Patients enrolled in the PARITY study must meet all of the following inclusion criteria: skeletally mature, primary bone malignancy or benign aggressive tumor of the lower extremity, and surgical excision with endoprosthetic reconstruction. All eligible patients will be randomized to one of two study arms. Patients in the ‘short’ arm will receive 1 dose of preoperative antibiotics followed by 24 hours of postoperative antibiotics. Patients in the ‘long’ arm will receive 1 dose of preoperative antibiotics followed by 5 days of postoperative antibiotics. Patients will then be followed for 1 year post-surgery. At each follow-up visit, patients will be assessed for infection, according to the CDC definition. Functional outcome and quality of life measures will also be assessed on follow-up. One hundred patients will be accrued for the PARITY pilot over a 1 year period.

Results: To-date, 12 sites are enrolled in the study (Canada & US). Primary funding for the PARITY pilot has been awarded by the OREF/MSTS. Supplementary funds have been awarded by the PSI Foundation (Toronto, Canada). McMaster University has been granted local ethics approval, and other sites are in the REB/IRB application process. The Case Report Forms, which will allow sites to record detailed data points, have been developed and validated. The DataFax Randomization System, which will allow all patients to be easily assigned to a study arm using a centralized web-based system, has been established. The central database is currently under construction.

Conclusions: Infection following tumor surgery is an important issue for Orthopaedic Oncologists. The results of our pilot study will determine the feasibility of a larger definitive trial and will help inform the development of set guidelines for antibiotic prophylaxis in the field. This will lead to fewer endoprosthetic infections and associated complications. Study enrollment is expected to begin in Summer 2012.
TREATMENT AND RESULTS IN 29 PATIENTS WITH DISTAL TIBIA OSTEOSARCOMA TREATED WITH LIMB SALVAGE SURGERY

Elisa Pala, MD; Caterina N. Abati, MD; Andreas F. Mavrogenis, MD; Pietro Ruggieri, MD, PhD; David Cheong, MD; Douglas Letson, MD, PhD

1IV Department of Orthopedics, Istituto Ortopedico Rizzoli, Bologna, Italy; 2Orthopedics, Moffitt Cancer Center, Tampa, FL, USA

Objective: Amputation has been the standard surgical treatment for distal tibia osteosarcoma. Advances in surgery and chemotherapy have made limb salvage possible. However, it is unclear whether limb salvage offers any improvement in function without compromising survival. Aim of this study was to evaluate survival, local recurrence, function and complications of patients with distal tibia osteosarcoma treated with limb salvage surgery.

Methods: We retrospectively reviewed 29 patients with distal tibia osteosarcoma treated with limb salvage surgery from 1985 to 2011 in two different Institutions. Mean age was 21 yrs (min 10 max 51 yrs). All pts received chemotherapy. All patients underwent resection and reconstruction: 8 arthrodesis, 8 intercalary allograft, 10 osteoarticular allograft (OA), 3 custom made distal tibia prosthesis. Of 10 OAs, 7 were done with preservation of the patient’s medial malleolus, which remarkably contributed to stability and fusion. Statistical analysis with Kaplan Meier curves and was performed and functional results assessed according to the MSTS system.

Results: At a mean follow up of 9.7 yrs (min. 0.5, max. 23 yrs) 19 pts are continuously NED, 3 are NED after metastasectomy, 3 are NED after amputation for local recurrence, 3 DWD and 1 dead for other disease. All the 3 cases of local recurrence required amputation. Kaplan Meier curves showed an overall survival of 85% at 10 and 20 years. Nine of the 23 cases (39%) had complications: 3 delayed union of an intercalary allograft, 2 non-unions of an intercalary allograft (one of these had infection after revision surgery and required amputation), 2 fractures of the allograft, 2 infections (1 treated with debridement and revision of internal fixation, 1 amputated). The mean MSTS functional score was 76% (ranging from 30% to 93%).

Conclusions: Good long-term survival and satisfactory function is achievable for patients with osteosarcoma of the distal tibia treated by limb salvage surgery. The risk of local recurrence needs to be considered, since its rate was 10.3%, although none of these patients died. In patients with allograft reconstruction, the rate of allograft-related complications is high (39%), but most of these complications were successfully managed. The technique of reconstruction with OA preserving the medial malleolus seems very promising, whenever feasible.
See pages 167 - 176 for financial disclosure index.
ASSOCIATION OF VITAMIN D RECEPTOR (VDR) GENE POLYMORPHISM AND VITAMIN D STATUS IN KNEE OSTEOARTHRITIS

Divya Sanghi, PhD Scholar¹; Rajeshwar N. Srivastava, MD¹; Saloni Raj, MBBS Scholar²
¹Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India;
²Orthopaedic Surgery, MS Ramaiah Medical College, Bangalore, India

Objective: Evidence suggests that low serum levels of vitamin D may increase the severity of Osteoarthritis (OA). VDR gene polymorphism is known for its association with osteoporosis. The inverse relationship between osteoporosis and OA suggests that VDR gene polymorphism is a candidate gene to be associated with OA. This study was done to analyze the association of vitamin D receptor gene polymorphism (Taq1 and Apa I) and serum vitamin D levels in knee osteoarthritis.

Methods: This case control study consisted of 180 Osteoarthritis Knee patients and 150 controls. Cases were clinically diagnosed according to ACR criteria. Gradation of the disease was done by using KL grading system on the basis of radiological findings. The serum levels of vitamin D were assessed by using kit of Enzyme Linked Immunosorbent Assay. Detection of VDR gene polymorphisms (Taq1 and Apa I) were done by PCR-RFLP technique.

Results: We observed an insignificant association for genotypes of TaqI(p=0.086) and ApaI(p=0.60) polymorphism between cases and controls. However, for TaqI marginal significant association (p=0.053, OR 1.4, 95% CI 1.008-1.945) was observed between wild type(T) allele and mutant type(t) allele, but for Apa I, there was no significant difference (p=0.334, OR 1.17, CI 1.367-1.867) between wild type(A) allele and mutant type(a) allele. We observed a significant association of low level of serum vitamin D levels in homozygous mutant(tt) genotypes as compared to heterozygous(Tt) and wild type(TT) genotypes. But in case of ApaI, we found higher serum vitamin D levels in homozygous mutant(aa) genotype in comparison to heterozygous(Aa) and wild type(AA) genotype but this difference was not statistically significant.

Conclusions: Though insignificant association was found between osteoarthritis and the genotypes of TaqI and ApaI polymorphism, a significant association with mutant allele of TaqI(t) was observed. Additionally, the association of mutant allele with reduced level of vitamin D was noted.

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ROLE OF VITAMIN D IN OSTEOARTHRITIS KNEE:  
A SIX-MONTH DOUBLE BLIND, RANDOMIZED, PLACEBO CONTROL TRIAL

Divya Sanghi, PhD Scholar¹; Rajeshwar N. Srivastava, MD¹; Saloni Raj, MBBS Scholar²

¹Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India;  
²Orthopaedic Surgery, MS Ramaiah Medical College, Bangalore, India

Objective: A six month, double blind, randomized and placebo controlled trial of vitamin D, in vitamin D insufficient OA knee subjects (serum 25(OH)D levels <50 nmol/L) was conducted.

Methods: 150 subjects of primary OA knee, diagnosed by ACR guidelines, were subjected to personal interview to determine their vitamin D intake (by 3 day dietary recall and food frequency table) and the daily sunlight exposure in hours. Serum levels of calcium, phosphorus, alkaline phosphatase and 25(OH)D were measured to determine their vitamin D profile. We identified 64 vitamin D insufficient subjects out of 150 primary OA knee patients. These were randomized by random allocation table for intervention. In cases a bolus dose of calciferol in 60,000 IU/day for 10 days followed by 6,000 IU/month for six months was administered and in controls a placebo in the same schedules and durations was given. Primary outcome measures were clinical WOMAC scores (pain, stiffness and physical function) and VAS for knee pain. Secondary outcome measures were radiological features (joint space width, osteophyte scores, subchondral sclerosis scores and tibio femoral alignment) and KL grades. Statistical analysis was performed on an intension to treat basis.

Results: There was no significant baseline difference of age, sex, analgesic frequency, dietary vitamin D intake, serum levels of vitamin D, calcium, phosphorus and alkaline phosphatase and in clinical and radiological scores between the cases and controls. BMI (25.96 vs 25.65, p=0.75) and pain (10.94 vs 10.64, p=0.66) was higher in the placebo group although difference was not statistically significant. There was no significant difference in radiological features and KL grades from baseline and at 6 months in both the groups. At six month, both the groups had an improvement in WOMAC and VAS pain scores but vitamin D showed benefit over placebo from baseline (p<0.01); for WOMAC physical function vitamin D group showed significant improvement over placebo which remained same as their baseline levels.

Conclusions: Although a long term study is being recommended to establish radiological progression, this short term randomized placebo control trial yields a beneficial effect of vitamin D in pain and physical function outcomes in KOA. Vitamin D intake was beneficial in symptomatic improvement of KOA.
GENETIC POLYMORPHISM IN GDF-5 GENE AS RISK FACTOR FOR DEVELOPMENT AND PROGRESSION OF OSTEOARTHRITIS

Rajeshwar N. Srivastava, MD; Abhishek Mishra, PhD Scholar; Saloni Raj, MBBS Scholar
Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India

Objective: In a case-control study, investigate the association of SNP in GDF-5 gene with osteoarthritis knee.

Methods: 300 cases with knee osteoarthritis and an equal number of age, gender matched healthy controls were included. Cases were diagnosed using the ACR Guidelines of knee osteoarthritis (KOA). Clinical symptoms were assessed with the knee specific WOMAC index and VAS for knee pain. The severity of disease was determined by radiological KL grades (Kellgren Lawren). The informed consent of the patients was obtained for the participation in this study. The study was approved by the Institutional Ethics Committee. The genomic DNA samples were isolated from blood and polymorphic study was done by polymerase chain reaction (PCR) with restriction fragments length polymorphism (RFLP). All statistical analysis was performed with the SPSS software package (version 16.0 for windows; SPSS Chicago, IL).

Results: The GDF-5 (BSiE1) genotypes were found to be present at significantly higher frequency in cases than in controls, resulting in about 1.62 fold increase of OA risk (P Value=0.040). OA knee was found to be significantly associated with BMI (P Value=0.00). A significant association was found with clinical score of knee OA - VAS with poor and good index (P value=0.010 and 0.026 respectively) and in WOMAC with poor index only (P value=0.0040). On stratifying all osteoarthritis subjects into 3 groups according to severity (KL grade 2 minimal, grade 3 moderate and grade 4 severe OA), no significant association was found.

Conclusions: GDF5, are now known to be consistently associated with the risk of knee OA, in different population. An association between the +104T/C GDF5 polymorphism with knee OA in Indian population further confirms a strong genetic influence of this SNP in KOA. This can serve as a potential biomarker and a risk factor for KOA. It may become a gateway for further research into epigenetic of this SNP, highlighting potential pathways for prevention and therapeutic intervention of knee osteoarthritis.
Objective: The objective of the study was to analyze TNF- B Nco1 polymorphism in relation to postoperative sepsis outcome in joint care surgeries.

Methods: The study group consisted of 153 patients undergoing major elective surgery. Blood samples were obtained for genomic DNA isolation. Genotyping of each patient for TNF-B polymorphism was performed. All the patients were followed for 1 month following surgery for any evidence of sepsis as determined by guidelines from Bone et al. Subjects with and without post-operative infection were compared on presence or absence of polymorphism and of confounder status. Comparison of the proportions gave the odds ratio and odds ratios adjusted for confounders. All the possible confounders were controlled by stratified or regression analysis.

Results: The overall allele frequency for TNF-B genotype was 0.32 for TNFB1 and 0.68 for TNFB2. In TNF-B genotype, homozygous recessive TNFB1 were 17 (11.1%), heterozygous TNFB1/ TNFB2 were 63 (41.2%) and homozygous dominant TNFB2 were 73 (47.7%). 125 patients showed an uncomplicated postoperative recovery, while 25 developed mild sepsis and 3 developed severe sepsis. Genotype distribution in patients with an uncomplicated clinical course was significantly different from that in patients with postoperative sepsis. Development of postoperative sepsis was significantly higher in patients homozygous for the allele TNFB2. When compared with patients carrying at least one TNFB1 allele (TNFB1 homozygous and heterozygous genotype), the TNFB2 homozygous genotype was associated with an OR of 3.39 (p=0.005; 95% CI 1.4 to 8.3) for the development of severe sepsis. Compared with the heterozygous genotype, the OR for the homozygous TNFB2 genotype was 5.5 (p=0.001; 95% CI 1.78 to 17.33).

Conclusions: The Nco1 polymorphism within the TNF-B gene influences the development of postoperative sepsis. Both homozygous genotype TNFB1 and TNFB2 has a higher risk of developing post operative infection. In general, TNFB2 homozygous genotype is significantly associated with development of postoperative sepsis. This suggests a genetic determination of the individual inflammatory response, which significantly influences susceptibility to postoperative infection in joint care surgeries.
UTILITY OF MOLECULAR GENETIC MARKERS IN SARCOMA DIAGNOSTICS
Michaela Leitnerová¹; Imrich Hikkel¹; Lucia Copáková¹; Pavel Babáš²
¹Department of Clinical Genetic, National Cancer Institute, Bratislava, Slovakia;
²Institute of Pathological Anatomy, Faculty of Medicine, Comenius University, Bratislava, Slovakia

Objective: Sarcomas are a heterogeneous group of malignant mesenchymal tumors of difficult histological classification and strong genetic predisposition. With current developments in molecular biology, characteristic genetic alteration has been identified in a variety of soft tissue tumors and sarcomas, which can facilitate tumor diagnosis and classification. Utility of these biomarkers for identifying the stage of disease and the bone marrow infiltration is the important advance in order to select the most appropriate therapeutic regimens.

Methods: RT PCR was done to detect specific gene expressions and gene fusions associated with translocations. Fresh tumor or formalin-fixed paraffin-embedded tissues were used to identify these specific biomarkers, which enabled definitive classification and detection the bone marrow infiltration.

Results: Thirty two tumor samples, 21 rhabdomyosarcoma (RMS), 8 synovial sarcoma and 3 myxoid liposarcoma were investigated for tumor specific gene fusions and expressions. All samples have satisfactory quality for RNA isolation and subsequent RT PCR analysis. In cases of RMS in 8 were of alveolar type and 13 embryonal type. RT PCR demonstrated a PAX3-FKHR fusion in 6 cases of alveolar type RMS. PAX7-FKHR fusion was not detected in any cases of alveolar type RMS. In all 13 cases embryonal type RMA, we ruled out the presence a PAX3-FKHR PAX7-FKHR fusion transcript. The myogenin, MyoD1 and γAChR transcript expression were demonstrated in 10 cases of embryonal type RMS and in 7 cases of alveolar type RMS. One case of alveolar type RMS was positive only for myogenin and γAChR expression. In six cases of synovial sarcoma, the specific gene fusion associated with SYT-SSX2 translocation was detected. The SYT-SSX1 translocation was detected only in one case of synovial sarcoma. Further, a FUS-CHOP translocation specific fusion gene was detected in two myxoid liposarcoma samples. Subsequently, we confirmed the bone marrow infiltration in one from 13 investigated samples.

Conclusions: These results demonstrate the utility of molecular genetic markers for characterization of different sarcomas and may hold significant clinical value. This work was supported by the Framework Programme for Research and Technology Development, project: Centre for predictive diagnostics of soft tissue tumors (ITMS: 26240220052), cofinanced by European Regional Development Fund.

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FLAVOKAWAIN B INDUCES G2/M CELL-CYCLE ARREST AND APOPTOSIS IN HUMAN OSTEOSARCOMA CELLS
Tao Ji, MD; Carol Lin, MD; Eskander Ramez, MD; Yi Guo, MD; Xiaolin Zi, MD; Bang Hoang, MD
1Department of Orthopaedic Surgery, UCI Medical Center, Orange, CA, USA; 2Department of Obstetrics and Gynecology, UCI Medical Center, Orange, CA, USA; 3Department of Urology, UCI Medical Center, Orange, CA, USA

Objective: Osteosarcoma is the most common primary bone malignancy with a high propensity for local invasion and distant metastasis. Limited by the severe toxicity of conventional agents, the therapeutic bottleneck of osteosarcoma still remains un conquered. Flavokawain B (FKB), a kava extract, has been reported to have significant anti-tumor effects on several carcinoma cell lines both in vitro and in vivo. Furthermore, it has been shown that flavokawains do not exhibit toxicity in long-term use. Its efficacy and low toxicity profile make FKB a promising agent for use as a novel chemotherapeutic strategy. In the current study, we investigated the anti-proliferative and apoptotic effects of FKB against human osteosarcomas (OS).

Methods: Cell viability and growth were assayed before and after treatment with FKB. Flow cytometric analysis was used to analyzed the cell cycle with PI stain and apoptosis with AnnexinV stain. All the apoptotic and cell cycle markers were determined by western-blot.

Results: Exposure of OS cells to FKB resulted in apoptosis, evidenced by loss of cell viability, morphological changes and the externalization of phosphatidylserine. Apoptosis induced by FKB resulted in activation of Caspase-3/7, -8 and -9 in the 143B cell line. FKB also down-regulated inhibitory apoptotic markers, including Bcl-2, Bcl-xl and Survivin with concomitant increase in apoptotic proteins, DR5, Bax, Puma and Fas. Taken together, the induction of apoptosis by FKB involved both extrinsic and intrinsic pathways. We also observed that FKB caused G2/M phase cell cycle arrest, which was observed through reductions in the levels of cyclin B1, cdc2 and cdc25c and increases in Wee1 and Myt1 levels. Additionally, migration and invasion ability was decreased by FKB in a dose-dependent manner. Cytotoxicity studies showed FKB had significantly lower cytotoxic effects on bone marrow cells and small intestinal epithelial cells compared with conventional chemotherapy reagents.

Conclusions: The evidence of apoptosis and cell cycle arrest by FKB with low toxicity provide a promising application of FKB as a chemotherapeutic compound. In vivo experiments utilizing FKB to reduce tumorigenesis and metastatic potential need to be completed.
Objective: Osteochondromas are the most frequent benign bone tumors and the knee is the most common location of them. Although there is a low incidence of sarcomatous change in solitary osteochondroma, patients undergo surgical resection mainly because of clinical symptoms due to pressure on adjacent tendon, nerves, muscles, or blood vessels. When symptomatic, surgical open excision has been the standard treatment with a low recurrence rate. However, the natural history of this tumor is poorly understood. We report a case of spontaneous regression of a solitary osteochondroma in a young female.

Methods: A 13-year-old girl was evaluated for a left knee mass and mild pain mostly related to physical activities. The physical examination showed a palpable bony mass not adherent to the skin and pain on palpation of the anteromedial aspect of the left knee. Plain radiographs and CT scan showed a solitary sessile osteochondroma of the distal femur.

Results: At that time, after discussing treatment options with the family and patient, it was decided to monitor the patient with periodic studies. Plain radiographs were taken every visit during the first three years with no radiographic changes. Repeat radiographs were obtained six years after the initial diagnosis and showed complete spontaneous resolution of the lesion.

Conclusions: The spontaneous regression of this tumor has been reported rarely, and generally occurred before skeletal maturity and with an average of 3 years from diagnosis. Although there are now only 24 documented cases in the literature of solitary osteochondromas that have spontaneously regressed, a large number of these tumors are asymptomatic and may never be identified. Therefore, the incidence probably is higher than reported. Regarding treatment, careful observation may be acceptable for typical and asymptomatic osteochondromas, especially in young children.
GIANT CELL TUMOR OF THE TIBIA ARISING FROM PAGETIC BONE

Kurt R. Weiss, MD; Rao Uma, MD

1Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, PA, USA;
2Anatomic Pathology, University of Pittsburgh, Pittsburgh, PA, USA

Objective: To describe an unusual case of giant cell tumor arising in Pagetic bone, and to review the medical literature on this rare complication of Paget’s disease.

Methods: An 81-year-old Caucasian female with known Paget’s disease affecting her skeleton on the right side presented with a several-month history of pain and swelling in her right proximal tibia. Cross-sectional imaging revealed a destructive, lytic lesion of her right proximal tibia with a substantial soft tissue mass (Figure 1). Due to the concern for sarcoma arising from the Pagetic bone, a CT-guided core needle biopsy was performed. The histology was consistent with giant cell tumor of bone, not sarcoma. As sarcoma was prominent on the differential diagnosis, an open biopsy was performed to confirm/refute the core needle biopsy. The open biopsy confirmed giant cell tumor of bone and Paget’s disease without evidence of sarcoma (Figure 2).

Results: The patient was then taken to the operating room for extended curettage, cementation, and intramedullary nail placement in the right tibia. She is presently 1-year post-operative with no signs of local recurrence or metastatic disease. She has returned to community ambulation with a walker and is without pain.

Conclusions: Giant cell tumor arising from Pagetic bone is a rare occurrence and has been reported mainly in the skull and pelvis. In Haibach’s 1985 series of 82 tumors arising from Pagetic bone, 81 of these were sarcomas and only one was giant cell tumor of bone (Haibach et al, Am J Clin Pathol). This is therefore an extremely unusual complication of Paget’s disease, and to our knowledge has not been reported in the tibia until now. Although the overwhelming majority of destructive tumors arising from Pagetic bone represent sarcomas, the authors still recommend biopsy of these lesions. Treatment paradigms and prognoses of sarcoma arising from Pagetic bone versus benign-aggressive lesions are vastly different and therefore warrant thorough diagnostic evaluation prior to the initiation of treatment.

Figure 1 displays a destructive lesion with a large soft tissue component in the lateral tibial cortex of a patient with known Paget’s disease. Based on the appearance and clinical scenario, this was concerning for sarcoma.

Figure 2 shows a histologic section from the patient’s open biopsy. This demonstrates both giant cell tumor and the underlying Paget’s disease with characteristic cement lines in the bone.
**Objective:** The aim of this study was to assess the functional outcome of patients with a histologically confirmed diagnosis of Chondroblastoma, treated at our institution between 1980 and 2010. We also attempted to identify possible factors related to increased risk of recurrence.

**Methods:** Patients were identified through our histopathology database with a proven diagnosis of chondroblastoma who were treated operatively. A retrospective review was undertaken using medical records, radiological imaging and patients completed the MSTS score and SF-12 questionnaire to assess functional outcome and general health condition respectively.

**Results:** 75 patients in total (55 male, 20 female) were identified as suitable for this study. Mean age of presentation was 18 years (3-49) and the mean follow-up was 6 years 9 months (1-20). The main presenting symptom was pain with associated symptoms of stiffness, swelling and pathological fractures. Lesions were distributed across a wide range of anatomical sites but most frequently affected the epiphyses or apophyses of long bones, particularly the proximal tibia, proximal humerus and distal femur. 20 patients had secondary ABC changes associated with chondroblastoma on histology. Surgical treatment included intralesional curettage and grafting (autograft or allograft) or the use of polymethylmethacrylate as a cementoma. The mean MSTS score was 27 (18-30) and the mean SF-12 score was 31 (27-35). 10 patients (13.3%) had a histologically confirmed local recurrence that was treated with further procedures and one of these patients had a shoulder replacement after aggressive recurrence.

**Conclusions:** Chondroblastoma is a rare benign bone tumour commonly presenting in adolescence and young adults that can be successfully treated with intralesional curettage and reconstruction with grafting. This study illustrates that we can achieve excellent functional outcomes, ensuring a high chance of joint preservation and a low rate of recurrence.
THE USE OF INTRAOPERATIVE CT SCAN IN THE RESECTION OF SPINE OSTEOID OSTEOMAS AND OSTEOBLASTOMAS

Odion Binitie, MD; Camila De Mattos; Lauren Tomlinson, BS; John P. Dormans, MD
Orthopedics, Children’s Hospital of Philadelphia, Philadelphia, PA, USA

Objective: The surgical treatment of osteoid osteomas and osteoblastomas of the spine can present a challenge due to their proximity to neural elements, which limits the use of radiofrequency ablation, and the necessity to resect the nidus to reduce the likelihood of local recurrence. Intraoperative computed tomography imaging (IOCT) during intralesional resection provides a method to localize the lesion and confirm removal of the nidus. We sought to review our short-term experience using this technique.

Methods: Eighteen consecutive patients with osteoid osteoma or osteoblastoma of the spine treated over a ten-year period were reviewed. Eleven patients (8 osteoid osteoma, 3 osteoblastoma) were treated prior to the acquisition of the intra-operative CT [group 1], and the IOCT was used in 7 resections (3 osteoid osteoma, 4 osteoblastoma) [group 2]. Mean age at presentation was 11.5 years. There were 8 female and 10 male patients. Seven lesions were in the cervical spine, 5 thoracic and 6 in the lumbar. Sixteen of the lesions were in the posterior elements. All patients presented with pain and 5 with thoracolumbar scoliosis (mean curve 24 degrees, range 13-51 degrees).

Results: All patients underwent an intralmesional resection and bone grafting. There was confirmation of nidus resection by histopathology in all seven patients in group 2, the nidus was not confirmed in two patients in group 1 [p 0.826]. Mean follow-up was 35 months (group 1- 49 months, group 2- 14 months). All patients initially had improvement in their symptoms. There were 3 local recurrences (1 in group 1 and 2 in group 2 [p 0.28]). Mean time to local recurrence was 14 months, and all 3 went on to have a repeat resection with resolution of symptoms.

Conclusions: This study illustrates our early experience with the utilization of intra-operative CT in the intralmesional resection of osteoid osteoma and osteoblastomas of the spine. Further follow-up is warranted; however, these early results demonstrate the utility of this modality in the real-time localization and confirmation of the complete resection of the nidus intraoperatively.
Objective: Giant cell tumor (GCT) is a benign locally aggressive tumor commonly seen within the distal radius, with quoted recurrence rates higher than other sites. In this multicenter retrospective review, we assess functional and oncologic outcomes between varying treatment types with the hypothesis that salvage of the wrist through curettage will function better than resection with arthrodesis.

Methods: Thirty-nine wrists over 25 years were treated for primary GCT of the distal radius between two centers. For their primary procedure 20 patients underwent curettage with adjuvants, 15 resection with radiocarpal arthrodesis, and 4 resection with osteoarticular allograft. An evaluation with radiographs, range of motion, grip strength, Disabilities of the Arm, Shoulder, and Hand (DASH), Visual Analog Scale (VAS) and Musculoskeletal Tumor Society (MSTS) scores at a minimum of one year. We used Fisher’s exact tests to compare groups on dichotomous outcomes, and Wilcoxon rank-sum tests to compare groups on continuous outcomes.

Results: One patient was deceased and 6 were lost to follow-up, leaving 32 available at a mean of 135 months. The recurrence rate was 35% for curettage and 0% in patients who underwent resection (p<0.05). There was no relationship between tumor grade and recurrence. There was no difference in functional outcome whether resection arthrodesis was performed as the primary procedure or to treat recurrence after curettage. There were 11 re-operations in 8 patients (47%) in the curettage group, but only one re-operation (9%) (p<0.05) and 100% union in the 11 patients who underwent resection arthrodesis with distal radius allograft. Radiographic arthritis was seen at the radiocarpal joint in 45% of curettage patients but did not correlate with functional outcome. There were no differences in DASH, VAS, or MSTS scores between the three groups, but a trend towards overall poorer pain and functional scores in the osteoarticular allograft group, and superior DASH scores in the arthrodesis group.

Conclusions: Resection for GCT of the distal radius with distal radius allograft demonstrates a lower recurrence rate, lower re-operation rate, and equivalent functional outcome to joint salvage with curettage. Patients initially choosing curettage can be assured that outcome after resection arthrodesis is no different whether performed as a primary or secondary procedure.

Level of Evidence: III
PRE-REFERRAL MRI USE IN MUSCULOSKELETAL ONCOLOGY PATIENTS IS NOT EXCESSIVE: A RETROSPECTIVE CASE SERIES

Christopher T. Martin, MD; Jose Morcuende, MD; Joseph A. Buckwalter, MD; Benjamin J. Miller, MD
Orthopaedics and Rehabilitation, University of Iowa, Iowa City, IA, USA

Objective: Health care spending in the United States has increased substantially in recent years, and expenses related to the use of Magnetic Resonance Imaging (MRI) have been targeted as a particular area of concern. However, little data exists with regards to inappropriate MRI use in musculoskeletal oncology patients. In this study, our objective was to identify the cost and incidence of the unnecessary and repeated MRI imaging studies amongst our musculoskeletal oncology patients who arrived with an MRI completed prior to their referral.

Methods: We retrospectively reviewed all 920 new musculoskeletal tumor patients from 2009 to 2010 to identify patients who either arrived with an unnecessary MRI or who had a repeat of their pre-referral MRI. We accepted as necessary any MRI for a primary bone sarcoma, for biopsy-proven soft tissue sarcomas, for soft tissue masses greater than 5 cm in diameter, for soft tissue masses deep to the fascia, for painful soft tissue masses, and for soft tissue masses that reportedly had been growing. Patients without these specific criteria were reviewed by a team of musculoskeletal oncologists to determine the necessity. The criteria for a repeat MRI were failure to visualize the tumor, lack of gadolinium contrast, lack of T1 or T2 MRI sequence, or poor image quality. Cost was determined using 2010 Medicare reimbursement rates.

Results: Of 920 patients, 320 (35%) arrived with an MRI completed before referral (Table 1). Eight of the 320 (3%) studies were unnecessary for making the diagnosis or for surgical planning, and 12 (4%) were necessary but were repeated (Table 2). The total cost of these 20 inappropriate studies was $11,474, which averages to $574 per study and $36 of waste per patient referred with an MRI.

Conclusions: MRI use by physicians in the community prior to referral to our tertiary center was not excessive. This is likely due, in part, to the relatively low utilization of MRI in our referral base. Overall, our results indicate that inappropriate MRI use in oncology patients may not be as widespread as previously reported.

Table 1: Patient Characteristics

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number of Patients</th>
<th>(%)</th>
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<td>Male</td>
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<tr>
<td>Female</td>
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<td>48%</td>
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<table>
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<tr>
<th>Tumor Location</th>
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<tbody>
<tr>
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<tr>
<td>Lower Leg/Foot</td>
<td>60</td>
<td>19%</td>
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<tr>
<td>Knee</td>
<td>84</td>
<td>26%</td>
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<td>Upper Extremity</td>
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<td>Spine</td>
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<tr>
<td>Hip/Pelvis</td>
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<td>Other</td>
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<table>
<thead>
<tr>
<th>Diagnosis</th>
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<tr>
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<td>74%</td>
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<tr>
<td>Malignant</td>
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<td>Unknown</td>
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<th>Tissue Involvement</th>
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<tr>
<td>Bone</td>
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<tr>
<td>Both Compartments</td>
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<td>&lt;1%</td>
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Table 2: Unnecessary and Inappropriately Repeated Studies by Diagnosis

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<th>Number of Repeat Studies</th>
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<td></td>
</tr>
<tr>
<td>Enchondroma</td>
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<td></td>
</tr>
<tr>
<td>Non-ossifying Fibroma</td>
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<td></td>
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<tr>
<td>Unicameral Bone Cyst</td>
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<td></td>
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<tr>
<td>Nerve Sheath Tumor</td>
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<td>2</td>
</tr>
<tr>
<td>Avascular Necrosis</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Lipoma</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Hemangioma</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Thrombosis</td>
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<tr>
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<tr>
<td>Total Benign</td>
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<tr>
<td><strong>Malignant</strong></td>
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<tr>
<td>Liposarcoma</td>
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<tr>
<td>Malignant Peripheral Nerve Sheath Tumor</td>
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<td></td>
</tr>
<tr>
<td>Chondrosarcoma</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Synovial Cell Sarcoma</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>T-Cell Lymphoma</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Myxoid Sarcoma</td>
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<td>1</td>
</tr>
<tr>
<td>Total Malignant</td>
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<td>6</td>
</tr>
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* Indicates the FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an “off label” use).
* FDA information not available at the time of printing. For full information, refer to inside back cover.
MRI IN SPINAL TRAUMA - A PREDICTOR OF NEUROLOGICAL RECOVERY?
Rajeshwar N. Srivastava, MD¹; Umesh Parasri²
¹Orthopaedic Surgery, KG Medical College, CSM Medical University, Lucknow, India;
²Radiology, KG Medical College, CSM Medical University, Lucknow, India

Objective: A study to correlate MRI findings with neurological recovery and functional outcome as predictor of recovery in spinal cord injury.

Methods: 62 patients of acute spinal trauma were evaluated by MRI and correlated with clinical findings at admission & discharge. Four types of MR signal patterns were seen in association with spinal cord injury- cord edema / non haemorrhagic cord contusion (CC), severe cord compression (SCC), cord hemorrhage (CH) and epidural heamatoma (EH). In cord contusion we further subdivided the group into contusion of size < 3 cm and contusion of size > 3 cm to evaluate any significance of length of cord contusion. In cord haemorrhage involving >1cm of the cord, focus was said to be sizable.

Results: There was a definitive correlation of cord contusion (CC) involving <3cm & > 3cm of cord. In >3cm chances of improvement was 5.75 times lesser than in patients with CC involving <3cm of cord (odds ratio = 5.75 (95% CI: 0.95, 36), Fisher’s exact p = 0.0427 (p<.05). Presence of sizable focus of haemorrhage (HC) in cord (>1cm) was most strongly associated with the poor outcome. The risk of retaining a complete cord injury at the time of follow up for patients who initially had significant haemorrhage in cord was more than 6 folds with patients without initial haemorrhage (odds ratio 6.97 and p= .0047). It was noted that the patients in which epidural hematoma (EH) was present, no improvement was seen, however, by statistical analysis it was not a risk factor and was not related with the outcome (odds ratio - 0.5 and p = 0.22). Presence of severe cord compression (SCC) was a risk factor for poor outcome(odds ratio - 4.90 and p = 0.0143.

Conclusions: On multiple logistic regression for estimating prognosis, sizable focus of hemorrhage was most consistently associated with poor outcome. In severe cord compression the risk of poor outcome was more, however was not statistically significant. Presence of cord oedema / non haemorrhagic contusion was not associated with poor outcome. The risk of retaining a complete cord injury at the time of follow up for patients who initially showed evidence of significant haemorrhage in cord was more than 6 folds with patients without initial haemorrhage.
Objective: Histological study of musculoskeletal tumors is the keystone for diagnosis, prognosis and treatment of these lesions. The assessment of clinical, imaging and histologic characteristics is the basic triad for an accurate diagnosis in these types of injuries. The histological study of these lesions is complemented with a cytological study, called “bone citology”. This is the direct inspection under microscope of a prepared sample, performed by an expert pathologist in order to get the diagnosis early. Main Objectives: To evaluate the correlation of bone cytology with definitive histo-pathological examination for diagnosis of bone metastases.

Methods: A diagnostic test examination conducted for cases between 1985 and 2010. Review of Regional Bone Tumor Registry of Valdivia (REBTRE) for all the patients diagnosed with metastases confirmed by biopsy (gold standard) that also underwent bone cytology. We considered sex, age, location, diagnosis, tumor and outcome. A Data collection sheet was developed, and an analysis of statistical variables using Win Episcope 2.0 program was made, using a confidence level of 95%.

Results: The total of patients diagnosed with metastases confirmed by biopsy that also underwent bone cytology is 356. Of these, 223 (63%) are women, with an average age of 57 years (range 21-88 and decest 13). Location was spine in 132 cases (37%), femur in 43 cases (12%) and rib in 38 cases (11%). In relation to type of tumor, breast in 124 cases (35%), unknown primary in 47 cases (13%), 38 cases of kidney (11%), 37 cases of lung (10%) and 32 cases of uterus (9%). The values for sensitivity 85%, specificity 87%, positive predictive value 99% and negative 28%, positive likelihood ratio 6.4 and negative 0.17, 85% efficiency, 94% prevalence and the pre test odds 14.5 and post test positive 94 and negative odds 2.55.

Conclusions: There are no published studies that have made this assessment, so this study provides important findings obtained in clinical practice of orthopedic oncology in relation to the validation of the bone cytology as a method in early diagnosis of bone metastases. Main Conclusion: Bone cytology is a useful tool in early diagnosis of bone metastases with values of high specificity and high sensitivity (around 80%), accompanied a positive predictive value approaching 100%. The effectiveness is high and additional tests support the bone cytology as an additional tool for study of metastases.

<table>
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<th>Absent Disease</th>
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<td>286</td>
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<tr>
<td>Negative</td>
<td>50</td>
<td>20</td>
<td>70</td>
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<tr>
<td>Total</td>
<td>333</td>
<td>23</td>
<td>356</td>
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MUSCULOSKELETAL TUMOR SOCIETY  
2012 ANNUAL MEETING  
SEPTEMBER 20 - 22, 2012  
TAMPA, FLORIDA

POSTER #15

THE BONE CYTOLOGY AS EARLY DIAGNOSTIC METHOD IN TUMORS OF THE SPINE

Javier Delgado¹, Pedro Valdivia¹, Matías Sepúlveda¹, Daniel Salgado³, Juan Daniel Carpio¹, Drina Omerovic⁴, María Teresa Poblete⁴, Cristian Carrasco⁴, Tatiana Benavides⁴

¹Department of Orthopedic Surgery, Orthopaedic Surgical Oncology, Valdivia Regional Hospital, Austral University of Chile, Valdivia, Chile;  
²Department of Orthopedic Surgery, Valdivia Regional Hospital, Austral University of Chile, Valdivia, Chile;  
³Orthopaedic Resident, Austral University of Chile, Valdivia Regional Hospital, Valdivia, Chile;  
⁴Department of Pathology, Valdivia Regional Hospital, Austral University of Chile, Valdivia, Chile

Objective: Histological study of musculoskeletal tumors is the keystone for diagnosis, prognosis and treatment of these lesions. The assessment of clinical, imaging and histologic characteristics is the basic triad for an accurate diagnosis in these types of injuries. The histological study of these lesions is complemented with a cytological study, called “bone cytology”. This is the direct inspection under microscope of a prepared sample, performed by an expert pathologist in order to get the diagnosis early. Main Objectives: To evaluate the correlation of bone cytology with definitive histopathological examination for diagnosis of tumors of the spine.

Methods: A diagnostic test examination conducted for cases between 1985 and 2010. Review of Regional Bone Tumor Registry of Valdivia (REBTRE) for all the patients diagnosed with tumors of the spine confirmed by biopsy (gold standard) that also underwent bone cytology. We considered sex, age, location, diagnosis, tumor and outcome. A Data collection sheet was developed, and an analysis of statistical variables using Win Episcope 2.0 program was made, using a confidence level of 95%.

Results: The total of patients with tumors of the spine confirmed by biopsy that also underwent bone cytology is 192. Of these, 116 (60%) are women, with an average age of 56 years (range 1-85 and 15 devest). Diagnosis was metastases in 131 cases (68%), breast in 51 cases (39%). The location was lumbar spine in 96 cases (50%) and Dorsal spine in 66 cases (34%). The values for sensitivity 81% and specificity 74%. Positive predictive value 96% and negative predictive value 35%. Positive likelihood ratio 3.1 and negative 0.25. Efficiency 80% and prevalence 88%. Pre test odds 7.3 and post test odds 22.8 positive and negative 1.8.

Conclusions: There are no published studies that have made this assessment, so this study provides important findings obtained in clinical practice of orthopedic oncology in relation to the validation of the bone cytology as a method in early diagnosis of tumors of the spine. Main Conclusion: Bone cytology is a useful tool in early diagnosis of bone tumors of the spine showing high sensitivity values above 80% and slightly lower specificity, accompanied a positive predictive value 95% and negative low (35 %). The effectiveness is high and additional tests support the bone cytology as an additional tool for study of tumors of the spine.

<table>
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<th>Spine</th>
<th>Present Disease</th>
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<td>Negative</td>
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<tr>
<td>Total</td>
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</table>

See pages 167 - 176 for financial disclosure index.
THE BONE CYTOLGY AS EARLY DIAGNOSTIC METHOD IN OSTEOSARCOMA

**Javier Delgado** 1, Pedro Valdivia 1, Matías Sepúlveda 2, Daniel Salgado 3, Juan Daniel Carpio 4, Drina Omerovic 4, María Teresa Poblete 4, Cristian Carrasco 4, Rubén Miranda 4

1Department of Orthopedic Surgery, Orthopaedic Surgical Oncology, Valdivia Regional Hospital, Austral University of Chile, Valdivia, Chile; 2Department of Orthopedic Surgery, Valdivia Regional Hospital, Austral University of Chile, Valdivia, Chile; 3Orthopaedic Resident, Austral University of Chile, Valdivia Regional Hospital, Valdivia, Chile; 4Department of Pathology, Valdivia Regional Hospital, Austral University of Chile, Valdivia, Chile

**Objective:** Histological study of musculoskeletal tumors is the cornerstone for diagnosis, prognosis and treatment of these lesions. The assessment of clinical, imaging and histologic characteristics is the basic triad for an accurate diagnosis in these types of injuries. The histological study of these lesions is complemented with a cytological study, called “bone cytology”. This is the direct inspection under microscope of a prepared sample, performed by an expert pathologist in order to get the diagnosis early. Main Objectives: To evaluate the correlation of bone cytology with definitive histopathological examination for diagnosis of osteosarcoma.

**Methods:** A diagnostic test examination conducted for cases between 1985 and 2010. Review of Regional Bone Tumor Registry of Valdivia (REBTRE) for all the patients diagnosed with osteosarcoma confirmed by biopsy (gold standard) that also underwent bone cytology. We considered sex, age, location and outcome. A Data collection sheet was developed, and an analysis of statistical variables using Win Episcope 2.0 program was made, using a confidence level of 95%.

**Results:** The total of patients diagnosed with osteosarcoma confirmed by biopsy that also underwent bone cytology is 40. Of these, 23 (58%) were men, with an average age of 21 years (range 4-60 and devest 12). Location was femur in 22 cases (55%) in preference to distal 21 cases (95%) and right 13 cases (60%). The humerus 7 cases (17.5%) and tibia 6 cases (15%), proximal preferably both. True-positive 31 cases and 9 cases for false-negatives without values for true negatives and false positives. The values for sensitivity and Efficiency 78%. Positive predictive value and prevalence 100%.

**Conclusions:** There are no published studies that have made this assessment, so this study provides important findings obtained in clinical practice of orthopedic oncology in relation to the validation of the bone cytology as a method in early diagnosis of osteosarcoma. Main Conclusion: Bone cytology is a useful tool in early diagnosis of osteosarcoma with values of sensitivity and efficiency of 78%, accompanied a positive predictive value of 100% as well as prevalence. The effectiveness is high and additional tests support the bone cytology as an additional tool for study of osteosarcoma.

<table>
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<th>Diagnostic Test for Bone Cytology</th>
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<tr>
<td><strong>Osteosarcoma</strong></td>
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<tr>
<td>Positive</td>
</tr>
<tr>
<td>Negative</td>
</tr>
<tr>
<td>Total</td>
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</table>
DIGITAL BONE AND SOFT TISSUE TUMOR PATHOLOGY TEACHING LIBRARY:
A NEW TOOL FOR SARCOMA PATHOLOGY TRAINING

Xiaohui Zhang, MD, PhD; Joseph Johnson, MS; Mark Lloyd, MS; Douglas Letson, MD, PhD;
Marilyn M. Bui, MD, PhD

1Sarcoma, Moffitt Cancer Center, Tampa, FL, USA;
2ANALYTIC MICROSCOPY CORE, Moffitt Cancer Center, Tampa, FL, USA;
3Pathology, Moffitt Cancer Center, Tampa, FL, USA;
4Cell Pathology & Biology, University of South Florida, Tampa, FL, USA

Objective: Whole slide scanning and digital pathology has revolutionized the teaching of pathology and other related disciplines. However, there is a lack of high quality digital sarcoma pathology teaching library. Due to the rarity and difficulty of sarcoma diagnosis, trainees of most programs have limited experience. We intend to establish an online virtual slide collection of sarcomas to enhance the training of surgical pathology and related specialties such as musculoskeletal radiology and surgical oncology.

Methods: Moffitt Cancer Center is the only NIH/NCI designated comprehensive cancer center in Florida, where 200-240 new sarcoma patients are seen annually. There is a rich collection of common and rare bone and soft tissue tumors. The project is done as a collaborative effort of sarcoma pathologists, surgeons, residents, fellows and Analytic Microscopic Core with the support from the Sarcoma Program. De-identified archived glass slides are selected by sarcoma pathologists using the WHO bone and soft tissue tumor classification (2006). The slides are scanned using AperioScanScope XT. High-resolution digital images of tissue sections can be viewed at designated user’s computer using a password protected server Spectrum. Corresponding clinical and radiological information and key pathologic findings are incorporated.

Results: A high quality digital teaching library 2,000 cases of common and rare bone and soft tissue tumors will be constructed. Each de-identified case consists of a brief clinical history, radiology, pathology and treatment information. The digital images are archived on a network server and can be shared among pathology, surgical oncology, and radiology trainees. It is searchable by tumor type, keyword or differential diagnosis. A testing mechanism is under development.

Conclusions: An online high quality virtual sarcoma pathology teaching library is a feasible approach for educational purpose. It will be beneficial to the trainees of pathology, surgical oncology and radiology.
Objective: To characterize musculoskeletal lesions associated with a high rate of non-diagnostic results during image guided core needle biopsy (CNB) and to determine whether non-diagnostic results affect clinical management.

Methods: Following IRB approval, a retrospective study was performed of 778 consecutive image guided CNBs of bone (n=423) and soft tissue (n=355) lesions at a single institution. Histologic reports were reviewed and a biopsy was considered non-diagnostic if a distinct pathologic diagnosis could not be rendered from the biopsy tissue that explained the lesion clinically and by imaging. The reference standard was either (i) the final diagnosis at surgery or (ii) clinical follow-up (mean 20 months). Diagnostic yield, defined as the number of diagnostic CNBs divided by the total number of CNBs, was calculated for the most common diagnoses. Subsequently, the clinical and imaging data for the non-diagnostic CNBs from the top two referring orthopedic oncologists were reviewed with them to determine if the non-diagnostic CNB result was useful in guiding clinical management.

Results: Of the 778 lesions biopsied, 55.7% (433/778) proved benign and 44.3% (345/778) proved malignant. The overall diagnostic yield with imaged guided core needle biopsy was 73.9% (575/778). Benign lesions had a significantly lower diagnostic yield than malignant lesions [58.2%, 252/433 versus 93.6%, 323/345; [p<0.0001]. The benign and malignant lesions associated with the highest rate of non-diagnostic results were: Benign- Langerhans cell histiocytosis, simple bone cyst, healing fractures, degenerative changes, osteomyelitis, and soft tissue cysts; Malignant- Ewing sarcoma and osteosarcoma. Of the 142 non-diagnostic biopsies assessed for clinical usefulness, the orthopedic oncologists deemed 59.9% (85/142) of the biopsies useful in guiding clinical management. Lesions that were likely to be benign prior to CNB (p<0.0001), not painful (p=0.0067), or non-aggressive on imaging (p=0.0014) had a significant association with a useful non-diagnostic CNB.

Conclusions: Non-diagnostic CNBs are significantly more likely to occur in benign versus malignant lesions. Moreover, 60% of the non-diagnostic biopsies were helpful in guiding clinical management.
EWING’S SARCOMA OF THE FOOT: EXPERIENCES OF A UK BONE TUMOUR UNIT
Elizabeth Gillott, MRCS, MBBS; Steve Kahane, MRCs, BSc, MBBS; Will Aston; John Skinner; Rob Pollock; Steve Cannon; Tim W. Briggs
Bone Tumour Unit, Royal National Orthopaedic Hospital, Stanmore, Stanmore, United Kingdom

Objective: Present the outcomes of those patients diagnosed with Ewing’s Sarcoma of the foot within the past 10 years and treated with limb salvage surgery at the Royal National Orthopaedic Hospital’s Bone Tumour Unit, Stanmore.

Methods: Retrospective study of the cases identified from the pathology database. Notes reviewed for presentation, treatment and follow up. MSTS (Musculoskeletal tumour score) and TESS (Toronto Extremity Salvage Score) calculated.

Results: 6 patients identified with positive diagnosis of Ewing’s Sarcoma of the Foot. Male:Female ratio of 5:1. Age range 15-31 (Mode 25). 4 cases skeletal, 2 extra skeletal. All cases reviewed by supra-regional MDT and received adjuvant and neo-adjuvant chemotherapy. All except one patient underwent limb-salvage surgery. MDT for remaining patient was amputation as only viable surgical option (patient and parent’s requested radiotherapy without surgical treatment). Mean survival 40 months (15-107 months). All patients survive at time of submission. Mean MSTS score 93% (80-100%), Mean TESS 94.6% (85-100). All patients reported a delay between first presentation and referral to the sarcoma unit. This experience is common across the literature for this rare pathology. Lowest scores submitted by the two patients who had amputation of their great toe. All patients happy with their outcome and decision to salvage their limb. All patients scored themselves as “not at all disabled” and two stated this would not have been their response if they had lost their foot.

Conclusions: Amputation is psychologically difficult to accept and patients are more receptive to limb salvage surgery. Our patients demonstrate good functional outcome. Our experience at Stanmore suggests that limb salvage surgery with adequate MDT surveillance for Ewing’s Sarcoma of the Foot can be a viable alternative to amputation.

Skeletal Ewing’s Sarcoma of the 1st Metatarsal

<table>
<thead>
<tr>
<th>Patient</th>
<th>Skeletal/ Extra skeletal</th>
<th>Metastases (at diagnosis)</th>
<th>Site</th>
<th>Gender</th>
<th>Age (at diagnosis)</th>
<th>MSTS Score</th>
<th>Tess Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Skeletal</td>
<td>Nil</td>
<td>Calcanueum</td>
<td>Male</td>
<td>14</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>Skeletal</td>
<td>Nil</td>
<td>1st MT</td>
<td>Male</td>
<td>25</td>
<td>80%</td>
<td>85%</td>
</tr>
<tr>
<td>3</td>
<td>Extra Skeletal</td>
<td>Nil</td>
<td>Plantar Arch</td>
<td>Male</td>
<td>25</td>
<td>90%</td>
<td>96.8%</td>
</tr>
<tr>
<td>4</td>
<td>Skeletal</td>
<td>Lung, Sacrum</td>
<td>4th &amp; 5th MT</td>
<td>Male</td>
<td>16</td>
<td>96%</td>
<td>*</td>
</tr>
<tr>
<td>5</td>
<td>Extra Skeletal</td>
<td>Lung</td>
<td>Medial Foot</td>
<td>Female</td>
<td>25</td>
<td>96%</td>
<td>98.1%</td>
</tr>
<tr>
<td>6</td>
<td>Skeletal</td>
<td>Lung</td>
<td>1st MT</td>
<td>Male</td>
<td>31</td>
<td>90%</td>
<td>93.1%</td>
</tr>
</tbody>
</table>

See pages 167 - 176 for financial disclosure index.
LONG-TERM RESULTS OF INTRALESIONAL CURETTAGE AND CRYOSURGERY FOR TREATMENT OF LOW-GRADE CHONDROSARCOMA

Mort Meftah, MD; Patricia Schult; Robert M. Henshaw, MD
Orthopaedic Oncology, Georgetown, WHC, Washington, DC, USA

Objective: There is limited data regarding outcomes following intralesional curettage and cryosurgical treatment of low-grade cartilage tumors of bone (enchondrosarcoma or chondrosarcoma). This is a retrospective analysis of long-term results of this technique, evaluating oncologic and functional outcomes.

Methods: 42 patients (43 lesions, 13 males, 29 females) treated with intra-lesional curettage and cryosurgery for low-grade chondrosarcomas between June 1983 and October 2006 were identified in a departmental database. Treated lesions involved the humerus (14), tibia (4), spine (1), shoulder (3), femur (16), pelvis (3), sacrum (1), and calcaneus (1). 11 patients were treated with closed circuit cryoprobes while 31 patients were treated with liquid nitrogen (modified Marcove technique). Functional outcome was determined using the Musculoskeletal Tumor Society (MSTS) scale, which was calculated at time of final follow-up. Oncologic outcome was determined by incidence of local or distal tumor relapse. Pearson correlation was calculated between the predicting factors (size of the lesion, soft-tissue extension, location, age, cortical erosion and presence of pre-operative pain) and outcomes (MSTS scores and tumor recurrence).

Results: Mean follow-up was 10.2 ± 4.6 years (range 5 - 22.5 years). Mean overall MSTS score was 26.5 ± 3.1 (range 17 - 30). Indications for treatment included low grade cartilage tumors with evidence of aggressive behavior (pain, interval enlargement, endosteal scalloping, Fig 1). There were 4 local recurrences, all in patients that had extension out of the bone with soft-tissue involvement at initial presentation (fig - 2). Mean time to recurrence was 1.3 ± 0.8 (range 0.6 - 2.2 years). No patients developed metastatic disease in the follow-up period. 34 patients (35 lesions, 81%) had radiologic evidence of cortical erosion, breakthrough or scalloping on CT or plain radiographs. There was a significant correlation between recurrence of the tumor and presence of soft-tissue extension (r=0.8), and size of the lesion (r=0.45). Kaplan-Meier survivorship for recurrence as the end point was 90.7%.

Demographic Data in Recurrent Cases

<table>
<thead>
<tr>
<th>Location</th>
<th>Time from index surgery</th>
<th>Cryotechnique</th>
<th>Treatment</th>
<th>Final Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelvis</td>
<td>1 year</td>
<td>Liquid Nitrogen</td>
<td>Repeat treatment with cryosurgery</td>
<td>No further recurrence or metastasis</td>
</tr>
<tr>
<td>Sacrum</td>
<td>2.2 year</td>
<td>Liquid Nitrogen</td>
<td>Wide surgical resection</td>
<td>No further recurrence or metastasis</td>
</tr>
<tr>
<td>Proximal femur</td>
<td>6 year</td>
<td>Liquid Nitrogen</td>
<td>Proximal femoral replacement</td>
<td>No further recurrence or metastasis</td>
</tr>
<tr>
<td>Calcaneus</td>
<td>1.6 year</td>
<td>cryoprobe</td>
<td>Below knee amputation</td>
<td>No further recurrence or metastasis</td>
</tr>
</tbody>
</table>

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Conclusions: Intra-lesional curettage and cryoablation for low-grade chondrosarcoma in selected patients was safe and effective. Indications for treatment include intra-compartmental lesions without significant soft-tissue expansion.

Pre-operative anteroposterior femoral radiograph (1A) of a patient with massive cartilage tumor that had endosteal scalloping on cross-sectional CT scans (red arrows, 1B). The patient underwent intralesional mechanical curettage through a cortical window (1C), cryosurgery using the pouring technique with liquid nitrogen (1D), and cementation with rush rods (1E, 1F).

Anteroposterior proximal femoral radiograph after intralesional curettage, cryosurgery and short intramedullary nail fixation (2A) of a patient that initially presented with pathologic fracture due to a low-grade chondrosarcoma with soft-tissue extension. The patient was lost to follow for 5 years and subsequently presented with massive recurrence on CT scan (red arrows, 2B), which was treated with proximal femoral replacement (2C).

See pages 167 - 176 for financial disclosure index.
PERIOSTEAL MESenchymal CHONDROSARCOma IN THE DISTAL TibIA
OF A FOUR YEAR OLD BOY

Dylan Nugent, MD; David Cheong, MD; Douglas Letson, MD, PhD; Jeffrey Keen, MD; Hector L. Monforte, MD; Alberto G. Ayala
1Orthopaedics, University of Florida College of Medicine Jacksonville, Jacksonville, FL, USA;
2Sarcoma, Moffitt Cancer Center, Tampa, FL, USA;
3Pathology, All Children’s Hospital, St. Petersburg, FL, USA;
4Pathology and Genomic Medicine, Methodist Hospital System, Houston, TX, USA;
5Orthopaedics and Sports Medicine, Flagler Orthopaedics and Sports Medicine, Palm Coast, FL, USA

Objective: Report the case of a mesenchymal chondrosarcoma arising from the periosteum on the distal tibia of a 4 year old boy.

Methods: Clinical case report and literature review.

Results: The patient presented with an asymptomatic mass in his left distal leg and underwent wide surgical excision after 2 cycles of neoadjuvant chemotherapy. Pathologic evaluation demonstrated negative surgical margins and a 5.4 x 2.5 x 1.0 cm firm, fibrous, and lobulated mass arising from the outer tibial cortex and periosteum with focal cortical disruption in the proximal 1/3 of the lesion. There were focal areas of osteoid matrix formation. Mitotic index was 2/10 hpf. Proliferative index averaged 4%. The tumor was composed of primitive undifferentiated cells amid collagenized tissue with focal osteoid-like formation and a hemangiopericyctoid pattern with areas of low-grade hyaline cartilage. There was strong SOX9 nuclear staining. There was a grade II response to chemotherapy, and no confluent necrosis. Final staging was T1, N0, M0, R0. The child is an active healthy boy without evidence of disease after 4 years of clinical and radiographic follow up.

Conclusions: The patient age and location of the tumor in this case are extremely rare. Only three cases of periosteal mesenchymal chondrosarcoma have previously been reported, all of which were in adult femurs. Of the handful of cases in children under the age of ten, none were located in the extremities. The strong sox9 nuclear positivity confirms the cartilaginous lineage of this tumor. Mesenchymal chondrosarcoma typically has an aggressive course characterized by local recurrence and/or distant metastasis and a poor prognosis with ten-year survival of less than fifty percent. Further studies are needed to form consensus guidelines for the management of this unusual tumor. En bloc excision seems to provide the best long term results especially in children, and may be of particular benefit in patients with hemangiopericyctoid features. The use of chemotherapy and radiation therapy is not well defined. Mesenchymal chondrosarcoma in children may respond differently than in older patients. The scarcity of reported cases likely accounts for the lack of consensus regarding the most appropriate management of this rare malignancy. Level of evidence: IV.

Coronal T1-weighted MRI shows a large somewhat heterogeneous soft tissue mass of intermediate signal adjacent to the lateral cortex of the left distal tibia.
Photomicrograph of immunohistochemical analysis exhibits a strong nuclear staining with SOX-9 which stains primitive cartilage.
**POSTER #22**

**PROGNOSTIC FACTORS OF HIGH-GRADE CHONDROSARCOMA - A SINGLE-CENTER EXPERIENCE WITH 175 PATIENTS**

*Philipp T. Funovics, MD*¹; *Martin Dominkus*¹; *Susanna Lang*²; *Reinhard Windhager*¹

¹Department of Orthopaedics, Medical University of Vienna, Vienna, Austria; ²Department of Pathology, Medical University of Vienna, Vienna, Austria

**Objective:** The identification of prognostic factors of high-grade chondrosarcoma is still regarded a difficult challenge. Aim of this study was to retrospectively present a single-center experience with high-grade chondrosarcoma over a forty year time span.

**Methods:** Since 1972, a total of 175 patients have been treated for high grade chondrosarcoma at the our institution excluding low-grade lesions and tumors of the small bones. The cohort comprised 102 males (58%) and 73 females (42%) with an average age of 52 years (range, 16 to 87; median, 54). Mean follow-up was 67 months (range, 1 to 412; median, 44). Ninety-five tumors were located in the trunk (54%), and 80 tumors arose in the extremities (46%). Eleven tumors were regarded as extraskeletal chondrosarcoma (6%), and 18 patients presented with primary metastatic disease (10%). Eight tumors (5%) were regarded irresectable, 167 patients (95%) underwent surgery including endoprosthetic reconstruction in 68 (39%) and initial amputation in 24 (14%).

**Results:** Eighty-seven patients (50%) died throughout follow-up. Median overall survival was 80 months with a five- and ten-year survival rate of 56% and 45%, respectively. Age (p<0.001), female gender (p=0.013), tumor site in the trunk (p=0.003) and primary metastatic disease (p=0.008) were strong negative predictors of outcome. Local recurrence was observed in 19 of 167 operated patients (11%). Local recurrences occurred up to 117 months postoperatively with a five- and ten-year local recurrence-free survival rate of 83% and 81%, respectively. Women showed a better local recurrence-free survival (p=0.046). Metastases were observed in 33 cases (19%). Correspondingly, the five- and ten-year metastasis-free survival rate was 75% and 71%, respectively, with a trend towards worse outcome of soft tissue chondrosarcoma (p=0.053). In multivariate analysis age (HR=1.04), site (HR for extremity=0.42) and primary metastatic disease (HR=2.59) were statistically significant predictors for overall survival.

**Conclusions:** High grade chondrosarcoma is an aggressive entity, especially outcomes of truncal tumors can be limited by the inability to achieve surgically adequate margins, leading to a considerable rate of local recurrence. Also, the unfavorable outcome for patients with metastatic disease underlines the need to search for further adjuvant therapies.

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EXPRESSION OF MAPK/ERK PATHWAY IN PATIENTS WITH HIGH GRADE OSTEOSARCOMA

Wonseok Song, MD; Chandhanarat Chandhanayingyong, MD; Suk Hyun Kweon, MD; Saqib Nizami; Yuhree Kim, MD; Jung Hyun Park, MD; Francis Young-In Lee
Orthopaedic Surgery, Columbia University, New York, NY, USA

Objective: The MAPK/ERK pathway is known to be involved in many cellular processes such as cell proliferation, differentiation and apoptosis. Furthermore, this pathway is activated in many cancers and is reported to be correlated with aggressive tumoral behavior. This study was performed to investigate the expression of the activated extracellular signal-regulated kinases (pERK1/2) and Bcl-2 (anti apoptotic protein) in human tissue samples, and to correlate their expression with the clinical outcomes in osteosarcoma patients.

Methods: In a series of 53 paraffin-embedded samples from incisional biopsy specimens in stage IIB extremity osteosarcoma, we assessed the expression of pERK1/2 and Bcl-2 by immunohistochemistry. These results were compared with survival data and other clinicopathological characteristics. The mean followup of the patients was 53 months (range 13 - 82 months).

Results: The immunoreactivity of pERK and Bcl-2 was observed as diffuse in both nucleus and cytoplasm of tumor cells. For pERK1/2 expression, the positive cells existed in confined area (clonal pattern) while the expression of Bcl-2, in most cases, is very diffusely located across the whole area. Of 53 patients samples, 27(51%) samples showed positivity in pERK1/2 staining and 43(81%) in Bcl-2 staining, respectively. pERK1/2 positivity was not associated with age, gender, initial tumor size, pathologic subtype or histologic response to chemotherapy. The expression of pERK1/2 (p=0.057) and poor histologic response to chemotherapy (p=0.119) had a trend of negative effect on event-free survival.

Conclusions: pERK1/2 could be potentially useful prognostic marker and therapeutic target in osteosarcoma.

Clinicopathologic Characteristics According to pERK1/2 Immunoactivity

<table>
<thead>
<tr>
<th>Variables</th>
<th>Positive</th>
<th>Negative</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>&lt;17</td>
<td>20(50%)</td>
<td>20 (50%)</td>
</tr>
<tr>
<td></td>
<td>&gt;17</td>
<td>7(53.8%)</td>
<td>6(46.2%)</td>
</tr>
<tr>
<td>gender</td>
<td>male</td>
<td>15(44.1%)</td>
<td>19(55.9%)</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>12(63.2%)</td>
<td>7(36.8%)</td>
</tr>
<tr>
<td>subtype</td>
<td>osteoblastic</td>
<td>20(58.8%)</td>
<td>14(41.2%)</td>
</tr>
<tr>
<td></td>
<td>others</td>
<td>7(36.8%)</td>
<td>12(63.2%)</td>
</tr>
<tr>
<td>tumor volume</td>
<td>&lt;150ml</td>
<td>15(45.5%)</td>
<td>18(55.5%)</td>
</tr>
<tr>
<td></td>
<td>&gt;150ml</td>
<td>12(60%)</td>
<td>8(40%)</td>
</tr>
<tr>
<td>chemotherapy response</td>
<td>good</td>
<td>8(47.1%)</td>
<td>9(52.9%)</td>
</tr>
<tr>
<td></td>
<td>poor</td>
<td>19(52.8%)</td>
<td>17(47.2%)</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>27(51%)</td>
<td>26(49%)</td>
</tr>
</tbody>
</table>

See pages 167 - 176 for financial disclosure index.
OBJECTIVE: Chondroid lesions commonly present as slow growing masses and frequently present a diagnostic dilemma. Distinguishing between benign and malignant lesions can be difficult utilizing clinico-histo-pathologic criteria. Previous studies have shown that different types of cancer (B-cell lymphoma, prostate cancer, lung cancer and others) have distinct miRNA profiles and these levels in serum have been shown to be useful for diagnosis, prognosis, and therapeutic response. We hypothesized that a defined panel of serum microRNA molecules could distinguish chondrosarcomas from normal cartilaginous tissues, helping to develop diagnostic and eventually treatment techniques.

METHODS: A rat swarm chondrosarcoma cell line grown at our institution (2 X 10^7 cells per half milliliter of saline), or 0.5 ml sterile saline solution as a control, was injected between the scapulae of 10 tumor rats and 10 control rats respectively. The rats were then sacrificed at 12 weeks post-injection. Tumors were dissected and isolated, and serum was collected. 380 miRNAs were analyzed by Taqman low-density arrays (Applied Biosystems, Foster City, CA) in the pooled serum from 3 control rats and 3 tumor rats. Cells from the isolated tumors and from a sample of the cells that were injected were also analyzed. Candidate miRNA (Mmu-miR-15b#, Mmu-miR-706, Mmu-miR-503, Mmu-miR-197, Mmu-miR-500, mmu-miR-352) were selected for further testing based on their concentration differences between control and tumor rat serum. Further analysis of the concentrations of the candidate miRNAs was performed using real time PCR on the remaining rat serum samples.

RESULTS: There was no demonstrable difference between the control rat serum and tumor rat serum concentrations in the levels of any of the candidate miRNAs tested.

CONCLUSIONS: Although serum microRNA levels may not be useful as a diagnostic tool, the next step will be to further analyze the bulk tumor microRNA levels and compare this to levels in normal articular cartilage.
Our analysis included the remaining 32 patients (66% male), who had a median age of 50 years (range, 15-83 years). Definitive diagnosis was delayed in 5 patients (15.6%) with sacral lesions. Diagnostic delays were due to inadequate imaging in 2 patients and to delays in obtaining the appropriate workup in 3 patients.

Conclusions: Delayed diagnosis of primary sacral lesions is not rare. Diagnoses were delayed in 15.6% of patients who underwent sacrectomy at our tertiary care hospital. In primary/secondary care settings, delays of months to years following onset of symptoms may be more common. However, with an adequate index of suspicion and appropriate imaging studies, most diagnostic delays of these potentially catastrophic tumors can be avoided.
ELUTION OF CISPLATIN FROM COMMERCIALY AVAILABLE BONE CEMENTS WITHOUT REDUCTION IN STRENGTH

Jill Meyer, PhD1; Matthew Squire, MD, MS2; Kevin MacDonald3
1Civil Engineering & Mechanics, University of Wisconsin - Milwaukee, Milwaukee, WI, USA;
2Orthopedic Surgery, University of Wisconsin Hospital and Clinics, Madison, WI, USA;
3Orthopedic Surgery, Virginia Mason Medical Center, Seattle, WA, USA

Objective: Local delivery of chemotherapy could potentially decrease rates of local recurrence for malignant bone tumors. The purpose of this study was to characterize the 4-day elution profile of cisplatin-loaded bone cement, and determine the effect on bending and compressive failure strength. Standard cement pellets and rectangular samples were prepared for four commercially available bone cements (Cemex, Palacos, Simplex P, SmartSet MV) with the inclusion of 5% w/w cisplatin for elution and strength testing.

Methods: For elution characterization, pellets were placed in saline solution and incubated at body temperature on a rotary platform for 96 hours, changing the saline solution every 24 hours. The concentration of eluded drug was determined using high-performance liquid chromatography (HPLC) analysis. For strength testing, cement samples with and without cisplatin were created for comparison. All samples were tested to failure using a custom built 3-point bending fixture. Then samples were ground to a cubic specimen and a compressive load was applied until failure.

Results: In general, for the elution study all cements eluted cisplatin over the four days and demonstrated a gradual decrease in the amount of elution each day. Cemex produced the greatest elution on each day, and the greatest overall elution. For each day, Cemex had a significantly greater elution compared to Palacos and SmartSet MV while all other brands were not statistically different (p<0.01). For mechanical testing, inclusion of cisplatin significantly increased the bending failure strength for Palacos (p = 0.0168). All other cements showed no significant difference in the bending failure strength between cement with cisplatin when compared to cement without cisplatin. For compression, the failure strength for SmartSet MV with cisplatin was significantly less than without cisplatin (p = 0.0069). All other brands showed no significant difference in failure strength with the inclusion of cisplatin (p < 0.05).

Figure 1.
Four-Day Elution Profile for Commercially Available Bone Cements with the Inclusion of 5% w/w Cisplatin.
Figure 2.
Comparison of Bone Cement Failure Strength During Bending and Compression with the Inclusion of 5% w/w Cisplatin.

Conclusions: Most brands of cement produced a similar elution profile for the 4-day study although there was significantly more elution from Cemex when compared to some brands. The addition of 5% w/w cisplatin did not significantly affect the failure strength of the majority of the cements tested during bending and compression loading. Only SmartSet MV showed a negative impact on the compression failure strength of the cement.
FRACTURE RISK ANALYSIS IN OSTEOCHONDROMA PATIENTS
Mathew Sunil Varre, Masters¹; J. C. Neilson, MD²; Jill Meyer, PhD¹
¹Civil Engineering & Mechanics, University of Wisconsin - Milwaukee, Milwaukee, WI, USA;
²Orthopedics, Medical College of Wisconsin, Milwaukee, WI, USA

Objective: Osteochondroma (OC) is common benign tumor, which occurs predominantly at the knee and shoulder joints. Problematic lesions are typically removed, causing small defects in the bone. These defects may increase the risk of fracture and therefore the patients are prescribed a period of non-weight bearing. The primary objective of this research is to evaluate the risk of fracture of the distal femur due to the removal of an OC lesion. Specifically, the effect of activities of daily living on the forces produced in the bone were analyzed using patient-specific computational models developed from computed tomography (CT) data.

Methods: A male subject with hereditary multiple exostoses (21yrs; 170cm; 85kg) was part of this retrospective study. Through approval by the IRB at the Children’s Hospital of Wisconsin, CT scans were obtained from the imaging facility at the Medical College of Wisconsin. As part of routine clinical assessment, a CT scan of the right femur of the patient was acquired using a GE Light Speed VCT scanner (120kV; dosage 346.5mAs) with a resolution of 512 mm x 512 mm and slice thickness and increment of 0.625 mm. The geometry and material properties of the femur were obtained from CT data. A computational model was developed to mimic the loads seen on the femur during seven activities of daily living: walking, standing up, sitting down, ascending stairs, descending stairs, one leg stance, and knee bending.

Results: The maximum force in the distal femur during the seven different physiological activities is shown in Figure 1. The highest forces were reported during stair climbing, followed by stair descent, walking, one-leg stance, standing up, and sitting down, respectively. The CT data used for this study was obtained six months after removal of the lesion and shows no risk of fracture around the lesion site. Future work will develop a similar model for patient data immediately post-operatively to provide more quantitative analysis of fracture risk for patients after the removal of a benign tumor.

Conclusions: A methodology for development of a CT based patient-specific computational model for an OC patient was established. This provides a means for future analysis of fracture risk prediction in patients with OC lesions.

Figure 1. Force Distribution in Distal Femur During Various Activities of Daily Living.

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DIAGNOSTIC DELAY OF SOFT TISSUE SARCOMAS
Herrick J. Siegel, MD; Diego Herrera, MD
Orthopaedic Surgery, University of Alabama at Birmingham, Birmingham, AL, USA

Objective: Attempts to improve the time to diagnosis have been made by producing guidelines for urgent referral. However, there is no evidence to show that those patients who are diagnosed and treated earlier are conferred a prognostic advantage. In fact it has been suggested that those patients who present earlier tend to have high-grade disease and have a less favorable outcome. The purpose of this study is to detail causes of failure or delay in patient referral patterns to a cancer specialist, and to assess whether delay or neglect has any impact on patient survival and limb salvage options. Furthermore, the study aims to identify patient demographics and tumor characteristics that may put patients at higher risk for a delayed referral to a specialist.

Methods: Between January 2003 and January 2007, 194 patients with a confirmed diagnosis of soft tissue sarcoma were treated by the sections of orthopaedic and surgical oncology a comprehensive cancer center. Standard demographic information, including age, sex, highest level of education, employment and insurance status, was collected via the data base. Histological diagnosis, size of tumor at presentation, and timing of referral from first noticing the mass to presentation to a SS were recorded. Specific causes for referral delays in each medical or surgical specialty were evaluated in order to identify trends.

Results: The mean time for a patient to be referred to the specialist from the onset of symptoms was 9.3 months (range: 0.5 -165 months). Only 14.6% were sub-categorized into the Timely group (<3 months to be referred from onset of mass), 20.4% in the Delayed group (3 -12 months to be referred from onset of mass) and 65% in the Neglected group (> 1 year to be referred from the time of symptom onset).

Conclusions: Medical student education concerning the initial management of soft tissue malignancies is crucial to decreasing referral time for patients with these often devastating tumors. Optimizing communication among clinicians, radiologists and pathologists cannot be overemphasized and can avoid many inadvertent diagnostic errors.
SYMPTOMATIC DEEP VENOUS THROMBOSIS FOLLOWING SOFT TISSUE MASS RESECTIONS

Herrick J. Siegel, MD; Jay Savage, MD
Orthopaedic Surgery, UAB, Birmingham, AL, USA

Objective: The incidence of deep venous thrombosis following soft tissue tumor surgery has not been well studied. A protocol for prophylaxis is not universally accepted. The identification and importance of potential risk factors is also poorly defined. The goal of this study is to report the incidence and potential risk factors for patients with symptomatic deep venous thrombosis following soft tissue surgery.

Methods: A retrospective review of patients treated at a single institution was conducted between 2002 and 2008. Four hundred and twenty-one patients were identified and medical records review to identify the incidence of thrombosis and potential risk factors.

Results: An incidence of symptomatic deep venous thrombosis was noted in less than 2% (n=7) of patients. Five patients had high grade sarcomas that were pre treated with radiation, one patient a benign schwannoma and one with a low grade liposarcoma. Weight, age and post operative activity level were not found to be independent risk factors. One hundred and five of the 410 patients received chemoprophylaxis and 316 without. No difference in the incidence of thrombosis was seen between those treated with chemoprophylaxis and that were not. Of these 7 patients, 4 received chemoprophylaxis with LovenoxTM and 1 with aspirin and 2 without prophylaxis. Tumor size greater than 10 cm and a history of thrombosis were noted in 5 of 7 patients. A higher wound complication incidence was seen in the group of patients receiving chemoprophylaxis compared to those that did not.

Conclusions: Chemoprophylaxis may be used following the treatment of soft tissue tumors; however

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EXTRASKELETAL MYXOID CHONDROSARCOMA: STUDY OF CLINICOPATHOLOGIC, IMMUNOHISTOCHEMICAL AND CYTOGENETIC FEATURES IN 20 PATIENTS

Chandhanarat Chandhanayingyong, MD1; Thana Siripisitsak2; Kanapon Pradniwat3; Sorranart Muangsomboon3; Apichat Asavamongkolkul, MD2; Fabrizio Remotti, Dr.4; Francis Y. Lee, MD, PhD1
1Center for Orthopaedic Research (COR), Department of Orthopaedic Surgery, Columbia University, New York, NY, USA; 2Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand; 3Department of Pathology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand; 4Department of Anatomic Pathology, Columbia University, New York, NY, USA

Objective: To access outcome and identify predictor of survival in extraskeletal myxoid chondrosarcoma (EMC) patients.

Methods: The clinicopathological, immunohistochemical, cytogenetic characteristics and treatment outcomes of EMC patients who were treated between 1992-2011 were examined.

Results: Twenty cases of EMC were identified. The ratio of male: female was 2.3:1. The median age was 64 years (range; 41-96). Fifty percent of all tumors occurred in proximal extremities and limb girdles. Two tumors arose at unusual sites: intra-articular of the knee and ethmoidal sinus. The median tumor size was 10 cm (range; 2.2-30). Mean follow-up time was 5.4 years (range, 0.6-19.7). Eight patients were continuous disease free, six were alive with disease and six were died of disease. Local recurrence was found in 8 (40%) patients and seven (35%) patients developed distance metastases. 5, 10 and 15-year overall-survival rates were 76.3%, 55.3% and 33.8% and event-free survival rates were 75%, 32.1% and 0% respectively. Sixteen tumors had characteristic appearance of EMC and four tumors (20%) showed solid-cellular variants. The immunoreactivity for S-100 protein (50%), synaptophysin (25%), chromogranin A (30%) and SOX-9 (77%). Epithelial markers (Cytokeratin, AE1 / AE3 and CAM5.2) were all negative. Expression of the markers suggests chondral and neural/neuroendocrine differentiation. In a reverse transcription polymerase chain reaction (RT-PCR) assay from paraffin embedded specimens showed fusion of EWSR1-NR4A3 (77%), TAF15-NR4A3 (16%) and TCF12-NR4A3 (7%), but were not adverse prognostic factor. Metastasis also adversely affected survival, but local recurrence did not.

Conclusions: EMC showed high rate of local recurrence and distant metastasis. Patients had prolonged survival after metastasis, but eventually died of tumor related cause. These features distinguish EMC from low-grade sarcomas.
POST-RADIATION FRACTURES IN THE SETTING OF SOFT-TISSUE SARCOMA TREATMENT

Ali Syed; Timothy A. Damron
Orthopaedic Surgery, SUNY Upstate Medical University, Syracuse, NY, USA

Objective: Adjunctive radiotherapy for soft tissue sarcoma treatment is associated with post-radiation fractures. Treatment remains controversial. The hypotheses of this study were that (1) the incidence in this patient population is greater than the 6% reported in the combined literature and (2) prophylactic stabilization in our hands has not prevented fracture.

Methods: Of 143 patients with lower extremity soft tissue sarcomas, 103 patients had received radiation therapy and comprised the study group. Average age was 56 years (Range: 5-95 years), most common diagnosis was undifferentiated pleomorphic sarcoma (37/103, 35.9%), and most common stage at presentation was AJCC III (39/103, 37.9%).

Results: Of those patients, 11/103 (10.7%) developed 16 pathological fractures in the radiated field at a mean 31 months (Range: 7-113) post-surgical resection. Fracture incidence was significantly higher in females (p=0.051) and in those who had periosteal stripping (p=0.046) but did not show any correlation with stage, grade, or location of tumor, nor with chemotherapy or radiation dosage (p>0.05). However, 7 of 39 patients (17.9%) who received combined EBRT and brachytherapy (BT) treatment developed fractures, whereas only 4 of 64 patients (6.3 %) who received either EBRT or BT alone developed fractures (p=0.0975). Fractures were treated with ORIF (8/16, 50%), observation (5/16, 31.3%), resection and reconstruction (2/16, 12.5%), or resection alone (1/16, 6.3%). Fracture healing rate was only 53.9% (7/13). Both of the two patients who underwent prophylactic stabilization (one tibial plate, one IM tibial rod) subsequently incurred fractures; those 2 patients accounted for a total of 5 of the 16 fractures (31.3%).

Conclusions: Post-radiation fracture risk may be underestimated in the current literature, and this study suggests caution in making the jump to prophylactic stabilization of these fractures, particularly in the tibia. Further, this study identifies combined EBRT and BT as a potential risk factor for post-radiation fractures in this setting.
Objective: To review an unusual presentation of soft tissue Ewings sarcoma presenting as presumed herniated nucleus pulposus, and review the literature on this tumor.

Methods: The patient is a 46-year-old male who presented to the spine surgery clinic with a several-month history of intractable right lower extremity radicular pain which began after lifting heavy boxes at work. His pain was refractory to conservative management with rest, physical therapy, epidural steroid injections, and chiropractor treatments. A lumbar spine MRI scan suggested disc bulges at L4-5 and L5-S1 but no disc herniations. He was sent for consideration for spinal decompression. Physical examination by the spine surgeon suggested a right posterior thigh mass with a positive Tinel’s sign. He was sent for an MRI scan of the thigh and evaluation by a musculoskeletal oncologist.

Results: Right thigh MRI demonstrated a 6x7x7.5 cm tumor in the posterior compartment arising from and encasing the sciatic nerve (Figures 1,2). Ultrasound-guided biopsy revealed a small round blue cell tumor with a high proliferative index (Ki 67=50-60%) and strong CD99 staining. The diagnosis of soft tissue Ewings sarcoma was confirmed with fluorescence in situ hybridization for the EWS-FLI1 translocation product. Staging studies revealed that the patient had localized disease making him Stage III (T2b,N0,M0,G3) by AJCC criteria. The patient received four cycles of neoadjuvant chemotherapy with vincristine, ifosfamide, doxorubicin, and etoposide (VIDE). He then underwent wide resection of the tumor and sciatic nerve. Pathologic margins were negative for tumor and he had 100% necrosis of the Ewings sarcoma. He remains free of detectable metastatic disease.

Conclusions: Soft tissue Ewings sarcoma is less common than skeletal Ewings sarcoma. A recent review of the NCI SEER database suggests that localized soft tissue Ewings sarcoma carries a more favorable prognosis than localized skeletal disease (Applebaum et al, Cancer, 2011). Low back pain and radicular pain are some of the most common complaints to primary care doctors and emergency departments. When radiographic studies do not match physical examination, practitioners must be vigilant to investigate non-spinal etiologies of these symptoms. To the best of our knowledge this represents the first reported incidence of radiculopathy caused by Ewings sarcoma of the sciatic nerve.

Sagittal T2-weighted MRI demonstrates the thigh tumor involving the patient’s sciatic nerve.

Axial T2-weighted MRI scan demonstrates a large heterogenous tumor in the right posteromedial thigh. The tumor completely arose from/encased the sciatic nerve.
Objective: Patient-derived measures are an important means of assessing treatment outcomes. Comparative and cost-effectiveness research is facilitated by health state utilities, a type of instrument that permits study of comprehensive health related quality of life outcome among diseases, and allows calculation of quality-adjusted life years. One such measure, the SF6D, is calculated from the widely utilized SF36. Patient answers result in scores from 1 to 6 along six domains of health, yielding a health state between 111111 (perfect health) to 666666. Preference weighted valuations in the general population then allow all 18,000 health states to be given a score between 1 (perfect health) and zero (death). The purpose of this study was to validate the SF6D in a population of sarcoma patients.

Methods: The SF6D was evaluated in a cross-sectional sample of lower extremity sarcoma patients at an academic institution. Patients who completed the SF36 and TESS (Toronto Extremity Salvage Score) as part of a registry were eligible for inclusion. Between 2011 and 2012, 55 patients completed 63 pairs of surveys. Patient characteristics are listed in Table 1. SF6D health states were computed from the SF36, and given preference weights based on a Bayesian modeling of a prior standard gamble valuation. The main outcome was the correlation between the SF6D and the TESS. A power analysis determined that 40 patients would be necessary to have an 80% chance of finding a correlation of at least 0.6, as evidence of construct validity.

Results: The mean preference weighted SF6D score was 0.59 (95% CI 0.4-0.81), comparing favorably to patients with spine pathology or coronary artery disease. With a skewness of 0.11, there was not evidence of ceiling or floor effects, and it closely fit a normal distribution (Figure 1). SF6D correlated significantly with the TESS (r=0.75, p<0.01, Figure 2). Respondents with the
use of a walking aid had significantly lower SF6D scores (p=0.03).

**Conclusions:** In a population of lower extremity sarcoma patients, the SF6D demonstrated convergent and face validity without evidence of floor or ceiling effects. It has the potential to facilitate comparative effectiveness research and economic modeling, while taking advantage of the wealth of prior work utilizing the SF36. Next steps include assessment of sensitivity to change and clinically important difference in a prospective cohort.

![Histogram of SF6D Preference Weighted Score](image1)

![Scatterplot of SF6D Weighted Score vs TESS](image2)

See pages 167 - 176 for financial disclosure index.
SARCOMA EXCISION AND PATTERN OF SENSORY NERVE INJURY

Neil Wickramasinghe1; Daniel Porter2
1Edinburgh University, Edinburgh, United Kingdom;
2Orthopaedics and Trauma, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

Objective: Sensory neurological dysfunction is a particularly pernicious complication of sarcoma excision surgery. This study aims to assess the likelihood of a sensation deficit occurring post sarcoma excision surgery, and subsequently to quantify and characterize these deficits. The study also aims to establish any predisposing factors in the occurrence of sensory deficit, with a view to informing management plans. Finally the study aims to assess whether subjective sensory dysfunction correlates to objective dysfunction, a crucial question regarding assessment during follow-up.

Methods: Sensory nerve function was assessed in 22 patients after sarcoma surgery. Sensation was subjectively evaluated using a patient questionnaire about sensation changes following surgery; and objectively evaluated using light touch (LT), pinprick (PP), and two-point discrimination. Statistical analysis was conducted with significance level set at p ≤0.05.

Results: 93% had an objective sensory deficit. Light touch is less likely to be damaged than pinprick sensation; and as scar size increases, the light touch and pinprick deficits also increase. Two-point discriminatory ability is significantly reduced around the scar, but improves as time after surgery elapses. 91% had a subjective deficit, most likely tingling or pain. Results also demonstrated that no significant correlation existed between any specific objective and subjective deficits.

Conclusions: Sensory disturbance post sarcoma surgery is common and debilitating. Efforts to minimize scar length are paramount in the prevention of sensory deficit. Sensation may also recover to an extent, thus sensory re-education techniques must become an integral aspect of management plans. Finally to obtain a comprehensive assessment of sensory function after sarcoma excision surgery, both objective and subjective assessment techniques must be utilized.
PROSPECTIVE STUDY OF PROTON REIRRADIATION FOR SOFT TISSUE SARCOMA: ARLY OUTCOMES AND MORBIDITY
Abigail B. Milby, MD; Curtiland Deville, MD; Stefan Both; Zelig Tochner; James Metz; Kristi Varillo, MS; Richard D. Lackman, MD; John P. Plastaras, MD, PhD
Hospital of the University of Pennsylvania, Philadelphia, PA, USA

Objective: The management of soft tissue sarcoma (STS) in the setting of previously-irradiated tissue is complex. Proton radiotherapy (PRT) is ideally suited to the problem of reirradiation by sparing further dose to previously-radiated surrounding organs. Our institution developed a prospective trial to assess the feasibility of using PRT for reirradiation of recurrent malignancies. We report our preliminary experience with reirradiation of STS.

Methods: Between March, 2010 and May, 2011, 11 patients with non-metastatic STS in or near prior treatment fields were enrolled on a prospective trial of PRT for reirradiation. The end of prior radiation was required to have completed at least 3 months before the start of PRT. Table 1 shows the original tumor characteristics. The median time from end of treatment of the prior course to the start of the PRT was 56.3 months (figure 1, primary recurrence). STS was confirmed in 8 patients with recurrent sarcoma and 3 with de novo sarcoma with prior radiation for rectal and prostate adenocarcinoma. As shown in table 2, radiotherapy was administered as double scatter proton therapy alone in 9 patients and with intensity modulated photon radiotherapy (IMRT) in 2 patients. One patient received chemotherapy prior to PRT. Surgical resection of the recurrent tumor was performed in 6 patients. Mean clinical target volume (CTV) size was 280 cm3.

Results: The median follow-up was 16.1 months (range 2.9-21.4) from the end of retreatment, and no living patients were lost during follow-up. Median survival was not reached. Seven (64%) patients were alive without evidence of local recurrence (LR) or distant metastasis (DM). Four (36%)...
patients had evidence of LR (figure 1, reirradiation recurrence) and 2 developed DM. Two patients died, one of LR and one of LR and DM, at 2.7 and 11.7 months, respectively. There was one acute PRT-related grade 3 toxicity which was a skin infection. There was no acute grade 4 toxicity. Late grade 3 toxicity soft tissue necrosis was observed in one patient treated pre-operatively to the LLE, requiring flap reconstruction. No other grade 3 or 4 late toxicities were observed thus far.

**Conclusions:** Preliminary results indicate that PRT for the reirradiation of soft tissue toxicity is associated with good early outcomes and moderate toxicity. Further follow up on these patients is needed to assess the long-term utility of PRT reirradiation in STS.

![Graph showing local control rates](image)

<table>
<thead>
<tr>
<th>Table 2. Recurrent Patient and Tumor Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>%</strong></td>
</tr>
<tr>
<td>Age, mean (range)</td>
</tr>
<tr>
<td>Race</td>
</tr>
<tr>
<td>Caucasian</td>
</tr>
<tr>
<td>African American</td>
</tr>
<tr>
<td>Recurrent Pathology</td>
</tr>
<tr>
<td>Liposarcoma</td>
</tr>
<tr>
<td>Spindle cell</td>
</tr>
<tr>
<td>Myxofibrosarcoma</td>
</tr>
<tr>
<td>Pleomorphic sarcoma</td>
</tr>
<tr>
<td>Leiomyosarcoma</td>
</tr>
<tr>
<td>Fibrosarcoma</td>
</tr>
<tr>
<td>Tumor Grade</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Size of Recurrence</td>
</tr>
<tr>
<td>≤ 5 cm</td>
</tr>
<tr>
<td>&gt; 5 cm</td>
</tr>
<tr>
<td>CTV size (cc), median (range)</td>
</tr>
<tr>
<td>&lt; 250 cc</td>
</tr>
<tr>
<td>≥ 250 cc</td>
</tr>
<tr>
<td>Surgery as part of recurrent treatment</td>
</tr>
<tr>
<td>Prior to Reirradiation</td>
</tr>
<tr>
<td>After Reirradiation</td>
</tr>
<tr>
<td>Concurrent Chemotherapy Regimen</td>
</tr>
<tr>
<td>Adriamycin/Ifosamid</td>
</tr>
<tr>
<td>No Chemotherapy</td>
</tr>
<tr>
<td>Dose (cGy), median (range)</td>
</tr>
<tr>
<td>Pre-operative</td>
</tr>
<tr>
<td>Post-operative</td>
</tr>
</tbody>
</table>

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EXPERIENCED OBSERVERS CAN DIFFERENTIATE BETWEEN LIPOMA AND WELL-DIFFERENTIATED LIPOSARCOMA USING ONLY MRI

Patrick O’Donnell, MD, PhD; Amir Sternheim, MD; William C. Eward, MD, DVM; Anthony Griffin; Lawrence White, MD; Jay S. Wunder, MD; Peter C. Ferguson, MD, MSC, FRCSC

1Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA; 2Orthopaedic Surgery, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada; 3Musculoskeletal Radiology, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada; 4Orthopaedic Surgery, Duke University, Durham, NC, USA

Objective: To determine the accuracy, inter-rater reliability, and relationship of stranding, nodularity, and size in the MRI differentiation of extremity lipoma and well-differentiated liposarcoma.

Methods: MRI scans of 60 patients with large (>5cm), deep, pathologically proven lipoma (31 patients) or well-differentiated liposarcoma (29 patients) were examined by 10 observers with subspecialty training in musculoskeletal radiology or orthopaedic oncology, blinded to diagnosis. Observers indicated whether the amount of stranding, nodularity, and size of each tumor suggested a benign or malignant diagnosis, and rendered a diagnosis of lipoma or well differentiated liposarcoma. The accuracy, reliability, and relationship of stranding, nodularity, and size to diagnosis were calculated for all samples.

Results: 69% of reader MRI diagnoses agreed with the final pathology diagnosis (95% CI 65-73%). Readers tended to err choosing a diagnosis of liposarcoma and correctly identified lipomas in 63% of cases (95% CI 58-69%) and liposarcomas in 75% of cases (95% CI 69-80%). Inter-rater reliability for diagnosis showed substantial agreement with a Kappa estimate of 0.63 (95% CI 0.61-0.65). Inter-rater reliability showed only slight agreement for stranding and size but moderate agreement for nodularity (Kappa estimates 0.17, 0.11, and 0.41; 95% CI 0.14 - 0.19, 0.09-0.13, 0.39-0.43 respectively). Assessment of the relationship of stranding, nodularity, and size to correct diagnosis showed that the presence of each was associated with a decreased likelihood of a lipoma diagnosis (p < 0.01).

Conclusions: While the diagnosis of lipoma vs. well-differentiated liposarcoma cannot be made with 100% certainty by MRI alone, experienced observers have a 69% chance of rendering a correct diagnosis. The presence of tumor stranding, nodularity, and worrisome size showed some association with the identification of a correct diagnosis, and as such these characteristics may be used in the determination of a tumor as either lipoma or well-differentiated liposarcoma, but they are not diagnostic. Given the negligible metastatic potential of well-differentiated liposarcoma and inherent difficulty of obtaining representative biopsy of these tumors, marginal excision without adjuvant therapy and pathological examination is recommended to render a definitive diagnosis.

See pages 167 - 176 for financial disclosure index.
EFFECT OF RADIATION THERAPY AND PERIOPERATIVE BLOOD TRANSFUSION ON RECURRENCE IN MYXOID LIPOSARCOMA PATIENTS

Dean Wang; Karen J. Fritchie; Amy S. Nowacki; Michael J. Joyce; Brian P. Rubin; Steven Lietman

1Orthopaedics/Pathology, Cleveland Clinic, Cleveland, OH, USA;
2Orthopaedics, UCLA, Los Angeles, CA, USA;
3Pathology, Mayo Clinic, Rochester, MN, USA

Objective: Previous studies investigating prognostic factors for liposarcomas group myxoid/round cell subtypes with all other histologic subtypes (i.e., well-differentiated, dedifferentiated, and pleomorphic) in their analyses. Recent data shows that myxoid/round cell liposarcomas exhibit unique characteristics compared with other liposarcomas and due to their potential for recurrence, an evaluation of prognostic factors for extremity myxoid liposarcomas was undertaken.

Methods: A retrospective review of forty-seven primary myxoid liposarcomas of the extremities surgically treated at a single institution between 1980 and 2010 was completed. Associations among patient, tumor, treatment factors, local recurrence and distant metastasis were investigated.

Results: The 5- and 12-year overall survival rates were 68% and 57%, respectively, with a median follow-up time of 54 months (Figure 1). Patients who received radiation therapy were less likely to experience a local recurrence than those who did not (p=0.022) and this association remained after treating death as a competing risk (p=0.025)(Table 1 and Figure 2). A trend towards increased local recurrence was noted in patients who received ≥3 transfusion units, with the log-rank comparison and the Cox proportional

Table 1. Summary of patient, tumor, treatment and transfusion factors by local recurrence

<table>
<thead>
<tr>
<th>Factor</th>
<th>Local Recurrence (n=4)</th>
<th>No Local Recurrence (n=43)</th>
<th>Cox proportional model p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>49.5 (15.0)</td>
<td>49.8 (12.1)</td>
<td>0.972</td>
</tr>
<tr>
<td>Male</td>
<td>1 (25%)</td>
<td>26 (60%)</td>
<td>0.144</td>
</tr>
<tr>
<td>Positive smoking history</td>
<td>1 (25%)</td>
<td>24 (56%)</td>
<td>0.168</td>
</tr>
<tr>
<td>Tumor diameter</td>
<td>14.9 (10.2)</td>
<td>14.4 (8.2)</td>
<td>0.631</td>
</tr>
<tr>
<td>Tumor volume</td>
<td>15745 (3607)</td>
<td>6067 (8803)</td>
<td>0.101</td>
</tr>
<tr>
<td>Surgical margin positive</td>
<td>0 (0%)</td>
<td>7 (16%)</td>
<td>0.266</td>
</tr>
<tr>
<td>Received transfusion(1)</td>
<td>3 (100%)</td>
<td>11 (55%)</td>
<td>0.074</td>
</tr>
<tr>
<td>Transfusion of at least 3 units(2)</td>
<td>3 (100%)</td>
<td>5 (45%)</td>
<td>0.030</td>
</tr>
<tr>
<td>Received radiation therapy</td>
<td>0 (0%)</td>
<td>26 (60%)</td>
<td>0.010</td>
</tr>
<tr>
<td>Received chemotherapy</td>
<td>1 (25%)</td>
<td>10 (23%)</td>
<td>0.752</td>
</tr>
</tbody>
</table>

mean (standard deviation) for continuous variables; count (percent) for categorical variables

(1)Local recurrence n = 3, No local recurrence n = 20
(2)Local recurrence n = 3, No local recurrence n = 11

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hazards likelihood ratio test being significant (p[Cox model]=0.030)(Table 2).

Conclusions: Radiation therapy for myxoid liposarcoma leads to a significant decrease in local recurrence. Perioperative transfusion of ≥3 units may lead to an increase in local recurrence in these sarcomas.

Table 2. Summary of patient, tumor, treatment and transfusion factors by distant metastasis

<table>
<thead>
<tr>
<th>Factor</th>
<th>Distant Metastasis (n=14)</th>
<th>No Distant Metastasis (n=33)</th>
<th>Cox proportional model p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 49.6 (10.1)</td>
<td>49.8 (13.1)</td>
<td>0.840</td>
<td></td>
</tr>
<tr>
<td>Male 8 (57%)</td>
<td>19 (58%)</td>
<td>0.896</td>
<td></td>
</tr>
<tr>
<td>Positive smoking history 8 (57%)</td>
<td>17 (52%)</td>
<td>0.830</td>
<td></td>
</tr>
<tr>
<td>Tumor diameter 16.2 (9.0)</td>
<td>13.8 (7.9)</td>
<td>0.116</td>
<td></td>
</tr>
<tr>
<td>Tumor volume 8615 (9813)</td>
<td>5592 (8402)</td>
<td>0.046</td>
<td></td>
</tr>
<tr>
<td>Surgical margin positive 2 (14%)</td>
<td>5 (15%)</td>
<td>0.910</td>
<td></td>
</tr>
<tr>
<td>Received transfusion (1) 5 (83%)</td>
<td>9 (53%)</td>
<td>0.157</td>
<td></td>
</tr>
<tr>
<td>Transfusion of at least 3 units (2) 3 (60%)</td>
<td>5 (56%)</td>
<td>0.692</td>
<td></td>
</tr>
<tr>
<td>Received radiation therapy 8 (57%)</td>
<td>18 (55%)</td>
<td>0.968</td>
<td></td>
</tr>
<tr>
<td>Received chemotherapy 5 (36%)</td>
<td>6 (18%)</td>
<td>0.087</td>
<td></td>
</tr>
</tbody>
</table>

mean (standard deviation) for continuous variables; count (percent) for categorical variables

(1) Distant metastasis n = 6, No distant metastasis n = 17
(2) Distant metastasis n = 5, No distant metastasis n = 9

See pages 167 - 176 for financial disclosure index.
LYMPHANGIOSARCOMA OF THE UPPER EXTREMITY IN CHRONIC LYMPHEDEMA AFTER MASTECTOMY FOR BREAST CANCER: A CASE REPORT

Eduardo D. Abalo; Pablo D. Plater; Emilio C. Corinaldesi
CEMIC, Buenos Aires, Argentina

Objective: Lymphangiosarcoma is an uncommon and aggressive malignant vascular tumor that seems to arise from the endothelium of the lymphatic spaces. Also known as Stewart-Treves syndrome, in the upper limb is characterized by its appearance as a complication of chronic lymphedema due to a radical mastectomy for breast carcinoma. Treatment described in the literature has included chemotherapy, radiation therapy, and local excision, but radical ablative surgery is recommended most commonly. We report a case of upper limb lymphangiosarcoma following mastectomy.

Methods: A 79-year old female with a history of the left breast cancer treated with a radical mastectomy, radiation, and chemotherapy in 1996, presented to our clinic with a massively swollen left upper limb and a bleeding cutaneous ulcer. On clinical examination, the patient’s left arm was swollen and had multiple ulcerated purple papular lesions on the skin with surrounding erythema and indurations, and absence of deep infiltration was noted. MRI showed lymphedema of the arm as a diffuse increased signal and intermediate signal dermal-based nodular tumor of the forearm with no compromise of the underlying muscle or bone. The larger lesion on the forearm was biopsied and histology confirmed the diagnosis of lymphangiosarcoma.

Results: Due to the aggressiveness of the tumor and the impossibility of achieve adequate margins of resection, disarticulation of the left shoulder joint was performed successfully. Within three weeks of the procedure, the patient performed four cycles of local radiotherapy, and systemic chemotherapy.

She presented a tumor recurrence along the chest wall twelve months postoperative follow-up and developed metastases in the brain 14 months after the procedure and expired a month later.

Conclusions: Lymphangiosarcoma is a malignant vascular tumor of unknown etiology, which can be difficult to diagnose and has a poor prognosis. It occurs approximately 10 years after radical mastectomy for breast cancer in women whose subsequent course has been complicated by chronic lymphedema. Unfamiliarity with this disease and the initial innocuous appearance of the tumor often lead to delayed diagnosis. Since the role of chemotherapy and radiation therapy has not been well established, early diagnosis and radical resection of lesions appear as the best alternative to improve the survival of patients.
INCREASE IN TUMOR SIZE ON MRI IS ASSOCIATED WITH GREATER PATHOLOGIC NECROSIS AND POOR SURVIVAL IN PATIENTS WITH SOFT TISSUE SARCOMA TREATED WITH NEOADJUVANT RADIOTHERAPY

Meena Bedi, MD1; Jordan Kharofa2; Jason Chang2; Eduardo V. Zambrano2; Keith Baynes3; Alan P. Mautz2; Melissa DuBois2; David M. King4; Donald A. Hackbarth4; John A. Charlson5

1Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI, USA; 2Pathology, Medical College of Wisconsin, Milwaukee, WI, USA; 3Radiology, Medical College of Wisconsin, Milwaukee, WI, USA; 4Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA; 5Medical Oncology, Medical College of Wisconsin, Milwaukee, WI, USA

Objective: MRI is used to evaluate treatment response to neoadjuvant therapy (NAT) for primary soft tissue sarcomas (STS). However, it is not well understood if radiographic response predicts for treatment outcomes. The objective of this study was to evaluate if radiographic changes following preoperative therapy predict for pathologic response and survival.

Methods: From 2003-2010, 62 patients (pts) with STS of the extremity and body wall were treated with neoadjuvant radiation +/- chemotherapy. MRI’s were obtained before and 3-4 weeks after the completion of radiation. Tumor size and volume were measured on T1-weighted sequences. Change in MRI volume was correlated with percent (%) necrosis, viable cells, and fibrosis on pathology. The Kaplan-Meier method was used to assess survival. ROC analysis was done to assess change in volume that best predicted for >70% necrosis.

Results: Median pre-treatment tumor size was 8.6 cm on MRI. 48 pts had high grade, 2 pts had intermediate grade and 12 pts had low grade tumors. 22 pts received neoadjuvant chemotherapy. Median tumor volume was a decrease in 15.08 cm3 after NAT. An increase in tumor volume was associated with greater pathologic necrosis (R=0.39, p=0.001), less viable cells (R=-0.39, p=0.005) and less fibrosis (R=-0.51, p<0.001) on final pathology. High grade tumors had more pathologic necrosis (R= 0.42, p<0.001) and comprised the majority of pts with increases in volume following NAT (87%). On ROC analysis, a tumor volume increase of at least 66% predicted for ≥ 70% necrosis with 94% specificity (CI 88-99%). At a median follow up of 33 months, the cumulative incidence of local failure and distant metastases were 3.2% and 27.4%. The 3 year DFS and OS were 70% and 82%, respectively. In pts with an increase in tumor volume following NAT, the 3 year OS was 65% vs 93% in pts with a decrease in volume (p=0.004). In tumors with ≥ 70% pathologic necrosis, the 3 year OS was 38% vs 91% if pathologic necrosis was <70% (p<0.001).

Conclusions: MR-based increase in tumor size after NAT is associated with greater % necrosis, less viable cells, and less fibrosis on pathology. Pts with tumor swelling and necrosis following NAT are more likely to have high grade tumors and worse overall survival.

See pages 167 - 176 for financial disclosure index.
Objective: Neoadjuvant therapy with radiation +/- chemotherapy is an accepted management for soft tissue sarcomas (STS) of the extremity and body wall. Lymphedema as a result of these therapies can result from various mechanisms, and has been reported to be around 30%. The purpose of this study was to identify our institutional edema rates following neoadjuvant therapies for STS as well as the variables that predict for edema.

Methods: From 2000-2010, 125 patients (pts) with STS of the extremities and body-wall were treated with neoadjuvant radiation +/- chemotherapy followed by limb-sparing resection. We retrospectively reviewed pt and tumor variables and treatment outcomes. The presence of post-therapy edema was determined by the treating physician at follow-up and subjectively by each physician. The fisher exact test was used for univariate analysis (UVA) and logistic regression analysis was used for multivariate analysis (MVA).

Results: The median follow-up was 3.5 yrs. Median tumor size was 8.6 cm. The median preoperative radiation dose was 50 Gy. 42% of pts underwent neoadjuvant sequential chemotherapy. Major veins were sacrificed in 26 (20.6%) pts. The superficial femoral was sacrificed in 8 (6.5%), profunda femoral in 9 (7.2%), obturator in 8 (6.5%), popliteal in 1 (0.8%) and internal iliac in 1 (0.8%) pt. Post-therapy edema occurred in 28 (22.4%) of pts. Predictors for edema on UVA included smoking (p=0.006), sacrifice of a major vein at the time of resection (p=0.007), and trended towards significance if a tumor was ≥ 3mm from the surface. On MVA, smoking (p=0.02) and sacrifice of a major vein (p=0.02) were predictive for post-therapy edema. Neither age, sex, performance status, the presence of diabetes or cardiovascular disease, histology, grade, administration of chemotherapy, immediate flap reconstruction at the time of resection, type of flap, or tumor size predicted for edema. Pts with anterior thigh tumors were less likely to develop post-therapy edema compared to other extremity tumor locations (p=0.04).

Conclusions: The results of this retrospective study indicate that smokers and pts who undergo resection of a major vein are more prone to post-therapy edema. Moreover, anterior thigh tumors are less likely to develop post-therapy edema complications.
PROXIMAL MEDIAL THIGH TUMORS HAVE INCREASED RISK OF MAJOR ACUTE WOUND COMPLICATIONS IN PATIENTS WITH SOFT TISSUE SARCOMAS TREATED WITH NEOADJUVANT RADIATION FOLLOWED BY LIMB-SALVAGE SURGERY

Meena Bedi, MD; David King, MD; Robert Whitfield, MD; Donald A. Hackbarth, MD; John C. Neilson; John A. Charlson; Dian Wang, MD, PhD
1Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI, USA; 2Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA; 3Plastic Surgery, Medical College of Wisconsin, Milwaukee, WI, USA; 4Medical Oncology, Medical College of Wisconsin, Milwaukee, WI, USA

Objective: Neoadjuvant therapy with radiation +/- chemotherapy is a widely accepted management for soft tissue sarcomas (STS) of the extremity and body wall. Major acute wound complications (MAWC) are known to be higher in a pre-operative setting than with post-operative treatment for these tumors, and range from 32-44%. Our goal was analyze our institutional wound outcomes and predict those patients (pts) at higher risk for wound complications.

Methods: From 2000-2010, 125 pts with STS of the extremities and body-wall were treated with neoadjuvant radiation +/- chemotherapy followed by limb-sparing resection. We retrospectively reviewed pt demographic and treatment variables as well as outcomes. MAWC were defined as those requiring operation, prolonged wound care or antibiotics ≤ 6 months after their definitive surgery. The fisher exact test was used for univariate analysis (UVA) and a logistic regression analysis was used for multivariate analysis (MVA).

Results: Median follow-up was 3.5 yrs. Median age at diagnosis was 55 and the median tumor size was 8.6 cm. Median preoperative radiation dose was 50 Gy. 55 pts underwent neoadjuvant sequential chemotherapy. Limb-sparing surgery was performed in all pts. Plastic surgery was involved in 43% of closures. Wound closures were primary or local in 59.2%, rotational in 32% and free-tissue in 8.8% of pts. MAWC occurred in 27% of pts. Predictors for MAWC on UVA included proximal lower extremity tumors (p=0.003) and trended towards significance for deep (TXb) tumors (p=0.07) and sacrifice of a major vein at the time of resection (p=0.07). Proximal lower extremity tumors was the only significant predictor on MVA for MAWC (p=0.04). Of the extremity tumors, medial compartment thigh tumors were found to be predictive for MAWC (p=0.05), where 34% of patients with medial lesions had a MAWC. Neither age, sex, performance status, the presence of diabetes or cardiovascular disease, smoking history, histology, grade, administration of chemotherapy, immediate flap reconstruction, type of reconstructive flap, or tumor size predicted for MAWC.

Conclusions: Pts with proximal medial thigh tumors are at an increased risk of developing MAWC. Thus, discussion about the potential increased risk for MAWC in pts with tumors in these locations should be considered.
CAUSE AND EFFECT OF LOCAL RECURRENCE IN EXTREMITY SOFT TISSUE SARCOMA - ARE WE MAKING A DIFFERENCE?
Vignesh K. Alamanda; Samuel N. Crosby, MD; Kristin R. Archer, PhD; Yanna Song; Jennifer L. Halpern, MD; Herbert S. Schwartz, MD; Ginger E. Holt, MD
1Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, TN, USA; 2Department of Biostatistics, Vanderbilt University Medical Center, Nashville, TN, USA

Objective: Limb salvage surgery (LSS) has gained widespread acceptance as the current treatment for treating extremity soft tissue sarcoma (STS) and has been greatly refined since its inception. Combined with improved adjuvant treatment modalities, rates of local relapse have greatly decreased. Nonetheless, local recurrence still occurs and identifying the cause and the subsequent effects of local recurrence in this age of LSS can provide insights as LSS has continued to evolve.

Methods: This retrospective study evaluated 278 patients treated for STS of the extremities between 2000-2006. Primarily excised STS (n=172), incompletely excised specimens (n=106) with residual disease (n=29) and without (n=77), were all assessed for margin status, local recurrence, and overall survival. Patients with a local recurrence (n=41) were compared with those without (n=237) to assess differences in subsequent prognosis. Wilcoxon rank sum test was used to compare continuous variables and either χ² or Fisher’s exact test was used to compare categorical variables. Kaplan Meier and Gray’s test for cumulative risk were performed between those with recurrence and those without.

Results: Positive margins were the single strongest predictor of local recurrence following primary or re-excision in extremity soft tissue sarcoma. (p = 0.0000011) In patients who underwent a re-excision, the presence or absence of residual disease upon re-excision did not have any bearing on local recurrence. (p=0.27) In comparing patients with and without local recurrence, there was no statistically significant difference in the rate and the proportion encountering distant metastasis and death due to sarcoma. (p = 0.44 and 0.09 respectively).

Conclusions: Despite advancements in surgery, radiation, and imaging, positive margins still occur, and the presence of positive margins following definitive treatment continues to remain as a strong predictor for local recurrence. While local recurrence represents a negative outcome for a patient, its impact on future prognosis is influenced by a variety of factors such as time to local recurrence as well as the tumor’s inherent biological characteristics.
FAILURE TO CORRECTLY DIAGNOSE EXTREMITY SOFT TISSUE SARCOMAS - IS A LACK OF EDUCATION TO BLAME?
Vignesh K. Alamanda; Samuel N. Crosby, MD; Kristin R. Archer, PhD; Shannon Mathis; Herbert S. Schwartz, MD; Ginger E. Holt, MD
Department of Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, TN, USA

Objective: Soft tissue sarcomas (STS) continue to be misdiagnosed and inappropriately excised without proper pre-operative diagnosis and planning. This incomplete primary excision results in a second resection which results in greater emotional tolls, higher costs and inferior functional outcomes. In an attempt to understand why STS masses continue to be inappropriately excised, we sought to analyze the clinical judgment of residents in training and the structure of sarcoma educational programs in both orthopaedic and general surgery.

Methods: A case based sarcoma survey was designed and validated to assess clinical decision making, practice patterns and demographics. Program leaders of both general surgery and orthopaedic residency programs in the United States were contacted by email with a request to forward the survey to their respective residents. The aggregate response for all of the clinical cases by each respondent was correlated with the selections made for practice patterns and demographic data. Bivariate analyses were carried out followed by multivariate analyses. Statistical significance was maintained at p < 0.05.

Results: A combined total of 381 responses were returned from both groups. A higher percentage of respondents from the orthopaedic group (84.2%) noted having a dedicated STS rotation as compared to the respondents from general surgery (35.8%); p<.001. Factors such as depth and location of the mass, rate of growth, and imaging characteristics were considered to be important in guiding the respondents’ decisions. Both groups considered a tumor size of 3.8cm to be largest size that they would be comfortable with excising without a biopsy. In correlating the correct clinical step with the respondent’s practice patterns, it was found that each additional year of training resulted in a 10% increased odds of selecting the correct clinical decision for both groups.

Conclusions: Educational opportunities in recognizing soft tissue sarcomas exist at the resident level in both general and orthopaedic surgery training programs in the United States. Our study shows these opportunities to be greatest in general surgery training programs at this time. Educational programs following residency training should also be implemented to further reduce rates of inappropriate excisions through continuing education in sarcoma care with an emphasis on the hazards of misdiagnosis.

See pages 167 - 176 for financial disclosure index.
Objective: Previous studies have shown no survival difference for incompletely excised sarcomas. In contrast, a functional outcome difference between the two has been shown. Our hypothesis was that there would be a significant financial difference between primary and secondary excisions of STS with re-excisions independently incurring a higher cost and an even higher cost when the primary surgery is considered.

Methods: A financial database query for cost data (actual, professional, and technical) for STS excisions from 2005-2006 was performed. A total of 117 patients (74 primary excisions and 43 re-excisions) were identified. Student’s t-test and Wilcoxon Rank Sum tests were used to compare differences in demographics and tumor characteristics between two groups. Wilcoxon Rank Sum tests and linear regression analyses examined the association between excision and actual, professional and technical costs. Sub-analyses were performed for primary excision to determine the relation between tumor size and cost. Statistical significance was maintained at p < .05.

Results: Re-excising a STS is significantly more expensive than a primary excision. The average surgeon’s cost for a primary excision was $11,689 and $14,303 for a re-excision. Re-excision costs $3,331 more in surgeon’s costs and $8,485 more in technical charges than a primary excision. Moreover, when the cost of the primary excision is factored in, the cost of care doubles. The cost of a primary excision rose in proportion to the size of the STS (as tumor size increases by 1 cm, the cost increases by $214.), while in re-excisions the cost remained independent of the tumor size. Re-excision of a 5cm tumor cost the same as a primary excision of a 30cm tumor. When all finances are considered, the average cost for a primary excision is $45,312, and $48,208 for a re-excision.

Conclusions: We found a significant financial difference between the two groups with re-excisions incurring a much higher cost; when the primary surgery is considered, the financial burden doubles. In this study, avoiding an unnecessary surgical procedure would have saved, on average, $48,208. This lends even greater impetus to correctly diagnose STS and refer patients to a sarcoma center for early treatment.
Objective: Malignant ulceration, or fungation, of soft tissue sarcomas occurs not uncommonly, but little literature exists regarding associated factors and outcomes. Fungating sarcomas have been associated with decreased survival but similar recurrence and limb salvage rates when compared to non-ulcerating tumors. The purpose of our study is to evaluate the factors, treatments, and outcomes associated with fungating soft tissue sarcomas in order to improve prevention, determine prognosis, and guide appropriate treatment.

Methods: We performed a retrospective review of inpatient and outpatient medical records, radiologic studies, and pathology reports of all patients presenting with fungating soft-tissue sarcoma of the pelvis or an extremity treated at Los Angeles County Hospital and/or USC University Hospital between 2005 and 2012. Seventeen patients met the study criteria, with follow up ranging from 3 months to six years. The patients were evaluated according to epidemiologic variables, adjuvant treatments used, and outcomes, including limb salvage, recurrence, metastasis, and survival.

Results: Overall survival for the study group was 47%. Twenty nine per cent (5/17) of patients initially underwent primary amputation of limb. Of this group, 3 patients developed distant metastasis, and overall survival was 80%. Twenty nine per cent (5/17) patients developed local recurrence, of which 80% developed subsequent distant metastasis. Fifty nine per cent (10/17) of the group eventually developed metastasis, 90% of which occurred in the lungs. Ninety per cent of these metastatic patients received adjuvant chemotherapy, with 22% surviving at least four years from diagnosis.

Conclusions: When compared to historical series of similar non-fungating sarcomas, fungating soft tissue sarcomas carry a worsened prognosis, with a higher rate of amputation, local recurrence, metastasis, and mortality.
DETECTION OF RECURRENT SARCOMA FOLLOWING RESECTION: MRI WITH A “TWIST”

Laura M. Fayad, MD; Filippo del Grande, MD; Charles Mugera, MD; Kristy L. Weber, MD

1Radiology, Orthopaedic Surgery & Oncology, Johns Hopkins University, Baltimore, MD, USA; 2Orthopaedic Surgery, Johns Hopkins University, Baltimore, MD, USA; 3Radiology, Johns Hopkins University, Baltimore, MD, USA

Objective: To investigate the added value of functional MRI with a perfusion sequence to a conventional MR imaging tumor protocol for the detection of tumor recurrence following surgical resection.

Methods: Eleven subjects who had undergone MRI for the evaluation of potential postoperative recurrence were included. MRI sequences included conventional T1, T2 and static post-contrast T1 weighted imaging as well as perfusion imaging (time-resolved angiography with interleaved stochastic trajectories, “TWIST”, time resolution 10 seconds). Two radiologists (in consensus) viewed the images and recorded the presence or absence of “mass-like” signal and signal characteristics of the surgical bed (hypointense, isointense, hyperintense relative to muscle on T1 and T2 imaging, presence or absence of contrast enhancement). For the perfusion scan, readers recorded the presence or absence of arterial-phase enhancement. By imaging, recurrence was defined as a “mass-like” signal abnormality with contrast enhancement on conventional imaging and an area of arterial enhancement on the perfusion scan. The diagnostic performance of conventional MRI and that of the TWIST were determined using histology as the reference to define recurrence.

Results: There were 3/11 histologically-proven recurrent sarcomas; remaining 8/11 cases showed no evidence of recurrence by biopsy or had documented stability by imaging and clinical follow-up for at least 6 months. Recurrent tumors were all isointense to muscle on T1 imaging, hyperintense on T2 imaging and enhanced following contrast administration; By TWIST, all recurrences showed evidence of arterial phase enhancement while in patients without recurrence, there was no evidence of arterial phase enhancement. By conventional MRI, tumor recurrence was correctly detected in 2/3 cases and suggested in 3/8 cases without recurrence (sensitivity/specificity for detecting tumor recurrence 40% and 83.3% respectively). By the perfusion scan, all recurrences were identified correctly by arterial phase enhancement, and there was no evidence of arterial enhancement in cases of no recurrence (sensitivity and specificity were 100% each).

Conclusions: These preliminary results suggest that the addition of a functional perfusion sequence (“TWIST”) to a conventional tumor imaging protocol potentially provides a means of enhanced detection of recurrence following surgery.

71 year old woman with recurrent malignant fibrous histiocytoma. Axial T1 weighted image shows no definite abnormality. Axial fat-suppressed T2 weighted image shows an ovoid region of high signal intensity within the vastus lateralis muscle, of uncertain etiology given that muscle signal abnormalities are common following surgery due to denervation and post-treatment inflammation. Coronal perfusion sequence performed with TWIST reveals an avidly enhancing nodule in the region of T2 signal abnormality, highly suspicious for recurrence. This patient subsequently underwent a biopsy with histologically-proven recurrence.
Objective: Patients with soft tissue sarcoma of the extremities who present with >3 lung metastases have a dismal prognosis. Treatment for patients presenting with numerous lung metastases is generally considered palliative. Surgical resection of soft tissue sarcoma of the extremities is associated with variable periods of recovery. The role of palliative resection of the primary tumour, undertaken to improve quality of life by alleviating local symptoms, has not been well elucidated. We sought to investigate the role of palliative surgery in patients with soft tissue sarcoma presenting with multiple lung metastases.

Methods: We reviewed six patients presenting with soft tissue sarcoma and >3 pulmonary metastases who were treated with resection of the primary tumour for palliative purposes. Patients were identified from our prospectively maintained database at the University of Toronto/Mount Sinai Hospital.

Results: Mean patient age was 69 years (range 55-91 years). Mean follow-up was 234.5 days (range 98-567). There were two patients with undifferentiated pleomorphic sarcoma, one patient with leiomeiosarcoma, one patient with myxofibrosarcoma, one patient with mesenchymal chondrosarcoma, and one patient with extraskeletal osteosarcoma. All tumours were high-grade and located in the proximal thigh. All tumours were large and causing significant local symptoms, with a mean tumour diameter of 14.4 cm (range 5-29 cm). Four of the six patients had wound complications requiring reoperation. While four patients returned to independent ambulation with a mean recovery time of 3.5 months (range 1 to 9 months), two patients were neither pain-free nor able to ambulate independently again (with survival times of 120 and 220 days).

Conclusions: Because resection of large soft tissue sarcomas has a high complication rate and a prolonged recovery time, palliative surgery to control local symptoms in patients who present with extensive lung metastases must be carefully considered. While some patients recover in time to improve their quality of life, others spend their remaining days recovering from surgery. Further evaluation of the role of aggressive surgery in improving quality of life in these patients is warranted.
ANTIPROTUSIO CAGE RECONSTRUCTION IN COMBINATION WITH DUAL MOBILITY TECHNOLOGY TO IMPROVE HIP STABILITY

Herrick J. Siegel, MD; Graham Calvert, MD
Orthopaedic Surgery, UAB, Birmingham, AL, USA

Objective: Post-operative hip stability remains a major concern following revision hip reconstruction using an antiprotrusio cage for periacetabular bone loss from metastatic bone disease. Dual mobility technology combines the advantage of a large head with the tripolar effect of a smaller head rotating within a larger head without the impact on polyethylene wear.

Methods: This study includes 15 patients treated with antiprotrusio cups with cemented anatomic dual mobility cups. The follow up was a minimum of 6 months with a mean of 17.4 months. Stability was assessed by radiographs taken at 3, 6, 12, 18 months and yearly thereafter. All patients had known metastatic disease involving the periacetabulum. Six patients had proximal femur replacements. Seven had intact greater trochanters with functional abductors and 2 had loss of abductor attachment or function.

Results: Four of 15 patients were treated for post-operative dislocations during the follow up period. This included 2 of the 4 proximal femur replacements and both patients with no abductors. Two of 4 were revised to a constrained liner and 1 was revised by limb lengthening. In 1 patient the instability was caused by loss of cement fixation between the cup and antiprotrusio cage.

Conclusions: The combination of a dual mobility hip with antiprotrusio cage is a good option in patients with an intact abductor mechanism. For those with proximal femur replacements, stability remains a challenge and patients should be made aware of their high risk of dislocation. A cemented contrained liner may put significant stress on the antiprotrusio cage reconstruction and is not recommended at the initial surgery, but may used on a delayed basis for recurrent instability.
RESULTS OF CEMENT VERSUS BONE GRAFT RECONSTRUCTION AFTER INTRALESIONAL CURETTAGE OF BONE TUMORS IN THE SKELETALLY-IMMATURE PATIENT
Matthew T. Wallace, MD, MBA; Robert M. Henshaw, MD
1Orthopaedic Surgery, George Washington University, Washington, DC, USA; 2Musculoskeletal Oncology, Washington Cancer Institute, Washington, DC, USA

Objective: Background: Resection of periphyseal tumors in children presents several unique challenges and complications. Injury to the adjacent physis during resection and adjuvant application has been associated with adverse growth-related outcomes including angular deformities and physeal arrests. The appropriate method of reconstructing bone defects after resection is also controversial. To date there is scant literature on the use of polymethylmethacrylate bone cement as a method of reconstruction in children, and few long-term studies exist on the incidence of growth-related complications after reconstruction. The objective of this study is to evaluate the long-term mechanical, oncological, and developmental outcomes of polymethylmethacrylate use in children.

Methods: Methods: The authors retrospectively reviewed the medical records and radiographs of 37 skeletally-immature patients after intralesional resection of locally-aggressive bone tumors. These patients were divided into 18 reconstructed with polymethylmethacrylate cement, and 19 reconstructed with bone graft. Follow-up clinical and radiographic evaluations performed after skeletal maturity were reviewed to assess the structural durability, local recurrence rates, reoperations, and the incidence of postoperative complications including deformity, adjacent joint arthrosis, growth arrest, pain, and functional limitation.

Results: Results: The avg. patient age at the time of surgery was 11.85 years (range 6-15). The average length of patient follow-up was 4.7 years (range 1-10.25 years). There were no statistically significant differences observed in the rates of reoperation, local tumor recurrence, growth-related complications, ad-

<table>
<thead>
<tr>
<th>Complications</th>
<th>Odds Ratio (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reoperation</td>
<td>0.833 (0.2-3.4)</td>
<td>NS (0.99)</td>
</tr>
<tr>
<td>Local Recurrence</td>
<td>0.450 (0.08-2.4)</td>
<td>NS (0.99)</td>
</tr>
<tr>
<td>Pain</td>
<td>1.10 (0.2-5.6)</td>
<td>NS (1)</td>
</tr>
<tr>
<td>Functional Limitation</td>
<td>2.42 (0.2-29.6)</td>
<td>NS (0.99)</td>
</tr>
<tr>
<td>Arthrosis</td>
<td>2.42 (0.2-29.6)</td>
<td>NS (0.99)</td>
</tr>
<tr>
<td>Deformity</td>
<td>1.07 (0.1-8.7)</td>
<td>NS (1)</td>
</tr>
<tr>
<td>Growth Arrest</td>
<td>0.468 (0.04-5.7)</td>
<td>NS (0.98)</td>
</tr>
<tr>
<td>Loosening</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Fracture</td>
<td>N/S</td>
<td>NS (0.56)</td>
</tr>
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♦ Indicates the FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an “off label” use).

• FDA information not available at the time of printing. For full information, refer to inside back cover.
BIOMECHANICAL ANALYSIS OF FIXATION METHODS OF IMPELLING FEMORAL NECK FRACTURES: A COMPARISON OF PERCUTANEOUS CEMENT AND CEPHALOMEDULLARY FIXATION
Brian Palumbo, MD; Gerald E. Alexander, MD; Aniruddh Nayak, MS; Leon Anijar; Sergio Gutierrez, PhD; Charles C. Nalley, MD; Roger C. Gaskins, MD; Brandon Santoni

Objective: To determine if percutaneous cementation alone sufficiently treats osteolytic lesions of the femoral neck such that fracture may be avoided. In combination with internal fixation, acute increases in load to failure afforded by cement augmentation of the simulated lesions may help define the prophylactic role of such an intervention.

Methods: N=27 femurs were allocated to three groups (Figure 1): (1) Percutaneous Cementation with Internal Fixation (PCIF, n=9); (2) Percutaneous Cementation alone (PC, n=9); and (3) Internal Fixation alone (IF, n=9). In all femora, a high risk lesion was created in the femoral neck according to the Mirels score and Harrington’s criteria. In the PC and PCIF groups, methyl methacrylate cement was injected into the lesion until radiographic notation of cement interdigitation into abutting cancellous bone. Cementation was performed after the hip fracture fixation system was implanted in the PCIF treatment arm. The distal end of each specimen was potted in high strength resin with the long axis of the femur was oriented 20° from vertical and destructive compression loading was applied to the femoral head at 2 mm/sec.

Results: We identified no significant differences in failure load between groups. On average, the PCIF treatment group demonstrated the largest failure load (Table 1). The primary failure mode was disparate between the groups. Failure location in the PC group was localized to the femoral neck region and initiated as low-energy compression failures of the intermedial neck adjacent to the lesion with subsequent collapse of the femoral head into varus. In the IF and PCIF groups, failure occurred in one of three distinct locations: (1) femoral neck; (2) intertrochanteric region; or (3) subtrochanteric region. The combined augmentation shifted femur failure away from the lesion-containing neck to the intertrochanteric region in 6/9 femurs.

Conclusions: Study results indicate that internal fixation supplemented with percutaneous cementation affords, on average, the greatest biomechanical integrity. The combined augmentation shifted femur failure away from the lesion-containing neck to the intertrochanteric region in 67% femurs tested. Further, insights regarding technical aspects associated with the cementoplasty technique to confer optimized augmentation for a biomechanical perspective were obtained.

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Failure Load (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percutaneous Cement (PC)</td>
<td>5867.04 ± 1759.80</td>
</tr>
<tr>
<td>Cement + Internal Fixation (PCIF)</td>
<td>6923.16 ± 2437.19</td>
</tr>
<tr>
<td>Internal Fixation (IF)</td>
<td>6013.26 ± 1877.93</td>
</tr>
</tbody>
</table>

p-values: PC vs. PCIF = 0.308 PC vs. IF = 0.871 PCIF vs. IF = 0.407

P-Values - Failure Load Comparison Between the Treatment Groups

<table>
<thead>
<tr>
<th>P-Values</th>
<th>0.308</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC vs PCIF</td>
<td>0.871</td>
</tr>
<tr>
<td>PCIF vs IF</td>
<td>0.407</td>
</tr>
</tbody>
</table>

See pages 167 - 176 for financial disclosure index.
Figure 1. AP Radiographs of the PC, IF and PCIF treatment groups

♦ Indicates the FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an “off label” use).

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EXTENDER MECHANISM FUNCTION AFTER LIMB-SPARING RESECTION
OF THE PROXIMAL TIBIA
Adam S. Levin, MD; John H. Healey, MD; Patrick J. Boland, MD; Edward A. Athanasian, MD; Carol D. Morris, MD
Orthopaedic Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, USA

Objective: To compare outcomes and survivorship between the various methods of reconstruction for oncologic resection of the proximal tibia articular surface and extensor mechanism, in a contemporaneous cohort.

Methods: Between 1995 and 2011, 45 patients at our institution underwent limb-sparing resection of the proximal tibial articulation, including the tibial tubercle. During this period, flap coverage was routinely used. Analysis included patient age, reconstructive type, knee range of motion, active knee extension, postoperative complications, and future revision reconstruction or amputation.

Results: Reconstructive procedures included osteoarticular allograft (22), APC (13), and proximal tibia endoprosthesis (10). Allograft and APC reconstructions involved a tendon-to-tendon extensor mechanism repair using nonabsorbable suture. In patients with endoprosthetic reconstruction, the extensor mechanism was either resected without reconstruction (1), or repaired to the prosthesis using nonabsorbable suture with (4) or without metallic augmentation (5). The median ROM for the entire cohort was 100 degrees (Table 1). There was no significant difference in range of motion between those with osteoarticular allograft (100 deg), APC (90 deg), or endoprosthesis (102.5 deg). Overall, 83% with extensor mechanism repair or reconstruction retained active knee extension. Those with tendon-to-tendon repairs had a greater likelihood of retaining active knee extension (91%) than those with tendon-to-metal repairs (50%, p=0.03). Despite the routine use of flap closure, 29% had wound complications (Table 2). Seven patients required amputation for infection (3), local recurrence (2), contracture (1), or late traumatic injury (1), resulting in a limb salvage rate of 84%. Nine patients (20%) required a revision reconstruction at a median follow-up of 6.1 years for infection (6), fracture/nonunion (2),

<table>
<thead>
<tr>
<th>Reconstruction</th>
<th>N</th>
<th>Median Age</th>
<th>Extensor Mechanism Reconstruction</th>
<th>Median ROM</th>
<th>Active Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoarticular Allograft</td>
<td>22</td>
<td>12 (7-55)</td>
<td>Tendon-Tendon</td>
<td>100</td>
<td>19/19 (100%)</td>
</tr>
<tr>
<td>Alloprosthetic Composite</td>
<td>13</td>
<td>17 (12-62)</td>
<td>Tendon-Tendon</td>
<td>90</td>
<td>10/13 (77%)</td>
</tr>
<tr>
<td>Endoprosthesis</td>
<td>10</td>
<td>58 (5-81)</td>
<td>Tendon-Prosthesis</td>
<td>102.5</td>
<td>4/8 (50%)</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>15 (5-81)</td>
<td></td>
<td>100</td>
<td>33/40 (83%)</td>
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</table>

<table>
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<tr>
<th>Reconstruction</th>
<th>Complication</th>
<th>Wound Complication</th>
<th>Revision</th>
<th>Amputation</th>
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</thead>
<tbody>
<tr>
<td>Osteoarticular Allograft</td>
<td>73%</td>
<td>32%</td>
<td>23%</td>
<td>18%</td>
</tr>
<tr>
<td>Alloprosthetic Composite</td>
<td>50%</td>
<td>25%</td>
<td>17%</td>
<td>8%</td>
</tr>
<tr>
<td>Endoprosthesis</td>
<td>64%</td>
<td>27%</td>
<td>18%</td>
<td>18%</td>
</tr>
<tr>
<td>Total</td>
<td>64%</td>
<td>29%</td>
<td>20%</td>
<td>16%</td>
</tr>
</tbody>
</table>
or degenerative changes (1). The complication rates were not different between the reconstructive types.

**Conclusions:** While the selection of the optimal reconstruction after limb-sparing oncologic resection of the proximal tibia may be specific to each patient, osteoarticular allograft, APC, and endoprosthetic reconstructions each demonstrate maintenance and durability of knee function in a large percentage of patients. Tendon-to-tendon extensor mechanism repair results in greater retention of active extension than tendon-to-metal repairs.
EARLY FOLLOW-UP OF A NON-FLUTED PRESS-FIT INGROWTH STEM FOR TUMOR PROSTHESES
Patrick O’Donnell, MD, PhD1; Anthony Griffin2; William C. Eward, MD, DVM3; Amir Sternheim, MD2; Jay S. Wunder, MD2; Peter C. Ferguson, MD, MSC, FRCSC2
1Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA; 2Orthopaedic Surgery, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada; 3Orthopaedic Surgery, Duke University, Durham, NC, USA

Objective: To evaluate the early follow-up results of a non-fluted uncemented stem for use with the GMRS tumor prosthesis system and the early complications associated with this implant.

Methods: Fifty-three patients (54 implants) were identified from a prospective database where a non-fluted hydroxyapatite-coated ingrowth stem was used as part of the limb sparing reconstruction following sarcoma resection. Forty-nine implants were inserted directly following resection of tumor and 6 implants were utilized for revision of a failed Kotz endoprosthesis. Patients were categorized into two cohorts. Thirty-three patients had a stem implanted requiring a custom adapter to link with a GMRS tumor prosthesis. Twenty patients had a custom non-fluted GMRS uncemented stem used in conjunction with their GMRS tumor endoprosthesis reconstruction. The design of the non-fluted GMRS stems was similar to the Restoration cohort, except the morse taper mated directly with the GMRS components. All patients had a minimum of 1-year of follow-up. The rates of stem revision for any reason were calculated.

Results: The average follow-up was 30.6 months (range 12-75 months). The average stem size was 15mm (range 11-20mm). 13 stems were inserted into the middle third of the tibia for a knee endoprosthesis, 6 into the middle third of the femur for a hip endoprosthesis, and 35 stems into the middle third of the femur for a knee endoprosthesis. In the Restoration stem with GMRS adapter cohort, there were two undisplaced linear intra-operative fractures requiring cerclage wiring, and two post-operative broken adapters requiring surgical revision with adapter exchange. There were no insertion fractures or mechanical failures in the non-fluted GMRS press-fit ingrowth stem cohort. In total, 5 stems had to be revised or removed for infection at a mean of 3.8 months (range 1-6 months) and three stems for tumor progression at a mean of 11.6 months (range 6-23 months). Aseptic loosening was not observed in any patient.

Conclusions: At early term follow-up, non-fluted hydroxy-apatite coated ingrowth stems lead to stable ingrowth with no evidence of aseptic loosening. Initial concerns regarding rotational stability of uncemented tumor prosthesis stems and the need for anti-rotational flutes as currently exist on commercially available GMRS stems seem to be unwarranted.
**Objective:** The treatment of unstable thoracic spine fractures remains controversial. Theoretical biomechanical advantages of transpedicular screw fixation include three-column control of vertebral segments and fixation of a vertebral segment in the absence of intact posterior elements. Additionally, pedicle screw constructs may obviate the need for neural canal dissection and potential neural element impingement by intracanal instrumentation.

**Methods:** A prospective longitudinal study was done to compare posterior fixation in acute unstable thoracolumbar injuries by monoaxial and polyaxial pedicle screws. Thirty-eight cases formed the study group as per inclusion criteria. By random allocation 18 patients were managed by polyaxial pedicle screw rod (PPSR) system-Gp A and 20 by monoaxial pedicle screw and rod system (MPSR) -Gp B.

**Results:** In Gp A, at 1 year follow up, 12/17 (66.6%) of AIS A remained at AIS-A, 2/17 (11.11%) recovered from AIS-A to AIS-B and 1 (5.55%) recovered from AIS-A to AIS-C. 2/17 (11.11%) patients were ambulatory at 1 year and had shown full neurological recovery AIS-A to AIS-E. In Gp B, At 1 year follow up, 13/16 (81.25%) of AIS A remained at AIS-A, 2/16 (12.5%) recovered from AIS-A to AIS-B and 1/16 (6.5%) recovered from AIS-A to AIS-C. There were 3 implant related postoperative complication in patient fixed with monoaxialpedicle screw (MPSR)-Gp B. In 1 the rod migrated proximally on right side and in two others there was breakage of upper two pedicle screw through neck. There was no implant failure in polyaxial screw rod system (PPSR)- Gp A. Rate of implant failure accounted for 15% in Gp B and this was found to be statistically significant. At 1 year, 32/38 (85.2%) were on wheel chair ambulation, 2/38 (5.26%) were walking with support and 4/38 (10.5%) were ambulatory without any aid.

**Conclusions:** There was no significant difference in neurological recovery, pain function scores and ambulatory status in the two groups. The polyaxis facilitates surgical procedure and reduces surgical time and blood loss. Polyaxial pedicle screw is superior to monoaxial in terms of reduction, stability and implant failures.
EVALUATION OF A NONINVASIVE EXPANDABLE PROSTHESIS IN MUSCULOSKELETAL ONCOLOGY PATIENTS FOR THE UPPER AND LOWER LIMBS

Kathleen S. Beebe, MD; Joseph Benevenia, MD; Neil Kaushal, MD; Francis Patterson, MD

Orthopaedics, UMDNJ-NJMS, Newark, NJ, USA

Objective: The noninvasive expandable prosthesis is used for limb-salvage surgery following tumor resection in skeletally immature patients. Though this prosthesis is approved for the lower extremity, our experience has included compassionate use for the upper extremity. The purpose of this study is to report our updated experience with the Repiphysis® (Wright Medical Technology; Arlington, TN) noninvasive expandable prosthesis for both the upper and lower extremity.

Methods: We retrospectively reviewed 17 consecutive patients who presented to our institution and required implantation of the Repiphysis® between 2003-2011 with minimum follow-up of 12 months. Demographic, pathological, surgical data, and functional data were collected.

Results: Nineteen Repiphysis® prostheses were implanted in 17 patients. Mean age was 10 years (range; 7-16) with average follow-up of 46 months (range; 12-96 mo). Fourteen patients underwent a total of 75 expansion procedures with an average of 5.4 lengthening procedures (range; 1-10) per patient. Mean lengthening was 8.8 mm per session and mean total expansion was 4.7 cm (range; 0.98-9.9). No complications of lengthening occurred. Eight non-oncologic complications were noted. The mean MSTS score after rehabilitation was 26.7 (range, 24-28) and 23.2 (range; 10-30) for upper and lower limb implants, respectively. There were two infections in our series of 12 patients, one of which presented with an infection from an outside institution. In both of these cases the patient underwent successful re-implantation. One patient suffered loss of limb due to local recurrence and no patient had greater than a 1 cm limb length discrepancy that is not currently undergoing expansions.

Conclusions: The Repiphysis® provides acceptable functional outcomes for both upper and lower extremity implantation following tumor resection in skeletally immature patients. It appears that the noninvasive nature of this prosthesis gives it an advantage as compared to conventional expandable prosthetics, which require open procedure that can potentially increase the risk of infection from repeated hardware exposure.
MULTIPLANAR OSTEOTOMY FOR TUMOR RESECTIONS GUIDED BY NAVIGATION

German Farfalli; Luis Aponte-Tinao, MD; Lucas Ritacco; Miguel Ayerza, MD; D. Luis Muscolo, MD
Italian Hospital of Buenos Aires, Buenos Aires, Argentina

Objective: Multiplanar osteotomies had been recently described in selected patients with sarcomas, however, these osteotomies are technically demanding to program and to execute them intraoperatively. The techniques of surgical navigation to assist operations are becoming more frequently described in orthopaedic oncology. We analyzed multiplanar osteotomies resections guided by navigation in 13 patients with bone tumors and then reconstructed with intercalary allografts.

Methods: We performed multiplanar osteotomies resections guided by navigation in 13 patients with bone tumors and then reconstructed with intercalary allografts. The mean age was 43 years. Seven patients were females and four males. Nine tumors were located in the distal femur, three in the proximal tibia and one in the foot. The surgical anatomic specimens were 3D reconstructed after surgery and superposed on preoperative plan.

Results: At the final followup, no patient experienced a local recurrence or metastasis. In 4 patients 4 osteotomies were performed and in nine patients three osteotomies were done. The average functional score was 28 points. We found a correspondence between the planned resection and the anatomic specimen.

Conclusions: Our results showed that navigation technique with adequate preoperative planning allowed the surgeon to reproduce intraoperatively the planned resection with accuracy in these complex multiplanary resections.
TUMOR ENDOPROTHESIS-RADIUS BONE SYSTEM STRESS-DEFORMITY STATE.
BIOMECHANICAL STUDY

Oleg Vyra, MD; Victor Burlaka; Mikhaylo Karpinsky
Bone Tumor Department, Sytenko Institute of Spine and Joint Pathology, Kharkiv, Ukraine

Objective: The most common complications of tumor prosthesis (TP) replacements are prosthetic stem fractures (1,6-18,2%) and periprosthetic fractures (0,7-8,1%). Maximal loading peak is on the base of the intramedullary stem. The main goal of this study is to create mathematical models of the radius for stress load calculation of different external and internal fixing prosthesis parts.

Methods: Using the finite elements method we’ve studied of mechanical properties of the “endoprosthesis - radius bone” system (ERBS). Three types of mathematical model of ERBS were created: for round, oval and triangle bone cross-sections. We studied bone on-lay sleeve form, bi-plate and tri-plate of extracortical prosthesis fixators.

Results: Tension loading. ERBS with round cross-sections: Max tensions were in diaphysis of the normal bone. In the ERBS maximal tensions were in the proximal part of the stem and in extracortical sleeve of the endoprosthesis. ERBS with oval cross-sections: Max loading were on ribs of the diaphysis of normal bone. Strength of loading was considerable less that the same of the round bone. ERBS with triangle cross-section: Max loading were on ribs of the diaphysis of normal bone. In the ERBS max tensions were also in the proximal part of the stem and in extracortical plates of the endoprosthesis. Bending loading. ERBS with round cross-section: Bending loading to normal radius leads to peak of tension in diaphysis. Two type of loading were in system: stretch on upper surface and pressing on lower surface. ERBS with oval cross-section: Max tensions were along of the ribs in diaphysis of the normal radius. ERBS with triangle cross-section: Three stiffening ribs allow significantly decrease to meaning of load peak in the bone with triangle cross-section in bending. Area of such peaks were in the diaphysis of the bone.

Conclusions: The oval form of the bone with stiffening ribs ensure to decrease of loading on bone and fixing prosthesis parts. Triangle radius form with three stiffening ribs still more increases strength of the bone and allows to decrease of the loading. TP with tri-plate fixation ensure to ideal conditions for load sharing on all elements of the system. TP with combined type fixation has even load on all elements of connection. TP with triplate extracortical fixation for triangle bone is most optimal system. Max tensions are in external parts of fixation devices of the same system.
AUTOLOGOUS DOUBLE-BARREL VASCULARIZED FIBULA BONE GRAFT FOR ARTHRODESIS OF THE SHOULDER AFTER TUMOR RESECTION

Karl Wieser, MD; Kourosh Modaressi, MD; Franziska Seeli, BScN; Bruno Fuchs, MD
Orthopedics, University Hospital Balgrist, Zurich, Switzerland

Objective: To describe a new surgical technique of shoulder arthrodesis using a free double-barrel vascularized fibular autograft and to analyze the first mid term experience using this technique after wide tumors resection of the proximal humerus.

Methods: We present a detailed description of the surgical technique and the outcome of three patients, which were treated with an autologous double-barrel vascularized fibular bone graft for arthrodesis of the shoulder after resection of a malignant bone tumor of the proximal humerus with loss of the abductor function due to axillary nerve resection.

Results: A wide surgical margin was achieved in all patients. Two of them could be reintegrated and are able to work with excellent shoulder function. Another patient developed systemic metastasis and a deep infection under chemotherapy two years after index surgery, and subsequently died. All three patients had very good function.

Conclusions: The fibula’s unique dual endosteal and periosteal blood supply makes it effective as a double-barrel bone graft for major long bone defects, which requires extra bone volume to prevent fractures until bone hypertrophy occurs. Additional bone and scar formation between the two struts are believed to provide a stable and long lasting construct, as seen in our patients.

♦ Indicates the FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use).
- FDA information not available at the time of printing. For full information, refer to inside back cover.
NON-INVASIVE JOINT-SPARING GROWING PROSTHESIS FOR OSTEOSARCOMA OF THE PROXIMAL TIBIA

Bruno Fuchs, MD
Orthopedics, University Hospital Balgrist, Zurich, Switzerland

Objective: Malignant bone sarcomas of the growing skeleton represent a particular challenge. Amputation is very mutilating, and rotationplasty although functionally a good alternative, is not opted for because of its disfiguring aspect. A growing prosthesis may represent an alternative, particularly when there is considerable growth left. Further, sparing the joint may offer great functional advantages whereas -in contrast to resecting the joint- a closer margin must be accepted. We herein represent a non-invasive joint sparing growing prosthesis which was implanted in a 10 year old child.

Methods: A 10 year old male represented with pain in the proximal tibia after a fall. A non-displaced pathological fracture at the proximal tibia was seen, and a biopsy revealed an osteosarcoma. The boy underwent neoadjuvant chemotherapy according to the EURAMOS protocol, and then resection of the proximal tibia sparing the epiphysis was performed. A custom made growing prosthesis was manufactured. This uncemented HA-coated growing prosthesis has a plateau which receives the remaining epiphysis (of ca 1cm thickness) and which allows the fixation of the tibial plateau with screws. The extensor mechanism was reconstructed using a medial gastrocnemius flap together with a split skin graft. The soft tissues healed uneventfully, and adjuvant chemotherapy was resumed 3 weeks postoperatively.

Results: Six months later, the prosthesis was non-invasively lengthened using an external magnet for the first time. The patient has full extension and walks without walking aids at one year follow-up.

Conclusions: A non-invasive joint sparing growing prosthesis represents a valuable alternative for young children with bone sarcomas. Although technically certainly challenging, it leads to good function, and the non-invasive growing can be performed on an outpatient basis.
Objective: Evaluate the function outcome and complications associated with the use of a modular intercalary endoprosthetic replacement system (Osteobridge) for intercalary diaphyseal resections for bone tumor in primary and metastatic musculoskeletal tumors.

Methods: Eleven patients underwent segmental bone resection and limb salvage surgery for primary and metastatic bone tumors involving the diaphysis of the humerus, tibia, and femur. Patients had reconstruction using a modular intramidullary diaphyseal segmental defect fixation system. There were eight males and three females with a mean age of 62 years (range 48-74). Histologic diagnosis included adamantinoma, osteosarcoma, myxoid MFH, pleomoyphic sarcoma, myeloma, renal carcinoma, prostatic carcinoma, and lung carcinoma.

Results: The mean intercalary spacer length was 9cm (range 4-13cm) and the mean stem length was 120cm (range 90-150cm). Interlocking screws were used in 5 cases. All implants were cemented with tobramycin polymethyl methacrylate. The mean follow-up was 14 months (range 2-36 months). At the latest examination six patients are alive with no evidence of local disease. Three patients with primary sarcomas have been continuously disease free and three with secondary tumors. Five patients died, four died from metastatic disease without local recurrence and one died of other causes. Revision surgery was necessary in one patient with a primary femoral sarcoma due to mechanical loosening of the device six months post-op and has been stable, alive, CDF for 30 months. The mean Musculoskeletal Tumor Society functional score was 25 out of 30 points (83%), range (18-30 points).

Conclusions: In circumstances where intercalary diaphyseal resection is necessary for tumor control and bone stability, the use of a cemented segmental modular endoprosthetic devices provide results equivalent to custom implants, and plate-cement constructs. The modularity of these implants provide flexibility not seen in custom devices and may help avoid the complications seen with biologic methods that require additional host bone healing response.
Objective: Infection rates in megaprostheses of joint are high, over 30% in some cases and are difficult to treat. The objective was to review all surgically managed infections of megaprostheses at our institution over 10 years. Host, infection, and treatment variables were studied to identify variables predictive of treatment failure.

Methods: A retrospective review of all patients with megaprostheses placed for both oncologic and non-oncologic indications over the last 10 years. Patients surgically treated for a megaprosthetic infection were included. Treatment failure was defined as any unplanned reoperation for uncontrolled infection or a death related to infection. Fisher’s exact test and Pearson’s chi-squared test were used to determine significance of variables on treatment success or failure.

Results: Thirty-one patients were surgically treated for a megaprosthetic infection, 291 total megaprostheses were implanted, resulting in an 11% incidence of infection. Sixteen had a treatment failure, with 3 deaths and 13 unplanned reoperations. Component type, diagnosis, patient comorbidities, Charlson Comorbidity Index, BMI, immunosuppressive use, tobacco use, infecting organism, treatment type, time to infection were not predictive of a treatment failure. Age 65 and older had more failures than those patients under age 65 (p = 0.049). Eleven of these patients experienced a failure, 3 resulting in death and 8 requiring an unplanned reoperation. Five reoperations were amputations which eradicated infection. In the combined I&D and single stage revision group, most patients had a treatment failure. Within the I&D only group, multiple debridements resulted in less failures than those that underwent only one I&D (p = 0.282).

More aggressive treatment, either two stage revision or amputation, had more successes than failures, however not with significance. Most patients with prior joint infection failed their treatment (p=.333).

Conclusions: We report an 11% incidence of infection, consistent with other reported series. While available numbers are too low for statistical significance, more aggressive surgery seemed to yield a better outcome. Multiple operative debridements may yield a superior outcome. Patients contemplating megaprosthetic reconstruction after treatment of periprosthetic sepsis, caution may be warranted, and amputation may be a better option, especially in those 65 and older.
REVIEW OF 7 PATIENTS WITH TOTAL HUMERUS REPLACEMENT WITH COMPARISON TO PROXIMAL AND DISTAL HUMERUS REPLACEMENTS

Lisa Ercolano, MD; Matthew Colman; Mark Goodman
Orthopaedics, UPMC, Pittsburgh, PA, USA

Objective: To assess for differences in complications, survival, morbidity and mortality we have reviewed host and implant characteristics of all patients since 1990 with total humerus replacements and compared them to proximal and distal humerus replacement counterparts.

Methods: A retrospective review of all total humerus procedures (TH, N=7) was performed at our tertiary institution since 1990 with minimum 12-month follow-up (mean 37.9 months). We recorded patient characteristics, disease indications, treatment profiles, complications, disease recurrence, implant survival, and all cause mortality. The Fisher exact test was used to compare these outcomes to those for 8 consecutive distal humeral replacements/total elbow arthroplasty (DHR) and 10 proximal humeral replacements/hemiarthroplasty (PHR) to determine differences in morbidity and mortality.

Results: Mean age at index surgery was 60 years. The most common diagnosis in the TH (43%) and the PHR (40%) groups was chondrosarcoma, while the DHR group was predominantly metastatic disease (75%). Pathologic fracture was a surgical indication in 43%, 38%, and 50% of the TH, DHR, and PHR groups, respectively. The TH group had one death (14%) and three implant failures (43%), 2 of which resulted in glenohumeral disarticulation for intractable infection and one which resulted from both instability at the proximal articulation and bushing wear with aseptic loosening at the distal articulation. There were no differences between the TH, DHR, and PHR groups in patient mortality (14% vs. 50% vs. 50%, p=0.35), implant failure (43% vs. 25% vs. 20%, p=0.57), local recurrence of disease (0% vs. 38% vs. 20%, p=0.21), or amputation (29% vs. 13% vs. 10%, p=0.65).

Conclusions: We report a relatively high complication rate for this salvage operation. We observed one instance of combined proximal and distal failure in the TH group, but in general complications were not different for TH versus the PHR or DHR counterparts. Trends include a greater tendency toward implant failure and increased requirement of amputation in the TH group. Overall, infection was the most common mode of failure. Aseptic loosening and metal wear requiring revision were other observed failure modes. Consistent with other authors, we would consider TH a viable treatment option for patients that are properly counseled as to the relatively high complication rate and possibility of reoperation.
SKIN FLAP ADVANCEMENT FOLLOWING SARCOMA RESECTIONS: A TECHNIQUE TO DECREASE DEFECT SIZE AND OPTIMIZE THE SKIN TO SKIN GRAFT INTERFACE

Wayne Chen; William G. Ward, MD
Orthopaedics, Wake Forest University, Winston Salem, NC, USA

Objective: Split-thickness skin graft (STSG) is frequently required for limb salvage reconstructions following musculoskeletal tumor resections. Due to the subcutaneous fatty tissues, there is often a poor quality interface with a step-off between the remaining deep tissues (often muscle) and the surrounding skin margin. STSG does not take well on this fat. The senior author has utilized a technique of marginal skin advancement via continuous absorbable sutures approximating the leading skin edge down to the deep tissues to decrease the defect size and improve the margin interface. A review of 16 years experience was performed to determine the success of this technique in combination with STSG and VAC application.

Methods: A search of the senior author’s surgical case records from 1995 through 2011 yielded 61 patients (mean age 58, range 15 to 91) who underwent resection of sarcoma followed by margin advancement and STSG. The medical records were reviewed to determine the patient demographics, tumor characteristics, defect size before and after the skin advancement (when recorded), and the graft success rate. 56 patients (92%) received a primary STSG in which tumor resection, flap advancement, and STSG were performed in a single operation; in 5 patients (8%) it was staged to allow for pathologic tumor margin verification and/or granulation tissue maturation via serial VAC applications.

Results: In 61 patients, skin margin flap advancement significantly reduced defect size (from mean 198.62 cm2 to 122.30 cm2, mean difference 76.32 cm2, p=0.00001, paired t-test). STSG was successfully applied to the smaller defect in 60 patients (98.4% success rate) with a mean 97.7% take of the skin graft. One patient had a partially failed STSG (1.6% failure rate) requiring multiple irrigation and debridements, VAC changes, and repeat STSG. 8 patients (13.1%) had delayed wound healing and/or wound infection post-operatively that successfully resolved with antibiotics.

Conclusions: Skin margin flap advancement is a novel surgical technique that reduces the size of the uncovered defect following tumor resections, resulting in less exposed tissue requiring STSG coverage. The improved margin interface supports a high rate of STSG take. Continued use of this technique of skin flap advancement is supported by these results.

See pages 167 - 176 for financial disclosure index.
MODULAR ENDOPROSTHETIC REPLACEMENT IN LIMB SALVAGE FOR MALIGNANT DISTAL HUMERAL TUMORS

Suhel Kotwal, MD; Bryan S. Moon, MD; Robert L. Satcher, MD, PhD; Patrick P. Lin, MD; Valerae O. Lewis, MD
Orthopedic Oncology, MD Anderson Cancer Center, Houston, TX, USA

Objective: Distal humerus is a common site for malignant musculoskeletal tumors. Reconstruction with osteo-articular allografts and allo-prosthetic composites have high complication rates, including non-union, fracture and infection. Limb ablation is associated with negative social, emotional and psychological impact in the upper extremity. Advances in adjuvant therapies and distal humeral endoprosthetic replacements provide salvage of the upper limb with improved functional and oncological outcomes. Reports of limb salvage with modular distal humeral endoprosthetic reconstruction in extensive humeral tumors are sporadic. Our objective was to define the functional and oncological outcome of this procedure at our institution.

Methods: We undertook a retrospective study of 27 patients who underwent distal humeral replacement utilizing modular prostheses, as limb salvage following excision of extensive malignant tumor of the distal humerus from 1990 to 2011. Twenty had primary malignant bone sarcoma, while 10 had metastatic disease. All but 2 were adults with mean age of 53.4 years. Average follow-up was 32.2 months with maximum being 142 months. Functional and oncological outcomes were analyzed.

Results: Six patients were still alive at the time of review, while 21 died of malignant disease. Deep prosthetic infection was encountered in two patients requiring irrigation, debridement with retention of components. Aseptic loosening of the ulnar component was noted in 4 patients. One proceeded to receive revision of the component, while 3 did not require further surgery. Progression of disease resulted in shoulder disarticulation in one patient. Mean active elbow flexion was 105°, extension of 7.5°. Eleven patients had residual flexion contracture of mean of 7.5°. Implant survival at final follow-up was 93%. Average Musculoskeletal Tumor Society Score (MSTS) was 81%.

Conclusions: Distal humeral endoprosthetic replacement can provide a reliable treatment option in indicated patients restoring mechanical stability and reasonable functional results of the upper limb without compromising patient survival, with low complication rate. In general, even in older patient population, this is a preferable elective alternative to limb ablative surgery.
ANTIBIOTIC PROPHYLACTIC IN MEGA PROSTHESIS. ARE 24 HOURS ENOUGH TO PREVENT ACUTE INFECTIONS?

Marcos Galli Serra, MD; Walter M. Parizzia; Carlos M. Autorino; Emiliano Alvarez Salinas
Hospital Universitario Austral, Pilar, Argentina

Objective: Postoperative deep infection is an unfortunate and dire complication for patients who have undergone oncologic mega prosthesis reconstruction. Appropriately administered antibiotic prophylactic reduces the incidence of surgical wound infection. The current lack of guideline for the prescription of prophylactic antibiotics in Musculoskeletal Tumor surgery has left Orthopedics oncologist with varying opinions and practices. The aim of this study was to analyze our experience and results with a regimen of 24hrs single antibiotic prophylactic for mega prosthesis surgery.

Methods: We retrospectively review 45 mega prosthesis performed between April 2008 and March 2012. All patients included in the study received one grame of a first generation cephalosporin (cephalothin) 30 minutes before incision, readministration of one grame was done if the surgery extended for more than 2 hours, three more doses of one grame were administered to the patient in the postoperative period and prophylaxis end within 24 hrs after the surgery. There were 20 males and 25 females with an average age of 54,6 (6-80). We limited follow up to 1 year presuming subsequent infection were not related to the initial surgery. There were 2 saddle prosthesis, 6 total femur replacement, 16 proximal femur, 3 intercalar femur, 8 distal femur, 1 proximal tibia, 1 intercalar tibia, 3 proximal humerus, 1 intercalar humerus, 4 elbow.

Results: 4 patients develop an infection (9,09%). 3 acute infection (one total femur replacement in a leiomyosarcoma of the cuadriceps involving the femur, one saddle prothesis in a metastatic renal carcinoma of pelvis and one osteosarcoma of the proximal humerus with reconstruction of the articular capsule with a goretex mesh) and 1 chronic (intercalar tibia in a metastastic renal carcinoma). 1 patient died (Osteosarcoma in a patient of 68 years with a pathological fracture at the proximal femur) on the first postoperative week due to a complication related to the surgery (fat embolism).

Conclusions: Peri-operative antibiotics are given to treat an existing infection and/or prevent a new infection. The selection and duration of antimicrobial prophylaxis should have the smallest impact possible on the normal bacterial flora of the patient and the microbiologic ecology of the hospital. In our study with 24hrs of antibiotic prophylaxis with a first generation cephalothin we had a low rate of infection.
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  Moderator;
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Rapp, Barbara ..........(n) ..........Executive Director
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Scarborough, Mark T. ..........(n) ..........Poster #11
Schlepp, Calvin L. ..........(n) ..........Paper #7
Schoenecker, Jonathan G. ..........(n) ..........Paper #22
Schult, Patricia ..........(n) ..........Poster #20
Schwab, Joseph ..........(n) ..........Papers #6,10

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9=Board member/committee appointments from a society) For full information, refer to inside back cover.
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Friday, September 21, 2012

PA/ARNP/ALLIED HEALTH SCIENTIFIC SESSION

6:30 a.m. Registration and Breakfast

7:45 a.m. Welcome
David Johnson, PA-C
Moffitt Cancer Center, Tampa, FL

8:00 a.m. p. 179 The Work-up of Sarcomas
David Cheong, MD
Moffitt Cancer Center, Tampa, FL

9:00 a.m. p. 180 Staging, Proper Follow Up and Surveillance for Sarcomas
Rick Gonzalez, MD
Moffitt Cancer Center, Tampa, FL

10:00 a.m. Break

10:15 a.m. p. 181 Sarcoma Medical Oncology
Anthony Conley, MD
Moffitt Cancer Center, Tampa, FL
Damon Reed, MD
Moffitt Cancer Center, Tampa, FL

11:15 a.m. p. 182 Management of Metastatic Bone Disease
Odion Binitie, MD
Moffitt Cancer Center, Tampa, FL

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and/or medical device for the use described (i.e., the drug or medical device is being discussed for an “off label” use) and •FDA information not available at the time of printing. For full information, refer to inside back cover.
Friday, October 1, 2010

12:15 p.m.        Lunch

1:30 p.m.        p. 183 The Role of XRT Involving Sarcomas
  Robert Lavey, MD
  Moffitt Cancer Center, Tampa, FL

2:30 p.m.        p. 184 Sarcoma Medical Oncology
  Anthony Conley, MD
  Damon Reed, MD
  Moffitt Cancer Center, Tampa, FL

3:30 p.m.        Break

3:45 p.m.        p. 185 Pain and Palliative Care
  Sorin Buga, MD
  Moffitt Cancer Center, Tampa, FL

4:45 p.m.        Closing Remarks
  David Johnson  PA-C
  Moffitt Cancer Center, Tampa, FL

See pages 167 - 176 for financial disclosure index.
The Work-up of Sarcomas

David Cheong, MD

Moffitt Cancer Center, Tampa, FL

NOTES:

♦ Indicates the FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an “off label” use).
• FDA information not available at the time of printing. For full information, refer to inside back cover.
Staging, Proper Follow Up and Surveillance for Sarcomas
Rick Gonzalez, MD
Moffitt Cancer Center, Tampa, FL

NOTES:

See pages 167 - 176 for financial disclosure index.
Sarcoma Medical Oncology

Anthony Conley, MD
Moffitt Cancer Center, Tampa, FL

Damon Reed, MD
Moffitt Cancer Center, Tampa, FL

NOTES:

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• FDA information not available at the time of printing. For full information, refer to inside back cover.
Management of Metastatic Bone Disease

Odion Binitie, MD
Moffitt Cancer Center, Tampa, FL

NOTES:

See pages 167 - 176 for financial disclosure index.
The Role of XRT Involving Sarcomas

Robert Lavey, MD
Moffitt Cancer Center, Tampa, FL

NOTES:

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Sarcoma Medical Oncology

Anthony Conley, MD
Moffitt Cancer Center, Tampa, FL

Damon Reed, MD
Moffitt Cancer Center, Tampa, FL

NOTES:

See pages 167 - 176 for financial disclosure index.
Pain and Palliative Care

Sorin Buga, MD
Moffitt Cancer Center, Tampa, FL

NOTES:

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Albert Aboulafia, MD  
(Member 1995)  
Sinai Hospital Cancer Institute  
2401 W. Belvedere Avenue  
Baltimore, MD 21215-5271 USA  
Phone: (410) 601-9266  
Fax: (410) 601-4601  
E-mail: Aaboulaf@lifebridgehealth.org

John A. Abraham, MD  
(Candidate 2007)  
The Rothman Institute at Thomas Jefferson University  
925 Chestnut Street  
Philadelphia, PA 19107 USA  
Phone: 215-339-3620  
Fax: 215-503-0580  
E-mail: john.abraham@rothmaninsti-tute.com

Zachary Adler, MD  
(Candidate 2008)  
University of Florida-Shands Hospital  
Department of Orthopaedics  
P.O. Box 112727  
Gainesville, FL 32608 USA  
Phone: 352-273-7356  
Fax: 352-273-7356  
E-mail: shariej@ortho.ufl.edu

Manish Agarwal, MD  
(Member 2006)  
Ullas, 1st Floor  
17 Laburnum Road  
Mumbai, Gamdevi 400007  
INDIA  
Phone: 91-9820353542  
E-mail: mgagarwal@gmail.com

Emad Al Absi, MD  
(Candidate 2009)  
Saad Specialist Hospital  
P.O. Box 30353  
Al Khobar, 31952  
SAUDI ARABIA  
Phone: 96-6501452873  
E-mail: eeabsi@yahoo.com

Mohammad Alfawareh, MD  
(Candidate 2009)  
King Fahad Medical City  
P.O. Box 365386  
Riyah, 11393  
SAUDI ARABIA  
Phone: 713-563-1274  
Fax: 713-792-8448  
E-mail: alfawarehm@yahoo.com

Raffi Avedian, MD  
(Candidate 2010)  
Stanford Orthopaedic Surgery  
450 Broadway Street  
PAV C MC 6432  
Redwood City, CA 94063 USA  
Phone: 650-721-7625  
Fax: 650-721-3470  
E-mail: ravedian@stanford.edu

Miguel Ayerzas, MD  
(Associate 2002)  
Italian Hospital of Buenos Aires  
Potosi 4215  
Buenos Aires, ARGENTINA  
Phone: 54-11-958-4011  
Fax: 54-11-981-0991  
E-mail: miguel.ayerza@hospitalitaliano.org.ar

Tessa Balach, MD  
(Candidate 2011)  
University of Connecticut Health Center  
263 Farmington Avenue, MC 4037  
628 South Royal Street  
Farmington, CT 06030-4037 USA  
Phone: 860-679-2105  
Fax: 860-679-6649  
E-mail: balach@uchc.edu

Christopher P. Beauchamp, MD  
(Member 1991)  
Mayo Clinic  
5777 East Mayo Boulevard  
Phoenix, AZ 85254 USA  
Phone: 480-342-2762  
Fax: 480-342-2696  
E-mail: beauchamp.christopher@mayo.edu

Kathleen Beebe, MD  
(Member 2006)  
UMDNJ- New Jersey Medical School  
140 Bergen Street, Room D-1610  
Newark, NJ 07103 USA  
Phone: 973-972-3534  
Fax: 973-972-5296  
E-mail: kathleen.beebe@umdnj.edu
William Dunham, MD  
(Emeritus 1978)  
1150 Greymoor Road  
Birmingham, AL 35242 USA  
Phone: 205-991-1895

Abubakar A. Durrani, MD  
(Member 2006)  
Children’s Hospital Medical Center  
Department of Orthopaedic Surgery  
3333 Burnet Avenue  
Cincinnati, OH 45229 USA  
Phone: 513-636-0974  
Fax: 513-636-3928  
E-mail: atiq.durrani@cchmc.org

John L. Eady, MD  
(Member 1983)  
VA Hospital  
6021 Marthas Glen Road  
Columbia, SC 29209 USA  
Phone: 803-776-0866  
Fax: 803-776-4943  
E-mail: jl_eady_98@yahoo.com

Jeffrey J. Eckardt, MD  
(Member 1982)  
UCLA  
10833 Le Conte Ave  
Los Angeles, CA 90095-6907 USA  
Phone: 803-776-0866  
Fax: 803-776-4943  
E-mail: Jeckardt@mednet.ucla.edu

Fred Eilber, MD  
(Emeritus 1978)  
UCLA Medical Center  
Division of Surgical Oncology  
10833 Le Conte Ave.  
Los Angeles, CA 90095-1782 USA  
Phone: 310-825-7575  
Fax: 310-825-7575  
E-mail: feilber@mednet.ucla.edu

Cynthia Emory, MD  
(Candidate 2010)  
Wake Forest Baptist Health  
Medical Center Blvd.  
Winston-Salem, NC 27157 USA  
Phone: 336-716-9813  
Fax: 336-716-8018  
E-mail: clemory@wakehealth.edu

William F. Enneking, MD  
(Emeritus 1977)  
UF Orthopaedic Institute  
5246 SW 24th Drive  
Gainsville, FL 32608 USA  
Phone: 352-273-7365  
Fax: 352-273-7388  
E-mail: billkingfisher@aol.com

Robert Esther, MD  
(Member 2009)  
University of North Carolina  
Department of Orthopaedics  
Campus Box 7055  
Chapel Hill, NC 27599 USA  
Phone: 919-966-3340  
Fax: 919-966-7130  
E-mail: bob@med.unc.edu

Andrea Evenski, MD  
(Candidate 2010)  
University of Pennsylvania  
301 S. 8th Street Suite 2C  
Philadelphia, PA 19146 USA  
Phone: 215-829-5022  
Fax: 215-829-5060  
E-mail: andrea.evenski@uphs.upenn.edu

German Farfalli, MD  
(Associate 2011)  
Italian Hospital of Buenos Aires  
Potosi 4247  
Gascon 450  
Buenos Aires, 1199  
ARGENTINA  
Phone: 00541149584011  
Fax: 00541149584011  
E-mail: german.farfalli@hospitalitaliano.org.ar

Peter Ferguson, MD  
(Member 2007)  
600 University Avenue #476G  
Toronto, Ontario M5G 1X5  
CANADA  
Phone: 416-586-4800  
Fax: 416-586-8397  
E-mail: pferguson@mtsmai.on.ca

Daniel Flugstad, MD  
(Member 1995)  
Swedish Hospital Medical Center,  
Seattle  
1145 Broadway  
Seattle, WA 98122 USA  
Phone: 206-860-4481  
Fax: 206-860-2201  
E-mail: daniel.flugstad@polyclinic.com

Jonathan Forsberg, MD  
(Candidate 2011)  
3814 Everett Street  
Kensington, MD 20895 USA  
E-mail: jaforsberg@me.com

Edward J. Fox, MD  
(Member 2007)  
Hershey Medical Center-Penn State  
30 Hope Drive  
EC-089  
Hershey, PA 19543 USA  
Phone: 717-531-4816  
E-mail: efox1@hmc.psu.edu

Frank J. Frassica, MD  
(Member 1992)  
Johns Hopkins University  
601 North Caroline Street, Suite 5215  
Baltimore, MD 21287 USA  
Phone: 410-502-1714  
Fax: 410-955-1719  
E-mail: ffrassil@jhmi.edu

Gary E. Friedlaender, MD  
(Member 1983)  
Yale New Haven Hospital  
P.O. Box 208071  
New Haven, CT 06520-8071 USA  
Phone: 203-737-5660  
Fax: 203-737-1102  
E-mail: gary.friedlaender@yale.edu

Bruno Fuchs, MD  
(Associate 2007)  
Balgrist University Hospital  
Forchstr 340  
Zurich, 8008  
SWITZERLAND  
Phone: 41-44-386-16-61  
Fax: 41-44-386-16-69  
E-mail: bruno.fuchs@balgrist.ch
Mark C. Gebhardt, MD  
(Member 1984)  
Beth Israel Deaconess Medical Center 
330 Brookline Avenue 
Stoneman 10 
Boston, MA 02215 USA 
Phone: 617-667-9598 
Fax: 617-667-2155 
E-mail: mgebhardt@bidmc.harvard.edu

David Geller, MD  
(Candidate 2008)  
Montefiore Medical Center 
3400 Bainbridge Avenue, 6th Floor 
Bronx, NY 10467 USA 
Phone: 718-920-4429 - 5722 
Fax: 718-515-4386 
E-mail: dgeller@montefiore.org

Patrick J. Getty, MD  
(Member 2007)  
University Hospital, 
Case Medical Center 
11100 Euclid Avenue 
Cleveland, OH 44106 USA 
Phone: 216-844-3033 
Fax: 216-844-5970 
E-mail: patrick.getty@uhhospitals.org

Michelle Ghert, MD  
(Member 2007)  
McMaster University 
699 Concession Street 
Hamilton, Ontario L8V 5C2 
CANADA 
Phone: 905-387-9495 
Fax: 905-575-6343 
E-mail: Michelle.Ghert@jcc.hhsc.ca

Parker Gibbs, MD  
(Member 2002)  
University of Florida 
Dept. of Orthopaedic Surgery 
P.O. Box 112727 
Gainesville, FL 32611 USA 
Phone: 352-273-7365 
Fax: 352-273-7388 
E-mail: gibbscp@ortho.ufl.edu

Nathan Gilbert, MD  
(Candidate 2007)  
Greater Dallas Orthopaedics, PLLC. 
12230 Coit Road, Ste 100 
Dallas, TX 75251 USA 
Phone: 214-252-7020 
Fax: 214-252-7025 
E-mail: ngilbe@yahoo.com

Steven Gitelis, MD  
(Member 1982)  
Rush University Medical Center 
1725 W. Harrison #440 
Chicago, IL 60612 USA 
Phone: 312-243-4244 
Fax: 312-243-2744 
E-mail: steven.gitelis@rushortho.com

Mark Goodman, MD  
(Member 2002)  
University of Pittsburgh 
Suite 415 
5200 Centre Avenue 
Pittsburgh, PA 15232 USA 
Phone: 412-802-4123 
Fax: 412-682-6332 
E-mail: goodmanma2@upmc.edu

David Greenberg, MD  
(Candidate 2010)  
St. Louis University 
Department of Orthopaedic Surgery 
3635 Vista Ave, 7th Floor Desloge Towers 
St. Louis, MO 63110 USA 
Phone: 314-577-8850 
Fax: 314-268-5121 
E-mail: dgreenb5@slu.edu

Bjorn Gunterberg, MD  
(Emeritus 1989)  
Sahlgren Hospital 
Dept. of Orthopedic Surgery 
S-412 45 
Gothenberg, 
SWEDEN 
Phone: 46 31 3428256 
E-mail: bjorn.gunterberg@ugregives.sc

Jennifer L. Halpern, MD  
(Candidate 2007)  
Vanderbilt Orthopaedic Institute 
Medical Center East, South Tower, 
Suite 4200 
Nashville, TN 37232-8774 USA 
Phone: 615-343-8612 
Fax: 615-343-1028 
E-mail: jennifer.halpern@vanderbilt.edu

James B. Hayden, MD  
(Member 2002)  
Oregon Health & Sciences University 
Department of Orthopaedics, OP-31 
3181 SW Sam Jackson Park Road 
Portland, OR 97239 USA 
Phone: 503-494-6406 
Fax: 503-494-5050 
E-mail: haydenj@ohsu.edu

Rex C. Haydon, MD  
(Member 2007)  
University of Chicago 
5841 South Maryland Avenue, 
MC3079 
Chicago, IL 60637 USA 
Phone: 773-702-3442 
Fax: 773-702-4384 
E-mail: rhaydon@ surgery.bsd.uchicago.edu

John H. Healey, MD  
(Member 1987)  
Memorial Sloan-Kettering Cancer Ctr. 
1275 York Avenue 
New York, NY 10065 USA 
Phone: 212-639-7610 
Fax: 212-794-4015 
E-mail: healeyj@mskcc.org

Robert K. Heck, MD  
(Member 2004)  
Campbell Clinic Orthopaedics 
1211 Union Avenue, Suite 500 
Memphis, TN 38104 USA 
Phone: 901-759-3236 
Fax: 901-759-3234 
E-mail: rheck@campbellclinic.com

John P. Heiner, MD  
(Member 1993)  
University of Wisconsin 
1685 Highland Avenue 
6th Floor 
Madison, WI 53705-2281 USA 
Phone: 608-263-4069 
Fax: 608-263-5631 
E-mail: heiner@ortho.wisc.edu

Scott W. Helmers, MD  
(Member 2006)  
Kaiser Permanente San Diego 
4650 Palm Ave 
San Diego, CA 92154 USA 
Phone: 866-459-2912 
E-mail: scott.w.helmers@kp.org
Chris S. Helmstedter, MD
(Member 2002)
Southern California Kaiser Permanente
1011 Baldwin Park Blvd.
Dept. of Orthopedics
Baldwin Park, CA 91706 USA
Phone: 626-851-6150
Fax: 626-851-5909
E-mail: Chris.s.helmstedter@kp.org

Robert M. Henshaw, MD
(Member 2002)
Washington Cancer Institute/Georgetown University
110 Irving St., NW Rm C-2164
Washington, DC 20010 USA
Phone: 202-877-3970
Fax: 202-877-8959
E-mail: robert.m.henshaw@medstar.net

Ronald W. Hillock, MD
(Candidate 2007)
Desert Orthopaedics Center
2650 N. Tamaya Way
Las Vegas, NV 89149 USA
Phone: 702-731-1616
Fax: 702-731-0741
E-mail: rwhdlh@hotmail.com

Bang H. Hoang, MD
(Member 2008)
Department of Orthopaedic Surgery
101 The City Drive South, Pavilion III
Orange, CA 92868 USA
Phone: 714-456-7801
Fax: 714-456-7547
E-mail: bhhoang@uci.edu

Ginger E. Holt, MD
(Member 2007)
Vanderbilt Orthopaedic Institute
Medical Center East, South Tower, Suite 4200
1215 21st Avenue South
Nashville, TN 37232-8774 USA
Phone: 615-343-8612
Fax: 615-343-1028
E-mail: ginger.e.holt@vanderbilt.edu

Francis J. Hornicek, MD
(Member 1993)
Massachusetts General
Suite 3700, Section 3B
32 Fruit Street
Boston, MA 02114 USA
Phone: 617-724-6802
Fax: 617-726-6823
E-mail: fhornicek@partners.org

Stephen Horowitz, MD
(Member 1993)
5000 Sagemore Drive, Suite 202
Marlton, NJ 08053 USA
Phone: 856-988-1966
Fax: 856-988-1965
E-mail: shoro1@comcast.net

Andrew Howlett, MD
(Candidate 2009)
Providence Orthopaedic
820 S. McClellan
#300
Spokane, WA 99204 USA
Phone: 509-464-7880
Fax: 509-464-7961
E-mail: andrewthowlett@gmail.com

Ronald Hugate, MD
(Member 2008)
Colorado Limb Consultants
1601 E. 19th Ave., Suite 3300
Denver, CO 80218 USA
Phone: 303-837-0072
Fax: 303-837-0075
E-mail: hugate@msn.com

Carrie Y. Inwards, MD
(Affiliate 2004)
Mayo Clinic
200 First Street, SW
Rochester, MN 55905 USA
Phone: 507-284-1187
E-mail: inwards.carrie@mayo.edu

Ronald B. Irwin, MD
(Member 1978)
Mount Clemens Regional Medical Ctr
Ted Wahby Cancer Center
1080 Harrington Boulevard, Suite 201
Mount Clemens, MI 48043 USA
Phone: 586-493-7575
Fax: 586-493-7576
E-mail: Ronald.Irwin@mcrmc.org

Paul Jacobs, MD
(Emeritus 1981)
4641 North Lake Drive
Milwaukee, WI 53211 USA
Phone: 414-332-8531
E-mail: docandbj@mhs.net

Kenneth A. Jaffe, MD
(Member 1992)
Alabama Orthopaedic Center
3436 Oak Canyon Circle
Birmingham, AL 35243 USA
Phone: 205-802-6700
Fax: 205-802-6701
E-mail: kaj9116@aol.com

Norman Jaffe, MD
(Emeritus 1978)
MD Anderson Cancer Ctr
1515 Holcombe Blvd, Unit 87
Houston, TX 77030 USA
Phone: 713-792-6626
Fax: 713-792-0608
E-mail: njaffe@mdanderson.org

Reynaldo Jesus-Garcia, MD
(Associate 1992)
Federal University
211 Tuim Street, Ap 61
Sao Paulo, 04514-100 BRAZIL
Phone: 55-11-3747-3209
Fax: 55-11-5052-3507
E-mail: rjesusgarcia.dot@epm.br

Michael H. Jofe, MD
(Member 2002)
Joe DiMaggio Children’s Hospital
1150 North 35th Avenue
Suite 345
Hollywood, FL 33021 USA
Phone: 954-265-6300
Fax: 954-961-3600
E-mail: mjofe@mhs.net

James O. Johnston, MD
(Emeritus 1979)
Kaiser South San Francisco
30 Toro Court
Portola Valley, CA 94028 USA
Phone: 650-851-1153
Fax: 650-851-1109
E-mail: yodajoj@sbcglobal.net

Kevin Jones, MD
(Candidate 2009)
Huntsman Cancer Institute
2000 Circle of Hope
Salt Lake City, UT 84112 USA
Phone: 801-585-0300
Fax: 801-585-7084
E-mail: kevin.jones@hci.utah.edu
Michael J. Joyce, MD  
(Member 1987)  
Cleveland Clinic  
9500 Euclid Ave A-41  
Cleveland, OH 44195 USA  
Phone: 216-444-4282  
Fax: 216-445-1638  
E-mail: joycemich@aol.com

Melissa Kounine, MD  
(Candidate 2009)  
University of Toledo Medical Ctr.  
Dept. of Orthopaedic Surgery  
3005 Arlington Ave. MS 1094  
Toledo, OH 43614 USA  
Phone: 419-383-6331  
E-mail: mkounine@gmail.com

Lee Leddy, MD  
(Candidate 2009)  
Medical University of South Carolina  
96 Jonathan Lucas Street  
Charleston, SC 29425 USA  
Phone: 843-792-0601  
Fax: 843-792-5170  
E-mail: leddyl@musc.edu

Cynthia M. Kelly, MD  
(Member 2002)  
Colorado Limb Consultants  
1601 E. 19th Ave., Suite 3300  
Denver, CO 80218 USA  
Phone: 303-837-0072  
Fax: 303-837-0075  
E-mail: cindykellymd@yahoo.com

J. Ivan Krajbich, MD  
(Member 1992)  
Shriners Hospitals for Children-Portland  
3101 SW Sam Jackson Park Road  
Portland, OR 97239 USA  
Phone: 503-221-3424  
Fax: 503-221-3490  
E-mail: ikrajbich@shrinenet.org

Francis Young Lee, MD  
(Member 2003)  
Columbia University Medical Center  
622 W. 168th Street, PH11  
New York, NY 10032 USA  
Phone: 212-305-3293  
Fax: 212-305-8271  
E-mail: FL127@columbia.edu

Samuel Kenan, MD  
(Member 1994)  
North Shore LIS Medical Center  
300 Old Country Road  
Suite 221  
Mineola, NY 11501 USA  
Phone: 516 280 3733  
Fax: 516 280 3734  
E-mail: samuel.kenan@gmail.com

Jeffrey Krygier, MD  
(Candidate 2008)  
Santa Clara Valley Medical Center  
751 South Bascom Ave  
San Jose, CA 95128 USA  
Phone: 408-885-5395  
Fax: 408-885-3749  
E-mail: Jeffrey.Krygier@l lhs.scgov.org

Robert E. Leggon, MD  
(Member 2001)  
Marshfield Clinic  
Dept. of Orthopaedic Surgery  
1000 North Oak Ave.  
Marshfield, WI 54449-5777 USA  
Phone: 715-387-5129  
Fax: 715-387-5754  
E-mail: leggon.robert@marshfieldclinic.org

David M. King, MD  
(Member 2003)  
Medical College of Wisconsin  
9200 W. Wisconsin Avenue  
Milwaukee, WI 53226 USA  
Phone: 414-805-7467  
Fax: 414-805-7499  
E-mail: dking@mcw.edu

Jeffrey S. Kneisl, MD  
(Member 1993)  
Carolinas Medical Center  
Orthopaedic Surgery  
PO Box 32861  
Charlotte, NC 28232 USA  
Phone: 704-355-5026  
Fax: 704-355-7905  
E-mail: jeffrey.kneisl@ carolinashcare.org

Richard D. Lackman, MD  
(Member 1990)  
Cooper Health  
3 Cooper Plaza  
Suite 400  
Camden, NJ 08103 USA  
Phone: 856-361-1757  
Fax: 856-361-1761  
E-mail: Lackman-Richard@cooperhealth.edu

Douglas Letson, MD  
(Member 2002)  
Moffitt Cancer Center  
12902 USF Magnolia Dr  
FOB-1  
Tampa, FL 33612 USA  
Phone: 813-745-2297  
Fax: 813-972-8337  
E-mail: douglas.letson@moffitt.org

Anna Kulidjian, MD  
(Candidate 2010)  
UCSD Dept. of Orthopaedics  
350 Dickinson Suite 121  
San Diego, CA 92103 USA  
Phone: 619-543-2539  
Fax: 619-543-2540  
E-mail: akulidjian@ucsd.edu

Michael Lewis, MD  
(Emeritus 1977)  
111 Arroqui Rd  
Santa Barbara, CA 93108 USA  
Phone: 805-695-8181  
E-mail: mml1234@aol.com

Robert K. Kotz, MD  
(Associate 1989)  
Universitatsklinik Wein  
Wahringer Gurtel 18-20  
Wein, A-1090  
AUSTRIA  
Phone: 43-140-400-4082  
Fax: 43-140-400-4029

Joseph M. Lane, MD  
(Member 1979)  
Hospital for Special Surgery  
555 E 70th St.  
New York, NY 10021 USA  
Phone: 212-606-1255  
Fax: 212-772-1061  
E-mail: lanej@hss.edu

Valerae O. Lewis, MD  
(Member 2004)  
MD Anderson Cancer Center  
P.O. Box 301402, Unit 1448  
Houston, TX 77230-1402 USA  
Phone: 713-792-5073  
Fax: 713-792-8448  
E-mail: volewis@mdanderson.org
Steven A. Lietman, MD  
(Member 2005)  
Cleveland Clinic Foundation  
9500 Euclid Avenue  
A41 Crile Building  
Cleveland, OH 44195 USA  
Phone: 216-445-2742  
Fax: 216-445-6245  
E-mail: lietmas@ccf.org

Patrick Lin, MD  
(Member 2003)  
MD Anderson Cancer Center  
Dept. of Orthopaedic Oncology  
Unit 1448  
P.O. Box 301402  
Houston, TX 77230 USA  
Phone: 713-745-0088  
Fax: 713-792-8448  
E-mail: plin@mdanderson.org

Bennie G. Lindeque, MD  
(Affiliate 1988)  
9814 E. Arizona Drive  
Apt. 533  
Denver, CO 80247 USA  
Phone: 720-747-4115  
Fax: 303-372-5683  
E-mail: bennie.lindeque@ucdenver.edu

Brock Lindsey, MD  
(Candidate 2010)  
West Virginia University  
PO Box 9196  
Morgantown, WV 26506-9196 USA  
Phone: 304-293-1317  
Fax: 304-293-7042  
E-mail: blindsey@hsc.wvu.edu

Dieter Lindskog, MD  
(Member 2004)  
Yale University  
Dept. of Orthopaedic Surgery  
800 Howard Ave.  
PO Box 208071  
New Haven, CT 06520-8071 USA  
Phone: 203-785-2579  
Fax: 203-785-7132  
E-mail: dieter.lindskog@yale.edu

Jennifer Lisle, MD  
(Candidate 2007)  
University of Vermont  
Stafford 426C, 95 Carrington Avenue  
Burlington, VT 05405-0084 USA  
Phone: 802-656-4259  
Fax: 802-656-4297  
E-mail: jennifer.lisle@med.uvm.edu

Jeffrey Luna, MD  
(Candidate 2008)  
Trinity Regional Medical Center  
2518 North 27th Street  
Fort Dodge, IA 50501 USA  
Phone: 515-574-8333  
Fax: 515-573-5540  
E-mail: jetluna@yahoo.com

Hue Luu, MD  
(Member 2009)  
University of Chicago  
5841 South Maryland  
MC3079  
Chicago, IL 60637 USA  
Phone: 773-702-6216  
Fax: 773-702-4765  
E-mail: hluu@surgerybsd.uchicago.edu

Gerhard E. Maale, MD  
(Member 1996)  
Dallas-Ft. Worth Sarcoma Group  
8230 Walnut Hill Ln., Suite 514  
Dallas, TX 75231 USA  
Phone: 214-691-9777  
Fax: 214-691-1123  
E-mail: bscott@caregate.net

Kevin MacDonald, MD  
(Candidate 2011)  
University of Wisconsin  
1685 Highland Ave  
6139 Centennial Building  
Madison, WI 53705 USA  
Phone: 608-262-8020  
Fax: 608-265-6375  
E-mail: kevin.macdonald@vmmc.org

Aditya Maheshwari, MD  
(Candidate 2010)  
SUNY Downstate Medical Center  
450 Clarkson Ave Box 30  
Brooklyn, NY 11203 USA  
Phone: 718-270-3200  
Fax: 718-270-3983  
E-mail: adityavikramm@gmail.com

John Makley, MD  
(Emeritus 1977)  
15404 Russell Road  
Chagrin Falls, OH 44022 USA  
Phone: 440-247-1967  
Fax: 440-247-8807  
E-mail: johnmakley1@adelphia.net

Martin Malawer, MD  
(Member 1978)  
Washington Musculoskeletal Tumor Center  
7830 Old Georgetown Road, Ste C15  
Bethesda, MD 20814 USA  
Phone: 202-877-3970, cell 703 909-1740  
Fax: 703 821-1879  
E-mail: mmalawer1@aol.com

Bruce A. Mallin, MD  
(Member 2000)  
BAM  
2036 East.Glenn Drive  
Phoenix, AZ 85020 USA  
Phone: 602-258-8500  
Fax: 602-258-8510  
E-mail: bmallin@gmail.com

Henry Mankin, MD  
(Emeritus 1974)  
185 Dean Road  
Brookline, MA 02445 USA  
Phone: 617-726-2735  
Fax: 617-724-7356  
E-mail: hmankin@partners.org

Mark W. Manoso, MD  
(Member 2006)  
Madigan Army Medical Center  
Attn: MCHJ-SOP,  
9040 A Fitzsimmons Avenue  
Tacoma, WA 98431 USA  
Phone: 253-968-3121  
Fax: 253-968-1586  
E-mail: mark.w.manoso@us.army.mil

Rex A.W. Marco, MD  
(Member 2004)  
University of Texas  
6700 West Loop South, Suite 110  
Bellaire, TX 77401 USA  
Phone: 713-838-8300  
Fax: 713-218-7477  
E-mail: rexmarco@gmail.com

Kenneth E. Marks, MD  
(Member 2009)  
Cleveland Clinic Foundation  
Dept. of Orthopaedic Surgery  
9500 Euclid Ave.  
Cleveland, OH 44106 USA  
Phone: 216-444-2637  
Fax: 216-445-6574  
E-mail: marksk@ccf.org
Joel Mayerson, MD  
(Member 2007)  
The Ohio State University  
Department of Orthopaedic Surgery  
376 W. 10th Ave, Suite 725 Prior Hall  
Columbus, OH 43210 USA  
Phone: 614-293-4420  
Fax: 614-293-3747  
E-mail: joel.mayerson@osumc.edu

Lawrence R. Menendez, MD  
(Member 1992)  
University of Southern California  
University Hosp.  
1520 San Pablo Street, #2000  
Los Angeles, CA 90033 USA  
Phone: 323-442-5830  
Fax: 323-442-5829  
E-mail: menendez@usc.edu

Jeffry Menzner, MD  
(Member 2005)  
1075 North Curtis Road, Suite 300  
Boise, ID 83706 USA  
Phone: 208-323-2600  
Fax: 208-323-9172  
E-mail: hughv@boc.md

Kurt D. Merkel, MD  
(Member 1998)  
St. Louis University  
3009 N. Ballas Road, Suite 243A  
St. Louis, MO 63131 USA  
Phone: 314-989-1091  
Fax: 314-432-8144  
E-mail: kmdictation@yahoo.com

Benjamin Miller, MD  
(Candidate 2010)  
University of Iowa  
200 Hawkins Dr., 01025 JPP  
Iowa City, IA 52242 USA  
Phone: 319-384-5535  
Fax: 319-384-9312  
E-mail: benjamin-j-miller@uiowa.edu

Eugene R. Mindell, MD  
(Emeritus 1977)  
SUNY at Buffalo School of Medicine  
Department of Orthopaedics  
100 High St., Room B280  
Buffalo, NY 14203-1126 USA  
Phone: 716-859-1531  
Fax: 716-859-2541  
E-mail: emindell@kaleidahealth.org

Walid A. Mnaymneh, MD  
(Emeritus 1977)  
Univ. of Miami  
Dept. of Ortho. & Rehab  
PO Box 016960, D27  
Miami, FL 33101-6960 USA  
Phone: 305-243-3512  
Fax: 305-243-7658  
E-mail: tbel@med.miami.edu

Michael P. Mott, MD  
(Member 2004)  
Henry Ford Hospital  
2799 W. Grand Boulevard  
Detroit, MI 48202 USA  
Phone: 313-916-1961  
Fax: 313-916-2478  
E-mail: mmott2@hfhs.org
Amos Peyser, MD  
(Associate 2005)  
Shaare Zedec Medical Center  
Head of Orthopaedic Department  
P.O. Box 3235  
Jerusalem, Israel 91031  
ISRAEL  
Phone: 972-2-6778611  
Fax: 972-2-6423074  
E-mail: amosp@szmc.org.il

Olavo Pires De Camargo, MD  
(Associate 1988)  
University of Sao Paulo  
Dept. of Orthopaedics  
Rua Rio de Janeiro, 338, 7a  
CEP: 01240/010  
Sao Paulo, SP  
BRAZIL  
Phone: 55-11-31235620  
Fax: 55-11-31235620  
E-mail: olapcama@uol.com.br

J. David Pitcher, Jr., MD  
(Member 1998)  
University of Miami  
University of Miami Hospital  
1400 N.W. 12th Avenue #4036  
Miami, FL 33136 USA  
Phone: 305-325-4466  
Fax: 305-325-3928  
E-mail: dpitcher@med.miami.edu

Scott Porter, MD  
(Member 2009)  
Greenville Hospital System  
701 Grove Rd.  
Academic Support Tower, 2nd Fl.  
Greenville, SC 29605 USA  
Phone: 864-455-7878  
Fax: 864-455-7082  
E-mail: MNagelkirk@ghs.org

Benjamin Potter, MD  
(Candidate 2008)  
Walter Reed Army Medical Center  
NW; Bldg 2; Clinic 5A  
Washington, DC 20307 USA  
Phone: 202-356-1012  
Fax: 202-782-7041

Douglas J. Pritchard, MD  
(Emeritus 1977)  
Mayo Clinic Rochester, Emeritus  
1139 Fox Croft Ln SW  
Rochester, MN 55902 USA  
Phone: 507-288-9159  
E-mail: djpjmp@charter.net

Ajay Puri, MD  
(Associate 2011)  
Tata Memorial Hospital  
Room No. 26 E. Borges Road Parel  
Mumbai, 400012  
INDIA  
Phone: 91 22 24177000 Extn 4295  
Fax: 91 22 24146937  
E-mail: docpuri@gmail.com

Robert H. Quinn, MD  
(Member 2002)  
University of Texas Health Science Center  
Department of Orthopaedics, Mail Code 7774  
7703 Floyd Curl Drive  
San Antonio, TX 78220-3900 USA  
Phone: 210-567-5132  
Fax: 210-567-5167  
E-mail: quinnr@uthscsa.edu

R. Lor Randall, MD, FACS  
(Member 2003)  
University of Utah School of Medicine  
Huntsman Cancer Institute  
2000 Circle of Hope, Suite 4262  
Salt Lake City, UT 84112 USA  
Phone: 801-585-0300  
Fax: 801-585-7084  
E-mail: r.lor.randall@hci.utah.edu

Timothy B. Rapp, MD  
(Member 2007)  
New York University  
11th Floor  
160 East 34th St  
New York, NY 10016 USA  
Phone: 212 731-6558  
E-mail: timothy.rapp@nyumc.org

Kevin Raskin, MD  
(Member 2009)  
Massachusetts General Hospital  
Dept. of Orthopaedics  
55 Fruit Street , Yawkey 3B  
Boston, MA 02114 USA  
Phone: 617-726-0604  
Fax: 617-726-6823  
E-mail: kraskin@partners.org

John E. Ready, MD  
(Member 1996)  
Brigham & Women’s Hospital  
75 Francis St.  
Boston, MA 02115 USA  
Phone: 617-732-5368  
Fax: 617-730-2817  
E-mail: jready@partners.org

John D. Reith, MD  
(Member 2001)  
Department of Pathology  
P.O. Box 100275  
Gainesville, FL 32610-0275 USA  
Phone: 352-265-0238  
Fax: 352-265-0437  
E-mail: reith@pathology.ufl.edu

Michael Rock, MD  
(Member 1984)  
Mayo Clinic  
200 First St., SW  
Rochester, MN 55905-3008 USA  
Phone: 507-284-9214  
Fax: 507-266-4234  
E-mail: rock.michael@mayo.edu

Ronald J. Rooney, MD  
(Member 1996)  
LSU HSC Department of Orthopaedics  
1542 Tulane Avenue  
RM 619  
New Orleans, LA 70112 USA  
Phone: 504-568-4680  
Fax: 504-568-4466  
E-mail: Rroone@lsuhsc.edu

Peter Rose, MD  
(Candidate 2008)  
Mayo Clinic  
Department of Orthopaedic Surgery  
200 First Street SW  
Rochester, MN 55906 USA  
Phone: 507-284-4051  
Fax: 507-266-4234  
E-mail: rose.peter@mayo.edu

Howard G. Rosenthal, MD  
(Member 1999)  
Mid-America Sarcoma Institute  
12140 Nall Ave.  
Suite 200-A  
Overland Park, KS 66209 USA  
Phone: 913-498-6840  
Fax: 913-696-1434  
E-mail: rosenthal@sarcomasource.com
Randy N. Rosier, MD  
(Member 2000)  
Univ. of Rochester Medical Center  
601 Elmwood Ave  
P.O. Box 665  
Rochester, NY 14642-0001 USA  
Phone: 585-275-5168  
Fax: 585-756-4721  
E-mail: randy_rosier@urmc.rochester.edu

Corey Rothrock, MD  
(Candidate 2008)  
Louisville Oncology Orthopaedics  
515 Broadway, 3rd Floor  
Louisville, KY 40202 USA  
Phone: 502-629-3315  
Fax: 502-629-2055  
E-mail: corey.rothrock@nortonhealthcare.org

Bruce T. Rougraff, MD  
(Member 1996)  
St. Vincents Indiana Orthopaedic Hospital  
8450 Northwest Blvd  
Indianapolis, IN 46278 USA  
Phone: 317-802-2000  
Fax: 317-802-2887  
E-mail: brougraff@aol.com

Pietro Ruggieri, MD  
(Associate 2011)  
Univ. of Bologna,  
Istituto Ortopedico Rizzoli  
Via Pupilli 1  
Bologna, 40136 ITALY  
Phone: 390516366460  
E-mail: pietro.ruggieri@ior.it

Paul Saiz, MD  
(Member 2002)  
Las Cruces Orthopaedic Associates  
675 Avenida de Mesilla  
Las Cruces, NM 88005 USA  
Phone: 505-525-3335  
E-mail: huesosaiz@aol.com

Robert Satcher, MD  
(Member 2004)  
MD Anderson Cancer Center  
Orthopaedic Oncology, Unit 1448  
1400 Pressler St, FCT10.5044  
Houston, TX 77230-1402 USA  
Phone: 713-792-4652  
Fax: 713-792-8448  
E-mail: rlsatcher@mdanderson.org

Chigusa Sawamura, MD  
(Associate 2010)  
Tokyo Medical and Dental University  
1-5-45 Yushima, Bunkyo-ku  
Tokyo, 113-8510 JAPAN  
Phone: 81-3-3813-6111  
E-mail: sawaorth@tmd.ac.jp

Mark T. Scarborough, MD  
(Member 1996)  
University of Florida, Shands Hospital  
PO Box 112727  
Gainsville, FL 32611 USA  
Phone: 352-273-7365  
Fax: 352-273-7388  
E-mail: scarbmt@ortho.ufl.edu

Norman S. Schachar, MD  
(Member 1988)  
Univ. of Calgary, Foothills Hospital  
Suite 436, 3330 Hospital Dr. NW  
Calgary, Alberta T2N 4N1 CANADA  
Phone: 403-220-3880  
Fax: 403-270-0617  
E-mail: nsschach@ucalgary.ca

Richard A. Schaefer, MD, MPH  
(Member 2006)  
Uniformed Services University of the Health Sciences  
4301 Jones Bridge Road  
Bethesda, MD 28014 USA  
Phone: 703-805-0096  
Fax: 703-805-0820  
E-mail: rschaefer@usuhs.mil

Tom Scharschmidt, MD  
(Candidate 2009)  
Ohio State University  
Dept. of Orthopaedics  
325 W. 10th, 725 Prier Hall  
Columbus, OH 43210 USA  
Phone: 614-293-4420  
Fax: 614-292-8448  
E-mail: thomas.scharschmidt@osumc.edu

Joseph Schwab, MD  
(Candidate 2008)  
Massachusetts General Hospital  
Yawkey #3A, 55 Fruit Street  
Boston, MA 02114 USA  
Phone: 617-272-8636  
Fax: 617-726-7587  
E-mail: jhschwab@partners.org

Herbert S. Schwartz, MD  
(Member 1992)  
Vanderbilt Orthopaedic Institute  
Medical Center East, South Tower,  
Suite 4200  
1215 21st Avenue South  
Nashville, TN 37232-8774 USA  
Phone: 615-322-8890  
Fax: 615-343-1028  
E-mail: herbert.s.schwartz@vanderbilt.edu

Steven M. Scott, MD  
(Member 1992)  
Intermountain Orthopaedic Specialty Group  
Eccles Outpatient Care Center  
5169 S. Cottonwood Street, Suite 430  
Murray, UT 84157 USA  
Phone: 801-507-3475  
Fax: 801-507-3499  
E-mail: steven.scott@mail.org

Sean P. Scully, MD, PhD  
(Member 1996)  
University of Miami Hospital  
1400 N.W. 12th Avenue, Suite 4035  
Miami, FL 33136 USA  
Phone: 305-325-4683  
Fax: 305-325-4784  
E-mail: sscurry@med.miami.edu

Matthew J. Seidel, MD  
(Member 2007)  
Orthopaedic Surgical Oncology of Arizona  
9700 N 91st Street  
B-108  
Phoenix, AZ 85028 USA  
Phone: 602-258-8500  
Fax: 602-258-8510  
E-mail: mseidel@oso.md

Ahmad Shahin, MD  
(Member 2009)  
Medical School El Meno-fyia Univ.  
Bulding no. 7,  
St. No 15 from Elnadi St.  
Tanta, Gharbia, Egypt, Gharbia 31511 EGYPT  
Phone: +2040-3347818  
Fax: +2403332230  
E-mail: profashahin@hotmail.com
<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Institution</th>
<th>Address</th>
<th>City</th>
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<th>Fax</th>
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<tr>
<td>Thomas C. Shives, MD</td>
<td>Member 1979</td>
<td>Mayo Clinic</td>
<td>200 First St. SW, Rochester, MN 55905 USA</td>
<td>Rochester, MN</td>
<td>55905</td>
<td>USA</td>
<td>507-284-8531</td>
<td>507-266-4234</td>
<td><a href="mailto:shives.thomas@mayo.edu">shives.thomas@mayo.edu</a></td>
</tr>
<tr>
<td>Herrick J. Siegel, MD</td>
<td>Member 2006</td>
<td>University of Alabama at Birmingham</td>
<td>Chief, Orthopaedic Oncology 1313 13th Street, South Birmingham, AL 35205 USA</td>
<td>Birmingham, AL</td>
<td>35205</td>
<td>USA</td>
<td>205-930-8554</td>
<td>205-930-8570</td>
<td><a href="mailto:hsiegel@uabmc.edu">hsiegel@uabmc.edu</a></td>
</tr>
<tr>
<td>Franklin H. Sim, MD</td>
<td>Member 1977</td>
<td>Mayo Clinic</td>
<td>200 First Street, SW, Rochester, MN 55905 USA</td>
<td>Rochester, MN</td>
<td>55905</td>
<td>USA</td>
<td>507-284-8314</td>
<td>507-266-4234</td>
<td><a href="mailto:sim.franklin@mayo.edu">sim.franklin@mayo.edu</a></td>
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<tr>
<td>Michael A. Simon, MD</td>
<td>Emeritus 1978</td>
<td>Univ. of Chicago Medical School</td>
<td>5841 South Maryland MC3079, Chicago, IL 60637 USA</td>
<td>Chicago, IL</td>
<td>60637</td>
<td>USA</td>
<td>773-702-6144</td>
<td>773-702-4384</td>
<td><a href="mailto:msimon@surgery.bsd.uchicago.edu">msimon@surgery.bsd.uchicago.edu</a></td>
</tr>
<tr>
<td>Joel Sorger, MD</td>
<td>Member 2002</td>
<td>Cincinnati Childrens Hospital</td>
<td>3333 Burnet Avenue MLC 2017, Cincinnati, OH 45229-3039 USA</td>
<td>Cincinnati, OH</td>
<td>45229</td>
<td>USA</td>
<td>513-636-0974</td>
<td>513-636-3928</td>
<td><a href="mailto:joel.sorger@cchmc.org">joel.sorger@cchmc.org</a></td>
</tr>
<tr>
<td>Dempsey S. Springfield, MD</td>
<td>Member 1978</td>
<td>Yawkey Center for Outpatient Care</td>
<td>Suite 3B-3700, 55 Fruit Street, Boston, MA 02114 USA</td>
<td>Boston, MA</td>
<td>02114</td>
<td>USA</td>
<td>617-643-2092</td>
<td>617-724-0718</td>
<td><a href="mailto:dspringfield@partners.org">dspringfield@partners.org</a></td>
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<tr>
<td>Robert P. Stanton, MD</td>
<td>Member 1996</td>
<td>Nemours Childrens Clinic</td>
<td>5153 N. 9th Ave, Pensacola, FL 32504 USA</td>
<td>Pensacola, FL</td>
<td>32504</td>
<td>USA</td>
<td>850-505-4720</td>
<td>850-505-4726</td>
<td><a href="mailto:Rstanton@nemours.org">Rstanton@nemours.org</a></td>
</tr>
<tr>
<td>Robert Tamurian, MD</td>
<td>Member 2008</td>
<td>Northern California Orthopaedic Ctr</td>
<td>6403 Coyle Avenue, Suite 170, Carmichael, CA 95068 USA</td>
<td>Carmichael, CA</td>
<td>95068</td>
<td>USA</td>
<td>916-965-4000</td>
<td>916-965-5053</td>
<td><a href="mailto:rtamurian@gmail.com">rtamurian@gmail.com</a></td>
</tr>
<tr>
<td>Kimberly J. Templeton, MD</td>
<td>Member 2001</td>
<td>Kansas University Medical Center</td>
<td>3901 Rainbow Blvd, Mail Stop 3017, Kansas City, KS 66160 USA</td>
<td>Kansas City, KS</td>
<td>66160</td>
<td>USA</td>
<td>913-588-6131</td>
<td>913-588-8186</td>
<td><a href="mailto:ktemplet@kumc.edu">ktemplet@kumc.edu</a></td>
</tr>
<tr>
<td>Richard M. Terek, MD</td>
<td>Member 1996</td>
<td>Brown University</td>
<td>2 Dudley Street, Suite 200, Providence, RI 02905 USA</td>
<td>Providence, RI</td>
<td>02905</td>
<td>USA</td>
<td>401-457-1555</td>
<td>401-831-8992</td>
<td><a href="mailto:richard_terek@brown.edu">richard_terek@brown.edu</a></td>
</tr>
<tr>
<td>Mihir M. Thacker, MD</td>
<td>Member 2006</td>
<td>A I DuPont Hospital for Children</td>
<td>1600 Rockland Road, Wilmington, DE 19803 USA</td>
<td>Wilmington, DE</td>
<td>19803</td>
<td>USA</td>
<td>302-651-5007</td>
<td>302-651-5951</td>
<td><a href="mailto:mthacker@nemours.org">mthacker@nemours.org</a></td>
</tr>
<tr>
<td>H. Thomas Temple, MD</td>
<td>Member 2000</td>
<td>Univ. of Miami School of Medicine</td>
<td>1400 NW 12th Avenue, Room 4036, Miami, FL 33136 USA</td>
<td>Miami, FL</td>
<td>33136</td>
<td>USA</td>
<td>305-325-4475</td>
<td>305-325-3928</td>
<td><a href="mailto:htemple@med.miami.edu">htemple@med.miami.edu</a></td>
</tr>
<tr>
<td>Luke M. Vaughan, MD</td>
<td>Member 1992</td>
<td>Assoc. Clin. Prof Orthopaedics, UCSD</td>
<td>2029 Del Mar Road, Del Mar, CA 92014 USA</td>
<td>Del Mar, CA</td>
<td>92014</td>
<td>USA</td>
<td>858-792-7720</td>
<td>858-792-0576</td>
<td><a href="mailto:NMcVey@scrippsclinic.com">NMcVey@scrippsclinic.com</a></td>
</tr>
<tr>
<td>Walter W. Virkus, MD</td>
<td>Member 2004</td>
<td>Rush University Medical Center</td>
<td>1725 W. Harrison, Suite 440, Chicago, IL 60612 USA</td>
<td>Chicago, IL</td>
<td>60612</td>
<td>USA</td>
<td>312-563-2600</td>
<td>312-563-2658</td>
<td><a href="mailto:wvirkus@rushortho.com">wvirkus@rushortho.com</a></td>
</tr>
<tr>
<td>William G. Ward, MD</td>
<td>Member 1996</td>
<td>Wake Forrest Univ. Health Services</td>
<td>Department of Orthopaedics Medical Center Boulevard, Winston Salem, NC 27157 USA</td>
<td>Winston Salem, NC</td>
<td>27157</td>
<td>USA</td>
<td>336-716-3952</td>
<td>336-716-6286</td>
<td><a href="mailto:wgward@wakehealth.edu">wgward@wakehealth.edu</a></td>
</tr>
</tbody>
</table>

**Note:** The above information includes names, affiliations, and contact details for various medical professionals. The data is structured in a table format for clarity and ease of reading.
Kristy L. Weber, MD  
(Member 2002)  
Johns Hopkins University  
Department of Orthopaedic Surgery  
JHOC #5251, 601 N. Caroline St.  
Baltimore, MD 21287 USA  
Phone: 410-955-2888  
Fax: 410-502-6816  
E-mail: kweber6@jhmi.edu

Scott D. Weiner, MD  
(Member 1996)  
Summa Health System / Akron City Hospital  
Department of Orthopaedics  
444 N. Main Street  
Akron, OH 44310 USA  
Phone: 330-379-5661  
Fax: 330-379-5053  
E-mail: WeinerSD@summahealth.org

Lawrence D. Weis, MD  
(Member 1978)  
Yale Department of Orthopaedics & Rehab  
West Haven VA Hospital  
P.O. Box 635  
Georgetown, CT 06829-0635 USA  
Phone: 203-938-0822  
Fax: 203-938-0659  
E-mail: lweis82056@aol.com

Kurt Weiss, MD  
(Candidate 2010)  
University of Pittsburgh Medical Center  
3471 Fifth Avenue  
Pittsburgh, PA 15213 USA  
Phone: 412-605-3203  
Fax: 412-687-0802  
E-mail: weisskr@upmc.edu

Jason S. Weisstein, MD, MPH  
(Member 2007)  
Desert Orthopedic Center  
39000 Bob Hope Drive, PO Box 1730  
Harry and Diane Rinker Bldg.  
Rancho Mirage, CA 92270 USA  
Phone: 760-568-2684  
Fax: 760-837-2257  
E-mail: jweisstein@desertortho.com

Doris E. Wenger, MD  
(Affiliate 2005)  
Mayo Clinic  
Department of Radiology  
200 1st Street SW  
Rochester, MN 55905 USA  
Phone: 507-266-0631  
Fax: 507-284-2405  
E-mail: wenger.doris@mayo.edu

Ross M. Wilkins, MD  
(Member 1987)  
Colorado Limb Consultants  
The Denver Clinic for Extremities at Risk  
1601 East 19th Ave., Suite 3300  
Denver, CO 80218 USA  
Phone: 303-837-0072  
Fax: 303-837-0075  
E-mail: drrmw@aol.com

Ronald P. Williams, MD  
(Member 1997)  
Texas Oncology  
901 W. 38th Suite 200  
Austin, TX 78705 USA  
Phone: 512 421 4100  
Fax: 512 451 3482  
E-mail: ronald.williams@usoncology.com

Philip Z. Wirganowicz, MD  
(Member 2001)  
Kaiser Permanente Medical Center  
280 West MacArthur Blvd  
Dept of Orthopaedic Surgery  
Oakland, CA 94611 USA  
Phone: 510-752-7744  
Fax: 510-752-1590  
E-mail: pwirgano@yahoo.com

Stephen J. Withrow, DVM  
(Emeritus 1987)  
Colorado State University  
Animal Cancer Center  
300 West Drake Road  
Fort Collins, CO 80523-1620 USA  
Phone: 970-297-4175  
Fax: 970-297-1254  
E-mail: swithrow@colostate.edu

James Wittig, MD  
(Member 2010)  
Mt. Sinai Medical Center  
5 East 98th Street Box 1188  
New York, NY 10029 USA  
Phone: 212-241-1807  
Fax: 212-241-5965  
E-mail: drjameswittig@aol.com

Felasa M. Wodajo, MD  
(Member 2004)  
Virginia Hospital Center  
1625 N. George Mason Dr. Suite 464  
Arlington, VA 22205 USA  
Phone: 703 717 4670  
Fax: 703 717 4671  
E-mail: wodajo@tumors.md

Jay S. Wunder, MD  
(Member 2005)  
University Musculoskeletal Oncology Unit  
Mount Sinai Hospital  
600 University Avenue, #476  
Toronto, Ontario M5G 1X5 CANADA  
Phone: 416-586-5995  
Fax: 416-586-8611  
E-mail: jwunder@mtsinai.on.ca

L. Daniel Wurtz, MD  
(Member 2002)  
Department of Orthopaedic Surgery  
Indiana University School of Medicine  
541 Clinical Dr, Room 600  
Indianapolis, IN 46202 USA  
Phone: 317-274-3227  
Fax: 317-274-7395  
E-mail: dwurtz@iupui.edu

Zhiqing Xing, MD  
(Candidate 2010)  
University of South Alabama  
3421 Medical Park Drive  
2 Medical Park  
Mobile, AL 36693 USA  
Phone: 251-665-8200  
Fax: 251-665-8255  
E-mail: xingzhq@yahoo.com
Suzanne Yandow, MD  
(Member 2009)  
Texas A & M Physicians  
Clinical Building One, Suite 1100  
8441 State Hwy 47  
Bryan, TX 77807 USA  
Phone: 979-436-0514  
Fax: 979-776-6903  
E-mail: yandow@medicine.tamhsc.edu

Michael J. Yaszemski, MD, PhD  
(Member 2004)  
Mayo Clinic  
200 1st Street SW  
Rochester, MN 55905 USA  
Phone: 507-266-5262  
Fax: 507-266-4234  
E-mail: yaszemski.michael@mayo.edu

Kenneth Yaw, MD  
(Member 1994)  
PO Box 2344  
Roswell, NM 88202-2344 USA  
Phone: 575-622-7600  
Fax: 412-291-1526  
E-mail: ken@kenyaw.com

Erik Zeegen, MD  
(Member 2002)  
16311 Ventura Blvd., Suite 800  
Encino, CA 91436 USA  
Phone: 818-788-7343  
Fax: 818-788-9453  
E-mail: erikzeegen@yahoo.com

Robert J. Zehr, MD  
(Member 1996)  
Zehr Center for Orthopaedics  
2659 Professional Circle, Suite 115  
Naples, FL 34119 USA  
Phone: 239-596-0100  
Fax: 239-596-6737  
E-mail: rizehr@zehrcenter.com

Chunlin Zhang, MD  
(Associate 2011)  
The Sixth People’s Hospital,  
Shanghai Jiaotong Univ  
Orthopaedics Department  
600 Yishan Road  
Shanghai, 200233  
CHINA  
Phone: 86 13 761904091  
E-mail: shzhangchunlin@gmail.com

In Memoriam

Alan D. Aaron (2004)  
Chevy Chase, MD

Michael Bonfiglio (1995)  
Iowa City, IA

Theodore Boville  
San Francisco, CA

Thomas Brower (1998)  
Lexington, KY

Mario Campanacci (1999)  
Bologna, Italy

Andrei Czitrom (1982)  
Seattle, WA

Todd T. Grant (1996)  
Santa Monica, CA

Jack Ivins (1997)  
Rochester, MN

Alan Marc Levine (2009)  
Baltimore, MD

Ralph C. Marcove (2001)  
New York, NY

John Murray (2000)  
Houston, TX

James R. Neff (2005)  
Omaha, NE

Kalamazoo, MI

Bertil Stener (2000)  
Gothenburg, Sweden

Kent K. Wu (1999)  
Detroit, MI

Alan Yasko (2010)  
Chicago, IL
Please print legibly.

Name (required for CME Credits): ___________________________________________________________

Email address (optional): ________________________________________________________________

This educational meeting (Check all that apply):

• Confirmed that my knowledge in this subject area is up to date
• Presented me with new knowledge on the topic
• Presented me with new knowledge directly applicable to my practice
• Will stimulate me to gain further information on the topic
• None of the above

What is your overall rating of the effectiveness of this meeting on your learning and application of knowledge to your practice?

Poor □ Marginal □ Fair □ Good □ Very Good □ Excellent □

What suggestions do you have for improving this meeting?
_____________________________________________________________________________________
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205
Evaluation, Continued

Overall, how well did this session meet the following learning objectives?

- Evaluate treatment approaches and their application to your practice for current controversies
  
  - Navigation/Margins/Pelvis/Soft Tissue Sarcoma
  - Genetics/Complications
  - New Technology
  - Moffitt Cancer Center
  - Imaging/Metastatic Disease/Pediatric Reconstruction/
    Reconstruction/Radiation
  - Young Investigators
  - Multi-Institutional
  - Founder’s Lecture
  - Young Investigator Award Winners

- Answer patient questions regarding different treatment options
  
  - Navigation/Margins/Pelvis/Soft Tissue Sarcoma
  - Genetics/Complications
  - New Technology
  - Moffitt Cancer Center
  - Imaging/Metastatic Disease/Pediatric Reconstruction/
    Reconstruction/Radiation
  - Young Investigators
  - Multi-Institutional
  - Founder’s Lecture
  - Young Investigator Award Winners

- Identify your approach to treating ...
  
  - Navigation/Margins/Pelvis/Soft Tissue Sarcoma
  - Genetics/Complications
  - New Technology
  - Moffitt Cancer Center
  - Imaging/Metastatic Disease/Pediatric Reconstruction/
    Reconstruction/Radiation
  - Young Investigators
  - Multi-Institutional
  - Founder’s Lecture
  - Young Investigator Award Winners
Evaluation, Continued

- Describe potential complications and surgical approaches to avoid and treat …

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How well did this session meet your current learning needs in this content area?

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To what extent will you implement knowledge gained into your practice within the next year?

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</table>
Please Comment:

1. Which presentations were of most interest to you?

2. What topics or symposia were not addressed that you would like to have had presented?

3. Based on the 2012 program content, will you try to attend the 2013 MSTS Annual Meeting? Yes  No

4. Additional comments and suggestions:

Please return to the MSTS Registration Desk (Grand Salon Foyer) by Saturday, September 22, or mail to: Musculoskeletal Tumor Society Attn: Barbara Rapp, Executive Director P.O. Box 320062 Alexandria, VA 22320 USA or fax to: (703)548-4882

THIS IS ESSENTIAL FOR CME CREDITS
**PA/ARNP/Allied Health Scientific Session Evaluation Form**

**Friday, September 21, 2012**

8:00 a.m.  
**The Work-up of Sarcomas**  
_David Cheong, MD_  

9:00 a.m.  
**Staging, Proper Follow Up and Surveillance for Sarcomas**  
_Rick Gonzalez, MD_  

10:15 a.m.  
**Sarcoma Medical Oncology**  
_Anthony Conley, MD_  
_Damon Reed, MD_  

11:15 a.m.  
**Management of Metastatic Bone Disease**  
_Odion Binitie, MD_  

1:30 p.m.  
**The Role of XRT Involving Sarcomas**  
_Robert Lavey, MD_  

2:30 p.m.  
**Sarcoma Medical Oncology**  
_Anthony Conley, MD_  
_Damon Reed, MD_  

3:45 p.m.  
**Pain and Palliative Care**  
_Sorin Buga, MD_  

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Please critique the presentations taking into consideration the following items:

- Was the level of information appropriate to the audience?
- Were the presentations of interest and the information current?
Please Comment:

1. Which presentations were of most interest to you?

2. Additional comments and suggestions:

3. Based on the 2012 program content, will you try to attend the Future Sessions?  ☐ Yes  ☐ No

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Accreditation and Continuing Education Credit

This Annual Meeting of the Musculoskeletal Tumor Society (MSTS) 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 Academy of Orthopaedic Surgeons and the Musculoskeletal Tumor Society. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to sponsor continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this educational activity for a maximum of **10.75 AMA PRA Category 1 Credits™**. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Disclaimer

The material presented at the MSTS Annual Meeting has been made available by the Musculoskeletal Tumor Society for educational purposes only. This material is not intended to represent the only, nor necessarily the best, methods or procedures appropriate for the medical situations discussed, but rather is intended to present an approach, view, statement or opinion of the faculty, which may be helpful to others who face similar situations.

The Musculoskeletal Tumor Society (MSTS) disclaims any and all liability for injury or other damages resulting to any individual attending a course and for all claims, which may arise out of the use of the techniques, demonstrated therein by such individuals, whether these claims shall be asserted by a physician or any other person.

Disclosure

Each faculty member in this course has been asked to disclose if he or she has received something of value (in excess of $500) from a commercial company or institution, which relates directly or indirectly to the subject of their presentation. The Academy has identified the options to disclose as follows:

- **n** = Respondent answered ‘No’ to all items indicating no conflicts;
- **1** = Royalties from a company or supplier;
- **2** = Speakers bureau/paid presentations;
- **3A** = Paid employee for a company or supplier;
- **3B** = Paid consultant for a company or supplier;
- **3C** = Unpaid consultant for a company or supplier;
- **4** = Stock or stock options;
- **5** = Research support;
- **6** = Other financial/material support from a company or supplier;
- **7** = Royalties, financial or material support from publishers;
- **8** = Medical/Orthopaedic publications editorial/governing board;
- **9** = Board member/committee appointments from a society

An indication of the participant’s disclosure appears after his or her name as well as the commercial company or institution that provided the support.

The Academy and the MSTS do not view the existence of these disclosed interests or commitments as necessarily implying bias or decreasing the value of the author’s participation in the course.

FDA

Some drugs or medical devices demonstrated at this Annual Meeting may not have been cleared by the FDA or have been cleared by the FDA for specific purposes only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.

Academy policy provides that “off label” uses of a drug or medical device may be described in the Academy’s CME activities so long as the “off label” use of the drug or medical device is also specifically disclosed (i.e., it must be disclosed that the FDA has not cleared the drug or device for the described purpose). Any drug or medical device is being used “off label” if the described use is not set forth on the product’s approval label.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and/or medical device for the use described (i.e., the drug or medical device is being discussed for an “off label” use).
Thank you for attending the 2012 MSTS Annual Meeting.

We look forward to seeing you in 2013!

2013 Annual Meeting
October 3 - 5, 2013
Hyatt Regency San Francisco, California

John H. Healey, MD, MSTS President
Richard J. O'Donnell, MD, Program Chair