THE HIP SOCIETY

The Forty-Second Open (Winter) Meeting of The Hip Society

The Twentieth Combined Open Meeting of The Hip Society and the American Association of Hip and Knee Surgeons (AAHKS)

Final Scientific Program

Saturday, March 15, 2014
Ernest N. Morial Convention Center, Theater A
New Orleans, Louisiana
# ANOUNCEMENTS

## FUTURE MEETINGS AND CALLS FOR ABSTRACTS

### AAOS Annual Meetings

- March 24-28, 2015, Las Vegas, Nevada
- March 1-5, 2016, Orlando, Florida
- March 14-18, 2017, San Diego, California

### AAHKS 24th Annual Meeting

- November 7-9, 2014, Sheraton Dallas Hotel, Dallas, TX

<table>
<thead>
<tr>
<th>Call for Symposia Proposals Covering All Aspects of Arthroplasty and Health Policy</th>
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</thead>
<tbody>
<tr>
<td><strong>Symposia submissions are due by May 1, 2014</strong></td>
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</tbody>
</table>

Abstracts for the 2014 AAHKS Annual Meeting may be submitted on the AAHKS’ website ([www.aahks.org](http://www.aahks.org))

| **Abstracts are due by June 2, 2014**                                            |
Welcome to the Twentieth Combined Open Meeting of The Hip Society and the American Association of Hip and Knee Surgeons (AAHKS)
At the 2014 AAOS Specialty Day

General Information

The Mission of The Hip Society:

The Mission of The Hip Society is to advance knowledge of hip disorders, promote evidence-based treatment, and refine surgery of the hip in order to improve the lives of patients.

Meeting Objectives:

The objectives of the Open Meeting of The Hip Society and AAHKS are to provide up-to-date information on the treatment of hip conditions, including non-arthroplasty options, and the latest surgical techniques as well as the current thinking on bearing surfaces. Other objectives address the difficult primary THA and complication management and include an update on revision THA.

CME Accreditation:

This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the American Academy of Orthopaedic Surgeons (AAOS) and The Hip Society. The AAOS is accredited by the ACCME to sponsor continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of 7.75 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Important

☐ Please participate when audience response system (ARS) is used.

☐ Please do not remove ARS keypads from the session room.

☐ Please complete evaluation online at: https://www.surveymonkey.com/s/2014WM_HIP

☐ Please silence all electronic devices while inside the session room.

☐ Please refrain from unauthorized photography and video recording of presentations.

☐ Your registration for, and attendance of, this session gives The Hip Society permission to capture images of session attendees and to use these images for internal and marketing purposes.
# ACKNOWLEDGEMENTS

## Past Presidents of The Hip Society

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969-1970</td>
<td>Frank E. Stinchfield, MD (Deceased)</td>
</tr>
<tr>
<td>1970-1971</td>
<td>Walter P. Blount, MD (Deceased)</td>
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<tr>
<td>1971-1972</td>
<td>Albert B. Ferguson, Jr., MD</td>
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<tr>
<td>1972-1973</td>
<td>J. Vernon Luck, Sr., MD (Deceased)</td>
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<tr>
<td>1973-1974</td>
<td>Mark B. Coventry, MD (Deceased)</td>
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<tr>
<td>1974-1975</td>
<td>Emmett M. Lunceford, Jr., MD (Deceased)</td>
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<tr>
<td>1976-1978</td>
<td>Augusto Sarmiento, MD</td>
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<tr>
<td>1978-1979</td>
<td>Marshall R. Urist, MD (Deceased)</td>
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<tr>
<td>1979-1980</td>
<td>Harlan C. Amstutz, MD</td>
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<tr>
<td>1980-1981</td>
<td>Philip D. Wilson, Jr., MD</td>
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<tr>
<td>1981-1982</td>
<td>Richard C. Johnston, MD, MS</td>
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<tr>
<td>1982-1983</td>
<td>Clement B. Sledge, MD</td>
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<tr>
<td>1983-1984</td>
<td>Floyd H. Jergesen, MD (Deceased)</td>
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<tr>
<td>1984-1985</td>
<td>C. McCollister Evarts, MD</td>
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<tr>
<td>1985-1986</td>
<td>Jorge O. Galante, MD, DMSc.</td>
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<tr>
<td>1986-1987</td>
<td>Lee H. Riley, Jr., MD (Deceased)</td>
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<td>1987-1988</td>
<td>William R. Murray, MD (Deceased)</td>
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<td>1988-1989</td>
<td>Joseph E. Miller, MD (Deceased)</td>
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<td>1989-1990</td>
<td>Donald E. McCollum, MD (Deceased)</td>
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<tr>
<td>1990-1991</td>
<td>J. Phillip Nelson, MD</td>
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<tr>
<td>1991-1992</td>
<td>Nas S. Eftekhar, MD</td>
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<tr>
<td>1992-1993</td>
<td>William N. Capello, MD</td>
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<td>1993-1994</td>
<td>Robert H. Fitzgerald, Jr., MD</td>
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<td>1994-1995</td>
<td>Mark G. Lazansky, MD</td>
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<td>1995-1996</td>
<td>Richard B. Welch, MD</td>
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<td>1996-1997</td>
<td>Dennis K. Collis, MD</td>
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<td>1997-1998</td>
<td>Eduardo A. Salvati, MD</td>
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<td>1998-1999</td>
<td>Robert B. Bourne, MD, FRCSC</td>
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<td>1999-2000</td>
<td>Richard D. Coutts, MD</td>
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<td>2000-2001</td>
<td>Leo A. Whiteside, MD</td>
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<td>2001-2002</td>
<td>Benjamin E. Bierbaum, MD</td>
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<td>2002-2003</td>
<td>Miguel E. Cabanela, MD</td>
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<td>2003-2004</td>
<td>Charles A. Engh, Sr., MD</td>
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<td>2004-2005</td>
<td>Richard E. White, MD</td>
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<td>2005-2006</td>
<td>James A. D’Antonio, MD</td>
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<td>2006-2007</td>
<td>John J. Callaghan, MD</td>
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<td>2007-2008</td>
<td>Lawrence D. Dorr, MD</td>
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<td>2008-2009</td>
<td>Wayne G. Paprosky, MD</td>
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<td>2009-2010</td>
<td>William J. Maloney, III, MD</td>
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<td>2010-2011</td>
<td>Chitranjan S. Ranawat, MD</td>
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<tr>
<td>2011-2012</td>
<td>Adolph V. Lombardi, Jr., MD, FACS</td>
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<tr>
<td>2012-2013</td>
<td>David G. Lewallen, MD</td>
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## Past Presidents of AAHKS

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<tr>
<td>1991</td>
<td>J. Phillip Nelson, MD</td>
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<td>1996</td>
<td>Hugh S. Tullos, MD (Deceased)</td>
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<td>1997</td>
<td>Merrill A. Ritter, MD</td>
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<td>1998</td>
<td>Richard H. Rothman, MD, PhD</td>
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<td>1999</td>
<td>James A. Rand, MD</td>
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<td>2000</td>
<td>Richard B. Welch, MD</td>
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<td>2001</td>
<td>John J. Callaghan, MD</td>
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<td>2002</td>
<td>Douglas A. Dennis, MD</td>
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<tr>
<td>2003</td>
<td>Clifford W. Colwell, Jr., MD</td>
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<td>2004</td>
<td>Richard F. Santore, MD</td>
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<td>2005</td>
<td>Joseph C. McCarthy, MD</td>
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<td>2006</td>
<td>William J. Hozack, MD</td>
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<td>2007</td>
<td>Daniel J. Berry, MD</td>
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<td>2008</td>
<td>David G. Lewallen, MD</td>
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<td>2009</td>
<td>William J. Robb, III, MD</td>
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<td>2010</td>
<td>Mary I. O’Connor, MD</td>
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<td>2011</td>
<td>Carlos J. Laverna, MD</td>
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<tr>
<td>2012</td>
<td>Thomas P. Vail, MD</td>
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THE HIP SOCIETY EXECUTIVE BOARD 2013-2014

Vincent D. Pellegrini, Jr., MD - President
Paul F. Lachiewicz, MD - 1st Vice President
Daniel J. Berry, MD - 2nd Vice President
Douglas E. Padgett, MD - Secretary
Harry E. Rubash, MD - Treasurer
David G. Lewallen, MD - Immediate Past President
Kevin L. Garvin, MD - Chair, Education Committee
Thomas P. Vail, MD - Chair, Membership Committee
Jay R. Lieberman, MD - Member-At-Large
Adolph V. Lombardi, Jr., MD – Ex-Officio

THE HIP SOCIETY EDUCATION COMMITTEE 2013-2014

Kevin L. Garvin, MD – Chair
Vincent D. Pellegrini, Jr., MD
Steven J. MacDonald, MD, FRCSC
A. Seth Greenwald, D.Phil. (Oxon)
Robert T. Trousdale, MD - Past Chair

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Brian S. Parsley, MD - 1st Vice President
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William A. Jiranek, MD - 3rd Vice President
William J. Maloney, III, MD - Secretary
Robert T. Trousdale, MD - Treasurer
Thomas P. Vail, MD - Immediate Past President
Carlos J. Lavernia, MD - Past President
Members-At-Large:
Michael E. Berend, MD; Christopher L. Peters, MD
Stefano A. Bini, MD and Rafael J. Sierra, MD

THE 2013 PROGRAM CO-CHAIRS

The Hip Society
Kevin L. Garvin, MD

AAHKS
Bryan D. Springer, MD

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## SCIENTIFIC PROGRAM

### HIP

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<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Page</th>
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<tbody>
<tr>
<td>7:55 am – 8:00 am</td>
<td><strong>WELCOME</strong> Vincent D. Pellegrini, Jr, MD (Charleston, SC) President, The Hip Society</td>
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<tr>
<td>8:00 am – 8:40 am</td>
<td><strong>Symposium I: Surgical Approach for Primary Total Hip Arthroplasty</strong> Moderator: Daniel J. Berry, MD (Rochester, MN)</td>
<td>15</td>
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<tr>
<td>8:06 am – 8:12 am</td>
<td><strong>Direct Anterior Approach: A Senior Surgeon’s Experience: It’s Not Too Late but Is It Better?</strong> Bernard N. Stulberg, MD (Cleveland, OH)</td>
<td>18</td>
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<tr>
<td>8:12 am – 8:18 am</td>
<td><strong>Anterolateral Approach</strong> Adolph V. Lombardi, Jr, MD, FACS (New Albany, OH)</td>
<td>23</td>
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<tr>
<td>8:18 am – 8:24 am</td>
<td><strong>Posterior Approach: Is it the Gold Standard?</strong> Mark W. Pagnano, MD (Rochester, MN)</td>
<td>24</td>
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<tr>
<td>8:24 am – 8:40 am</td>
<td><strong>Case-Based Discussion and Audience Response Panel:</strong> Joel M. Matta, MD Bernard N. Stulberg, MD Adolph V. Lombardi, Jr, MD, FACS Mark W. Pagnano, MD</td>
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<tr>
<td>8:40 am – 9:30 am</td>
<td><strong>Symposium II: Components for Primary Total Hip Arthroplasty: Are They all Equivalent?</strong> Moderator: Douglas A. Dennis, MD (Denver, CO)</td>
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<tr>
<td>8:40 am – 8:46 am</td>
<td><strong>Short Stems Do Work</strong> Roger H. Emerson, MD (Plano, TX)</td>
<td>25</td>
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<td>8:46 am – 8:52 am</td>
<td><strong>20 Years of Experience: Tapered Stems</strong> John B. Meding, MD (Mooresville, IN)</td>
<td>26</td>
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<tr>
<td>8:52 am – 8:58 am</td>
<td><strong>Extensively Coated Stems</strong> C. Anderson Engh, MD (Alexandria, VA)</td>
<td>28</td>
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<tr>
<td>8:58 am – 9:04 am</td>
<td><strong>35 Years of Experience with Cemented Stems</strong> John J. Callaghan, MD (Iowa City, IA)</td>
<td>29</td>
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<td>9:04 am – 9:10 am</td>
<td><strong>Uncemented Acetabular Components</strong> Aaron G. Rosenberg, MD (Deerfield, IL)</td>
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<tr>
<td>9:10 am – 9:16 am</td>
<td><strong>Achieving Bone Ingrowth and Cup Stability</strong> J. Dennis Bobyn, PhD (Montreal, QC Canada)</td>
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<tr>
<td>9:16 am – 9:30 am</td>
<td><strong>Case-Based Discussion and Audience Response Panel:</strong> Roger H. Emerson, MD John B. Meding, MD C. Anderson Engh, MD John J. Callaghan, MD Aaron G. Rosenberg, MD J. Dennis Bobyn, PhD</td>
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<tr>
<td>9:30 am – 9:40 am</td>
<td><strong>Break</strong></td>
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<tr>
<td>9:40 am – 10:20 am</td>
<td><strong>Symposium III: Preventing Hospital Readmissions and Managing Complications</strong> Moderator: Vincent D. Pellegrini, Jr, MD (Charleston, SC)</td>
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### KNEE

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<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:55 am – 8:00 am</td>
<td><strong>WELCOME</strong> Steven J. MacDonald, MD, FRCSC (London, ON Canada) President, The Knee Society</td>
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<tr>
<td>8:01 am – 8:40 am</td>
<td><strong>Symposium I: Non-Operative and Non-Arthroplasty Options for Management of Knee OA</strong> Moderator: William L. Griffin, MD (Charlotte, NC)</td>
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<tr>
<td>8:06 am – 8:12 am</td>
<td><strong>Oral Agents: What’s the Evidence</strong> Jay R. Lieberman, MD (Los Angeles, CA)</td>
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<td>8:14 am – 8:19 am</td>
<td><strong>Injectables: Now and In The Future</strong> William J. Maloney, III, MD (Redwood City, CA)</td>
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<td>8:20 am – 8:25 am</td>
<td><strong>Bracing and Shoe Wear: What’s The Evidence it Helps</strong> Richard Iorio, MD (New York, NY)</td>
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<td>8:26 am – 8:31 am</td>
<td><strong>Osteotomy: Current Role in our Armentarium</strong> Stephen J. Incavo, MD (Houston, TX)</td>
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<td>8:32 am – 8:40 am</td>
<td><strong>Discussion</strong></td>
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<td>8:40 am – 9:43 am</td>
<td><strong>Symposium II: Unicompartmental Knee Replacement</strong> Moderator: David G. Lewallen, MD (Rochester, MN)</td>
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<td>8:42 am – 8:48 am</td>
<td><strong>Patient Selection: Past and Present</strong> Richard D. Scott, MD (Boston, MA)</td>
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<td>8:49 am – 8:55 am</td>
<td><strong>Why Unicompartmental Knee Replacement Fails?</strong> Michael E. Berend, MD (Mooresville, IN)</td>
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<td>8:56 am – 9:11 am</td>
<td><strong>Debate I: Mobile Bearing vs. Fixed Bearing: It Makes a Difference</strong></td>
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<td>8:56 am – 9:04 am</td>
<td><strong>Affirm</strong> David W. Murray, MD, FRCS (Oxford, United Kingdom)</td>
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<td>9:05 am – 9:11 am</td>
<td><strong>Oppose</strong> Craig J. Della Valle, MD (Chicago, IL)</td>
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<td>9:12 am – 9:32 am</td>
<td><strong>Newer Technologies</strong></td>
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<td>9:30 am – 9:40 am</td>
<td><strong>Break</strong></td>
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<tr>
<td>9:40 am – 10:20 am</td>
<td><strong>Symposium III: Preventing Hospital Readmissions and Managing Complications</strong> Moderator: Vincent D. Pellegrini, Jr, MD (Charleston, SC)</td>
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<td>9:46 am – 10:11 am</td>
<td><strong>Video: Custom Implants</strong> Thomas S. Thornhill, MD (Boston, MA)</td>
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<td>9:49 am – 10:11 am</td>
<td><strong>Video: Patient Specific Instrumentation</strong> Keith R. Berend, MD (New Albany, OH)</td>
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<tr>
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<th>KNEE (Theater B)</th>
<th>Knee Page</th>
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<tbody>
<tr>
<td>9:40 am – 9:45 am</td>
<td>Preventing Readmission: Defining the Complications in Total Hip Arthroplasty</td>
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<td>9:26 am – 9:32 am</td>
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<tr>
<td>William L. Healy, MD (Newton, MA)</td>
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<td>Andrew D. Pearle, MD (New York, NY)</td>
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<td>9:45 am – 9:50 am</td>
<td>What is the Data on Hospital Readmission for THA in the US?</td>
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<td>9:33 am – 9:43 am</td>
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<td>Vincent D. Pellegrini, Jr, MD (Charleston, SC)</td>
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<td>Kevin L. Garvin, MD (Omaha, NE)</td>
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<td>Moderator: Daniel J. Berry, MD (Rochester, MN)</td>
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<td>9:55 am – 10:00 am</td>
<td>Preventing Readmission: Management of Thromboembolic Disease</td>
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<td>Paul F. Lachiewicz, MD (Chapel Hill, NC)</td>
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<td>William L. Healy, MD (Newton, MA)</td>
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<td>Steven J. MacDonald, MD, FRCS (London, ON Canada)</td>
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<td>10:00 am – 10:05 am</td>
<td>Preventing Readmission: The Role of Your Internist</td>
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<td>10:00 am – 10:15 am</td>
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<td>Richard Iorio, MD (New York, NY)</td>
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<td>10:05 am – 10:20 am</td>
<td>Case-Based Discussion and Audience Response Panel:</td>
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<td>10:15 am – 11:39 am</td>
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<td>William L. Healy, MD</td>
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<td>Moderator: Steven J. MacDonald, MD, FRCS</td>
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<td>Richard Iorio, MD</td>
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<td>10:20 am – 10:48 am</td>
<td>Symposium IV: Hip Preservation</td>
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<td>Moderator: Robert T. Trousdale, MD (Rochester, MN)</td>
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<td>John C. Clohisy, MD (Saint Louis, MO)</td>
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<td>Thomas P. Vail, MD (San Francisco, CA)</td>
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<tr>
<td>10:25 am – 10:30 am</td>
<td>Predictors of Success in PAO Surgery</td>
<td>44</td>
<td>10:27 am – 10:32 am</td>
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<td>Paul E. Beaulé, MD, FRCS (Ottawa, ON Canada)</td>
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<td>Kevin J. Bozic, MD, MBA (San Francisco, CA)</td>
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<td>10:30 am – 10:35 am</td>
<td>The Role of Arthroscopy In Hip Preservation</td>
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<td>10:33 am – 10:38 am</td>
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<td>Joseph C. McCarthy, MD (Boston, MA)</td>
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<td>Johan Bellemans, MD, PhD (Pellenberg, Belgium)</td>
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<tr>
<td>10:35 am – 10:48 am</td>
<td>Case-Based Discussion and Audience Response Panel:</td>
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<td>10:39 am – 10:44 am</td>
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<td>John C. Clohisy, MD</td>
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<td>Ormande M. Mahoney, MD (Athens, GA)</td>
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<td>Paul E. Beaulé, MD, FRCS</td>
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<td>Joseph C. McCarthy, MD</td>
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<td>10:48 am – 11:30 am</td>
<td>Presidential Guest Speaker</td>
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<tr>
<td>Introduction and Moderator: Vincent D. Pellegrini, Jr, MD (Charleston, SC)</td>
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<tr>
<td>10:50 am – 11:20 am</td>
<td>National Joint Registry 10 Years On: What Has Been Achieved and Lessons Learned</td>
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<td>10:54 am – 11:30 am</td>
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<tr>
<td>Paul J. Gregg, MBBS, MD, FRCS (Eng), FRCS (Ed) (Middlesbrough, United Kingdom)</td>
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<tr>
<td>11:20 am – 11:25 am</td>
<td>US Registries</td>
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<tr>
<td>David G. Lewallen, MD (Rochester, MN)</td>
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<td>Kevin L. Garvin, MD (Omaha, NE)</td>
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<tr>
<td>11:25 am – 11:30 am</td>
<td>Discussion</td>
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<td>11:01 am – 11:12 am</td>
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<tr>
<td>11:30 am – 11:38 am</td>
<td>The Hip Society Scientific Awards</td>
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<tr>
<td>Moderator: Kevin L. Garvin, MD (Omaha, NE)</td>
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<tr>
<td>11:30 am – 11:38 am</td>
<td>The John Charnley Award: Long Term Wear of HXLPE in THA</td>
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<td>11:07 am – 11:12 am</td>
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<tr>
<td>Geraint E. R. Thomas MA, MBBS, MRCS (Oxford, United Kingdom)</td>
<td></td>
<td></td>
<td>Henry D. Clarke, MD (Phoenix, AZ)</td>
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© 2014 The Hip Society
## Symposium VI: My Worst Case Competition

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<tbody>
<tr>
<td>1:00 pm</td>
<td>Symposium VI: My Worst Case Competition</td>
<td>Moderator: Leo A. Whiteside, MD (Saint Louis, MO)</td>
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<tr>
<td>1:00 pm</td>
<td>At 5 Years Highly-Porous-Metal Tibial Components</td>
<td>Arlen D. Hanssen, MD (Rochester, MN)</td>
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<tr>
<td>1:00 pm</td>
<td>Were Durable and Reliable in Primary Total Knee Arthroplasty: A Randomized Clinical Trial</td>
<td>Paul C. Moodie, MD (Rochester, MN)</td>
</tr>
<tr>
<td>1:00 pm</td>
<td>Patient Specific Instrumentation: The Way of the Future</td>
<td>Harry E. Rubash, MD (Boston, MA)</td>
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<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter(s)</th>
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<tbody>
<tr>
<td>11:38 am</td>
<td>The Frank Stinchfield Award Optimized Orientation in Total Hips</td>
<td>Jacob M. Elkins, MD, PhD (Iowa City, IA)</td>
</tr>
<tr>
<td>11:46 am</td>
<td>The Otto Aufranc Award Preventative Factors for Infection following Hip Arthroplasty</td>
<td>Richard Iorio, MD (New York, NY)</td>
</tr>
<tr>
<td>11:54 am</td>
<td>The Hip Society 2014 Lifetime Achievement Award</td>
<td>Introduction: Joseph C. McCarthy, MD (Boston, MA)</td>
</tr>
<tr>
<td></td>
<td>Recipient: Chitranjan S. Ranawat, MD (New York, NY)</td>
<td></td>
</tr>
<tr>
<td>12:00 pm</td>
<td>Introduction of the 2014 Hip Society Rothman-Ranawat Traveling Fellowship</td>
<td>Adolph V. Lombardi, Jr, MD, FACS (New Albany, OH)</td>
</tr>
<tr>
<td></td>
<td>Recap of the 2013 Hip Society Rothman-Ranawat Traveling Fellowship</td>
<td>Gregory K. Deirmengian, MD (Philadelphia, PA)</td>
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<td></td>
<td>Sumon Nandi, MD (Boston, MA)</td>
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<tr>
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<td>Lunch</td>
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</tr>
<tr>
<td>1:00 pm</td>
<td>Highlights of the 2013 AAHKS Meeting</td>
<td>Thomas K. Fehring, MD (Charlotte, NC)</td>
</tr>
<tr>
<td>1:10 pm</td>
<td>Symposium V: Bearing Choices</td>
<td>Moderator: William J. Maloney, III, MD (Redwood City, CA)</td>
</tr>
<tr>
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<td>Surface Replacement: What are the Indications?</td>
<td>Thomas P. Schmalzried, MD (Los Angeles, CA)</td>
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<td>Metal on Metal and Large Heads: Worth the Risk?</td>
<td>Donald S. Garbuz, MD, MHSc, FRCS (Vancouver, BC Canada)</td>
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<td>HXLPE: As Good as Expected</td>
<td>Richard W. McCa iden, MD (London, ON Canada)</td>
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<tr>
<td>1:28 pm</td>
<td>Ceramic</td>
<td>William N. Capello, MD (Indianapolis, IN)</td>
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<tr>
<td>1:34 pm</td>
<td>Case-Based Discussion and Audience Response</td>
<td>Panel: Thomas P. Schmalzried, MD, Donald S. Garbuz, MD, MHSc, FRCS, Richard W. McCa iden, William N. Capello, MD</td>
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<td>1:46 pm</td>
<td>Symposium VI: Modularity in Total Hip Arthroplasty: Choices and Compromises</td>
<td>Moderator: William J. Hozack, MD (Philadelphia, PA)</td>
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<tr>
<td>1:46 pm</td>
<td>Why I Prefer a Monolithic Acetabular Component</td>
<td>Thomas P. Sculco, MD (New York, NY)</td>
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<td>Why I Prefer Modularity for the Acetabular Component</td>
<td>Thomas P. Vail, MD (San Francisco, CA)</td>
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<tr>
<td>1:58 pm</td>
<td>Why I Prefer Less Modularity for Primary and Revision Stems</td>
<td>Javad Parviz, MD, FRCS (Philadelphia, PA)</td>
</tr>
<tr>
<td>2:04 pm</td>
<td>Why I Prefer More Modularity for Primary and Revision Stems</td>
<td>Christopher L. Peters, MD (Salt Lake Cty, UT)</td>
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## KNEE (Theater B)

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter(s)</th>
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</thead>
<tbody>
<tr>
<td>11:13 am</td>
<td>Debate III: Patient Specific Instrumentation: The Way of the Future</td>
<td>Harry E. Rubash, MD (Boston, MA)</td>
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<tr>
<td>11:19 pm</td>
<td>Oppose</td>
<td>Robert L. Barrack, MD (Saint Louis, MO)</td>
</tr>
<tr>
<td>11:25 pm</td>
<td>Robotic TKA: A Future Reality</td>
<td>Harry E. Rubash, MD (Boston, MA)</td>
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<tr>
<td>11:52 pm</td>
<td>Audience Response and Discussion</td>
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<tr>
<td>11:40 pm</td>
<td>Symposium V: The Knee Society Awards</td>
<td>Moderator: William L. Healy, MD (Newton, MA)</td>
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<tr>
<td></td>
<td>The John Insall Award</td>
<td>Introduction: Michael A. Kelly, MD (Hackensack, NJ)</td>
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<tr>
<td></td>
<td>The Chitranjan Ranawat Award</td>
<td>Introduction: Paul F. Lachiewicz, MD (Chapel Hill, NC)</td>
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<td></td>
<td>Morbid Obesity and TKA: A Matched-Control Study</td>
<td>James A. Browne, MD (Charlottesville, VA)</td>
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<td></td>
<td>Randomized Clinical Trial Comparing Femoral &amp; Sciatic Blocks to Periarticular Injection for Pain Management after TKA</td>
<td>Robert T. Trousdale, MD (Rochester, MN)</td>
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<tr>
<td></td>
<td>The Mark Coventry Award</td>
<td>Introduction: Robert T. Trousdale, MD (Rochester, MN)</td>
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<tr>
<td></td>
<td>At 5 Years Highly-Porous-Metal Tibial Components</td>
<td>Luis Pulido, MD (Rochester, MN)</td>
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Panel:
Thomas P. Sculco, MD
Thomas P. Vail, MD
Javad Parvizi, MD, FRCS
Christopher L. Peters, MD

1:13 pm – 1:18 pm  Aaron G. Rosenberg, MD, FACS (Deerfield, IL)

2:25 pm – 2:31 pm  Symposium VII: Metallosis
Moderator: Steven J. MacDonald, MD, FRCSC
(London, ON Canada)

1:19 pm – 1:24 pm  William J. Hozack, MD (Philadelphia, PA)

3:33 pm – 3:39 pm  The Diagnosis of Metallosis-Not Infection: Getting it Correct
Craig J. Della Valle, MD (Chicago, IL)

1:25 pm – 1:28 pm  Audience Voting and Crowning of the New Champion

2:31 pm – 2:37 pm  Revision for Metallosis: Results of Revision for Failed THA
William L. Griffin, MD (Charlotte, NC)

1:34 pm – 2:25 pm  Symposium VII: Performing A Primary TKA
Moderator: Robert E. Booth, Jr, MD (Philadelphia, PA)

1:13 pm – 1:18 pm  Aaron G. Rosenberg, MD, FACS (Deerfield, IL)

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William A. Jiranek, MD  
Scott M. Sporer, MD, MS  
Wayne G. Paprosky, MD, FACS  
Daniel J. Berry, MD  
Douglas E. Padgett, MD  
Clive P. Duncan, MD  
Bassam A. Masri, MD, FRCSC | 3:01 pm – 3:07 pm | Quadciceps Mechanism Reconstruction: Technique and Outcomes  
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|              | Evaluation of the Stiff Knee  
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<td>4:58 pm – 5:10 pm</td>
<td>Mark W. Pagnano, MD (Rochester, MN)</td>
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<td>5:10 pm</td>
<td>Discussion</td>
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<td>ADJOURN</td>
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Financial disclosures for The Hip Society Program are on pages: 98 - 101

Financial disclosures for The Knee Society Program are on pages: 87 - 91
The Board of Directors of The Hip Society established the Lifetime Achievement Award in 2008 to recognize those who have achieved academic excellence and made significant contributions to study of arthritic diseases of the hip, as well as to recognize the accomplishments of the distinguished persons who have created a lasting legacy in this field.

Taking risks to advance hip surgery has been the story of Dr. Ranawat’s career. He was a pioneer in the development of performing total hip replacement without trochanteric osteotomy using the posterior approach. His superb technical skills improved the operation by preserving the capsule with the operation and through design of instruments to allow visualization of the acetabulum as well as it is seen with the anterior approach.

Dr. Ranawat is also a pioneer in educational forums for teaching hip surgery. He was the engine behind the formation of AAHKS. Now AAHKS is the largest organization for joint arthroplasty surgeons with more than 1,000 members. Just as important is his pioneering of hip replacement surgery and education in India. He founded the premier educational conference for hip and knee surgery. His efforts to bring total joint replacement surgery to his native country have elevated him there to celebrity status. He has been given the award in India comparable to the United States Medal of Freedom. It is a singular achievement for one man to convert an entire country’s attitude from fear and skepticism to confidence.

Dr. Ranawat’s entire career has been inside academic institutions, mostly at Hospital for Special Surgery in New York City. For several years he was the Chairman of the Orthopedic Department at Lenox-Hill Hospital, but has subsequently returned to HSS. His legacy at both institutions, and for all surgeons who studied under him, is superb, meticulous technique for operations, and an insatiable curiosity for improving patient outcomes through research. His reputation, and following, both nationally and internationally, has been a role model for hundreds of orthopedic surgeons.

The Hip Society is honored to present the 2014 Lifetime Achievement Award to Chitranjan S. Ranawat, MD

Congratulations, Dr. Ranawat!
**Presidential Guest Speaker**

Prof. Paul J. Gregg, MB.BS., MD, FRCS(Eng), FRCS(Ed.)

Emeritus Consultant Orthopaedic Surgeon, James Cook University Hospital, Middlesbrough, UK and Professor of Orthopaedic Surgical Science. University of Durham, UK.

Previously Senior Lecturer, Department of Orthopaedic Surgery, University of Edinburgh; Foundation Professor of Orthopaedic Surgery, University of Leicester School of Medicine; Professor of Orthopaedic Surgery Medical School, University of Newcastle upon Tyne.

British Orthopaedic Research Society Presidents Medal; British Orthopaedic Association Robert Jones Gold medal; ABC Travelling Fellow.


Vice Chair National Joint Registry Steering Committee (2003-2014)

Previous Chair of British Orthopaedic Association Education Committee: MRC Steering Committee for Spine Stabilization Trial; NHS Orthopaedic Collaborative for Joint Replacement; British Orthopaedic Association Professional Practice Committee; British Orthopaedic Association Research Committee.

Previous member of several Department of Health Committees and National Orthopaedic Committees.

More than 160 peer reviewed publications.
The Hip Society welcomes
The 2014 Hip Society Rothman-Ranawat Traveling Fellows:

Stanislav Y. Bondarenko, MD, PhD
(Kharkiv, Ukraine)

Ran Schwarzkopf, MD, MSc
(Orange, California)

Nikhil A. Shah, FRCS, MCh, MS, DNB
(Wigan, Lancashire, UK)

Eleftherios Tsiridis, MD, MSc, PhD, FRCS
(Thessaloniki, Greece)

The deadline to submit applications for the 2015 Hip Society Rothman-Ranawat Traveling Fellowship is **August 15, 2014**. For more information, visit [www.hipsoc.org](http://www.hipsoc.org).
THE 2014 HIP SOCIETY AWARDS

THE 2014 JOHN CHARNLEY AWARD

Long Term Wear of Highly Cross-Linked Polyethylene in Total Hip Arthroplasty

Presenter: Geraint E. R. Thomas MA, MBBS, MRCS
Co-Authors: Siôn Glyn-Jones MA, MBBS, FRCS, DPhil; Patrick Garfjeld-Roberts MA, BM BCh, MRCS
Roger Gundle MA, FRCS, DPhil; Adrian Taylor MBBS, FRCS; Peter McLardy-Smith MA, FRCS; David W. Murray MA, MBBS, MD, FRCS

THE 2014 OTTO AUFRANC AWARD

Modifiable vs. Non-Modifiable Risk Factors for Infection after Hip Arthroplasty

Presenter: Richard Iorio, MD
Co-Authors: Guy Maoz, MD; Michael Phillips, MD; Joseph Bosco, MD; James Slover, MD, MS;
Anna Stachel, MPH; Ifeoma Inneh, MPH

THE 2014 FRANK STINCHFIELD AWARD

Redefining the “Safe Zone” for Optimal Wear and Stability in Total Hips. It’s Smaller than we Thought: A Computational Analysis

Presenter: Jacob M. Elkins, MD, PhD
Co-Authors: John J. Callaghan, MD; Thomas D. Brown, PhD

SUPPORT THE HIP SOCIETY THROUGH OREF!

Under OREF’s new sharing plan, donors contributing less than $1,000 to the OREF annual campaign may now choose to designate 50% of their gifts to The Hip Society, with 50% directed to OREF. OREF has made this important enhancement to the 2011 OREF annual giving program in an effort to respond to frequent requests for a lower sharing level for donors and to increase the funds raised for The Hip Society, and for all the organizations that participate in the OREF designated giving program. This change invites broader participation by donors to The Hip Society at all gift levels. As in past years, donors contributing $1,000 or more (Order of Merit) will also have the opportunity to designate a portion of their gifts to The Hip Society, with a minimum of $500 directed to OREF. The Hip Society members can make secure online gifts to OREF and The Hip Society at www.oref.org/ks.
TECHNIQUE COURSES

AAOS/AAHKS/POSNA Open and Arthroscopic Techniques for Adolescent and Young Adult Hip Preservation/Disorders

July 24 (Evening) – 25, 2014  •  Rosemont, IL
Young-Jo Kim, MD, PhD, and Christopher M. Larson, MD
Course Directors

FAI/dysplasia thought-leaders. Concentrated hands-on training. One essential course!

Course highlights include:
• Spend one full day in the hands-on lab learning advanced open and arthroscopic treatment methods
• Learn from and interact with primary investigators in controversial topics
• Experienced faculty provide individualized instruction

Details & Registration www.aaos.org/3644

AAOS
American Academy of Orthopaedic Surgeons

AAOS/AAHKS Advanced Surgical Techniques for Management of Knee Arthritis

October 10 – 11, 2014  •  Rosemont, IL
Keith R. Berend, MD, and Michael Bolognesi, MD
Course Directors

This highly-interactive course presents proven surgical techniques to treat knee arthritis and prevent and manage complications associated with primary and revision TKA.

Course highlights include:
• Spend the majority of your time in the cadaver lab working side-by-side with expert faculty
• Challenge the faculty and review problematic cases during lively panel discussions

Details & Registration www.aaos.org/3055

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Direct Anterior Approach: Safe and Effective  
Joel M. Matta, MD

The Anterior Approach (AA) for THA has grown steadily and rapidly over the past 10 years. In 2003 less than 1% of US surgeons utilized AA for THA while a survey at the AAHKS 2012 meeting indicated 19% of surgeon attendees utilizing AA. The past 2 years have demonstrated strong surgeon interest in this technique with over 800 surgeons per year receiving training at AAOS, ICJR or industry sponsored venues on primary and revision AA.

AA follows the Hueter approach also known as the “short Smith-Petersen”. Originally described and performed for hip replacement, by Robert Judet in Paris in 1947, Judet operated supine aided by a special orthopedic table. To date over 20,000 AA THA’s have been performed in Judet’s department. In US, K. Keggi, Waterbury, CT has performed a modified tensor fascia splitting AA supine on a standard operating table beginning in about 1975. I began AA in 1996 supine, utilizing Judet’s orthopedic table which was then out of production. Beginning in 2003, however a new and useful for AA orthopedic table became available which I adopted and which also facilitated a US course for surgeons that year.

I began AA to avoid the potential problems of existing approaches: dislocation with posterior and abductor weakness with antero-lateral by preserving the abductor and short rotator tendons as well as posterior capsule.

The primary purpose of the orthopedic table is to enhance access to the femur with a secondary benefit of improved acetabular exposure. Also, the orthopedic table can enhance accuracy and stability of pelvis and hip position during intra operative image intensification. Today, most AA surgeries are performed with an orthopedic table or leg positioning device though many are also performed on a standard OR table. Supine position and a radiolucent table, used by most AA surgeons affords the advantage of rapid and accurate information from image intensification regarding cup position, leg length and offset though AA can be performed without intraoperative image intensification as easily as other approaches for THA.

A growing number of references support safety and efficacy of AA when performed by experienced surgeons though a surgeon may experience increased complication rates during the learning phase (up to 100 cases). Documented benefits for experienced surgeons include: low dislocation rate, improved rate of accurate cup position, earlier functional recovery, decreased length of hospital stay, low rates of fracture, infection and nerve palsy. All references however do not agree entirely with these findings.

The beneficial evolution in surgical techniques is driven by several factors including clinic studies, individual surgeon preferences, patient preferences and cost benefits.

Whether or not AA is an improved method for THA over the already proven methods of antero-lateral and posterior approach, remains controversial. The past 10 years of AA growth however have shown AA at a minimum, to be among the good choices for surgeons and patients. A surgeon should take advantage of available education and training prior to starting AA.
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INTRODUCTION: There is significant patient interest in the Direct Anterior Approach (DAA) to primary Total Hip Arthroplasty (THA) and surgeons are weighing the benefits and risks of introduction within their practice. An experienced hip surgeon will evaluate its benefit in reference to an already successful hip practice, and the risks and benefits for his patients and practice may vary from newer surgeons who wish to grow their practice. The purpose of this study was to evaluate a senior surgeon’s experience introducing the DAA into his practice, to document the risks and benefits, and to suggest guidance to those of similar experience who choose to learn and offer this approach to their patients.

METHODS: A retrospective study was performed in two parts: 1) comparing patient experience and outcome of those with initial introduction of the DAA to a matched population with THA through the surgeon’s standard posterolateral approach; and 2) assess the outcome of those later patients as the surgeon became increasingly familiar and comfortable with the DAA approach. Demographics, operative information and pre- and post-operative Harris Hip Score (HHS) evaluations were collected. In addition, complications were assessed. Radiographic data was collected for Part 1 only.

RESULTS: Part 1: Forty-two patients were considered for the initial study group to assess progress in addressing the learning curve. These were compared to 42 patients appropriately matched with prior THA through the posterolateral approach.

Procedure time was significantly different between groups (p<0.0001), where procedure time averaged 23 minutes longer for the DAA. Mean blood loss between groups was also significantly different (p=0.0018); where the DAA averaged 244cc more blood loss. Mean abduction angle for the DAA was 42 degrees vs. 50 degrees for the posterolateral approach (p<0.0001). Mean version for the DAA was 21 degrees vs. 18 for the posterolateral approach (p=0.0233). There were minor differences between the groups when comparing HHS.

The choice of stem influenced the type of complications (p=0.0442) in the DAA group only, but the number of overall complications did not differ significantly between groups (p=0.1737). The complication that occurred most often in the DAA was late periprosthetic fracture. The complications that occurred most often in the posterolateral group were delayed wound healing and dislocation.

Part 2: Ninety-six patients were included in Part 2, including specific populations for whom the surgeon found this operation particularly beneficial in his practice. In this population there were 2 dislocations (1 traumatic, 1 hypermobile patient) both requiring revision. There were 2 patients with transient femoral paresis requiring gait modification until resolution, and 1 patient with a late femoral nerve palsy related to anticoagulation for a non-orthopaedic condition – which has not yet resolved. Three femoral components of a newly introduced design have subsided – 2 requiring further surgical intervention; one patient continues to be monitored for possible deep periprosthetic infection. All other patients have recovered without complication, have reached full ambulatory capacity by 4 weeks, and have regained ROM without difficulty. The second group of DAA patients has significantly improved pain profiles versus DAA group 1 and the control group at the early time intervals studied.

The results indicate that the learning curve for an experienced surgeon who is beginning to use the direct anterior approach is a minimum of 20-30 THAs. Problems persist, and relate to technical features of implantation and device selection.
The DAA has offered several specific benefits to the senior surgeon’s practice. It has become his approach of choice for women and obese/morbidly obese patients, as it allows safety of recovery and appropriate sizing of implant choices. It has been an option offered to male patients with limited deformity at the hip. It has not replaced the use of the posterolateral approach for complex hip deformities or revision hip Arthroplasty.

To minimize the risk of introduction of this procedure, the surgeon and his team need to plan and commit to the learning approach, structure the introduction using familiar and predictable implants, and adjust the indications through careful patient selection. Thorough discussions with patients are important for a successful introduction into a senior surgeon’s practice.
Anterolateral Approach in Primary Total Hip Arthroplasty
Adolph V. Lombardi, Jr, MD, FACS

Numerous variations of the direct lateral or anterolateral abductor splitting approach have been described, with the essence of all being a partial release of the confluence of the vastus lateralis and gluteus medius and minimus from the anterolateral attachment to the femur. For more than a decade we have utilized a less invasive modification to the direct lateral approach. Essentials are avoidance of dissection into the vastus lateralis insertion, a limit of 1-2 cm proximal dissection into the gluteus medius, and an effort to spare the majority of the gluteus minimus insertion. Virtues of the direct lateral approach are excellent visualization of the acetabulum and proximal femur for appropriate component alignment and orientation. While touted as safer with respect to minimizing dislocation, the direct lateral approach has been reported to require a slightly prolonged rehabilitation to eliminate postoperative limp. To evaluate the efficacy of the less invasive direct lateral approach (LIDL) in primary THA, we reviewed our experience with a single, short tapered titanium femoral component, and compared outcomes with THA performed with an LIDL approach and a direct anterior supine intermuscular (ASI) approach.

A query of our practice arthroplasty registry revealed 239 patients (280 hips) who underwent primary cementless THA with short, tapered femoral component between January 2006 and February 2008. There were 106 men (45%) and 131 women (55%). Mean age was 62.7 years (range, 27-89) and BMI was 29.4 kg/m² (range, 19-60). The ASI was utilized in 143 THA, and the LIDL approach was used in 137 THA. Disease profiles, gender, age, BMI, and preoperative clinical scores were similar between the 2 approach groups.

Mean follow-up was 4.6 years. Harris hip scores (HHS) improved by a mean of 33.8 points, from a preoperative mean of 50.1 to a mean of 84.1 at most recent follow-up. There were no differences between approach groups in mean postoperative HHS or improvement in HHS. Six femoral components (2.1%) have been revised, 2 LIDL (both due to infection) and 4 ASI (1 infection, 2 due to periprosthetic femoral fracture, and 1 well fixed revised in the case of a loose cup secondary to inability to dissociate the prosthetic femoral head from the trunnion) (p=NS). Operative times were longer for the ASI approach, a mean of 72.4 minutes compared with 65.5 minutes with the LIDL (p=0.0002), likely a reflection of the surgeons’ more established experience with the LIDL at the time of this series. While estimated blood loss and need for transfusion were not significantly different between groups, mean hemoglobin level at discharge was lower in ASI patients (10.2 g/dl) than LIDL patients (10.9 g/dl; p=0.0000). Mean length of stay was similar between approach groups, at 1.9 days for the ASI group and 2.0 days for the LIDL.

In this series, good results with a low rate of stem revision were achieved with a short, tapered titanium femoral component with proximal, porous plasma-sprayed coating, using either a less invasive direct lateral or direct anterior approach. Patients treated with the LIDL approach had equivalent clinical and functional results compared with patients treated with the ASI approach.

REFERENCES

Mini-Posterior Surgical Approach for THA
Mark W. Pagnano, MD

I. Mini-posterior technique advantages
   A. Familiar anatomy
   B. Widely applicable
   C. Predictable (and thus preventable) sources of errors
   D. Demonstrated functional advantages over the 2-Incision THA in recent prospective randomized trials and in direct comparison studies

II. Familiar anatomy
   A. A substantial number of surgeons routinely use the posterior approach
   B. With careful attention to skin incision placement and leg positioning intraoperatively it is relatively easy for most surgeons to shorten the skin incision
   C. With the addition of specialized retractors, offset reamers and offset cup and stem inserters many THA can be done with a skin incision of 10 cm or less
   D. Easily converted to standard posterior approach if intraoperative concerns arise
   E. Formal posterior capsular repair substantially lowers historical risk of dislocation

III. Widely applicable
   A. With relatively little variation this approach can be used for a broad range of THA patients
   B. Several variations of the mini-posterior technique exist (Sculco, Dorr, Swanson, Goldstein)
   C. Dorr technique has been used in my practice and we have studied it extensively in direct comparison studies against the 2-Incision and direct anterior techniques

REFERENCES

Short Stems Do Work
Roger H. Emerson, MD

Introduction: Surgeons can choose from various stem lengths. Longer stems have been reserved for revision situations. Various short stems are available for primary total hip replacement. The best length for a press-fit stem designed for biologic fixation has not been determined. Shorter stems are available which are less invasive of the femur and are easier to remove if need be. The shorter length allows for ease of placement in tissue sparing surgical approaches. The authors have used a particular shorter stem on a selective basis which only differs from a current design in long-term use by the length of the tip. The extent of the porous is the same. Clinical outcome and survivorship of this new shorter design has not been established.

Methods: Between October 2005 and July 2008 139 sequential shorter stems were placed in selective patients, all through the direct anterior approach. The stem was a wedge-fit blade design with proximal plasma spray porous coating. Choice of the shorter stem was based on the quality of the femoral bone, the capability of restoring offset and leg length, and the fit and fill of the stem in the canal at surgery, using fluoroscopic guidance. The patients were followed as part of an office-based joint registry. Prospective data was collected on diagnosis, gender, age, BMI, complications and Harris clinical scores. A mailing was done to update clinical records for survivorship. Radiographic data was collected.

Results: Stem length was an average 105 mm, (95-120mm). The shorter stem was used in all bone types, but primarily Dorr type A and B bone. The average age was 66 years (24 to 88 yrs), BMI 28.4 (18 to 43), with 49 males and 90 females. Follow-up was an average 5.5 yrs, (3.5 to 7.5yrs), with a minimum follow up of 5 yrs in 121 patients. The average Harris clinical score at 5 years was 97.3, and the pain score was 42 at final follow-up. Thigh pain was noted in 5% of patients out to 6 months. No stems in this series were revised. Two cup were revised for loosening. Survivorship at 7.5 years was 98.5% for revision for any reason. There were no stems with fibrous fixation. There were no serious complications that required a second operation.

Discussion and Conclusions: The shorter stems in this series is 30 mm shorter than the longer version of the stem. The shorter stem was used to facilitate the placement of the stem component through the direct anterior approach, thereby reducing the need for soft tissue releasing and retraction. Fluoroscopic guidance was used in all cases and made decision making about stem placement consistent and reproducible. This undoubtedly contributed to the success of this shorter stem. Historical controls of the same stem in the longer version are published with follow-up to 22 years. Based on this study the authors are using this shorter stem design on all patients where the fit and fill at surgery is deemed complete. At a minimum 5 years, fixation has been secure and clinical outcomes have been indistinguishable from longer stems. Different short stem designs may not have similar outcomes.
20 Years of Experience: Tapered Stems

John B. Meding, MD; Merrill A Ritter, MD; E. Michael Keating, MD; Philip M. Faris, MD
and Michael E. Berend, MD

Uncemented stems have been used in THA for well over two decades. Yet, there are relatively few twenty-year follow-up studies reporting on uncemented stems that are still in use today.1-7 Belmont et al.1 reported a 20-year survivorship of 98% in 223 AML stems. Corten et al.2 reported a 20-year survivorship of 99% in 126 Mallory-Head stems. Lombardi et al.3 also reported a 20-year survivorship of 99% in 1866 Mallory-Head stems. McLaughlin and Lee4 published a 22-year survivorship of 99% in 145 Taperloc stems and a 26-year survivorship of 99% from the same cohort.5 Streit et al.6 reported 22-year survivorship of 86% in 354 CLS stems. Vidalain et al.7 published a 23-year survivorship of 97% in 114 Corail stems.

From a consecutive series of 157 THAs performed between 1987 and 1993 using the Bi-Metric stem,8 the clinical and radiographic results of a 111 THAs in ninety-seven patients were reviewed with a minimum follow-up of twenty years. The primary diagnosis was OA in seventy-seven hips (69%). The average age at operation was fifty-five years. The average Harris hip score improved from 46 points to an average of 87 points at the most recent follow-up. The average post-operative pain score was 38 points. No patient reported any activity related thigh pain at final follow-up. All hips had evidence of proximal femoral remodeling consistent with osseous ingrowth. One stem was revised due to a periprosthetic fracture. No femoral component had evidence of loosening. According to the criteria of Engh et al.9 fixation of the stem by bone ingrowth occurred in all hips. Kaplan-Meier survival analysis for aseptic loosening demonstrated a 100% survival rate at twenty years according to both the standard-case and best-case scenario.

This femoral component provided durable long-term fixation and excellent survivorship continuing into the third decade after implantation. If one includes the present report, it appears that of the uncemented stems available for implantation today, only six are supported with 20-year survivorship data. The long-term results of this study and others2-7 support the continued use of uncemented tapered titanium stems in primary THA.

REFERENCES


Extensively Coated Stems
Charles A. Engh, MD and C. Anderson Engh, Jr., MD

The first extensively coated femoral component approved for use without cement was released in 1983. Today, there are many implants with a similar amount of porous coating. The hallmark of these porous-coated implants are a cylindrical shape distally and a triangular metaphyseal shape. Extensively coated components gain initial stability in the femoral diaphysis.

Since 1982, we have used extensively porous-coated femoral components. Our oldest series of patients is a consecutive non-selected group of 211 hips that have been followed for a mean of 20 years. Combining the loose and the revised, there is only a 3% femoral failure. Currently we are following 6,714 hips with a mean follow-up of 7 years (0-29yrs.) The mean age of these patients is 62 years old (15-97yrs.) 1% of hips have been revised, 39 for failure of ingrowth, 10 for infection, 7 stem fractures, and 3 at the time of a periprosthetic fracture. We have studied patients with disease processes not originally thought to work well with noncemented techniques, including rheumatoid arthritis, avascular necrosis and patients over 65.

Despite the good results, the main concern is that proximal bone loss secondary to the stress shielding caused by a stiff extensively porous-coated femoral component will lead to difficulty at the time of revision. At a mean 14 years, we have not seen any adverse clinical consequences that can be attributed to proximal stress shielding, though the longer term consequences of adaptive femoral remodeling need to be followed. In our patients, extensive proximal bone loss secondary to stress shielding is a radiographic sign of bone ingrowth that occurs in 25% of cases. In the remaining 70-75% of cases, lesser degrees of proximal bone loss occur which confirm bone ingrowth.

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35 Years of Experience with Cemented Stems
John J. Callaghan, MD

Our evaluation of the Charnley total hip arthroplasty over 35 years has enabled us to demonstrate the remarkable outcome of cemented total hip arthroplasty, especially on the femoral side, as well as to provide the rationale for the way the devices and techniques we use to perform these procedures today.

We have had the opportunity to study a single surgeon practice over a 26-year period. The surgeon, Richard Johnston, used polished flatback Charnley femoral components from 1970 to 1980, Iowa 30 microinch Ra Iowa femoral components from 1980 to 1986, Iowa 80 microinch Ra Iowa femoral components from 1986 to 1991 and polished Iowa and modified Iowa femoral components from 1991 to 1996. Acetabular components were all polyethylene 22 millimeter from 1970 to 1980, metal backed cemented 28 millimeter from 1980 to 1986 and cementless metal backed modular from 1986 to 1996.

The Iowa Experience:

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Patients Under Age 50:

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The Exeter Experience:

These durable long term results of cemented femoral fixation have been corroborated by those using the Exeter polished tapered stem.

- 325 hips, 15-17 year follow-up
- 100% survivorship for endpoint of aseptic loosening of the femoral component

- 130 hips, 10-17 year follow-up
- 100% survivorship for endpoint of aseptic loosening of the femoral component

- 142 hips, 10-17 year follow-up
- 2.2% of stems revised for loosening or osteolysis

Ling et al (J Arthroplasty 2009)
- 3.2% revision rate for aseptic femoral loosening at 33 year f/u

Matte Finish Collared Stems:

Callaghan et al (JBJS 2008)
- 304 hips at 19-20 yr follow-up
- 2.6% revised for aseptic femoral loosening

Skutek et al (JBJS 2007)
- Harris Design 2
- 195 hips, 25 year follow-up
- 2% revised
DISCUSSION: If polished femoral stems that are user friendly to cement mantles (ie Exeter and Charnley type) and contemporary cementing techniques (cement plug, pressurization gun, and adequate canal preparation) are utilized, excellent long term fixation in both older and younger patients can be obtained with cementing the femoral component in the total hip arthroplasty construct.
The degree to which cementless fixation has eclipsed cemented acetabular fixation in the U.S. is evidenced by the fact that this symposium features reviews of multiple femoral component fixation techniques, while evaluating only cementless acetabular fixation. Cementless acetabular implants are currently used in the majority of total hips in the US because: 1) reviews comparing cementless and cemented acetabular component survival are equivocal, 2) high quality cemented fixation is technically demanding, and 3) cementless re-operations are most frequently related to bearing surface wear, and not component fixation. Improvements in wear characteristics of the bearing surface promise even greater implant longevity.

In a review of a consecutive series of 204 primary arthroplasties with a first generation porous coated acetabular metal shell at 20 to 25 years follow up, loosening of the shell was limited to 3%, liner exchange required or recommended for wear in 19% while 92% retained the origin shell. Mean age for the entire cohort at index surgery was 52, with 42 as the mean age of patients requiring re-operation for wear or lysis. No patient older than 60 required or had been recommended to have a liner change. Fixation quality of this implant has also been evaluated by post-mortem retrievals in 17 cases at 4-25 years (avg 11). All were fixed by bone ingrowth with the mean extent of ingrowth 33% (± 21%), and the mean volume fraction of ingrowth 13% (± 9%). Polyethylene granulomas were noted consistently; their extent and size correlated with time in-vivo.

The use of screws has not demonstrated a benefit in comparison to simple press fit fixation and mono-block components have not proven superior to modular. A study of 9584 hips including over 20 different cementless acetabular components demonstrated a higher risk of revision for beaded and HA-coated than titanium wire mesh implants. Early and late failure rates as well as implant longevity and bearing surface wear rates have been shown to be influenced by geometry, ingrowth substrate features, coatings, degree of press fit, adjuvant fixation technologies, as well as modular locking mechanisms and surface interfaces.

REFERENCES


Achieving Bone Ingrowth and Cup Stability  
**J. Dennis Bobyn, PhD**

Noncemented acetabular implants have generally provided good results in terms of immediate and long term fixation. The study of various implant designs over three decades has provided valuable design information and guidelines for clinical use.

**Bone Ingrowth.** Sufficient initial stability is essential for maximizing the potential for bone ingrowth – this requires implant-bone micromotion to be ≤30-40 microns. Initial stability is enhanced with an interference fit of 1-2 mm, beyond which the risk of acetabular fracture increases. Spikes, fins and screws increase initial fixation but aren’t necessary for achieving bone ingrowth. Excessive interface motion results primarily in fibrous tissue ingrowth, with increased risk of implant migration and aseptic loosening.

**The Interface.** The size and shape of the acetabulum makes it difficult to visualize the bone-implant interface using plain radiography. It is therefore often difficult to ascertain where and whether the implant is ingrown with bone or fibrous tissue. Bone ingrowth usually occupies only about 20% of the cup surface area in cases of rigid fixation and tends to be greater around regions of screw fixation. Screw holes are sites for wear debris access and fretting debris generation. CT scanning provides much clearer definition of the bone-implant interface.

**What Doesn’t Work.** Threaded cups generally haven’t shown the same longevity of fixation as have porous coated cups, with or without hydroxyapatite coating. Cups without true porous coatings, i.e., cups with textured or roughened surfaces, have shown higher rates of aseptic loosening.

**What Works.** Acetabular implants with three-dimensional porous coatings such as sintered beads and fiber metal have shown excellent fixation in the long term, absent of wear debris-induced osteolysis. Next generation structures with greater friction and volume porosity (e.g. porous tantalum, direct metal laser sintered porous titanium) have increased potential for rapid bone ingrowth fixation and resistance to migration. Monoblock implants have shown good fixation potential but are more sensitive to insertion technique.

**Future Considerations.** Improving and maintaining peri-implant bone density in the long term will promote enduring cup fixation. Modulating the local biology to improve the rate and extent of bone formation, as can be achieved by direct bisphosphonate delivery from the implant, is a promising approach in this regard. Load sharing designs such as monoblock cups can help preserve the bony foundation over time.

**REFERENCES**

Patient outcome following total hip arthroplasty (THA) is generally excellent with survivorship reported over 90% at twenty years. However, complications associated with THA, including anesthetic complications, medical complications, surgical complications, and rehabilitation complications can adversely affect patient outcome. Furthermore, complications following THA can be associated with hospital re-admission and increased cost for THA.

Reporting of complications is not standardized. In order to develop a standardized list of THA complications, The Hip Society THA Complications workgroup surveyed the orthopaedic literature and proposed a list of THA complications, with standardized definitions. An expert opinion survey was used to test the applicability and reasonableness of the proposed THA complications with members of The Hip Society. A complication stratification system was developed from a validated grading scheme for complications of hip preservation surgery.

One hundred five clinical members (100%) of The Hip Society responded to the THA Complications Survey. All the proposed complications and definitions were endorsed by the members (P<0.0001). Members also provided 568 comments and suggestions for improvement which were incorporated into the final product of the workgroup. Twenty THA complications and adverse events and their definitions were endorsed by The Hip Society.

1. Bleeding
2. Wound Complication
3. Thromboembolic Disease
4. Neural Deficit
5. Vascular Injury
6. Dislocation/Instability
7. Periprosthetic Fracture
8. Abductor Muscle Disruption
9. Leg Length Discrepancy
10. Deep Periprosthetic Joint Infection
11. Heterotopic Ossification
12. Bearing Surface Wear
13. Osteolysis
14. Implant Loosenings
15. Cup Liner Dissociation
16. Implant Fracture
17. Re-Operation
18. Revision
19. Re-Admission
20. Death

Complications can occur after surgical operations for many diverse reasons including an evolving disease process, a surgical error, a medical error, a nursing error, patient noncompliance with care, and events without error beyond physician and patient control such as falls or trauma. Adverse events after an operation or procedure are conditions which may compromise the process of care or the outcome of care, but not all adverse events are complications. Complications and adverse events can be expected with surgical procedures at a small but finite incidence, despite the exercise of reasonable and safe care. Orthopaedic Surgery has a long tradition of learning from complications and adverse events, in order to prevent the unfavorable occurrences. If THA complications can be prevented or minimized, it is likely that patient outcomes from THA can be improved, hospital re-admissions can be reduced and the cost of THA can be decreased.
What are the Data on Hospital Readmission after THA in the US?
Vincent D. Pellegrini Jr., MD

Perioperative cardiac events, stroke, and venous thromboembolism constitute the predominant major non-orthopaedic complications for the patient after total hip replacement. Cardiac events are the most common, but VTED the most feared, threat to the life of the patient. As hospital length of stay after total hip replacement has decreased over the past three decades, there is conflicting evidence about its impact on readmission rates. One recent Medicare claims data analysis from 2002-2007 noted an overall 30-day readmission rate of 6.8% after THA with a mean length of stay of 4.2 days; the 30-day readmission rate was 7.1% from 2002-2004 and decreased to 6.3% during 2005-2007 in that report. In comparison, a 1995-1996 Medicare database review reported an all-cause 90-day readmission rate of only 4.6% after elective THA. Conversely, a Danish registry analysis of THA from 2004-2008 noted a declining length of stay from 6.3 to 3.9 days with a concurrent decrease in 90-day readmission rate from 14.5% to 10.9%.

Perioperative cardiac events constitute approximately 50% of all causes for readmission after THA and are significantly reduced in patients with known, or those at risk for, coronary artery disease with the use of atenolol as a beta-blocker to protect the heart. Overall mortality is reduced nearly 5-fold over the first year after operation in atenolol-treated patients with the principal effect attributed to a reduction in cardiac death during the first six to eight months postoperatively. The ideal VTE prophylaxis is yet to be determined; it must represent a balance between the risk of death from PE and major hemorrhage, the morbidity of bleeding associated with anticoagulation, and the preferences and risk tolerances of individual patients. Two recent studies looked at aspirin as a preventive measure to lower the risk of recurrent VTE after a conventionally treated episode. Taken together, aspirin was associated with a 32% reduction in the recurrence of VTE (hazard ratio 0.68, p=0.007) and a 34% reduction in major adverse vascular events (hazard ratio 0.66; p=0.002), and it is important to note that this benefit accrued without an accompanying increase in the risk of adverse bleeding. Given this combination of efficacy in preventing VTE in the absence of a compromise in safety, as measured by untoward bleeding, the findings of these two studies might legitimately be expected to stimulate a re-evaluation of aspirin for VTE prophylaxis in the perioperative setting, perhaps in conjunction with contemporary methods of mechanical compression.

SELECTED REFERENCES


Preventing Readmission: Management of the Surgical Wound

Kevin L. Garvin, MD

In 2005, it was estimated that nearly 20 percent of Medicare patients were readmitted to the hospital within 30 days of their hospitalization. This so-called “revolving door” has been a major concern for healthcare workers and government officials. The focus has been to provide high-quality and affordable care to patients. In 2012, the Centers for Medicare and Medicaid Services (CMS) first targeted acute myocardial infarction, congestive heart failure and pneumonia as diagnoses with high readmission rates hoping to lower the number of readmissions by withholding Medicare reimbursements to hospitals with excess rates of readmission.

Recently, total hip and total knee replacements have also been targeted because of the large number of surgeries performed annually and the expense associated with the surgeries. Further, of the top five surgical readmissions, two are orthopaedic surgeries (major hip or knee surgery and other hip or femur fracture). CMS has begun collecting readmission data following hip or knee replacement. It must be assumed that this data will be used to penalize hospitals with “high” readmission rates. CMS assumes that the financial penalty will have the effect of lowering the number of patients who are readmitted after hospitalization for total hip or total knee arthroplasty and that a large or a significant number of the hospitalizations or readmission are preventable. Unfortunately, it has been demonstrated that reducing readmissions is challenging! A multimillion dollar CMS study (community-wide project) found that only modest improvement in 30-day readmissions was noted in 14 communities compared with the readmission rates of 50 comparison communities. Also, there were no significant differences in the rates of the more widely used measure of all-cause 30-day hospital readmissions in proportion to their hospital discharges.

Dailey et al provided further information that may negatively affect patient care. The authors retrospectively studied 3,264 orthopaedic surgical admissions. The information on the patients who were readmitted within 30 days was subjected to univariant and multivariant analysis to determine the odds ratio for readmission. The authors found that a longer length of hospital stay or an admission to the intensive care unit (ICU) significantly increased the likelihood of a 30-readmission regardless of the patient’s demographics or discharge disposition. Patients in this study who were initially admitted to the ICU had a serious health problem. The authors stated that the ICU stay and long hospitalization indicate that the prehospital and perihospital health of the patient influences hospital readmission. The authors also reported that their finding of race association with readmission in orthopaedic patients could overlap with socioeconomic disparity. The high readmission risk associated with a “sicker population” may discourage physicians from providing elective orthopaedic care for this population. It is preferred that a risk adjustment be used for this “sicker population” who have a high risk of hospital readmission. The authors suggest similar stratifications for those patients with risk-associated socioeconomic concerns. Until a more even-handed approach can be applied it is likely that CMS will enforce financial penalties to hospitals with higher unplanned readmissions for total hip and total knee arthroplasty and for femoral fractures. It is therefore essential that we analyze the risk factors and make changes where and when they are possible to lower these readmission rates.

Infection, hematoma and other wound related problems are the most common reasons for hospital readmission after total joint arthroplasty. Modifiable associated risk factors include: anticoagulation, transfusion (perhaps lessened when spinal hypotensive anesthesia and/or tranexamic acid are used), surgical colonization (improve the bacteria-specific antibiotic selection and decolonization), obesity (managed with a weight loss program yielding a BMI <40), smoking, diabetes and depression. Surgical factors including the length of surgery and the complexity of the surgery are also important.
In summary, hospitals with high readmission rates for total hip arthroplasty and total knee patients will be targeted and penalized by CMS. Several modifiable risk factors have been presented and future studies will help to determine if readmission rates can be decreased by improving or lessening the associated risk factors.
The prevention of venous thromboembolism in 2014 involves a careful balancing of both the risks of symptomatic thromboembolism (deep vein thrombosis and pulmonary embolism) and the risks of local wound bleeding-drainage and other major bleeding. There is now relative concordance among the 3 guidelines: ACCP, AAOS, and SCIP, with greater emphasis on individualizing prophylaxis based on patient risk factors (prior history of venous thromboembolism) and the surgical risk of important local wound bleeding. Aspirin alone or in combination with a mechanical sequential venous compression device are now considered acceptable choices for patients without a prior history of venous thrombosis or those with a higher risk of local bleeding complications (extensive dissection, excessive intraoperative bleeding, and revision arthroplasties). For those patients with a higher risk (prior history of thromboembolism or thrombophilias), many of us are delaying the use of potent anticoagulants until the morning after surgery or using an agent (warfarin) with both less potency and less risk of bleeding. There are several newer oral agents (dabigitran, rivaroxiban, and apixiban) which seem to be more convenient, but may have a higher risk of bleeding than low molecular weight heparins without greater efficacy. A recent study of a relatively new mobile mechanical compression device (with or without aspirin) in 1509 patients who had a primary THA reported very low rates of venous thromboembolism (0.53%) and pulmonary embolism (0.20%), without a risk of serious local bleeding, and which were comparable to other studies with potent anticoagulants. Further studies of this device, outside of a “registry” and in the patients of community hip surgeons, and compared to aspirin alone are certainly warranted. Ultrasound screening for venous thromboembolism is not recommended.

If the complication of local or systemic bleeding occurs postoperatively, the use of potent anticoagulants should be discontinued to prevent readmission for hematoma surgical evacuation. The suspected diagnosis of symptomatic proximal or distal venous thrombosis postoperatively should be confirmed by Duplex ultrasonography as an outpatient, and, depending on the circumstances, may be treated as an outpatient with subcutaneous therapeutic-dose low molecular weight heparin and close observation. Symptomatic pulmonary embolism obviously requires readmission for anticoagulation, cardiopulmonary support and wound observation.

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Preventing Readmission: The Role of Your Internist  
Richard Iorio, MD

While THA generally has favorable clinical outcomes in patients with advanced hip OA, there remains a risk of unfavorable outcomes. This includes operative and post-operative complications potentially leading to readmissions or revision surgery.

Often these suboptimal outcomes are tied to comorbidities or complications associated with their THA. Modifiable risk factors for poor clinical outcomes following THA include: 1. morbid obesity, 2. poorly controlled diabetes and nutrition, 3. Staphylococcus aureus (S. aureus) colonization, 4. cardiovascular disease, 5. venous thromboembolic disease (VTED), 6. tobacco use, 7. neurocognitive, psychological and behavioral problems (including drug or alcohol, dependency) and 8. physical deconditioning and fall risk. Together, these eight modifiable risk factors significantly account for avoidable complications and poor clinical outcomes following THA. Identifying and modifying these risk factors prior to surgery presents an opportunity to decrease avoidable complications, improve clinical outcomes, and decrease costs associated with unnecessary health services utilization following these procedures.

Although some of these modifiable risk factors may be longstanding and recalcitrant to change, patients may express a renewed interest in addressing them if they stand in the way of obtaining THA, a procedure they hope will result in dramatic changes in pain, physical function and quality of life. The prospect of undergoing THA may therefore provide an opportunity (i.e. “teachable moment”) to identify and manage such modifiable risk factors through shared decision making.

Primary care physicians, internists and specialty physician involved in the pre-admission clearance process can all participate in decreasing these risk factors preoperatively.

- Comorbidity Prevalence in TJA patients
  - Hypertension 60.1%
  - Hyperlipidemia 55.3%
  - Diabetes 19.2%
  - Depressive Disorders 14.5%
  - Morbid Obesity 13.8%
  - Valve Disease 7.8%
  - Cerebrovascular Disease 4.4%
  - CHF 2.8%
  - Ischemic Heart Disease 13.5%
  - Dysrhythmias 10.8%
  - Musculoskeletal Comorbidities 73.8%
  - Tobacco Use 22.0%

Additionally, the patients with comorbidities that did not have a readmission may have an increased risk of a complicated initial hospitalization.

506/2772 TJA patients had a length of stay of 7 days or longer with average costs of $32,609-$84,678 per admission, substantially higher than our average of $24,000 during that time period.

The vast majority (95%) of increased length of stay or readmitted patients had at least 1 modifiable risk factor in their history. Additionally, about 50% had 2 or more modifiable risk factors.

This represents an overwhelming opportunity for cost savings, improvement in care and improvement in quality of life for our TJA patients.
Summary

- Modifiable risk factors do play a major role in outcomes post TJA. By addressing these issues and enrolling patients in a risk modification program prior to surgical intervention, we may be able to lower rates of complications associated with these procedures.

- In light of these findings, we have implemented a Peri-operative Orthopaedic Surgical Home (POSH) model that allows for risk stratification of TJA candidates and clinical treatment to mitigate modifiable risk factors in high-risk patients (morbid obesity, poorly controlled diabetes, malnutrition and hyperglycemia, smoking, S. aureus colonization, cardiovascular disease, venous thromboembolic disease, neurocognitive, psychological and behavioral problems (which include drug and alcohol dependency), and physical deconditioning of comorbidities affecting mobility and fall risk.

- At NYULMC HJD, we have incorporated a trans-departmental (anesthesia, internal medicine, pulmonary, cardiology, endocrine, nutrition, bariatrics, physical therapy and psychiatry) approach to decrease perioperative morbidity and mortality and decrease readmissions. In today’s bundled payment and quality driven environment, it is no longer economically feasible to simply accept increased risk in poorly managed patients. We have chosen to take an active role in managing modifiable risk factors and will delay surgery until these risk factors are controlled.

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Optimal Placement of the Acetabulum for Dysplasia Patients
Stephen T. Duncan, MD; Gail Pashos; Angela D. Keith, MS; Geneva Baca; Perry L. Schoenecker, MD and John C. Clohisy, MD

Introduction: Acetabular reorientation during the Bernese periacetabular osteotomy (PAO) is complex and is a key step in optimizing clinical outcomes of the procedure. Achieving hip joint stability without creating secondary femoroacetabular impingement is challenging and criteria for an optimal acetabular correction have not been determined. This study proposes radiographic target ranges for the PAO acetabular reorientation and examines the frequency in which the acetabular correction is within the predetermined target ranges.

Methods: A retrospective review of the institution’s hip preservation database for patients with acetabular hip dysplasia undergoing PAO from January 2007 to December 2011 was performed. Patients with a diagnosis other than classic hip dysplasia (Perthes or neuromuscular disease) on the affected hip were excluded. Clinical data including patient demographics and radiographic measurements were collected. Pre- and post-operative AP pelvis, false profile, and frog lateral radiographs were evaluated. We defined the acceptable ranges for acetabular reorientation to be: lateral center edge angle (LCEA, 25°-40°), anterior center edge angle (ACEA, 18°-38°), acetabular inclination (0°-10°), extrusion index (0-20%), and medial offset (0-10 mm).

Results: There were 123 females (76%) and 39 males (24%). Mean age was 27 years and the average BMI was 25 kg/m². Comparison of preoperative and follow-up radiographs demonstrated an average improvement of 18.4° (from 11.0° to 29.4°, p <0.001) in the LCEA with 78% meeting our target, an average improvement of 17.3° (from 13.8° to 31.1°, p<0.001) in the anterior center-edge angle with 83% meeting our target, and an average improvement of 14.7° (from 18.2° to 3.5°, p<0.001) in acetabular inclination angle with 83% meeting our target. The extrusion index improved an average of 18.9% (from 34.2 to 15.3%, p<0.001) with 77% meeting our target, and the hip center was translated medially an average of 4.8 mm (from 13.8 mm to 9.0 mm, p<0.001) with 61% meeting our target. When combining the LCEA, the ACEA, the acetabular inclination angle, and the extrusion index, 49% PAOs met the target ranges for all the parameters.

Conclusion and Discussion: Our proposed radiographic target ranges for individual parameters of acetabular reorientation were achieved in the majority of cases (61-83%), while obtaining desired corrections for all four parameters simultaneously was less common (49%). Refined strategies to consistently obtain optimal, multidimensional acetabular correction with the PAO may enhance the clinical efficacy of this procedure.
Predictors of Success in Peri-Acetabular Osteotomy (PAO) Surgery

Paul E. Beaulé, MD, FRCSC

Introduction: With the Bernese Peri-acetabular osteotomy (PAO) is entering its' fourth decade, there is no doubt that it remains the gold standard for corrective osteotomy in treatment of acetabular dysplasia. Having said that, it still remains a relative invasive surgical procedure with risk of major complications ranging from 6% to 37%. Consequently identifying who may most benefit from this procedure as well as what are the predictors of success is important. Having said that, one must first define what qualifies as success and/or failure for a joint preserving procedure of the hip. For the vast majority of published reports on the PAO, conversion to total hip replacement remains the end point for failure (Table 1). However it is not always clear if the patient has actually benefited from the intervention despite not having another procedure. When Garbuz et al looked at the outcome of PAO in patients aged greater than 40, they were able to categorize their results as good to excellent as WOMAC scores >65.

The purpose of this study was to examine the clinical outcome of patients suffering with hip dysplasia treated with a Periacetabular Osteotomy (PAO) at one center looking at predictors of poor outcome and overall survivorship.

Methods: Data was prospectively collected on 67 patients (72 hips) who underwent a PAO. Mean age at time of surgery was 31.65 years (range 14.46-53.65), mean BMI was 25.74 (range 17-31-40.77). 75% patients were female. Data collected at time of surgery included: Tonnis grade (median 0, range 0-2), Tonnis angle (mean 18.02 degrees, range 0-55), minimum joint space width (mean 5.56 mm, range 1-45) center-edge angle (mean: 14.6) and alpha angle (mean 52.54 degrees, range 29-82) with 53% of hips having alpha angle 50.5. Clinical outcome measures including the Western Ontario and McMaster Universities Osteoarthritis Index [WOMAC], the UCLA Activity Scale, and the 12-Item Short Form Health Survey [SF-12] were collected preoperatively and yearly at a minimum one year postoperatively.

Results: The overall WOMAC score improved from 53.9 to 74.4 (p <.01). In regards to good to excellent on WOMAC (>65), pre op 29.6% increased to 69.6% post-op (p < .01). SF-12 Physical and Mental improved from 37.2 to 44.9 (p<0.01) and from 45.29 to 48 (p=.21), respectively. UCLA activity score improved from 5.3 to 6.6 (p<.01). The mean post operative CE Angle improved significant to 29.5° (10.7 – 49) as well as the Tonnis angle to Tonnis to 9.6° (-5 to 13) (p=.001). Only 14.5% of patients had an alpha greater than 50.5 post-operatively.

Four hips had reoperations on their hips: 3 hip arthroscopies at a mean time of 3.2 years (38.9 months) and 1 had a total hip at 7.2yrs, giving a survivorship of 94.1% at 5yrs. Pre-op alpha angle was a significant predictor of WOMAC outcome, as higher alpha angle was associated with lower WOMAC score (p = .04).

In terms of complications, there was one re-operation for excision of HO at 2.15 yrs and one patient with a femoral nerve palsy that fully recovered at one year.

Conclusions: Our overall survivorship for the PAO at five years is comparable to other clinical series with overall functional scores improving significantly. A greater alpha pre-operatively was associated with a poorer outcome. Interestingly large alpha angles have been associated with more significant acetabular cartilage damage. Finally, although the majority of patients did significant improvement, residual intra-articular damage after PAO may compromise clinical outcome which poses the question of role of hip arthroscopy during the initial management.
<table>
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<th>DEMOGRAPHICS</th>
<th>FOLLOW-UP SURVIVORSHIP</th>
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<td>Garras et al Br JBJS’07 52 pts (58 hips) Mean age:37.6 42 ♂; 10 ♂</td>
<td>Mean F/U= 5.5yrs SURVIVORSHIP -None provided. -7.7% conversion rate to THR at 3yrs.</td>
<td>-None Identified.</td>
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<td>Matheny et al JBJS’09 109 pts (135 hips) Mean age: 25.7 95 ♂; 14 ♂</td>
<td>Mean F/U=9.0yrs SURVIVORSHIP -96% at 5 yrs -84% at 10yrs</td>
<td>-Age &gt; 35 yrs at time of surgery -Poor or fair pre-op congruency PROBABILITY OF FAILURE WAS: -14% if none were present -36% if one was present -95% if the 2 were present</td>
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<td>Troelsen et al JBJS’09 96 pts (116 hips) Mean age: 29.9 90 ♂; 26 ♂</td>
<td>Mean F/U=6.8yrs SURVIVORSHIP -90.5% at 5yrs -81.6% at 9.2yrs</td>
<td>-CE &lt;0°; -Post-op Sourcil width &lt;2.5cm -Presence of Os Acetabuli -Post-op Distance to ilioischial line &gt;2.0cm</td>
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<td>Steppacher et al CORR’08 58 hips Mean age: 29.4 45 ♂; 13 ♂</td>
<td>Mean F/U =20.4yrs SURVIVORSHIP -93.2% at 5yrs -87.6% at 10yrs -60.0% at 20yrs</td>
<td>-30 yrs and older -Pre-op Merle d’Aubigne &lt;14 -Tonnis grade ≥2 -Postoperative extrusion index of 20% or more</td>
</tr>
<tr>
<td>Albers et al CORR’13 165 hips into 2Groups: Mean age:28 One third ♂ I)Optimal Orientation (43 hips) II) Impingement: retroversion/aspherical head (122 hips)</td>
<td>Mean F/U=11.1yrs SURVIVORSHIP -95.2% &amp; 90.5% at 5yrs&amp;10yrs; -86.8% &amp; 78.6% at 5 yrs&amp; 10yrs;</td>
<td>-Age&gt;30 years, -Preoperative Merle d’Aubigne-Postel &lt;15, -Pre-OP positive Trendelenburg sign, -Nonspherical head, -Preoperative OA C Grade 1, -Severin &gt; Grade 3, -Excessive acetabular anteverision, -Acetabular retroversion, -LCE&gt; 22 (undercoverage), -No offset correction in a nonspherical femoral head</td>
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REFERENCES


**Introduction:** Dysplasia is a common but complex condition with a wide variation in presentation and joint architecture. It has been shown that there is a relationship between mild acetabular dysplasia and labral and acetabular cartilage lesions.

**Materials & Methods:** Surgical findings were classified by location and by severity of the chondral lesions of the femoral head, acetabulum and labrum. Between 1991 and 2013, we identified 228 hips in 185 patients with mild to moderate acetabular dysplasia who underwent arthroscopic evaluation of their hip. The articular cartilage of the posterior, superior, lateral, and anterior regions of the acetabulum and femoral head were assessed for signs of chondral damage during arthroscopy. The degree of damage was classified as absent, mild (grades I or II), or moderate to severe (grades III or IV). Sixty-five patients went on to receive total hip arthroplasty at an average of 3.1 ± 3.1 years after arthroscopy. A logistic analysis was conducted to predict conversion to THA following hip arthroscopy for patients with dysplasia using age, gender, and condition of the articular cartilage for each region of the femoral head and acetabulum at arthroscopy.

**Results:** A logistic analysis revealed increasing age (p = 0.019), mild chondral changes on the posterior femoral head (p = 0.001), and moderate to severe chondral changes on the anterior acetabulum (p = 0.007), made a significant contribution to the predictor, independent of gender and lesions on the lateral and anterior femoral head and superior, lateral and posterior acetabulum. Older patients were 1.046 times (95% CI: 1.007, 1.086) more likely to convert to THR. Patients with mild arthritic changes (grades 1 and 2) of the posterior femoral head were 9.97 times (95% CI: 2.62, 37.99) more likely to convert to THR, while patients with moderate to severe arthritic changes (grades 3 and 4) of the superior acetabulum were 6.12 times (95% CI: 1.66, 22.58) more likely to convert to THR.

**Conclusion:** Even in mild dysplasia uncovering of the anterior femoral head subjects the labrum to increased load and potential susceptibility to tearing. Patients with mild acetabular dysplasia are good candidates for hip arthroscopy if they have an isolated labral tear and mild or no articular damage. A thorough understanding of anatomy, pain generators and patient expectations are critical to positive outcomes with arthroscopic intervention. Monitoring follow up outcome data, collaboration with osteotomy colleagues, and evolving dynamic radiologic imaging will facilitate more precise treatment.

**REFERENCES**

Presidential Guest Speaker

National Joint Registry 10 Years On: What Has Been Achieved and Lessons Learned
Prof. Paul J. Gregg, MBBS, MD, FRCS (Eng), FRCS (Ed)

This paper will describe the history and set up of the National Joint Registry for England and Wales; challenges and problems related to set up; summary of current hip replacement in England and Wales and examples of data analysis which have been important in practice as it relates to quality and safety.

The National Joint Registry was established in 2003 following the report into the failure of the 3M Capital Hip prosthesis. The project is managed by the Healthcare Quality Improvement Partnership under a contract with NHS England. The work is overseen by a Steering Committee, supported by several sub-committees which include, Editorial Board, Surgeon Outlier and Implant Outlier Committees, Research Committee and Data quality Committees. Data collection and IT management is delivered under contract by Northgate Information Solutions and statistical analysis is delivered under contract by the University of Bristol. The project is funded by a levy on the sale of hip and knee prostheses.

There are currently more than 1.5 million records and 180,000 registrations per year from approximately 400 orthopaedic units.

Current practice shows only 33% of hips are cemented; 43%cementless; 20%hybrid;1% resurfacing and 2%LHMoM. Commonest surgical approach is posterior.

146 brands of femoral stems and 101 brands of acetabular cups are used with 856 different combinations and 17% "mix and match".

Kaplan Meier estimates of cumulative probability of revision for different types of hip replacement at 9 years, based on 539,372 cases, will be presented.

The workings of the Research, Surgeon and Implant Outlier Committees will be briefly described and a summary of findings to date, including the Annual Clinical Report to Trusts and the management of "potentially outlying surgeons".

Mention will be made of the Clinician Feedback and Supplier Feedback systems and the on-going Patient Reported Outcome Study.

The conclusion will include a summary of the strengths and weaknesses and pay particular attention to the difficulties encountered with hospital and surgeon and government/Department of Health influence.
Arthroplasty Registries designed to track the results of total joint procedures were started in the early 1970’s soon after the introduction of cemented THA and TKA in the United States. Initial registries were institutionally based and allowed case finding, improved follow-up, and retrospective clinical studies. Subsequent national registry efforts began with the hip in Sweden and soon spread to the knee and to other countries in Scandinavia and then subsequently the rest of the world. Not coincidentally, registries have tended to flourish in well developed countries with a government based single payor systems with direct or indirect (mandated) government financial support of these efforts in place, justified in part due to the significant financial savings that occur for the payor with even modest improvements in reoperation rates are achieved. As numbers of cases, years of follow-up and level of data detail have all increased, ever more sophisticated population based data have become available especially from the larger and longer running national registries with major impact on worldwide practice patterns, surgical technique, payment decisions, implant usage patterns and even the introduction, availability or recall of specific hip and knee devices.

Currently in the US existing device registries can be categorized into institutional, health system based, multicenter research registries, State based, and National registries. National registries have been organized and funded by single specialty organizations, collaborations of multiple specialty societies, Government mandated (as a regulatory condition of use of novel implants), and via multistake holder support.

For hip and knee arthroplasty US based registries at the institutional, health system, multicenter, State, and national level all are active and focused on specific individual goals and missions, but all share a unique current opportunity to help build a nationwide collaborative to fulfill needed national benchmarking, safety surveillance, and quality assurance efforts. With rapid changes underway in part related to current regulatory and health care reform activities, the real potential exists for use of registry participation by hospitals and providers for quality initiatives, reimbursement adjustments, and certification and/or recertification programs. Recent initiatives by the FDA to examine the potential for national registry data to serve in enhanced premarket approval and improved, more effective post market surveillance of medical devices could provide an added major impetus for collaboration by existing US arthroplasties in a comprehensive US national registry effort.
Long Term Wear Of Highly Cross-Linked Polyethylene In Total Hip Arthroplasty

Geraint E. R. Thomas MA, MBBS, MRCS; Siôn Glyn-Jones MA, MBBS, FRCS, DPhil; Patrick Garfield-Roberts MA, BM BCh, MRCS; Roger Gundle MA, FRCS, DPhil; Adrian Taylor MBBS, FRCS; Peter McLardy-Smith MA, FRCS and David W. Murray MA, MBBS, MD, FRCS

Background: The use of highly cross-linked polyethylene (HXLPE) is now commonplace for total hip arthroplasty. Hip simulator studies and short-term in vivo measurements suggest that the wear rate of some types of HXLPE is significantly less than conventional Ultra High Molecular Weight Polyethylene (UHMWPE). However, there is little long-term data to support its use.

Purpose: The aim of this study was to measure the long-term steady-state wear of HXLPE compared to UHMWPE liners in a prospective, double-blind, randomized, controlled trial using radiostereometric analysis.

Patients and Method: Fifty-four patients were randomised to receive hip replacements with either UHMWPE liners or HXLPE liners. All patients received a cemented stem and an uncemented acetabular component. Clinical outcomes were assessed and the three-dimensional penetration of the head into the socket was determined for a minimum of ten years.

Results: At ten years there was no significant linear wear of HXLPE (0.003 mm/year, 95% confidence interval, ±0.010, p = 0.55), whereas there was significant linear wear of UHMWPE (0.030 mm/year, 95% confidence interval, ±0.012, p < 0.001). There was a significant difference in wear rate between the two types of polyethylene (p<0.001). The volumetric wear for the UHMWPE group was 98 mm³ (95% confidence interval, ±46 mm³) and 14 mm³ (95% confidence interval, ±40 mm³) for the HXLPE group (p = 0.01).

Conclusions: This study demonstrates that HXLPE has no detectable steady-state in vivo wear. This should decrease the incidence of failure due to aseptic loosening and the incidence of revision procedures.

Level of Evidence: Level I Double-blind randomized trial. See the Guidelines for Authors for a complete description of levels of evidence.
The Frank Stinchfield Award

Redefining the “Safe Zone” for Optimal Wear and Stability in Total Hips.
It’s Smaller than we Thought: A Computational Analysis

Jacob M. Elkins, MD, PhD; John J. Callaghan, MD and Thomas D. Brown, PhD

Background: Positioning of total hip bearings involves significant tradeoffs, as cup orientations most favorable in terms of stability are not necessarily ideal in terms of reduction of contact stress and wear potential. Previous studies and models have not addressed these potentially competing considerations for optimal THA function.

Questions/Purposes: We therefore asked if component positioning in total hips could be optimized in terms of both excessive bearing surface wear and stability. Specifically, we sought to identify the optimal acetabular component inclination and anteversion orientation which simultaneously minimized wear while maximizing construct stability, for several permutations of femoral head diameter and femoral stem anteversion.

Methods: A validated metal-on-metal THA finite element (FE) model was used in this investigation. Five dislocation-prone motions as well as gait were considered, as were permutations of femoral anteversion (0° to 30°), femoral head diameter (32 mm to 48 mm), cup inclination (25° to 75°), and cup anteversion (0° to 50°), resulting in 4,320 distinct FE simulations. A novel metric was developed to delineate optimized cup orientation by considering both surface wear and component stability.

Results: Ideal cup position was more restrictive than the historically defined safe zone, and was substantially more sensitive to cup anteversion than to inclination. Ideal acetabular positioning varied with both femoral head diameter and femoral version. Regressions demonstrated strong correlations between optimal cup inclination vs. head diameter (Pearson’s r = -0.88), between optimal cup inclination vs. femoral anteversion (r = 0.96), between optimal cup anteversion vs. head diameter (r = 0.99) and between optimal cup anteversion and femoral anteversion (r = - 23 0.98).

Conclusions: The 24 “landing zone” of ideal cup orientation was substantially smaller than historical guidelines, and specifically did not increase with increased head size, challenging the presumption that larger heads are more forgiving in terms of optimal stability and wear. Additionally, ideal cup positioning was considerably more sensitive to cup anteversion than to inclination. Finally, the current investigation is the first to quantitatively suggest that ideal cup positioning varies with both femoral anteversion and femoral head size.

Clinical Relevance: Positioning THA bearings involves significant tradeoffs regarding stability and long-term bearing wear. The computational analysis identified optimal orientations to balance these considerations. The conclusions from this study can readily be translated to other hard bearing surfaces – including ceramics and highly cross linked polyethylene – suggesting careful consideration of the choices and compromises in positioning acetabular and femoral components in total hip arthroplasty constructs.
The Otto Aufranc Award

**Modifiable vs. Non-Modifiable Risk Factors for Infection after Hip Arthroplasty**

*Richard Iorio, MD; Guy Maoz, MD; Michael Phillips, MD; Joseph Bosco, MD; James Slover, MD, MS; Anna Stachel, MPH and Ifeoma Inneh, MPH*

**Background:** Surgical site infections (SSI) are associated with increased morbidity and cost. Patient and procedure-related factors could possibly be modified prior to surgery to decrease risk for SSI.

**Questions/purposes:** We sought to identify and quantify the magnitude of modifiable risk factors for deep SSIs after primary hip arthroplasty.

**Patients and Methods:** A consecutive series of 3,672 primary hip arthroplasty surgeries performed at a single specialty hospital over a three year period were reviewed. All deep SSIs were identified using the Centers for Disease Control and Prevention case definitions. Univariate and multivariate analyses determined the association between patient and surgical risk factors and SSIs.

**Results:** Forty seven (1.3%) deep SSIs were identified. Infection developed in 20/363 cases of non-same day procedures and 27/3,309 of same day procedures (p=0.006). Univariate analysis revealed ASA score >2 (OR 4.76), BMI ≥40 (OR 3.86), increased operating time (OR 2.45), low case load (OR 1.97), Revision (OR 5.28), Diabetes complications (OR 6.8), S. aureus colonization and hemiarthroplasty (OR 4.64) as significant risk factors for deep SSI. Tobacco use was an additive risk factor when combined with other significant risk factors (OR 7.2-12.2).

**Conclusion:** Non-same day hip arthroplasty surgeries have a significantly higher infection rate than same day surgeries. Potentially modifiable risk factors in our patient population include S. aureus colonization, diabetes complications and elevated BMI. Tobacco use was an additive increased risk factor. Modifying risk factors may decrease the incidence of SSIs. When reporting deep SSI rates, stratification into preventable vs. non-preventable 24 infections may provide a better assessment of performance on an institutional and individual surgeon level.

*Level of Evidence: Level IV, Prognostic study.*
Al this time, the only generally-available hip resurfacing components are metal-metal. The results of metal-metal hip resurfacing depend on patient demographics and the size of the resurfacing bearing. With more than 15 years follow-up, the survival of hip resurfacing in larger stature (male) patients <65 years with osteoarthritis is at least as good as total hip replacement in that demographic with functionally superior outcomes. Greater surgeon experience with the hip resurfacing procedure is associated with a reduction in complications and better implant survival.

Thus, hip resurfacing is indicated for relatively young, larger-stature (male) individuals with osteoarthritis, preferably performed by a surgeon with experience in hip resurfacing.
Metal on Meta Large Heads – Not Worth the Risk
Donald S. Garbuz, MD, MHSc, FRCSC

When new hip implants are introduced four basic criteria must be met: 1. Excellent survivorship. 2. Excellent Function 3. Minimal adverse events 4. Revisability

Metal on metal large head total hips were introduced as a high performance hip replacement with great potential. This talk will focus primarily on what does not work in metal on metal THAs. Results of studies performed at our center on this issue will be highlighted.

At our center 3 recent studies have investigated large head MOM THA’s (1,2). The first study was a RCT on large head MOM vs Resurfacing. This study was awarded the 2009 Charnley award. This study was the first to highlight the marked increase in metal ion levels, particularly cobalt in large head MOM THAs. In this study the conclusion was that the problem was at the taper/ head, sleeve junction. Highlights of this study will be presented.

A follow-up to this study looked at clinical consequence of these increased ion levels. In this study which highlights will be presented a prevalence of pseudotumours of 32% was seen in asymptomatic patients with large head MOM THAs.

While our studies investigated one particular device several studies from other centers have reported similar findings to our work. References are included (3,4). These studies reported on similar devices from different manufacturers. The conclusion is that all large head metal on metal hips have similar problems with adverse events. Recent studies looking at modular metal on metal hips though not as bad as those with monoblock cups are still concerning with respect to high ion levels and high prevalence of adverse local tissue reactions. Based on these high rates of adverse events and high failure rates large head metal and metal is probably not worth the risk.

The last issue pertains to revisability. Given that these implants are often used in very young active patients revisability is important. At our center we recently reported on our revisions of large head metal on metal total hips (5). Results of this study will be highlighted. In this study there were high rates of complications and high failure rates of rerevisions

In conclusion large head MOM articulations should no longer be used due to high failure rates, high percentage of adverse events and poor revisability. Outstanding issue is natural history of the large percent of patients who have pseudotumours but no symptoms.

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In response to the concerns about wear and osteolysis in THA, conventional Ultra High Molecular Weight Polyethylene (UHMWPE) has been largely replaced by Highly Cross-Linked Polyethylene (HXLPE), first introduced for clinical use in 1999. Therefore, the first generation HXLPEs have now been in clinical use for over a decade. A number of systematic review and meta-analysis publications1-4 have demonstrated significantly lower femoral head penetration rates and a reduction in osteolysis with the use of HXLPE compared to conventional UHMWPE at early and mid-term follow-up. While this represents strong evidence in favor of HXLPE, most of the individual studies examined consisted of a relatively small number of patients, with only early or mid-term follow-up.

We recently reviewed our institution’s experience with the use of first generation HXLPE over the last decade and beyond. We sought to carefully examine all revision cases to determine if any had occurred for wear related causes. A review of our prospective database demonstrated a total of 1484 total hip joint replacements using HXLPE were performed between 1999 and 2007 (minimum of 5 years follow-up). We used four different HXLPE liners during this period: XLPE® (1009 liners - 68%), Marathon® (321 liners - 21.6%), Crossfire® (97 liners - 6.5%), and Longevity® (57 liners - 3.8%). Average follow-up was 8.2 years where 418 cases (28%) had a minimum of 10 years follow-up. There were 56 re-operations (3.8%), 17 for instability (1.1%), 16 for infection (1.1%), 11 for aseptic loosening (0.7%), 7 for peri-prosthetic fracture (0.5%) and 5 for other reasons (0.3%). All 11 cases of aseptic loosening occurred on the femoral side, most occurring early due to subsidence and/or cement mantle fracture. There were no cases of either liner fracture or observed liner wear leading to reoperation.

To the best of our knowledge, this is the largest single institution prospective follow-up study of HXLPE with mid to long-term results. To date, with over a decade of clinical experience, we have demonstrated no significant drawbacks to the use first-generation HXLPE. Our findings are supported by the recent Australian registry which demonstrated a significantly lower revision rate at 11 years with HXLPE compared to UHMWPE5. After a decade of use, HXLPE appears to be safe and effective and may represent the current gold standard of bearing surfaces for total hip replacement.

REFERENCES

Ceramic Bearings for THA
William N. Capello, MD

Introduction: The question to be addressed is whether Ceramic/Ceramic bearings, introduced in the US in 1996, are still a relevant option in today’s THA.

Methods: Data was obtained from 8 recent publications, all having 10+ year follow up of a ceramic/ceramic bearing mated with a Ti alloyed implant. Additional information was obtained from a ceramic manufacturer and a recent article concerning taper corrosion.

Results: The publications reported on 1,111 hips with no osteolysis, 0-1.3% ceramic fracture, and 0-3% squeaking (none significant). Taper corrosion was less with ceramic/metal junctions compared to CoCr/Metal. We know of no revisions of ceramic/ceramic bearings for osteolysis, taper corrosion, or psuedotumor.

Conclusion: With no reported osteolysis, very low fracture rates, and insignificant squeaking, we believe ceramic/ceramic bearings to be a viable option in today’s THA.
Why I Prefer a Monolithic Acetabular Component
Thomas P. Sculco, MD

There are many types and articulating surfaces in acetabular cups. Most of the designs currently available are modular, the liner snapping into a locking mechanism of some type. These modular inserts may be polyethylene, usually highly cross linked polyethylene, or ceramic. Metal shells used in metal on metal devices are usually of a monoblock design.

The elliptical monoblock design has been available for 20 years and was originally made of Titanium with a compression molded polyethylene liner. Tantalum (trabecular metal) was used as the shell material in the more recent designs and the polyethylene is actually molded directly into the tantalum framework.

Monoblock acetabular components have a number of advantages. They do not allow access to the ilium because there are no holes in the socket shell with the monoblock construct. They require no locking mechanism which may increase metallic debris. No back surface liner wear can occur because all motion is eliminated at the liner/shell interface. However, because of this absence of screw holes there is an inability to visualize the floor of the acetabulum and perfect coaptation between the shell and the acetabular floor may not occur. The presence of dome gaps of greater than 1.5mm have been noted in 5% of these components but these have not compromised implant stability and in a review of over 600 cups there has been no change in implant position. The elliptical shape of the cup makes the mouth of the acetabular component two millimeters greater than the dome so that an exceptionally strong acetabular rim fit results.

Results with over 258 monoblock cups with a minimum of 10 year follow-up (10-15 years) have been excellent. The incidence of pelvic osteolysis was not seen in any patient in this series. There were 3 revisions for instability but none for mechanical failure. There were three femoral revisions for loosening but the cup was intact and not revised in these patients. Utilizing the Livermore measurement method polyethylene wear averages 0.08mm per year (0.06mm-0.13mm) and there have been no revisions for wear. Radiographic evaluation demonstrates stable bony interface in all patients. At minimum 10 year follow up the monoblock acetabular component with compression molded polyethylene confirms the theoretical advantages of this design and results have been excellent to date.

REFERENCES


Modularity in hip arthroplasty brings with it a degree of flexibility in the reconstructive process that provides tangible benefits to patients and surgeons performing total hip replacement. These advantages include options to achieve an optimized and personalized reconstruction by taking advantage of options for changing offset, face orientation, head size, supplemental fixation, and materials options. Modularity can simplify the revision process. Larger series comparing monoblock to modular cups have indicated no difference in wear rates, revision rates, or rates of osteolysis. Design changes have improved the performance of modular cups. Most notably, the potential for backside wear is minimized through polished surface finishes and enhanced locking mechanisms. In addition, enhanced edge design can limit the potential adverse effects associated with edge loading. Certain advantages of monoblock designs, such as optimizing the composite thickness of the implant may apply to the smallest segment of the population or the resurfacing procedure that requires a larger head size.
There is no doubt that the introduction of modular femoral stem into orthopedics has had a very positive impact in revision arthropalsty. The modularity allows the reconstructive surgeon to restore the limb length, offset, and version while obtaining a secure fixation. The modular stem has an excellent role in reconstruction of femora with proximal bone loss that does not allow proximal fit and fixation. It is also indicated for patients with periprosthetic fracture of the femur where integrity of calcar is in question.

Some years ago we witnessed an increased enthusiasm to utilize modular stem during primary total hip arthroplasty. The manufacturers and the innovators of such designs had used the same argument, namely better ability to restore offset. Version, and limb length as the argument to popularize the modular primary stems. The use of modular femoral stems during primary THA has lead to some untoward and in my opinion disastrous consequences. First was the issue of stem fractures that appeared to happen with relative frequency for some stems. Recently the discover that the metal particle generation from the body and neck junction, particularly by “unmatched” stems has lead to adverse local tissue reactions akin to the MOM bearing surface failures and perhaps worst in some circumstances. The latter has lead some orthopedic manufacturers to withdraw the femoral stem from the market. It is abundantly clear that not all innovations have brought positive impact into the field. Utilization of an innovation based on claims that are not substantiated can have adverse consequences for our patients and the surgical discipline.
Why I Prefer More Modularity for Primary and Revision Stems
Christopher L. Peters, MD

Primary Femoral Component
During the first two decades of experience with total hip arthroplasty, non-modular mono-block cemented femoral component designs (Charnley, Charnley-Mueller) with relatively small diameter femoral heads were commonly utilized with high levels of success. Femoral component modularity at the head level and subsequently the neck level was introduced with the theoretical advantages of inventory reduction, improved restoration of hip biomechanics, and facilitation of surgical technique with less invasive surgical approaches.

Although femoral component modularity at the head level is now well accepted, concerns regarding taper fretting and corrosion particularly with larger diameter femoral heads have heightened. The recent introduction of modular neck prostheses has also been associated with high failure rates due to fretting corrosion and in some designs neck breakage. The perils of this technology are evident in the recent voluntary recall of two modular neck femoral component designs due to fretting/corrosion and metallosis.

Nevertheless, specific femoral component modular designs such as the SROM prosthesis have demonstrated mid-to-long-term clinical success and are particularly useful for complicated primary THA. The ability of this design to address extremely small femora, adjust femoral anteversion and distorted proximal femoral anatomy is unique. Common applications today include cases of dysplasia, SCFE, Down’s syndrome, and dwarfism.

Revision Femoral Component
Femoral modularity in revision THA has emerged as the preferred implant design due to the unique attribute of independent preparation of metaphyseal and diaphyseal bone. Virtually all major implant manufacturers offer a successful modular revision system. Commonalities include: multiple distal stem options (length, splined, porous coated), multiple proximal body types to address proximal bone loss, and reliable large taper junctions located in the sub/inter-trochanteric region. Short to mid-term reports show high clinical success rates comparable to non-modular designs with strong surgeon preference for modular designs. Prudent use includes protection of the modular junction with host or allograft bone and assurance of excellent distal fixation.
**Symposium VII: Metallosis**

2:25 pm – 2:31 pm

**The Diagnosis of Metallosis-Not Infection: Getting it Correct**

*Paul H. Yi, BA; Michael B. Cross, MD, Mario Moric, MS; Brett R. Levine, MD, MS; Scott M. Sporer, MD; Wayne G. Paprosky, MD; Joshua J. Jacobs, MD and Craig J. Della Valle, MD*

**Introduction:** Failed metal-on-metal (MOM) bearings and corrosion reactions are being increasingly encountered with little to guide evaluation for periprosthetic joint infection (PJI). Our purpose was to determine the utility of the erythrocyte sedimentation rate (ESR), C-Reactive Protein (CRP), synovial fluid white blood cell (WBC) count and differential (%PMN) in diagnosing PJI in failed hips with a MOM bearing or corrosion.

**Methods:** 150 revision THAs (92 MOM bearings, 19 MOM hip resurfacings, 30 non-MOM bearings with corrosion and 9 full-thickness bearing surface wear with metallosis) were retrospectively evaluated. Nineteen patients were diagnosed as infected using MSIS criteria. Mean laboratory values were compared between groups and receiver operator characteristic curves (ROC) generated with an area under the curve (AUC) to determine test performance.

**Results:** The synovial fluid WBC count was judged to be inaccurate secondary to cellular debris in 47 of the 141 patients where one was obtained (33.3%); a WBC count was still reported, however, in 35 hips, 11 of which were falsely positive. Infected patients had significantly higher mean serum ESR, CRP, synovial fluid WBC counts and differential (p < 0.05, all). The best tests for diagnosis of PJI were the synovial fluid WBC count (AUC=98%, optimal cutoff 4350 WBC/μL), and differential (AUC = 90%, optimal cutoff 85% PMN) after the inaccurate specimens were excluded. Diagnostic performance of the synovial fluid WBC count and differential improved after excluding inaccurate samples. The ESR and CRP both had good sensitivity.

**Conclusions:** The diagnosis of PJI is extremely difficult in patients with MOM bearings or corrosion and the synovial fluid WBC count can frequently be falsely positive and should be relied upon only if a manual count is done and if a differential can be performed. The confusion in diagnosis is further augmented by an intra-operative appearance that looks purulent. A more aggressive approach to preoperative evaluation for PJI is recommended in these patients to allow for careful evaluation of the synovial fluid specimen, the integration of synovial fluid culture results, and repeat aspiration if necessary.

**REFERENCES**


Metallosis: Results of Revision THA

William L. Griffin, MD; Louis S. Stryker, MD; Susan M. Odum, PhD; Thomas K. Fehring, MD and Bryan D. Springer MD

Introduction: There are a wide range of intra-operative findings with revision of failed metal-metal THAs. Surgery may range from a simple revision of a loose cup with no significant soft tissue or bone damage, to extensive tissue and bone necrosis with abductor deficiency. Pre-operative evaluation with a MARS-MRI can help determine the complexity of the revision and special implant needs.

Reason for Revision: Risk Stratification algorithms which take into account patient symptoms, implant design, ion levels, component position, and cross sectional imaging with U/S or a MARS-MRI, help determine when revision surgery is warranted for metal-metal THAs. Failure can be due to: aseptic loosening, metallosis - ranging from fluid accumulation to extensive soft tissue and bone destruction, increasing ion levels, pain, and occasionally unexplained pain and secondary gain associated with recalled implants.

Results of Revision: Revision of metal-metal total hips is associated with higher complication rates than seen with revision of metal on polyethylene or ceramic on ceramic bearings. Postoperative complications include a higher infection rate, dislocation, failure of acetabular fixation, and decreased clinical scores.

In a review of the Charlotte experience with 114 monoblock metal-metal revisions, there was a 20% rate of major complications (23/114). There was a 16% rate of re-operations (18/114), with 7 patients requiring multiple reoperations. Seven patients (6%) were revised for fixation failure and 5 of these had severe bone loss requiring custom tri-flange components. In addition 6% developed postoperative infection, 4% had post-operative dislocations, and 3% sustained intra-operative acetabular fractures.

Conclusion: Complications and re-operation rates following revision for failed monoblock metal on metal total hip arthroplasty are high (20% and 16%, respectively). Surgeons should anticipate the most common modes of failure (aseptic loosening, deep infection, and dislocation) and develop strategies to prevent their occurrence.

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1) High Rate of Infection After Aseptic Revision of Failed Metal-on-Metal Total Hip Arthroplasty. Cody C., Wyles BS, Robert E. Van Demark III MD, Rafael J. Sierra MD, Robert T. Trousdale MD Clinical Orthopaedics and Related Research, February 2014, Volume 472, Issue 2, pp 509-516
6) High Complication Rate After Revision of Large-head Metal-on-metal Total Hip Arthroplasty.
Munro JT, Masri BA, Duncan CP, Garbuz DS. Clin Orthop Relat Res. February 2014, Volume 472, Issue 2, pp 523-528


8) Early Complications Following Revision of Monoblock Metal on Metal Total Hip Arthroplasty. Louis S Stryker, M.D. Susan M. Odum, PhD, Thomas K. Fehring, M.D, Bryan D. Springer, M.D. In press
Current Concerns with Metal-on-Metal Hip Arthroplasty

The American Academy of Orthopaedic Surgeons gratefully acknowledges the work of the Association of Hip & Knee Surgeons in the development of this information statement. It is an educational tool based on the opinion of the authors and not a product of a systematic review. Readers are encouraged to consider the information presented and reach their own conclusions.

Metal-on-metal (MoM) bearings were reintroduced over the last two decades because of their lower volumetric wear rates in comparison to conventional metal-on-polyethylene bearings.¹ This has the potential to substantially reduce wear-induced osteolysis as the major cause of failure. Other proposed advantages of MoM hip arthroplasty include greater implant stability, and bone conservation (for hip resurfacings). It has been estimated that since 1996 more than 1,000,000 MoM articular couples have been implanted worldwide. However, with increasing clinical experience, the national joint registries have recently reported the failure rate of total hip arthroscopy (THA) with MoM bearings to be 2-3 fold higher than contemporary THA with non-metal-on-metal bearings.³,⁴ Moreover, adverse periprosthetic tissue reactions involving the hip joint have emerged as an important reason for failure in MoM patients.

The information provided in this white paper is intended as an aid to the orthopaedic surgeon in the assessment and management of patients with metal-on-metal bearings. It is recognized that each patient may have specific circumstances or features that require individualized approaches, and this document is not intended to be proscriptive in any fashion. In addition, it is recognized that there is insufficient high quality evidence in this area to develop a formal guideline based on a systematic review of the literature. Thus, a document based on a consensus of experienced practitioners is in order given the state of the published literature.

Adverse Local Tissue Reaction Risk Stratification Algorithm for Evaluating Patients with Metal-on-Metal Hip Arthroplasty

A painful MoM hip arthroplasty has various intrinsic and extrinsic causes (Table 1). As in all painful THA,⁵ a thorough clinical history, a detailed physical examination, as well as radiographic and laboratory tests are essential to delineate potential cause(s) of pain in patients with MoM hip arthroplasty. A systematic risk stratification recommendation, for multiple modes of failure including adverse local tissue reactions, based on the currently available evidence is presented here to optimize management (Tables 2, 3, 4). The algorithm presented in this review will continue to develop as further evidence becomes available. For patients who have a stemmed total hip or surface replacement device that has been recalled by the manufacturer, this risk stratification scheme still applies. In addition, the surgeon should inform the patient about the recall and direct them to information from the manufacturer (on its website) regarding the recall and suggested follow up.
### Table 1: Extrinsic/Intrinsic to the Hip

<table>
<thead>
<tr>
<th>Extrinsic to the Hip</th>
<th>Intracapsular/Implant-Related:</th>
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<tbody>
<tr>
<td>• Peripheral vascular disease</td>
<td>• Infection</td>
</tr>
<tr>
<td>• Hernia (femoral, inguinal)</td>
<td>• Loosening</td>
</tr>
<tr>
<td>• Peripheral nerve injury (e.g. sciatic, femoral, meralgia paresthetica)</td>
<td>• Instability/Subluxation</td>
</tr>
<tr>
<td>• Malignancy or metastases</td>
<td>• Periprosthetic fracture</td>
</tr>
<tr>
<td>• Metabolic bone disease (e.g. Paget’s disease, osteomalacia)</td>
<td>• Adverse soft tissue reaction</td>
</tr>
<tr>
<td>• Complex regional pain syndrome</td>
<td>• Extracapsular:</td>
</tr>
<tr>
<td>• Psychological disorder</td>
<td>• Trochanteric bursitis</td>
</tr>
<tr>
<td>• Peripheral vascular disease</td>
<td>• Iliopsoas tendonitis</td>
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### Table 2: MoM ‘Low’ Risk Group

<table>
<thead>
<tr>
<th>‘Low’ Risk Group Stratification</th>
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<tr>
<td>Patient Factors</td>
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</table>
### Symptoms
- Asymptomatic (including no systemic or mechanical symptoms)

### Clinical Examination
- No Change in Gait (i.e. No Limp, No abductor weakness)
- No Swelling

### Implant Type
- Small Diameter Femoral Head (<36mm) Modular Mom THA; hip resurfacing in males <50 with OA

### Radiographs (2 views Serial for Comparison when available)
- Optimal Acetabular Cup Orientation
- No Implant Osteolysis/Loosening

### Infection Work-Up (ESR, CRP, Hip Aspiration)
- Within Normal Limits

### Metal Ion Level Test (if available)
- Low (<3 ppb)

### Cross-Sectional Imaging (if available)
These studies include MARS MRI; Ultrasound or CT when MRI contraindicated or MARS protocol not available.
- Within Normal Limits

### Treatment Recommendation
- Annual Follow Up

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**Table 3: MoM ‘High’ Risk Group**

### ‘High’ Risk Group Stratification

<table>
<thead>
<tr>
<th>Patient Factors</th>
<th>'Female with Dysplasia (for Hip Resurfacing)’</th>
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<tbody>
<tr>
<td></td>
<td>‘High activity level patient’</td>
</tr>
<tr>
<td>Symptoms</td>
<td>• Symptomatic</td>
</tr>
<tr>
<td></td>
<td>• Severe Local Hip and/or mechanical Symptoms</td>
</tr>
<tr>
<td></td>
<td>• Systemic Symptoms</td>
</tr>
<tr>
<td>Clinical Examination</td>
<td>• Change in Gait (i.e. Limp). Abductor weakness</td>
</tr>
<tr>
<td></td>
<td>• Swelling</td>
</tr>
<tr>
<td>Implant Type</td>
<td>• Large diameter femoral head (≥36mm) Modular or Non-modular MoM THA</td>
</tr>
<tr>
<td></td>
<td>• Recalled MoM Implant</td>
</tr>
<tr>
<td>Radiographs (2 views Serial for Comparison when available)</td>
<td>• Suboptimal Acetabular Cup Orientation</td>
</tr>
<tr>
<td></td>
<td>• Implant Osteolysis/Loosening</td>
</tr>
<tr>
<td>Infection Work-Up (ESR, CRP, Hip Aspiration)</td>
<td>• Within Normal Limits</td>
</tr>
<tr>
<td>Metal Ion Level Test</td>
<td>• High (&gt;10 ppb)</td>
</tr>
<tr>
<td>Cross-Sectional Imaging (MARS MRI; Ultrasound or CT when MRI contraindicated or MARS protocol not available)</td>
<td>• Presence of Abnormal Tissue Reactions with Involvement of Surrounding Muscles and/or Bone</td>
</tr>
<tr>
<td></td>
<td>• Solid lesions</td>
</tr>
<tr>
<td></td>
<td>• Cystic Lesions with Thickened Wall</td>
</tr>
<tr>
<td></td>
<td>• Mixed Solid and Cystic Lesions</td>
</tr>
<tr>
<td>Treatment Recommendation</td>
<td>• Consider Revision Surgery</td>
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</table>

**Table 4: MoM ‘Moderate’ Risk Group**

<table>
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<tr>
<th>‘Moderate’ Risk Group Stratification</th>
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<td></td>
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</table>
| **Patient Factors** | • Male or Female  
• Dysplasia (for Hip Resurfacing)  
• Moderate activity level patient |
|---------------------|---------------------------------------------------------------------|
| **Symptoms**        | • Symptomatic  
• Mild Local Hip symptoms (e.g. Pain, Mechanical symptoms)  
• No Systemic symptoms |
| **Clinical Examination** | • Change in Gait (i.e. Limp). No abductor weakness  
• No Swelling |
| **Implant Type**    | • Large diameter femoral head (≥36mm) modular or non-modular MoM THA  
• Recalled MoM Implant  
• Hip Resurfacing with Risk Factors (Female with Dysplasia)  
• Modular neck device |
| **Radiographs (2 views Serial for Comparison when available)** | • Optimal acetabular cup orientation  
• No Implant Osteolysis/Loosening |
| **Infection Work-Up (ESR, CRP, Hip Aspiration)** | • Within Normal Limits |
| **Metal Ion Level Test** | • Moderately Elevated (3-10 ppb) |
| **Cross-Sectional Imaging (MARS MRI; Ultrasound or CT when MRI contraindicated or MARS protocol not available)** | • Presence of abnormal tissue reactions without Involvement of Surrounding Muscles and/or Bone  
• Simple Cystic Lesions or Small Cystic Lesions Without Thickened Wall |
| **Treatment Recommendation** | • Follow Up in 6 months |
Revision Surgery

- Consider Revision Surgery if symptoms progress, Imaging Abnormality Progresses and/or Rising Metal Ion Levels over 6 Months

Clinical Evaluation

A complete history is essential to evaluate patients with MoM hip arthroplasty. The temporal onset, duration, severity, location, and character of the pain help narrow the differential diagnosis. A history of delayed wound healing, pain after dental or gastrointestinal procedures all hint of joint sepsis. Other symptoms such as a feeling of swelling or fullness about the hip, and mechanical symptoms of crepitus, clicking or squeaking should be elicited. A clinical history of metal allergy manifested as a dermal reaction to metal jewelry may also be helpful in assessing potential hypersensitivity reactions. Furthermore, a thorough review of systems should be noted for any potential systemic symptoms.

Comprehensive neurovascular examination is necessary to rule out neurogenic and vascular causes of pain. Inspection of the skin should note previous scars and signs of infection. Careful palpation should be performed around the hip to detect any soft tissue mass. Range of motion should be examined to determine the positions that may elicit the patient’s pain, as reproduction of pain on active hip flexion and passive hip extension may suggest iliopsoas tendinitis. Abduction strength must be assessed.

Radiographic Evaluation

After a complete history and physical examination, evaluation of a MoM hip arthroplasty should follow with a critical review of serial plain radiographs, focusing on signs of implant-related complications such as loosening or osteolysis particularly in retro-acetabular, ischial and pubic regions. For hip resurfacing implants, the presence of radiographic sign of impingement (an indentation typically located in the lateral or anterolateral aspects of the femoral neck) should be noted. As the acetabular components with high inclination angle have been shown to demonstrate elevated serum and joint fluid levels of metal ions and increased wear secondary to edge loading, it is important to measure the acetabular component orientation in both planes including abduction angle relative to the pelvic horizontal on anteroposterior view. A shoot-through lateral is also helpful is assessing acetabular component anteversion.

ESR/CRP and Hip Aspiration

In contrast to metal-on-polyethylene (MoPE) THA, where elevation of both erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) have specificity for infection as high as 0.93, interpretation of elevated ESR and CRP should be done with caution in MoM hip arthroplasty patients as elevated ESR/CRP have been reported in non-infected cases of adverse
soft tissue reactions. Synovial fluid white cell count greater than 3,000 WBC/mL combined with predominant polymorphonuclear cells (>80%) has been reported to have the highest accuracy and sensitivity for infection in MoPE THA. However, these parameters may not be applicable in MoM hip arthroplasty as adverse soft tissue reactions (proven to be culture negative) often have white cell counts greater than 3,000 WBC/mL combined with >95% polymorphonuclear cells. Although manual cell count should be obtained as tissue debris in suspension may lead to falsely elevated automated cell counts, no absolute quantity of cells can be suggested at this time. However, the higher the number of cells, predominance of monocytes, would warrant further investigation.

**Sensitivity and Specificity of Metal Ion Levels in Predicting MoM Failure**

Metal ions are released from the bearing surfaces and from modular connections by virtue of mechanically assisted crevice corrosion (MACC). Metal ion levels are influenced by factors such as the implant type, implant materials and design, diameter of the bearings, and positioning of the implant. In 2010, the British Medicine and Healthcare Products Regulatory Agency issued a safety alert pertaining to all types of MoM hip implants and recommended cross sectional imaging studies in patients with either cobalt or chromium ion levels above 7 parts per billion (ppb or μg/l). Read the MoM device alert

More recently, the sensitivity and specificity of the 7 ppb cut-off level has been reported to be 52% and 89%, respectively, indicating that the 7 ppb has relative poor ability to identify MoM failures. The lowering of the cut-off level to 5 ppb increases the sensitivity to 63% and lowers specificity to 86%. In measuring trace metals cobalt and chromium with concentrations in the parts-per-billion range, the risk of contamination is a major technical challenge. Adherence to stringent protocols is required from specimen collection to sample introduction to the analysis. While metal ion levels are a useful diagnostic test for assessing MoM hip arthroplasty, its role is limited to being an important adjunct to systemic clinical assessment and other investigative tools. Therefore, metal ion levels alone should not be relied on as the sole parameter to determine clinical recommendation for revision surgery. Furthermore, the correlation between cobalt or chromium serum, blood or synovial fluid levels, and adverse local tissue reactions observed at the time of revision surgery is incompletely understood. In addition, the interpretation of metal ion levels is confounded in patients who have other Co- and Cr-containing metallic implants, particularly bilateral MoM total hip or surface replacements. In light of the current limitations of the metal ion levels in guiding surgical intervention, research efforts are currently underway to identify diagnostic tests, such as biomarkers in synovial fluid that would be helpful in detecting periprosthetic necrosis prior to the occurrence of significant adverse local tissue reactions.

**Ultrasound & Magnetic Resonance Imaging**

As ultrasound is not affected by metal artifacts, ultrasound is a useful tool to detect the presence of a soft-tissue mass adjacent to MoM implant. It can differentiate solid lesions from cystic lesions, and can also be used to guide biopsy and aspirations. Ultrasound has been used to screen a large number of asymptomatic MoM patients in order to establish prevalence of
asymptomatic pseudotumours. However, this imaging technique remains operator dependent, and its utility may be limited in evaluating the deep structures.

Metal artifact reduction sequence magnetic resonance imaging (MARS MRI) has the capacity to produce high-resolution images of the periprosthetic tissues in patients with MoM hip arthroplasty. Image distortion due to susceptibility artifact generated by the ferromagnetic property of the cobalt-chromium implant is reduced with various modification of pulse sequence. Modified MRI has been demonstrated to be the most accurate test to detect the wear-induced synovial response predating the presence of osteolysis on radiographs or standard MRI. MARS MRI is an important cross sectional imaging modality in detection of adverse local soft tissue reactions. MRI can delineate anatomical extension boundaries of periprosthetic fluid collections and solid masses, as well as detection of any compression of juxtaposed neurovascular structures, which is of particular importance in pre-operative planning. It also allows evaluation of the surrounding soft tissue envelope such as the integrity of hip abductor and gluteal musculature. Therefore, early application of MRI may be an important tool that allows early detection of adverse soft tissue reactions. As wear-induced synovitis has been observed in both symptomatic and asymptomatic MoM patients, a prospective study is currently underway to monitor these patients longitudinally. Metal artifact reduction technique continues to be refined with development of new imaging optimization protocols. Therefore, the utility of MARS MRI in evaluating patients with MoM hip arthroplasty is likely to have an increasing role in the clinical decision-making process.

**Frequency of Follow Up**

The frequency of follow up examinations needs to be tailored to the individual patient based on the risk stratification category and intervening clinical course. Annual follow up is recommended for patients with a MoM total hip or surface replacement arthroplasty. Patients in the moderate risk category and patients electing to forego surgery in the high risk category should be followed at 4 to 6 months intervals. Follow up evaluation should include a careful history and physical and plain radiography. In addition, the orthopaedic surgeon should consider repeat MARS-MRI testing and metal ion analysis, depending on the individual patient’s signs, symptoms, radiographs and clinical course.

**Implant Retrieval Analysis**

For those patients who undergo revision surgery of their metal on metal bearing, it is recommended that the implant be evaluated at a center experienced in implant retrieval analysis of such devices. The mechanism of failure of the hip reconstruction can be ascertained by a gross and microscopic evaluation of the implant in concert with clinical, radiographic and histopathologic findings. Delineating the mechanism(s) of failure will provide valuable information to surgeons, manufacturers and implant designers.

**Summary**

There should be a low threshold to perform a systematic evaluation of patients with MoM hip
arthroplasty as early recognition and diagnosis will facilitate the initiation of appropriate treatment prior to significant adverse biological reactions. A painful MoM hip arthroplasty has various intrinsic and extrinsic causes and a systematic treatment approach based on the currently available data is presented to optimize management of MoM patients. The risk stratification algorithm presented will continue to develop as further evidence become available providing additional insights. While specialized tests such as metal ion analysis are useful modalities for assessing MoM hip arthroplasty, over-reliance on any single investigative tool in the clinical decision-making process should be avoided. Future research focusing on validation of the current diagnostic tools for detecting adverse local tissue reactions as well as optimization of MoM bearings and modular connections to further diminish wear and corrosion is warranted.

References:


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Transfemoral Approach
Arlen D. Hanssen, MD

Utilization of an extensile proximal femoral osteotomy (PFO) technique has steadily increased due to the rising number of complex revision THRs being performed. The two primary PFO techniques include: 1) the classic extended trochanteric osteotomy (ETO) and 2) the transfemoral approach (TFA). In distinction to the classic ETO which elevates the anterolateral proximal femur with an osteotomy directed from posterior to anterior, the TFA typically elevates the anterior femur (and occasionally the posterolateral femur with a secondary femoral elevation) with an osteotomy directed along the lateral midline of the proximal femur. The classic ETO is usually performed in conjunction with a posterolateral approach but can be performed during a direct lateral surgical approach. The TFA requires surgical predetermination to utilize this surgical approach. The indications for using these technical variations is primarily based by personal preference and experience.

Extensile osteotomy techniques provide an intact muscle-osseous sleeve (preservation of soft tissue attachments to bone), afford wide acetabular exposure, and facilitate femoral component exposure and removal as well as accurate distal cement retrieval and diaphyseal machining under direct vision. Use of a PFO is particularly useful when using modular femoral implants as surgical access to the mid-diaphyseal femoral region is more direct and more easily visualized compared with proximal intramedullary techniques. The possibility of placing a distally fixed component in varus is virtually eliminated. The osteotomized fragments allow alteration of the proximal femur to more accurately conform with revision prostheses and adjustment of soft tissue tension. Other advantages include protection of a weakened or osteopenic trochanter from iatrogenic injury.

Surgical indications include: 1) removal of well-fixed cement mantles with a loose or well-fixed stem, 2) removal of extensively porous-coated or tapered cementless stems, 3) removal of some infected prostheses for complete removal of all foreign material, 4) correction of proximal femoral deformity in conjunction with a revision THR, and 5) need for extensile acetabular exposure to remove implants with intra-pelvic protrusion.

The literature demonstrates a relatively low rate of trochanteric nonunion associated with these extensile techniques as compared with conventional trochanteric osteotomy techniques. Extensile trochanteric techniques are associated with fewer intraoperative femoral fractures or cortical perforations and decreased surgical time as compared with traditional intra-medullary femoral revision techniques. The tips and tricks associated with the sequence of performing the transfemoral approach will be demonstrated in this video vignette.

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History of ETO
For many years surgeons have been frustrated by poor union rates of conventional trochanteric osteotomies, and by the relatively poor access to the proximal femoral metaphysis and distal femur. Consequently, surgeons began to experiment with longer osteotomy fragments to improve access and chances of union. Wagner described a proximal femoral osteotomy which included the greater trochanter and part of proximal femur. He used long, straight titanium fluted prosthesis and often the osteotomy was not rigidly fixed. He never published his results.

Peters et al (JBJS 1993) described surgical technique and results of extended trochanteric osteotomy performed either by Anterolateral or Posterolateral approach. In their technique, they detached the vastus lateralis attachment from the trochanteric fragment and reported a 100% union rate in a series of 21 patients. Paprosky (JOA 1995) further popularized and described the surgical technique of ETO, emphasizing the vascularity of the fragment by keeping the attachment of Vastus lateralis to the trochanteric fragment. Firestone and Headley (JOA 1997) described its usefulness in severe protrusio secondary to total hip replacement. Noble et al. (JBJS 2005) showed that ETO reduces the strength of femur up to 73% and advised caution in handling femur intraoperatively when doing ETO.

Indications

Indication in Primary THA
1. Severe Proximal Femoral Deformity
2. High Grade Developmental Dysplasia
3. Removal of Intraosseous Hardware
4. Severe Protrusio

Indications in Revision THA
1. Removal of well fixed cemented and cement less femoral component
2. Extensive cement going down the canal
3. Loose femoral component with well fixed distal cement mantle
4. Severe proximal femur deformities that interfere distal cement removal or obstruct straight reaming
5. Varus Remodelling of Proximal femur
6. Periprosthetic Fracture (Vancouver B2/B3)
7. Osteolysis or osteopenia of the greater trochanter rendering the bone inadequate for
either wire fixation or cable fixation after a conventional osteotomy
8. Proximal-medial bone loss requiring distal cable fixation for trochanteric
   Reattachment
9. To assist in dislocation of the failed THA in cases with extensive soft tissue
   Scarring or heterotopic ossification
10. Desire to advance the trochanter

Preoperative Planning
- Preoperative planning is very important in ETO.
- Standard Pelvis AP, Hip AP and lateral radiographs are required as a part of preoperative
  planning.
- Pelvis X ray with both hip helps in determining leg length.
- Hip x ray AP helps in determining the length of osteotomy.
- Preoperative templating will further assist in determining the length of osteotomy.
- Lateral x-ray would help in making decision for a straight or a curved stem based on
  curvature of femur.

Operative Technique
Exposure using Posterolateral Approach
- Before starting the surgical procedure, it is important have oscillating saw, gigli saw, pencil
  tip burr, trephines, metal cutting burr, reverse hooks/splitters, flexible osteotome set and
  cerclage wire available.
- Lateral decubitus position
- Extended posterolateral approach
- Posterior border of vastus lateralis is identified and stripped from intermuscular septum
  carefully coagulating/ligating the perforators.
- Length of osteotomy is planned preoperatively based length needed to remove stem easily.
- Posterior capsule and external rotators mobilized posteriorly and tagged.
- Tendon of gluteus maximus may be released to facilitate mobilization of femur.
- If possible dislocate hip and release scar prior to osteotomy
- If stem is loose, it’s extracted before doing osteotomy.
- Osteotomy is performed using a saw just anterior to linea aspera starting from Greater
  trochanter to the predetermined length in diaphysis.
- The direction of saw should be perpendicular to the cortex of the femur
- During osteotomy hip is kept extended, minimally internally rotated and knee flexed to
  protect sciatic nerve.
- Caution is necessary when making cut distal to the greater trochanter because this area of
  osteotomy tends to be cut thin and prone to fracture.
- Distal transverse limb of the osteotomy may be accurately done using pencil burr.
- Round the distal cut with a pencil tip burr
- Anterior cut may be templated with a drill 2.5 mm thickness through muscle, then initiated
  distally with a saw and completed with an osteotome placed in the osteotomy beneath the
  lateralis muscle
- Since the blood supply and innervation of Vastus Lateralis comes from anteriorly, it is
  important to avoid dissection in the anterolateral limb of osteotomy.
- Osteotomy fragment should encompass one third of the circumference of the diaphysis and
  should include whole of the greater trochanter.
- Attachment of Vastus Lateralis is preserved to the osteotomized fragment
- Once the anterior osteotomy is complete the anterior capsule is divided so that fragment
  can be lifted anteriorly with attached gluteus medius, gluteus minimus and Vastus Lateralis.
- Multiple osteotomes are used to gently mobilize the fragment with particular care in the
  section just distal to the vastus tubercle
- On completion of osteotomy, prosthesis is removed if it’s loose.

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- Gigli saw is used if it’s not loose
- In case of a well fixed cementless stem, metal cutting burr can be used to cut it at the junction between tapered and cylindrical stem and the rest of it removed using a trephine 0.5mm larger than the stem

Bone Preparation
- Remaining pseudo membrane or cement is removed using a reverse hook to minimize the risk of fracture.
- Femur should be handled carefully to avoid intraoperative fracture.
- In a study done at our Institution, we found strength of femur to be 75% less after an ETO.
- Distal pedestal is opened up.
- Depending on the type of stem to be used, distal canal is reamed using either straight or flexible reamers.
- A cerclage wire may be placed distal to the osteotomy to decrease risk of fracture

Repair of Osteotomy
- We routinely use at least 3 double cerclage wires (one just distal to lesser trochanter and 2 further down and evenly spaced)
- A burr can be used to shape the osteotomized fragment to seat against the prosthesis and allow a good fit.
- Repair the capsule and external rotator remnants to the trochanter making drill holes

Post Operative Regimen
- Post operative regimen is individualized
- We routinely use brace after ETO
- Patient is kept toe touch weight bearing for 6 weeks and than allowed weight bearing as tolerated if there are signs of healing.
- Hip flexion and abduction exercises were not allowed for first 6 weeks.

Clinical Results
1. Miner et al\(^4\) reported 166 cases of ETO with a mean follow up of 3.9 years. Hip abduction brace was put on all patients for 8 weeks. All the patients received a fully coated monoblock stem with a non-union rate of 1.2%, malunion of 0.6%, intraoperative undisplaced fracture rate of 10.8% and 2.8% fracture of osteotomized fragment. The overall complication rate was 10.2%. Mean time to union was 12.3 weeks.
2. Chen et al\(^5\) reported 43 ETO’s followed up for a mean duration of 43 months. Mean time to union of osteotomy was 5 months with delayed union in patient’s where strut graft was used. They had 2 patients with fracture of trochanteric fragment and one non-union which didn’t require operative intervention.
3. Levine et al\(^6\) reported 14 patients with Vancouver B2/B3 periprosthetic fractures where ETO was done as a part of approach and removal of prosthesis. Mean time for osteotomy site healing was 13.1 weeks. All 14 femoral components with a minimum follow up of 24 months showed evidence of osteointegration.
4. Mardones et al\(^7\) reported 75 ETO’s with a mean follow up of 2 years. The mean osteotomy length was 14 cm and at least 2 cables were used. One stem revised for loosening, one non-union of osteotomy and 73 healed completely. There were 3 intraoperative fractures and one post op fracture of osteotomy fragment. Fully porous coated distally fixed CoCr prosthesis was used in all cases. Patients were protected weight bearing for 8 weeks and were advised to avoid active SLR and abduction for the similar length period.
5. MacDonald et al\(^8\) reported a series of 45 ETO’s done through a direct lateral approach with a mean follow up of 2 years. The mean length of osteotomy was 133.9mm. The mean migration of fragment was 2.1mm. They reported more migration with the use if circlage wires vs. Cables. There were 2 cases of trochanteric escape requiring surgical intervention.
The mean time to union was 10.3 months with one dislocation unrelated to osteotomy. The osteotomy union rate was 89% with 11% complication rate. There was one case of stem subsidence and 2 late fractures of trochanteric fragment.

6. Peters JR et al\(^1\) reported series of 21 ETO’s done through either Posterolateral or anterolateral approach. They lifted the vastus lateralis completely from the trochanteric fragment. All osteotomies healed by the end of 6 months and there were no fractures. They fixed the osteotomy with circlage wires and six of them had strut allograft. One case of recurrent dislocation was treated with repositioning of cup.

7. Park et al\(^9\) reported a series of 62 revisions (32 ETO’s) with a mean follow up of 4.2 years using tapered and modular distal fixation stems. All 32 ETO’s healed with a mean of 4 months. They reported 2 intraoperative fractures.

8. Levine et al\(^10\) reported 23 consecutive infected total hip arthroplasties where ETO was performed as a part of the 2 stage procedure with a mean follow up of 49 months. 22 of 23 ETO are healed by 11.5 weeks. 12 patient’s required reopening of osteotomy at the time of reimplantation. However, they healed well at a mean of 11.3 weeks.

9. Huffman and Ries\(^11\) reported a series of 43 consecutive ETO’s with average duration of follow up of 16.6 months. They used combined vertical and horizontal cables for osteotomy fixation. None of their patients wore Abduction brace postoperatively and none had proximal migration, non-union or malunion at osteotomy site. Mean duration to healing was 15 weeks. Intraoperative fracture occurred in 12% cases.

10. Arbindi et al\(^12\) reported a series of 142 consecutive ETO’s performed during the period of 1992-1996. 122 patients were followed up for a mean of 2.6 years. There were no non-union, no case of proximal migration more than 2 mm with complete radiological healing at 3 months in all cases. There were 25(20%) intraoperative femur fractures which could be managed with additional cerclage wires or strut allograft. A re-evaluation of this cohort with additional patients (1992-1998) showed a non-union rate of 1.2 %( 2 patients) and malunion rate of 0.6%(1 patient)

11. Firestone and Headley\(^13\) reported a series of six ETO’s done in case of severe protrusion following THA. They didn’t report any complication as result of approach or component removal.

Discussion

Extended trochanteric osteotomy is a very useful technique in difficult hip revisions. Most described series used posterolateral approach for ETO. MacDonald et al reported a series of 45 ETO’s using anterolateral approach and they reported higher complication rate including proximal migration of the fragment, trochanteric escape and late fractures. Disadvantage of anterior approach for ETO is damage of neurovascular supply of Vastus lateralis with potential late trochanteric fractures. Most reported series kept the attachment of vastus lateralis to the osteotomy fragment and did the anterior cut with saw. If prosthesis didn’t allow, than did the anterior cut using either with multiple drill holes or osteotome. Peters JR et al reported good clinical outcome with detachment of the vastus lateralis with good clinical outcome. We do not recommend detachment of vastus lateralis to retain vascularity of extended trochanteric fragment. We routinely bevel the distal cut in ETO. It is universally accepted that at least 2 cables/cerclage wires are required to fix the osteotomy. Schwab et al\(^14\) in a cadaveric study reported no difference between 2 vs. 3 cables with regards to stiffness, peak force and displacement in 3 planes. Although there data did not show any clear difference, author continued to use 3 cables in selected cases. Chen et al didn’t find any significant correlation in mean time to healing with number of cables used. Huffman and Ries reported a series of 43 ETO’s where they used a proximal vertical cable in addition to horizontal cables and showed good results with mean union time of 15 weeks and no proximal migration of osteotomized fragment. Rounding and bevelling of distal cut is routinely done to minimize stress riser. However, in a study done at our institution, we found fracture to originate consistently from this point. This made us to believe that, distal rounding and bevelling may not be useful in preventing stress riser, however further studies are needed to confirm it. Noble et al showed that ETO reduces torsional strength to
73% of original femora and even after implantation with repair of ETO, its 23% weaker compared to similar construct without ETO. Therefore, its been advised to be cautious in handling of femur intraoperatively when ETO has been done. Postoperatively, protection in the form of abduction brace and protected weight bearing should be planned as a part of regime.

Extended trochanteric osteotomy is an important surgical tool for revision hip surgeons. To achieve optimum result, it’s important to do adequate preoperative planning, preserve bone stock, preserve vascularity of bone fragment, avoid intraoperative fracture and achieve stable implant fixation. When performed well, ETO gives predictable results with minimal complications.

REFERENCES

Acetabular Revision: Recommendations for Surgical Success  
Scott M. Sporer, MD, MS

Objectives:
1) Predict acetabular bone loss and develop a surgeon comfort “threshold” for acetabular revision
2) Demonstrate surgical techniques to address acetabular defects with cavitary bone loss.
3) Demonstrate surgical techniques to address segmental acetabular bone loss unable to be reconstructed with an isolated hemispherical acetabular component.

Defect Classification
Acetabular defect classifications can be used to predict intraoperative bone loss and to help guide reconstructive options. The classification of Paprosky utilizes four radiographic criteria from an AP pelvic radiograph: 1) Superior migration of the hip center 2) ischial osteolysis 3) teardrop osteolysis and 4) position of the implant relative to Kohler’s line. (Figure #1). Superior migration represents bone loss of the acetabular dome involving the anterior and posterior columns. Ischial osteolysis indicates bone loss from the posterior column including the posterior wall while teardrop osteolysis and migration beyond Kohler’s line represent medial bone loss. Proximal migration of the acetabular component beyond 3 centimeters from the native hip center or severe ischial lysis correlates with difficulty obtaining initial stability with a hemispherical component alone. These defects will require additional structural support from either a bulk allograft, metallic augmentation, acetabular cage or a custom implant in order to obtain stable initial fixation.

Treatment Algorithm
The treatment of an acetabular defect depends upon the degree and location of bone loss along with the potential for biologic fixation. Situations such as pelvic irradiation may result in periacetabular osteonecrosis with limited ingrowth potential. In these situations, nonbiologic fixation options such as acetabular cages and fixed angled devices, which offload the host bone, should be considered. Fortunately, the vast majority of acetabular revisions can be managed successfully with a hemispherical component. An algorithmic approach to acetabular defects can be helpful for both preoperative planning as well as surgical decision making. (Figure #2)
Tips and Pearls for Acetabular Revision:

Paprosky Type IIB:

- Ream until anterior and posterior column engaged to allow intrinsic trial stability
- Ream slightly superior to improve coverage
- Avoid “Chasing” superior dome – O.K. to leave superior portion of acetabular component uncovered
- Reverse Ream with reamer 1-2 mm undersized to pack cavitary defects
- Use Cup with multiple Holes
- Avoid Spiked Cup
Paprosky Type IIC:

- Ream until anterior and posterior column engaged to allow intrinsic trial stability along acetabular rim
- Medial bone graft added until reverse reamer 1mm undersized “disengages” from drive shaft
- 2 mm press-fit of acetabular component
- Use larger cup size if “in between” sizes
- Use Cup with multiple Holes

Paprosky Type IIIA – Distal Femoral allograft:

- Verify infection free surgical site before opening distal femoral allograft
- Culture Femoral Allograft
- Avoid use of femoral head allograft
- Elevate Abductor musculature to allow adequate visualization of iliac wing – Taylor retractor
- Cut “#7” portion of allograft at slightly <90˚ to allow intrinsic stability
- Use 6.5 Cancellous screws always with a washer
- Tap allograft to avoid fracture
- Avoid tendency to place component in excessive abduction and retroversion – i.e.- leave cup uncovered.
- Place screws through cup/allograft/host bone if possible
Paprosky Type IIIA – Hemispherical component with Metal Augment:

- Progressively ream in anatomic position to engage anterior/posterior column to allow intrinsic stability to acetabular trial
- Place superior augment with trial in place (appropriate version and abduction) Augment can be placed in any position/orientation to allow improved initial stability. Leave 1-2 mm between cup and augment for placement of cement
- Use motorized burr along superior dome to fit host bone to augment to improve intrinsic stability and maximize bone contact.
- Pack augment with bone graft leaving metal of augment facing cup exposed
- Place cement directly onto porous revision cup only in areas mating with augment.
- Insert cup with cement in doughy phase to improve interdigitation between cup and augment
- Consider cement with antibiotics
- Before cement hardens, attempt to place screw in revision cup to eliminate motion during final seating of screws
- Place bone wax in end of screws to facilitate cup removal
Paprosky Type IIIB – Hemispherical component with Metal Augment - no discontinuity:

- Augments used to “reconstruct” pelvis with non biologic material
- Exposed all margins of acetabular defect
- Progressively ream until two points of fixation are achieved. (ant-posterior, anterior-inferior, posterior-inferior)
- Inferior bone stock (ischium) often minimally involved
- Intrinsic stability will not be able to be obtained with trial.
- Use augments to decrease acetabular volume and facilitate press-fit between cup and augment. i.e. attempt to place augment in direct contact with revision cup
- Secure augment first
- Reverse ream with augment in place to pack bone graft
- Clear bone graft from exposed host bone. i.e. – maximize host bone

Paprosky Type IIIB – Pelvic discontinuity Distraction:

- Porous acetabular component used to “reconstruct” pelvis with biologic material as an internal fixation device
- Exposed all margins of acetabular defect and discontinuity thoroughly
- If gross motion seen and bone contact possible, use posterior column plate
- Progressively ream until two points of fixation are achieved. (ant-posterior, anterior-inferior, posterior-inferior)
- Intrinsic stability will not be able to be obtained.
- Use augments to decrease acetabular volume and facilitate press-fit between cup and augment. i.e.- attempt to place augment in direct contact with revision cup
- Bridge discontinuity with augment and place screws cephalad and caudal
- Remove fibrous tissue in discontinuity and place graft
- Reverse ream with augment in place to pack bone graft
- Clear bone graft from exposed host bone. i.e. – maximize host bone-Revision cup area
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The unacceptable failure rate of cemented femoral revisions led to many different cementless femoral designs employing fixation in the damaged proximal femur, with biological coating’s limited to this area. The results of these devices were uniformly poor and were abandoned for the most part by the mid 1990’s.

Fully porous coated devices employing distal fixation in the diaphysis emerged as the gold standard for revisions, with several authors reporting greater than 95% success rate at 15 to 20 years of follow-up. Surgical techniques and ease of insertion improved with the introduction of the extended trochanteric osteotomy as well as curved, long, fully porous coated stems with diameters up to 23mm. The limits of these stems were stretched to include any stem diameter in which even 1 - 2cm. of diaphyseal contact could be achieved. When diaphyseal fixation was not possible (Type IV), the alternatives were either impaction grafting or allograft prosthetic composite (APC).

As the results of fully porous coated stems were very carefully scrutinized, it became apparent that certain types of bone loss did not yield the most satisfactory results both clinically and radiographically. When less than 4 cm. of diaphyseal press fit (Type IIIb) was achieved, mechanical failure rate (MFR) was over 25%. It also became apparent that even when there was 4-6 cm. diaphyseal contact (Type IIIa) and the stem diameter was 18mm. or greater, post-op pain and function scores were significantly less than those with smaller diameter stems. This was probably due to modular mismatch from the stiffness of the chrome cobalt stem. Due to fairly significant amounts of bone loss and large diameter stems, impaction grafting became quite popular. The main purpose of this was to restore bone. The limitations were such that when the stems were in varus, there was a higher incidence of loosening and extended trochanteric osteotomies were not recommended. Additionally, in these more severe defects, there was torsional remodeling leading to marked distortion of anteversion. This made judging the amount of anteversion to apply to the stem at the time of insertion very difficult, leading to higher rates of dislocation. These distortions were not present in Type I and Type II femurs.

The clinical results were, overall, much improved from cemented femoral revisions and proximal coated femoral revisions. Due to some of the problems with the fully coated monoblock stems and impaction grafting, the use of modular taper stems emerged and is currently the most common method of fixation for femoral revisions. Initially, there was breakage at the modular junctions, but these junctions have been enhanced and the risk of stem fracture has been substantially reduced. Moreover, we believe if there is no clear advantage to modularity such as in Type I and Type II femurs, then monoblock taper stems should be used.

In severe femoral proximal remodeling, anteversion adjustments provided by modularity are of benefit in Type IIIA and Type IIIB revisions. The verdict is still out on Type IV femurs. We are extending the indications of taper stems to these particular femurs. The early to mid term results have been promising. However, there are still Type IV femurs that require either impaction grafting, tumor prostheses or A.P.C’s.

In summary, for the past 10 years, low modulus taper stems of the Wagner design have been used for almost all Type IIIA and Type IIIB bone defects. The taper design with fluted splines allows for fixation when there is less than 2cm. of diaphysis. The results in these femurs even with diameters of up to 26mm. have led to very low M.F.R.’s and significantly less thigh pain. Independent anteversion adjustment is also a huge advantage in these modular stems. Similar success rates, albeit with less follow-up, have been noted in Type IV femurs.
Revision for Periprosthetic Fracture
Daniel J. Berry, MD

Prevention: Many periprosthetic femur fractures may be prevented by (1) good patient follow-up, (2) timely reoperation of lytic lesions if radiographs suggest fracture risk, (3) prophylactic use of longer stemmed implants or strut grafts to bypass cortical defects at revision surgery.

Treatment: Periprosthetic fractures can be treated using an algorithmic approach based on the Vancouver classification system.

Fractures of greater or lesser trochanter (Type A):
- nonoperative treatment if displacement acceptable and if not associated with lysis.
- operative treatment if displacement unacceptable or associated with progressive lysis.

Fractures of distal femur well distal to implant (Type C):
- treat as any other femur fracture, usually operatively.
- fixation options: plate/retrograde nails

Fractures around the implant or at its tip (Type B):
These fractures almost always require surgery. Nonoperative treatment is associated with high rate of malunion, nonunion, poor results. Treatment is according to fixation status of implant and bone quality.
- Well-fixed stem (Type B1): ORIF with cable plate and/or strut grafts or locking plate with indirect reduction technique.
- Loose stem, reconstructible bone (Type B2): revise implant to long stem; usually use uncemented distally-fixed implant; occasionally long cemented stem (avoid cement extrusion)
  * Principles: obtain fracture stability, implant stability, and optimize conditions for bone healing (use bone grafts, don't strip periosteum)
- Loose stem, unreconstructible proximal bone damage (Type B3): revise substituting for proximal femur with allograft prosthetic composite or tumor prosthesis or strong fluted tapered modular stem.
  *For most Type B2 and B3 fractures the author prefers fluted tapered modular stems which gain axial and rotational stability distal to the fracture. Wrap the fracture around the proximal stem using it as a scaffold.
Diagnosing the Cause of Dislocation and Surgical Treatment for Recurrent Dislocation
Douglas E. Padgett, MD

1. What to do with the patient who dislocates after THR?
   a. Who did the surgery?
      i. You: what happened at primary procedure?
      ii. Elsewhere: try to find out what happened at procedure?
   b. Timing of Instability:
      i. Early (first 6-8 weeks)
      ii. Later
      iii. First timer vs multiple dislocator
   c. Direction of instability:
      i. This is important and relative to approach.
         1. i.e.- early dislocator who subluxes anteriorly done via a posterior approach has a different natural history than a posterior dislocator
   d. Mechanism:
      i. What were the circumstances?
         1. Don’t accept the “spontaneous dislocation”: I was just sitting there and my hip popped out!
         2. Adherence to precautions?
         3. Does the patient understand them?
   e. Radiographic evaluation:
      i. Minimal data set:
         1. Centered AP pelvis, true lateral of the femur
            a. Socket: abduction angle, version angle on true lateral
            b. Femur: length, offset
            c. Combined offset: look at opposite hip
            d. If this is the acute dislocation: must determine the direction of dislocation because it will affect reduction techniques
   f. Reduction of the dislocated hip:
      i. Knowledge of direction of instability to guide reduction maneuver
         1. Sedation
         2. Strength not as important as appropriate leverage:
            a. Think martial arts
         3. Post-reduction: check ROM for stability
   g. Bracing:
      i. Controversial
      ii. Data not compelling:
      iii. Type of brace:
         1. Hip abduction brace
            a. Posterior dislocation:
               i. Motion limits:
                  • Hip flexion stop at 70 degrees
                  • Abduction fixed at 25-30 degrees
            b. Anterior dislocation:
               i. Need to control rotation and restrict extension
                  • Hip flexion arc 20 degrees to 70 degrees
                  • Long leg extension to limit external rotation
iv. Duration of bracing:
   1. Data not clear
   2. Most recommend 6 week course of bracing BUT re-enforcement of hip precautions

h. Prognosis
   i. Patient Factors:
      1. Sex, diagnosis, cognition
   ii. Implant Factors:
      1. Head size, cup size, head-neck ratio, offset (femoral, acetabular)
   iii. Surgeon Factors:
      1. Soft tissue tension (leg length/ offset)
      2. Offset affect upon impingement:
         a. Socket offset
         b. Femoral offset
         c. Combined
      3. Version: stem / cup and combined!

iv. The Natural History of the THR:
   1. Cumulative Dislocation Rate
   2. Distribution of when dislocation occurs
   3. What happens to the :
      a. Early dislocator
      b. Late dislocator

2. The Recurrent Dislocator:
   a. Role of conservative treatment:
      i. Limited!
      ii. Perhaps in the cognitively impaired, noncompliant patient
   b. Surgical management of the recurrent dislocator:
      i. Tailor to etiology (if known!)
      ii. Rush Algorithm extremely helpful (Wera et al J Arthroplasty ’12): 6 Etiologies
         1. Acetabular malposition
         2. Femoral malposition
         3. Abductor deficiency
         4. Prosthetic impingement
         5. Bearing Wear
         6. Unknown
      iii. Options: Try to base upon etiology if identifiable
         1. Change version (stem/cup)
         2. Change head size/liner
         3. Trochanteric advancement:
            a. An older but effective treatment
         4. Constrained liners:
            a. Short term success outstanding BUT:
            b. Same criteria for acceptable cup position in the primary THR
            c. Poorly placed cup is NOT salvaged by simply placing in a constrained liner.
         5. Dual Mobility Liners:
            a. European Data is encouraging but remember:
               i. Same indications for use as constrained liners
               ii. Intraprosthetic dislocation can occur!
REFERENCES


Staphylococci predate man by billions of years. In that time, they have evaded all attempts at control, manmade and otherwise. Therefore, it comes as no surprise that 85 years after the discovery of penicillin, Staphylococci remain a major cause of morbidity and mortality.

Despite a decline in methicillin resistant Staphylococcus aureus (MRSA) related deaths (1), there exists an epidemic of community acquired MRSA expressing novel mechanisms of antibiotic resistance, and mechanisms targeting the host immunity (2). This may be reflected by the increased incidence of periprosthetic joint infections attributable to resistant organisms (3), and the very poor response to attempted implant retention and eradication rates with two stage revision procedures (3-6).

The identification of virulence factors seen in hospital acquired-MRSA in community acquired-MRSA reflects the rapidity with which Staphylococci can adapt to evade successful treatment (7). The blurring of the line between hospital and community acquired MRSA, and the persistence of these species for long periods in asymptomatic carriers, means the rules for at risk populations, are rapidly being eroded (8).

Staphylococci expressing resistance to glycopeptides, daptomycin and rifampicin (9), and the emergence of insensitive Staphylococci requiring toxic doses of antibiotics, has pushed antibiotic treatment into the realms of anticancer chemotherapy (10). The appearance of genes on transferable plasmids capable of altering the Saphylococcal ribosomal RNA has resulted in resistance to Linezolid, previously the last line of defence (11).

This is no time for complacency in the fight against Staphylococci, instead extreme vigilance in outcomes analysis and vigorous collaboration with our colleagues in Infectious Disease and Pharmaceutical Science should guide and inform our future efforts.

REFERENCES


Revision THA for Infection
Bassam A. Masri, MD, FRCSC

While there has been a recent resurgence in the interest in one-stage exchange arthroplasty for infection after a total hip arthroplasty, two-stage exchange arthroplasty with an articulated spacer continues to be the standard of in most centre. The surgical technique requires attention to detail, and the observation of some basic principles.

The contraindications for one-stage exchange arthroplasty include: lack of a known organism, presence of multiple organisms, presence of resistant organism, presence of draining sinus, active sepsis, and the presence of severe bone loss that requires a complex reconstruction. A one-stage exchange requires reimplantation with antibiotic-loaded cement. In most series, cemented femoral fixation in revision total hip arthroplasty does not do as well in the long-term as cementless fixation. For cementless fixation to be successful at eradicating infection, a two-stage procedure is required, which makes two-stage exchange arthroplasty a more appealing solution despite its higher potential morbidity and higher toll on the patient, at least in the short term.

At the first stage, the implants are removed, and the wound is thoroughly debrided, and an articulated antibiotic loaded spacer is inserted. Four to six weeks of intravenous antibiotics under the supervision of an infectious diseases consultant are then given, and the patients is then monitored for period of a few weeks, averaging about 6 weeks for signs of infection recurrence while off antibiotics, and for signs that the inflammatory markers (ESR and CRP) are returning to normal. Complete return to normal is not necessary, particularly for the ESR, but a downwards trend in necessary. Quite often, the CRP will return to normal with resolution of the infection.

From a technical point of view, the following should be observed at the first stage:

1. Exposure: Exposure has to be wide enough so that all infected tissue is adequately debrided and all foreign material is removed. We typically favor the posterolateral approach because it is extensile and can easily incorporate a variety of femoral osteotomies that may be used for removal of well-fixed implants or cement from the femur. In many cases, the extended femoral osteotomy is necessary, particularly in the case of well-fixed fully porous-coated stems, or if cement needs to be removed from the femur. Excessive devascularization of the femur is not desirable, and the blood supply to bone should be respected. All infected-appearing tissue should be debrided.

2. Implant removal: Unfortunately, most infected hip replacements present with well-fixed implants. For this reason, the surgeon should be familiar with the specialized techniques to remove well-ingrown acetabular cups or stems. On the cup side, the surgeon should be familiar with the techniques to remove the liner from a metal-backed shell, and different implant systems use different methods. It is best for the surgeon to obtain the implant labels and to consult with the implant manufacturer if specific extraction devices are required. This simple step in preoperative planning may prevent a lot of intraoperative aggravation. Once the liner is removed, the screws need to be removed. Once again, it is crucial that the correct screw driver be available. Some implant systems use a hex-head screw driver but others use a Torx head screw driver. Some hospitals may not have the appropriate screw driver and therefore this should be considered preoperatively and ordered as necessary. Once the screws are removed, a hemispherical thin blade extraction system is helpful for atraumatic removal of the cup. Specialized instruments for well-fixed cementless stem removal or cement removal may be required and these have to be available. If trephines are needed for removing a well-fixed fully-porous coated stem, the surgeon needs to know the size of the
existing stem, and should have at least 5-10 trephines that are 0.5 mm larger than the stem available and sterile in the operating room. These trephines get dull quickly and multiple trephines are always required. Metal cutting high-speed burrs are also essential.

3. Once the implants are removed, the wound needs to be irrigated with at least 9 liters of sterile normal saline. Once the wound has been well-irrigated and fully debrided, the articulated spacer can be inserted.

4. The cup for the articulated spacer is cemented into the acetabular bed without creation of keying holes. This allows reasonable fixation but without solid interdigitation that would make cup removal at the second stage difficult. We prefer to use a one-size fits all cup for all cases, and the acetabular deficiency is filled with antibiotic-loaded bone cement. The typical dose of antibiotics in the cement, for sensitive organisms, is 3.6 gms of tobramycin and 1.5 gms of vancomycin per package of bone cement.

5. The femoral spacer is prepared using reamers or broached depending on the length of the stem. Standard length stems are prepared using broaches and longer stems are prepared using reamers. For the longer stems, reaming up to 13 mm is necessary, and fixation is achieved in a press-fit manner using a bowed stem design which achieved three point fixation. The appropriate mold for the size and length of the stem is lubricated with mineral oil, antibiotic cement is inserted into the mold, and the stem is inserted into the antibiotic-loaded cement so that it is fully coated with cement. Once the cement hardens, the mold is opened and the stem is press-fit into the femur. A variety of head lengths are available to fine-tune leg lengths, and the acetabular cup has a snap-fit configuration to provide some constraint against dislocation.

Using this technique, we looked up the 10-15 year outcomes after a two-stage revision for hip infection in 103 patients using the PROSTALAC (prosthesis of antibiotic-loaded acrylic cement) articulated hip spacer system in the interval between stages.

All patients were contacted to determine their current functional and infection status. The Oxford-12, SF-12, and WOMAC questionnaires were administered. Eleven of 99 patients had reinfection; 7 of whom responded to repeat surgery with no further sequelae. The long-term success rate for two-stage revision was 89%, or 96% with additional surgery. We were able to follow up 48 living patients, 71 % of whom provided health-related quality of life outcome scores. Quality of life outcomes were good with a global WOMAC of 80.6 ± 18.3, Oxford-12 of 74.0 ± 22.3, SF-12 of 53.1 ± 9.4 (mental) & 33.5 ± 13.5 (physical) and a mean satisfaction score of 90.5 ± 15.3.

Two-stage revision for hip infection using a PROSTALAC interim spacer offers a predictable and lasting solution for patients with this difficult problem. However, in some patients in whom a well-fixed cementless stem might cause bone loss when removed, a technique of a partial two-stage exchange whereby the acetabular component is removed and a temporary antibiotic-loaded articulated acetabular spacer is inserted without revising the femoral side has been described by Ekpo et al. The authors reported an 89% success rate at a minimum follow-up of two years, which is certainly encouraging.

More recently,

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CME Accreditation Statement
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Goals and Objectives
The objectives of the Open Meeting of The Hip Society are to provide up-to-date information on the treatment of hip problems including arthroplasty and non-arthroplasty options and surgical techniques.
Interactive symposia will be utilized.

Upon completion of this program, participants should be able to:

• Update clinical skills and basic knowledge through research findings and biomechanical studies.
• Discuss the various surgical and non-surgical treatments and management of conditions related to the hip joint.
• Determine indications and complications in total hip arthroplasty.
• Critique presentations of surgical techniques and demonstrations of treatment options.
• Evaluate the efficacy of new treatment options through evidence-based data.

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