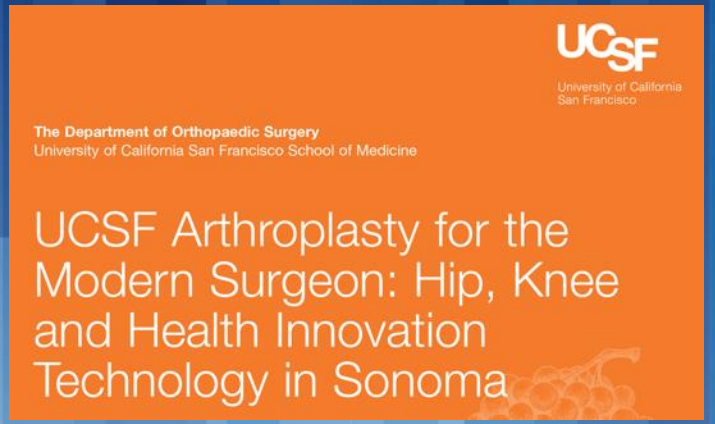
Is New Always Better? What have We Learned from Total Hip Arthroplasty?

Michael P. Bolognesi, MD
Professor of Orthopaedic Surgery
Division Chief, Adult Reconstruction
Duke University Medical Center



DUKE ARTHROPLASTY CLUB

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Division of Adult Reconstruction

Disclosures

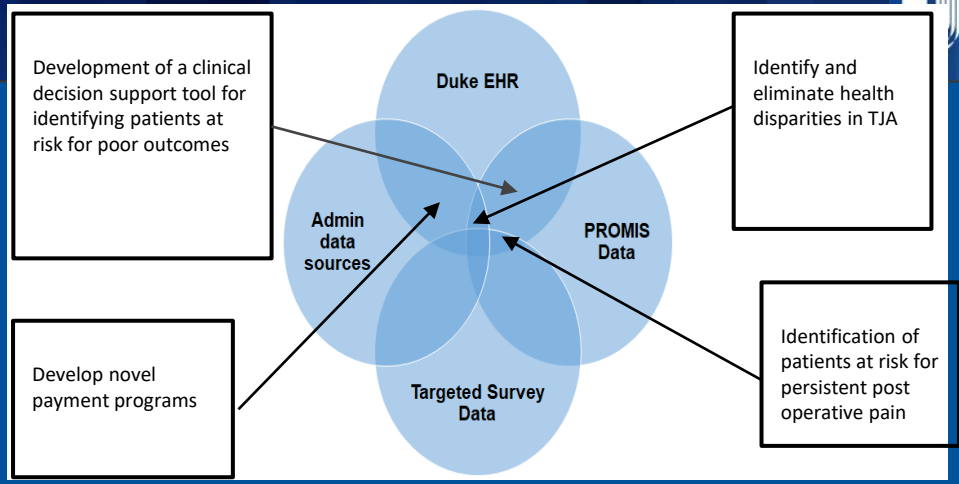
- *Amedica - Stock Options, Surgical Advisory Board*
- *Zimmer Biomet - Royalties, Consulting Payments, Resident Educational Support, Design Surgeon, Research Support*
- *Total Joint Orthopedics - Stock and Stock Options, Advisory Board Member, Resident Educational Support, Consultant Payments, Design Surgeon*
- *Depuy - Research Support, Resident Educational Support, Principal Investigator*
- *Exactech- Resident Educational Support*
- *Stryker - Resident Educational Support*
- *Smith and Nephew- Royalties, Resident Educational Support, Fellowship Support*
- *EOA- Board of Directors*
- *SOA Board of Directors*
- *Omega - Fellowship Support- Fellowship Director*
- *North American Specialty Hospital- Advisory Board*

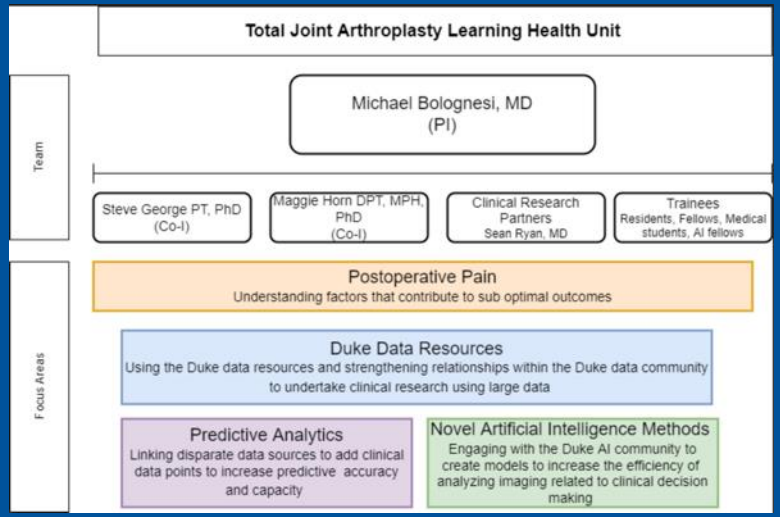
TOTAL JOINT ARTHROPLASTY

LEARNING HEALTH UNIT

DATA. DECISIONS. OUTCOMES.

Duke Clinical Research Institute | MUSCULOSKELETAL

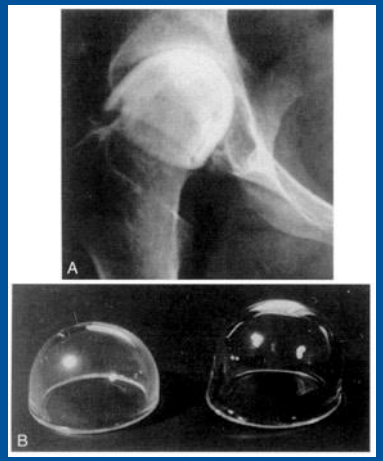




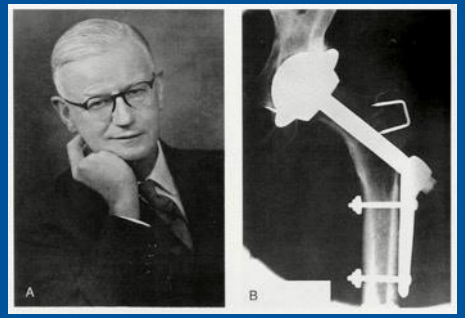
Overview

- *History*
- *MOM*
- *The Trunnion*
- *Modularity*
- *The Concern about Dislocation..*
- *I apologize that this talk casts a little negative light on the operation of the century.…*

History



Charnley
MOM x 2
Highly Cross Linked Poly



Results

- *Lots of things work*

Review

The operation of the century: total hip replacement

Ian D Learmonth, Claire Young, Cecil Rorabeck

Yet we have made many changes along the way in

A Story about Hylamer…

Hylamer

- *Collaborative project between Depuy and Dupont*
- *Subjected UHMWPE to high pressure and high temperature and then cooled at a slow controlled rated*
- *Increased crystallinity from 50% to 90%*
- *Higher yield strength, tensile strength, creep resistance, impact resistance and modulus.*
- *No improved wear in simulator studies?*
- *Over 80,000 liners implanted*

Brief Communication

Early Failure of Hylamer Acetabular Inserts Due to Eccentric Wear

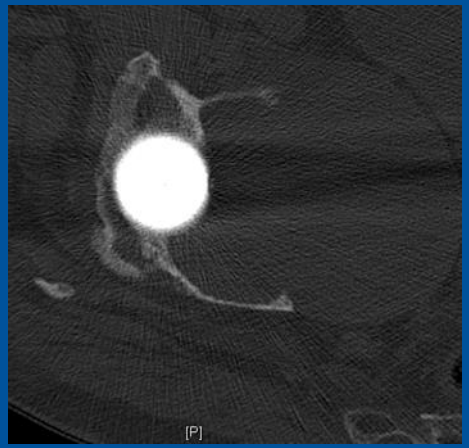
Michael J. Chmell, MD, Robert Poss, MD, William H. Thomas, MD, and Clement B. Sledge, MD

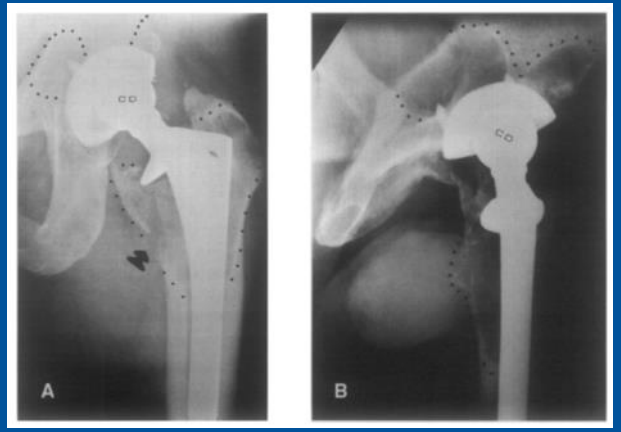
Brief Communication

Early Osteolysis With Hylamer Acetabular Liners

James H. Graeter, MD, and Russell Nevins, MD

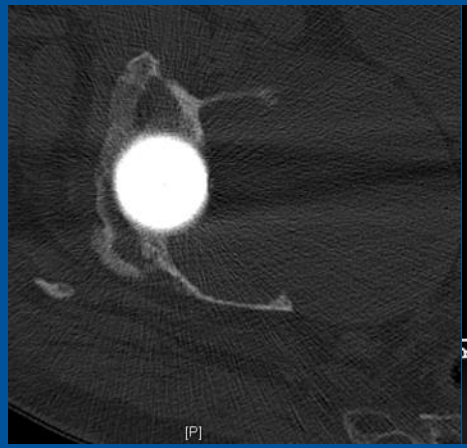
Abstract: We reviewed 78 patients with Hylamer acetabular liners (DePuy-Dupont Orthopedics, Warsaw, IN), with a mean follow-up of 3.8 years (range, 2–6 years), for signs of osteolysis secondary to polyethylene wear. Nine patients (11.5%) showed osteolysis greater than 1 cm^2. One patient had a greater trochanter fracture through a lytic area, one patient required a revision at 4 years for severe acetabular and femoral lysis with lesser trochanter fracture, and a second patient is awaiting revision. **Key words:** DePuy, Hylamer wear, osteolysis, revision.





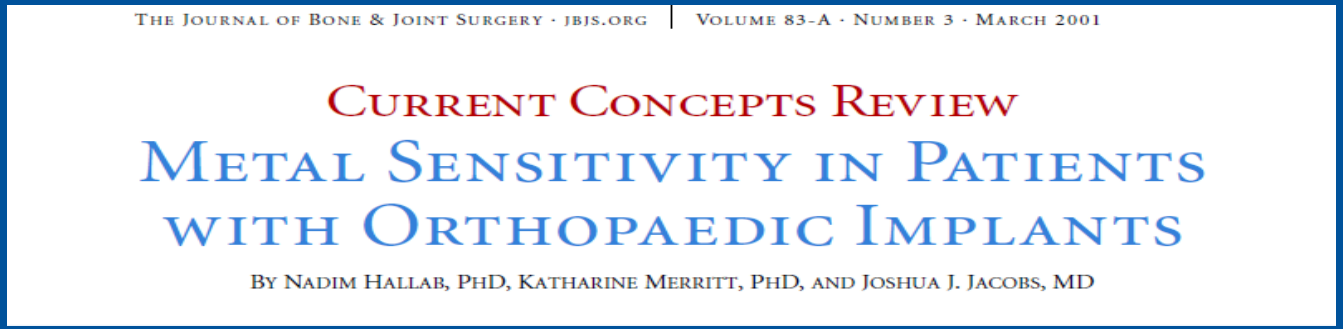
- *Utilization stopped in the mid 90's*
- *Oxidation on shelf in first three years*
- *Loss of mechanical properties and fracture resistance*

Disclosure: No “modern” bearing is perfect



Be Aware….. Bearing couplings

All metals in contact with biological systems undergo corrosion. This electrochemical process leads to the formation of metal ions, which may activate the immune system by forming complexes with endogenous proteins.



THE JOURNAL OF BONE & JOINT SURGERY · JBJS.ORG | VOLUME 83-A · NUMBER 3 · MARCH 2001

CURRENT CONCEPTS REVIEW

METAL SENSITIVITY IN PATIENTS WITH ORTHOPAEDIC IMPLANTS

BY NADIM HALLAB, PHD, KATHARINE MERRITT, PHD, AND JOSHUA J. JACOBS, MD

The first time MOM on failed…

Loosening, infection, bearing failure, Charnley implant!

Duke Orthopaedic Files

So why did we bring MOM back?….

Proposed Advantages

- *Decreased wear related lysis*
- *Implant longevity*
- *Decreased dislocation related to head size (approach dependent)*
- *Improved function?*

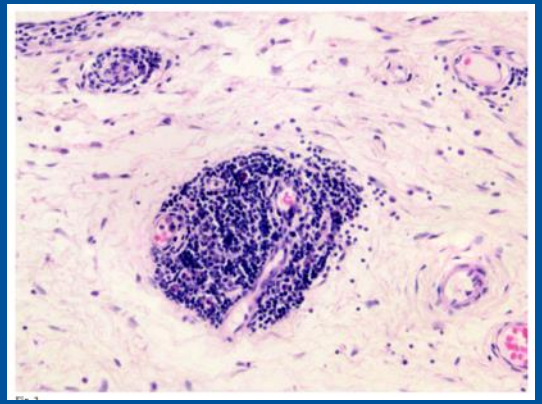
The optimal metal bearing:
smooth surface, large diameter, low clearance, and idealized lubrication environment (high carbon content, forged or cast?)

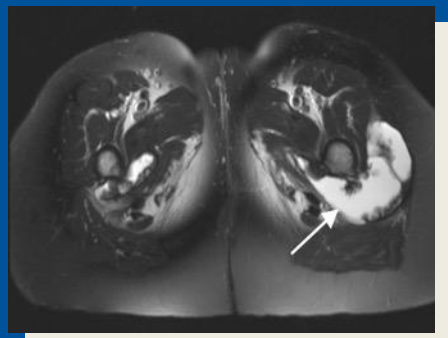
Pandit et al

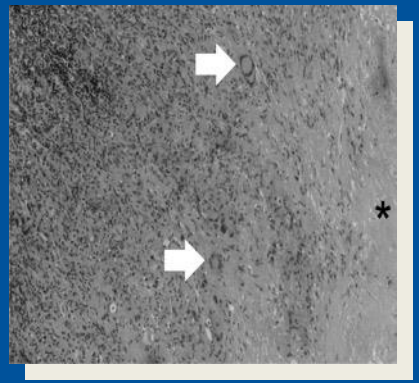
An Unusual Lymphocytic Perivascular Infiltration in Tissues Around Contemporary Metal-on-Metal Joint Replacements

By A.P. Davies, MD, H.G. Willert, MD, P.A. Campbell, PhD, I.D. Learmonth, FRCS, and C.P. Case, MRCPath

Investigation performed at Bristol Implant Research Centre, Avon Orthopaedic Centre, Southmead Hospital, Bristol, United Kingdom

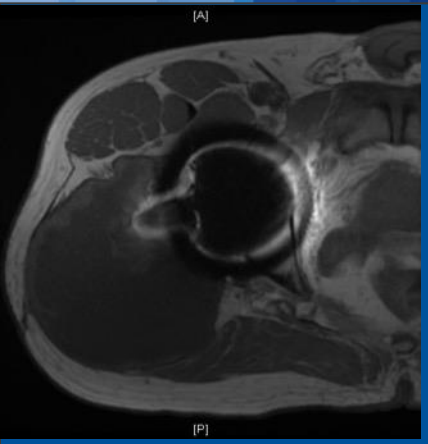


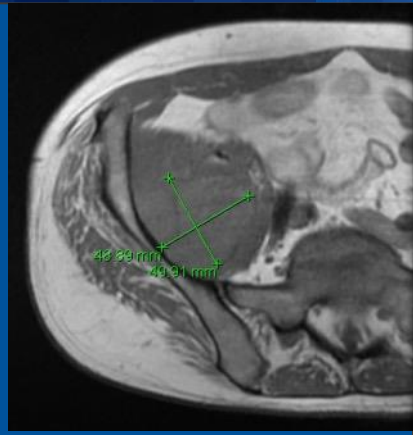




J Bone Joint Surg Br. 2008; 90-B:847-851

Real Concerns





- *Serum Cobalt and Chromium*
- *Carcinogenicity*
- *Chromosomal abnormalities*
- *Metal sensitivity- ALVAL*
- *Local tissue toxicity- metal reactivity leading to necrosis, osteolysis*
- *Pseudotumor*
- *High failure rate*
- *Technical issues?*

www.periodictable.com

Medical Device Alert

MHRA

- **May 25, 2010**: UK Medicines and Healthcare products Regulatory Agency (MHRA) Device Alerts

DePuy Orthopaedics Inc. a Johnson & Johnson company

March 5, 2010

URGENT FIELD SAFETY NOTICE

DePuy ASR™ XL Monoblock Metal-on-Metal System

Type of Action: New revision rate data/information regarding the use of the device

- **August 24, 2010-** U.S. voluntary recall

Lay press and internet helping us out as always..

Concerns

www.nyti

THE JOURNAL OF BONE & JOINT SURGERY

JBJS

This is an enhanced PDF from The Journal of Bone and Joint Surgery

The PDF of the article you requested follows this cover page.

Arthroprosthetic Cobaltism: Neurological and Cardiac Manifestations in Two Patients with Metal-on-Metal Arthroplasty: A Case Report

Stephen S. Tower

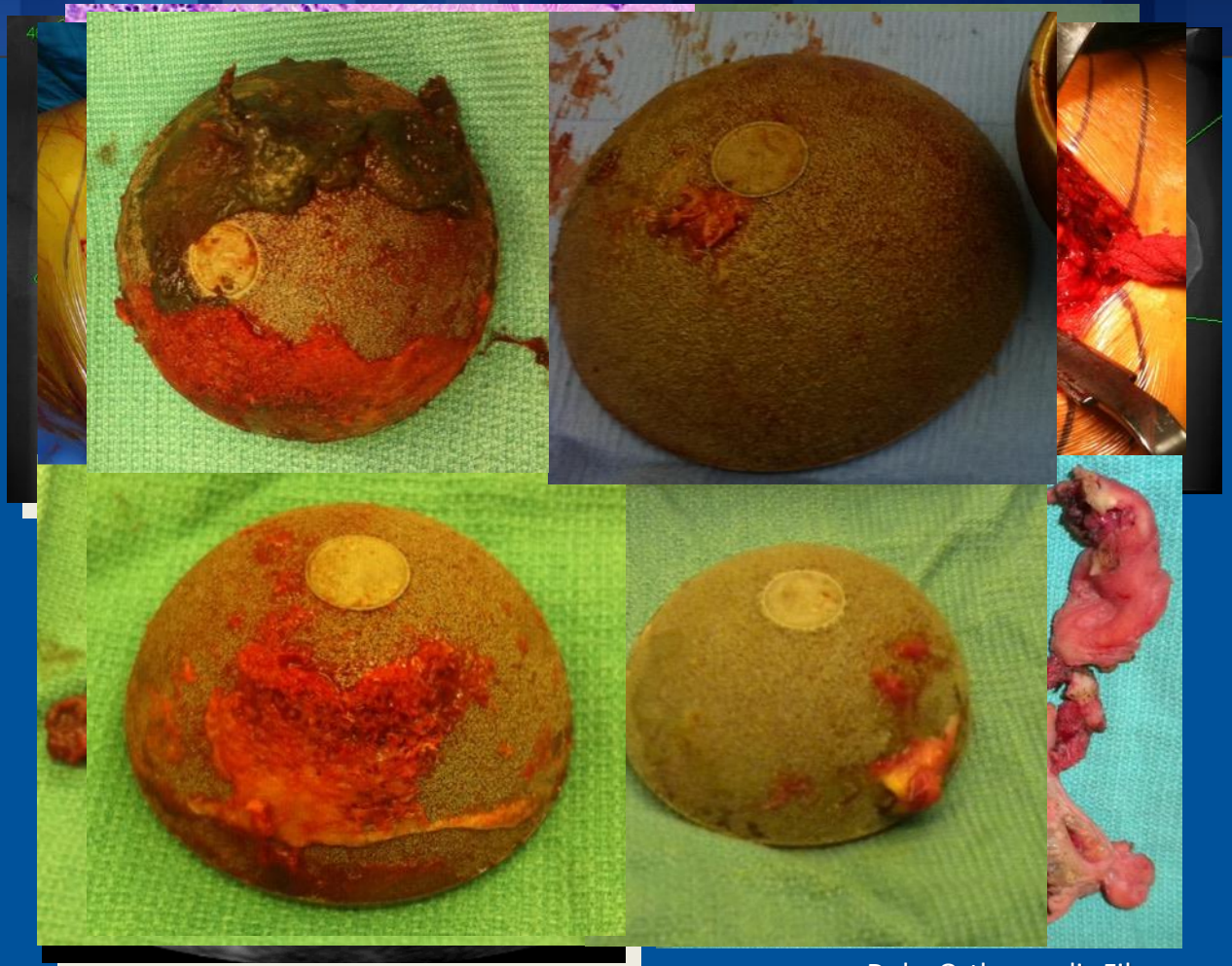
J Bone Joint Surg Am. published online Oct 29, 2010
Access the most recent version at doi:10.2106/JBJS.J.00125

zimmer

www.wtvd/abc11_investigates.com

We were seeing a lot of painful MOM THA's

- Work up became predictable
- Regular WU (films, infection, etc)
- Serum Cobalt
- Serum Chromium
- MARS MRI
- US Exam
- Aspiration in selected cases



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Or you could see this…..

Clin Orthop Relat Res (2013) 471:430–438
DOI 10.1007/s11999-012-2547-5

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

SYMPOSIUM: PAPERS PRESENTED AT THE ANNUAL MEETINGS OF THE HIP SOCIETY

The Withdrawn ASR™ THA and Hip Resurfacing Systems

How Have Our Patients Fared Over 1 to 6 Years?

**Kevin T. Hug MD, Tyler S. Watters MD,
Thomas P. Vail MD, Michael P. Bolognesi MD**

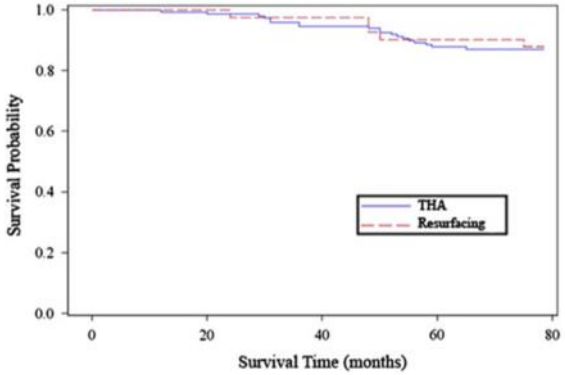


Fig. 1 The Kaplan-Meier cumulative probability of survival of the ASR™ cup with an end point of revision for any reason is 0.87 for THA and 0.88 for hip resurfacing.

But it was not just the ASR….

Patient Cohort (MRI)

966
Metal-on-Metal THA (2002-2012)

207
MARS MRI

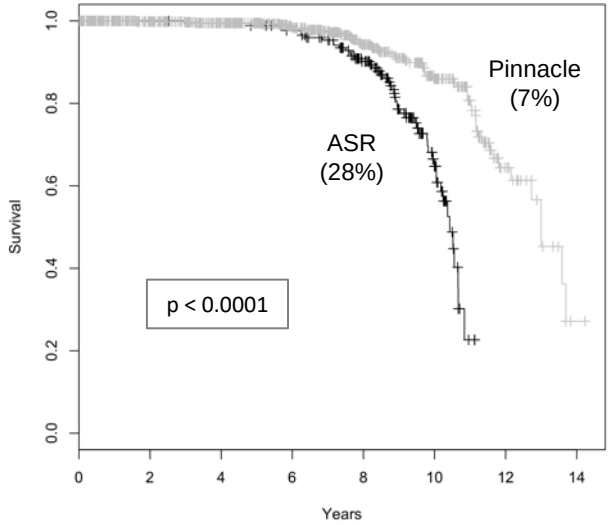
78
DePuy Articular Surface Replacement (ASR)

129
DePuy Pinnacle/Ultamet

Average Follow-up:	8.5 years	8.0 years
Min 2-year:	100%	100%

[178 ASR] + [788 Pinnacle/Ultamet]

Revision Rates



Comparing ASR and Pinnacle Cohorts

Key Findings

- ASR – earlier timing to MRI, higher Cobalt (and Ratio)
- No other significant differences
- Pseudotumor Findings:
  - Similar prevalence, size, and category

	Overall (N=207)	ASR (N=78)	Pinnacle (N=129)	P-values
Demographics				
Age, mean (years)	51.4	50.1	52.2	0.097
Male, N (%)	119	49 (63%)	70 (54%)	0.228
Patient factors				
Time to MRI	6.5	5.6	7.0	**< 0.0001**
Bilateral MOM	56 (27%)	23 (30%)	33 (26%)	0.540
Symptomatic	129 (62%)	49 (63%)	80 (62%)	0.908
Laboratory Data				
Cobalt Median (Mean) (µg/L)	7.1 (13.6)	9.7 (20.1)	4.8 (9.3)	**< 0.0001**
Chrom Median (Mean) (µg/L)	2.6 (7.2)	3.0 (6.4)	2.4 (7.7)	0.462
Ratio Median (Mean)	1.8 (3.0)	3.4 (4.7)	1.3 (1.9)	**< 0.0001**
MARS-MRI Results				
Pseudotumor Present, N (%)	107 (52%)	41 (53%)	66 (51%)	0.280
Size Median (mean) (cm)*	5.1 (5.9)	5.0 (5.8)	5.1 (5.9)	0.682
Category				0.974
Type I, N (%)	65 (61%)	24 (58%)	41 (62%)	
Type II, N (%)	22 (20%)	11 (27%)	11 (17%)	
Type III, N (%)	20 (19%)	6 (15%)	14 (21%)	

*Size was determined by measuring the maximum diameter in either the axial or coronal plane on MARS-MRI

Factors Associated With Pseudotumor Presence

Key Findings

- Patients with pseudotumor more likely to have:
  - Higher cobalt levels (and ratio)
  - High offset femoral component
  - Larger acetabular component

	Overall (n = 207)	Pseudotumor (n = 107)	No Pseudotumor (n = 100)	P-values
Demographics				
Time from index surgery (years)	6.5	6.3	6.7	0.316
Age, mean (years)	51.4	52.1	50.1	0.531
Male, N (%)	119 (57%)	66 (62%)	53 (53%)	0.207
Laboratory Results				
Cobalt Median (Mean) (µg/L)	7.1 (13.6)	8.7 (17)	5.9 (10.1)	**0.008**
Chrom Median (Mean) (µg/L)	2.6 (7.2)	2.7 (9.1)	2.5 (5.1)	0.363
Ratio Median (Mean)	1.8 (3.0)	2.4 (3.3)	1.6 (2.7)	**0.036**
Implant Factors				
Offset				
High	85	53	32	**0.0126**
Standard	98	43	55	
Unknown	24	11	13	
Cup Size Median (Mean) (mm)	55.0 (54.8)	56.0 (55.2)	54.0 (54.3)	**0.0277**

Pseudotumor Not Correlated With Symptoms

Key Findings

- Symptomatic vs Asymptomatic:
  - Similar metal ion levels
  - Similar pseudotumor prevalence, size, and category
  - Pseudotumor present in **47%** of asymptomatic patients

	Overall (n = 207)	Symptomatic * (n = 129)	Asymptomatic (n = 78)	P-values
Demographics				
Age, mean (years)	51.4	50.5	53.0	**0.046**
Male, N (%)	119 (57%)	70 (55%)	49 (76%)	0.228
Laboratory Results				
Cobalt Median (Mean) (µg/L)	7.1	7.2 (14.2)	5.7 (11.7)	0.471
Chrom Median (Mean) (µg/L)	2.6	2.9 (8.0)	2.4 (5.8)	0.841
Ratio Median (Mean)	1.8	1.9 (3.1)	1.7 (2.9)	0.617
MARS-MRI Results				
Pseudotumor Present (%)	107 (52%)	70 (54%)	37 (47%)	0.341
Size Median (Mean) (cm)*	5.1 (5.9)	5.4 (6.3)	4.9 (5.0)	0.295
Category				0.417
Type I, N (%)	65 (61%)	40 (57%)	25 (68%)	
Type II, N (%)	22 (20%)	17 (24%)	5 (13%)	
Type III, N (%)	20 (19%)	13 (19%)	7 (19%)	

*Symptomatic patients defined as having pain and/or weakness/limp

Pseudotumor Correlated With Revision

Key Findings

- Patients undergoing revision more likely to have:
  - Higher ion levels
  - Pseudotumor present
  - Larger pseudotumor
  - Thick-walled or solid pseudotumor

	Overall (n = 207)	Revision (n = 74)	No Revision (n =133)	P-values
Demographics				
Age, mean (years)	51.4	50.6	51.9	0.347
Female, N (%)	88	34 (46%)	54 (41%)	0.556
Laboratory Results				
Cobalt Median (Mean) (µg/L)	7.1 (13.6)	12.0 (25.1)	4.0 (6.9)	**<0.0001**
Chrom Median (Mean) (µg/L)	2.6 (7.2)	4.6 (13.2)	2.1 (3.6)	**<0.0001**
Ratio Median (Mean)	1.8 (3.0)	2.5 (3.8)	1.7 (2.5)	**0.0230**
Imaging Results				
Pseudotumor Present (%)	107 (51.7%)	51 (68.9%)	56 (42.1%)	**0.0002**
Size Median (Mean) (cm)*	5.1 (5.9)	6.5 (7.5)	4.2 (4.4)	**<0.0001**
Category				**<0.0001**
Type I, N (%)	65 (61%)	20 (39%)	45 (80%)	
Type II, N (%)	22 (21%)	16 (31%)	6 (11%)	
Type III, N (%)	20 (19%)	15 (29%)	5 (9%)	

Conclusions: Effects of Pseudotumors In Patients

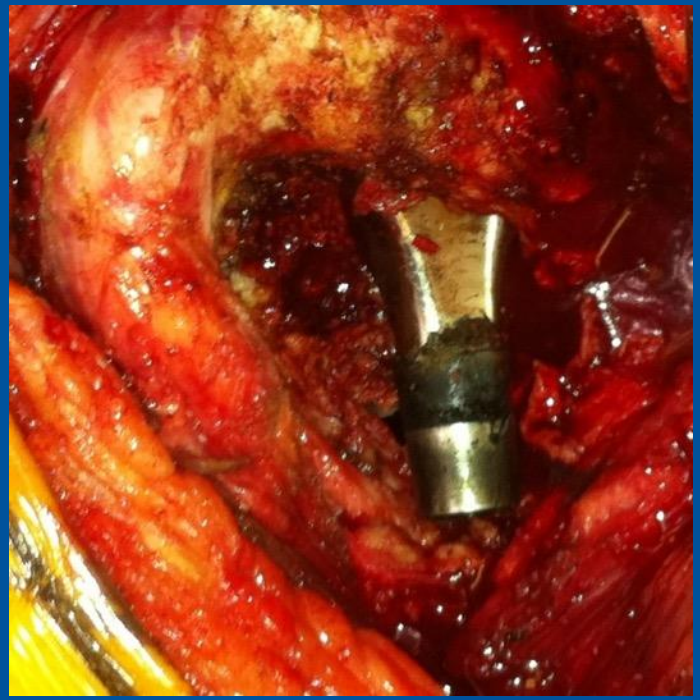
- **Overall high prevalence of pseudotumor in patients with MoM THA and MRI (52%)**
  - Nearly 40% of pseudotumors either thick-walled cystic lesions or solid lesions
- **Factors significantly correlated with pseudotumor presence:**
  - Elevated Cobalt ion levels and CoCr ratio
  - High offset stem
  - Increasing cup size
- **Patient symptoms may not be reliable indicator of pseudotumor presence or severity**
  - 38% of pseudotumors were in asymptomatic patients, no correlation with severity
  - In asymptomatic cohort, pseudotumor prevalence was 47%
- **Revised patients have higher ion levels and more frequent and severe pseudotumors**

So MOM THA 2.0 was not a good idea….

The revision of non ASR MOM THA educated us about the trunnion….





Not just in MOM THA….

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The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Diagnosis and Management of Adverse Local Tissue Reactions Secondary to Corrosion at the Head-Neck Junction in Patients With Metal on Polyethylene Bearings

Darren R. Plummer, MD, MBA [a], Richard A. Berger, MD [b], Wayne G. Paprosky, MD [b], Scott M. Sporer, MD [b], Joshua J. Jacobs, MD [b], Craig J. Della Valle, MD [b]

[a] Department of Orthopaedic Surgery, The Ohio State University Wexner Medical Center, Columbus, Ohio
[b] Orthopaedic Surgery, Midwest Orthopaedics at Rush, Chicago, Illinois

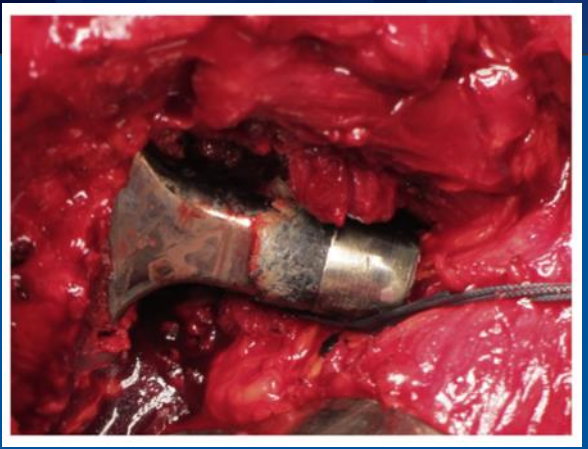

Table 1
Primary THA Components.

Case	Femoral Component	Femoral Head Size	Taper Neck Length	Acetabulum Component
1	Zimmer Versys Beaded FullCoat	32	+3.5	Zimmer Trilogy
2	Zimmer Versys Beaded FullCoat	28	+10.5	Zimmer Trilogy
3	Zimmer Versys Beaded FullCoat	36	+7	Zimmer Trilogy
4	Zimmer Versys Beaded FullCoat	28	+10.5	Zimmer Trilogy
5	Zimmer Versys Beaded FullCoat LHC	32	+3.5	Zimmer Trilogy
6	Zimmer Versys Beaded FullCoat Revision	32	+10.5	Zimmer Trilogy
7	Zimmer Versys FiberMetal Taper	32	−3.5	Zimmer Trilogy
8	Zimmer M/L Taper, Kinectiv Modular Neck	32	0	Zimmer Trilogy
9	DePuy Bantam AML Full Porocoat	28	+5	Zimmer Trilogy
10	Stryker Accolade	36	+0	Stryker Trident PSL
11	Zimmer Versys Beaded FullCoat LHC	40	+7	Zimmer Trilogy
12	Zimmer Epoch FullCoat	36	0	Zimmer Trilogy
13	Zimmer Versys Beaded FullCoat LM	32	0	Zimmer Trilogy
14	Zimmer Versys Beaded FullCoat	28	+3.5	Zimmer TM Modular
15	Zimmer Versys Beaded FullCoat LHC	32	+7	Zimmer Trilogy
16	Emperion Stem Full coat	32	0	S&N MR3
17	Zimmer Versys Beaded FullCoat LM	40	0	Zimmer Trabecular metal
18	Zimmer Versys Beaded FullCoat LHC	36	+3.5	Zimmer Trilogy
19	Zimmer Versys Beaded FullCoat	36	7	Zimmer Trilogy
20	Depuy Prodigy AML	32	13	Duraloc Marathon
21	Zimmer Versys Beaded FullCoat	32	0	Zimmer Trilogy
22	Zimmer Versys Beaded FullCoat LHC	32	3.5	Zimmer Trilogy
23	Depuy Tri-Lock	32	13	DePuy Pinnacle
24	Zimmer Versys Beaded FullCoat LHC	32	3	Zimmer Trilogy
25	Zimmer Bias Porous Coated stem	32	0	Zimmer HG2
26	Stryker Accolade	32	8	Stryker Tritanium
27	Zimmer Versys Beaded FullCoat	32	0	Zimmer Trilogy

The Journal of Arthroplasty 30 (2015) 641–648

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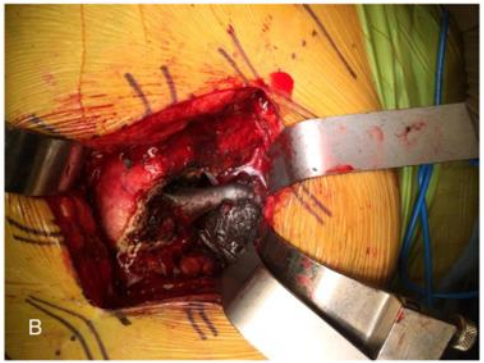
The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Gross Trunnion Failure After Primary Total Hip Arthroplasty

Samik Banerjee, MD, Jeffrey J. Cherian, DO, James V. Bono, MD, Steven M. Kurtz, PHD, Rudolph Geesink, MD, R. Michael Meneghini, MD, Ronald E. Delanois, MD, Michael A. Mont, MD

Fig. 2. (A) and (B) Initial radiographic images on presentation (patient 2) showing dissociation of the trunnion from the femoral head.



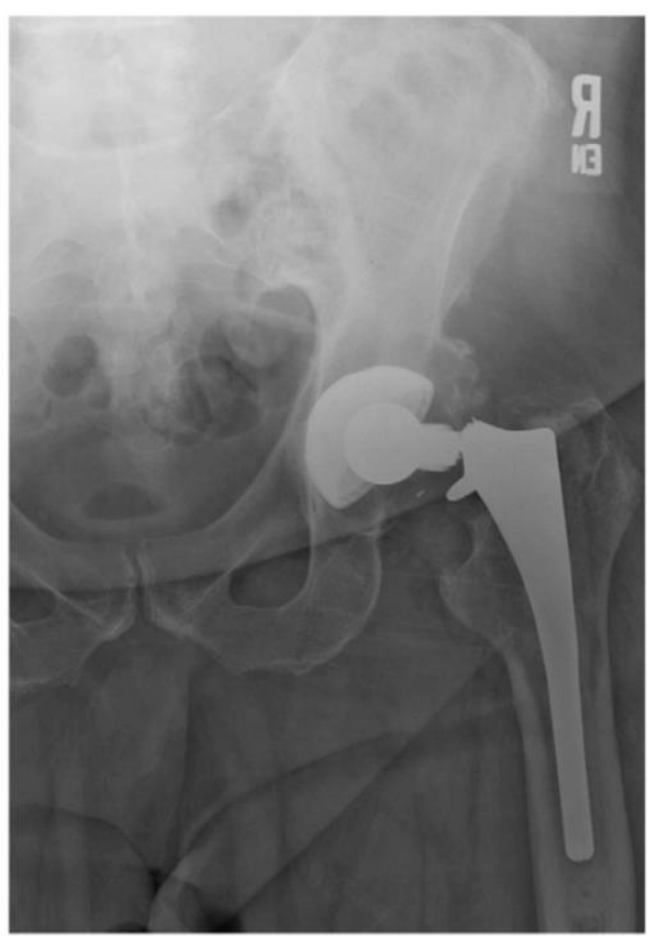


Fig. 4. Typical bird beak appearance of the trunnion as a result of severe mechanically assisted crevice corrosion. (patient 2).

Spontaneous Modular Femoral Head Dissociation Complicating Total Hip Arthroplasty

CARL T. TALMO, MD; KINZIE G. SHARP, PA-C; MAGDALENA MALINOWSKA, PA-C; JAMES V. BONO, MD; DANIEL M. WARD, MD; JUSTIN LAREAU, MD

Figure 1: Preoperative anteroposterior radiograph of the right hip in Patient 1, showing dissociation of the femoral head and femoral stem.

Figure 2: Postoperative photograph of the retrieved stem from Patient 1, showing severe trunnion wear and deformation. The inset illustrates notching of the trunnion.

Figure 3: Preoperative anteroposterior radiograph showing dissociation of the prosthetic left femoral head.

Significant metal debris was found within the hip joint and surrounding tissues, including the trochanteric bursa. The trunnion of the prosthesis showed corrosion, severe wear, and deformation, with deep

Figure 4: Postoperative photograph of the retrieved stem obtained from Patient 2, showing similar trunnion wear and deformation as seen in Patient 1, with deep grooves in the inferior femoral neck.

Current Concepts Review

Trunnionosis in Total Hip Arthroplasty

Mitchell C. Weiser, MD, MEng, and Carlos J. Lavernia, MD

Investigation performed at the Department of Orthopaedic Surgery, New York University Langone Medical Center, New York, NY, and the Arthritis Surgery Research Foundation, Miami, Florida

TABLE II Goldberg Fretting and Corrosion Score*

Severity of Corrosion and Fretting	Score	Criteria
None	1	No visible corrosion observed.
		No visible signs of fretting observed.
Mild	2	<30% of taper surface discolored or dull;
		Single band or bands of fretting scars involving 3 or fewer machine lines on taper surface
Moderate	3	>30% of taper surface discolored or dull, or
		<10% of taper surface containing black debris, pits, or etch marks;
		Several bands of fretting scars or single band involving more than 3 machine lines
Severe	4	>10% of taper surface containing black debris, pits, or etch marks;
		Several bands of fretting scars involving several adjacent machine lines, or flattened areas with nearby fretting scars

*Reproduced, with permission, from: Goldberg JR, Gilbert JL, Jacobs JJ, Bauer TW, Paprosky W, Leurgans S. A multicenter retrieval study of the taper interfaces of modular hip prostheses. Clin Orthop Relat Res. 2002 Aug;401:149-61. www.clinorthop.org.

TABLE IV Grades of Recommendation*

Recommendation	Grade
Flexible trunnion designs and alloy compositions should be avoided.	B
Large heads (≥32 mm) should be avoided.	C
Mixed alloy head-stem couples should be avoided.	C
Ceramic heads are less susceptible to trunnion corrosion.	B
Trunnion should be cleaned and dried prior to head impaction.	B
Head should be impacted with a single axial-aligned blow of sufficient force.	B
Serum cobalt and chromium ion levels are useful in diagnosing trunnion corrosion.	B
Advanced cross-sectional imaging is useful in the diagnosis of ALTR.	B
Well-fixed corroded femoral stems with structurally intact trunnions may be retained at the time of revision.	B

*According to Wright[90], grade A indicates good evidence (Level-I studies with consistent findings) for or against recommending intervention; grade B, fair evidence (Level-II or III studies with consistent findings) for or against recommending intervention; grade C, poor-quality evidence (Level-IV or V studies with consistent findings) for or against recommending intervention; and grade I, insufficient or conflicting evidence not allowing a recommendation for or against intervention.

How do you clear a trunnion?

- I really do not have a great answer..

The Journal of Arthroplasty 33 (2018) 2716–2719

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

2017 AAHKS Annual Meeting Symposium

Management of the Implant With Taper Corrosion: What to Change and What to Change It to?

Michael P. Bolognesi, MD *

Division of Orthopaedics, Duke University Medical Center, Durham, North Carolina

- Bill Giffin from OC one time told me to just make sure to get all of the black stuff off...

Head Selection in Trunnionosis Revision?

….Always?

HSSJ (2017) 13:241–247
DOI 10.1007/s11420-017-9566-4

HSS Journal®
The Musculoskeletal Journal of Hospital for Special Surgery

ORIGINAL ARTICLE

Ceramic Bearings with Titanium Adapter Sleeves Implanted During Revision Hip Arthroplasty Show Minimal Fretting or Corrosion: a Retrieval Analysis

Chelsea N. Koch, BS · Mark Figgie Jr., BS · Mark P. Figgie, MD · Marcella E. Elpers, BS · Timothy M. Wright, PhD · Douglas E. Padgett, MD

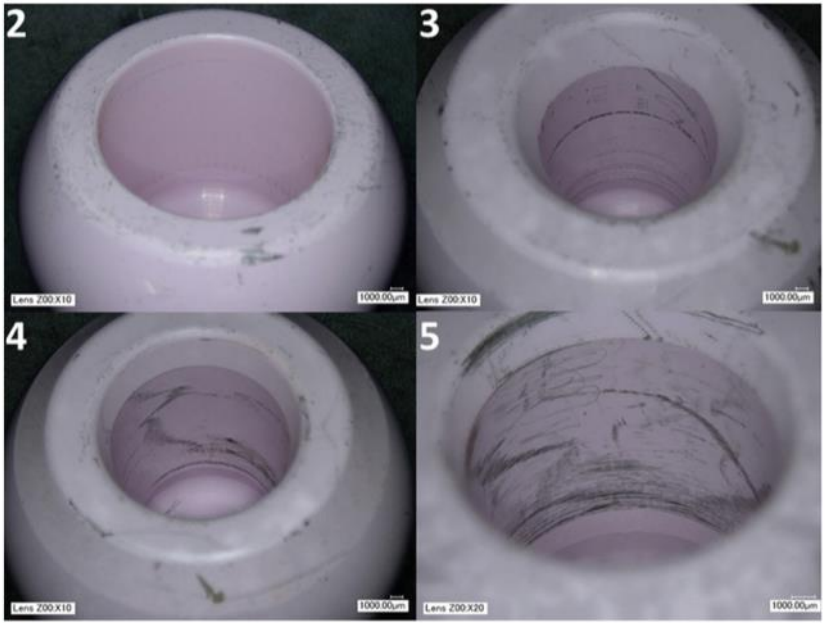


Fig. 2. Metal transfer on the female taper of the ceramic head exhibiting scores of 2 through 5.

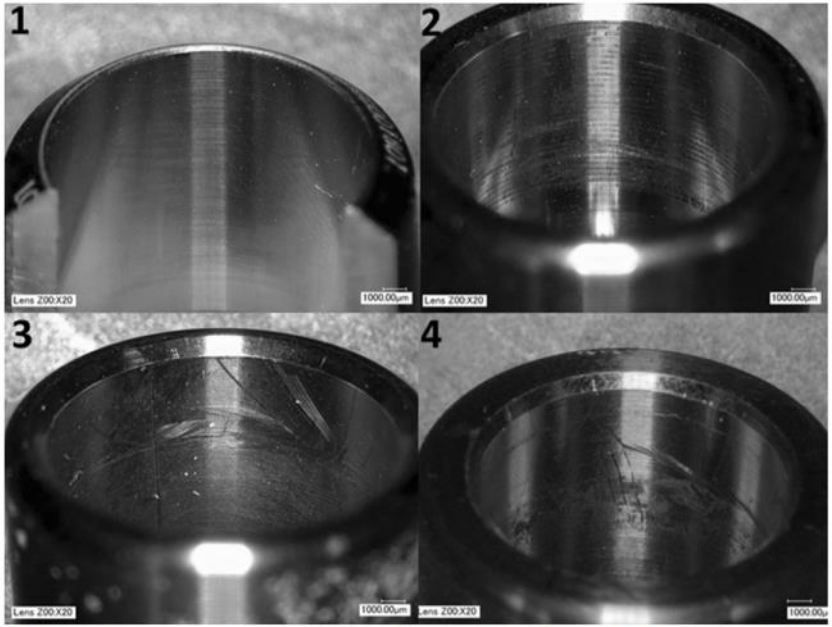


Fig. 3. Fretting and corrosion on the inner surface of the titanium alloy sleeve exhibiting scores of 1 through 4.

Speculation that something has changed about the trunnions?….

Increase in ceramic head use from 6.4% to 52% in Humana database

4. Bedard NA, Burnett RA, DeMik DE, Gao Y, Liu SS, Callaghan JJ. Are trends in total hip arthroplasty bearing surface continuing to change? 2007-2015 usage in a large database cohort. J Arthroplasty. 2017 Dec;32(12):3777-81. Epub 2017 Aug 3.

AJRR 2019- 67.8%

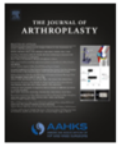
AJRR 2020- 71%

The Journal of Arthroplasty 33 (2018) 2705–2706

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org



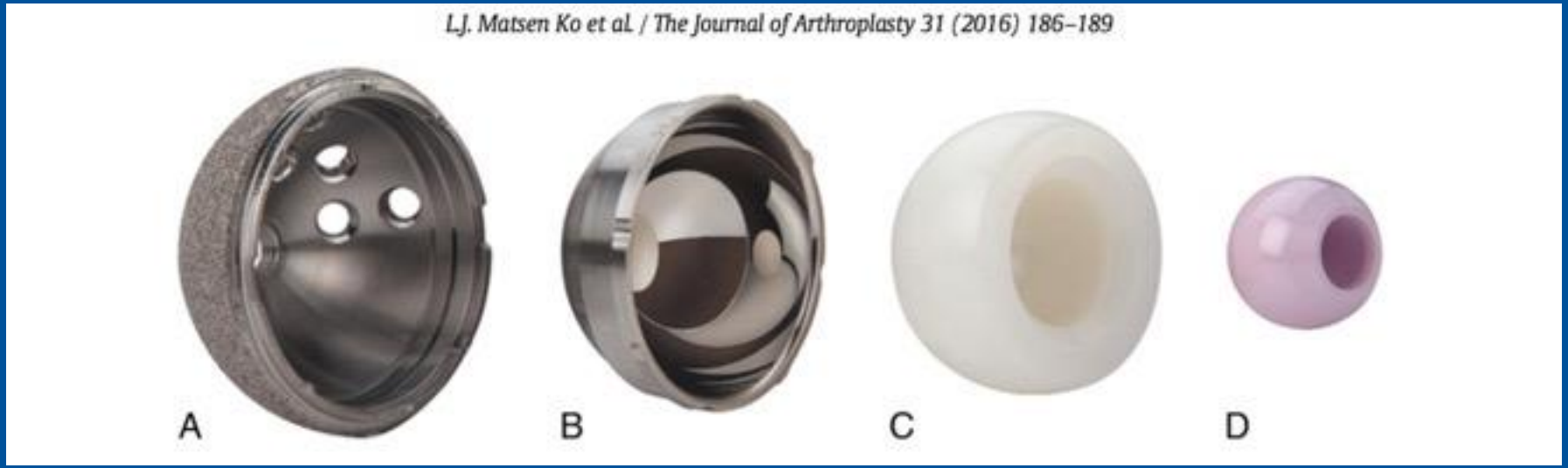
2017 AAHKS Annual Meeting Symposium

Introduction: The "New" Disease: Taper Corrosion After Total Hip Arthroplasty—A State-of-the-Art Update

The article in this symposium by Jacobs et al [2] provides information about our rapidly evolving, but still very incomplete, understanding of the etiology of taper corrosion. The process appears to

The material presented in this symposium provides a strong background about this problem for the practicing orthopedic surgeon and also practical information about diagnosis and treatment of taper corrosion. However, like any newly emerging problem, there is still much to be learned, and there is no doubt methods of diagnosis and treatment will advance in the future. Orthopedic surgeons treating this problem are advised to stay engaged in the academic processes as more information about this problem becomes available.

What is the next modular problem?….



Orthopaedic Advances

The Use of Dual-mobility Components in Total Hip Arthroplasty

Figure 1

A B

Figure 2

Photograph of the Anatomic Dual Mobility component (Stryker Orthopaedics, Mahwah, NJ).

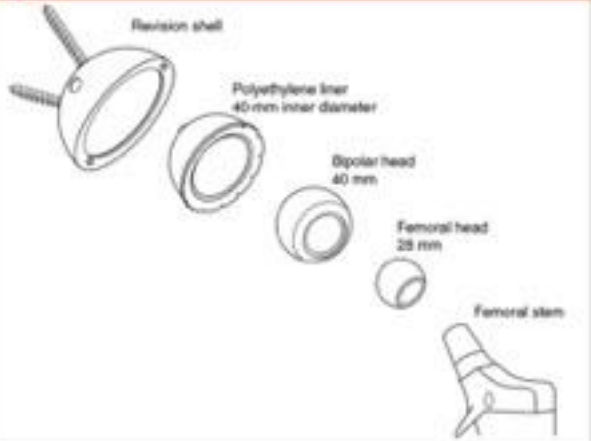
Figure 3

Photograph of the Modular Dual Mobility component (Stryker Orthopaedics, Mahwah, NJ).

Figure 4

Photograph of the E1 Active Articulation dual-mobility component (Biomet, Warsaw, IN).

Figure 5



The Journal of Arthroplasty 32 (2017) S220–S224

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Revision Arthroplasty

Outcomes of Modular Dual Mobility Acetabular Components in Revision Total Hip Arthroplasty

E. Grant Sutter, MD, MS *, Taylor R. McClellan, MD, David E. Attarian, MD, Michael P. Bolognesi, MD, Paul F. Lachiewicz, MD, Samuel S. Wellman, MD

Department of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina

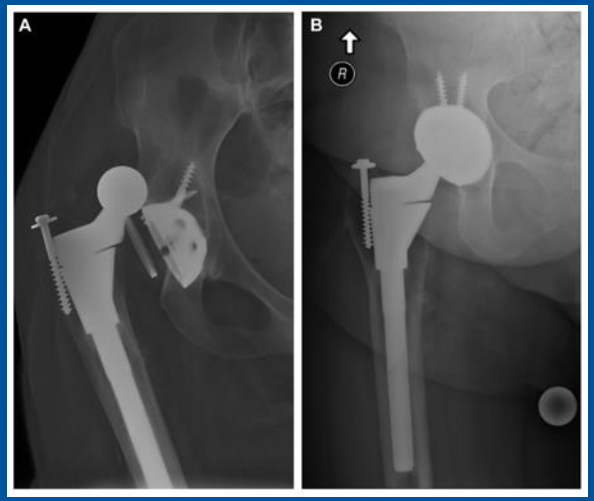


Table 1
Complications Following MDM Revision Surgery.

Complications (14)	Details	Management
Dislocations (2)	One isolated dislocation, 1 with 2 dislocations. No intraprosthetic dislocations	Both treated conservatively
Infection (9)	Six acute infections, 3 late infections	Acute infections: 5 I&D, head and liner exchange, Intravenous antibiotics without further issues. One early explant with spacer. Infection persisted and patient required Girdlestone procedure Late infections: explantation of components, placement of antibiotic spacer, and parenteral antibiotics
Femur stem loosening (1)	Thigh pain and radiographic evidence of stem loosening. No evidence of MDM cup failure	Femoral component revised, MDM components retained
Abductor deficiency and aseptic cup loosening (1)	Patient revised to MDM for instability and abductor deficiency. Developed pain and radiographic evidence of cup loosening	Re-revision surgery with removal of MDM components
Pain and adverse metal reaction (1)	Patient revised for MoM reaction. Evidence of adverse metal reaction, developed pain, and cup loosening (CoCr head)	Re-revision surgery with removal of MDM components. Implantation of ceramic head

MDM, modular dual mobility; I&D, irrigation and debridement; MoM, metal-on-metal; CoCr, cobalt chrome alloy.

The Journal of Arthroplasty 28 (2013) 543.e1–543.e3

Contents lists available at SciVerse ScienceDirect

The Journal of Arthroplasty

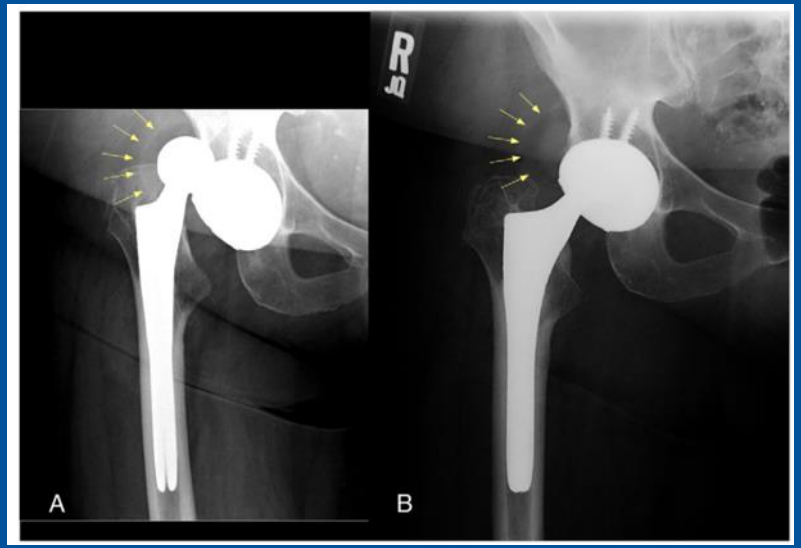
journal homepage: www.arthroplastyjournal.org

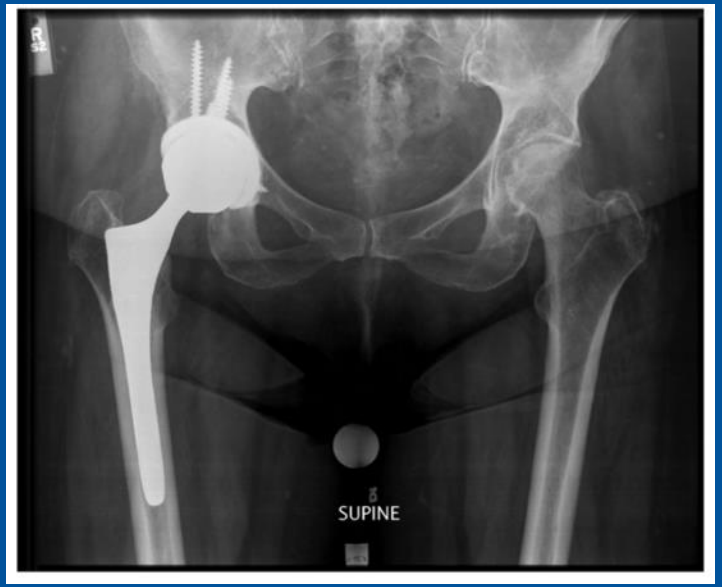
Case Report

Femoral Head Dislodgement Complicating Use of a Dual Mobility Prosthesis for Recurrent Instability

Jennifer A. Banzhof DO [b], Claire E. Robbins DPT [b], Alexander van der Ven MD [c], Carl T. Talmo MD [a], James V. Bono MD [a]

[a] Department of Orthopaedic Surgery, New England Baptist Hospital, Tufts University School of Medicine, Boston, MA
[b] Department of Orthopaedic Surgery, New England Baptist Hospital, Boston, MA
[c] Doctors Hospital for Orthopedics and Sports Medicine, Coral Gables, FL





Clin Orthop Relat Res (2016) 474:1072–1076
DOI 10.1007/s11999-015-4381-z

Clinical Orthopaedics and Related Research®
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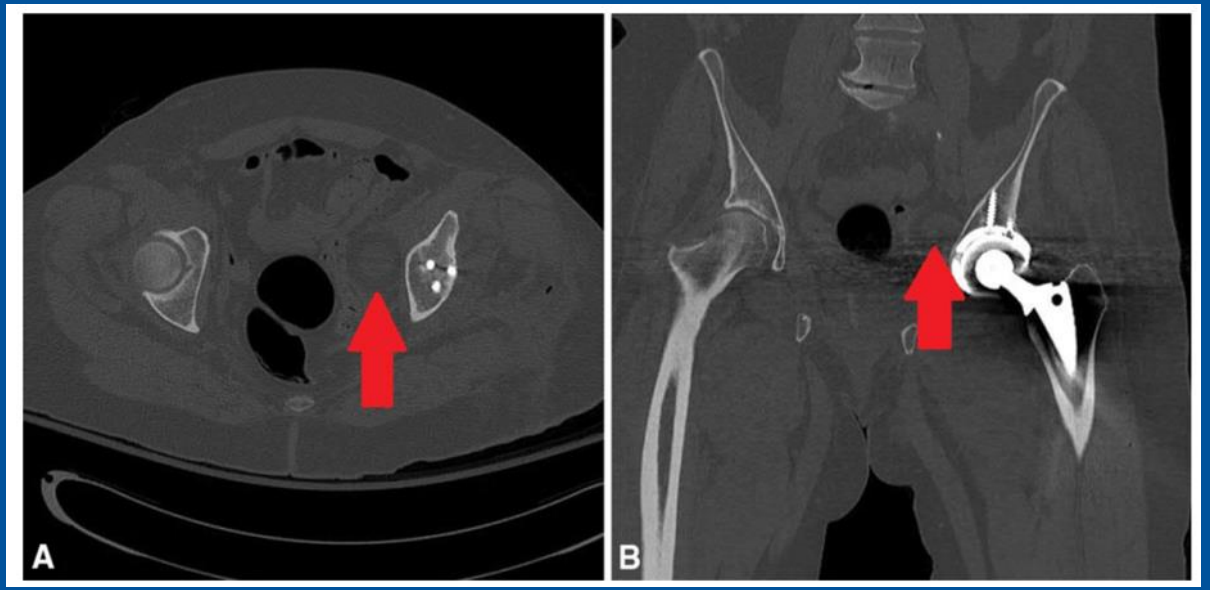
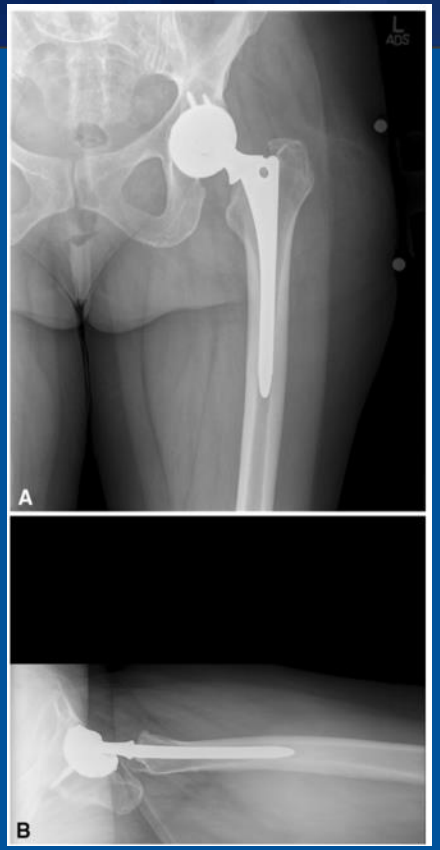
CASE REPORT

Dissociation and Intrapelvic Entrapment of a Dual-mobility Polyethylene Component

Keith A. Fehring MD, Daniel J. Berry MD





Metal ions and dual mobility…..

The Journal of Arthroplasty 31 (2016) 186–189

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Serum Metal Ion Levels Following Total Hip Arthroplasty With Modular Dual Mobility Components

Laura J. Matsen Ko, MD, Kimberley E. Pollag, RN, Joanne Y. Yoo, BS, Peter F. Sharkey, MD

Rothman Institute at Thomas Jefferson University Hospital, Philadelphia, Pennsylvania

Table 1
Data Related to Nine Patients With Serum Cobalt Levels Characterized as Significantly Elevated (>1.6 mcg/L).

Sex/Age/Side	Follow-Up (months)	Cobalt (mcg/L)	Chromium (mcg/L)	Oxford Hip Score	Inner Head Size	Other Potential Sources of Serum Metal Ions
M/50/L	36	3.1	0.4	45	28 mm	Vitamin B Use
F/60/L	25	4.8	0.1	48	22 mm	Contralateral THA
F/66/R	28	2.6	<1.0	48	22 mm	Contralateral THA
F/72/L	25	7.0	2.1	48	22 mm	Contralateral THA and Vitamin B Use
F/47/R	26	1.9	<0.1	36	22 mm	None Found
F/61/R	22	1.8	2.2	48	22 mm	Contralateral Metal-on-Metal THA
M/53/L	23	1.9	0.5	33	22 mm	None Found
F/31/L	21	5.3	0.2	45	22 mm	None Found
F/44/R	36	2.3	1.0	26	22 mm	None Found

M = male, F = female, R = right, L = left, THA = total hip arthroplasty.

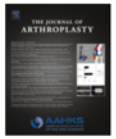
Metal ions and dual mobility…..

The Journal of Arthroplasty 32 (2017) 1581–1585

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org



Revision Arthroplasty

Metal Ion Levels in Young, Active Patients Receiving a Modular, Dual Mobility Total Hip Arthroplasty

Denis Nam, MD, MSc [a,*], Rondek Salih, BA [b], Katherine M. Brown, MPH [b], Ryan M. Nunley, MD [b], Robert L. Barrack, MD [b]

[a] Department of Orthopedic Surgery, Rush University Medical Center, Chicago, Illinois
[b] Department of Orthopedic Surgery, Washington University School of Medicine, Barnes-Jewish Hospital, St. Louis, Missouri

Table 4
Summary of Patients in Each Cohort with a Whole Blood Cobalt Level Outside the Reference Range at One Year Postoperatively.

	Age (y)	Gender (Male or Female)	Femoral Head Composition	One-Year Cobalt (μg/L)	One-Year Chromium (μg/L)	One-Year Postoperative Harris Hip Score
Conventional cohort						
Patient 1	42	Female	Oxidized zirconium	0.39	0.52	100
Dual mobility cohort						
Patient 1	44	Male	Ceramic	0.89	0.11	91
Patient 2	55	Male	Cobalt alloy	1.82	0.26	96
Patient 3	46	Female	Cobalt alloy	0.34	0.13	85
Patient 4	58	Male	Ceramic	0.86	−0.11	95

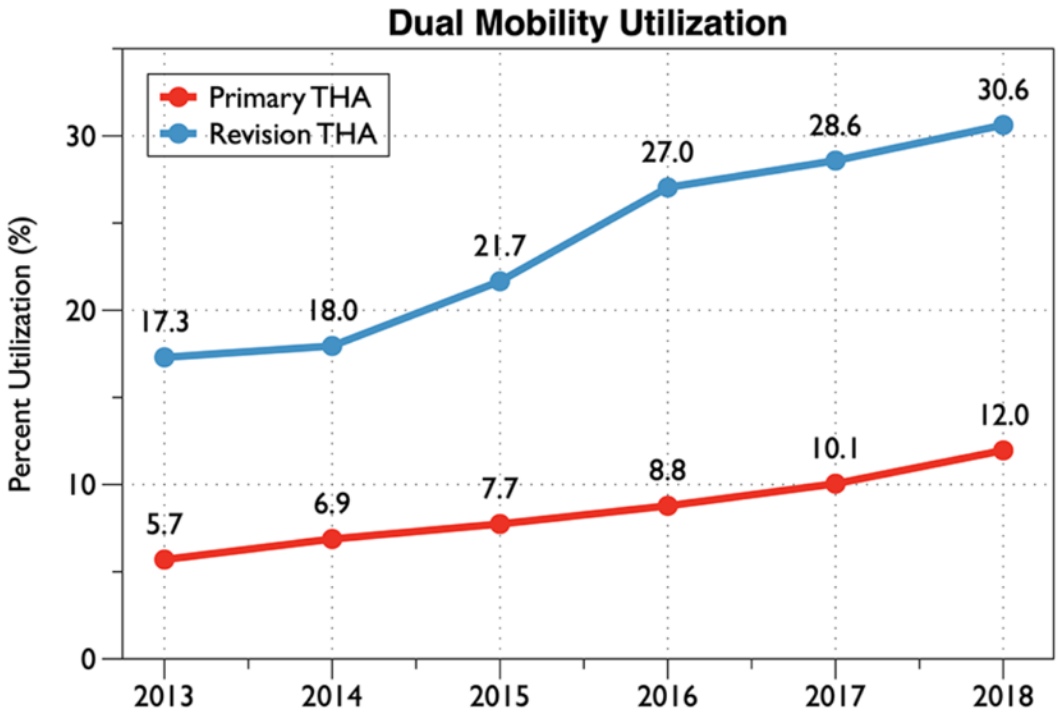
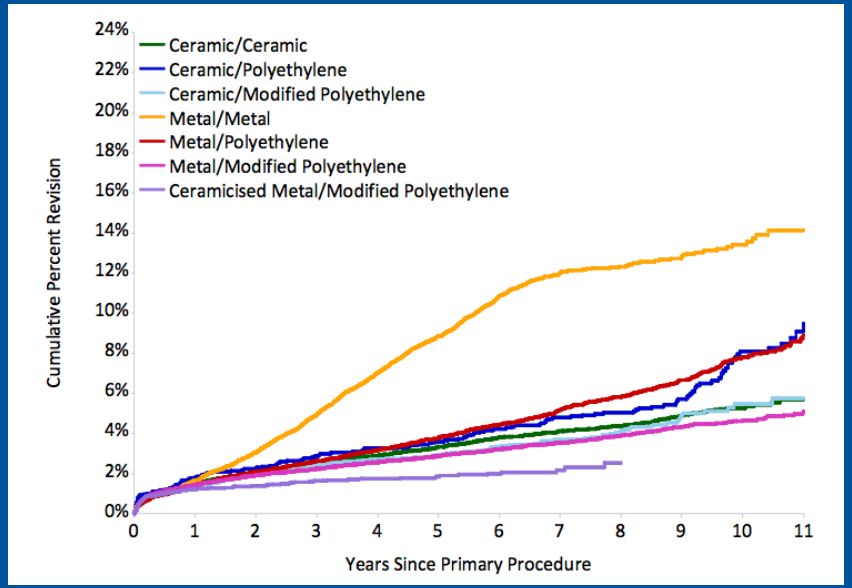


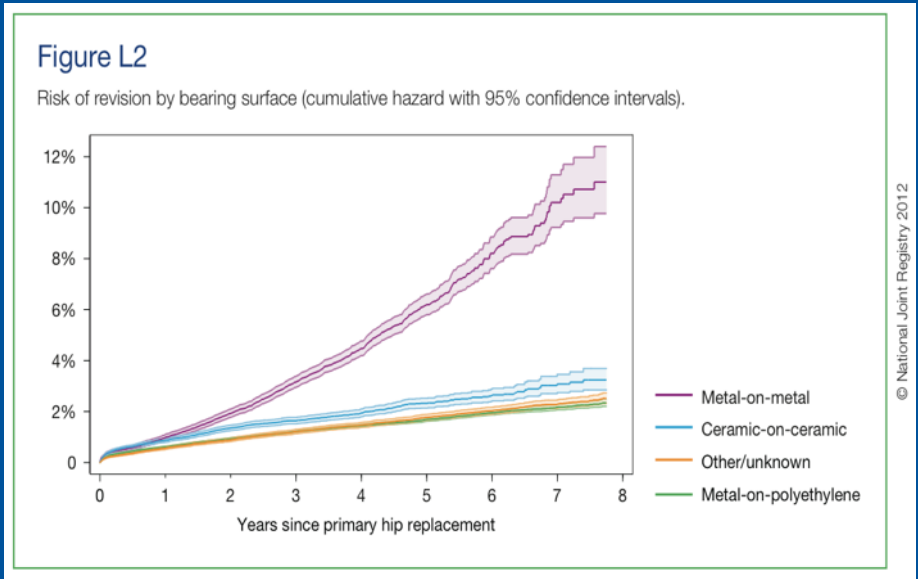
Fig. 1 Dual mobility utilization from 2013 through 2018, which showed a year-over-year increase for primary and revision total hip arthroplasty during the period examined

Courtesy of Nathanael Heckmann, MD

There has been at least one good idea..

There is no doubt XLPE works in the Hip….





One last thought about bearings...

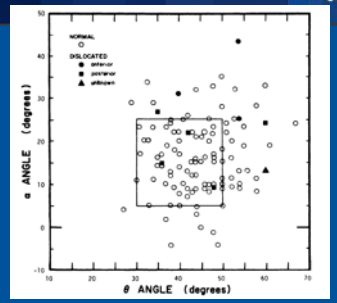
16. Jennings JM, Martin JR, Kim RH, Yang CC, Miner TM, Dennis DA. Metal artifact reduction sequence MRI abnormalities in asymptomatic patients with a ceramic-on-polyethylene total hip replacement. J Bone Joint Surg Am. 2017 Apr 5;99(7): 593-8.

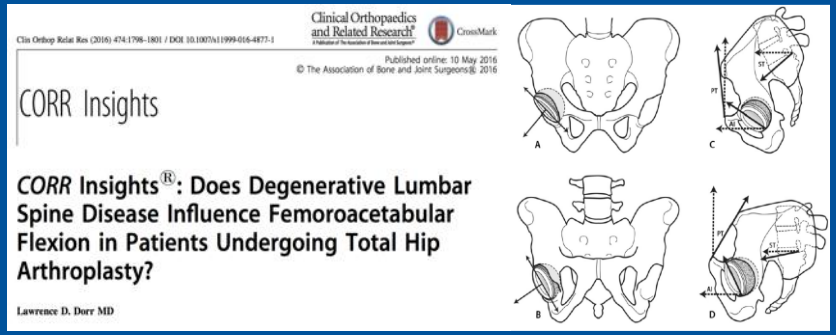
Ceramic-on-Polyethylene

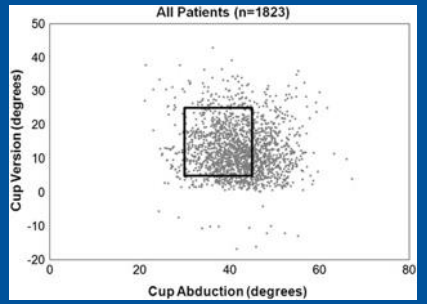
Among asymptomatic patients with a ceramic-on-polyethylene hip replacement, MARS MRI identified an 18% rate of fluid collections (9 of 50 hips)[16]. No solid lesions or tissue destructions were seen in this cohort. The clinical importance and natural history of these findings remain unknown and warrant longer-term follow-up.

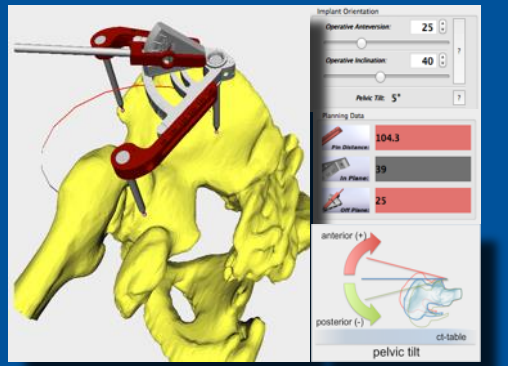
The Holy Grail for THA

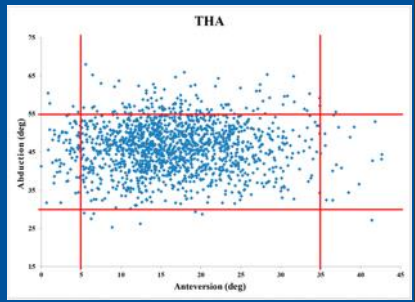
Safe Zone?
We may need some help postioning
The spine plays a real role











We have to figure out the spine…

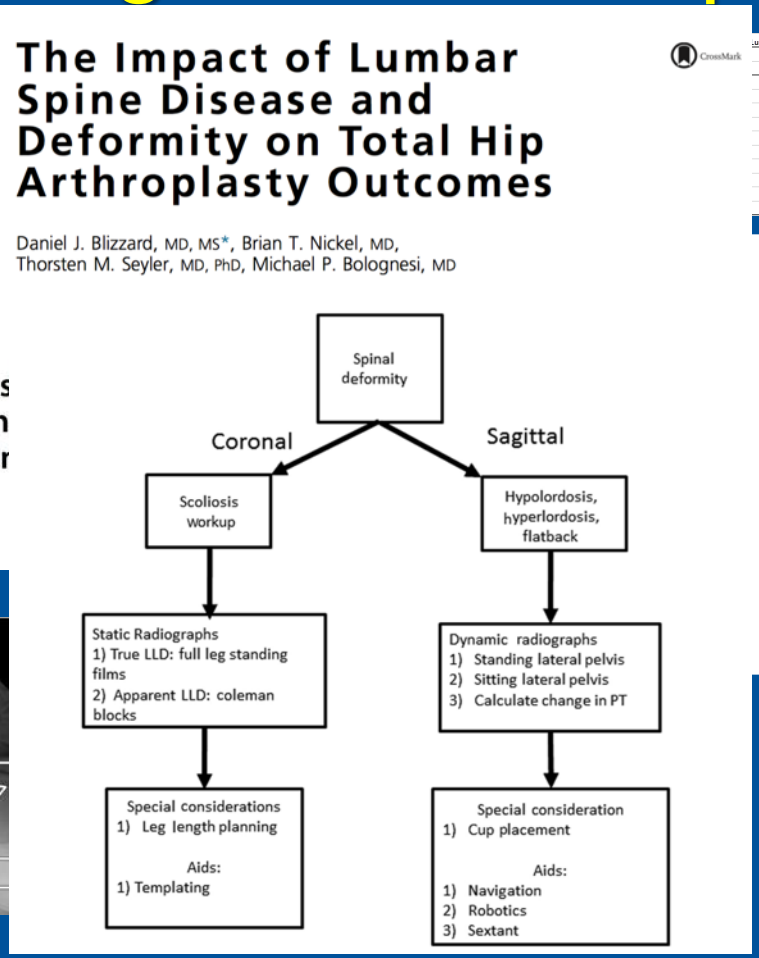
- It matters…..


Clin Orthop Relat Res (2016) 474:1798–1801 / DOI 10.1007/s1196

CORR Insights

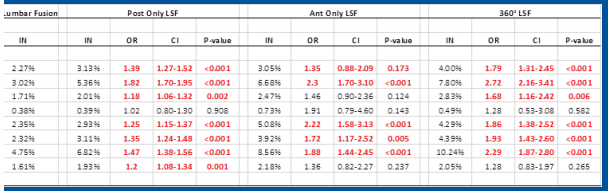
***CORR* Insights®: Does**
Spine Disease Influen
Flexion in Patients Ur
Arthroplasty?

Lawrence D. Dorr MD

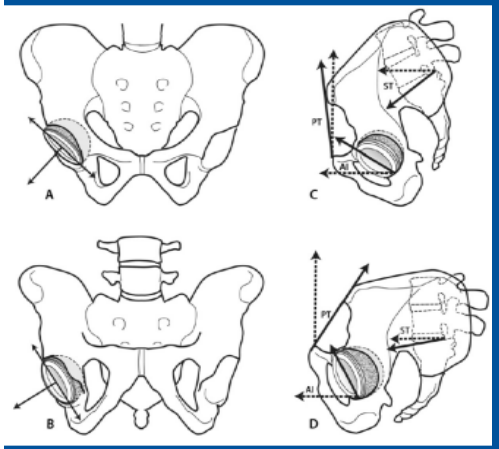

The Impact of Lumbar Spine Disease and Deformity on Total Hip Arthroplasty Outcomes

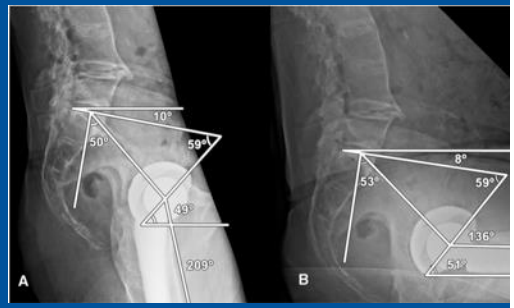
CrossMark

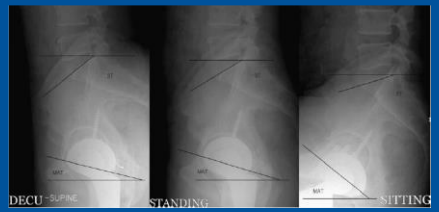
Daniel J. Blizzard, MD, MS*, Brian T. Nickel, MD,
Thorsten M. Seyler, MD, PhD, Michael P. Bolognesi, MD



umbar Fusion	Post Only LSF				Ant Only LSF				360° LSF			
IN	IN	OR	CI	P-value	IN	OR	CI	P-value	IN	OR	CI	P-value
2.27%	3.13%	1.39	1.27-1.52	<0.001	3.05%	1.35	0.88-2.09	0.173	4.00%	1.79	1.31-2.45	<0.001
3.02%	5.36%	1.82	1.70-1.95	<0.001	6.68%	2.3	1.70-3.10	<0.001	7.80%	2.72	2.16-3.41	<0.001
1.71%	2.01%	1.18	1.06-1.32	0.002	2.47%	1.46	0.90-2.36	0.124	2.83%	1.68	1.16-2.42	0.006
0.38%	0.39%	1.02	0.80-1.30	0.908	0.73%	1.91	0.79-4.60	0.143	0.49%	1.28	0.53-3.08	0.582
2.35%	2.93%	1.25	1.15-1.37	<0.001	5.08%	2.22	1.58-3.13	<0.001	4.29%	1.86	1.38-2.52	<0.001
2.32%	3.11%	1.35	1.24-1.48	<0.001	3.92%	1.72	1.17-2.52	0.005	4.39%	1.93	1.43-2.60	<0.001
4.75%	6.82%	1.47	1.38-1.56	<0.001	8.56%	1.88	1.44-2.45	<0.001	10.24%	2.29	1.87-2.80	<0.001
1.61%	1.93%	1.2	1.08-1.34	0.001	2.18%	1.36	0.82-2.27	0.237	2.05%	1.28	0.83-1.97	0.265








SmithNephew
CORI
Surgical System


ROSA
ROSA


Mako
Mako
Mako


VELYS

BattleBots?

Stryker

DePuy

Zimmer

Smith and Nephew

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Primary Hip & Knee Arthroplasty

Robotic Surgery in Total Joint Arthroplasty: A Survey of the AAHKS Membership to Understand the Utilization, Motivations, and Perceptions of Total Joint Surgeons

William F. Sherman, MD, MBA, Victor J. Wu, MD *

Department of Orthopaedic Surgery, Tulane University School of Medicine, New Orleans, LA

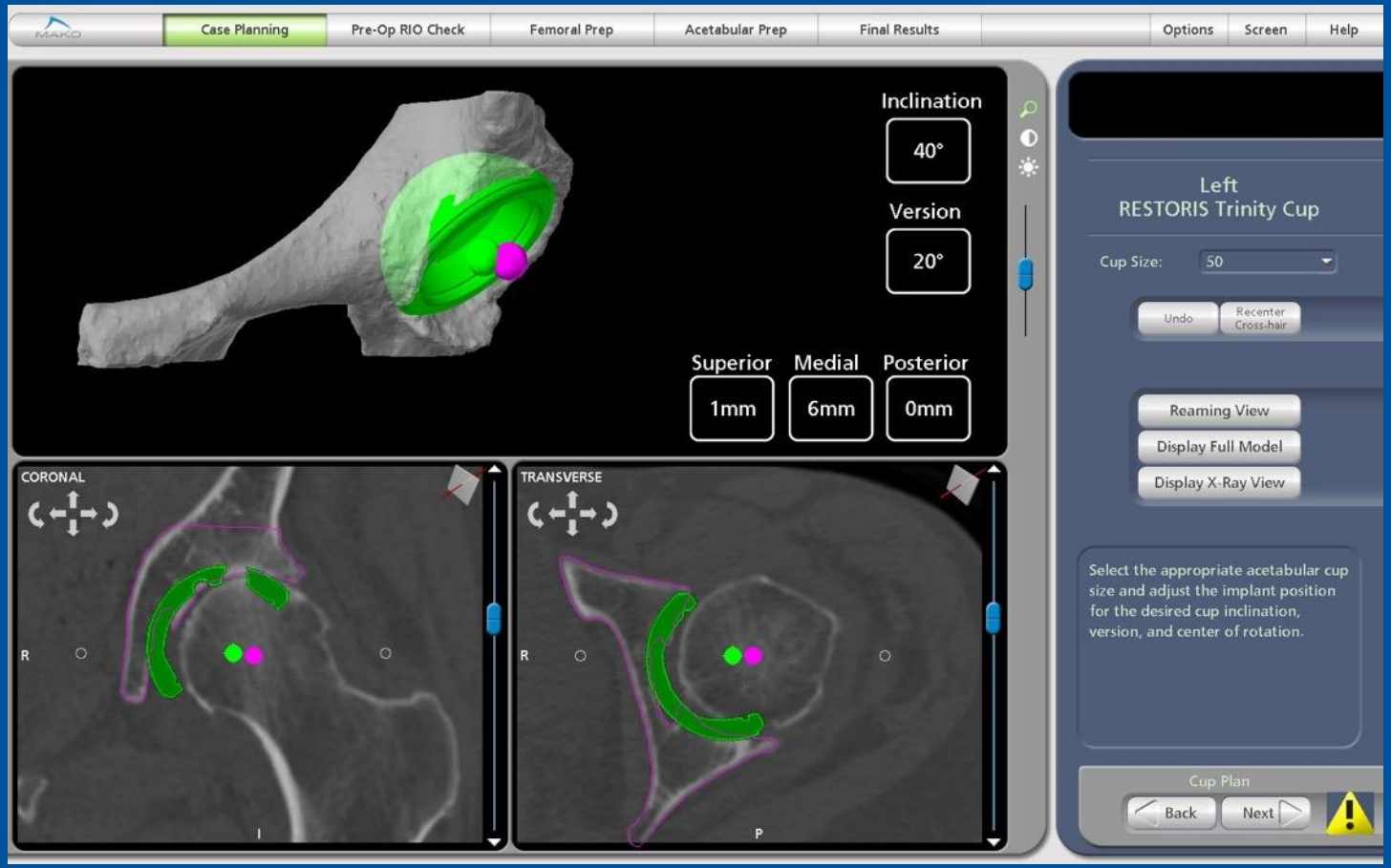
While increased precision was a major motivator for many respondents, non-clinical reasons such as marketing played a major role in a surgeon's decision-making process.

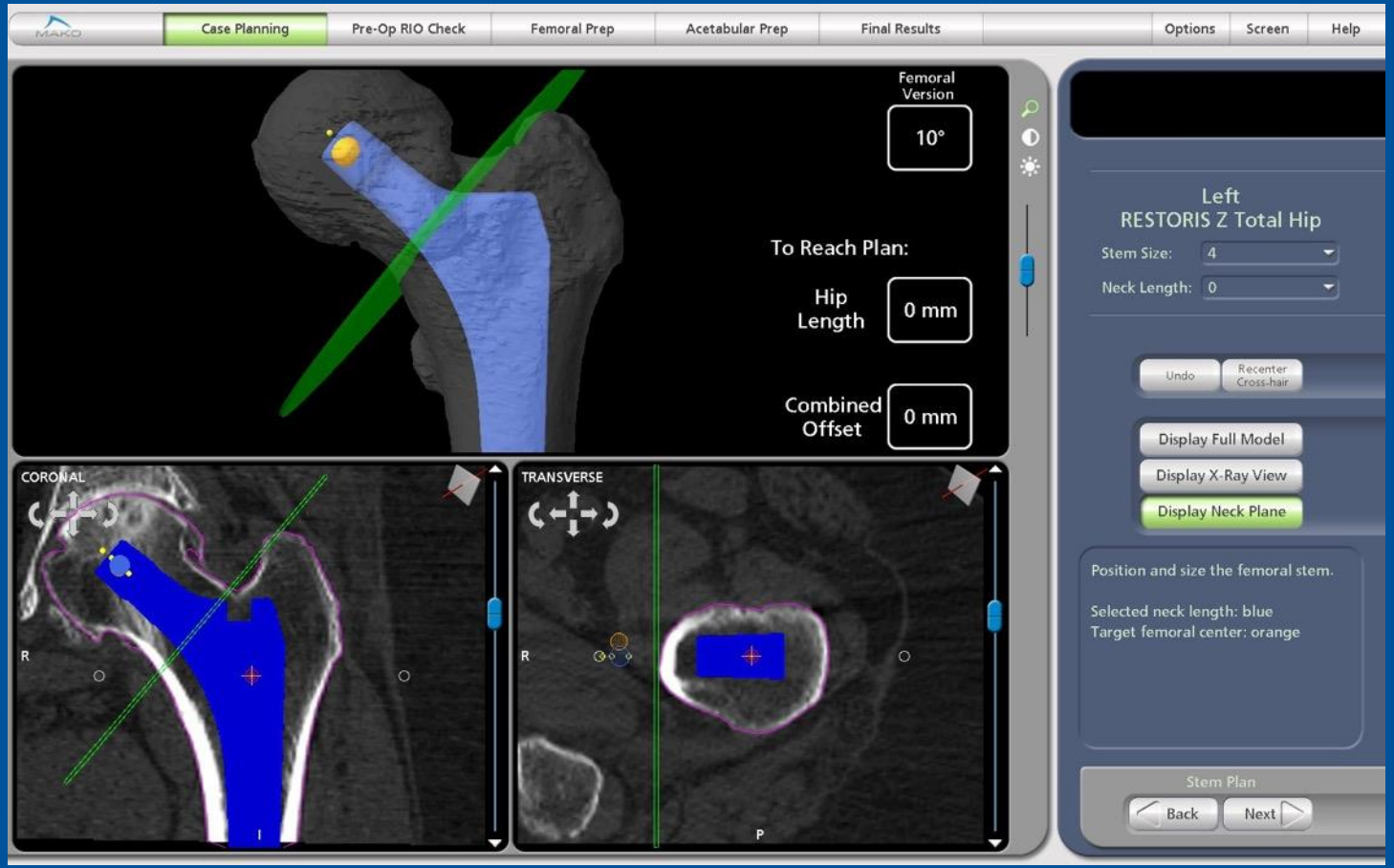
Robot arm–assisted surgery should be part of your

Current % of total joint practice using assistance (n = 239)
0%-20%
20%-40%
40%-60%
60%-80%
80%-100%

# of total joint cases for robot arm-assisted surgery competency (n = 704)	
0-20	128 (18.2)
20-40	381 (54.1)
40-70	131 (18.6)
70-100	35 (5.0)
100-200	15 (2.1)
200+	14 (2.0)

= 238)	
	174 (77.1)
	29 (12.2)
peers/staff	11 (4.7)
	11 (4.7)
	7 (2.9)
	6 (2.5)


MAKO
Case Planning
Pre-Op RIO Check
Femoral Prep
Acetabular Prep
Final Results
Options
Screen
Help
Inclination
40°
Version
20°
Superior
1mm
Medial
6mm
Posterior
0mm
CORONAL
R
I
TRANSVERSE
R
P
Left
RESTORIS Trinity Cup
Cup Size:
50
Undo
Recenter Cross-hair
Reaming View
Display Full Model
Display X-Ray View
Select the appropriate acetabular cup size and adjust the implant position for the desired cup inclination, version, and center of rotation.
Cup Plan
Back
Next


Case Planning
Pre-Op RIO Check
Femoral Prep
Acetabular Prep
Final Results
Options
Screen
Help
Femoral Version
10°
To Reach Plan:
Hip Length
0 mm
Combined Offset
0 mm
CORONAL
TRANSVERSE
R
R
I
P
Left
RESTORIS Z Total Hip
Stem Size: 4
Neck Length: 0
Undo
Recenter Cross-hair
Display Full Model
Display X-Ray View
Display Neck Plane
Position and size the femoral stem.
Selected neck length: blue
Target femoral center: orange
Stem Plan
Back
Next

Select Implant

Implant Placement

Animation

3D Model

Impingement Panels

3D Model and Selected implant

Selected implant placement

Table with cup angles for different reference planes and stem versions

Landmarked X-rays (if available)

Spinopelvic Classification

Impingement diagrams

All Robots Are Not Alike….

Name	TSolution-One	ROSA	Mako	Navio	Orthotaxy	CORI	OMNIbotic
Manufacturer	THINK Surgical, Fremont, CA	Zimmer Biomet, Warsaw, IN	Stryker, Mahwah, NJ	Smith & Nephew, Memphis, TN	DePuy Synthes, Warsaw, IN	Smith & Nephew, Memphis, TN	Corin, Tampa, FL
Platform	Open	Closed	Closed	Closed	Closed	Closed	Closed
Type	Active	Semiactive	Semiactive	Semiactive	Semiactive	Semiactive	Passive
FDA clearance	2019	2019	2015	2017	Pending	Pending	2017
Technique	Milling	Cutting guide	Saw or burr	Burr	Saw	Burr	Cutting guide
Image	CT	XR or imageless	CT	Imageless	CT	Imageless	CT

Siddiqi et al, JAAOS, 2021

The Data

Table 2
Outcomes of Robotic-Assisted Arthroplasty.

Author (y); Platform	Brief Outcomes Summary	Ref.
Total knee arthroplasty (TKA)		
Borner et al (2004); Robodoc	Postoperative knee alignment was restored to the planned ideal mechanical axis (00) in 97% of cases. Remaining cases were restored within 10 of ideal mechanical axis.	[37]
Song et al (2011); Robodoc	Significantly less radiographic outliers postoperatively with robotic TKA. No significant difference in patient-reported outcomes.	[38]
Song et al (2013); Robodoc	No differences in postoperative range of motion, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, and Hospital for Special Surgery (HSS) scores. Improved accuracy of flexion/extension gap balance with robotic-assisted TKA.	[39]
Koulalis et al (2011); iBlock	Improved accuracy and efficiency of final bone resections in all planes vs conventional computer-assisted navigation techniques.	[56]
Suero et al (2012); iBlock	Significant reduction in postoperative mechanical alignment variability and tourniquet time compared with conventional navigated instrumentation.	[57]
Koenig et al (2012); iBlock	Bone resections within 30 of neutral in 98% of cases.	[59]
Ponder et al (2013); iBlock	Significantly more accurate and repeatable bone resections than conventional instrumentation.	[58]
Unicompartmental knee arthroplasty (UKA)		
Gregori et al (2014); Navio PFS	Postsurgical mechanical axis alignment within 10 of the plan in 91% of cases. Improved Oxford Knee Scores from preoperative to 6 weeks postoperative.	[52]
Wallace et al (2014); Navio PFS	Rapid learning curve of an average of 8 (5-11) procedures with the average time over the first 4 cases (tracker placement to trial acceptance) of 64.9 (27-102) min.	[53]
Simons et al (2014); Navio PFS	Narrowed learning curve of the Navio system from an initial case duration of 85–48 min after 5 surgeries.	[54]
Lonner et al (2015); Navio PFS	Medial UKA achieved accurate implementation of the surgical plan with small errors in implant placement.	[51]
Lonner (2009); Mako	Robotic arm–assisted UKA demonstrated increased accuracy in recreating the posterior tibial slope and coronal tibial alignment.	[65]
Coon (2009); Mako	Robotic UKA demonstrated short learning curve and excellent radiographic outcomes (2.5 times improvement in tibial alignment, lower SD).	[66]
Jinnah et al (2009); Mako	Learning curve of robotic-assisted UKA procedures averaged 13 cases. The learning cases did not present an increased risk to the patient.	[67]
Lonner et al (2010); Mako	Tibial component alignment was found to be more accurate and less variable for Mako robotic arm–assisted surgeries compared to those with manual instrumentation.	[68]
Pearle et al (2010); MAKO	The planned and intraoperative tibiofemoral angle was within 1 degree. The postoperative long leg axis radiographs were within 1.6 degrees.	[63]
Citak et al (2013); Mako	UKA was more precise using a semiactive robotic system with femoral and tibial component position compared to the manual technique.	[69]
Jones et al (2013); Mako	Robotic arm–assisted UKA resulted in significantly lower postoperative pain and greater functionality as measured by American Knee Scores compared with manual UKA.	[29]
Coon et al (2014); MAKO	Mako UKA had a cumulative revision rate of 1.2% and high patient satisfaction at an average of 29.6 months follow-up.	[72]
Coon et al (2015); MAKO	At 2-year follow-up, 92% of patients indicated that they were either very satisfied or satisfied with their robotic arm-assisted UKA procedure.	[74]
Bicompartmental arthroplasty		
Tamam et al (2015); Mako	Patients who received patellofemoral arthroplasty in combination with medial or lateral UKA demonstrated 83% good to excellent results.	[70]
Conditt et al (2016); Mako	Robotic-assisted bicompartmental arthroplasty shows good survivorship and functional outcomes at 2-year follow-up with 1/48 procedures requiring revision to TKA.	[71]
Total hip arthroplasty (THA)		
Bargar et al (1998); Robodoc	Robotic THA showed statistically improved fit, fill, and alignment when using ROBODOC to perform cementless primary THA when compared with manual THA	[30]
Bach et al (2002); Robodoc	Robotic THA showed equivalent kinematic gait analysis, pelvic, and hip motion when compared with the conventional THA group	[35]
Haigo et al (2003); Robodoc	Robodoc femoral milling has shown decreased intraoperative embolic events compared with standard femoral broach preparation.	[36]
Schulz et al (2007); Robodoc	Concerns and limitations with aborted surgeries and increased operating time with clinical reports noting technical complications in almost 10% of cases.	[42]
Nawabi et al (2012); Mako	Mako-assisted THA had 4-6 times greater accuracy with version and inclination vs manual THA.	[79]
Illgren (2013); Mako	Significantly less dislocations at 6 months with robotic-assisted THA compared with manual THA performed with a posterior approach.	[13]
Elson et al (2013); Mako	95% of cup placement after impaction was recorded to be within 50 of the surgical plan.	[78]
Domb et al (2014); Mako	100% (vs 80% manual) of Mako THAs placed within the Lewinnek safe zone for anteversion and inclination and 92% (vs 62% manual) within the Callanan safe zone.	[77]
Jerabek et al (2014); Mako	Improved accuracy in achieving desired leg length and offset using Mako-assisted THA compared with manual THA.	[80]
Bukowksi et al (2014); Mako	Significantly higher modified Harris Hip scores and University of California, Los Angeles activity level with Mako-assisted THA compared with manual THA.	[83]
Suarez-Ahedo et al (2015); Mako	Robotic-assisted THA allowed for the use of smaller acetabular cups in relation to the patient' femoral head size, indicating greater preservation of acetabular stock.	[81]

Robotic Assistance i

A Proof of Principle Using

FREDERICK A. MATSEN III, M.D., JOSEF
BRIAN PRATT, M.S., DONALD BAUMC

The Journal of Arthroplasty 31 (2016) 2353–2363
Contents lists available at ScienceDirect
The Journal of Arthroplasty
journal homepage: www.arthroplastyjournal.org

y: A Comprehensive Review

Allen, DO

J. Jacofsky, M. Allen / The Journal of Arthroplasty 31 (2016) 2353–2363 2357

f Outcomes Summary Ref.

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compared with manual THA.
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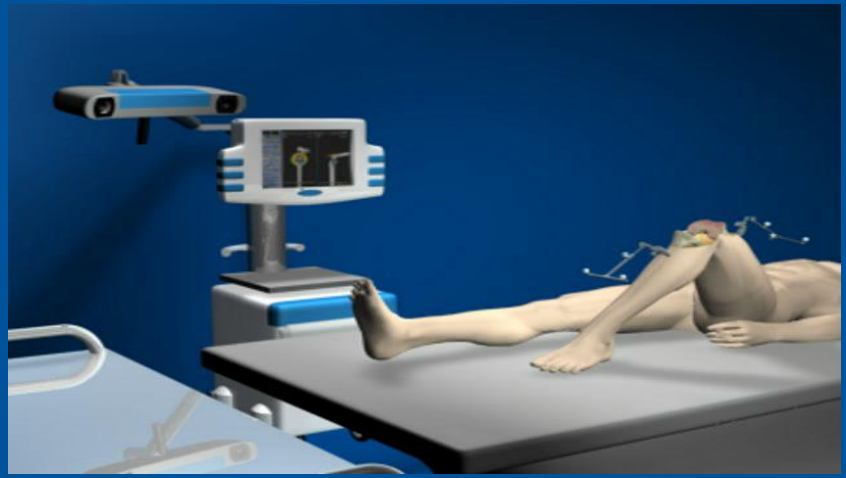
nt' femoral head size, indicating greater preservation of acetabular stock.

This is actually a slide from a talk I used to give about CAS

- **Landmark registration**
  - Accuracy, inter-observer reliability
- **Time**
  - Reported: 10-30 minutes per case
- **No short term advantages**
- **Pin loosening/fracture**
  - Real risk exists
- **Learning curve**
  - At least 10 cases?
- **Cost**
  - CE at high volume centers?



Stulberg et al, JBJS 2002
Robinson et al, CORR 2006
Nizard et al, CORR 2004
Haaker et al, CORR 2005
Stulberg et al, JBJS 2002

Summary..

- Learn from History….
- Dislocation has driven us to some extent…
- No MOM 3.0 please…
- Nobody has the trunnion issues figured out
- We need to keep an eye on modularity…
- Robotics needs to be confirmed as value added (is it really just CAS 2.0?)
- We need to be smart about surgical approach!

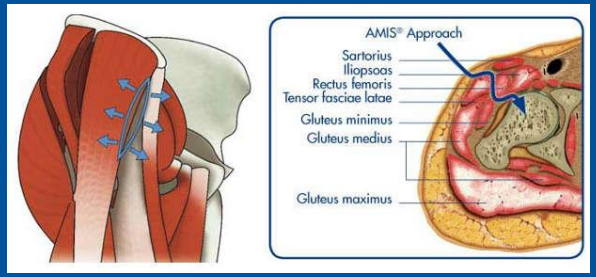

Duke Orthopaedic Surgery
Moving forward. Climbing higher.

There are a lot of ways to get in the hip…

- Posterior
- Direct lateral/ Hardinge
- Watson-Jones/ Rottinger
- Smith-Peterson/ Direct Anterior
- SuperCap/SuperPath

Wright Medical Technology

Yorkhospital.com



Jointreconstruction.com

The Two Incision Total Hip….

Technique

- Anterior incision- medial border of the TFL muscle, at the level of the greater trochanter (use fluoro)
- Anterior capsule removed and proximal part of femur removed in 3 segments
- Acetabulum is prepared
- Posterior incision similar to femoral nailing exposure is made
- Blind dissection made down to the femur for reaming and broaching
- Femoral implant delivered via the posterior incision

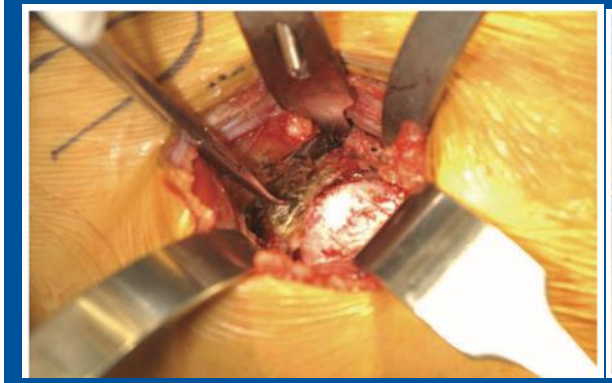
Early Complications of Primary Total Hip Replacement Performed with a Two-Incision Minimally Invasive Technique

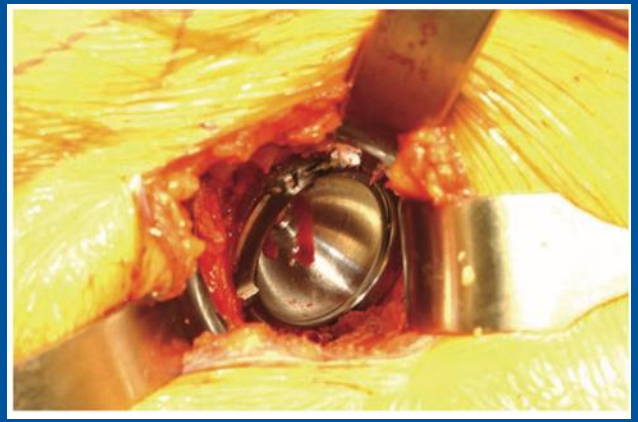
Surgical Technique

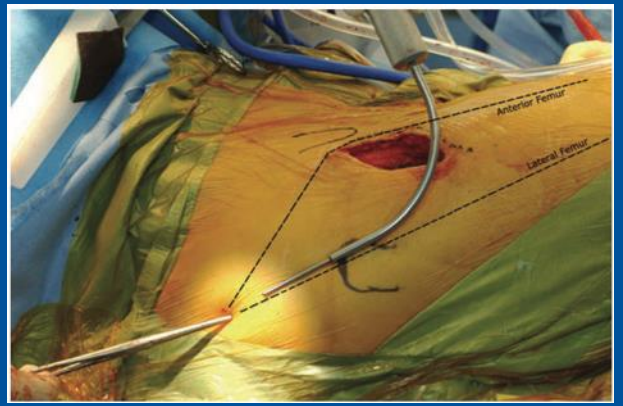
By B. Sonny Bal, MD, MBA, Doug Haltom, MD, Thomas Aleto, MD, and Matthew Barrett, MD

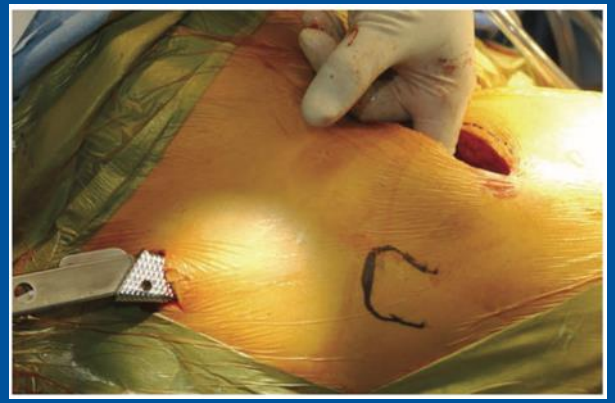
Investigation performed at the Department of Orthopaedic Surgery, School of Medicine, University of Missouri, Columbia, Missouri

The original scientific article in which the surgical technique was presented was published in JBJS Vol. 87-A, pp. 2432-2438, November 2005









Subcutaneous tissues deep to the posterior incision are spread blindly with long, curved scissors to develop a soft-tissue

Early in our experience with the two-incision technique, we used a femoral implant that required diaphyseal reaming of the femur. Later, a switch was made

As the femoral stem is impacted into the femur, the taper can get caught in the hip capsule. If this happens, the capsule is released as necessary.

unpredictable implant positioning despite the use of intraoperative fluoroscopy[4]. Early follow-up data on a consecutive series of patients managed with two-incision minimally invasive primary total hip arthroplasty demonstrated that 10% of the patients had undergone repeat surgery because of a femoral fracture, implant subsidence, dislocation, or a wound complication[4]. The results of minimally invasive primary total hip arthroplasty performed with use of this technique were also complicated by a high prevalence of lateral thigh numbness and a risk of injury to the femoral nerve.

CATASTROPHIC COMPLICATIONS OF MINIMALLY INVASIVE HIP SURGERY

A SERIES OF THREE CASES

BY THOMAS K. FEHRING, MD, AND J. BOHANNON MASON, MD

Investigation performed at the Charlotte Hip and Knee Center, Charlotte, North Carolina

CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 441, pp. 63–67

THE FRANK STINCHFIELD AWARD

Muscle Damage after Total Hip Arthroplasty Done with the Two-incision and Mini-posterior Techniques

Rodrigo Mardones, MD; Mark W. Pagnano, MD†; Joseph P. Nemanich, MD†; and Robert T. Trousdale, MD†*

Slower Recovery After Two-Incision Than Mini-Posterior-Incision Total Hip Arthroplasty

A Randomized Clinical Trial

By Mark W. Pagnano, MD, Robert T. Trousdale, MD, R. Michael Meneghini, MD, and Arlen D. Hanssen, MD

Investigation performed at Mayo Clinic, Rochester, Minnesota

CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 441, pp. 86–90

Two-incision THA Had Modest Outcomes and Some Substantial Complications

Mark W. Pagnano, MD; James Leone, MD; David G. Lewallen, MD; and Arlen D. Hanssen, MD

CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 453, pp. 156–159

Patients Preferred a Mini-posterior THA to a Contralateral Two-incision THA

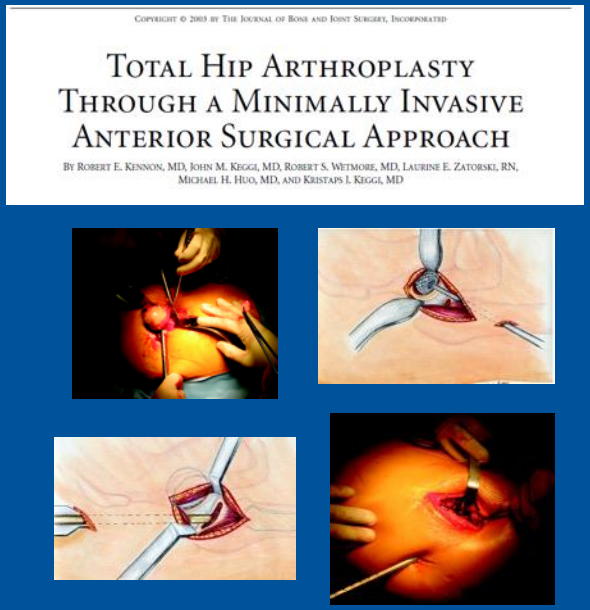
Mark W. Pagnano, MD; Robert T. Trousdale, MD; R. Michael Meneghini, MD; and Arlen D. Hanssen, MD

Are we seeing this again?….

Anterior Approach for THA?

Matta Anterior

ABMS Anterior



The Journal of Arthroplasty 31 (2016) 2295–2298

Contents lists available at ScienceDirect

The Journal of Arthroplasty

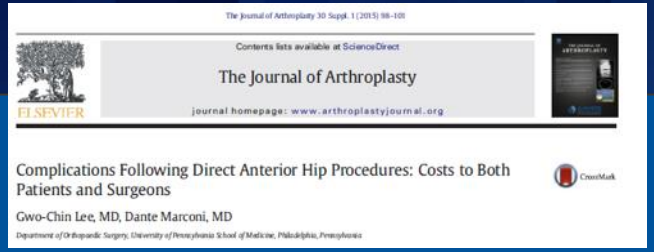
journal homepage: www.arthroplastyjournal.org

Complications - Other

Risk of Periprosthetic Fractures With Direct Anterior Primary Total Hip Arthroplasty

Keith R. Berend, MD [a, b, c, *], Amer J. Mirza, MD [d], Michael J. Morris, MD [a, c], Adolph V. Lombardi Jr, MD, FACS [a, b, c]

[a] Joint Implant Surgeons, Inc, New Albany, Ohio
[b] The Ohio State University Wexner Medical Center, Columbus, Ohio
[c] Mount Carmel Health System, New Albany, Ohio
[d] Summit Orthopaedics, LLP, Portland, Oregon



The Journal of Arthroplasty 30 Suppl. 1 (2015) 98–101

Contents lists available at ScienceDirect

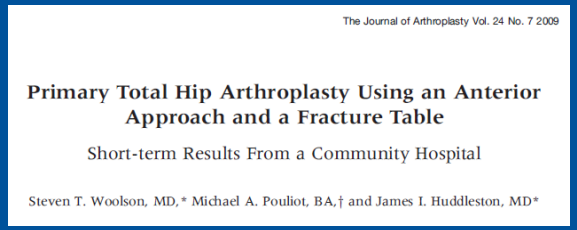
The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Complications Following Direct Anterior Hip Procedures: Costs to Both Patients and Surgeons

Gwo-Chin Lee, MD, Dante Marconi, MD

Department of Orthopaedic Surgery, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania

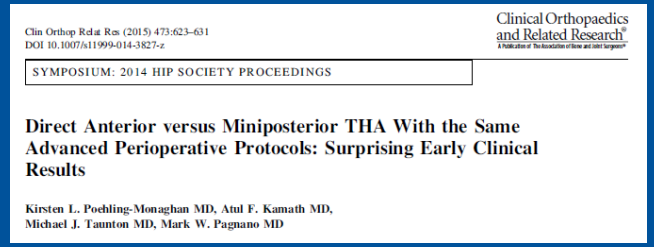


The Journal of Arthroplasty Vol. 24 No. 7 2009

Primary Total Hip Arthroplasty Using an Anterior Approach and a Fracture Table

Short-term Results From a Community Hospital

Steven T. Woolson, MD,* Michael A. Pouliot, BA,† and James I. Huddleston, MD*



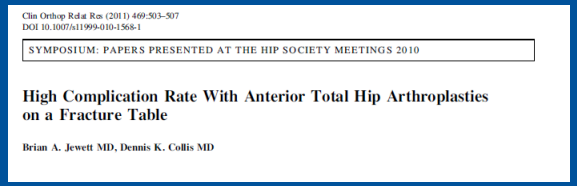
Clin Orthop Relat Res (2015) 473:623–631
DOI 10.1007/s11999-014-3827-z

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

SYMPOSIUM: 2014 HIP SOCIETY PROCEEDINGS

Direct Anterior versus Miniposterior THA With the Same Advanced Perioperative Protocols: Surprising Early Clinical Results

Kirsten L. Poehling-Monaghan MD, Atul F. Kamath MD, Michael J. Taunton MD, Mark W. Pagnano MD



Clin Orthop Relat Res (2011) 469:503–507
DOI 10.1007/s11999-010-1568-1

SYMPOSIUM: PAPERS PRESENTED AT THE HIP SOCIETY MEETINGS 2010

High Complication Rate With Anterior Total Hip Arthroplasties on a Fracture Table

Brian A. Jewett MD, Dennis K. Collis MD

Clin Orthop Relat Res (2014) 472:455–463
DOI 10.1007/s11999-013-3231-0

Clinical Orthopaedics and Related Research®
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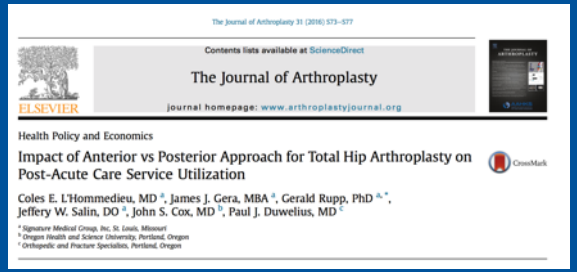
SYMPOSIUM: 2013 HIP SOCIETY PROCEEDINGS

Does the Direct Anterior Approach in THA Offer Faster Rehabilitation and Comparable Safety to the Posterior Approach?

José A. Rodriguez MD, Ajit J. Deshmukh MD, Parthiv A. Rathod MD, Michelle L. Greiz PT, Prashant P. Deshmane MD, Matthew S. Hepinstall MD, Amar S. Ranawat MD



The Journal of Arthroplasty 31 (2016) 573–577

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The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Health Policy and Economics

Impact of Anterior vs Posterior Approach for Total Hip Arthroplasty on Post-Acute Care Service Utilization

Coles E. L'Hommedieu, MD [a], James J. Gera, MBA [a], Gerald Rupp, PhD [a, *], Jeffery W. Salin, DO [a], John S. Cox, MD [b], Paul J. Duwelius, MD [c]

[a] Signature Medical Group, Inc, St. Louis, Missouri
[b] Oregon Health and Science University, Portland, Oregon
[c] Orthopedic and Fracture Specialists, Portland, Oregon

The Journal of Arthroplasty 31 (2016) 5127–5130

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The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Primary Arthroplasty

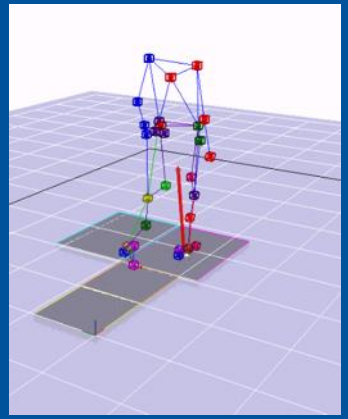
No Difference in Dislocation Seen in Anterior Vs Posterior Approach Total Hip Arthroplasty

Joseph D. Maratt, MD [a, *], Joel J. Gagnier, ND, MSc, PhD [a], Paul D. Butler, MD [b], Brian R. Hallstrom, MD [a, c], Andrew G. Urquhart, MD [a], Karl C. Roberts, MD [d]

[a] Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan
[b] Grand Rapids Orthopaedic Surgery Residency Program, Grand Rapids, Michigan
[c] Michigan Arthroplasty Registry Collaborative Quality Initiative, Ann Arbor, Michigan
[d] Department of Surgery, Michigan State University, Grand Rapids, Michigan

Gait Recovery

the K Lab
DUKE UNIVERSITY
Human Performance Research



The Journal of Arthroplasty Vol. 26 No. 6 Suppl. 1 2011

The Effect of Total Hip Arthroplasty Surgical Approach on Postoperative Gait Mechanics

Robin M. Queen, PhD,*† Robert J. Butler, PT, PhD,†‡ Tyler S. Watters, MD,*
Scott S. Kelley, MD,* David E. Attarian, MD,* and Michael P. Bolognesi, MD*

No difference at 6 weeks…

Contents lists available at SciVerse ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Does Surgical Approach During Total Hip Arthroplasty Alter Gait Recovery During the First Year Following Surgery?

Robin M. Queen PhD [a,b], Jordan F. Schaeffer MD [a], Robert J. Butler DPT, PhD [b,c], Carl C. Berasi BS [d], Scott S. Kelley MD [a], David E. Attarian MD [a], Michael P. Bolognesi MD [a]

[a] Department of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina
[b] Michael W. Krzyzewski Human Performance Lab, Duke University Medical Center, Durham, North Carolina
[c] Division of Physical Therapy, Department Community and Family Medicine, Duke University Medical Center, Durham, North Carolina
[d] Duke University School of Medicine, Duke University Medical Center, Durham, North Carolina

One year results…. Similar story

G. Meermans,
S. Konan,
R. Das,
A. Volpin,
F. S. Haddad

THE BONE & JOINT JOURNAL

■ HIP

The direct anterior approach in total hip arthroplasty

A SYSTEMATIC REVIEW OF THE LITERATURE

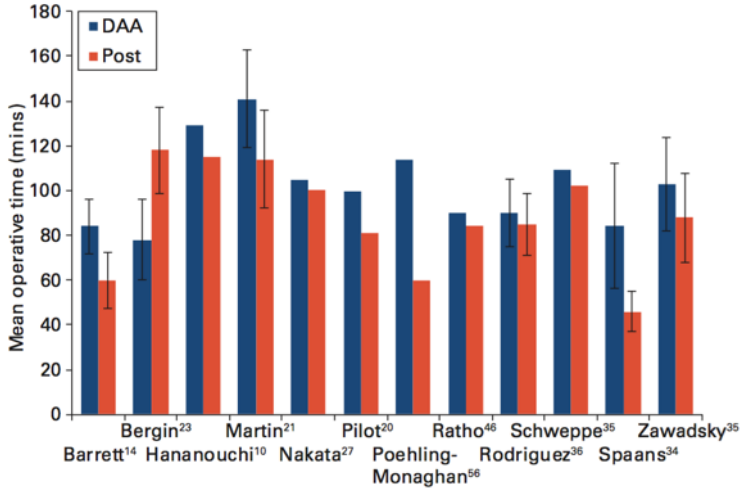


Table V. Blood loss

	Effect size	Cohen d
Barrett et al[14]	0.52	1.21
Bergin et al[23]	0.142	0.288
Nakata et al[27]	0.724	2.1
Spaans et al[34]	0.463	1.044
Pogliacomi et al[37]	-0.105	-0.211
Pogliacomi et al[38]	-0.461	-1.03