TRIBOLOGIA, BIOMECCANICA E DIAGNOSTICA

1. Does the use of a ceramic head eliminate the risk of trunnionosis?
2. A Systematic Review And Meta-Analysis Of Metal On Polyethylene Versus Ceramic On Polyethylene Bearing Surfaces
3. Wear in total hip arthroplasty using ceramic head: 10 years maximum fu
4. Functional and clinical outcome of THA using large diameter ceramic couples
5. Mis-seating of Trident ceramic acetabular liners: a 6-year audit of incidence and revision rate in South Devon, UK
6. Is wear of Dual Mobility Cup lower or upper than Conventional Cup? Analysis of an in vitro standard test
7. Potential Markers of Systemic Toxicity Induced by Metal Ions in Patients with Hip Resurfacing
8. What is the natural history of asymptomatic pseudotumours associated with metal-on-metal hip resurfacings?
9. Ceramic on Ceramic Clinical Results
10. Is Squeaking Still a Reason for Concern?
11. Is there any evidence that ceramic on poly is better than metal on poly?
12. What to do in case of breakage?
13. The Bearing is the Key!
14. XLPE: clinical implications of different poliethylenes
15. Metal on metal total hip replacement: our experience at mid-term follow-up
16. Metallosis in total hip arthoplasty: an experimental comparative study in three different bearings
17. Trunnionosis in Metal on Polyethylene Uncemented Accolade-Trident Total Hip Replacements
18. Stem-neck modular total hip arthroplasty: possible mechanical effects!
19. Recall ABG II Modular System: Kaplan Meyer at maximum of 6 years in a series of 151 consecutive patients
20. How should we follow-up asymptomatic metal-on-metal hip resurfacing patients? A prospective longitudinal cohort study
21. Conditions influencing cobalt and chromium circulating ions level in metal-on-metal patients
22. The Problem of Metal-on-Metal Total Hip Arthroplasty. Our experience in 59 cases

TRIBOLOGIA, BIOMECCANICA E DIAGNOSTICA

23. 5 year clinical outcomes of 601 metal-on-metal total hip replacements with 36mm heads
24. Hip arthroplasty with metal-on-metal tribology: 10-year f-up and ionic release trend in 36mm head implants
25. Metasul 28 mm MoM total hip replacements: Adverse reaction to metal debris incidence & outcome at 10 years
26. Taperosis – what is the problem? Patient evaluation
27. “Taperosis”: Insights for Clinical Practice from Histological Analysis
28. Taperosis: Treatment & Outcomes
29. Justification of Modularity. Monoblocks
30. Femoral neck modularity: still justified?
31. FAI and lumbar stiffness
32. Does the femoral head/neck contour in the skeletally mature change over time?
33. Initial stability of a new dual mobility cup model: a prospective study compared with European register findings
34. Dislocation: Diagnosing Instability
35. THA Dislocation: Diagnosis and Prevention
36. Assessment of the relationship between pelvic tilt and functional acetabular position with EOS 2D/3D technology
37. Dual mobility sockets in patients with high risk of dislocation
38. The use of dual mobility bearings in total hip arthroplasty. The UK experience
39. Is there a difference in acetabular component orientation and post-op dislocation between elective and trauma THAs?
40. The influence of obesity in cup positioning during total hip replacement
41. Elevated liner placement: an anatomical study.
42. Accurate anatomic restoration in primary total hip replacement with 3D hip planning
43. The correlation between femoral offset and clinical outcome
44. Body Mass Index, Wound Fat Depth and Radiographic Acetabular Inclination in Total Hip Arthroplasty
45. Dysmetry after Hip Arthroplasty
46. Bilateral Total Hip Arthroplasty: One-Stage versus Two-Stage Procedure
47. Robotic surgery applied to total hip arthroplasty: preliminary results and technical notes
48. Clinical and MRI results in 67 patients operated for gluteus medius and minimus tendon tears with a median follow-up of 4.6 years.
49. The use of 3T MRI in diagnosing intra-articular hip pathology
50. Radiographic evaluation of hip resurfacing: validation of a new zonal system

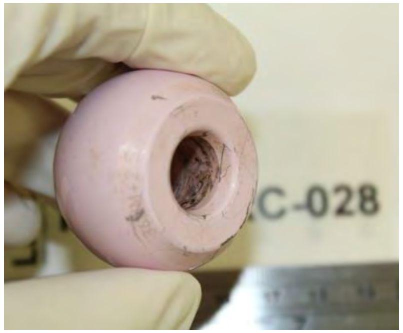
Does the use of a ceramic head eliminate the risk of trunnionosis?

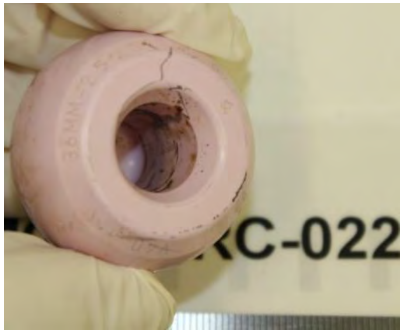
Anna Di Laura[1], Jay Meswania[1], Harry Hothi[1], Robert Whittaker[1], Young-Min Kwon[2],

Gordon Blunn[1], John A. Skinner[1], Alister J. Hart[1]

[1] Institute of Orthopaedics and Musculoskeletal Science, University College London and the Royal National Orthopaedic Hospital, Stanmore, United Kingdom

[2]Massachusetts General Hospital/Harvard Medical School, Boston, USA





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Histopathology:
Prof Adrienne Flanagan[2]

[1]Royal National Orthopaedic Hospital, Stanmore
[2]University College London
[3]Wrightington Hospital
[4]Baylor College, Houston, USA
[5]EPSRC centre for advanced metrology, UK

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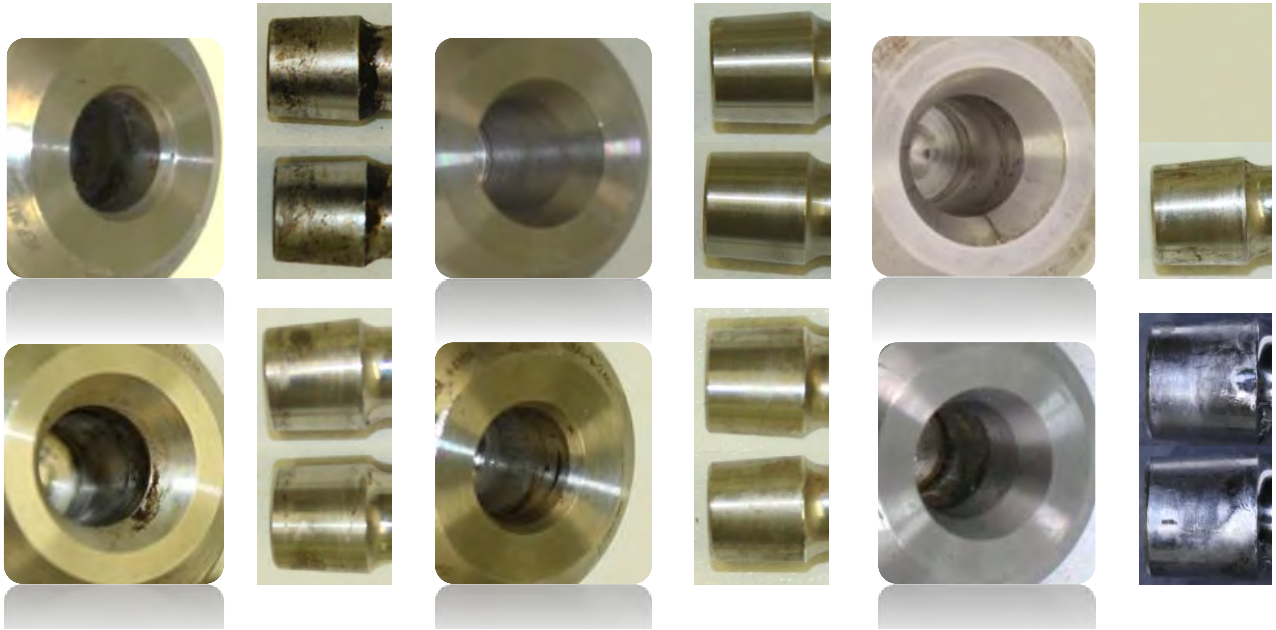
Introduction



Mechanical wear and corrosion at the head-stem taper junction, commonly referred to as trunnionosis has been implicated in soft tissue reactions and early revision of total hip replacements.

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Introduction

Royal National Orthopaedic Hospital NHS Trust NHS

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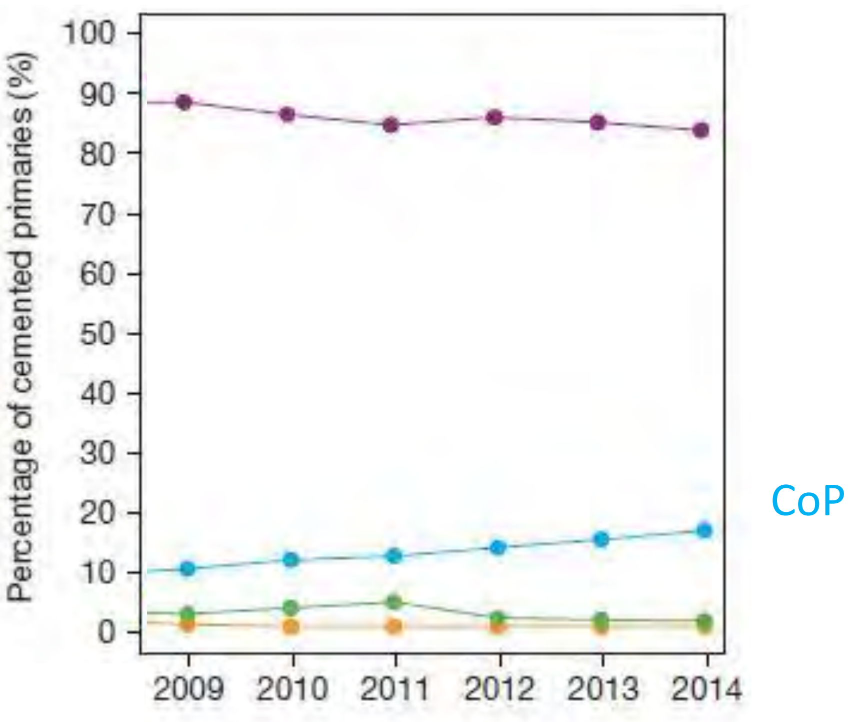
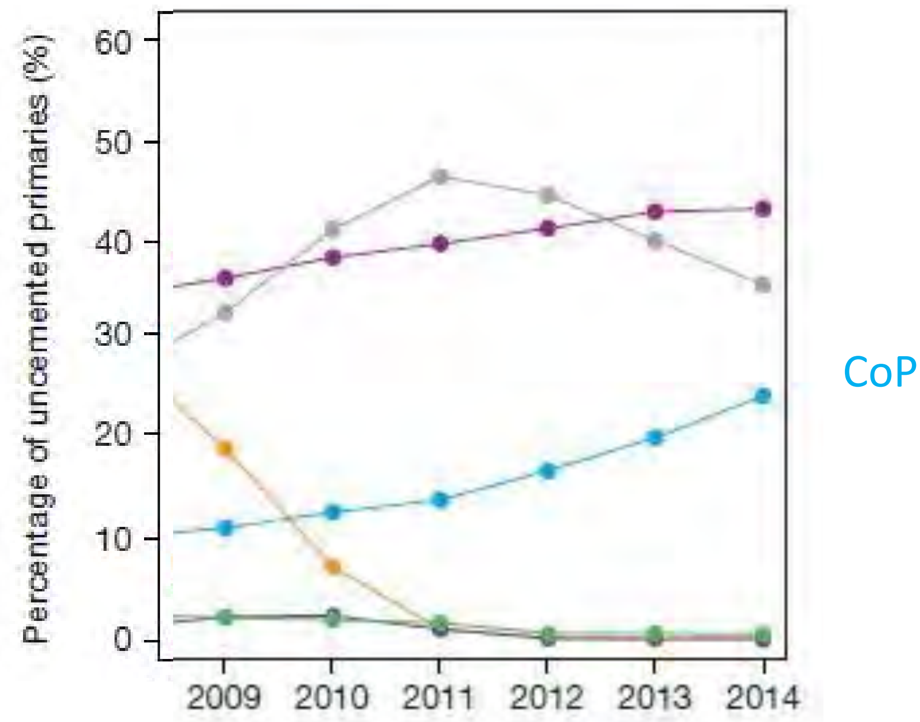
National Joint Registry for England, Wales, Northern Ireland and the Isle of Man: 12th Annual Report 2015.



Cemented



Uncemented

Research Questions

1 - Does the use of a ceramic head eliminate the damage at the head/stem junction?

2 - If not, is the damage at this junction clinically relevant?

Study Design

Question 1

GROUP **A**: **Dual Mobility**

n=24
BIOLOX®delta
heads

n=15
CoCr heads

- ONE stem design
- ONE V40 trunnion design
- ONE stem material
- **Only difference = head material**

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Study Design

Royal National Orthopaedic Hospital NHS Trust

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Question 1

GROUP A: Dual Mobility

n=24
BIOLOX®delta heads

n=15
CoCr heads

- ONE stem design
- ONE V40 trunnion design
- ONE stem material
- **Only difference = head material**

GROUP B: Standard UHMWPE

n=12
BIOLOX®delta heads

n=18
CoCr heads

- ONE stem design
- ONE V40 trunnion design
- ONE stem material
- **Only difference = head material**

Study Design

Question 1

GROUP A: Dual Mobility

n=24
BIOLOX®delta
heads

n=15
CoCr heads

Goldberg corrosion score [1]

+

Volume of material loss at the stem trunnion

GROUP B: Standard UHMWPE

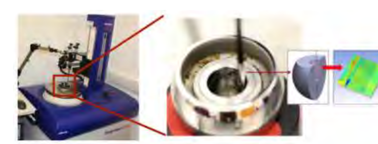
n=12
BIOLOX®delta
heads

n=18
CoCr heads

Goldberg corrosion score

+

Volume of material loss at stem trunnion and head taper



[1] Goldberg, Jay R., et al. "A multicenter retrieval study of the taper interfaces of modular hip prostheses." Clinical orthopaedics and related research 401 (2002): 149-161.

Research Questions

1 - Does the use of a ceramic head eliminate the damage at the head/stem junction?

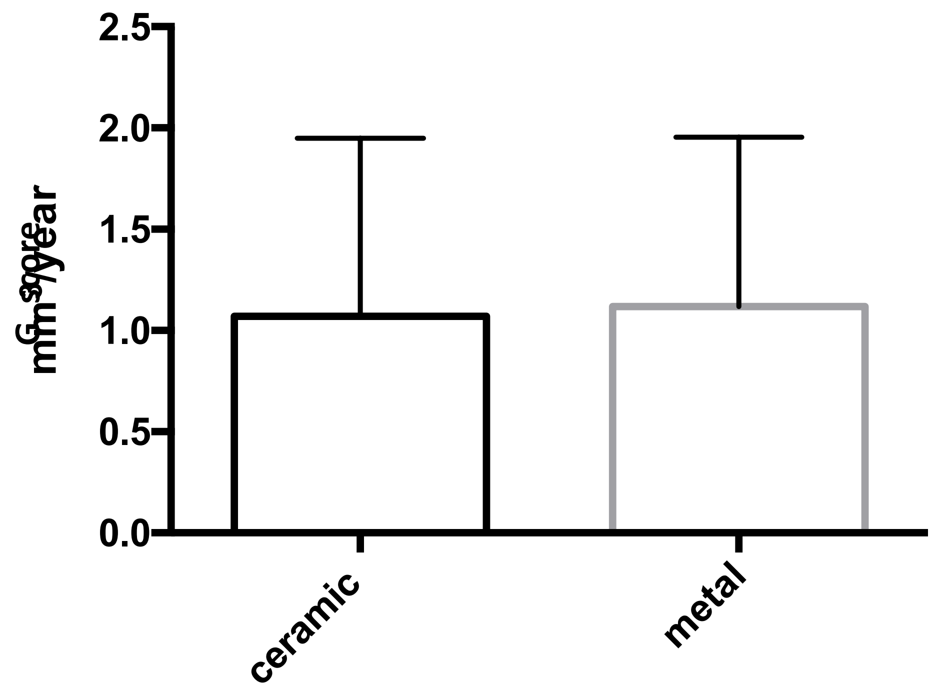
Results

GROUP **A**

Dual Mobility Bearing

Vs

Goldberg corrosion score



(p=0.4042)

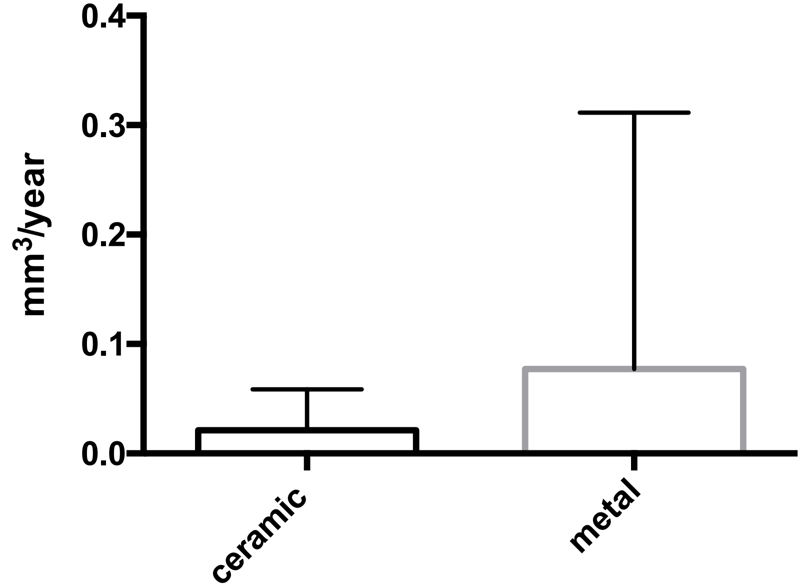
Results

GROUP **A**

Dual Mobility Bearing

Vs

Volume of material lost



(p=0.6726)

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Results

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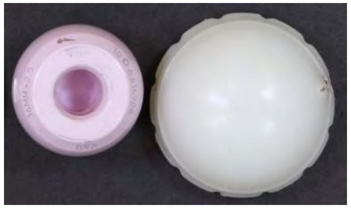
GROUP B:

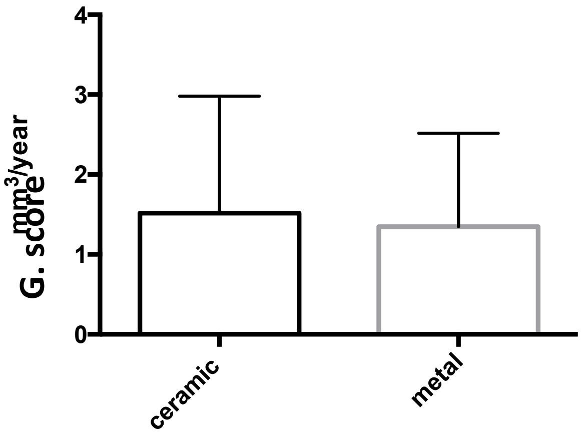


Standard UHMWPE Bearing

Vs

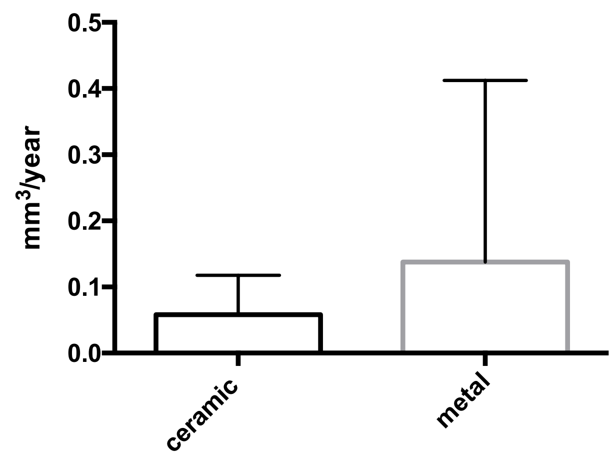
Goldberg score

p= 0.9883



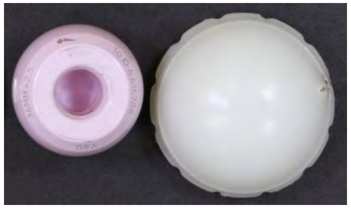
Volume of material lost

p= 0.5991



Results

GROUP **B**:

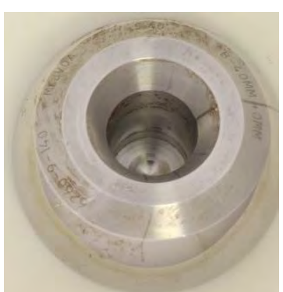


Standard UHMWPE Bearing

Vs

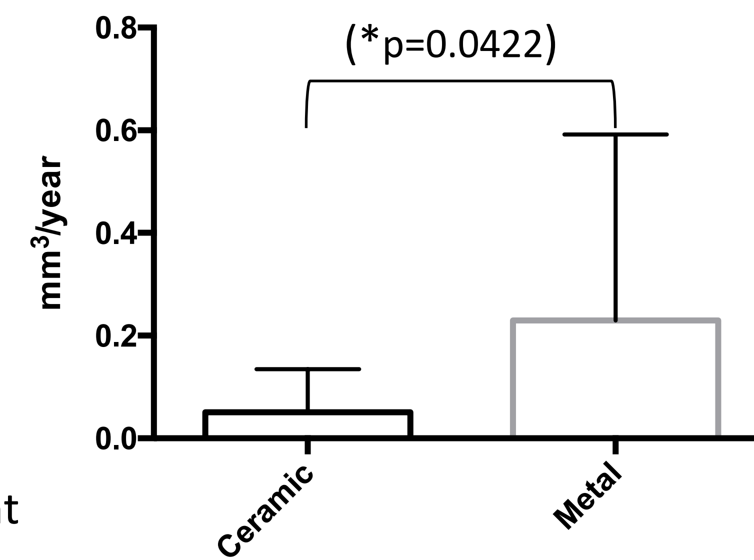
Goldberg score There was no statistical difference (p=0.9883)

Volume of material lost There was no statistical difference (p=0.5991)



Volume of material lost

Significantly different



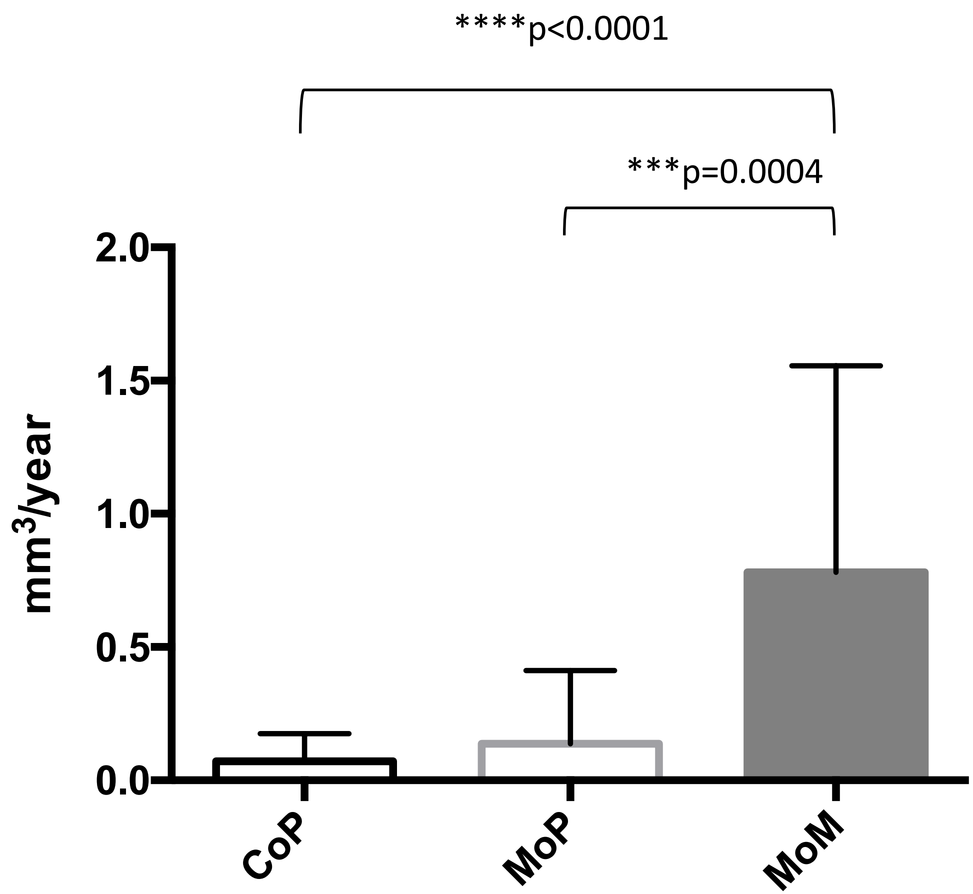
Research Questions

2 - Is the damage at the head/stem junction clinically relevant?

Results

CoP, MoP Vs MoM Bearing

Rates of material loss at the taper junction (stem+head)



[2]"Corrosion of Cemented Femoral Stems may Contribute to Implant Failure", ORS, 2015. Harry Hothi, Andreas Panagiotopoulos, Reshid Berber, Robert Whittaker, Shiraz Sabah, Johann Henckel, Gordon Blunn, John Skinner, Alister Hart.

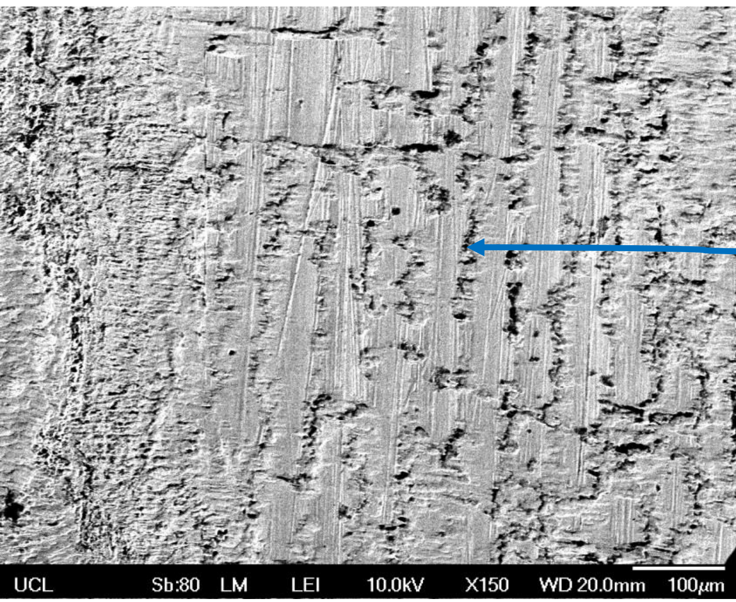
Discussion

Damage at the head/stem taper junction does occur in **CoP** bearing combination and it is **comparable** with **MoP** bearing combination at the stem trunnion, it is less at the head taper.

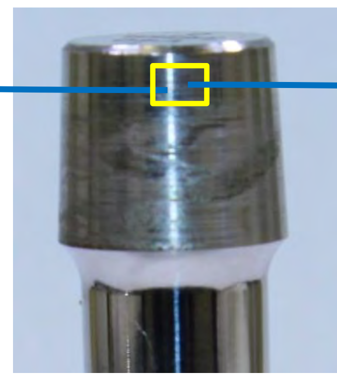
Rates of material loss at the taper junction were **negligible** when **compared with large diameter MoM implants** suggesting a mitigation of the problem;

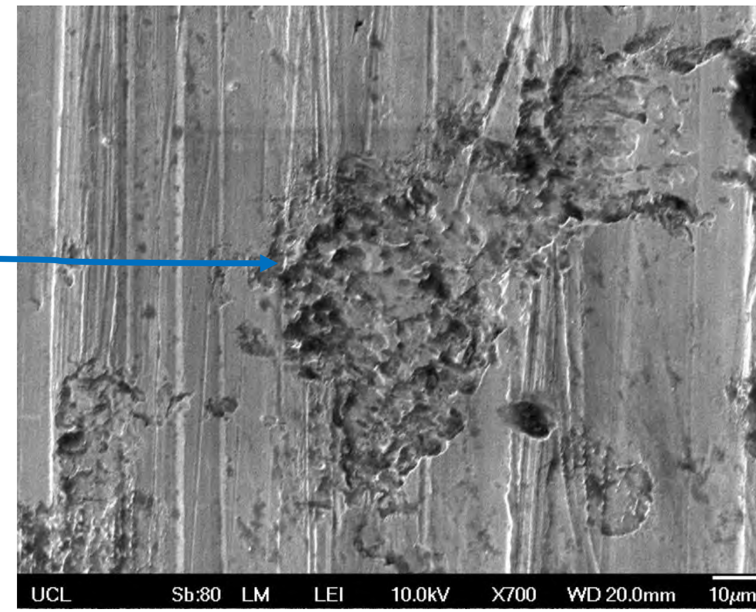
Conclusions

1 - Does the use of a ceramic head eliminate the damage at the head/stem junction?



NO





FRETTING

CORROSION

[3] Do Ceramic Femoral Heads Reduce Taper Fretting Corrosion in Hip Arthroplasty? A Retrieval Study
Steven M. Kurtz PhD, Sevi B. Kocagöz BS, Josa A. Hanzlik MS, Richard J. Underwood PhD, Jeremy L. Gilbert PhD, Daniel W. MacDonald MS, Gwo-Chin Lee MD, Michael A. Mont MD, Matthew J. Kraay MD, Gregg R. Klein MD, Javad Parvizi MD, Clare M. Rimnac PhD

Conclusions

1 - Does the use of a ceramic head eliminate the damage at the head/stem junction?

2 - If not, is the damage at the head/stem junction clinically relevant?

Difficult to answer but damage much less than in LDMOM

Thank You

Thank you for your attention

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INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
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26-27 NOVEMBER 2015

MILAN, ITALY

A Systematic Review And Meta-Analysis Of Metal On Polyethylene Versus Ceramic On Polyethylene Bearing Surfaces

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Thomas G. Ferreri MD (Cand)[2]
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[1]Orthopaedic Specialist Trainee Surgeon, Musgrove Park Hospital, Taunton [2]Central Michigan University College of Medicine, Mt. Pleasant, MI, USA
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[4] Orthopaedic Consultant, West Suffolk Hospital, UK

Disclosure

- No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this presentation

AGGREGATING MARGINAL GAINS

- NJR data comparing 7 and 10 year revision levels of the two most used implants with either MoP or CoP bearing surfaces show better survivorship for the ceramic heads[ii]

		Cumulative % probability revision at -	
Stem/Cup Brand	Bearing surface	7 years	10 years (All hips - 5.60 – 5.91)
Exeter V40/ Contemporary	MoP	1.91 (1.75 - 2.08)	3.21 (2.64 – 3.91)
	CoP	1.75 (1.22 – 2.53)	2.62 (1.31 - 5.21)
Corail/ Pinnacle	MoP	2.33 (2.04 - 2.66)	2.58 (2.19 - 3.04)
	CoP	1.84 (1.41 - 2.40)	-

Introduction

- Postulated that Ceramic on Polyethylene has a better survivorship than metal on polyethylene due to:
  - Less polyethylene wear
    - Lower median surface roughness
    - More forgiving scratch profile
    - Better wettability
  - Less corrosion at the head-neck junction
    - Galvanic and fretting

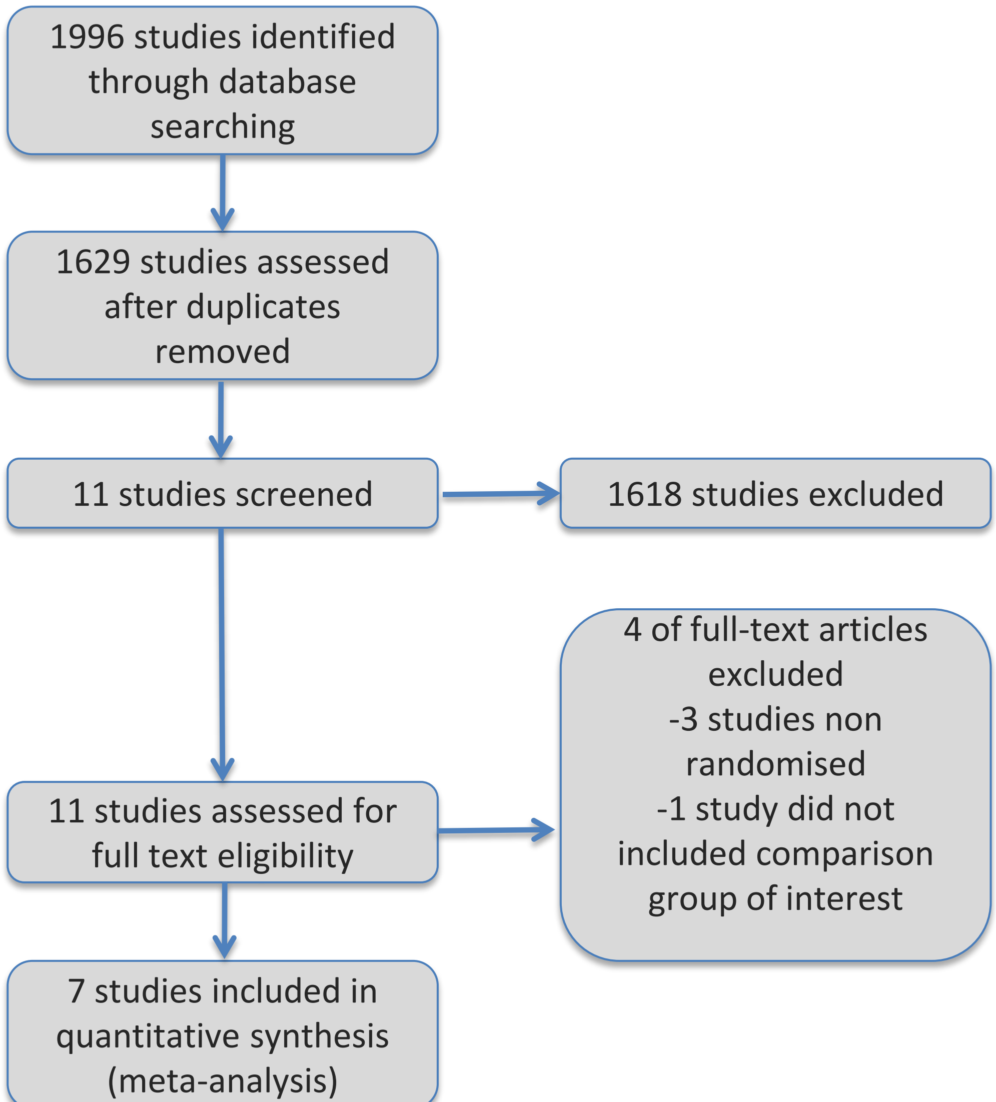
Outcomes

- Primary outcome: Level of polyethylene wear
  - Linear
  - Volumetric
- Secondary outcome
  - Metal ion levels
  - Any cause for revision (excluding infection)

Methods

- MEDLINE, EMBASE, CINALH, the Cochrane Database for Systematic Reviews, The Compendex of Engineering
- Study Inclusion
  - Adult patients >18 years
  - Primary total hip arthroplasty
  - Random allocation to Metal on poly or Ceramic on poly
- Cochrane Tool for Assessment of Risk of Bias
- GRADE guidelines
- Mantel-Haenszel Random-Effects model

Flow Diagram of Study Inclusion

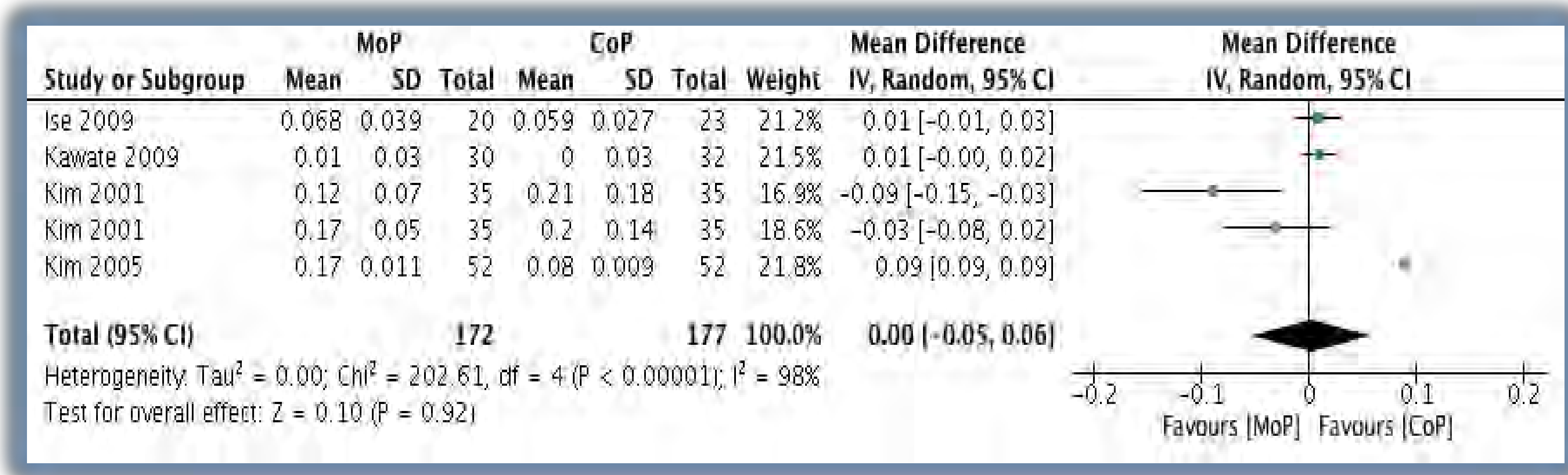


Results

- 7 Randomised trials
- 720 patients, 894 hips
- Average age range 54.0 - 68.9
- Follow up range 4.04 – 11 years
- 22, 26 and 28mm heads

Linear wear

- 4 studies
- 219 Patients
- 349 hips



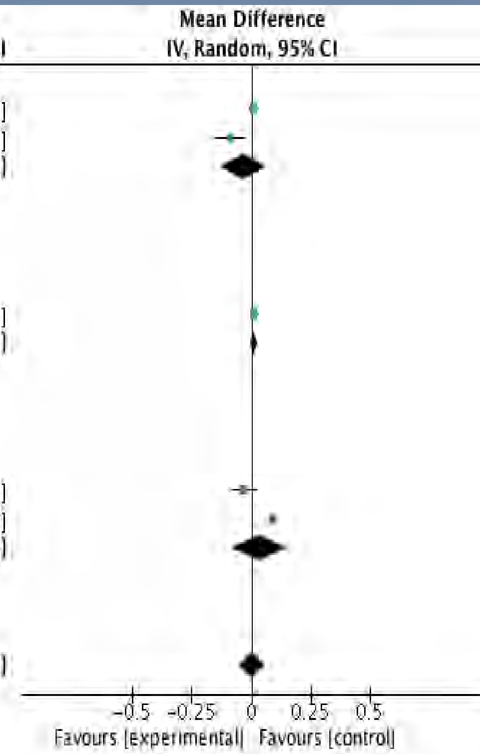
	MoP			CoP				Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Ise 2009	0.068	0.039	20	0.059	0.027	23	21.2%	0.01 [-0.01, 0.03]	
Kawate 2009	0.01	0.03	30	0	0.03	32	21.5%	0.01 [-0.00, 0.02]	
Kim 2001	0.12	0.07	35	0.21	0.18	35	16.9%	-0.09 [-0.15, -0.03]	
Kim 2001	0.17	0.05	35	0.2	0.14	35	18.6%	-0.03 [-0.08, 0.02]	
Kim 2005	0.17	0.011	52	0.08	0.009	52	21.8%	0.09 [0.09, 0.09]	
Total (95% CI)			**172**			**177**	**100.0%**	**0.00 [-0.05, 0.06]**	

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 202.61$, df = 4 ($P < 0.00001$); $I^2 = 98\%$
Test for overall effect: Z = 0.10 (P = 0.92)

- Not significantly different (MD: 0.00, 95% CI: -0.05-0.06, I^2=98%, p=0.92)

Linear wear and Head Size

Study or Subgroup	MoP Mean	MoP SD	MoP Total	CoP Mean	CoP SD	CoP Total	Weight	Mean Difference IV, Random, 95% CI
1.5.1 22mm								
Ise 2009	0.068	0.039	20	0.059	0.027	23	21.2%	0.01 [-0.01, 0.03]
Kim 2001	0.12	0.07	35	0.21	0.18	35	16.9%	-0.09 [-0.15, -0.03]
Subtotal (95% CI)			**55**			**58**	**38.1%**	**-0.04 [-0.13, 0.06]**
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 8.35$, df = 1 (P = 0.004); $I^2 = 88\%$								
Test for overall effect: Z = 0.72 (P = 0.47)								
1.5.2 26mm								
Kawate 2009	0.01	0.03	30	0	0.03	32	21.5%	0.01 [-0.00, 0.02]
Subtotal (95% CI)			**30**			**32**	**21.5%**	**0.01 [-0.00, 0.02]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.31 (P = 0.19)								
1.5.3 28mm								
Kim 2001	0.17	0.05	35	0.2	0.14	35	18.6%	-0.03 [-0.08, 0.02]
Kim 2005	0.17	0.011	52	0.08	0.009	52	21.8%	0.09 [0.09, 0.09]
Subtotal (95% CI)			**87**			**87**	**40.4%**	**0.03 [-0.08, 0.15]**
Heterogeneity: $Tau^2 = 0.01$; $Chi^2 = 22.67$, df = 1 (P < 0.00001); $I^2 = 96\%$								
Test for overall effect: Z = 0.54 (P = 0.59)								
Total (95% CI)			**172**			**177**	**100.0%**	**0.00 [-0.05, 0.06]**
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 202.61$, df = 4 (P < 0.00001); $I^2 = 98\%$								
Test for overall effect: Z = 0.10 (P = 0.92)								
Test for subgroup differences: $Chi^2 = 0.99$, df = 2 (P = 0.61), $I^2 = 0\%$								



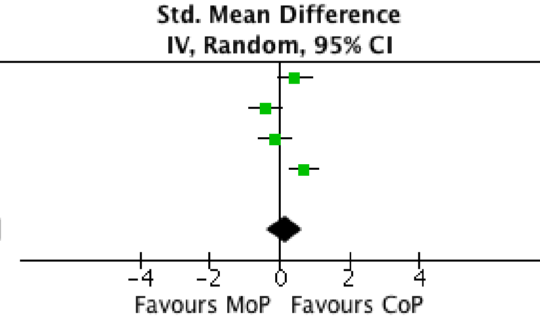
- Not significantly different ($X^2 = 0.99$, $I^2=0\%$, p=0.61).

Volumetric Wear

- 3 studies
- 182 Patients
- 306 hips

Study or Subgroup	MoP Mean	MoP SD	MoP Total	CoP Mean	CoP SD	CoP Total	Weight	Std. Mean Difference IV, Random, 95% CI
Kawate 2009	56.3	69.5	30	31.6	42.4	32	24.1%	0.43 [−0.08, 0.93]
Kim 2001	264.67	267.3	35	473.48	662.7	35	24.7%	−0.41 [−0.88, 0.06]
Kim 2001	627.01	601	35	730.77	906.7	35	24.8%	−0.13 [−0.60, 0.34]
Kim 2005	744.7	712	52	350.8	357	52	26.4%	0.69 [0.30, 1.09]
Total (95% CI)			**152**			**154**	**100.0%**	**0.15 [−0.36, 0.67]**

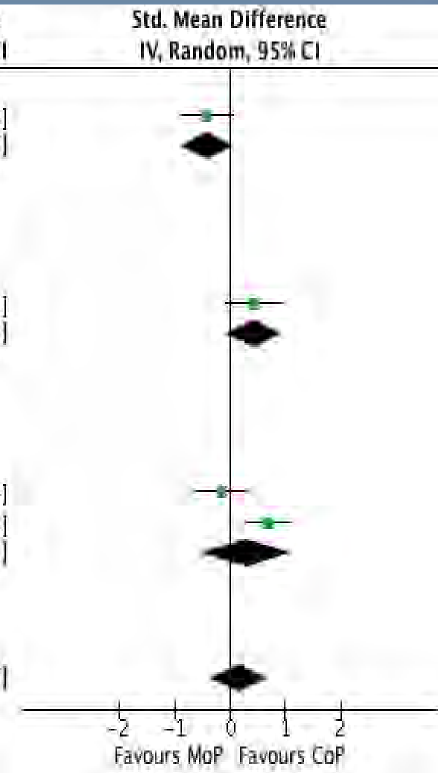
Heterogeneity: $Tau^2 = 0.22$; $Chi^2 = 15.03$, df = 3 (P = 0.002); $I^2 = 80\%$
Test for overall effect: Z = 0.58 (P = 0.56)



- SMD: 0.15, 95% CI: -0.36-0.67, I^2=80%, p=0.56)

Volumetric wear and Head Size

Study or Subgroup	MoP Mean	MoP SD	MoP Total	CoP Mean	CoP SD	CoP Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.7.1 22mm								
Kim 2001	264.67	267.3	35	473.48	662.7	35	24.7%	-0.41 [-0.88, 0.06]
Subtotal (95% CI)			**35**			**35**	**24.7%**	**-0.41 [-0.88, 0.06]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.69 (P = 0.09)								
1.7.2 26mm								
Kawate 2009	56.3	69.5	30	31.6	42.4	32	24.1%	0.43 [-0.08, 0.93]
Subtotal (95% CI)			**30**			**32**	**24.1%**	**0.43 [-0.08, 0.93]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.66 (P = 0.10)								
1.7.3 28mm								
Kim 2001	627.01	601	35	730.77	906.7	35	24.8%	-0.13 [-0.60, 0.34]
Kim 2005	744.7	712	52	350.8	357	52	26.4%	0.69 [0.30, 1.09]
Subtotal (95% CI)			**87**			**87**	**51.2%**	**0.29 [-0.52, 1.10]**
Heterogeneity: $Tau^2 = 0.29$; $Chi^2 = 6.98$, df = 1 (P = 0.008); $I^2 = 86\%$								
Test for overall effect: Z = 0.70 (P = 0.48)								
Total (95% CI)			**152**			**154**	**100.0%**	**0.15 [-0.36, 0.67]**
Heterogeneity: $Tau^2 = 0.22$; $Chi^2 = 15.03$, df = 3 (P = 0.002); $I^2 = 80\%$								
Test for overall effect: Z = 0.58 (P = 0.56)								
Test for subgroup differences: $Chi^2 = 6.07$, df = 2 (P = 0.05), $I^2 = 67.1\%$								



Not significantly different ($X^2 = 6.07$, $I^2=67.1\%$, $p>0.05$)

Metal Ion Levels

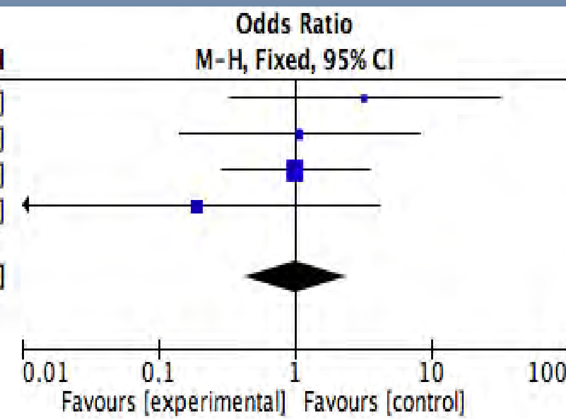
- One study
- Chromium and Titanium levels
- MoP had significantly higher serum Chromium levels in comparison to CoP ($p=0.015$)
- No significant differences in regards to Titanium levels ($p=0.67$).

Revision Rates

- 4 studies
- 495 patients
- 504 hips

Study or Subgroup	MoP Events	MoP Total	CoP Events	CoP Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Bjorgul 2013	3	127	1	134	9.3%	3.22 [0.33, 31.34]
Kawate 2009	2	29	2	31	17.7%	1.07 [0.14, 8.17]
Kim 2001	6	35	6	35	48.7%	1.00 [0.29, 3.47]
Kim 2005	0	52	2	52	24.3%	0.19 [0.01, 4.11]
Total (95% CI)		**243**		**252**	**100.0%**	**1.02 [0.43, 2.43]**
Total events	11		11			

Heterogeneity: $Chi^2 = 2.12$, df = 3 (P = 0.55); $I^2 = 0\%$
Test for overall effect: Z = 0.05 (P = 0.96)



(Odds Ratio: 1.02, 95% CI: 0.43-2.43, I^2=0%, p=0.96)

Limitations of Our Paper

- This study only applies to head sizes up to 28mm
- Limited follow-up time and small sample sizes of all the randomized trials included in this review

Conclusions

- No significant difference in linear or volumetric wear regardless of head size between the 2 groups
- No significant difference in revision rate between MoP and CoP
- Factors other than polyethylene wear may be important in determining choice of bearing surface

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- Images:
- http://static.guim.co.uk/sys-images/Guardian/Pix/pictures/2012/2/28/1330439186768/Hip-prosthesis-007.jpg
- https://tinderboxconsulting.files.wordpress.com/2012/08/team_gb_cycling.jpg

Thank You / Grazie

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- amitatrey@doctors.net.uk

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

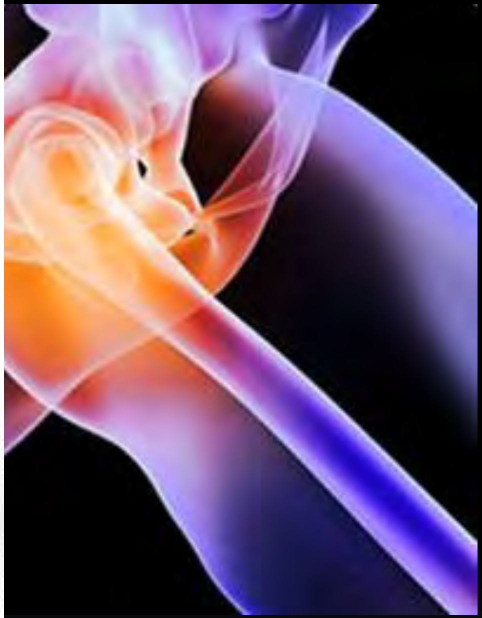
26-27 NOVEMBER 2015

MILAN, ITALY

WEAR IN TOTAL HIP ARTHROPLASTY USING CERAMIC HEAD: 10 YEARS MAXIMUM FU.

G. Malerba, C. De Ieso, G. Logroscino, F. Barberio, V. De Santis, G. Maccauro

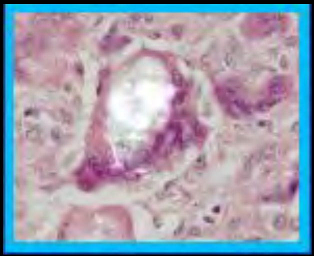
The increasing
arthroplasties in
necessary to i
characteristics i
longer implant s

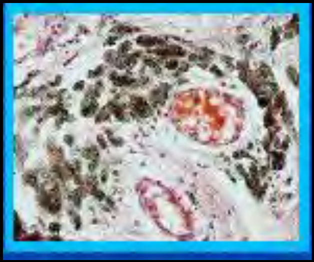


Ceramic materials are currently the landmark in the evaluation of wear characteristics.

WEAR → DEBRIS

↓





AUTOIMMUNE RESPONSE

↓

OSTEOLYSIS

↓

ASEPTIC LOOSENING

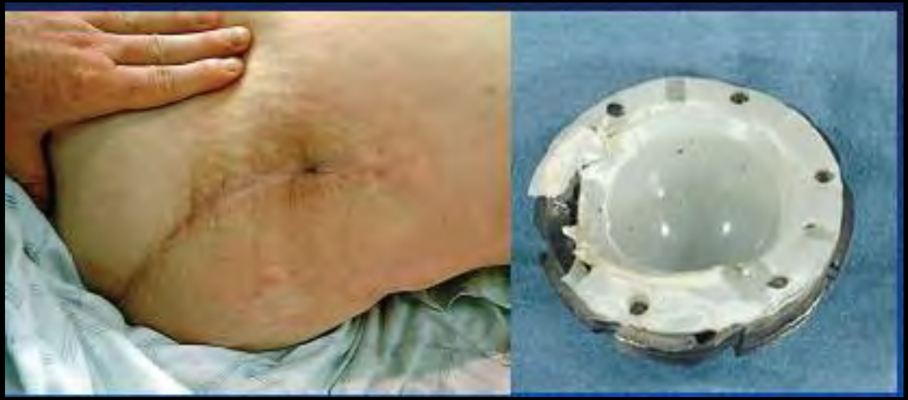
↓

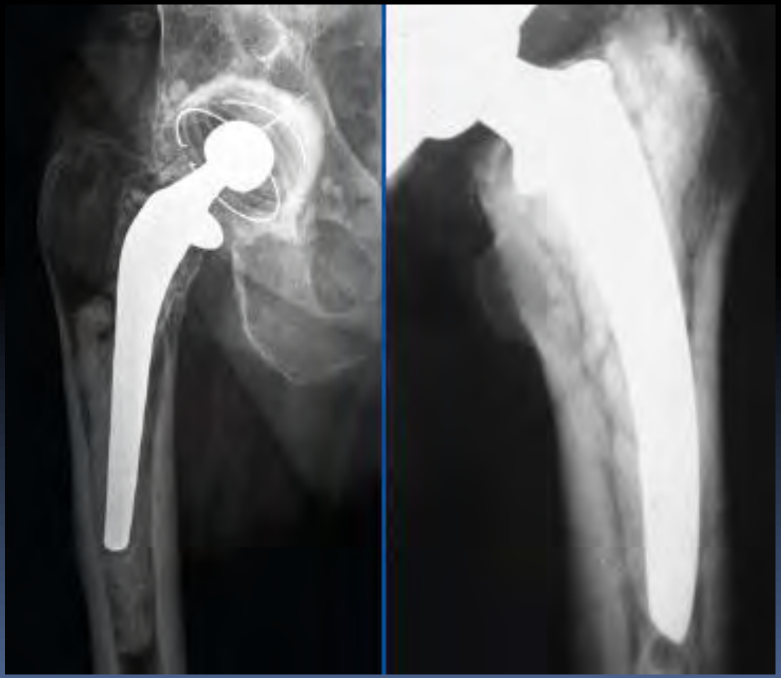
PROSTHESIS FAILURE

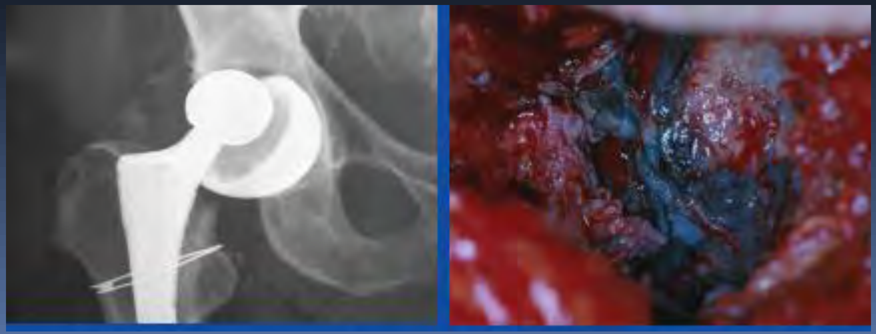
REVISION

FAILURE CAUSES

- Technical errors
- Particle disease
  aseptic loosening
  osteolysis
  periprosthetic fracture
- Infection
- Instability
- Implant breakage





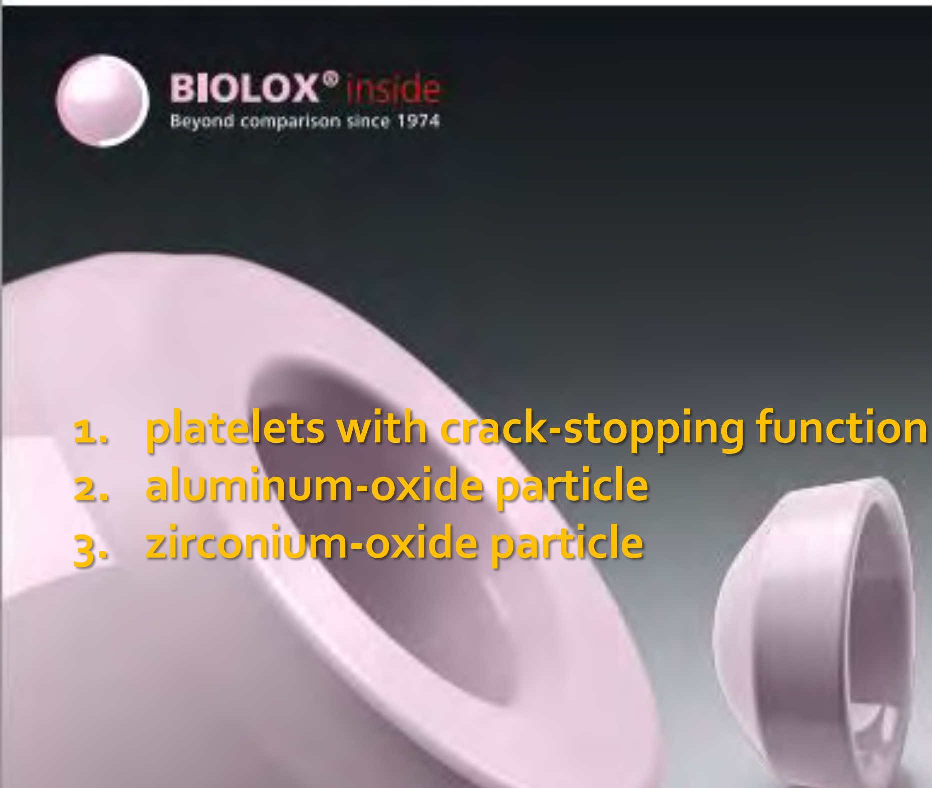


Wear: related to the friction between surfaces with different coefficients:

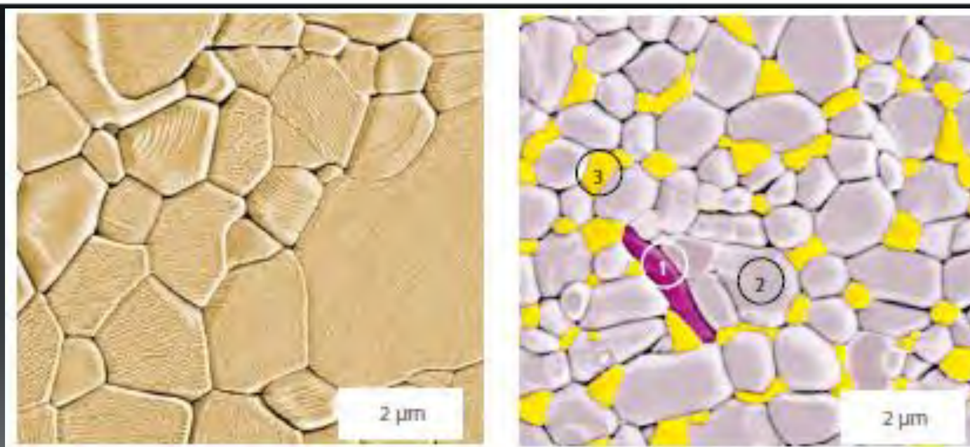
- Metal – polyethylene
- Metal - metal
- Ceramic – polyethylene
- Ceramic - ceramic

BIOLOX®delta

Prodotti medici CeramTec



1. platelets with crack-stopping function
2. aluminum-oxide particle
3. zirconium-oxide particle



Fonte: CeramTec GmbH   Fonte: CeramTec GmbH

Features & Benefits

Features	Benefits
Available in 28, 32, and 36mm femoral head sizes	Treats a wide variety of patient anatomies
ARTICUL/EZE® 12/14 Head Tapers available in three neck lengths, +1.5, +5.0, and +8.5	Designed to Restore Biomechanics
S-ROM® 11/13 head tapers available in three neck lengths, +0, +1.5, +3 and +6	Designed to Restore Biomechanics
BIOLOX delta material contains 74% alumina & 25% zirconia	Hardness of alumina (low wear) Fracture toughness; due to resistance to fracture of zirconia[2]
Latest generation of ceramic material	Improved wear on polyethylene vs. cobalt chrome heads[1] Improved burst strength compared to alumina ceramic heads[2].

References:
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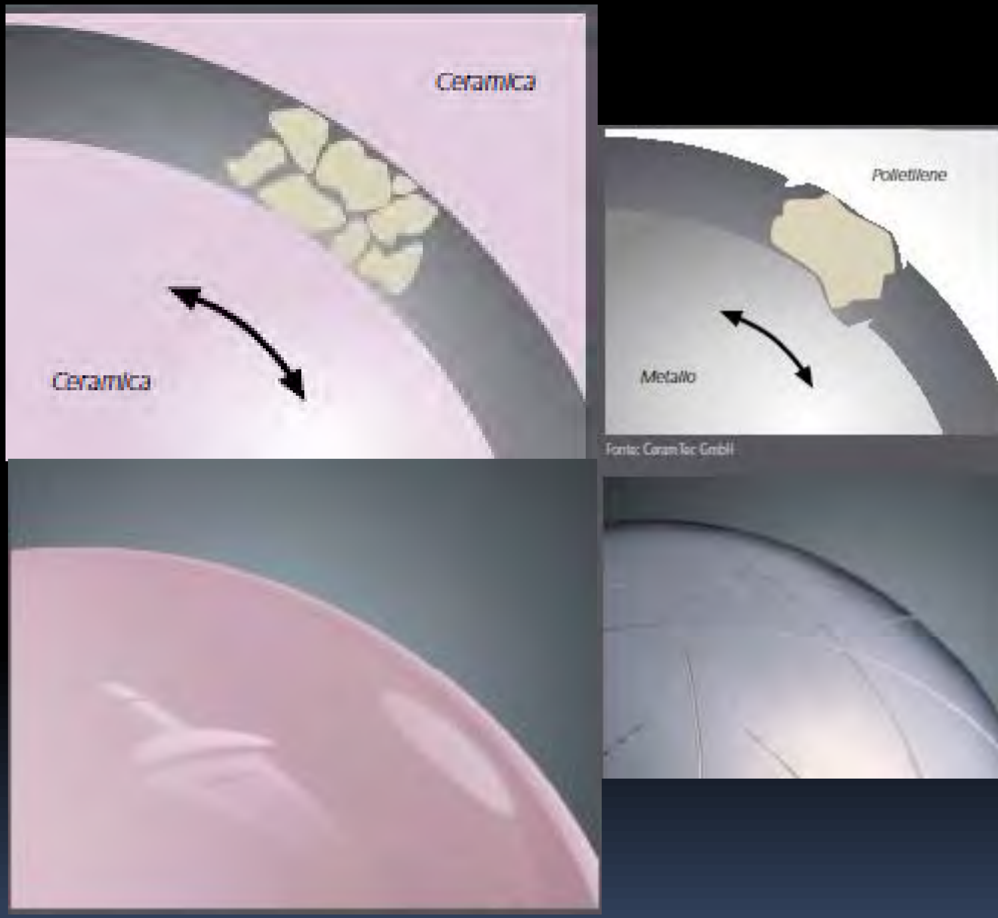
2.Rack, R. and H.G. Pfaff. "A New Ceramic Material for Orthopedics." Proceedings of the 5th International CeramTec Symposium, G. Thieme Verlag, Stuttgart, 2000: 141-145.

- 82% alumina
- 17% tetragonal zirconia particles
- 0,5% strontium aluminate
- 0,5% chromium oxide

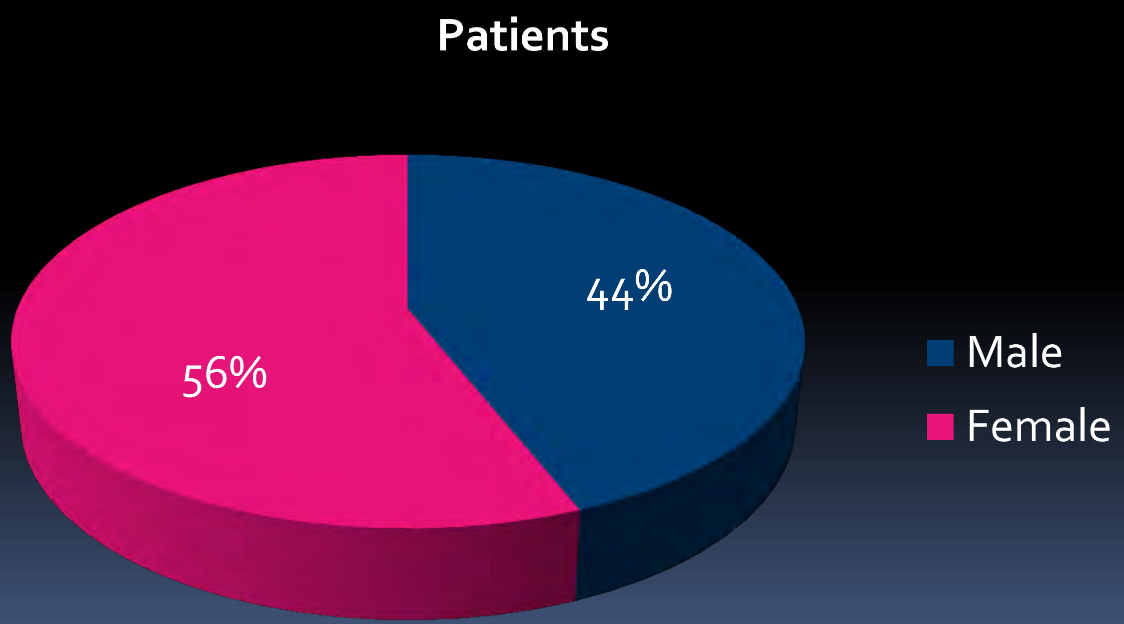
FEATURES

- Extreme Hardness
- Exacting Sphericity
- Optimal Clearance
- Nearly no Third-Body Wear
- Superior Surface Smoothness
- Scratches
- Excellent Biological Behaviour
- Supreme Wettability



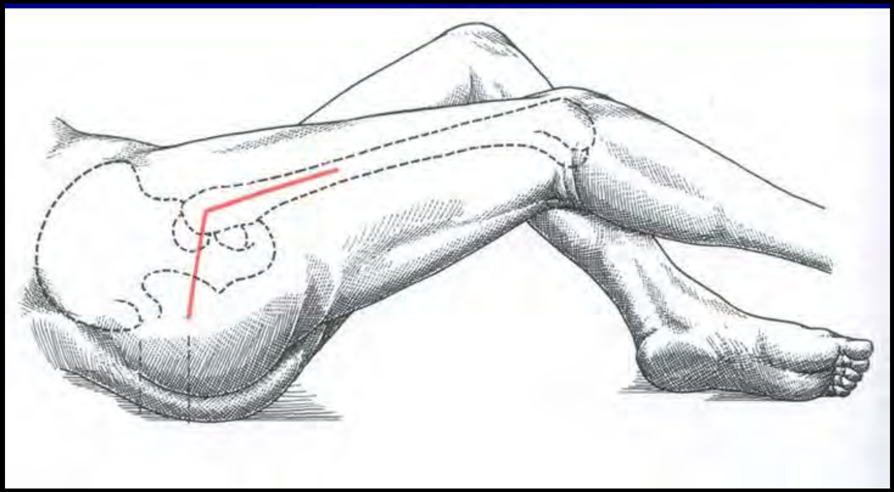
MATERIALS AND METHODS

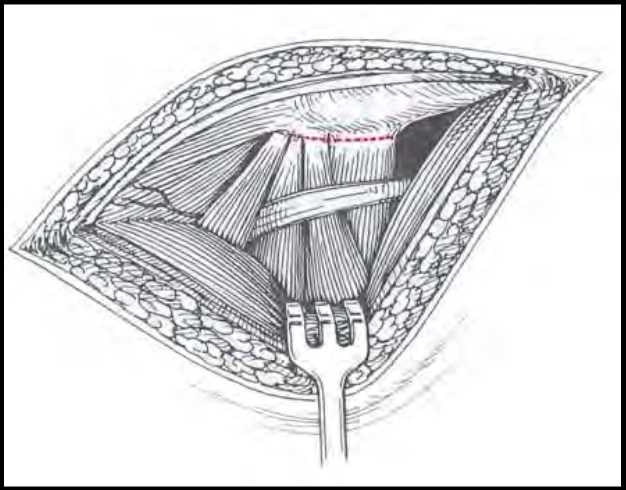
From 2005 to 2015 834 patiens have been selected



Mean age 68 aa

MATERIALS AND METHODS





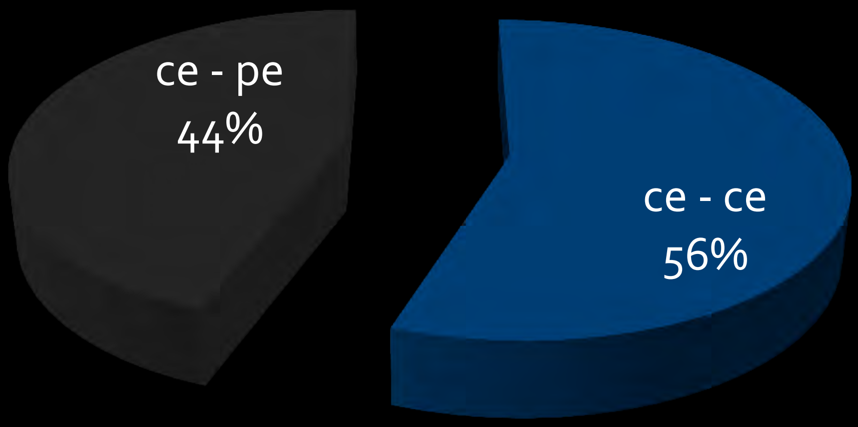
- Telephone interview for the clinical evaluation and the degree of satisfaction (LEQUESNE INDEX)

Lequesne MG. The algofunctional indices for hip and knee osteoarthritis. J Rheumatol 1997; 24: 779-81

- Verbal numerical rating scale of pain VNS
- Radiographic evaluation of wear

RESULTS

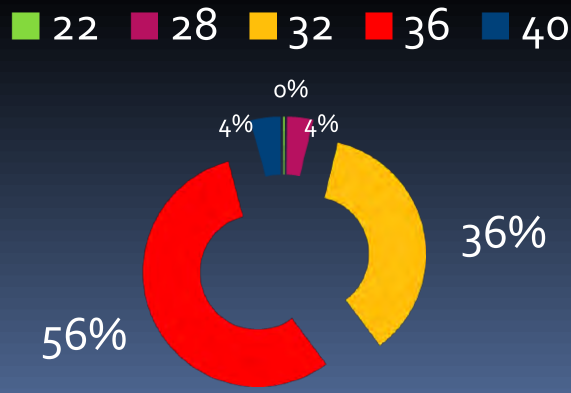
coupling

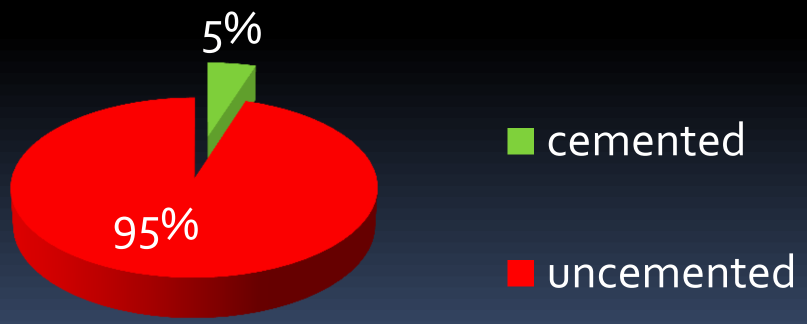


18 types of stem

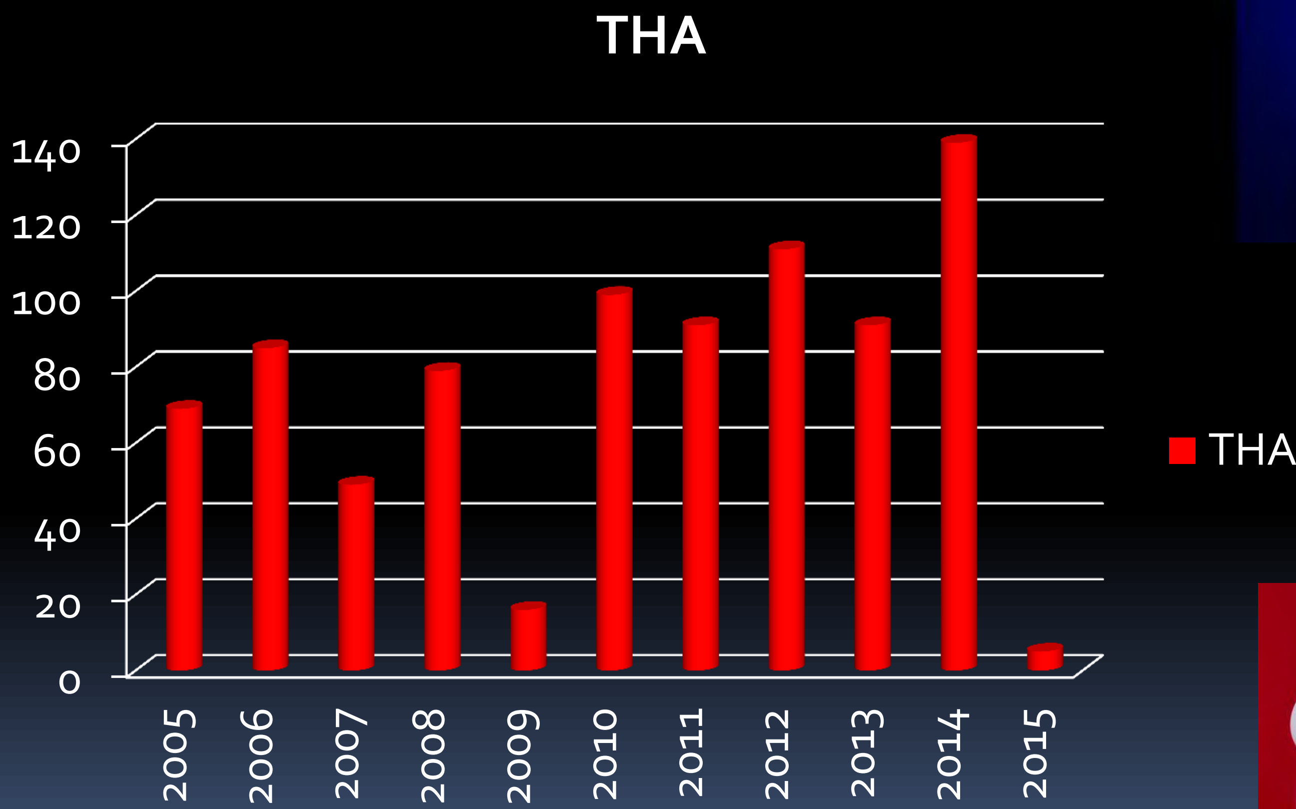
(5 stemless)

femoral heads



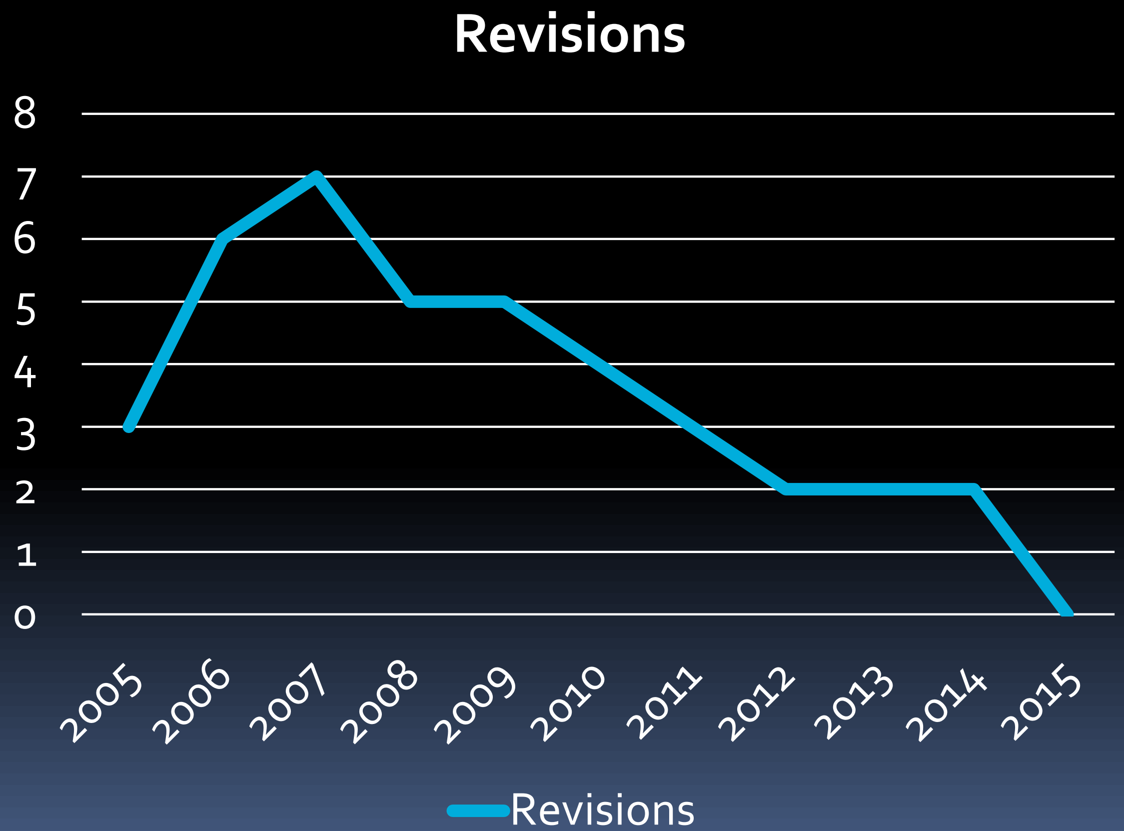


RESULTS


THA
140
120
100
80
60
40
20
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
THA

RESULTS

95% Survival rate of the implants in 10 years



48 pz

lost at follow up

- 12 aseptic loosening
- 13 infection
- 9 periprosthetic fracture
- 5 dislocation

LEQUESNE INDEX

DISCOMFORT PAIN

- Night sleep
- Morning stiffness
- Pain in walking (> 30 min)
- Pain on movement
- Pain sitting

DAILY ACTIVITIES

- Socks wearing
- Bend down
- Climbing stairs (<25 steps)
- Getting in the car

MAXIMUM DISTANCE COVERED

- Max Walkable distance
- Use of crutches

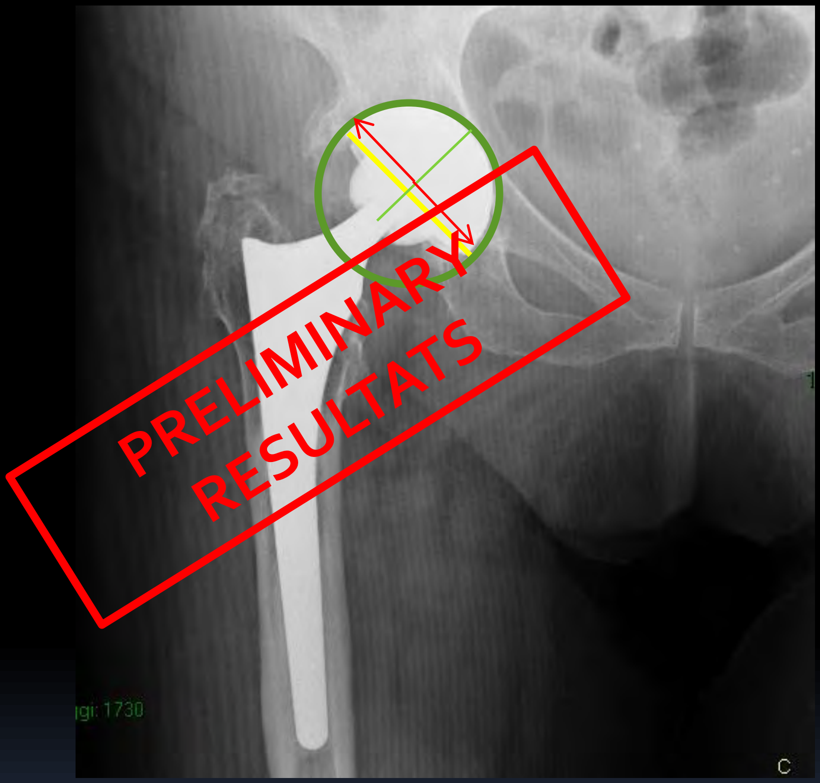
- CE – CE 21
- CE – PE 20

RESULTS SLIGHTLY BETTER IN CERAMIC ON CERAMIC COUPLING

VNS

ANALOGOUS RESULTS IN BOTH COUPLINGS

RADIOGRAPHIC EVALUATION



ANALOGOUS RESULTS IN BOTH COUPLINGS

DISCUSSION

No differences found in bearing related hip survivorship at 10-12 years follow-up between patients with ceramic on highly cross-linked polyethylene bearings compared to patients with ceramic on ceramic bearings.

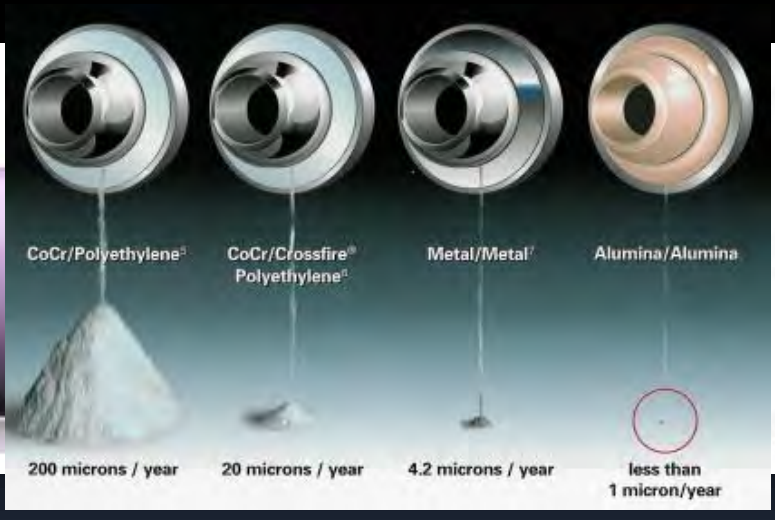
Epinette JA, Manley MT.
J Arthroplasty. 2014 Jul;29(7):1369-72

Ceramic-on-ceramic bearings in young patients: outcomes and activity levels at minimum ten-year follow-up.

Chana R, Facek M, Tilley S, Walter WK, Zicat B, Walter WL.
Bone Joint J. 2013 Dec;95-B(12):1603-9

CONCLUSION

the use of new material design and / or the improvements of material characteristics can produce benefits even in longer term

The ceramic components represent the gold standard, especially in young and active subjects with excellent results at adistance for functional outcomes and wear

CONCLUSION

The use of the ceramic head, whether it is coupled to a polyethylene insert or ceramic itself, certainly gives excellent results at 10 years follow up

The ceramic on polyethylene coupling can be a viable alternative to ceramic on ceramic, also considering its lower cost and the theoretical lower risk of breakage

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY

SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Functional and clinical Outcome of THA using Large diameter ceramic couples

R Raman, S Gopal, A Nisar, V Johnson, C Shaw

Academic Department of Orthopaedics

Hull and East Yorkshire Regional Arthroplasty Center (HEYRAC)

Hull York Medical School

Changing Patients

Increasing number of old AND young patients

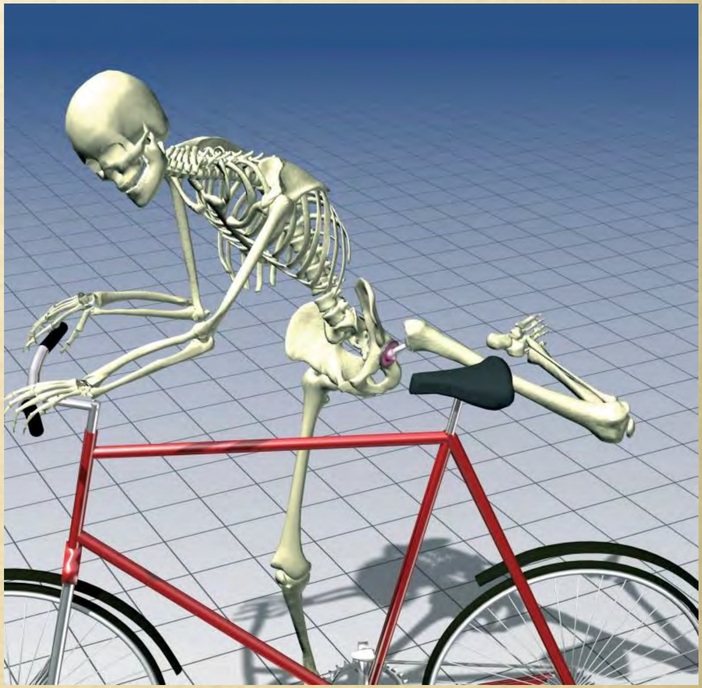
- World population > 65 yrs is growing ~ 1% per year

- Obesity increasing (adults and children)

  WHO: BMI > 25

- More and more young patients

- Increasing arthrosis in all age groups



Crowninshield RD, Hip Int 2006

PE wear...

- Main reason for aseptic loosening
- of acetabular and femoral components

- Aseptic Loosening - 75% of all revision cases
  Swedish National Hip Arthroplasty Register

- Finnish Arthroplasty Register: PE wear is limiting factor for survival of THA (patients < 55 a)
- Eskelinen A et al., Acta Orthopaedica 2006; 77 (1): 57–70

- Mean wear rate of 0,2 mm/a results in a 4 (!) – fold higher risk of osteolysis
- Orishimo et al. JBJS-Am 85, 2003

Revision THA - Indications

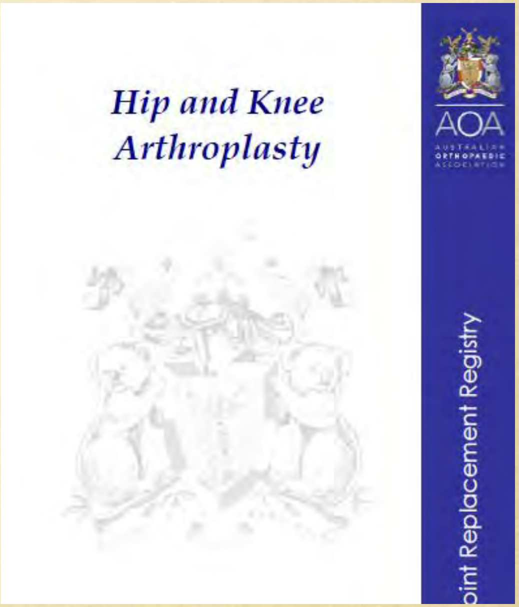
- Aseptic Loosening !!! (Wear related)

	No.	%	No.	%	No.	%	No.	%	No.	%
Indications for single stage revision	**5,405**		**5,968**		**6,191**		**5,955**		**23,519**	
Aseptic loosening	3,419	63%	3,628	61%	3,675	59%	3,340	56%	14,062	60%
Lysis	1,147	21%	1,095	18%	1,081	17%	913	15%	4,236	18%
Pain	1,072	20%	1,207	20%	1,692	27%	1,847	31%	5,818	25%
Infection	103	2%	97	2%	167	3%	171	3%	538	2%
Indications for stage one of a two stage revision	**374**		**392**		**440**		**497**		**1,703**	
Aseptic loosening	79	21%	72	18%	85	19%	74	15%	310	18%
Lysis	57	15%	46	12%	58	13%	46	9%	207	12%
Pain	64	17%	57	15%	84	19%	89	18%	294	17%
Infection	300	80%	299	76%	355	81%	399	80%	1,353	79%

Registry data

Table HT11: Primary Total Conventional Hip Replacement by Reason for Revision

Reason for Revision	Number	Percent
Loosening/Lysis	1902	30.1
Prosthesis Dislocation	1634	25.9
Infection	1061	16.8
Fracture	925	14.6
Metal Sensitivity	133	2.1
Pain	132	2.1
Leg Length Discrepancy	82	1.3
Malposition	68	1.1
Implant Breakage Acetabular	59	0.9
Implant Breakage Stem	53	0.8
Incorrect Sizing	43	0.7
Implant Breakage Hip Insert	38	0.6
Instability	33	0.5
Wear Hip Insert	25	0.4
Implant Breakage Head	23	0.4
Other	110	1.7
TOTAL	**6321**	**100.0**



Primary THR - CoC

- Single centre – Regional Arthroplasty unit- Prospective study
- 3 surgeon
- 1219 consecutive hips (1012 patients)
- All CoC couples

Results

- Mean Age: 64.9 yrs (11-82 yrs)
- Min Follow up 5 yrs (62-96 months)
- Biolox Delta Ceramic Liners and Biolox Delta ceramic heads
- Detailed clinical and radiological analysis

Clinical Results

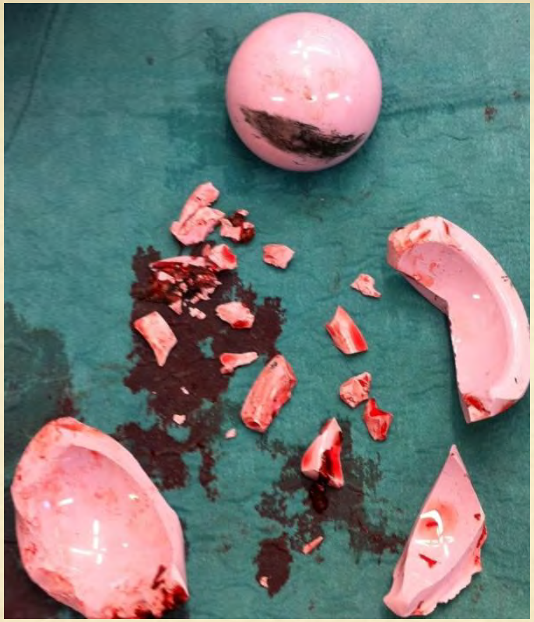
- Acetabular shell : 44-62mm
- 36mm CoC used in 92%
- 1 Dislocation (Frac NOF)
- Mean time to recreational sports: 3.9 months

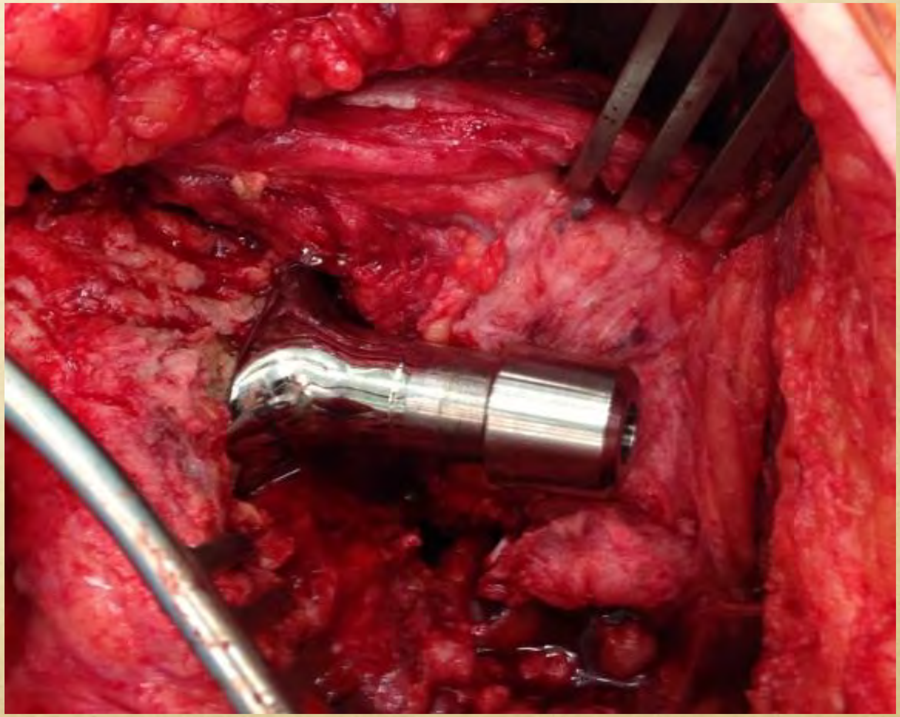
Results

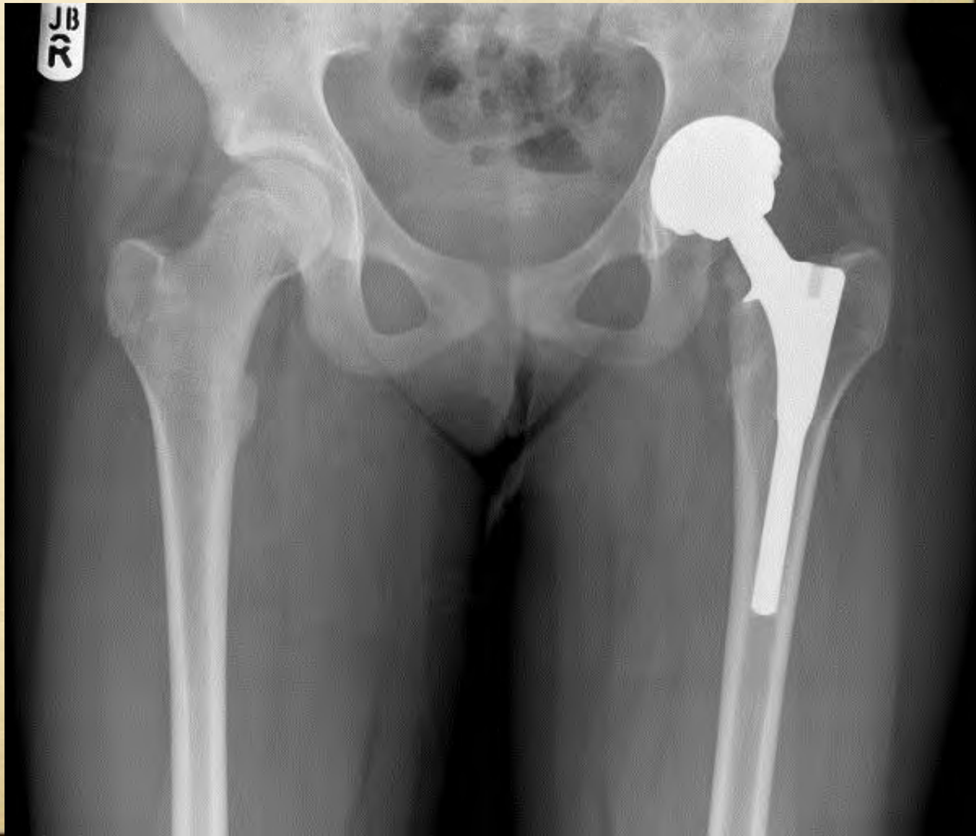
- 1 Dislocations
- 1 ceramic frac / 1 squeaking
- HHS – Improved from 61 to 95 (88-97)
- OHS -46 (39-47)
- Euroqol – EQ5 D:
  - 0.84 _health thermometer

Revisions

- 1 for infection,
- 4 for fracture – 1 intra op and 3 peri pros after trauma
- 1 cup revision – Liner fracture
- None for aseptic loosening/osteolysis







- 13 yrs – Female AVN(SUFE)
- Reliable and safe bearing
- Functional demand

- Frac NOF
- 36/50 shell
- Better ROM
- Lower risk of dislocation

Survival

- At 8 yrs
  - For aseptic loosening: 99.3%
  - Overall: 98.1%

NJR data for CSF *Plus* - COC

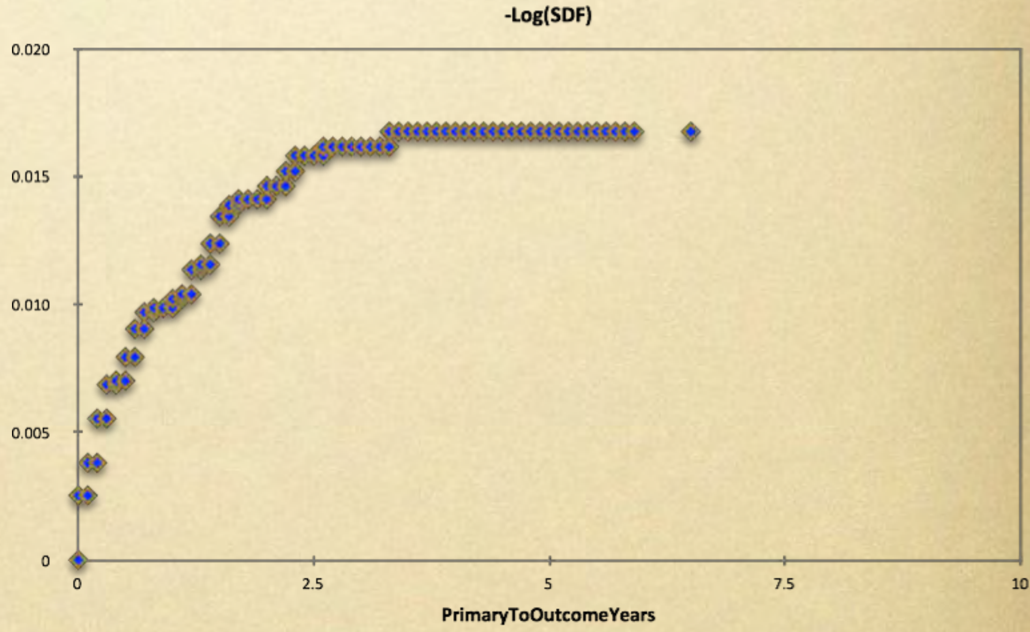
Patients 7135

Max follow up 6.5 years

revisions 96

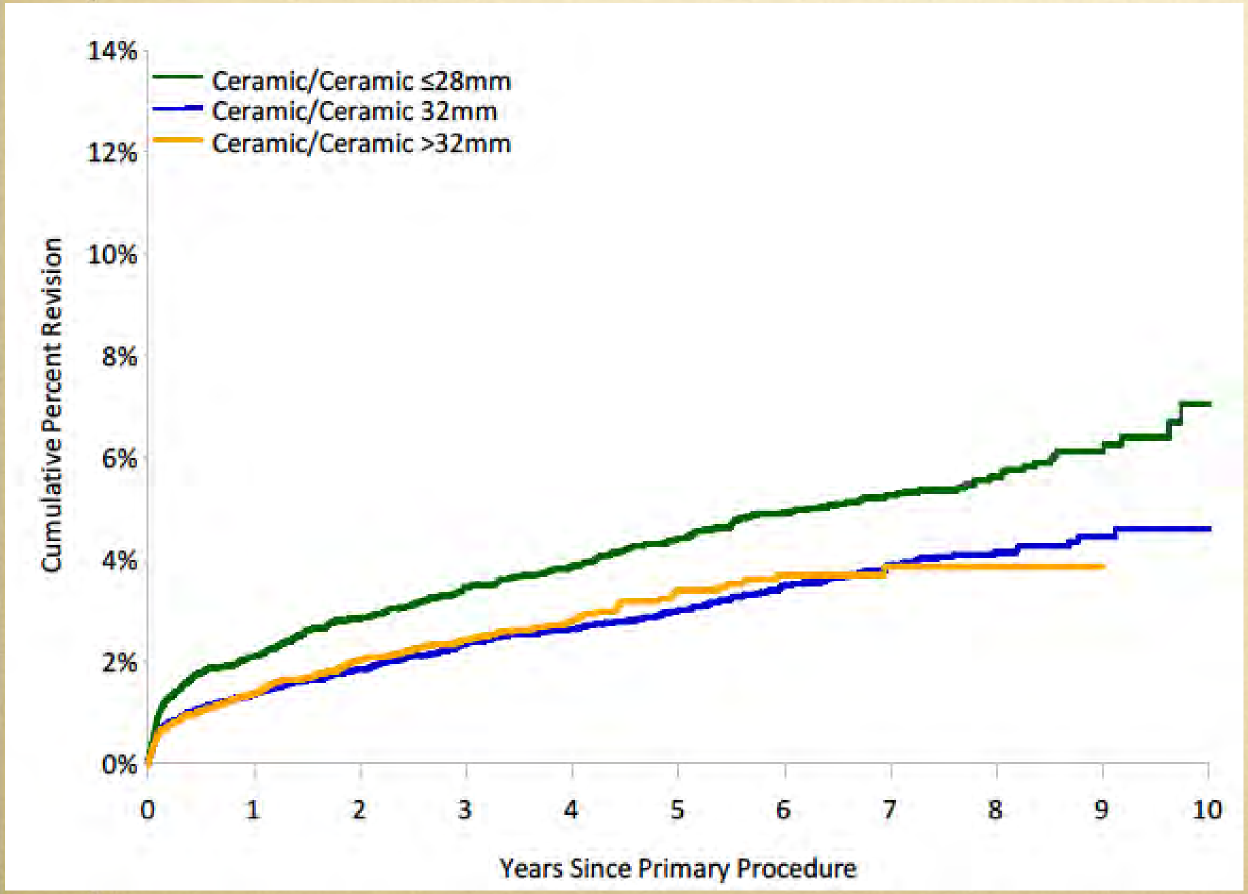
Revision rate at 3 years 1.6%

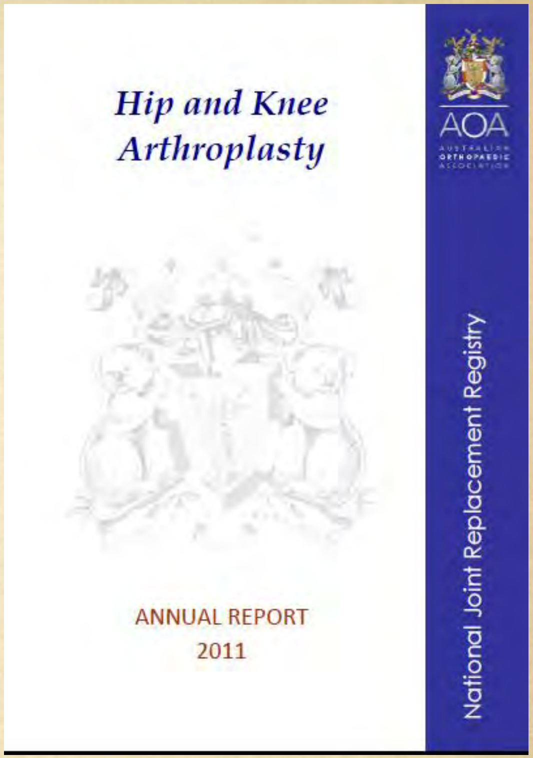
Revision rate at 5 years 1.7%



Head Sizes...

- 32mm: 132 - 1 problem (squeaking)
- 36mm: 791 - 1 problem (fracture of liner)
- 40mm: 83 - 0 problems





Cumulative Percent Revision of Ceramic/Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)

Conclusion

- CoC – Less risk of revision, osteolysis, infection, dislocation, aseptic loosening, debris disease
- Excellent clinical and functional outcome in this series
- Longer term f/u needed for this bearing to compliment the mid term results

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Mis-seating of Trident ceramic acetabular liners: a 6-year audit of incidence and revision rate in South Devon, UK

International Combined Meeting, British Hip Society/Societa Italiana dell'Anca
Milan, Italy
26th November 2015

Tom Law, Registrar, Trauma & Orthopaedics
Andrew Roberton, Core Surgical Trainee
Mr Mark Ashworth, Consultant Orthopaedic Surgeon

South Devon Healthcare Foundation Trust, Torquay, UK

Background

- Trident uncemented ceramic acetabular THR component in 2 parts
  - Metal shell, hydroxyapatite coated
  - Metal-backed ceramic liner (ceramic alone brittle)

- Shell implanted first, liner inserted separately
  - Acetabulum under-reamed for press fit

Component mechanics

- Taper locking mechanism with rim castellation for rotational control

- Mis-seating of liner leads to malalignment of cup

Aims – to discover:

- Rate of mis-seating of these components in 2 local hospitals
  - Torbay (NHS) and Mount Stuart (private)
  - 6 year study period (2008-2014)
  - Multiple surgeons
- Revision rate
  - Is malseating related to early revision?

Method

- All Trident ceramic uncemented acetabular components in study period identified
  - Theatre data collection system

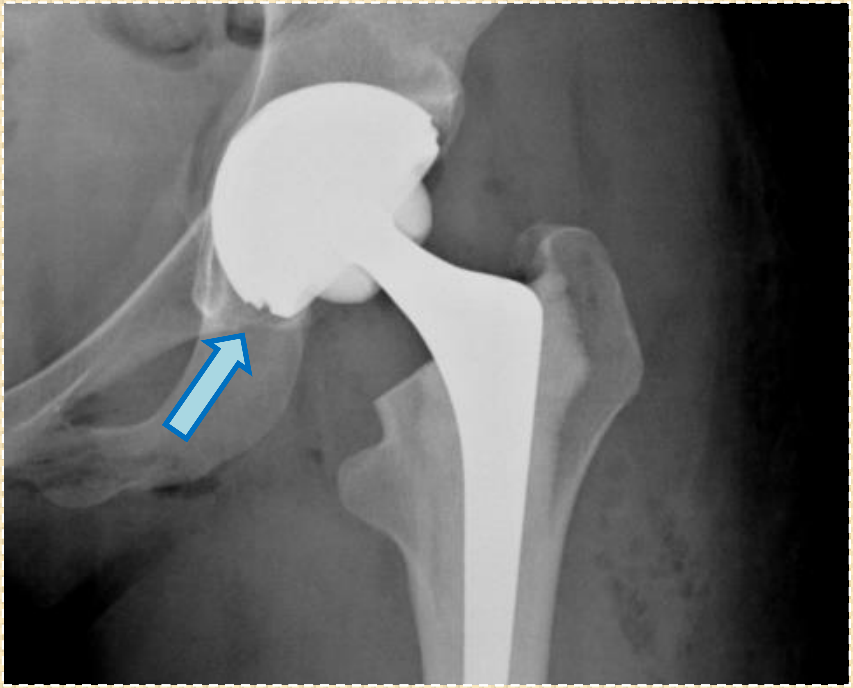
- Same database searched for revision procedures

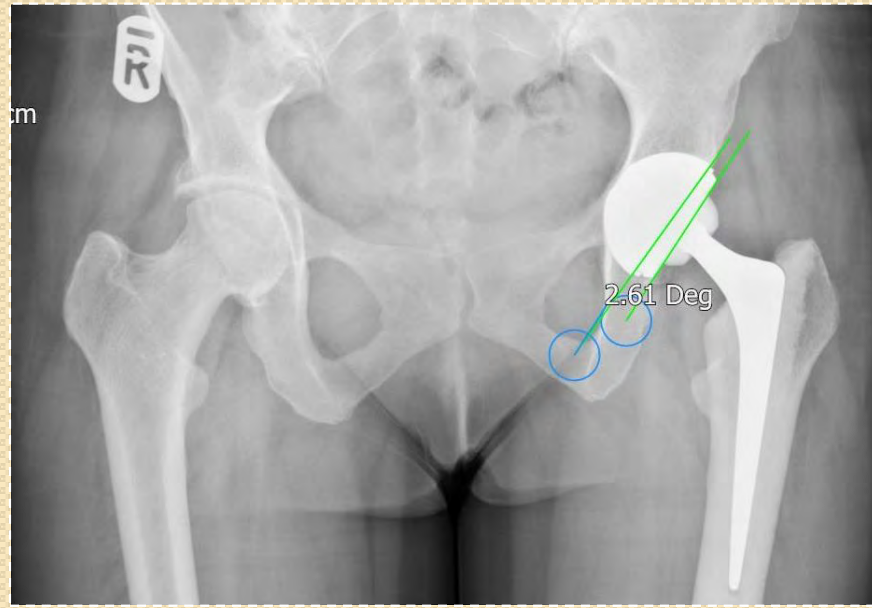
- Post-op AP and lateral digital radiographs reviewed for correct position
  - 1yr follow up views (if available) also reviewed

- Incorrect positioning:
  - Gap seen between metal layers
  - >1 degree misalignment between liner and shell metal parts

Gap between liner and shell

Misalignment of liner in shell by >1°





Radiographic criteria

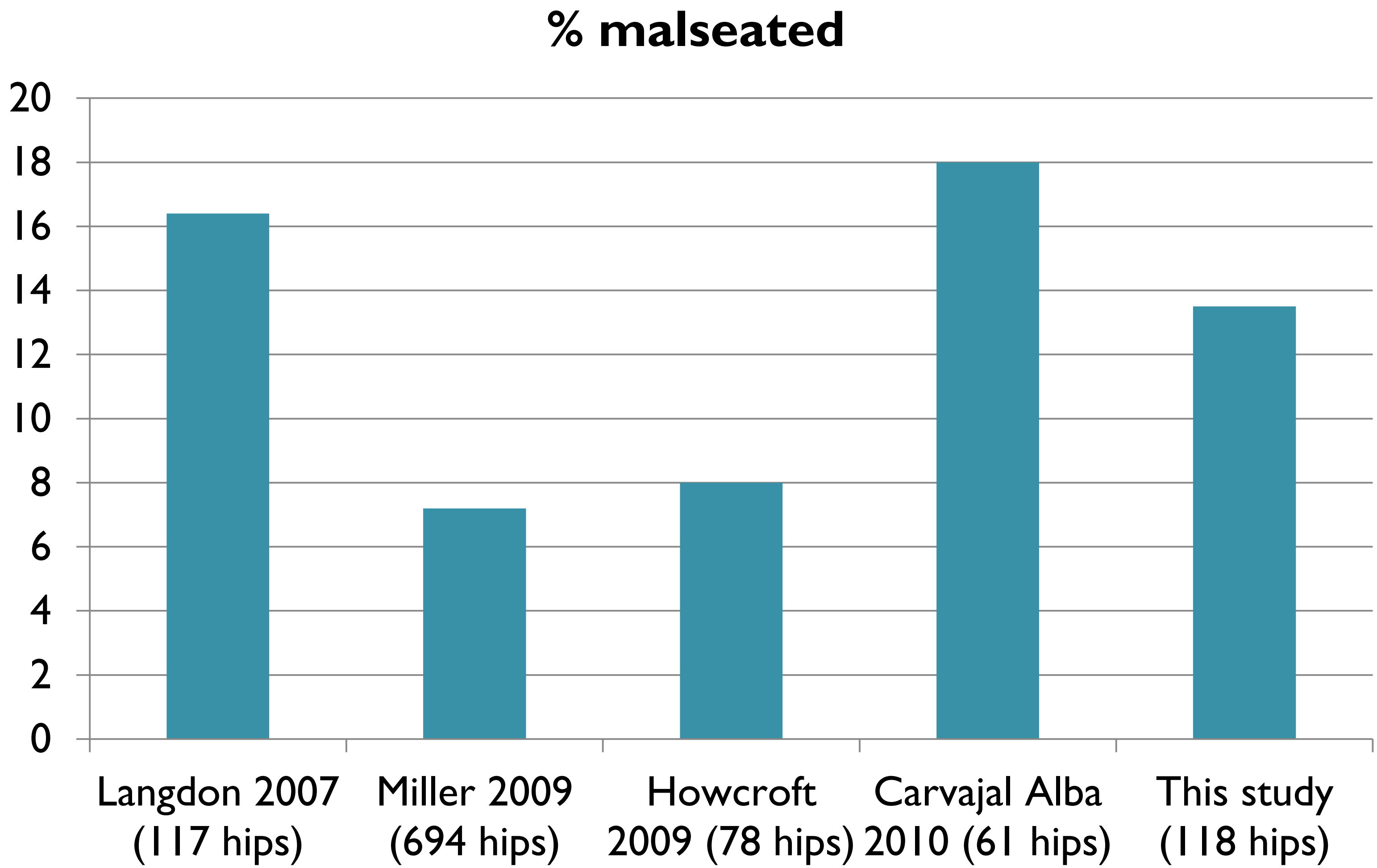
Results

- 118 hips in 108 patients from August 2008 to August 2014
- 16 not correctly seated post op (13.5%)
  - Of these, 3 were correctly seated at 1yr
    - 27% rate of subsequent seating
    - 6 still not seated, 2 no follow-up views available
- One revision
  - For painful psoas impingement
  - Liner correctly seated
- One dislocation at 1 month post op
  - Liner correctly seated

Current state of knowledge

- Langdon AJ et al, JBJS (Br) 2007
  - 117 hips,16.4% malseated
  - 1 revision for malseating
- Miller AN et al, Clin Orthop Relat Res 2009
  - 694 hips, 7.2% malseated
- Howcroft DWJ et al, Clin Orthop Relat Res 2009
  - 78 hips, (primary and revision)
  - 8% malseated
  - No revisions for any cause, 40% subsequent seating rate
- Carvajal Alba JA et al, Orthopaedics 2010
  - 61 hips, 18% malseated or suspicious
  - No revisions or adverse events
- Nunag P et al, Hip International 2012
  - 30 hips, 66% malseated (using EBRA – digital method to examine cup migration)

Current state of knowledge



Discussion

- Surgical technique involves check of position and possibly seating before reduction of hip
  - Technique varies between surgeons
  - Mis-seating occurs despite this

- Similar problem reported elsewhere
  - Variable rate, from 7% to 18%
  - Some centres revised hips for mis-seated component

- No clear correlation between malseating and revision

Limitations

- Length of follow up
  - Short considering lifetime of components
  - Current studies have similar follow up
- Biomechanics of implant malseating not clear
  - Shells deform on implantation, time-dependent
- Diagnosis of malseating difficult
  - No standard method
  - Plain radiography operator-dependent
  - Non metal-backed liner not seen on radiographs
- Restrospective study

Plan

- Modify surgical technique for Trident ceramic acetabular components
  - Position check documented in operation note
- Senior author now using different liner (polyethylene) in most cases
- Longer follow up needed
  - All malseated patients will be recalled
  - 20 year follow up planned

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- Langdown AJ, Pickard RJ, Hobbs CM, Clarke HJ, Dalton DJ, Grover ML. Incomplete seating of the liner with the Trident acetabular system: a cause for concern? *J Bone Joint Surg Br*. 2007 Mar;89(3):291-5.

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INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Is wear of Dual Mobility Cup (DMC) lower or upper than Conventional Cup ?

ANALYSIS OF AN *IN VITRO* STANDARD TEST

André FERREIRA – Clinique du Parc – Lyon – France

Thierry ASLANIAN – Nicolas MOUTTON – Groupe Lépine – Genay – France

Jacques Henry CATON - Clinique Emilie de Vialar – Lyon- France

Jean Louis PRUDHON – Clinique des Cèdres – Echirolles

Disclosures

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- Royalties Ceraver

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T. ASLANIAN – N. MOUTTON

- Ph.D. employed Groupe Lépine

INTRODUCTION

- **Hip dislocation remains major short complication after THA**
- **Polyethylene (PE) wear remains major long term complication**
- **Dual Mobility Cup is an effective method to prevent dislocation :**
  - At 10 Y/FU :
    - Dislocation rate : 0.95 % DMC vs 8.5 % Cup Standard
    - Revision rate : 2.1 % DMC vs 10 % Cup Standard

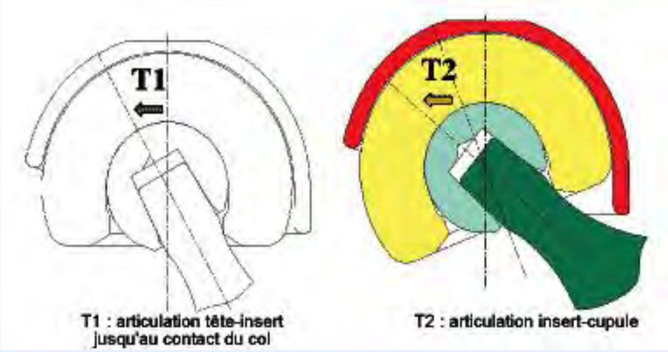
- **But wear is still on debate…**

No visible wear at 10 Y/FU

INTRODUCTION

- The specific DMC design, with its large head PE functionning with 3 articulations (small, large and 3rd) can raise the suspicion of an increase « double wear » with 2 main issues:

  osteolysis and loosening.



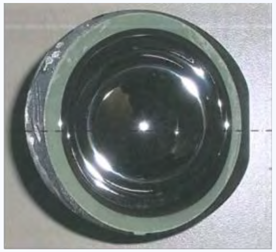
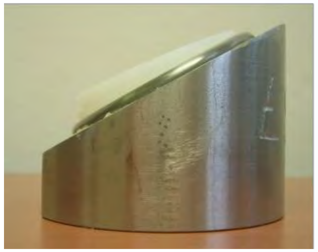
- Wear evaluation of DMC is necessary by experiments and clinical studies.

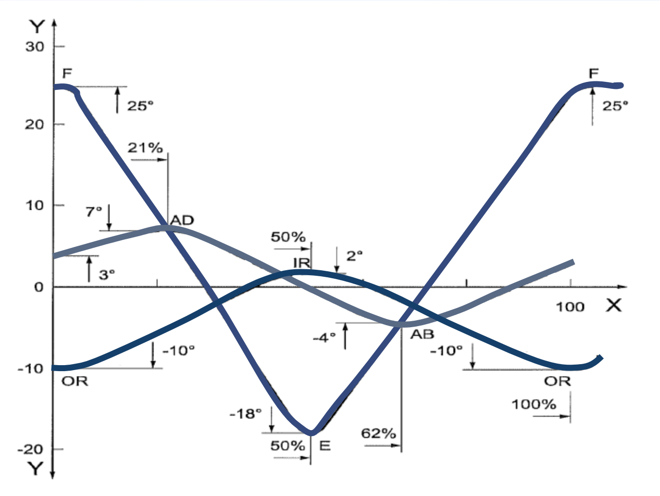
EXPERIMENTAL STUDY
MATERIAL & METHODS

- **A gravimetric standardized method (ISO 14242-1) is used to measure wear at 500 000, 1, 2, 3, 4 et 5 millions cycles.**

ISO14242-1 (2012) - Implants for surgery – **Wear of total hip-joint – P1**: **Loading and displacement** parameters for wear testing machines and **corresponding environmental** conditions for test



EXPERIMENTAL STUDY
MATERIAL & METHODS

- **Our objective was to compare DMC wear (loss of mass) to a Fixed Single Articulation Cup (FSAC) wear in the same experimental conditions.**

  - **2 cups DMC and FSAC are placed on a hip wear simulator with a normal configuration (30° inclination) according to international standards ISO 14242-1 and 14242-2 with lubricant liquid**
    (calf serum at 30+/- 2 g/l of protein at 37° +/- 2 °C)

  - **Without any blocage during the complete process.**

RESULTS

Loss of mass at 5 millions cycles :

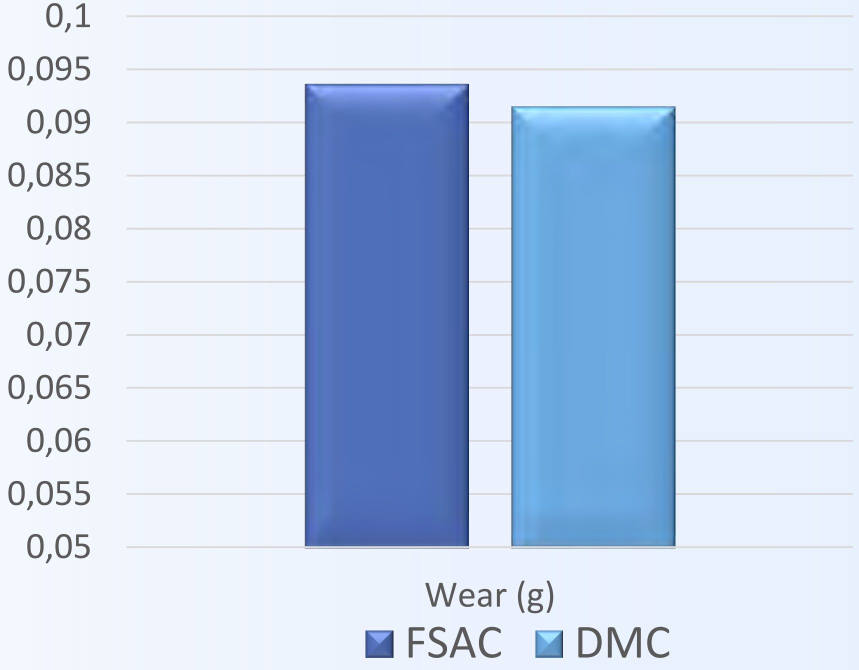
- Alumina ceramic (Céralepine™) 28 mm Head
- Conventional UHMWPE gamma sterilized

Fixed Standard Articulation Cup (**FSAC**) : 93,6 mg
ie **18,7 mg/million cycles**

Dual Mobility Cup (**DMC**) : 91,5 mg
ie **18,3 mg/million cycles**

Due to the volumetric mass (or density) of the UHMWPE (0,94 mm^3/mg), the calculated **volume loss** is for :

- FSAC: 19,9 mm^3/million cycle
- DMC: 19,5 mm^3/million cycle



DISCUSSION
(Wear testing machines)

Author	Reference	Material	Test Method	Results (Wear mg/ Million cycle)
D'Lima	J Orthop Res 2003	FSAC CoCr/UHMWPE	Non-standardized Gravimetric	**15,7 mg/MC** for Gamma sterilization
		FSAC CoCr/UHMWPE	Non-standardized Gravimetric	**12.5 mg/MC** for e-beam sterilization
Netter	J Arthroplasty 2014	**DMC** Steel/ UHMWPE/CoCr	Virtual : Finite Element Analysis	13.7 – 27.9 mm^3/MC ie **14 – 28.8 mg/MC** (d=0.97)
Stulberg	Orthopedics 2011	**DMC** Ceramic/UHMWPE/CoCr	Non precised	20.9 mm^3/MC ie **21.5 mg/MC** (d= 0.97)
Herrera	55th Annual meeting of the Orthop Res. Soc.	**DMC** CoCr/UHMWPE/CoCr	Non-standardized Gravimetric	**21.4 mg/MC**
Our study		FSAC Alumina Ceramic/UHMWPE	Standardized Gravimetric **(compliance ISO 14242-1)**	18.7 mg/MC
		DMC Alumina Ceramic/UHMWPE/CoCr	Standardized Gravimetric **(compliance ISO 14242-1)**	18.3 mg/MC

DISCUSSION
From loss of mass to penetration ?

- Gravimetric wear (loss of mass) by comparing with a statically loaded specimen (eliminate effect of creep alone)

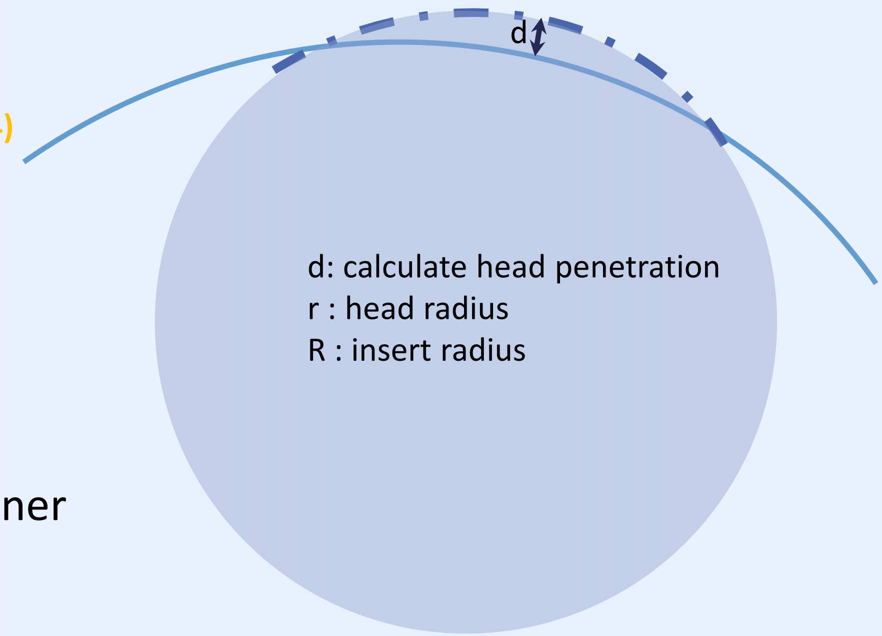
UHMWPE density (0,94)

- Calculate wear volume

Head diameter

- Calculate depth that head penetrates into liner (creep and wear) by using the formula

- $$V = \frac{\pi d^2(4dR-12rR+d^2-4rd)}{12(R+d-r)}$$



DISCUSSION
« clinical » wear...

- **Direct measurement of alterations of the curvature radii compared to with theorical dimensions**

  - **P. ADAM et al. (in Rev Chir Orthop 2005 – vol. 91 : 627-36) after examination of 40 retrieved PE implant BOUSQUET type is of 54,3 mm3/year**

  - **M. WROBLEWSKY (in Clin. Orthop 1986 – Vol.211 : 30-35): 30 to 80 mm3/year for Charnley LFA at 15 to 21 Y/FU**

CONCLUSION

- **Under same conditions (loading, cycles, sterilization, material and surface roughness), the gravimetric wear (for PE conventional) is comparable between a conventional (FSAC) and a dual mobility cup (DMC).**
- **After our study, alone in compliance with ISO 14242-1, it is possible to conclude that :**
  - **Dual Mobility Cup (DMC) wear is in the same order than those of a Fixed Single Articulation Cup (FSAC).**

=> Correlated to our clinical study at 10 years FU minimum of DMC what has not demonstrated evidence of wear and osteolysis.

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Rizzoli Orthopaedic Institute
I Orthopaedic and Trauma Clinic
Bologna University

Potential Markers of Systemic Toxicity Induced by Metal Ions in Patients with Hip Resurfacing

G. Tedesco, M. Cadossi, L. Savarino, A. Mazzotti,
A. Sambri, N. Baldini, S. Giannini

HIP RESURFACING

ADVANTAGES

- Large-diameter femoral head: higher stability, high-impact sport allowed
- Femoral bone-stock preservation
- Restoring of the geometrical parameters of the hip
- Physiological load transfer to the proximal femur

HIP RESURFACING

DISADVANTAGES

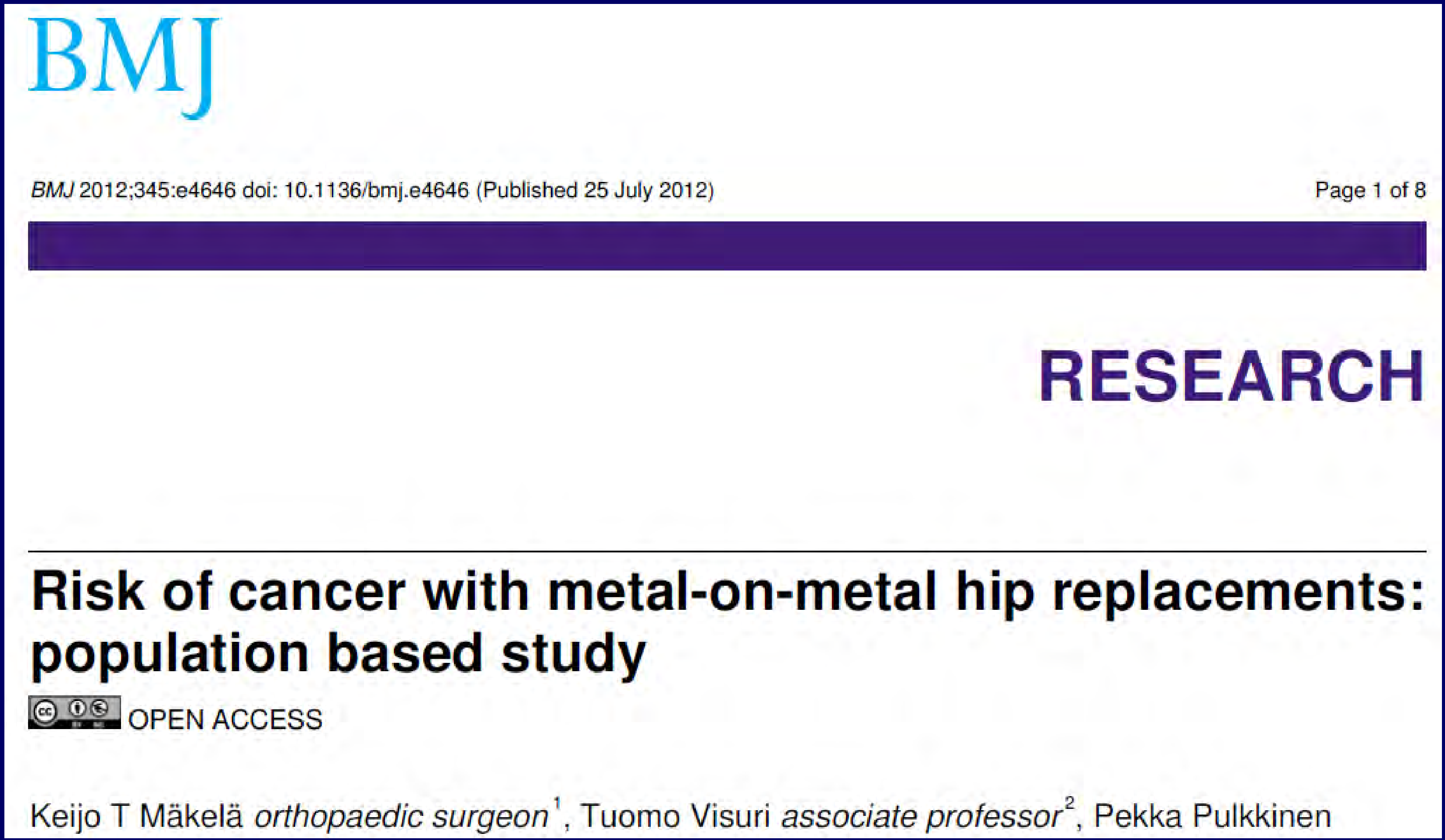
- Minor survival *vs* THR?
- Metal ion release
- Pseudotumor formation
- Revisions more complex with worse functional results

METAL ION RELEASE

- It is still unknown whether lower ion levels over a prolonged period may increase cancer risk
- In vitro studies have found relationship between metal ions and inflammation, cytotoxicity, altered lymphocyte concentrations, and irreversible chromosomal damage

Davies AP et al. JBJS Br 2005
Hart AJ et al. JBJS Br 2009
Savarino L et al J Biomed Mater Res 2000

METAL ION RELEASE


BMJ

BMJ 2012;345:e4646 doi: 10.1136/bmj.e4646 (Published 25 July 2012) Page 1 of 8

RESEARCH

Risk of cancer with metal-on-metal hip replacements: population based study

OPEN ACCESS

Keijo T Mäkelä *orthopaedic surgeon*[1], Tuomo Visuri *associate professor*[2], Pekka Pulkkinen

Several clinical studies, matching joint arthroplasty and cancer registries, reported no relationship between cancer and long lasting metal implants

STUDY

We investigated the correlation existed between Co and Cr serum levels and the serum content of:

- ✓ 8-hydroxydeoxyguanosine (8-OHdG), which is considered the most reliable biomarker in the estimation of reactive oxygen species (ROS)-induced DNA damage
- ✓ Circulating free DNA (cfDNA), as a surrogate marker for DNA tumor-specific alterations
- ✓ hypoxia-inducible factor-1α (HIF-1α), as a sign of hypoxic state

MATERIALS AND METHODS

STUDY GROUP

- 22 patients (15 men, 7 women) implanted with unilateral Birmingham Hip Resurfacing
- Osteoarthritis
- Mean follow-up: 8.7 year

CONTROL GROUP

- 21 subjects (11 men, 10 women) waiting for hip resurfacing
- Osteoarthritis
- Without metal implants within the body

RESULTS

TABLE I. Profile of Patients With Metal-On-Metal Hip Resurfacing (MOM-HR) and Presurgery Subjects

Parameter	Presurgery subjects ($n = 21$)	MOM-HR ($n = 22$)	p-Value[a]
Gender			
Male (number of patients)	11	15	0.4
Female (number of patients)	10	7	0.4
Age (years)	55.8 (40–76)	53.2 (26–73)	0.4
Follow-up (months)	–	104.2 (96–132)	
Cup inclination angle (°)	–	45.1 (35–55)	
Acetabular cup diameter (mm)	–	56.2 (46–62)	
Head diameter (mm)	–	48.9 (38–54)	
BMI (kg/m^2)	25.8 (20.7–32.8)	25.1 (17.0–32.0)	0.86
UCLA scale[19]	5.1 (2–9)	7.3 (3–10)	< 0.001
Harris hip score (points)[20]	64.4 (49–88)	94.7 (69.7–100)	0.005

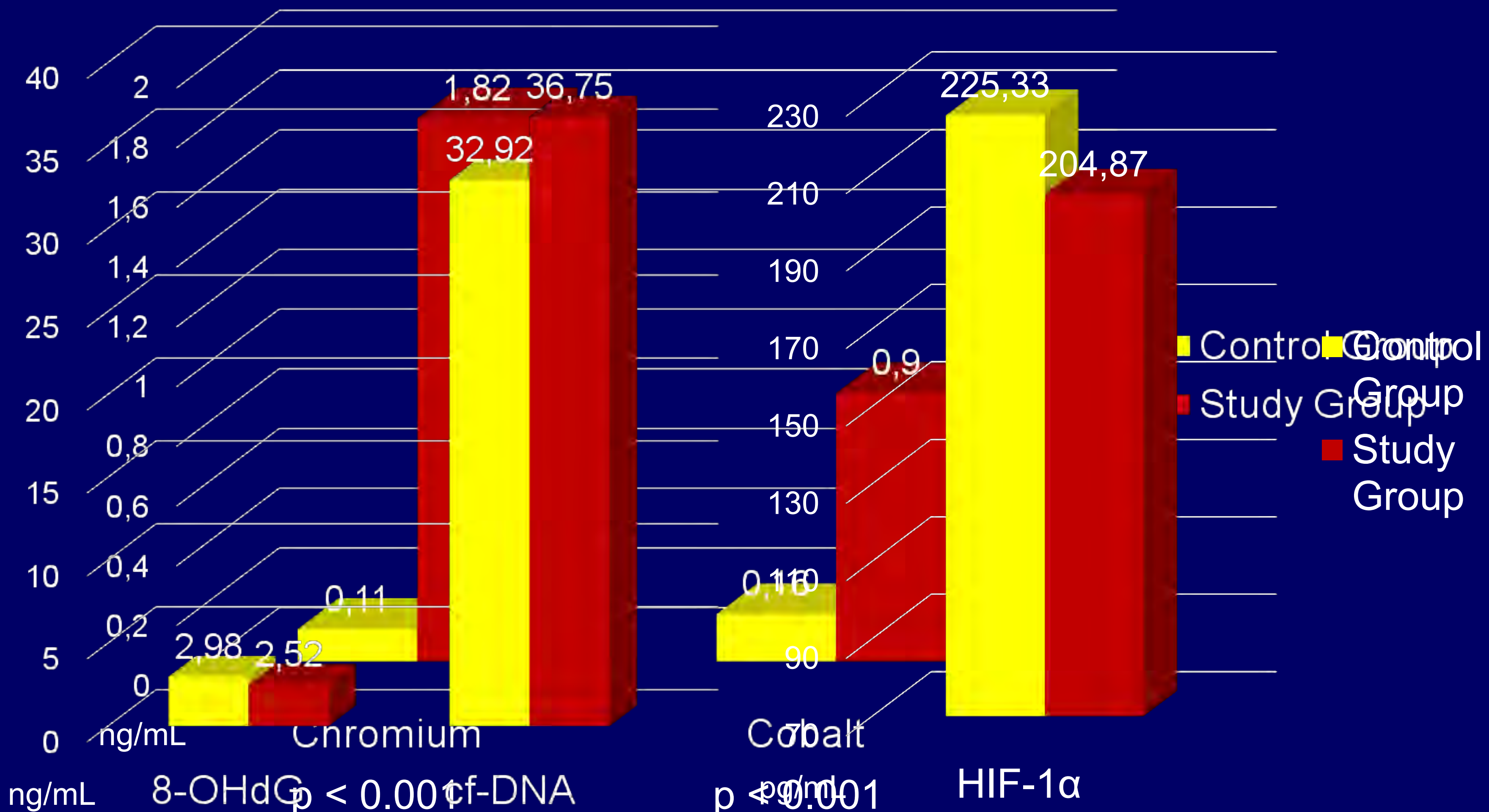
Values are expressed as mean, and range (in brackets).
[a] Calculated with Mann-Whitney U test ($p < 0.05$ is considered statistically significant).

- The groups were matched for age, sex, and BMI
- HHS and UCLA activity level were significantly different between groups
- Prosthesis were well positioned

RESULTS

TUMOR MARKERS LEVELS

METAL ION LEVELS



p < 0.001

p < 0.001

p = 0.09

p = 0.82

p = 0.49

CONCLUSION

- There are no scientific or epidemiological data that indicate a risk of carcinogenesis or teratogenesis related to the use of a hip resurfacing
- Rise in chronic low level of metal ions (~ 2 ng/mL) does not seem to be clinically relevant
- Further studies with a larger sample size should be performed in order to define the clinical relevance of biomarkers increase especially in younger subjects, where a chronic moderately elevated exposure has to be faced

INTERNATIONAL COMBINED MEETING

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26-27 NOVEMBER 2015

MILAN, ITALY

What is the natural history of asymptomatic pseudotumours associated with metal-on-metal hip resurfacings?

GS Matharu, SJ Ostlere, HG Pandit, DW Murray

Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Nuffield Orthopaedic Centre, Oxford, UK

International Combined Meeting 2015

British Hip Society and the Società Italiana dell'Anca

Milan, Italy

Conflicts of interest

GSM

- Fellowships: (1) The Royal College of Surgeons of England and The Arthritis Research Trust, (2) Arthritis Research UK
- Research grants: (1) The Orthopaedics Trust, (2) The Royal Orthopaedic Hospital Hip Research and Education Charitable Fund

SJO No conflicts of interest

HGP

- Paid speaker: Zimmer Biomet
- Research grants: (1) Zimmer Biomet, (2) Stryker

DWM

- Royalties & paid speaker: Zimmer Biomet
- Research grants: (1) Zimmer Biomet, (2) Stryker

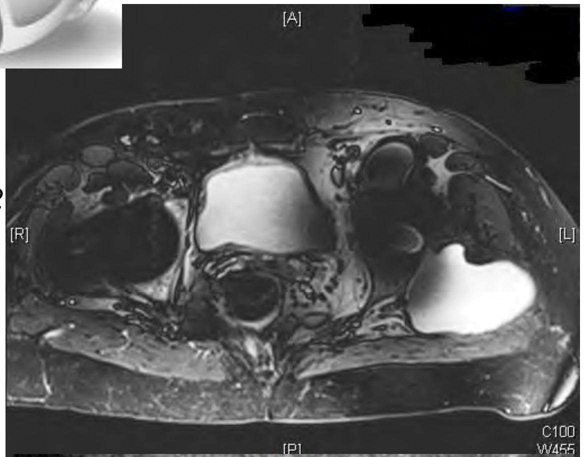
Background

Metal-on-metal (MoM) hip patients

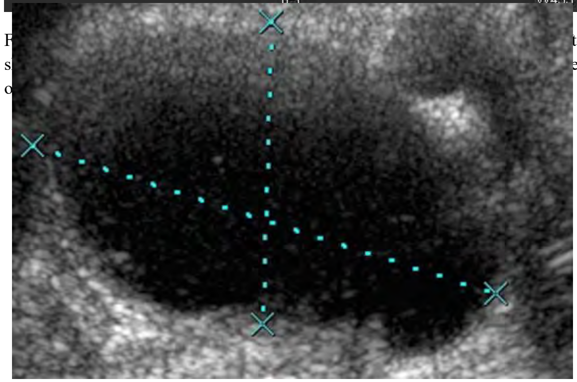
- Regular follow-up for most

Asymptomatic pseudotumours

- Prevalence = **4% to 61%** *Kwon 2011, Williams 2011, Hart 2012*



- Management dilemma
  - Especially if no bone or soft-tissue damage



- Authorities (*UK MHRA, Europe, US FDA*)
  - **No robust thresholds for revision**

Unclear natural history of asymptomatic pseudotumours

3 Longitudinal studies *Almousa 2013, van der Weegen 2013, Hasegawa 2014*

- *Small* – 10 to 24 MoM hips
- *Short follow-up* – mean 0.7 to 2.1 years

Clin Orthop Relat Res
DOI 10.1007/s11999-013-2944-4

Clinical Ortho
and Related Re

SYMPOSIUM: 2012 INTERNATIONAL HIP SOCIETY PROCEEDINGS

The Natural History of Inflammatory Pseudotumors in Asymptomatic Patients After Metal-on-metal Hip Arthroplasty

Sulaiman A. Almousa MBBS, Nelson V. Greidanus MD, MPH,
Bassam A. Masri MD, Clive P. Duncan MD, MSc,
Donald S. Garbuz MD, MHSc

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

ELSEVIER

Longitudinal Magnetic Resonance Imaging of Pseudotumors Following Metal-on-Metal Total Hip Arthroplasty

Masahiro Hasegawa, MD, PhD, Noriki Miyamoto, MD, PhD, Shinichi Miyazaki, MD, PhD,
Hiroki Wakabayashi, MD, PhD, Akihiro Sudo, MD, PhD

Progression of pseduotumours was common

To manage patients with asymptomatic pseudotumours

Better understanding - natural history & risk of progression

Study Aims

1. To assess the natural history of asymptomatic pseudotumours associated with MoM HRs

2. To identify factors from the initial assessment associated with future revision surgery

Patients and Methods

Prospective longitudinal cohort study

2007 / 2008

- 25 MoM HRs (21 patients) with asymptomatic pseudotumours *Kwon 2011*
- Asymptomatic – denied pain, satisfied, OHS ≥ 34 (good / excellent)
- Ultrasound + blood metal ions + x-ray + OHS (/48) + UCLA (/10)

2012 / 2013

- All non-revised patients recalled
- Repeated investigations (apart from blood metal ions)

UNIVERSITY OF OXFORD

Ultrasound assessment

- Performed by 1 experienced radiologist blinded to clinical data
  - Recommended for results comparable to MRI *Garbuz 2014*
- Sonoline Antares - Siemens Medical Solutions, USA

- Systematic approach / technique as per European Society of Skeletal Radiology

Pseudotumour

- Cystic, mixed, solid lesion communicating with joint
- Consistency, volume, location recorded

Results – patient cohort

Asymptomatic pseudotumours

25 MoM HRs (21 patients)

Mean age 59.9 years (range 39.2-73.1 years)

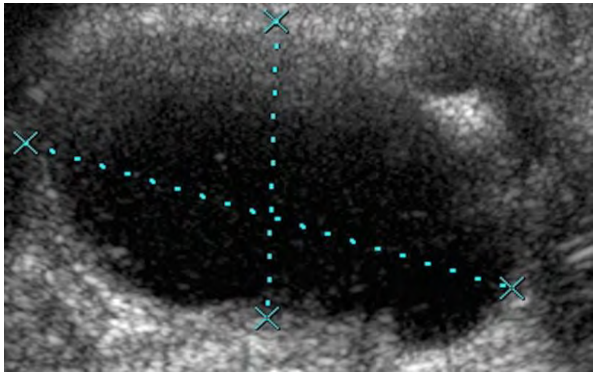
76% (n=19) female / 24% male (n=6)

Revised group

15 MoM HRs (60%)

Surveillance group

10 MoM HRs (40%)



Revised group (n=15)

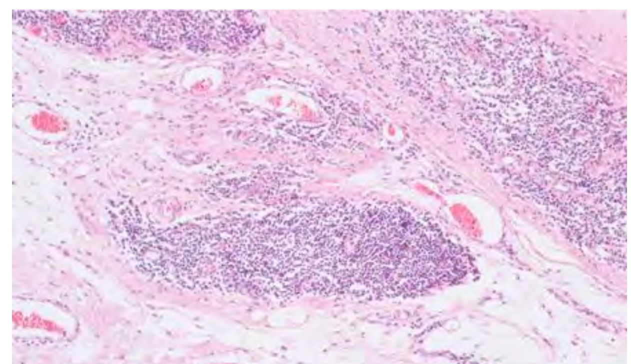
Time from initial assessment to revision

- Mean 2.7 years (range 0.4-6.4 years)

- All developed symptoms

Pseudotumours confirmed in all cases

- Intra-operative – *revised to non-MoM bearings*
- Histology



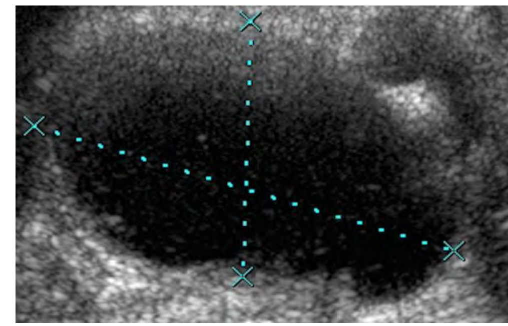
Median Oxford Hip Score

- Pre-revision = **37 (IQR 34-45)**
- 2 years post-revision = **32 (IQR 21-39)**

Surveillance group (n=10)

Time from initial to repeat assessment

- Mean 5.1 years (range 4.0-6.5 years)



Pseudotumour volume on ultrasound

- 2 increased (> 50%) / 4 stable / 4 decreased
  - No complete resolution
- No change in pseudotumour ($p=0.956$)

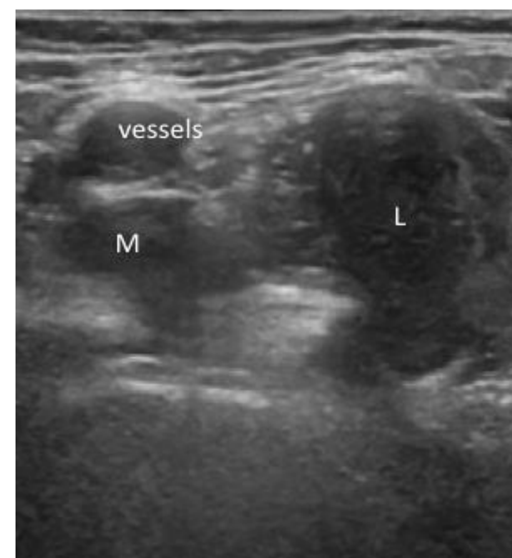
OHS - Median (IQR) initially **47** (44-48) vs. **46** (38-48) ($p=0.065$)

UCLA - Median (range) initially **6.9** (3-9) vs. **6.4** (4-8) ($p=0.102$)

X-ray - No loosening, osteolysis, femoral neck narrowing

Factors predicting future revision

Factor	SURVEILLANCE	REVISED	P-value
Gender	7 (70%) Female 3 (30%) Male	12 (80%) Female 3 (20%) Male	0.653
Age at first ultrasound	Mean 63.1 years (range 52.9-71.4 years)	Mean 57.8 years (range 39.2-73.1 years)	0.090
Unilateral or bilateral metal-on-metal hips	3 (30%) Bilateral 7 (70%) Unilateral	11 (73%) Bilateral 4 (27%) Unilateral	0.049*
Hip resurfacing design	BHR 3 (30%) Conserve 7 (70%) Recap 0 (0%)	BHR 9 (60%) Conserve 4 (27%) Recap 2 (13%)	0.082
Time between hip resurfacing and first ultrasound	Mean 3.3 years (range 1.8–6.8 years)	Mean 3.9 years (range 1.0–5.8 years)	0.401
Femoral component diameter	Median 46 mm (IQR 44-48 mm)	Median 46 mm (IQR 44-50 mm)	0.567
Acetabular inclination	Mean 47.2° (range 26.0°-61.7°)	Mean 49.0° (range 41.0°-62.6°)	0.627
Acetabular anteversion	Mean 18.7° (range 8.2°-32.0°)	Mean 16.3° (range 5.1°-34.3°)	0.555
Blood cobalt concentration	Median 3.4 µg/l (IQR 1.2 µg/l – 4.8 µg/l)	Median 7.9 µg/l (IQR 4.8 µg/l – 14.3 µg/l)	0.0048*
Blood chromium concentration	Median 2.8 µg/l (IQR 1.0 µg/l – 7.2 µg/l)	Median 9.4 µg/l (IQR 3.8 µg/l – 22.8 µg/l)	0.0162*
Initial OHS (0-48 scale)	Median 47 (IQR 44-48)	Median 38 (IQR 34-46)	0.0183*
Initial UCLA score (1-10 scale)	Mean 6.9 (range 3-9)	Mean 5.7 (range 3-8)	0.104
Initial pseudotumour volume	Median 18.7 cm^3 (IQR 16.9 cm^3-27.0 cm^3)	Median 36.0 cm^3 (IQR 22.4 cm^3-60.0 cm^3)	0.0458*
Initial pseudotumour consistency	Cystic 7 (70%) Mixed 3 (30%) Solid 0 (0%)	Cystic 6 (40%) Mixed 7 (47%) Solid 2 (13%)	0.389
Initial pseudotumour location **	Anterior+/-Lateral 1 (10%) Posterior+/-Lateral 6 (60%) Other 3 (30%)	Anterior+/-Lateral 7 (47%) Posterior+/-Lateral 7 (47%) Other 1 (6%)	0.092



Diagnostic test characteristics for predicting future revision

	Hips (%)	Sensitivity	Specificity	PPV	NPV
Blood metal ions > 5 µg/l	13 (52)	66.7 (38.4-88.2)	70.0 (34.8-93.3)	76.9 (46.2-95.0)	58.3 (27.7-84.8)
Blood metal ions > 7 µg/l	13 (52)	66.7 (38.4-88.2)	70.0 (34.8-93.3)	76.9 (46.2-95.0)	58.3 (27.7-84.8)
Blood metal ions > published levels *	12 (48)	66.7 (38.4-88.2)	80.0 (44.4-97.5)	83.3 (51.6-97.9)	61.5 (31.6-86.1)
Initial volume > 50 cm^3	5 (20)	26.7 (7.8-55.1)	90.0 (55.5-99.7)	80.0 (28.4-99.5)	45.0 (23.1-68.5)
Initial volume > 30 cm^3	10 (40)	60.0 (32.3-83.7)	90.0 (55.5-99.7)	90.0 (55.5-99.7)	60.0 (32.3-83.7)
Initial volume > 20 cm^3	16 (64)	80.0 (51.9-95.7)	60.0 (26.2-87.8)	75.0 (47.6-92.7)	66.7 (29.9-92.5)
Blood metal ions > published levels * and/or initial volume > 30 cm^3 **	16 (64)	86.7 (59.5-98.3)	70.0 (34.8-93.3)	81.2 (54.4-96.0)	77.8 (40.0-97.2)

The 2012 Otto Aufranc Award

The Interpretation of Metal Ion Levels in Unilateral and Bilateral Hip Resurfacing

Catherine Van Der Straeten MD, George Grammatopoulos MD, Harinderjit S. Gill BEng, DPhil, Alessandro Calistri MD, Patricia Campbell PhD, Koen A. De Smet MD

Unilateral

Cobalt > 4.0 µg/l
Chromium > 4.6 µg/l

Bilateral

Cobalt > 5.0 µg/l
Chromium > 7.4 µg/l

The Natural History of Inflammatory Pseudotumors in Asymptomatic Patients After Metal-on-metal Hip Arthroplasty

Sulaiman A. Almousa MBBS, Nelson V. Greidanus MD, MPH, Bassam A. Masri MD, Clive P. Duncan MD, MSc, Donald S. Garbuz MD, MHSc

Optimal test characteristics for predicting future revision

■ HIP

Similar incidence of periprosthetic fluid collections after ceramic-on-polyethylene total hip arthroplasties and metal-on-metal resurfacing arthroplasties

■ HIP

Pseudotumour incidence, cobalt levels and clinical outcome after large head metal-on-metal and conventional metal-on-polyethylene total hip arthroplasty

BENIGN lesions / "PHYSIOLOGICAL" response to arthroplasty and NOT "PSEUDOTUMOURS"?

- Less regular FU if outside threshold

Limitations

Small cohort / not applicable MoM THRs

Conclusions

- Threshold proposed for closer surveillance / revision of MoM HR patients with asymptomatic pseudotumours

High blood metal ions <u>AND/OR</u> pseudotumour >30 cm^3

- Can be used in interim until more robust data available on natural history of asymptomatic pseudotumours

Acknowledgments

- The authors would like to thank The Royal College of Surgeons of England and The Arthritis Research Trust for providing one author with funding in the form of a Surgical Research Fellowship

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

SERVIZIO SANITARIO REGIONALE
EMILIA - ROMAGNA
Istituto Ortopedico Rizzoli di Bologna
Istituto di Ricovero e Cura a Carattere Scientifico

Ceramic on Ceramic Clinical Results

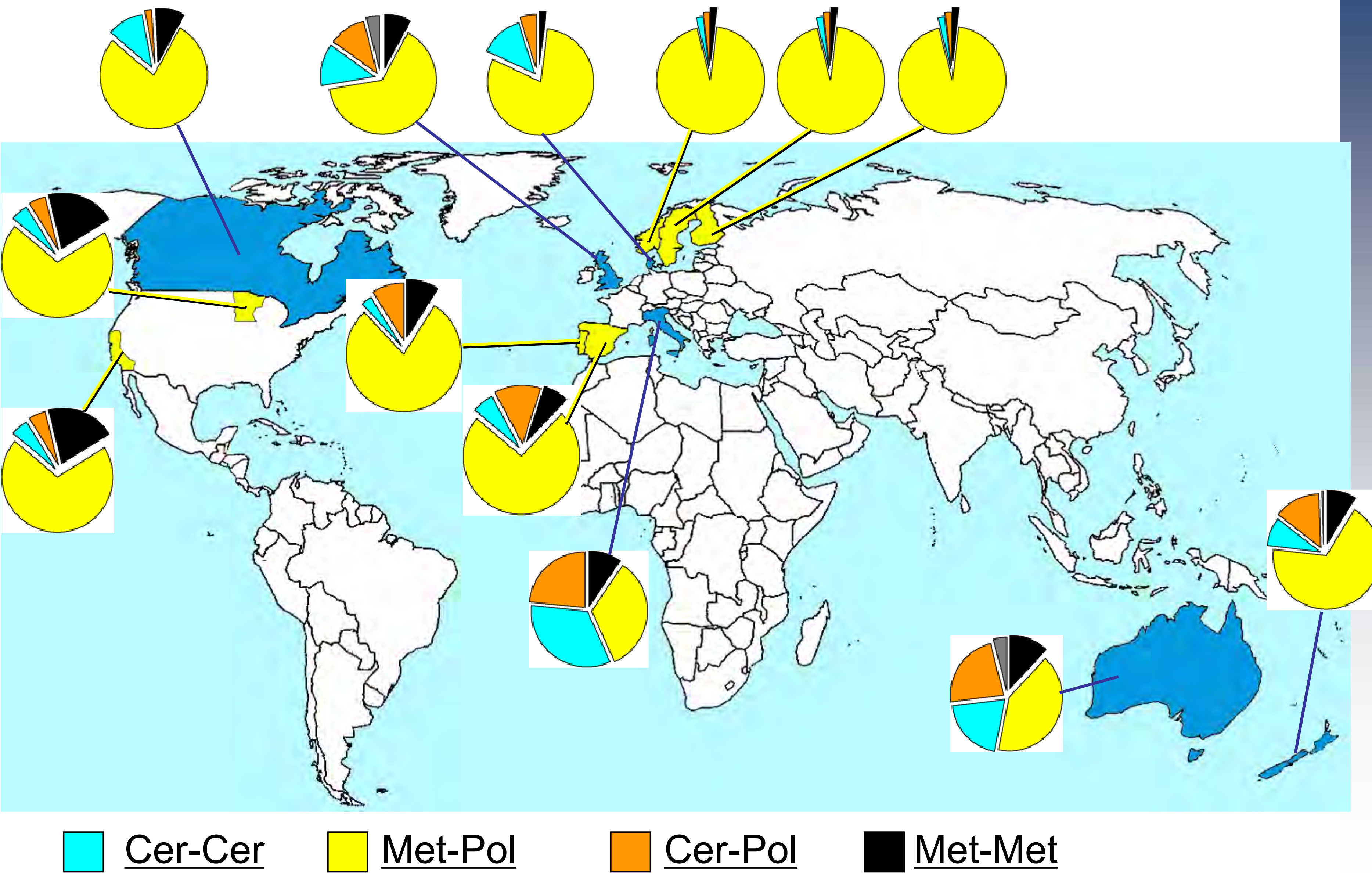
Aldo Toni

Chief of Hip & Knee Prosthetic Department,

Istituto Ortopedico Rizzoli

Bologna, ITALY

THA Bearings…different ideas around the world!!



Cer-Met Bearings

DePuy Synthes People inspired™
COMPANIES OF Johnson & Johnson

DePuy Orthopaedics, Inc., announced its decision to discontinue sales of its ULTAMET® Metal-on-Metal Articulation and COMPLETE™ Ceramic-on-Metal Acetabular Hip System worldwide. The discontinuation will be effective August 31, 2013. This will allow surgeons to plan accordingly for upcoming surgeries. The ceramic head used in COMPLETE will continue to be available for use in other bearing surface combinations.

Bearing materials

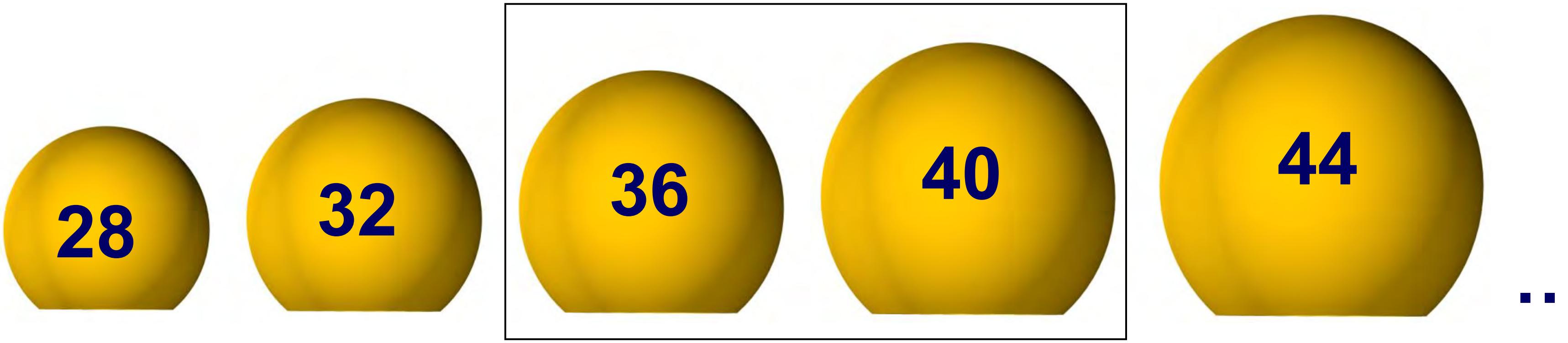
Do we need all of them ?
Which one is the best ?

More Active and Demanding patients acting in sports and expecting a longer prosthetic life

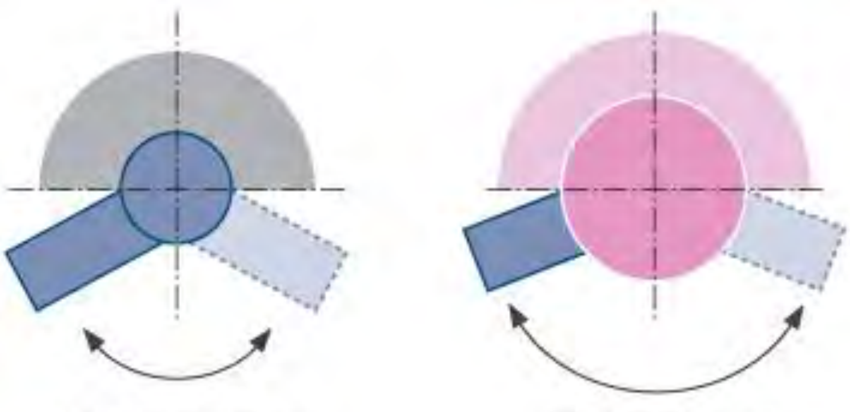
They requires
Long Lasting & Highly Performing THA

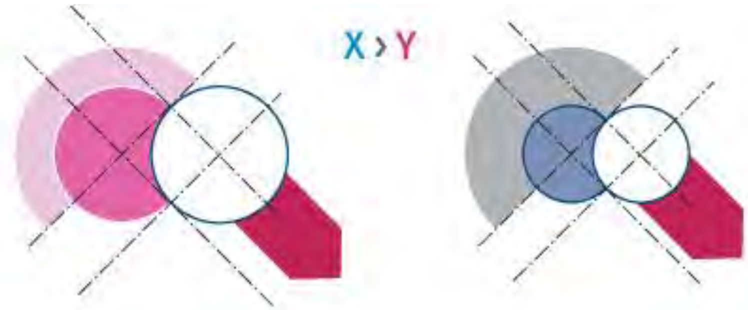
Low Wear THA
Wider Articular Range of Motion
Lowest Incidence of Dislocation

BIG HEADS & HARD BEARING or XLPE (Vit E)



How much Bigger is BETTER?





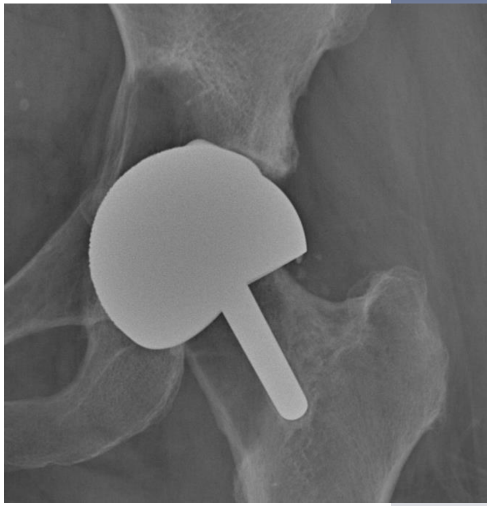
Study	Dislocation Rate
Hummel et al[3] (Revision Study)	28mm 10.6% (14/132), 32mm 2.7% (3/110)
Dowd et al[4]	28mm 3.7% (13/358), 32mm 1.2% (4/308), 36mm 0.2% (1/515)
Peters et al[5]	28mm 2.5% (4/160), 38mm 0% (0/136)
Cuckler et al[2]	28mm 2.5% (2/78), 38mm 0% (0/616)
Howie et al[6]	28mm 4.4% (12/275), 36mm 0.8% (2/258)

Bigger: more motion & less dislocation !

“Bigger is Better”

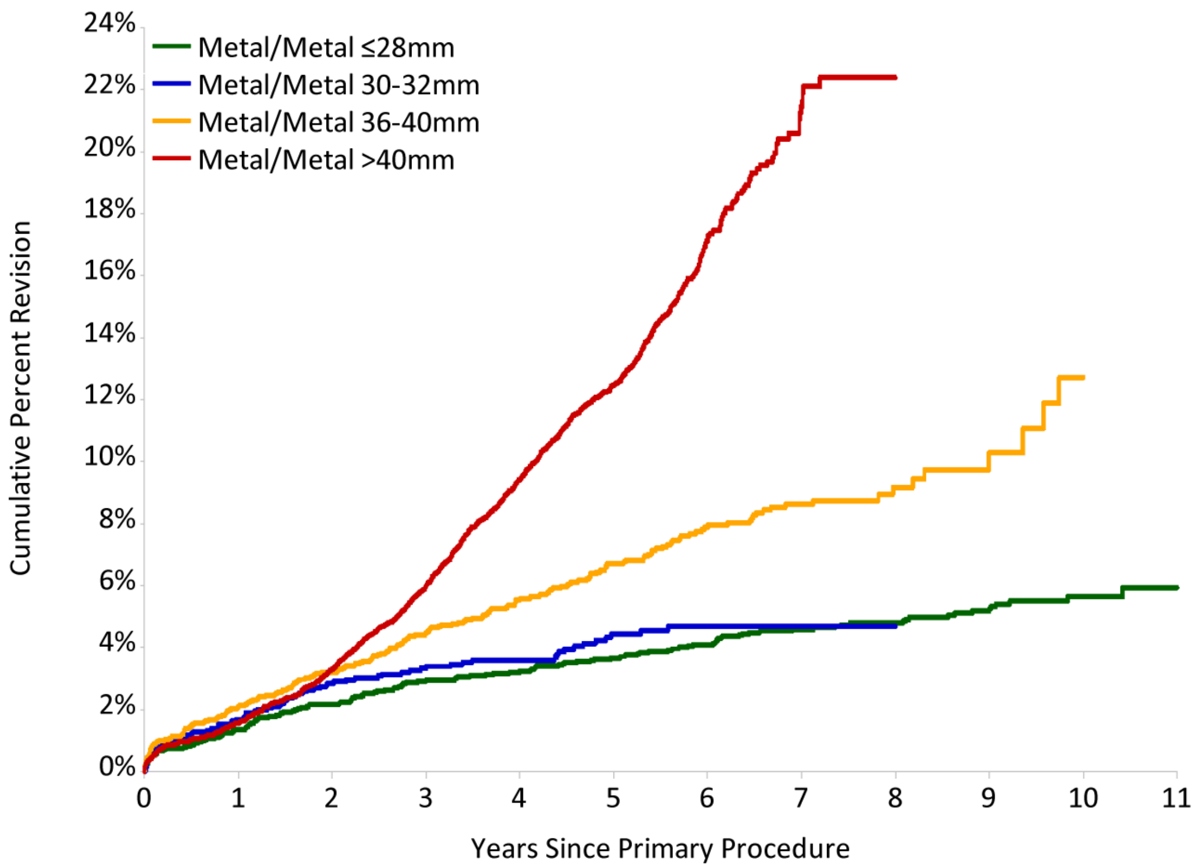
Large-Diameter-Head-THA!

No more neck fracture or epiphyseal necrosis…



… but Bigger metal head were soon related to higher revision rate

Figure HT22: Cumulative Percent Revision of Metal/Metal Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

Metal/Metal 30-32mm vs Metal/Metal ≤28mm

Entire Period: HR=1.22 (0.92, 1.61),p=0.171

Metal/Metal 36-40mm vs Metal/Metal ≤28mm

Entire Period: HR=1.96 (1.58, 2.43),p<0.001

Metal/Metal >40mm vs Metal/Metal ≤28mm

0 - 1Yr: HR=1.34 (1.02, 1.76),p=0.034

1Yr - 2Yr: HR=2.55 (1.88, 3.45),p<0.001

2Yr - 2.5Yr: HR=4.58 (3.04, 6.92),p<0.001

2.5Yr - 3Yr: HR=4.07 (2.72, 6.08),p<0.001

3Yr+: HR=8.73 (6.94, 10.99),p<0.001

Metal/Metal >40mm vs Metal/Metal 36-40mm

0 - 2Yr: HR=0.90 (0.75, 1.09),p=0.288

2Yr - 2.5Yr: HR=2.34 (1.58, 3.46),p<0.001

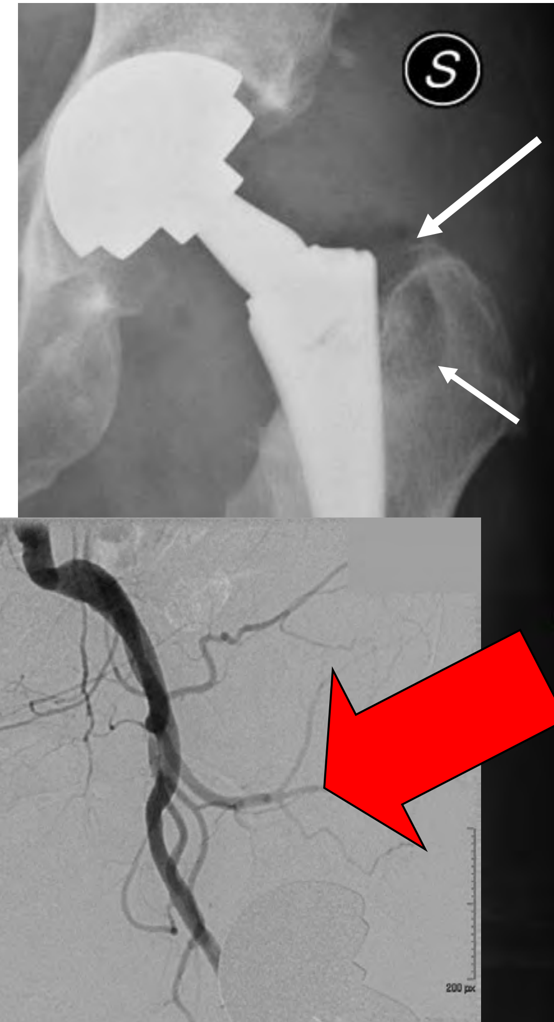
2.5Yr - 3Yr: HR=2.07 (1.41, 3.04),p<0.001

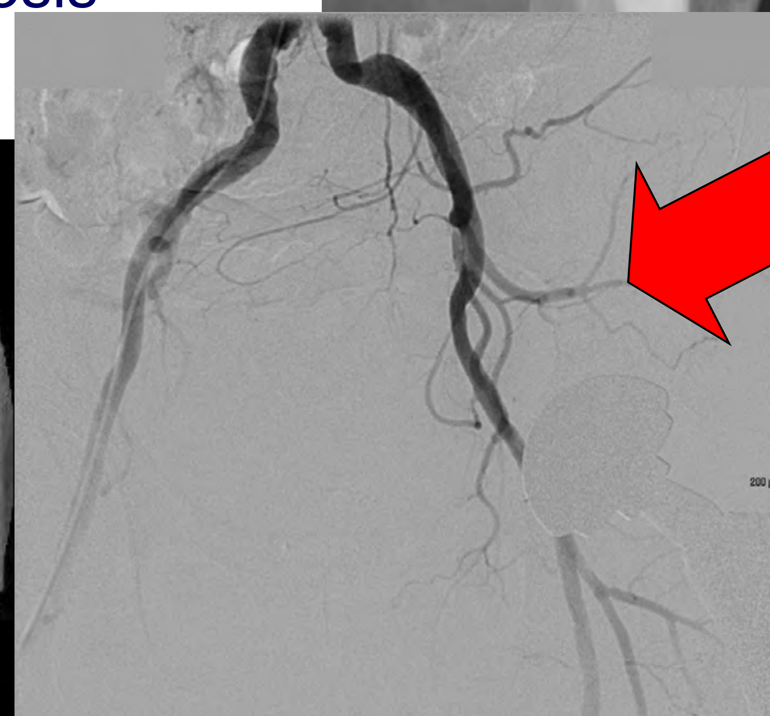
3Yr+: HR=4.45 (3.60, 5.50),p<0.001

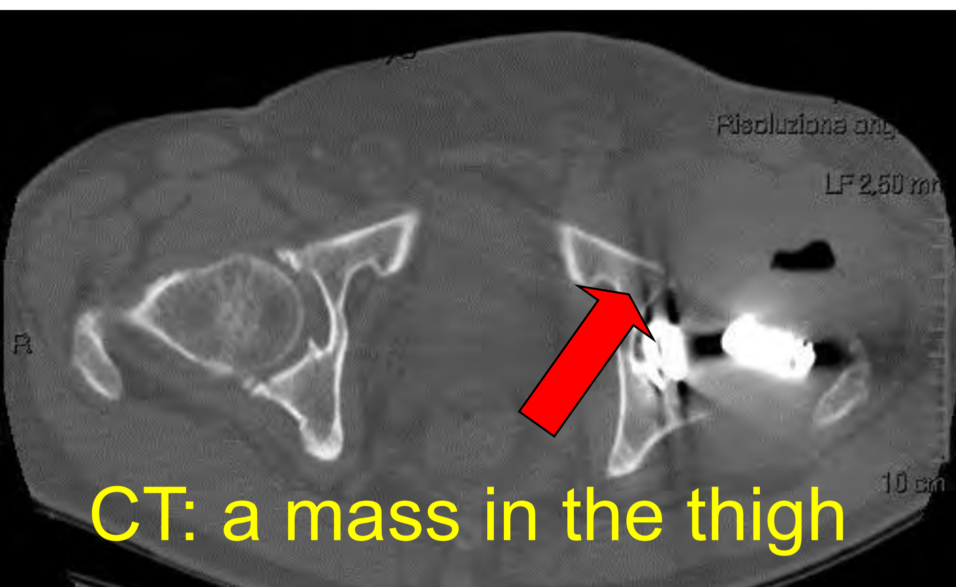
ARMD
(Adverse Reaction to Metal Debris)

ALVAL
(Aseptic Lymphocytic Vasculitis Associated Lesion)

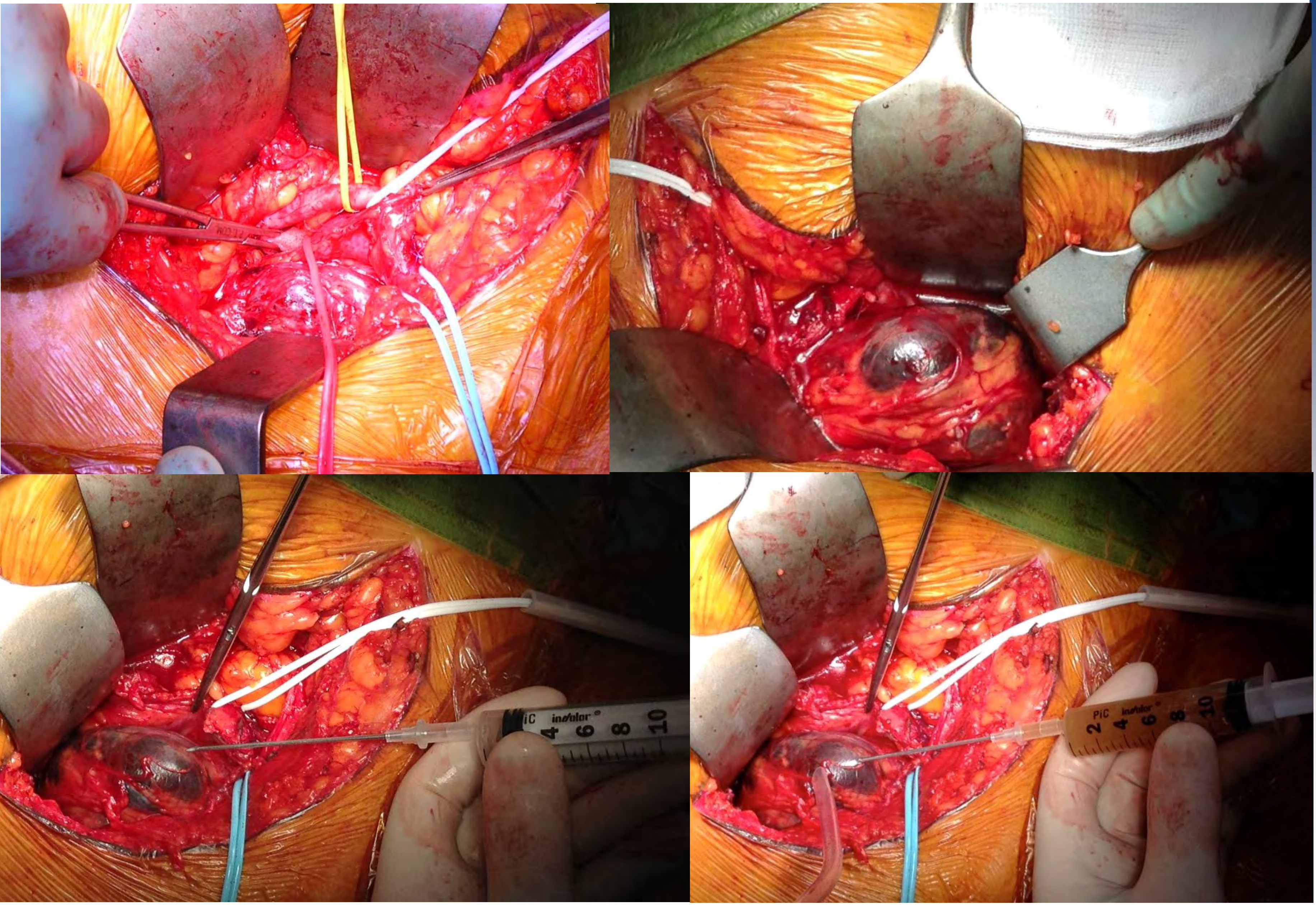
<u>begins</u> with perivascular lymphocytic cuffing evolving into lymphoid aggregates
<u>ends</u> with extensive tissue necrosis



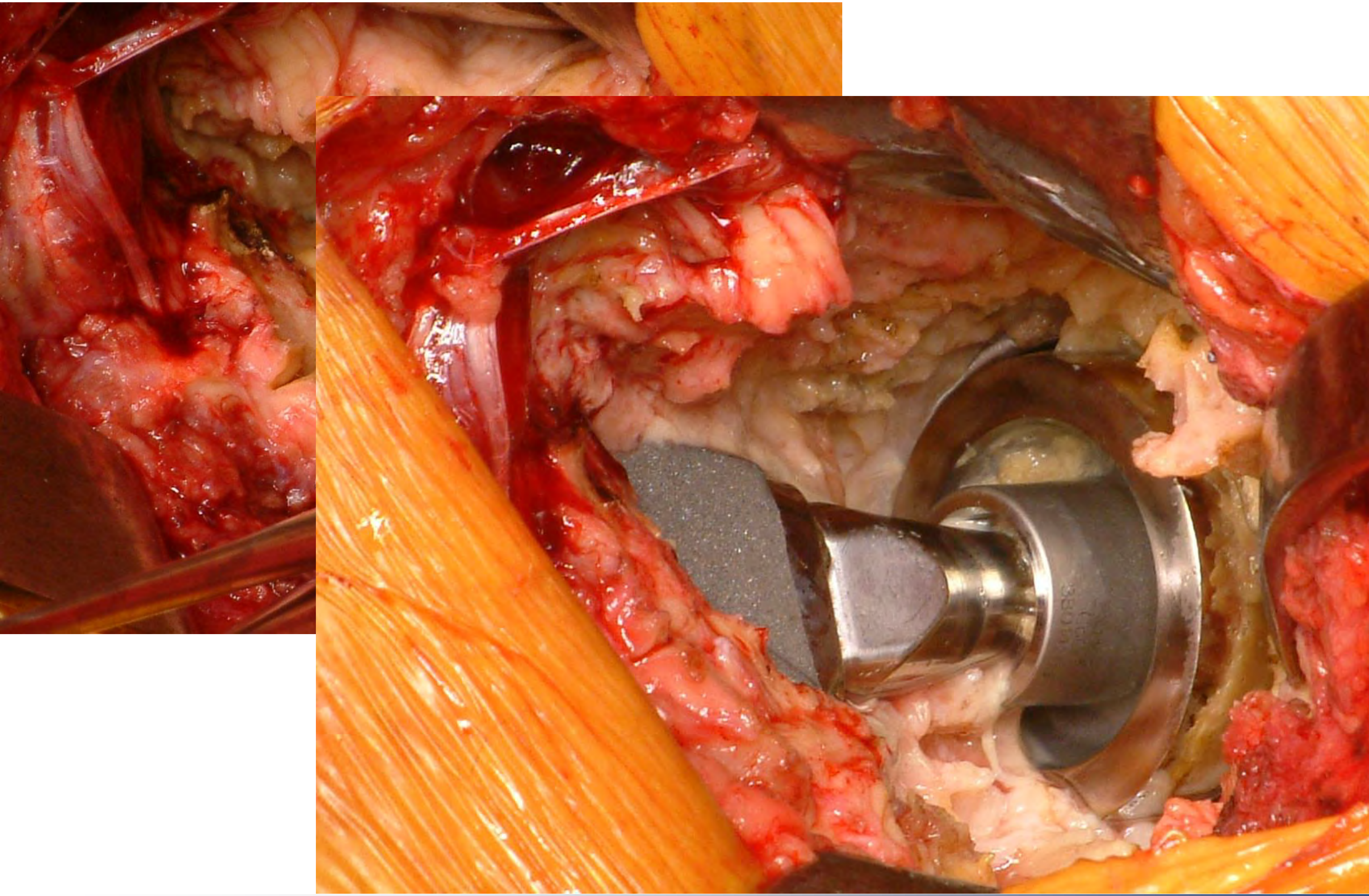


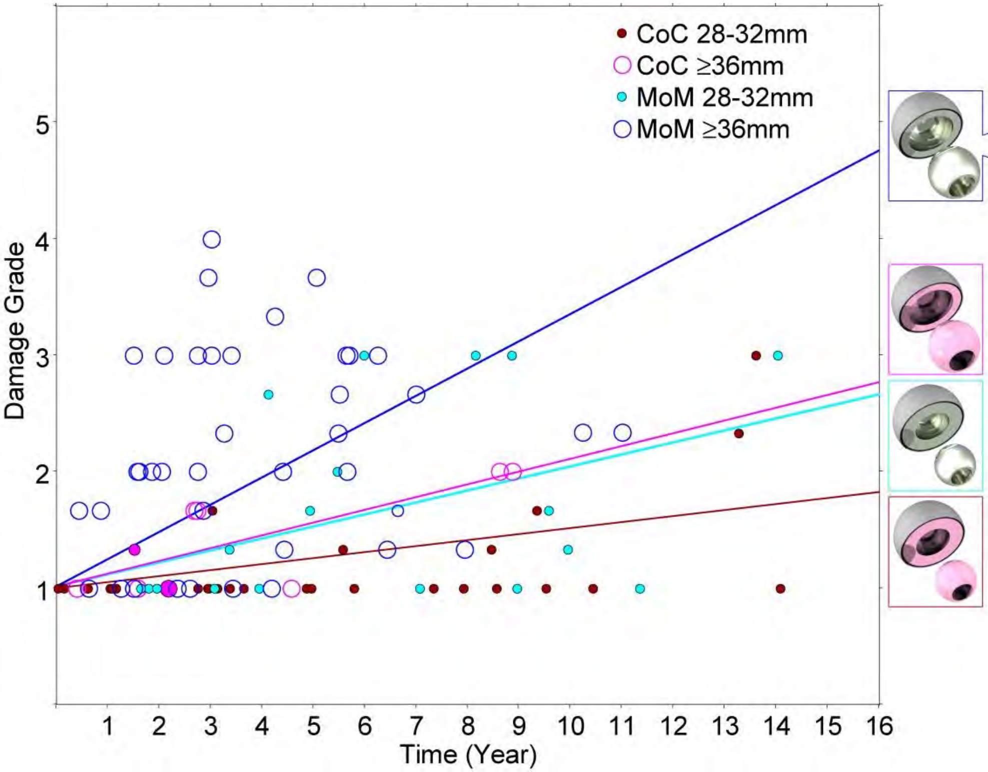


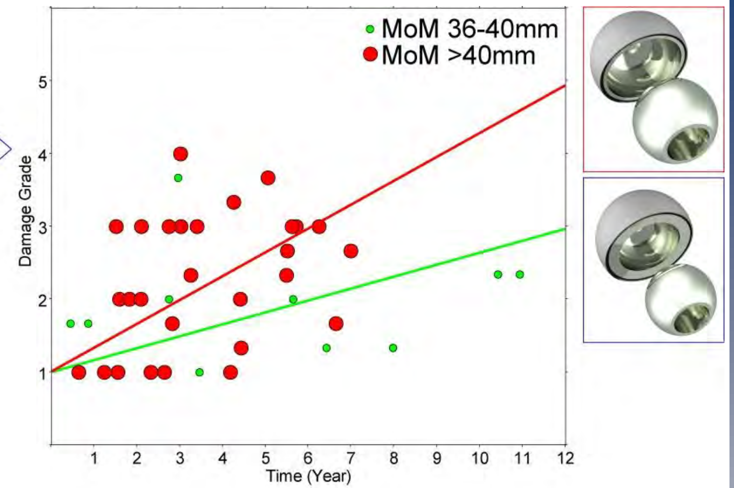
CT: a mass in the thigh

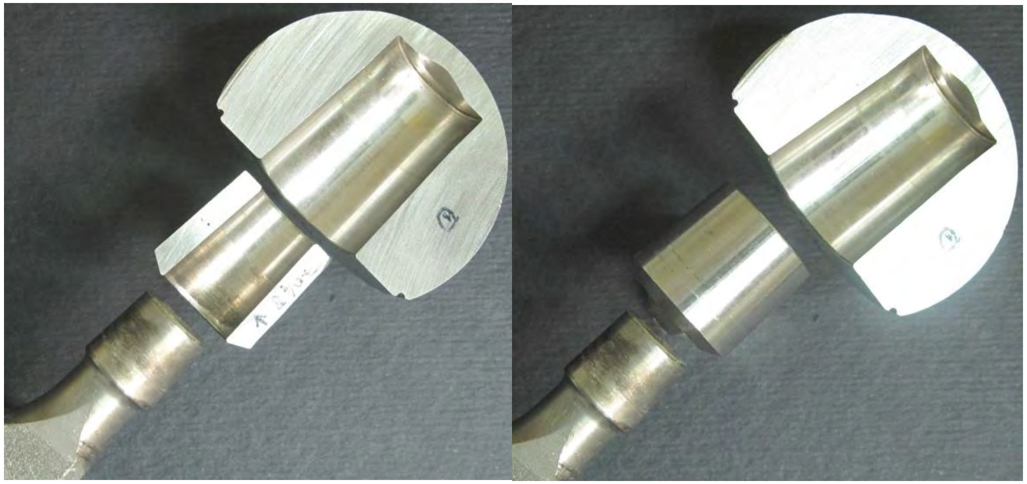


…severe articular tissues necrosis!!

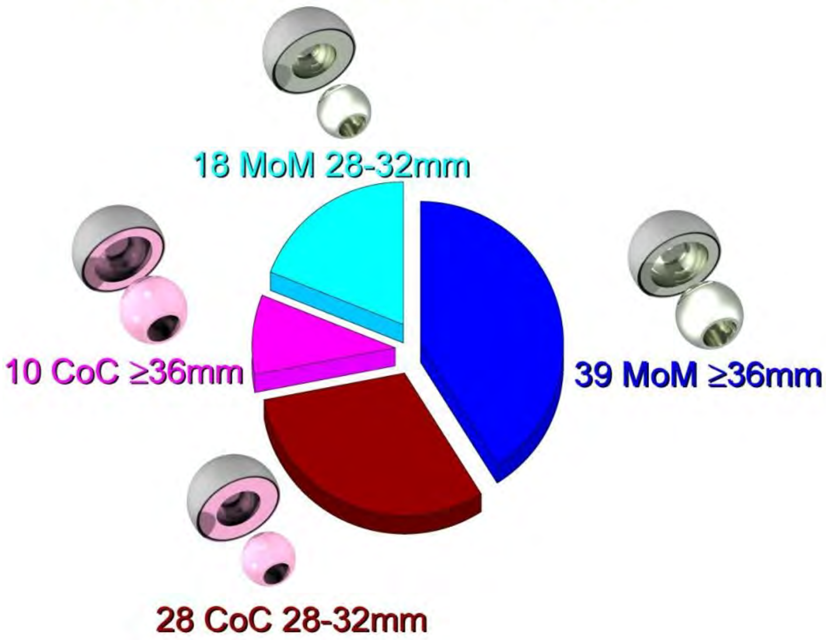








95 retrieved devices



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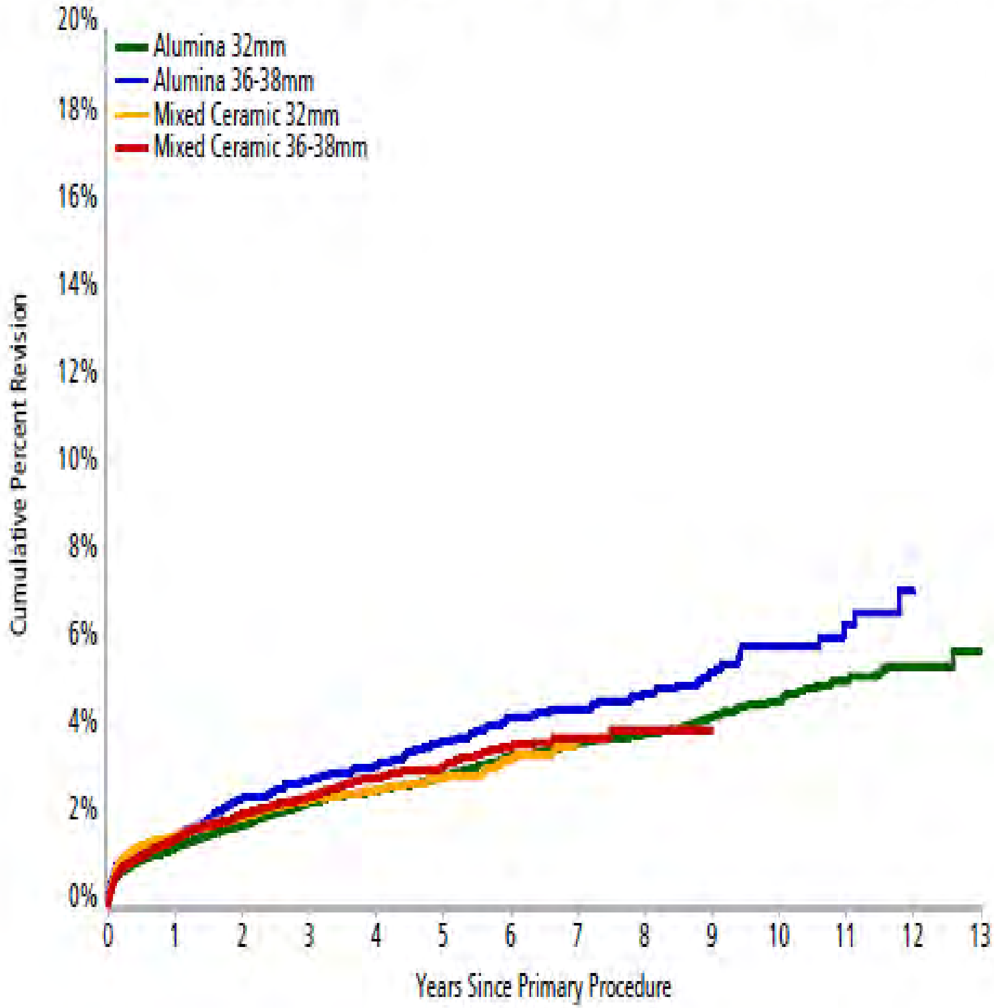
8.5 years


001
0 + 48
V40
FM61315
0048
3.5 years

Figure HT45: Cumulative Percent Revision of Primary Total Conventional Hip Replacement with Ceramic Femoral Head by Ceramic Type and Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

Alumina 36-38mm vs Alumina 32mm

Entire Period: HR=1.26 (1.07, 1.48),p=0.004

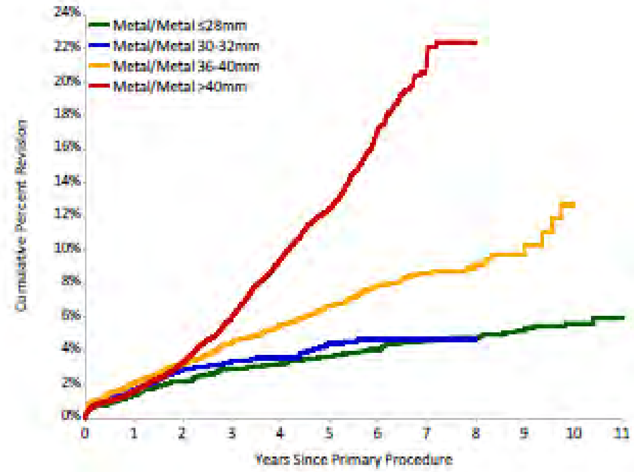
Mixed Ceramic 32mm vs Alumina 32mm

0 - 3Mth: HR=1.35 (1.11, 1.64),p=0.002

3Mth+: HR=0.87 (0.73, 1.03),p=0.104

Mixed Ceramic 36-38mm vs Alumina 32mm

Entire Period: HR=1.09 (0.97, 1.22),p=0.144



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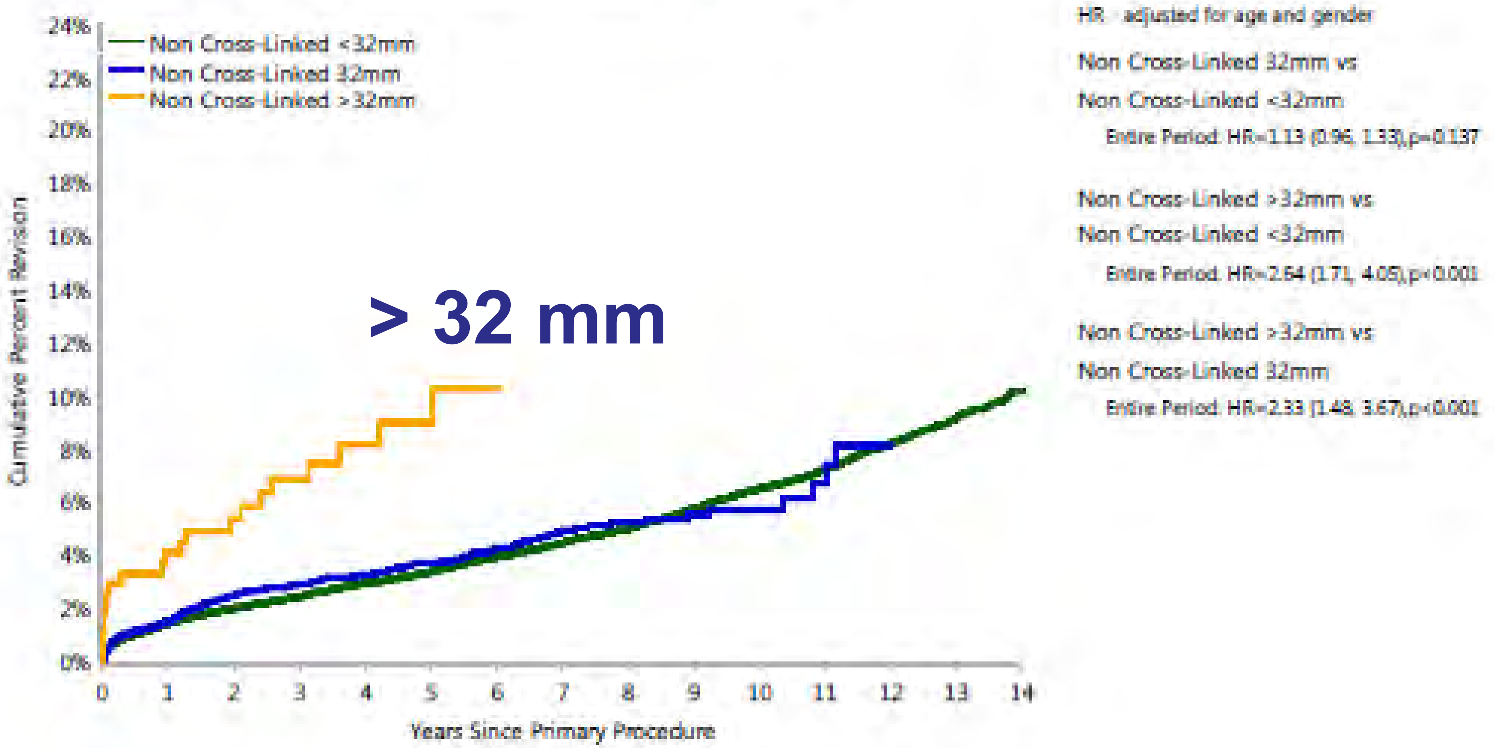
Non X-L POLYETHYLENE BEARING

Figure HT26 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using Non Cross-linked Polyethylene by Head Size (Primary Diagnosis OA)



STOP USING *STANDARD* POLYETHYLENE WITH BIG HEADS

LTM
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Focus on: BIOLOX® delta - BIOLOX® delta bearings

Also these ceramic device components contains

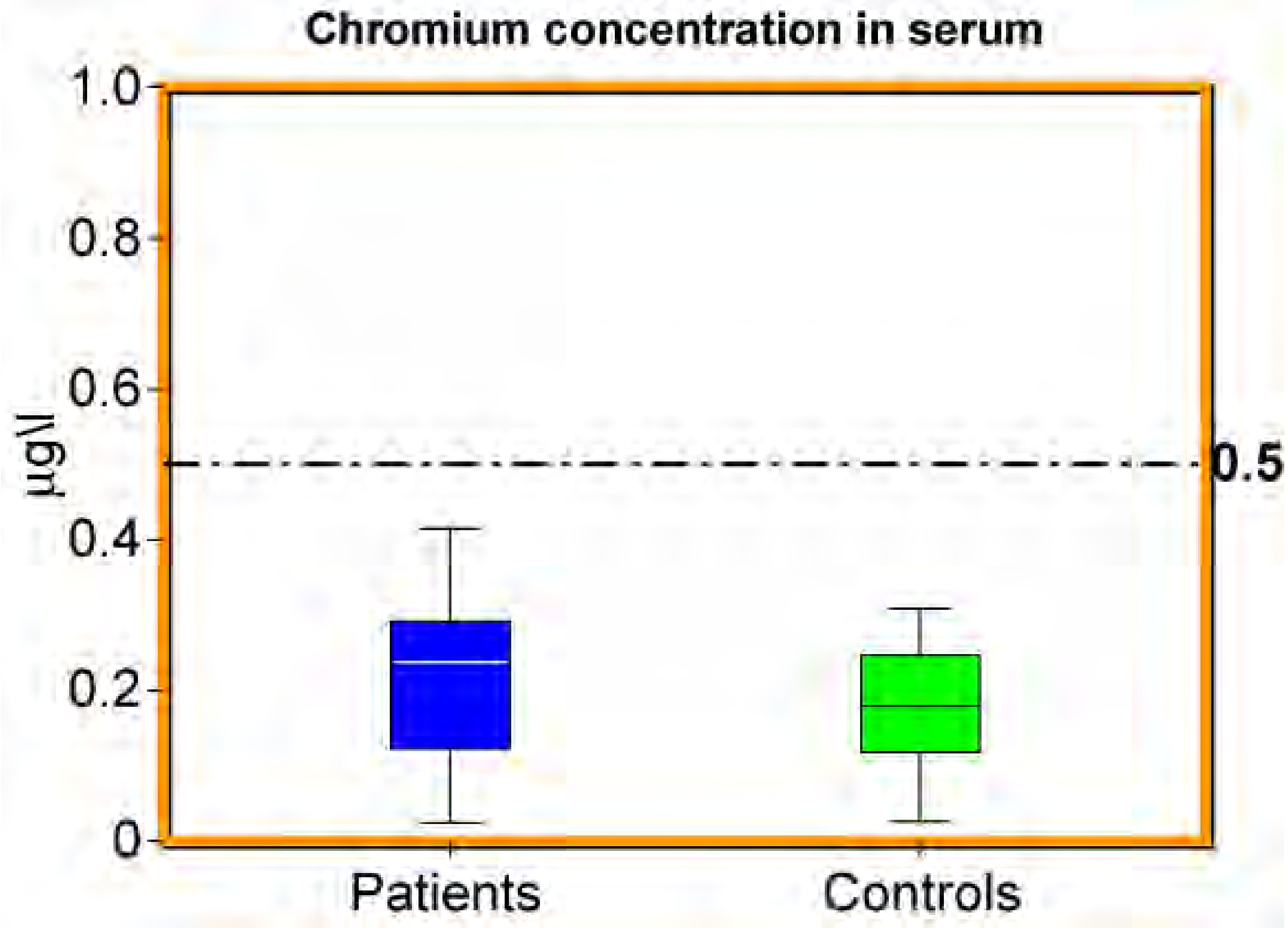
trivalent Cr ions

Component of the composite	**Formula**	**Volume %**
Alumina, doped with Chromia	Al_2O_3:Cr	80 %
Zirconia with Y-stabilization	ZrO_2:Y	17%
Strontiumaluminate (minor Cr-content)	$SrAl_{12-x}Cr_xO_{19}$	3 %

The present study was aimed at detecting any

'in vivo' release of Cr ions from these ceramic bearings

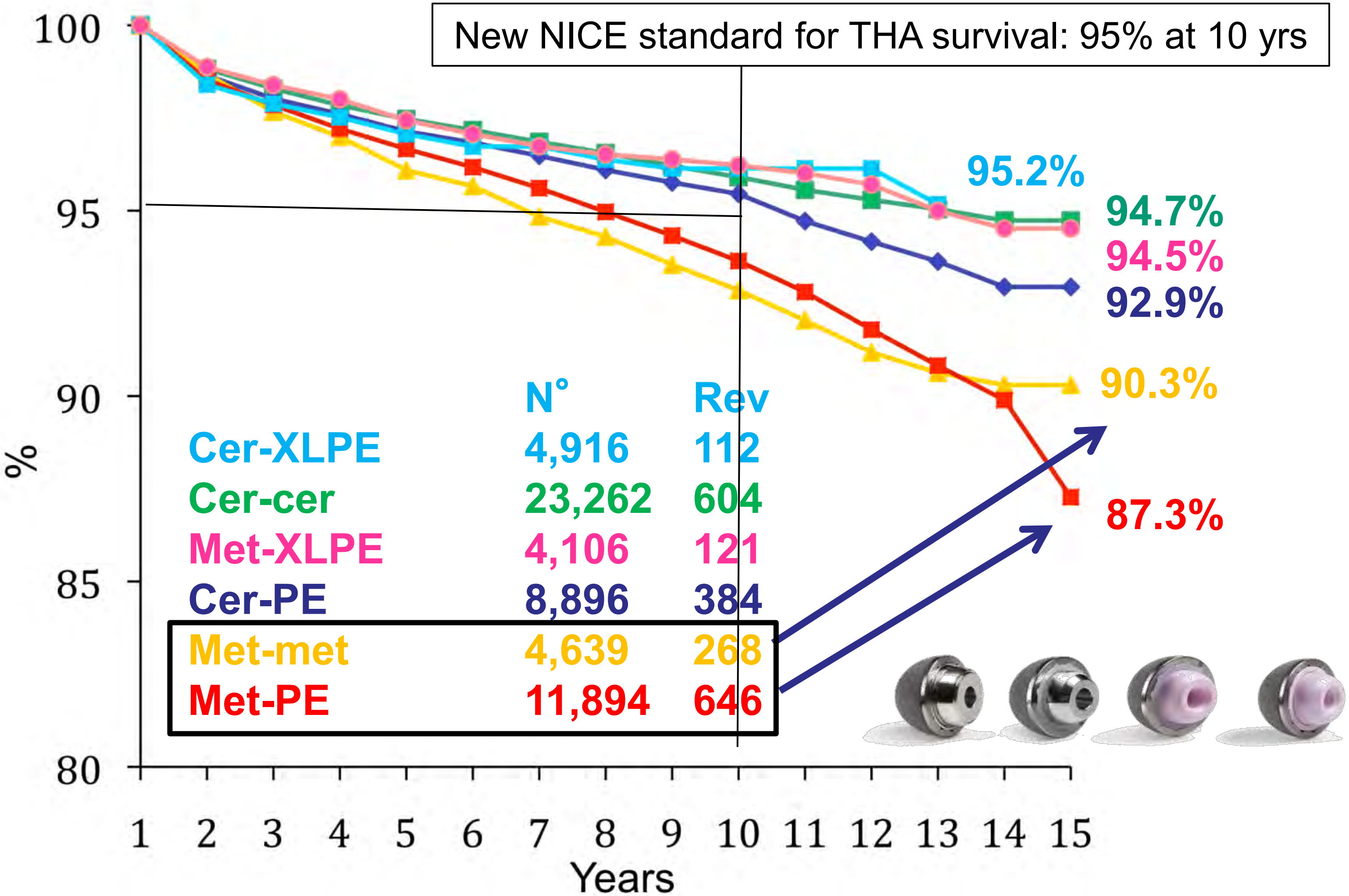
Results



Dotted lines represent higher lab reference value
Box are limited by values of the 25th and 75th percentile
Horizontal line crossing the box represents the median value
Vertical lines are extended from min to max value

Survival analysis: revision for any reason

BIG REGISTRY DATA: 57,713 THAs (2000-2014)



	N°	Rev
Cer-XLPE	4,916	112
Cer-cer	23,262	604
Met-XLPE	4,106	121
Cer-PE	8,896	384
Met-met	4,639	268
Met-PE	11,894	646

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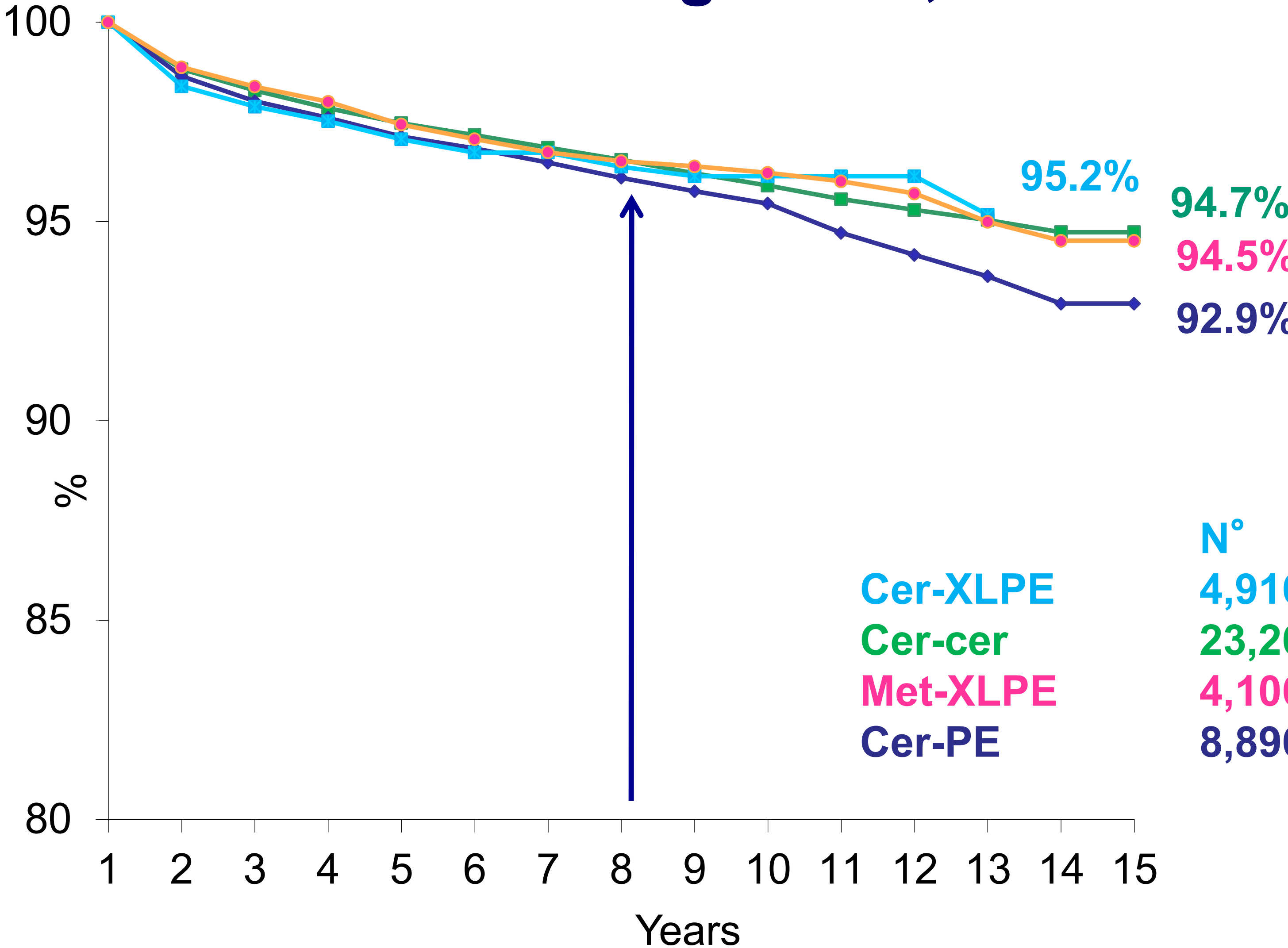
Survival analysis: revision for any reason

Different Bearings in 57,713 THAs



	N°	Rev
Cer-XLPE	4,916	112
Cer-cer	23,262	604
Met-XLPE	4,106	121
Cer-PE	8,896	384

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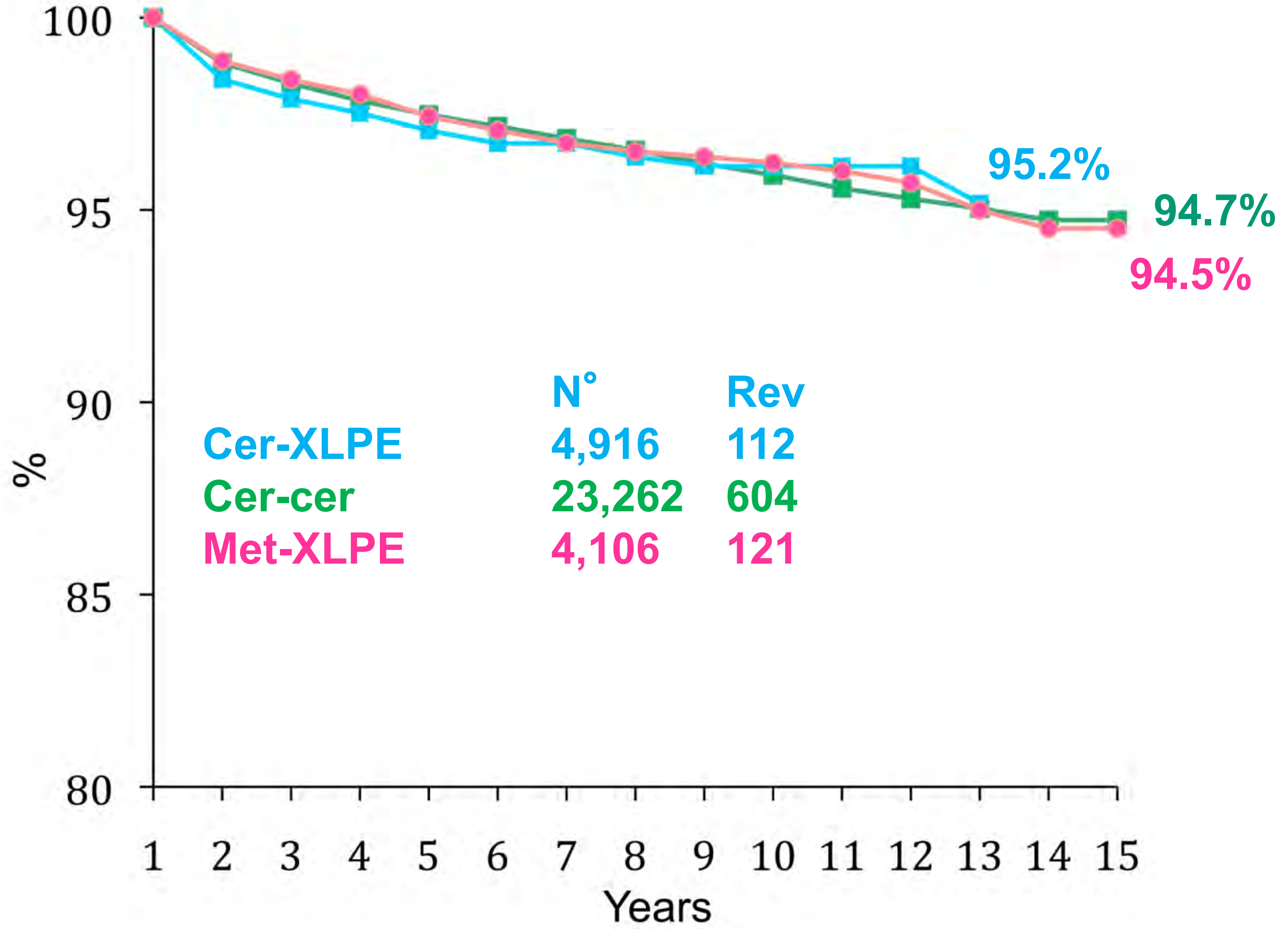
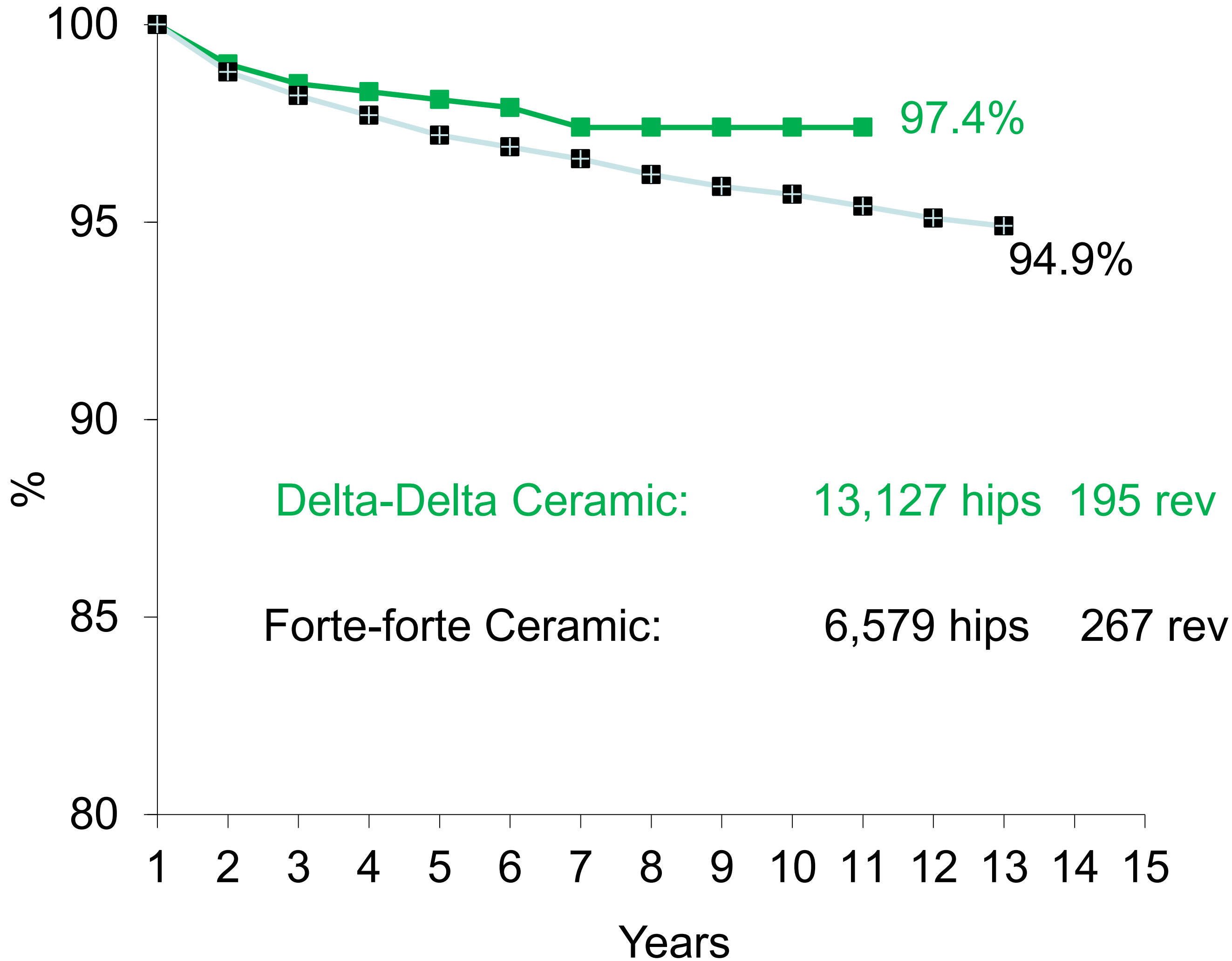
Survival analysis: revision for any reason
Similar Survivals at 13-15 years



CERAMIC-on CERAMIC BEARING



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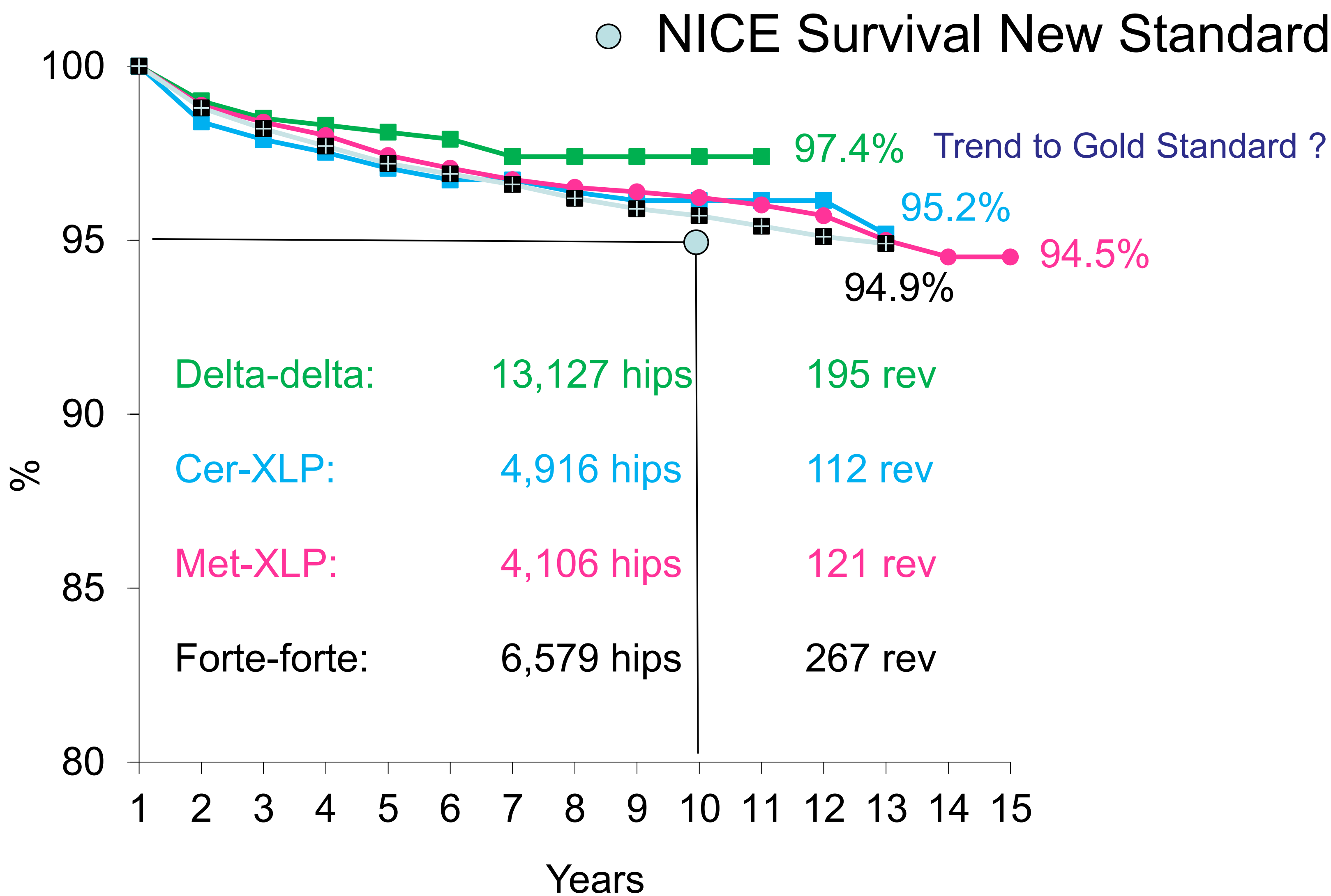
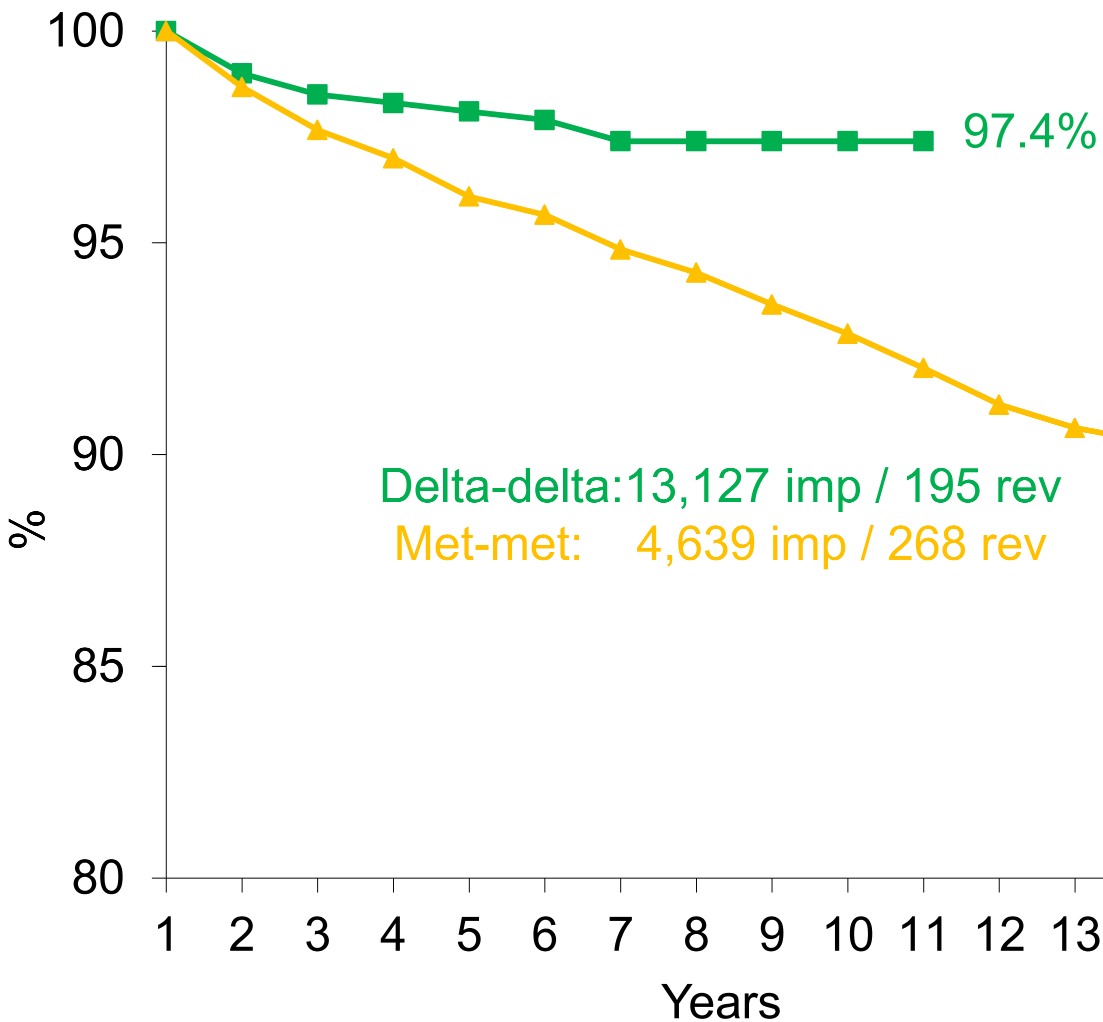
Survival analysis: revision for any reason

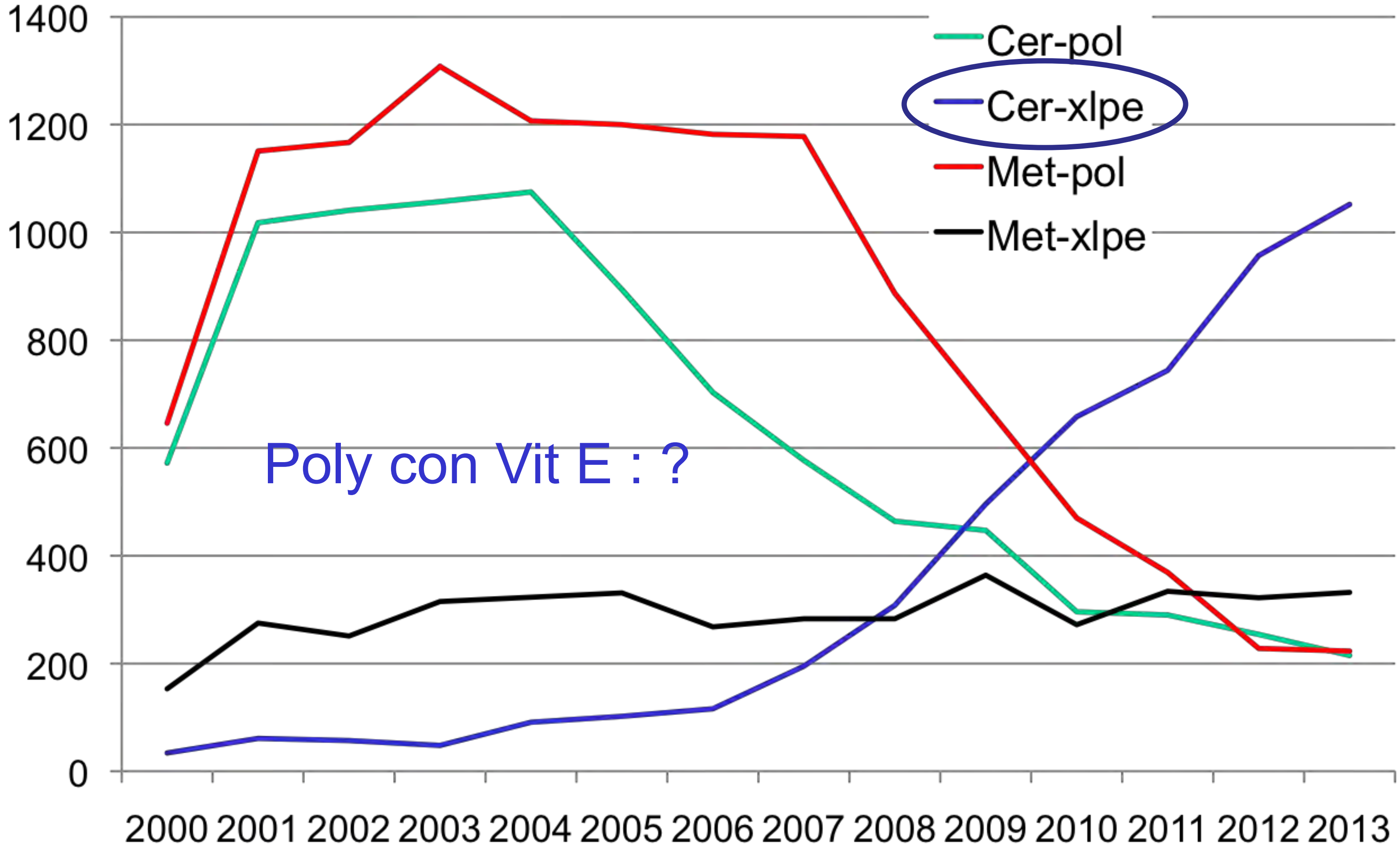


Survival analysis: revision for any reason



POLYETHYLENE BEARINGS

"pol": standard Polyethylene **"xlpe": x-linked Polyethylene**



LTM
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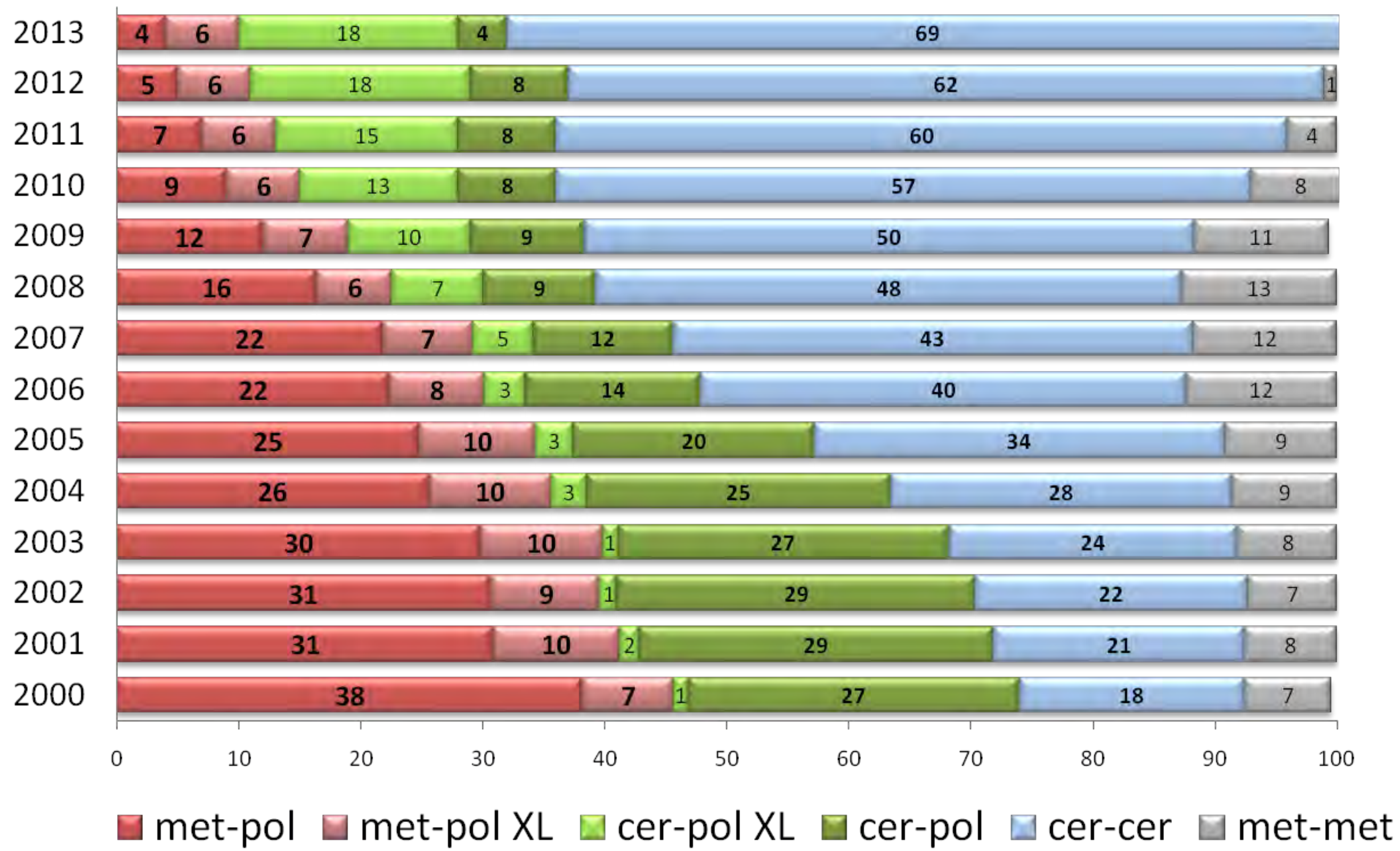
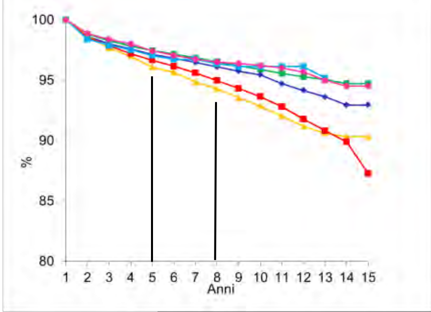
	Biolox® Forte	Biolox® Delta	Biolox® Delta			Biolox® Forte		
			28mm	32mm	≥36mm	28mm	32mm	36mm
Implants	7.874	7.204	1.137	2.040	4.661	12.360	3.468	2.159
Fractures	28	5	-	1	-	36	1	-
%	0.4%	0.1%	1 /7,838 **0,01 %**			0.3%	0.03%	0%

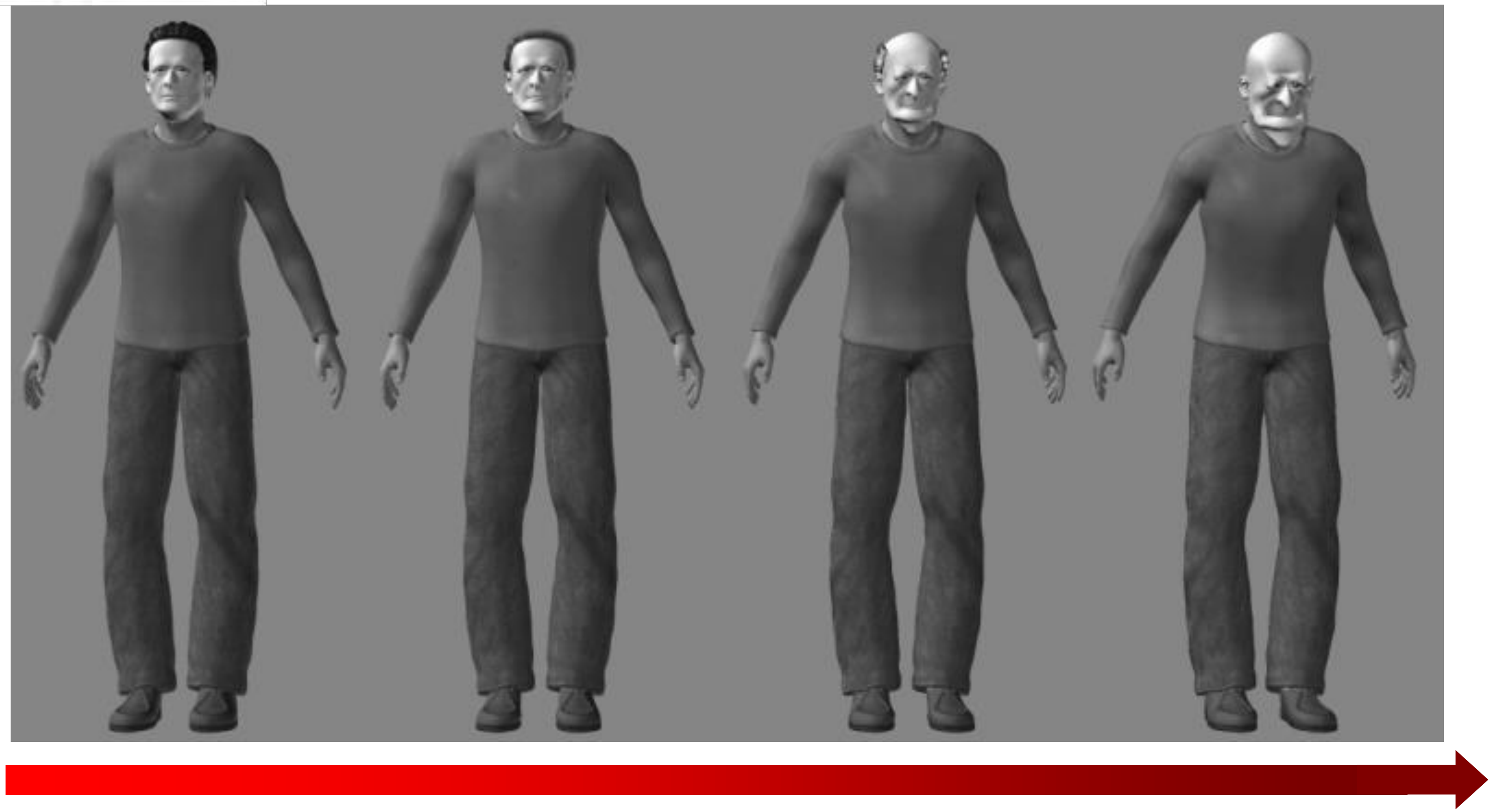
The fracture of Biolox Delta has been really EPISODIC !

Articular coupling in primary surgery





Choose Bearings upon Patients life expectancy and activity



Cer-Cer **Cer-XLPE** **Met-XLPE** **Met-PE**

Conclusions

- All combinations of bearing surface have advantages and disadvantages.
- MoM have recently fallen out of favour.
- In assessing the best bearing surface for an individual patient we feel it is necessary to analyse the specific implications for each patient.
- CoC for us is the better Bearing because osteolysis is over and risk of fracture is close to zero, with an excellent general overall survival.

Conclusions

• Cer-XLPE has good performance at 10-12 years (Gold Standard for younger and more active patients)

•Ceramic is a safe solution for Large Head up to 44 mm

•For Large Head THA, trunions should be made bigger to reduce torque, increasing contact surface, seeking for more stable solutions (Ceramtec Option Head solution)

•Up to 44

Picture of the very first orthopaedic surgery performed at the Rizzoli Institute on 1896

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Is Squeaking Still a Reason for Concern?

Evert J Smith
North Bristol NHS Trust
Bristol
UK

International Combined Meeting
British Hip Society
Società Italiana Dell’Anca
Milan
26 and 27 November 2015

Disclosure

Zimmer Biomet

Charity support - Arthroplasty for Arthritis

Industry support for bhac:
Amedica
Biocomposites
Biomimetics
Ceramtec
DJO
JRI
MDT
Medacta
Smith & Nephew
Wright Medical

Declaration of Interests and activities provided to Societies, Government bodies, Journals, NHS Trust, Ethics Committees and International Congresses

Squeaking in Hip Arthroplasty

- **All bearing couples may squeak**
- 4-10% of MoM bearing couples squeak
- The Judet acrylic hemiarthroplasty squeaked

Squeaking in Hip Arthroplasty

- All joints vibrate
- When the amplitude is in the audible range and large enough then squeaking is audible
- Audible noise in range 1-7.5kHz

Squeaking Noise

‘High pitched’ - like a door hinge - so should be reproducible.

Described as:

- *Grating*
- *Grinding*
- *Clicking*
- *Cracking*
- *Knocking*
- *Crunching*
- *Popping*

Squeaking - Grades

Grade

1. Rare
2. Occasional or intermittent
3. Frequent
4. Every step or position change

Capello W, D'Antonio J, Feinberg J, Manley M, Naughton M, J Arthroplasty 2008; 23: 39-43

Squeaking in Ceramics

- Ceramic on ceramic bearings used in Europe since 1970
- Biolox forte introduced in 1995
- Zirconia halted in USA by 2000 - ↑ fractures
- FDA approved 3rd generation (Biolox delta) ceramics in 2003 based on Investigational Device Exemption (IDE) premarket clinical trials in USA
- ***By 2005 squeaking was a problem for patients and surgeons***

Disadvantages of Ceramics

- ***Squeaking***
- Brittle – head and liner fractures
- Lack of edge support on liners
- Reduced revision options
- Cost

Ceramic Squeaking

Biolox Delta™ << Biolox Forte™
Wear at 3.0 Mc - X10↓
Surface roughness = no change

- Ceramic - an exceptional bearing couple
- Squeaking may affect up to 20% patients

Is it the trade off for:

- Excellent function
- Reduced osteolysis
- Longevity?

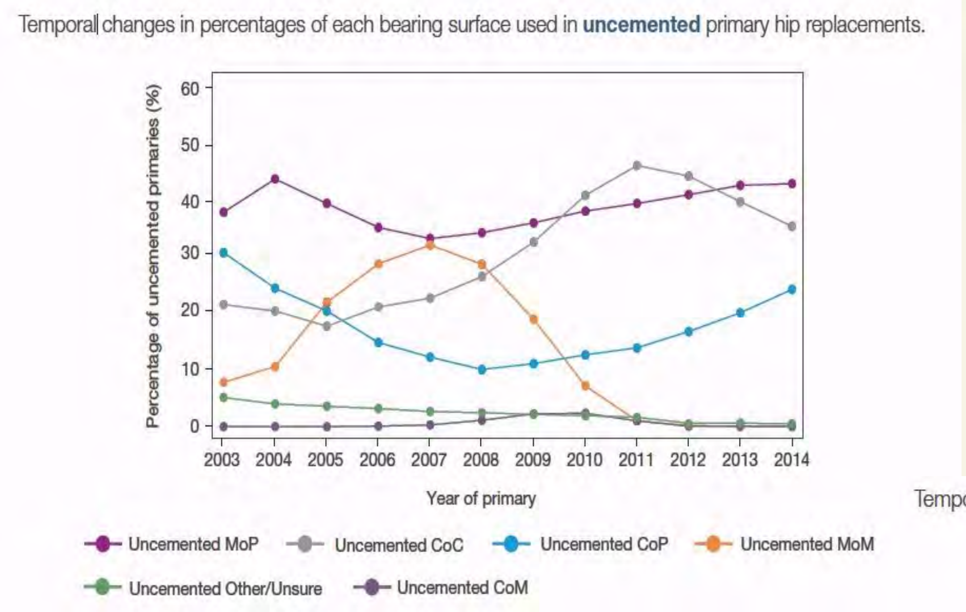
Ceramic Coupling

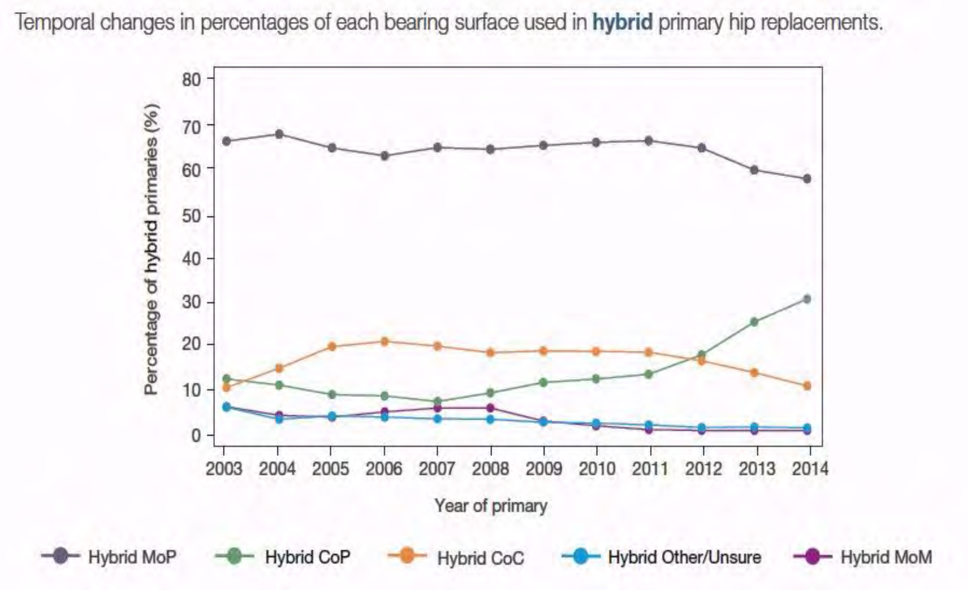
- Ceramic bearings in the UK - 14%
- Metal on Poly in the UK – 59%

- Ceramic bearings in USA -14%

Bozic K, Kurtz S, Lau E, Ong K, Vail T, Berry D J Bone Joint Surg 2009; 91: 1614-20

Ceramic on Ceramic - Declining





National Joint Registry for England, Wales and Northern Ireland 2014

Effect of Inclination Angle

Group	Severe	Stripe	Low
Cup Angle	60.8°	50.4°	42.8°

- Ceramics sensitive to positioning
- Correct cup inclination is ‘the’ basic pre-requisite.
- If cup too vertical - catastrophic wear of the coupling results
- ↑ wear leads to ↑ friction

Nevelos J, Ingham E, Doyle C, Nevelos A, Fisher J Journal of Materials Science: Materials in Medicine 2001; 12: 141-44
Dalla Pria P. 1st Symposium on the Ceramic Wear Couple. Stuttgart: Ferdinand Enke Verlag; 1996: 84-91

Ceramics with Edge Loading

- Edge loading induces severe contact stresses with break up of the ceramic grain boundary
- Chipping of ceramics initiates noise
- 3rd body wear – causes squeaking with friction induced vibration

↑ wear leads to ↑ friction

Toni A, Traina F, Stea S et al J Bone Joint 2006; 88:726-734
Sariali E, Stewart T, Jin Z et al J Biomech 2010; 44: 326-333
Sariali E, Jin Z Stewart T, Fisher J J Orthop Res 2010; 44: 326-333
Sanders A, Tibbits I, Brannon R J Orthop Res 2012; 30: 1377-1383

Long Term Follow-Up

- 5500 ceramic THAs
- In 25 years 13 (0.002%) alumina fractures recorded
- **No comment on squeaking**

Hannouche D, Nich C, Bizot P, Meunier A, Nizard R, Sedel L Clin Orthop 2003; 417: 19-26

- 265 patients
- 20 year FU
- **2.6% squeakers**

Sedel L EHS 2012

Ceramic Cup and Head

- Ceramic tapered threaded Biolox cup and a 38 mm alumina head
- Autophor 900-S stem (porous coated cobalt chromium molybdenum)
- 78 patients, minimum 20 year FU
- Cup protrusio -13 cases (17%)
- 7 revisions
- No fractures
- **No squeaking**

Petsatodis G, Papadopoulos P, Papavasiliou K, Hatzokos I, Agathangelidis F, Christodoulou A J Bone Joint Surg 2010; 92: 639-44

Composite Metal/Ceramic Cup

- 9 patients (21%) squeakers
- Trident cup
- ABG II stem (titanium-molybdenum 12%-zirconium6%-iron 2%: TMZF beta phase alloy and V40 taper neck)
- Deviation in inclination and anteversion not statistically significant
- Short necks - 2.7mm a risk factor for increased impingement

Keurentjies J, Kuipers R, Wever D, Scheurs B
Clin Orthop Relat Res 2008; 466: 1439-43

Squeaking in a Series of THAs

Biolox Forte bearings

- 0.5% (13/2384) squeaked
- Excessive cup inclination and anteversion
- Patients were younger, heavier and taller
- Squeaking delayed until >14 months

Walter W, O'Toole G, Walter W, Ellis A, Zicat B J Arthroplasty 2007; 22: 496-503

Securfit stem

Squeaking in the USA

Restrepo et al *(Trident cup with Accolade stem)*	18.4%
Mai et al *(Trident cup with variety of stems)*	17.0%
Lee et al *(Plasmacup with Bicontact stem)*	15.0%
Jarrett et al *(Accolade TMZF with Trident PSL cup V40 femoral head and Trident alumina insert)*	10.7%
Swanson et al *(Variety of cups and stems)*	8.9%
Christensen & Jacobs *(Trident cup with Accolade stem)*	7.7%
Hamilton et al *(Pinnacle cup and variety of stems)*	0.0%

Restrepo C, Post Z, Kai B, Hozack W J Bone Joint Surg 2010; 92: 550-57
Jarrett C, Ranawat A, Bruzzone M, Rodriguez J, Ranawat C J Bone Joint Surg 2009; 91: 1344-49
Christensen C, Jacobs C Poster presented at: 75th American Academy of Orthopaedic Surgeons; March 5-9, 2008; San Francisco, CA
Mai K, Verioti C, Ezzet K, Copp S, Walker R, Colwell C Clin Orthop Relat Res 2010; 468: 413-17
Lee Y, Ha Y, Yoo J, Koo K, Yoon K, Kim H J Bone Joint Surg 2009; 92: 1715-19
Hamilton W, McAuley J Dennis D, Murphy M, Blumenfeld T Clin Orthop Relat Res 2010; 468: 358-66
Swanson T, Peterson D, Seethala R, Bliss R, Spellmon C J Arthroplasty 2008; 25: 36-42

Response to Squeaking

- Rothman Institute halts ceramics!

- J Arthroplasty – 2008

  'It appears that exact etiology of squeaking remains unknown… and prompts the dire need for detailed and further research into this problem. We have temporarily halted the use of CoC bearing surfaces in our unit.'

Revision for Squeaking

- Early failure a cause for concern - patients given the option of revision

  Jarrett C, Ranawat A, Bruzzone M, Rodriguez J, Ranawat C J Bone Joint Surg 2009; 91: 1344-49

- 12% (11/95) revised to HXL poly liner with no complications

  Restrepo C, Matar W, Parvisi J, Rothman R, Hozak W Clin Orthop Relat Res 2010; 468: 2340-45

- 22% (2/9) squeaking hips revised

  Keurentjies J, Kuipers R, Wever D, Scheurs B Clin Orthop Relat Res 2008; 466: 1439-43

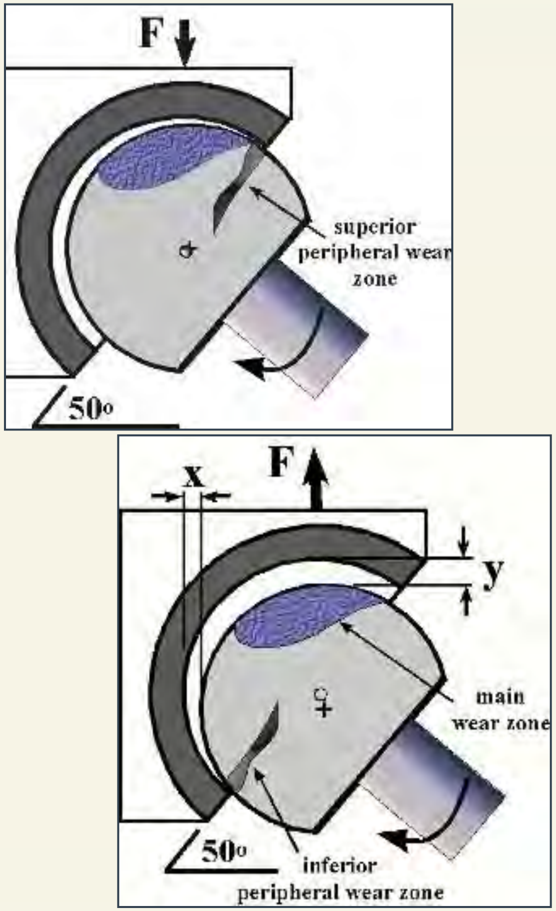
Patient Factors

- Age, height and weight
- Raised BMI – impact in some studies
- Timing – squeaking noted early in some patients - but mostly when 'normal' ROM returned or upon bending or altering their pelvic position – high heels

Ul Haq R, Park K-S, Seon J-K, Yoon T-R J Arthroplasty 2012; 27: 909-915
Ki SC, Kim BH, Ryu JH, Yoon DH, Chung YY. J Orthop Sci 2011; 16: 21-5

Surgeon Factors

- Posterior approach leading to increased cup anteversion
- Malposition of liner
- Leg length difference – laxity and increased micro-separation



Ecker T, Robbins C, van Flanden G et al Orthopaedics 2008; 31: 875
Ul Haq R, Park K-S, Seon J-K, Yoon T-R J Arthroplasty 2012; 27: 909-915

The Implant - Influenced by Surgeon

- Increased cup inclination
- Excessive cup anteversion
- Increased offset
- Lateralisation of hip centre
- Malpositioned liners
- Short neck lengths
- Head sizes $\geq$36mm

- Material – ? Biolox delta ceramics - not evaluated

Hamilton W, McAuley J, Blumenfeld T Lesko J, Himden S, Dennis D J Arthroplasty 2015; 30: 110-115

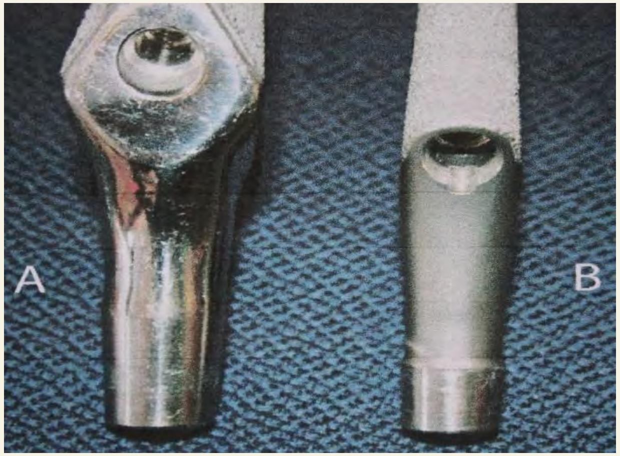
Squeaking and Implant Vibration

- Modal analysis used to evaluate ‘dynamic’ behavior of the implant
- Cementless femoral stems have their own eigenfrequencies
- Stems with lower eigenfrequency vibrated in the audible range and intiated squeaking
- Bearing clearance and the cup did not play a ’dynamic’ role

Hothan A, Huber G, Weiss C, Morlock M J Biomechanics 2011; 44: 837-841

Implant Design – Stem and Taper

- Accolade stem
  - TMZF and V40 taper neck - AP diameter in midsection 10mm
- Omnifit stem
  - titanium-aluminium 6%
  - vanadium 4% alloy and C taper neck geometry
- V40 taper increased squeaking by 7 fold (18.4% vs 2.6%)
- V40 taper and a slender neck - amplifies the vibration



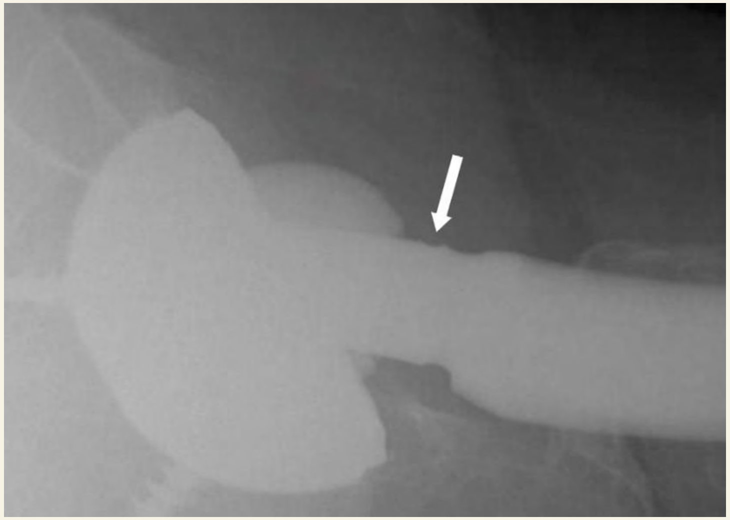
Restrepo C, Post Z, Kai B, Hozack W J Bone Joint Surg 2010; 92: 550-57
Mai K, Verioti C, Ezzet K, Copp S, Walker R, Colwell C Clin Orthop Relat Res 2010; 468: 413-17

Squeaking with Impingement

Socket – neck impingement

The neck is notched from the cup rim neck impingement

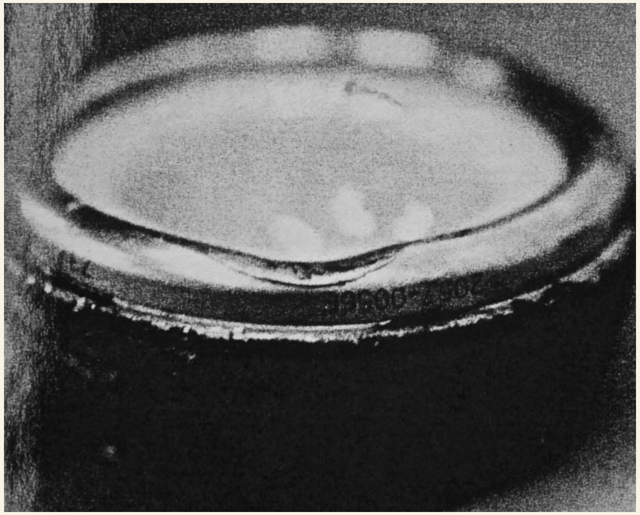
Walter W, O'Toole G, Walter W, Ellis A, Zicat J
Arthroplasty 2007; 22: 496-503
Keurentjies J, Kuipers R, Wever D, Scheurs B
Clin Orthop Relat Res 2008; 466: 1439-43



Lee Y et al JBJS 2010

Implant Design - Trident cup

- Raised metal rim with recessed ceramic liner
- Flush ceramic liners squeak less than a raised liners (0.6 vs 3.2%)
- Reduced arc and early neck-rim impingement
- Cup deformation



Murphy S Orthopaedics Today 2008; 28: 92
Barrack R, Barrack C, Skinner H Clin Orthop Relat Res 2004; 429: 73-79

Squeaking without Lubrication

- Dry and lubricated tests (25% bovine serum)
- Normal gait, high load, stripe wear, metal transfer, edge wear and micro-fracture parameters evaluated
- Squeaking produced in dry conditions
- With high load, stripe wear, or metal transfer
- Once squeaking occurred it did not stop

- Squeaking disappeared when lubricant added (except for the metal transfer condition)

- Squeaking is a problem of disrupted ceramic/ceramic lubrication

Chevillotte C, Trousdale R, Chen Q, Guyen O, An O Clin Orthop Relat Res 2010; 468: 345-50

Causes of Squeaking

↑friction/↓lubrication

- Impingement
- Subluxation
- Edge loading/stripe wear
- Micro-separation
- Metal transfer
- Debris (3rd body wear – Al2O3 ZrO2)
- Mismatch materials – zirconia on alumina

Fig. 3

Diagram showing proposed mechanisms and associations of squeaking in ceramic-on-ceramic total hip replacements.

Owen D, Rusell N, Smith P, Walter W Bone Joint J 2014; 96: 181-7
Morlock M, Nassautt R, Janssen R, Willmann G, Honl M J Arthroplasty 2001; 16: 1071-74

Ceramic Hips

- Not as forgiving as other bearing surfaces
- Surgical technique and design features are critical with ceramic bearings
- Squeaking can be unacceptable to the patient and may require revision surgery

Squeaking

Squeaking is a problem of component positioning and patient postural adaption.

Squeaking remains a concern.

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

SERVIZIO SANITARIO REGIONALE
EMILIA-ROMAGNA
Azienda Ospedaliero - Universitaria di Parma

SIGILLVM ALMAE VNIVERSITATIS STVDII PARMENSIS

DIPARTIMENTO CHIRURGICO
AZIENDA OSPEDALIERO-UNIVERSITARIA DI PARMA
U.O.C. CLINICA ORTOPEDICA
DIRETTORE: PROF. E. VAIENTI

IS THERE ANY EVIDENCE THAT CERAMIC ON POLY IS BETTER THAN METAL ON POLY?

E. VAIENTI

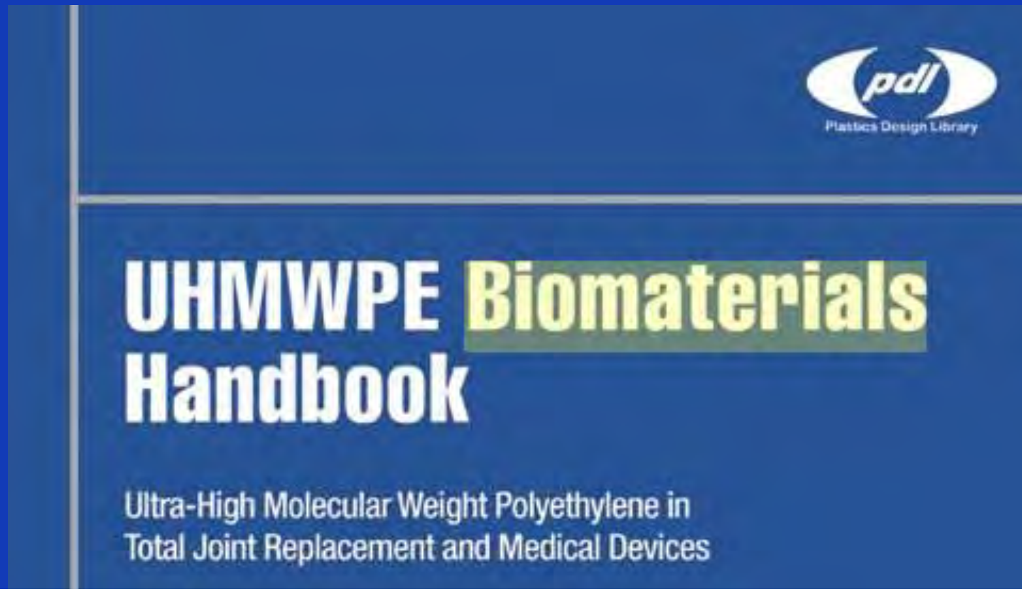


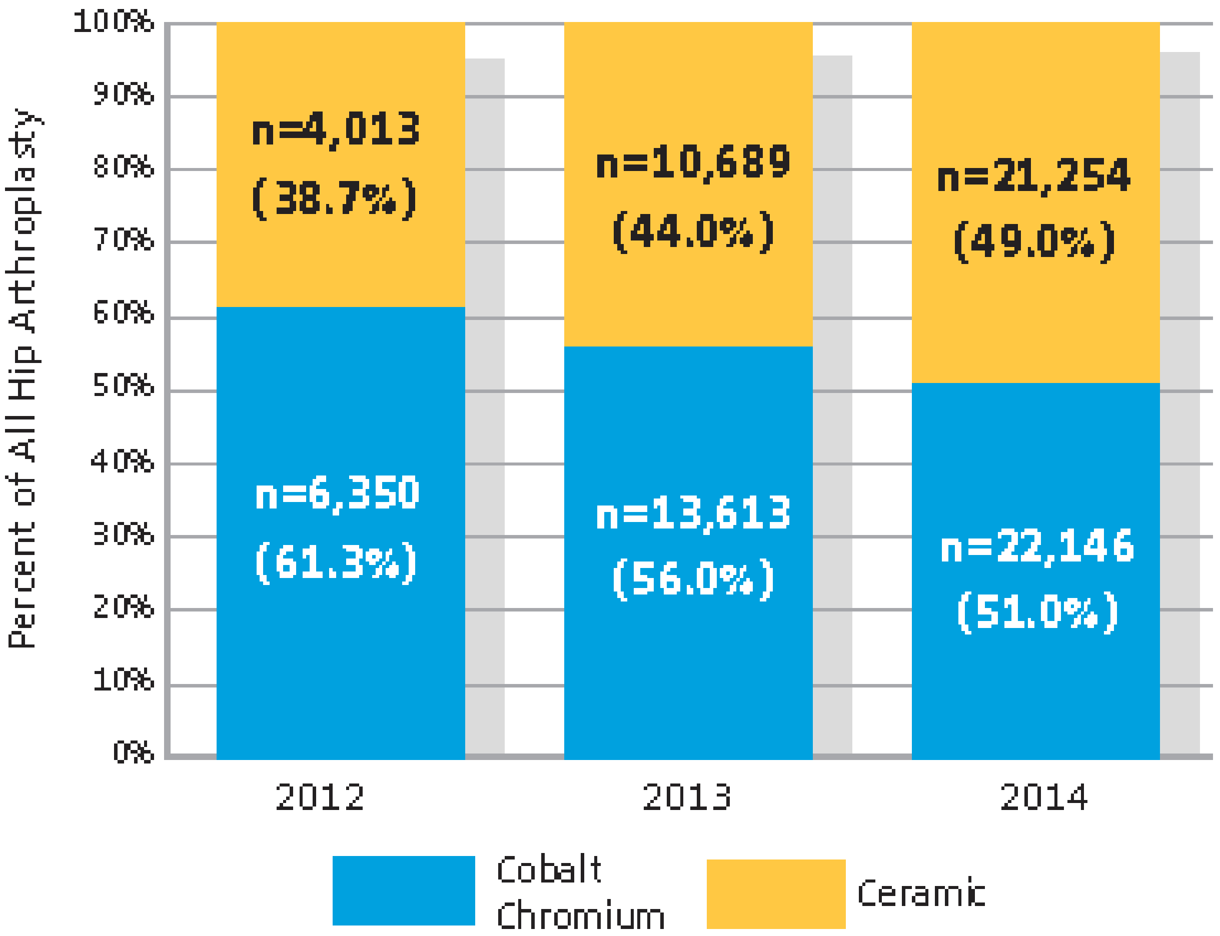
Table 7.2 Various Properties of Alumina and Zirconia Ceramics Used in the Total Hip Reconstruction [107–109]

Property	Alumina in 1970s	Alumina in 1980s	Alumina in 1990s	Zirconia	ZTA
Bending strength (MPa)	>450	>500	>550	>900	>1000
Fracture toughness (MPa·m$^{1/2}$)	4	4	4	8	5.7
Vickers hardness (0.1)	1800	1900	2000	1250	1975
Grain size (μm)	4.5	3.2	1.8	<0.5	<1.5 (alumina matrix)
Young's modulus (GPa)	380	380	380	210	350

ZTA, Zirconia toughened alumina microcomposite.

Figure 20: Composition of Femoral Heads (N=78,065)

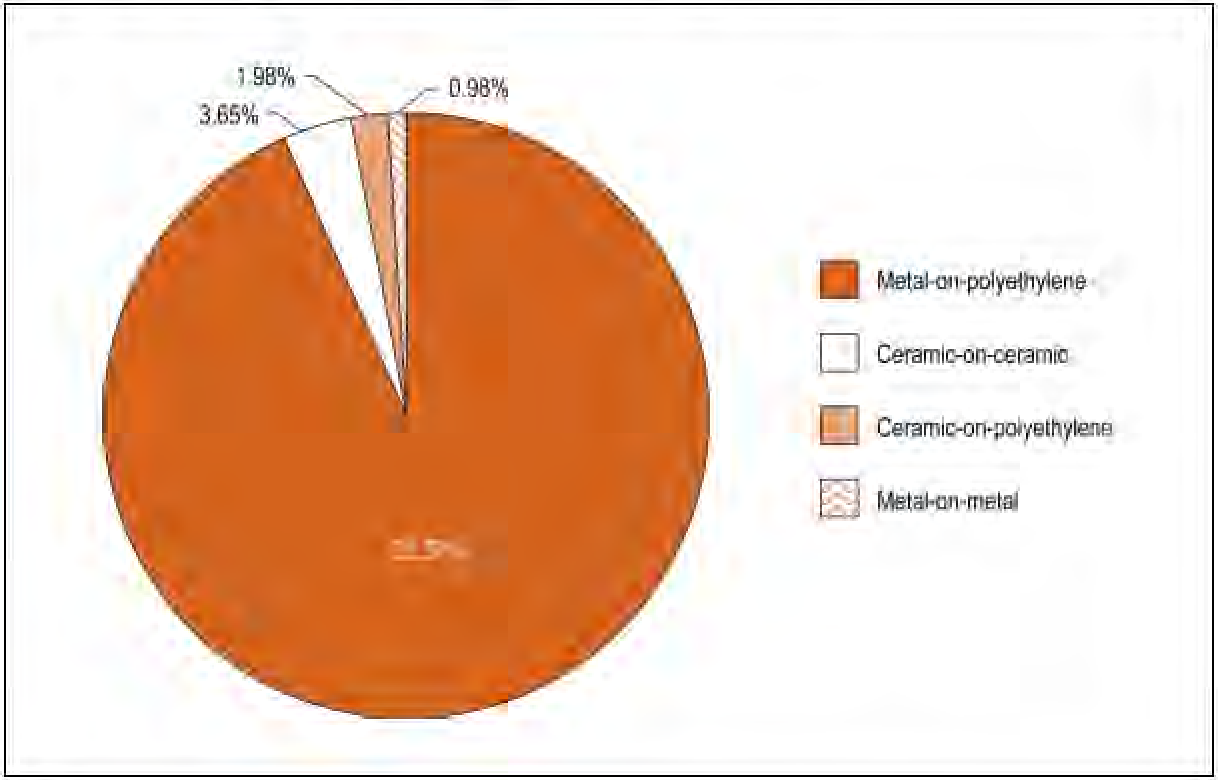
AJRR American Joint Replacement Registry
Improving Orthopaedic Care Through Data



ANNUAL REPORT 2014

Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry 2015 Annual Report

Figure 7: Bearing surfaces for hip replacements, 2013–2014



Notes

N = 12,599 bearing surfaces for primary total hip replacements.

Fewer than 5 cases of ceramic-on-metal were excluded from analysis. In accordance with CIHI's privacy policy, cells with counts of 1 to 4 are suppressed.

Source

Canadian Joint Replacement Registry, 2013–2014, Canadian Institute for Health Information.

AUSTRALIAN ORTHOPAEDIC ASSOCIATION
NATIONAL JOINT REPLACEMENT REGISTRY

Table HT27 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Bearing Surface (Primary Diagnosis OA)

Bearing Surface	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Ceramic/Ceramic	2109	65114	1.5 (1.4, 1.6)	2.4 (2.3, 2.6)	3.2 (3.0, 3.3)	4.0 (3.8, 4.2)	5.1 (4.9, 5.4)	6.5 (6.0, 7.0)
Ceramic/Non XLPE	350	5273	1.9 (1.6, 2.3)	3.2 (2.7, 3.7)	3.9 (3.4, 4.5)	4.9 (4.3, 5.6)	7.3 (6.5, 8.1)	11.4 (10.0, 12.9)
Ceramic/XLPE	775	30835	1.6 (1.4, 1.7)	2.5 (2.3, 2.7)	3.1 (2.8, 3.3)	3.6 (3.3, 3.9)	4.6 (4.1, 5.1)	
Ceramic/Metal	15	300	1.7 (0.7, 4.0)	3.7 (2.1, 6.6)	4.1 (2.3, 7.1)			
Metal/Metal	298	5129	1.5 (1.2, 1.9)	3.3 (2.8, 3.8)	4.3 (3.8, 4.9)	5.0 (4.4, 5.7)	6.3 (5.6, 7.0)	7.7 (6.7, 8.8)
Metal/Non XLPE	1991	34014	1.4 (1.3, 1.5)	2.4 (2.3, 2.6)	3.4 (3.2, 3.6)	4.5 (4.2, 4.7)	6.4 (6.1, 6.7)	9.9 (9.4, 10.5)
Metal/XLPE	2962	107225	1.5 (1.4, 1.6)	2.3 (2.2, 2.4)	2.9 (2.8, 3.0)	3.5 (3.3, 3.6)	4.3 (4.1, 4.5)	5.4 (4.8, 6.1)
Ceramicised Metal/Non XLPE	27	287	1.8 (0.7, 4.2)	4.0 (2.2, 7.1)	4.4 (2.5, 7.6)	7.9 (5.2, 12.1)	11.2 (7.7, 16.2)	
Ceramicised Metal/XLPE	299	14016	1.5 (1.3, 1.7)	2.0 (1.7, 2.2)	2.3 (2.0, 2.6)	2.6 (2.3, 2.9)	3.3 (2.9, 3.9)	
TOTAL	**8826**	**262193**						

Note: 253 procedures with unknown bearing surface, one procedure with Ceramicised Metal/Ceramic bearing surface and 7 procedures with Metal/Ceramic bearing surface have been excluded
All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

12th Annual Report

2015

National Joint Registry for England, Wales, Northern Ireland and the Isle of Man

Surgical data to 31 December 2014

Table 1 Frequency of material chosen for femoral heads in procedures performed in 2014.

Material	Number of procedures	Number of modular femoral heads used	Percentage
	97,472	95,850	
Ceramic		37,620	39%
Metal		58,230	61%

Swedish Hip Arthroplasty Register

Annual Report 2013

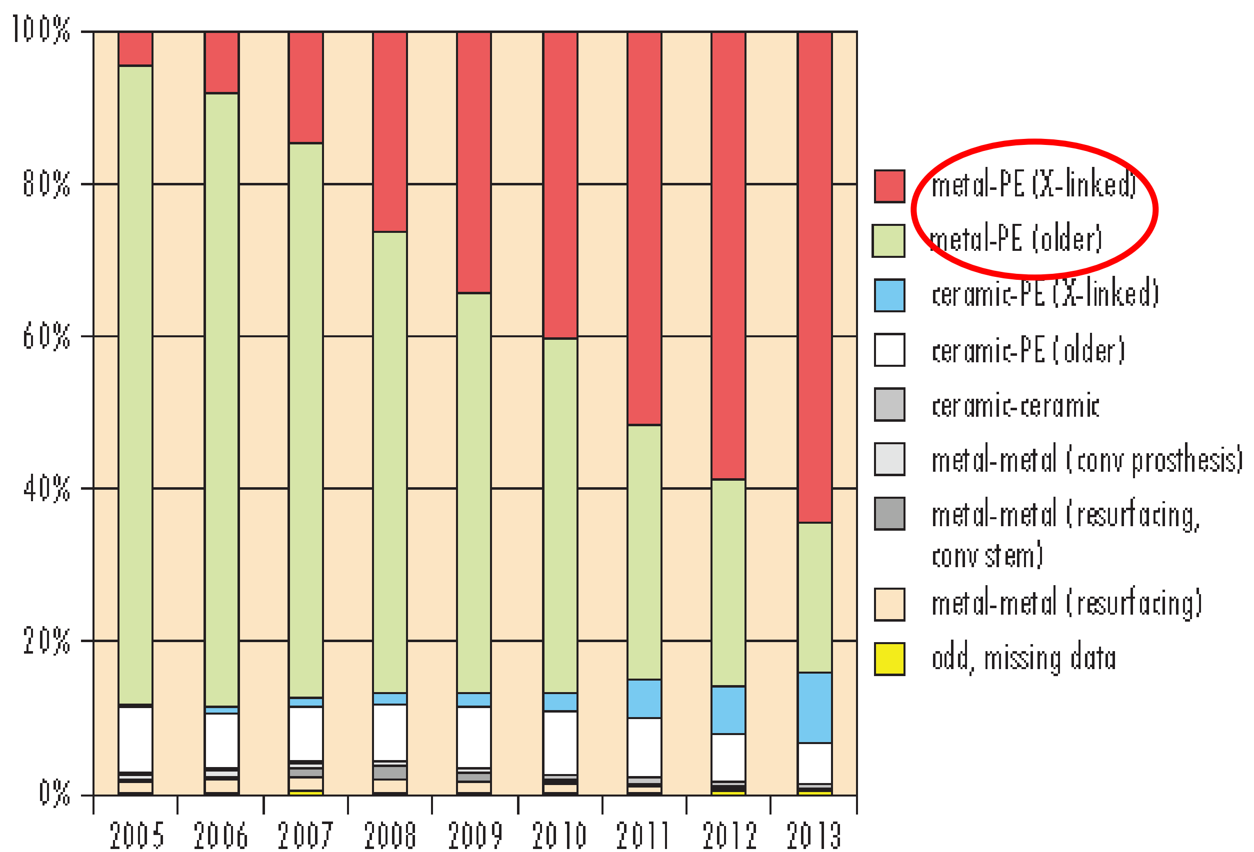


Figure 12. Type of inserted articulation since 2005–2013.

DATI COMPLESSIVI

SERVIZIO SANITARIO REGIONALE
EMILIA-ROMAGNA

VERSIONE 1 DEL 2 GENNAIO 2015

4.8 Articular couplings and head diameters

Number of primary total hip arthroplasty operations carried out on patients with admission date between 1st January 2000 and 31st December 2013, according to the **type of operation** and **articular coupling**.

Articular coupling	Primary		Total revision	
	N.	%	N.	%
Cer-cer	33.970	42,2	924	25,4
Met-poly	14.138	17,5	804	22,1
Cer-poly	11.372	14,1	767	21,1
Cer-X linked poly	7.187	8,9	457	12,6
Met-met	6.247	7,8	95	2,6
Met-X linked poly	5.848	7,3	497	13,7
Met-poly undefined*	826	1,0	52	1,4
Cer-poly undefined*	421	0,5	34	0,9
Biolox delta-met	222	0,3	-	-
Cerid-poly	180	0,2	-	-
Surface-treated met- Surface-treated metal	78	0,1	-	-
Oxinium-poly	64	0,1	2	0,1
Met-cer	3	0,0	-	-
Bionium Diamant-poly	2	0,0	1	0,0
Oxinium-cer	2	0,0	-	-
Total^	**80.560**	**100,0**	**3.633**	**100,0**

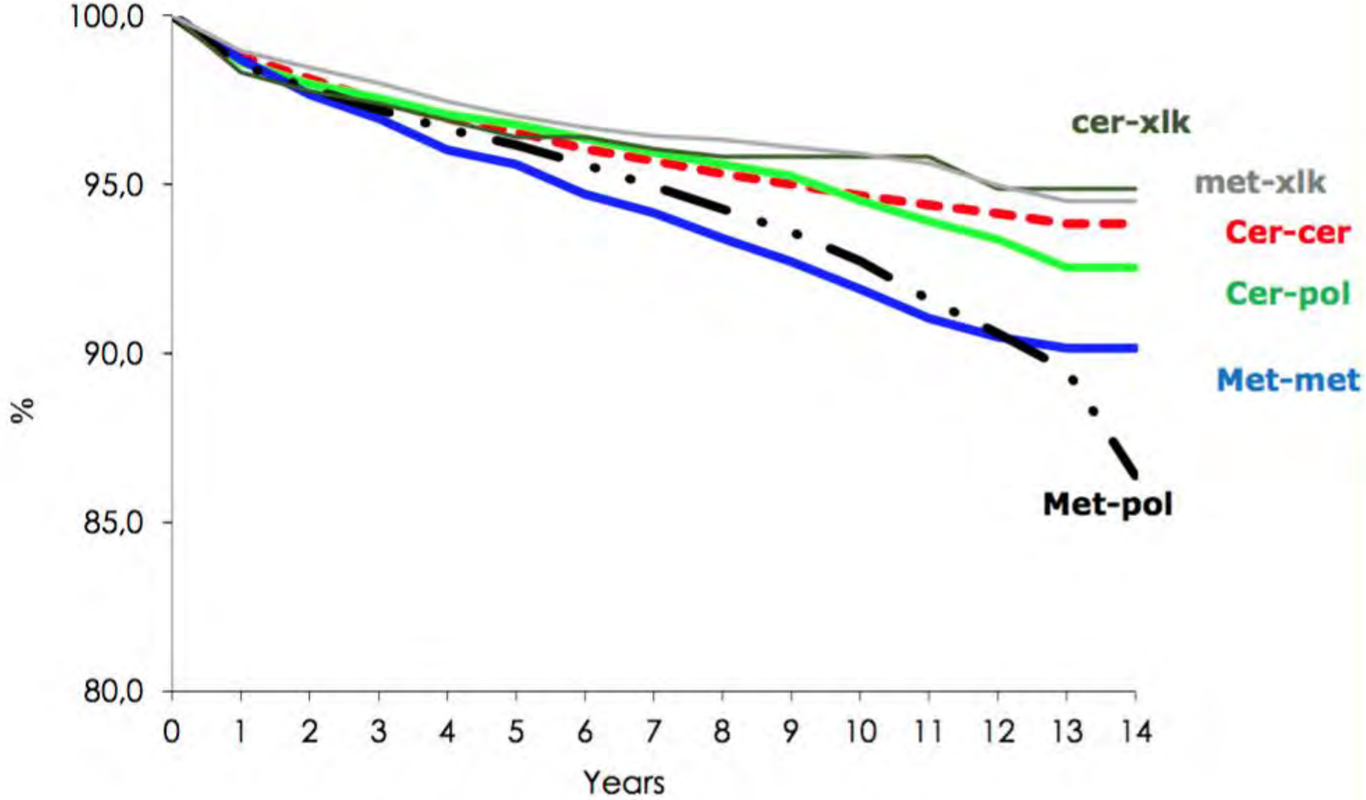
* missing label did not allow classification of poly
^310 missing data in primary surgery and 18 in total revision.

Percentage of elective THA according **to articular coupling** and **class age**

Age class	Elective THA in 2001			
	met-pol	cer-pol	cer-cer	met-met
<40	9,1	21,2	47,0	22,7
40-49	12,8	17,9	45,6	23,7
50-59	23,6	23,6	34,0	18,7
60-69	36,9	31,5	23,8	7,8
70-79	51,9	36,1	10,9	1,1
Over 80	65,6	30,9	3,4	0,0

Age class	Elective THA in 2013			
	met-pol	cer-pol	cer-cer	met-met
<40	2,0	13,8	84,2	0,0
40-49	2,3	14,4	83,3	0,0
50-59	3,0	15,2	81,7	0,1
60-69	5,5	23,0	71,4	0,2
70-79	13,5	32,9	53,3	0,2
Over 80	28,0	45,4	26,0	0,7

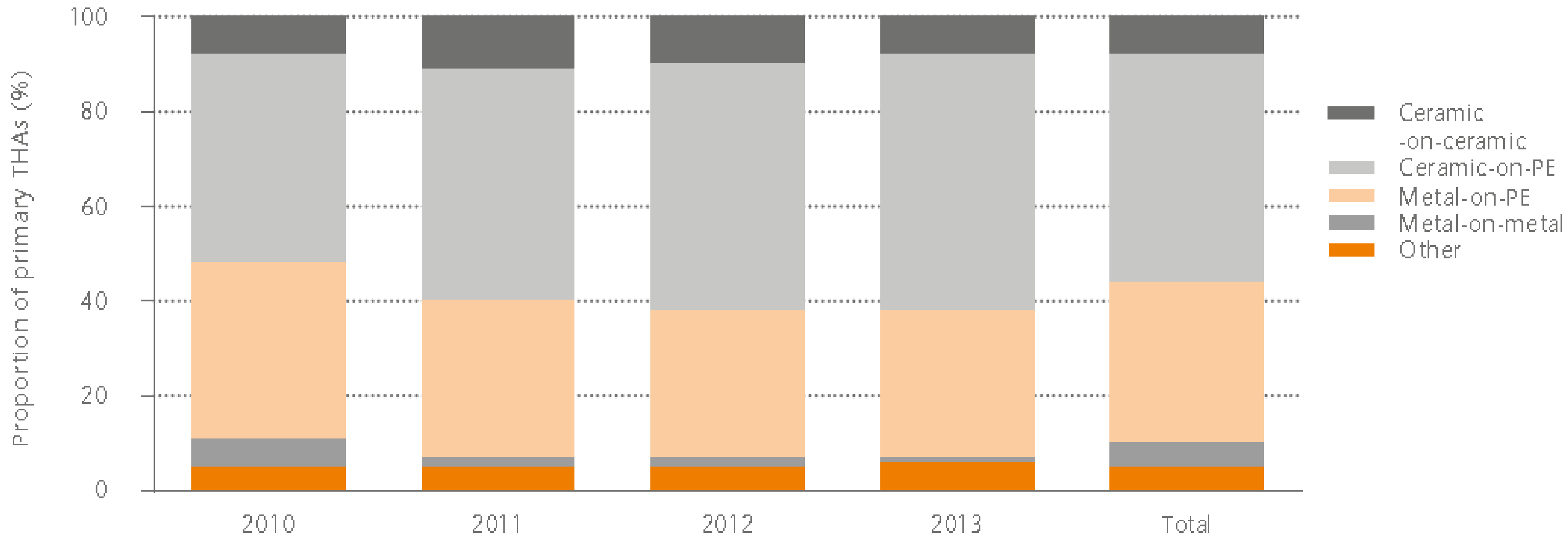
Survival curve



Difference is statistically significant (p=0,010, Wilcoxon test).
Met-met vs others is statistically significant (p=0.02, Wilcoxon test)

Insight into Quality & Safety

Netherlands Orthopaedic Association (NOV)
Dutch Arthroplasty Register (LROI)
www.lroi.nl

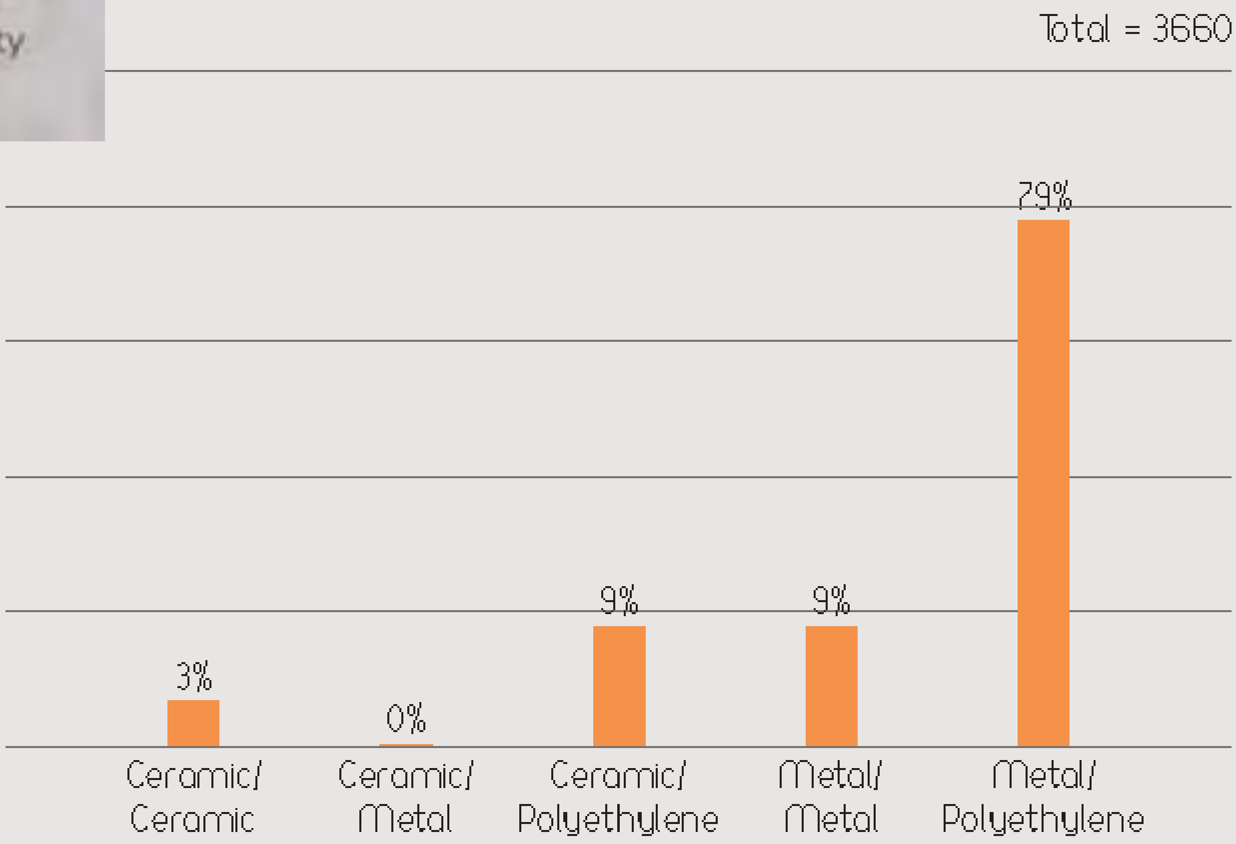


Articulation					
Ceramic-on-ceramic (%)	8.0	11.1	10.0	8.1	7.8
Ceramic-on-PE (%)	44.0	49.1	52.4	54.6	47.7
Metal-on-PE (%)	37.2	32.4	30.9	30.6	34.5
Metal-on-metal (%)	5.8	2.5	1.7	0.8	4.9
Other (%)	5.0	4.9	5.0	5.9	5.1
Total (n)	21,472	21,921	23,515	24,634	91,542

1st Annual Report
June 2009 – May 2010

Registo Português de Artroplastias
Portuguese Arthroplasty Register

Figure XXII Articular Pair



The Journal of Arthroplasty Vol. 17 No. 5 2002

A Literature Review of the Association Between Wear Rate and Osteolysis in Total Hip Arthroplasty

John H. Dumbleton, PhD, DSc,* Michael T. Manley, PhD,† and Avram A. Edidin, PhD‡

The literature indicates that the incidence of osteolysis increases with increased wear rate in the hip. Although volumetric wear is probably the key factor in the biologic response, review of published data must concentrate on linear wear because this is most often the measurement reported. With the caveat that larger heads produce greater wear volume than smaller heads for the same linear penetration, the literature suggests that osteolysis is infrequent when wear rates are <0.1 mm/y and almost absent <0.05 mm/y. For practical purposes, we suggest that a hip bearing wear rate of 0.1 mm/y can be taken as a wear threshold for polyethylene; below this level, osteolysis is rare, and above this level, the risk of osteolysis increases substantially.

- **Sugano al 1995 57 hip alumina 10 y 0,1 mm/y**
- **Cales 2000 zir 0,1**
- **Dambleto al 2002 CoCr 0,1**
- **Kim 2005 52 pz zir/CoCr 7,1 y 0,08/0,17**
- **Kray al 2006 30/30 pz zir/CoCr 4 y 0,005/0,060**

Long-Term Performance of Ceramic and Metal Femoral Heads on Conventional Polyethylene in Young and Active Patients

Investigation performed at the Hospital for Special Surgery, New York, NY

J Bone Joint Surg Am. 2013;95:1193-7

A Matched-Pair Analysis

Morteza Meftah, MD, Gregory G. Klingenstein, MD, Richard J. Yun, BS, Amar S. Ranawat, MD, and Chitranjan S. Ranawat, MD

ninety-one alumina ceramic femoral heads (CeramTec) and 157 cobalt-chromium metal heads (DePuy, Warsaw, Indiana), all 28 mm in diameter, were implanted and followed prospectively for a minimum of fifteen years. Of this cohort, thirty-one pairs of alumina ceramic and metal femoral heads (in forty-nine patients) were matched on the basis of age (within two years), sex, body weight (within 5 lb [2.25 kg]), diagnosis, and activity level (within a 1-point difference on the activity score of the University of California Los Angeles

Both types UHMWPE liners

TABLE II Comparative Radiographic Data on Ceramic and Metal Heads Showing Similar Component Orientation with Significantly Less Wear in the Ceramic Group

	Ceramic	Metal	P Value
Anteversion *(deg)*			1
Mean and stand. dev.	11 ± 4	11 ± 5	
Range	5-18	4-19	
Inclination *(deg)*			1
Mean and stand. dev.	37 ± 5	37 ± 4	
Range	27-48	29-44	
Wear *(mm/yr)*			0.0015
Mean and stand. dev.	0.086 ± 0.05	0.137 ± 0.05	
Range	0.004-0.19	0.03-0.25	
Radiographic osteolysis *(no. of hips)*	5	6	1
Revision or reoperation for osteolysis and/or loosening*	1†	3‡	0.6

*Although the difference was not significant, there were more revisions in the metal group. †Reoperation. ‡Revisions.

ceramic femoral heads were found to impart a clinical advantage over metal components, with lower rates of wear and subsequent osteolysis and/or loosening.

Table 7.3 Summary of Linear Penetration Reported for Ceramic-on-HXLPE Studies

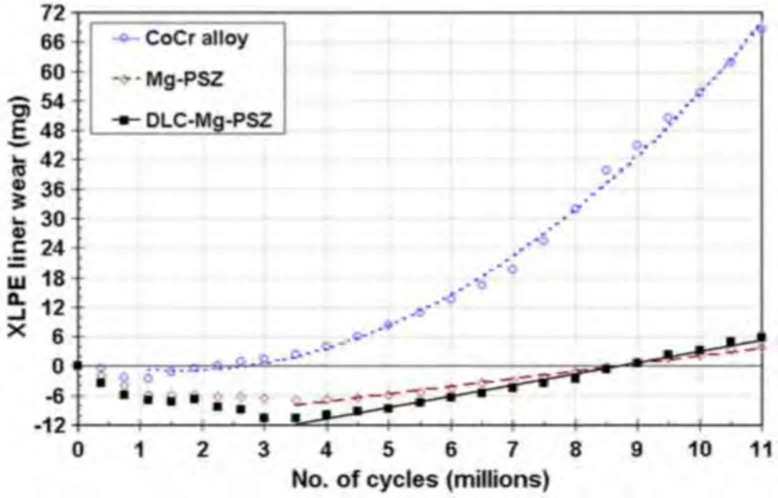
Ceramic Head Material (Manufacturer)	Mean (mm/year; Standard Error)	HXLPE Liner	Study	Study Type
Oxidized zirconium (Oxinium, Smith and Nephew)	0.041 (0.011)	Longevity	Garvin et al. [157]	Cohort
Zirconia (PHS head, Kyocera Corp)	0.067 (0.009)	Aeonian	Ise et al. [155]	RCT
Zirconia (HHZ head, Kobelco, Kobe Steel Ltd.)	0.059 (0.006)	Aeonian	Ise et al. [155]	RCT
Zirconia (3Y-TZP, Japan Medical Material)	0.000 (0.005)	Aeonian	Kawate et al. [156]	RCT
Zirconia (NGK Spark Plug)	0.030 (0.002)	Longevity	Nakahara et al. [154]	COH
Alumina (Kyocera Medical)	0.100 (0.006)	Aeonian	Oonishi et al. [153]	COH
Zirconia-toughened Alumina (ZTA) (Biolox® delta, CeramTec)	0.006 (0.014)	X3	Meftah et al. [158]	COH
Alumina (Biolox® forte, CeramTec)	0.031 (0.004)	Marathon	Kim et al. [159]	RCT
Oxidized zirconium (Oxinium™, Smith and Nephew)	0.061 (0.008)	XLPE	Morison et al. [160]	RCT
Alumina (Biolox® forte, CeramTec)	0.019 (0.013)	Crossfire	Epinette and Manley [161]	COH

Clin Orthop Relat Res (2011) 469:2337–2345
DOI 10.1007/s11999-011-1800-7

BASIC RESEARCH

Reduced Wear of Cross-linked UHMWPE Using Magnesia-stabilized Zirconia Femoral Heads in a Hip Simulator

Marcel E. Roy PhD, Leo A. Whiteside MD,
Mark E. Magill MD, Brian J. Katerberg BS



Ceramic materials induced less wear than CoCr femoral heads in simulator studies [11, 39, 43], but recent clinical studies reported no difference in wear of XLPE liners bearing against Y-TZP and CoCr femoral heads

Clin Orthop Relat Res (2009) 467:2644–2650
DOI 10.1007/s11999-009-0799-5

ORIGINAL ARTICLE

Clinical Comparison of Polyethylene Wear with Zirconia or Cobalt-Chromium Femoral Heads

**Maiken Stilling MD, Kjeld Anton Nielsen MD,
Kjeld Søballe MD, DMSc, Ole Rahbek MD, PhD**

Input variable	Zirconia heads	Cobalt-chromium heads
Number of hips	36	33
Gender (male/female)	22/14	19/14
Side (right/left)	18/18	19/14
Mean age at operation (years)	53.5 (43–64)	51.5 (29–60)
Mean cup size (mm)	56.5 (50–62)	60 (50–62)
Mean liner thickness (mm)	9.38 (6.8–11.8)	9.25 (6.8–11.8)
Mean weight (kg)	79 (58–112)	77 (55–120)
Mean radiographic followup (months)	58 (24–77)	58 (37–72)
Mean preoperative Harris hip score (maximum, 100 points)	54	57
Mean Harris hip score 3 months postoperatively (maximum, 100 points)	88	92

The published midterm wear results for Zr are contradictory, but our data do not suggest any advantage of Zr compared with CoCr heads.

The Journal of Arthroplasty Vol. 25 No. 8 2010

Minimum Five-Year Follow-Up Wear Measurement of Longevity Highly Cross-Linked Polyethylene Cup Against Cobalt-Chromium or Zirconia Heads

Ichiro Nakahara, MD,* Nobuo Nakamura, MD, PhD,†
Takashi Nishii, MD, PhD,*‡ Hidenobu Miki, MD, PhD,§
Takashi Sakai, MD, PhD,* and Nobuhiko Sugano, MD, PhD*‡

	Zirconia	Co-Cr	P
No. of hips	47	47	
Sex (male/female)	9/38	6/41	.40
Age at operation (y)	57.5 ± 9.5 (27-76)	56.9 ± 10.5 (27-75)	.75
Underlying disease			.67
Secondary OA	40	39	
ON	1	3	
Primary OA	2	2	
RDC	3	1	
RA	1	2	
Duration of follow-up (y)	6.7 ± 0.6 (5.0-8.2)	6.6 ± 0.5 (5.0-7.8)	.38
BMI	23.5 ± 3.8 (15.6-34.5)	23.5 ± 4.2 (18.3-35.0)	.95
Acetabular cup inclination (°)	40.7 ± 5.0 (32.3-50.7)	39.4 ± 5.0 (30.4-50.2)	.21
Acetabular cup anteversion (°)	22.6 ± 7.1 (7.5-34.7)	21.1 ± 6.8 (5.4-35.7)	.28

In conclusion, after the minimum 5-year follow-up, steady-state wear rate of Longevity highly cross-linked polyethylene was almost zero; and no advantage was seen for the 26-mm zirconia head compared with the cobalt-chromium head in this period.

The Journal of Arthroplasty Vol. 24 No. 8 2009

Differences in Highly Cross-Linked Polyethylene Wear Between Zirconia and Cobalt-Chromium Femoral Heads in Japanese Patients

A prospective, randomized study

Kenji Kawate, MD,* Tetsuji Ohmura, MD,† Ikuo Kawahara, MD,*
Katsuya Tamai, MD,‡ Tomoyuki Ueha, MD,* and Kazuo Takemura, MD§

Deviation

	Volumetric Wear (mm^3)		
Years	Zirconia Head	Cobalt-Chromium Head	*P*
0-1	32.7 ± 50.1	61.2 ± 67.0	.104
1-2	9.8 ± 46.6	−6.1 ± 64.7	
2-3	−4.5 ± 52.9	9.4 ± 55.1	
3-4	13.8 ± 39.0	−8.9 ± 53.4	
4-5	−18.0 ± 34.4	8 .9 ± 45.5	
Mean annual wear (1-5)	1.1 ± 8.5	1.4 ± 13.5	.254

mance. This study indicates that zirconia head offers no benefits over metal head in terms of wear reduction at 5 years in Japanese patients who have lightweight and thin polyethylene liners. Longer follow-up is required to evaluate if those ceramic heads in association with highly cross-linked polyethylenes are associated with less occurrence of osteolysis in our patients.

Wear Resistant Performance of Highly Cross-Linked and Annealed Ultra-High Molecular Weight Polyethylene against Ceramic Heads in Total Hip Arthroplasty

JOURNAL OF ORTHOPAEDIC RESEARCH DECEMBER 2012

Taishi Sato, Yasuharu Nakashima, Mio Akiyama, Takuaki Yamamoto, Taro Mawatari, Takashi Itokawa, Masanobu Ohishi, Goro Motomura, Masanobu Hirata, Yukihide Iwamoto

Department of Orthopaedic Surgery, Graduate School of Medical Sciences, Kyushu University, 3-1-1 Maidashi, Higashi-ku, Fukuoka 812-8582, Japan

Table 1. Patient Demographics

	CPE (n = 58)	XLPE (n = 335)
Head materials (no. of the hip)		
Zirconia	40	275
Alumina	24	72
CoCr	0	20
Head size (no. of the hip)		
22 mm	64	90 (all zirconia)
26 mm	0	277

Table 3. Comparison of Creep and Steady Wear Rate between Polyethylene Groups

	CPE	XLPE	p-Value
Creep (mm)	0.44 ± 0.29	0.19 ± 0.15	<0.0001
Steady wear rate (mm/year)	0.09 ± 0.06	0.0001 ± 0.03	<0.0001

Table 4. Comparison of Creep (A) and Steady Wear Rate (B) among Head Materials

	Zirconia	Alumina	Co–Cr	p-Value
(A) Creep				
CPE (mm)	0.39 ± 0.25	0.51 ± 0.034	—	0.19
XLPE (mm/year)	0.20 ± 0.17	0.21 ± 0.13	0.17 ± 0.09	0.31
(B) Steady wear rate				
CPE (mm)	0.115 ± 0.063	0.048 ± 0.055	—	<0.0001
XLPE (mm/year)	0.0008 ± 0.033	−0.0007 ± 0.037	−0.009 ± 0.035	0.45

Both XLPE creep and steady wear rates were significantly lower than those of CPE. Zirconia femoral heads resulted in significantly more wear than alumina in CPE, whereas no difference was found among head materials in XLPE. This is the first study comparing zirconia and alumina heads against XLPE resulting in no difference of wear rate with an average of 6 years follow-up. Head size and implantation period did not show any effects on XLPE wear rates.

Radiostereometric Analysis Comparison of Wear of Highly Cross-Linked Polyethylene Against 36- vs 28-mm Femoral Heads

Charles R. Bragdon, PhD,*† Meridith E. Greene, BS,*† Andrew A. Freiberg, MD,*† William H. Harris, MD,‡ and Henrik Malchau, MD*†

The Journal of Arthroplasty Vol. 22 No. 6 Suppl. 2 2007

Sixteen patients received cementless Trilogy Acetabular components (Zimmer Inc, Warsaw, Ind) with 28-mm-diameter femoral heads, and 14 patients received the same type of components with a 36-mm femoral head diameter.

Fig. 2. Median superior penetration and SE of femoral heads within the 2 groups of patients using the shell + marker RSA method.

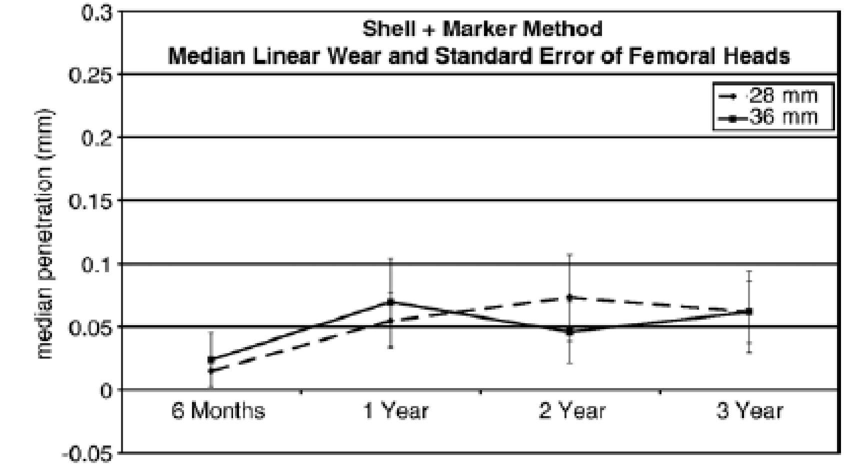
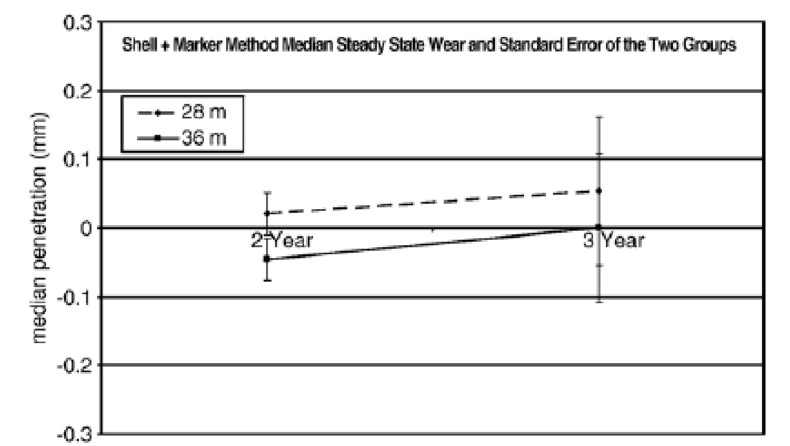


Fig. 3. Median steady state wear and SE within the 2 groups of patients using the shell + marker RSA method.



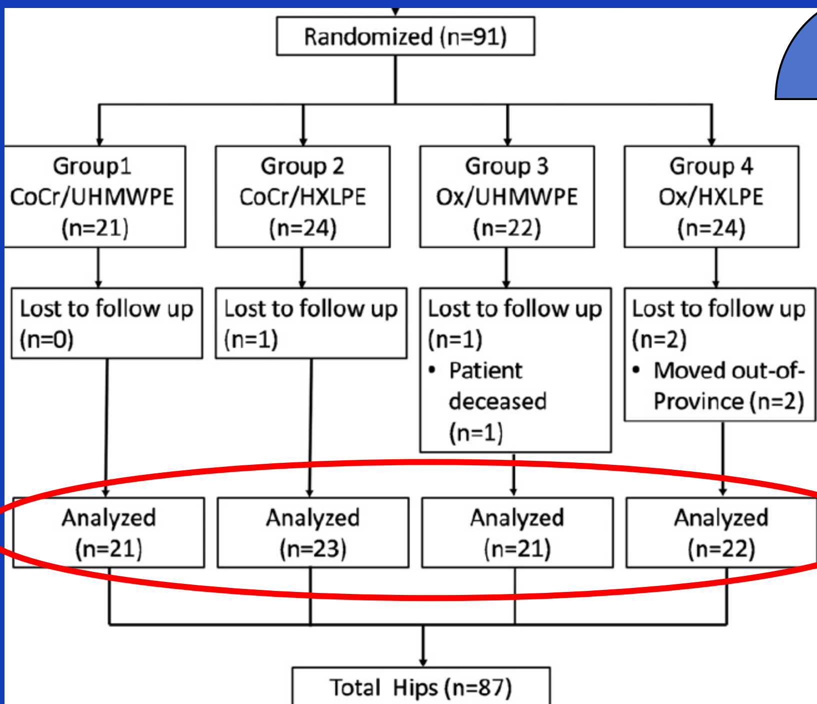
In this study, using the most precise method of radiographic measurement to evaluate the use of a 36-mm-diameter femoral head against highly cross-linked polyethylene, we found no difference in the superior penetration of the femoral head at 3 years compared with the use of a 28-mm femoral head.

A Randomized Controlled Trial Comparing Oxinium and Cobalt-Chrome on Standard and Cross-Linked Polyethylene

Contents lists available at ScienceDirect
The Journal of Arthroplasty
journal homepage: www.arthroplastyjournal.org

Zachary A. Morison, MSc [a], Sunit Patil, MD, FRCS(Ed) [b], Habeeb A. Khan, MBBS [a], Earl R. Bogoch, MD, FRCS(C) [a], Emil H. Schemitsch, MD, FRCS(C) [a], James P. Waddell, MD,

Accepted 10 April 2014



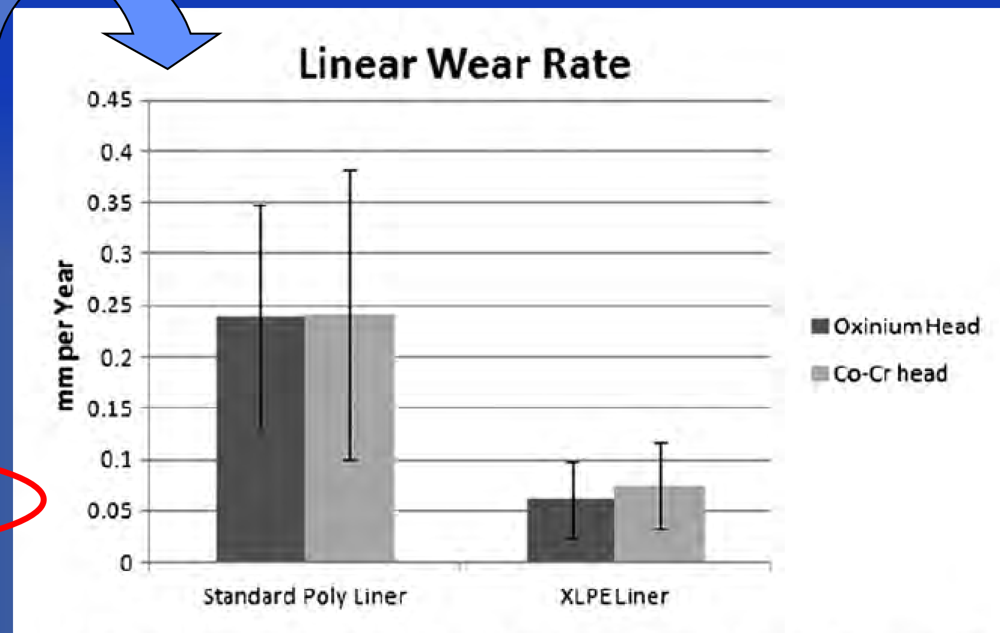


Fig. 3. The graph shows the mean linear wear rate between the four study groups.

The current data suggest that total hip arthroplasty utilizing Oxinium and HXLPE femoral heads is safe and effective. Our findings demonstrate that HXLPE results in approximately three times less wear than the standard UHMWPE. These findings are in-line with most current literature on HXLPE. Conversely, we did not find a significant reduction in linear wear rate by using Oxinium in place of cobalt-chrome femoral heads at early follow-up.

Wear and Migration of Highly Cross-Linked and Conventional Cemented Polyethylene Cups with Cobalt Chrome or Oxinium Femoral Heads: A Randomized Radiostereometric Study of 150 Patients

Thomas Kadar,[1,2] Geir Hallan,[1] Arild Aamodt,[3,4] Kari Indrekvam,[2,5] Mona Badawy,[5] Arne Skredderstuen,[1] Leif Ivar Havelin,[1,2] Terje Stokke,[6] Kristin Haugan,[3] Birgitte Espehaug,[1] Ove Furnes[1,2]

JOURNAL OF ORTHOPAEDIC RESEARCH AUGUST 2011

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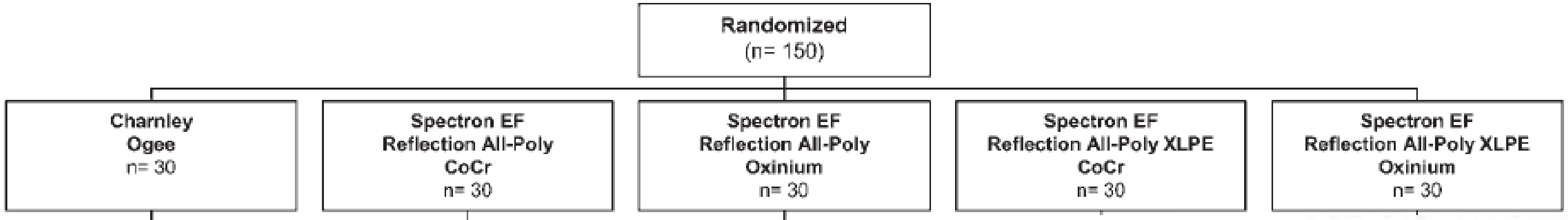
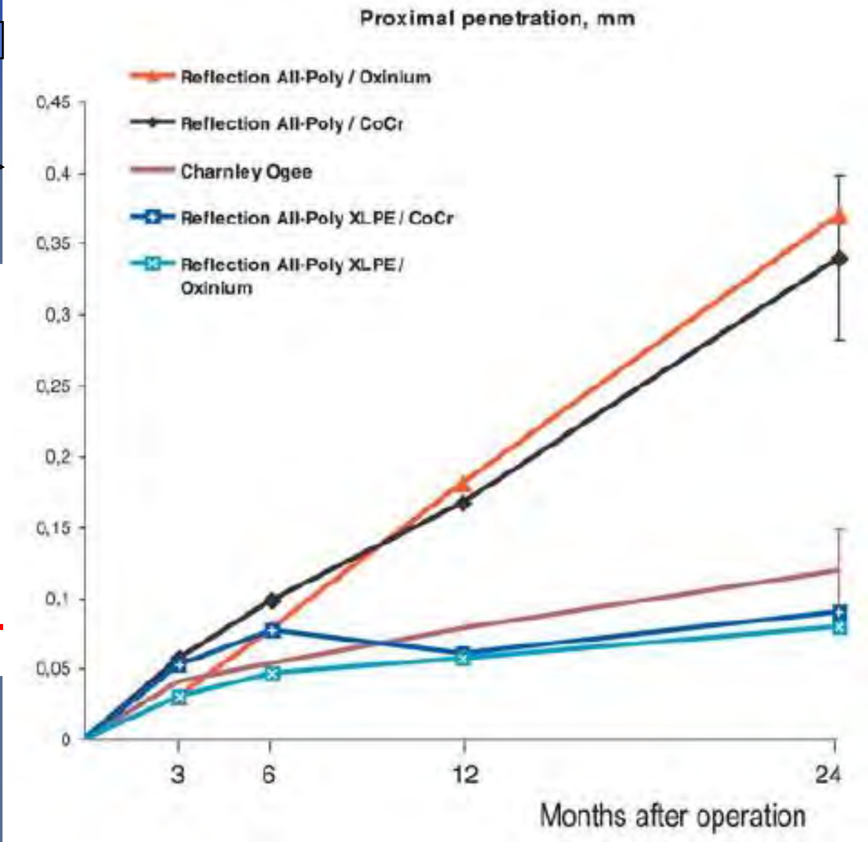




In the Reflection All-Poly groups with CoCr and Oxinium heads, the proximal penetration between 12 and 24 mos increased 0.18 mm ($p < 0.001$) and 0.17 mm ($p < 0.001$), respectively. The corresponding values for the Reflection All-Poly XLPE groups with CoCr and Oxinium heads were 0.03 mm ($p = 0.03$) and 0.02 mm ($p = 0.12$), respectively. In the Charnley Ogee group, the head penetration increased 0.04 mm ($p = 0.001$) between 12 and 24 mos.

HIP

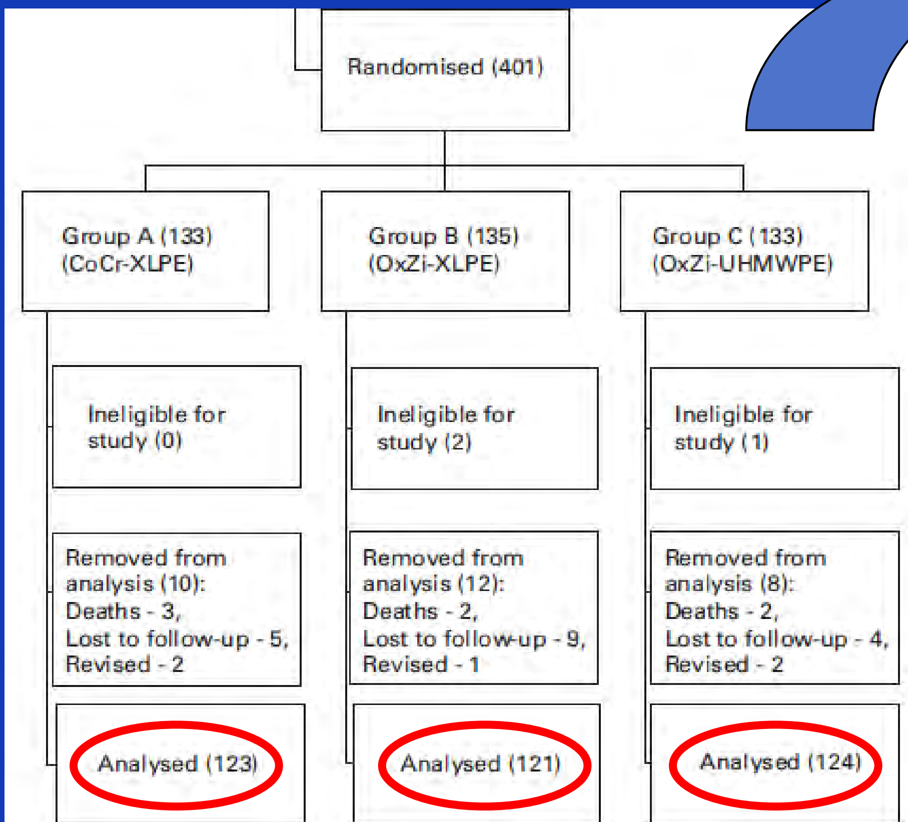
Five-year comparison of wear using oxidised zirconium and cobalt–chrome femoral heads in total hip arthroplasty

A MULTICENTRE RANDOMISED CONTROLLED TRIAL

S. S. Jassim,
S. Patel,
N. Wardle,
J. Tahmassebi,
R. Middleton,
D. L. Shardlow,
A. Stephen,
J. Hutchinson,
F. S. Haddad

From University College London Hospitals, London, United Kingdom

Cite this article: *Bone Joint J* 2015;97-B:883–9.



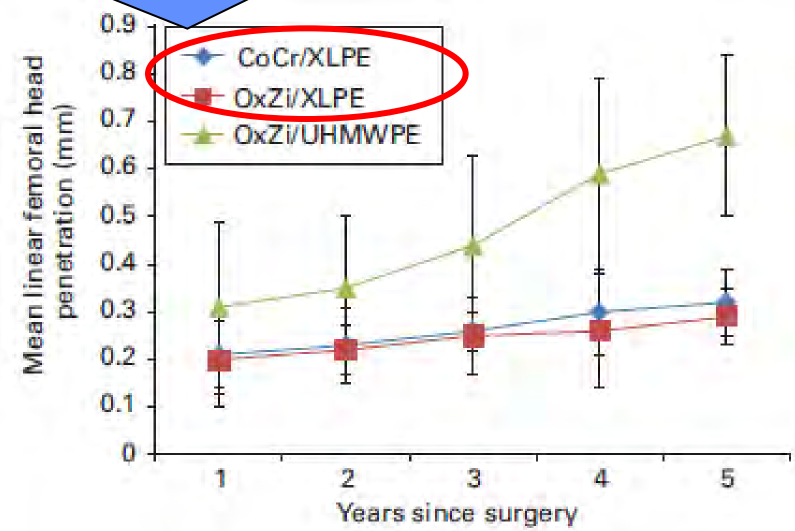


Fig. 2

Line graph demonstrating mean five-year linear wear of acetabular liner for groups of Cobalt-chrome (CoCr)/cross-linked polyethylene (XLPE), Oxidised zirconium (OxZi)/XLPE and OxZi/ultra-high molecular weight polyethylene (UHMWPE) (standard deviation in error bars)

In conclusion, this study has demonstrated that OxZi femoral heads are safe with low rates of wear when coupled with XLPE. At five years follow-up, there are no significant differences between its wear profile and that of CoCr against XLPE. It appears that the choice of material of the acetabular bearing is more important than the choice of femoral head bearing.

Prosthesis met-pol			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Aseptic loosening of the stem	**131**/11.581	1,1	20,6
Aseptic loosening of the cup	**126**/11.581	1,1	19,8
Recurrent prosthesis dislocation	**125**/11.581	1,1	19,6
Global aseptic loosening	**63**/11.581	0,5	9,9
Periprosthetic bone fracture	**55**/11.581	0,5	8,6
Septic loosening	**35**/11.581	0,3	5,5
Poly wear	**25**/11.581	0,2	3,9
Pain without loosening	**16**/11.581	0,1	2,5
Primary instability	**9**/11.581	0,1	1,4
Breakage of prosthesis	**9**/11.581	0,1	1,4
Other	**9**/11.581	0,1	1,4
Unknown	**34**/11.581	0,3	5,3
Total	**637/11.581**	**5,5**	**100,0**

Prosthesis met-XLK			
Cause of revision	**Rate**	**%**	**% distribut. of failure causes**
Periprosthetic bone fracture	**39**/4.501	0,9	28,9
Recurrent prosthesis dislocation	**29**/4.501	0,6	21,5
Aseptic loosening of the stem	**15**/4.501	0,3	11,1
Aseptic loosening of the cup	**14**/4.501	0,3	10,4
Global aseptic loosening	**11**/4.501	0,2	8,1
Septic loosening	**10**/4.501	0,2	7,4
Pain without loosening	**4**/4.501	0,1	3,0
Primary instability	**4**/4.501	0,1	3,0
Breakage of prosthesis	**1**/4.501	0,02	0,7
Other	**2**/4.501	0,04	1,5
Unknown	**6**/4.501	0,1	4,4
Total	**135/4.501**	**3,0**	**100,0**

CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 429, pp. 54–62

The Pros and Cons of Polyethylene Sterilization with Gamma Irradiation

Robert H. Hopper, Jr., PhD; C. Anderson Engh, Jr., MD; LaTonya B. Fowlkes; and Charles A. Engh, MD

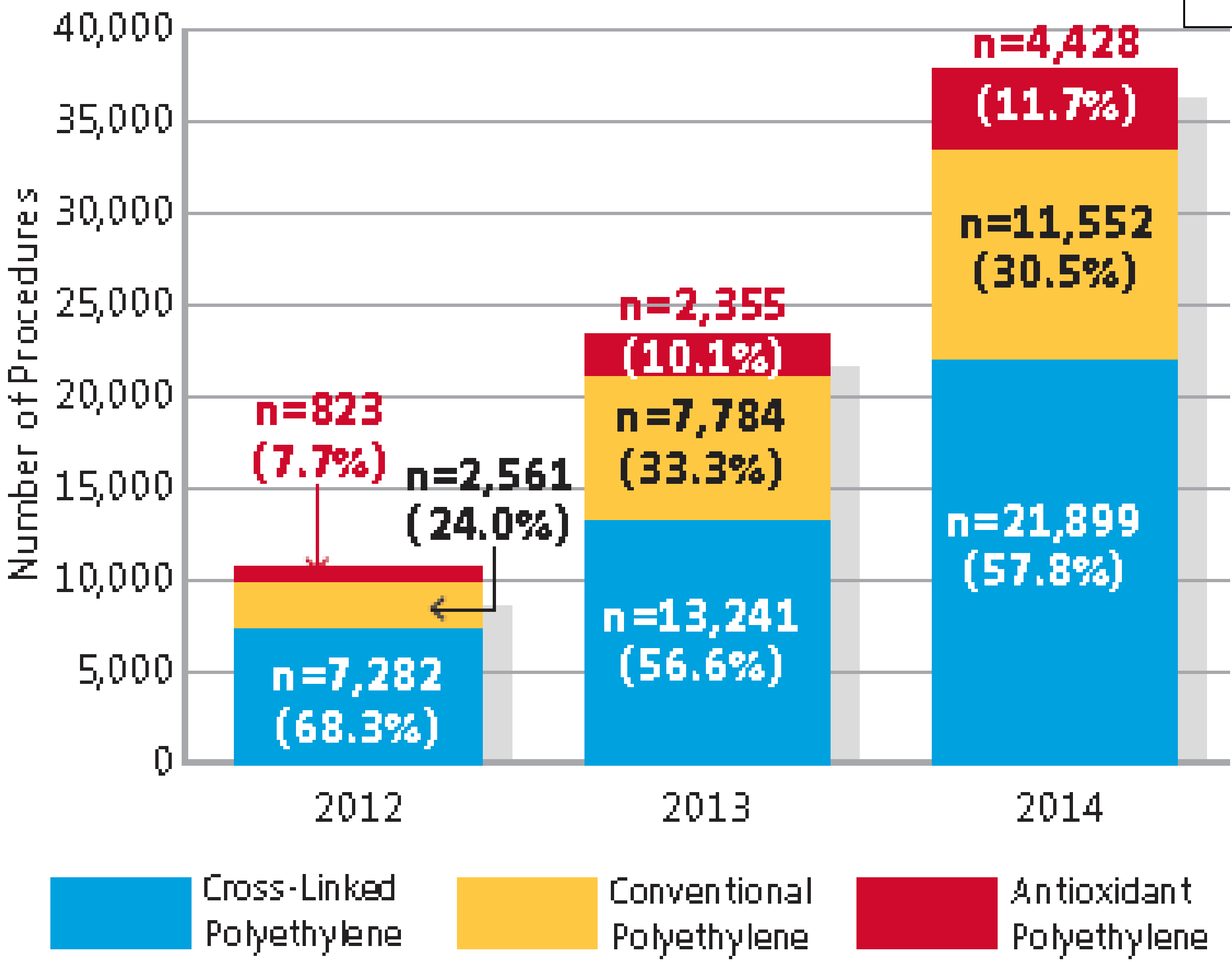
TABLE 3. Analysis Factors and Their Influence on Linear Wear Rate

Factor	Change in Wear Rate (mm/year)	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound	r^2 Change with Additional Factor	p Value
Terminal sterilization with gamma-irradiation versus a noncross-linking gas-plasma chemical surface treatment	−0.085	−0.107	−0.063	0.118	<0.001
One-year increase in age at surgery	−0.003	−0.004	−0.002	0.052	<0.001
One-year increase in shelf life of gamma-in-air-sterilized Hylamer liners	+0.064	+0.039	+0.088	0.027	<0.001
Unit increase in body mass index	−0.003	−0.005	−0.002	0.021	<0.001
Increasing PE thickness by 1 mm	+0.006	+0.002	+0.009	0.020	0.001
Ceramic instead of CoCr femoral head	−0.032	−0.054	−0.009	0.012	0.005
Preoperative diagnosis of inflammatory arthritis instead of osteoarthritis	−0.046	−0.083	−0.010	0.008	0.01
One-year increase in shelf life of gamma-in-air-sterilized Enduron liners	+0.014	+0.001	+0.026	0.006	0.03
Male instead of female	NS			N/A	0.07
Using a Duraloc 1200 instead of a 100 cup	NS			N/A	0.16
Using Hylamer instead of Enduron	NS			N/A	0.22
Using a +4 mm lateralized linear instead of a neutral liner	NS			N/A	0.28
Gamma sterilization in barrier packaging instead of air	NS			N/A	0.30
Increasing radiographic follow-up by 1 year	NS			N/A	0.35
Using a lipped liner instead of a neutral liner	NS			N/A	0.41
Increasing cup abduction angle by 1°	NS			N/A	0.45
Using a 28-mm head instead of a 32-mm head	NS			N/A	0.50
Using a nonmodular 1-piece cup instead of a Duraloc 100 cup	NS			N/A	0.54
Using a lateral instead of a posterior approach	NS			N/A	0.55
Surgeon 2 instead of Surgeon 1	NS			N/A	0.68
Preoperative diagnosis of osteonecrosis instead of osteoarthritis	NS			N/A	0.77
Using a low (1.8–2.5 Mrad) dosage instead of standard (2.5–4.0 Mrad) dosage for gamma-barrier sterilization	NS			N/A	0.77
Preoperative diagnosis of trauma instead of osteoarthritis	NS			N/A	0.91
Preoperative diagnosis of hip dysplasia instead of osteoarthritis	NS			N/A	0.93
Increasing patient's body weight by 1 kilogram	NS			N/A	0.97

NS = Not significant, N/A = Not applicable; *Positive values indicate factors that increase the wear rate, whereas negative values designate factors that decreases the wear rate

HEAD MATERIAL WAS ONLY THE 6th MOST IMPORTANT FACTOR AND IT EXPLAINED APPROXIMATELY 1% OF THE VARIABILITY IN CLINICAL PENETRATION RATE

Figure 24: Polyethylene Usage in Acetabular Liners (N=71,925)

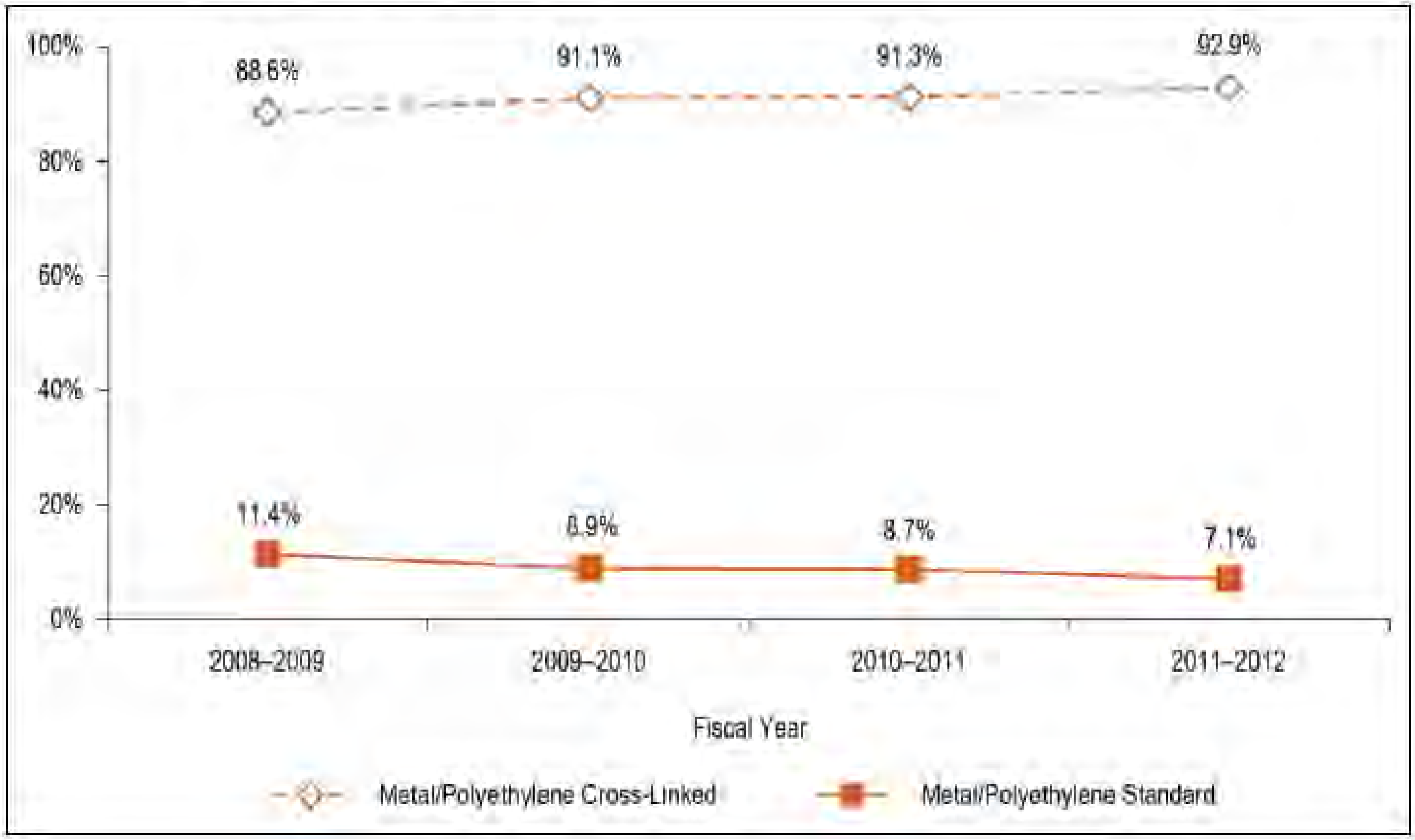


AJRR American Joint Replacement Registry

Improving Orthopaedic Care Through Data

Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry 2015 Annual Report

Figure 20: Types of Metal-on-Polyethylene Bearing Surfaces for Hip Replacements, 2008–2009 to 2011–2012



Notes

The denominator for percentage calculations excludes records that have no information available on bearing surfaces.

Bearing surfaces were as reported by data submitters.

Source

Canadian Joint Replacement Registry, 2008–2009 to 2011–2012, Canadian Institute for Health Information.

Percentage of total hip arthroplasty interventions between 2001 and 2013, according to the **type of polyethylene** used.

Year of surgery	Primary surgery		
	Standard poly	Crosslinked poly	Not defined poly
2001	80,0	16,1	3,8
2002	83,6	14,6	1,8
2003	82,4	16,5	1,1
2004	79,1	20,4	0,5
2005	76,4	22,6	1,0
2006	75,5	24,3	0,2
2007	71,7	28,1	0,2
2008	64,8	35,0	[illegible]
2009	55,1	44,9	
2010	46,7	53,3	
2011	42,0	58,0	
2012	25,6	74,4	
2013	25,8	74,2	

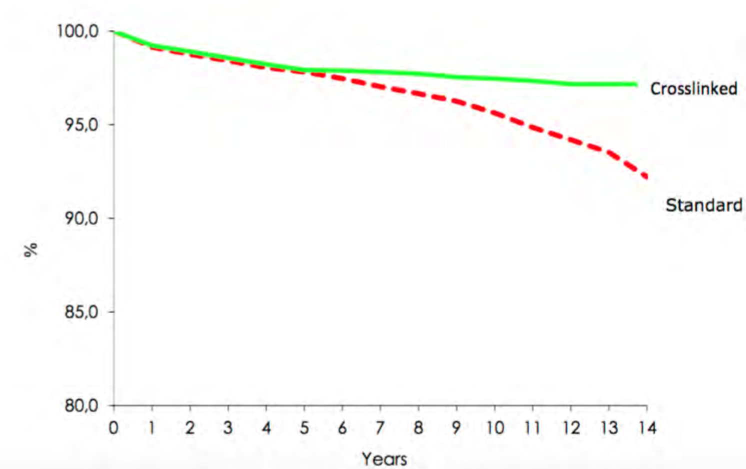
* missing label did not allow classification of poly

R.I.P.O.
Registro Implantologia Protesica Ortopedica

9.9 Analysis of survival in primary total hip arthroplasty according to types of polyethylene

Polyethylene	N.	n. revisions	% survival 14 yrs	c.I at 95%
Standard	20654	700	92,2	90,9-93,5
Cross linked	9463	150	97,2	96,5-97,8

Survival curve



Lubricants **2015**, *3*, 413-436; doi:10.3390/lubricants3020413

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Review

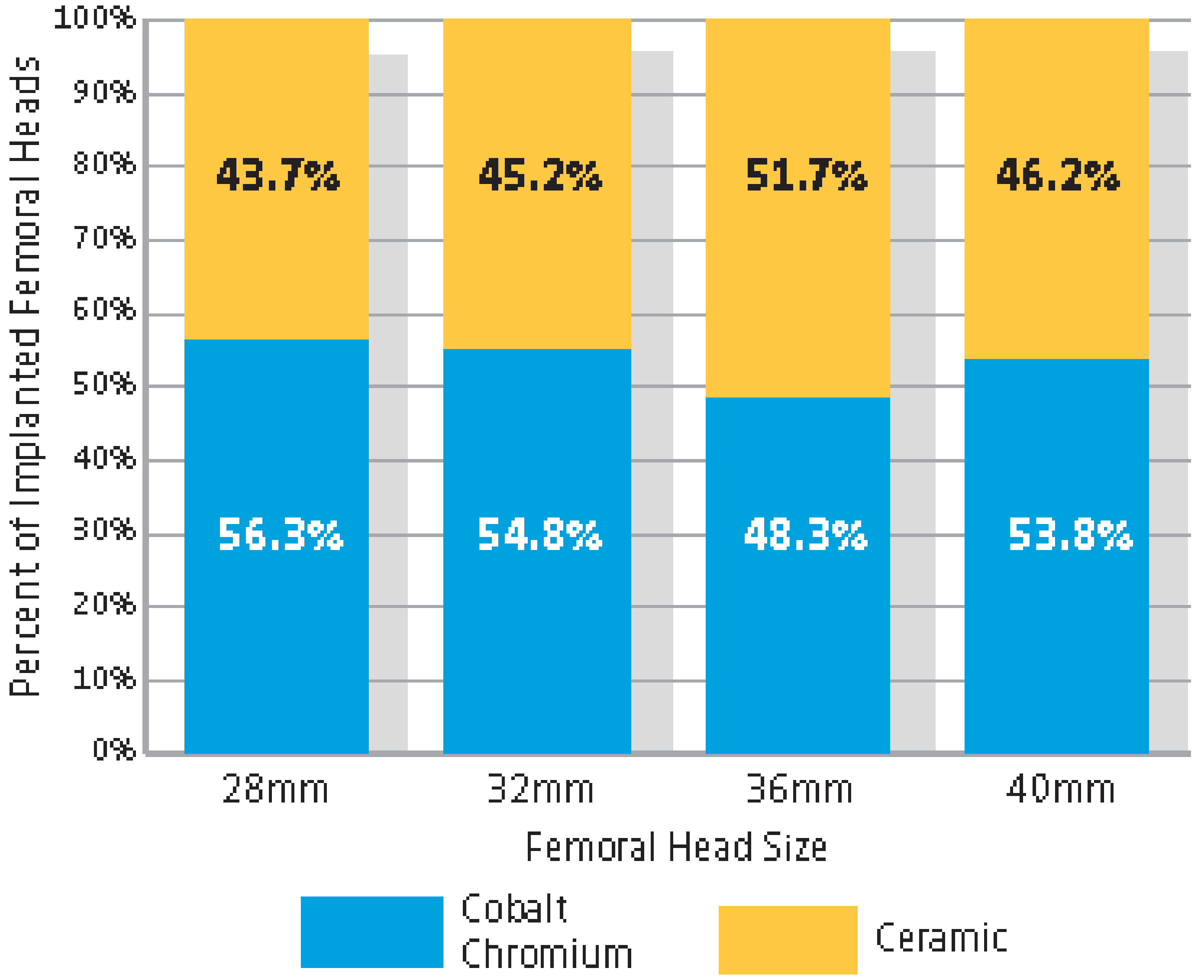
Wear Performance of UHMWPE and Reinforced UHMWPE Composites in Arthroplasty Applications: A Review

Juan C. Baena *, Jingping Wu and Zhongxiao Peng

School of Mechanical and Manufacturing Engineering, The University of New South Wales, Sydney NSW 2052, Australia; E-Mails: j.p.wu@unsw.edu.au (J.W.); z.peng@unsw.edu.au (Z.P.)

performance of the material so its service life can be further extended. This paper has reviewed reported methods for improving the mechanical properties through creating a cross-linked structure, using an irradiation process with and without vitamin E, and by adding micron or nano-particles. Surface engineering techniques for the improvement of the lubrication conditions are also reviewed. Existing studies have demonstrated that cross-linked UHMWPE by gamma radiation is an effective way to significantly improve the wear resistance of the material from a wear rate of about 20 mm^3 per million cycles of untreated material to close to a zero wear rate for gamma radiated to 280 kGy. Including fillers can also improve the mechanical properties and wear resistance. However, the reported improvement varies from 25% to 86% depending on different filler materials, their concentrations and/or directions. Similarly, according to the reported results, surface modifications can improve the wear resistance from 30% for the surface coating of diamond like carbon to 90% using ion beam surface modification method. As wear

Figure 22: **Composition of Femoral Heads by Size (N=74,833)**



Year of surgery	Diameter of the head (mm) in THA					
	<=28 cer	<=28 met	32 cer	32 met	>=36 cer	>=36 met
2000	44,0	52,3	1,1	1,4	0,0	1,2
2001	49,3	48,2	0,7	0,4	0,0	1,5
2002	52,1	46,1	0,9	0,1	0,0	0,8
2003	50,9	46,7	0,9	0,1	0,3	1,2
2004	51,1	41,6	3,2	0,6	1,3	2,2
2005	34,1	38,2	16,7	1,6	5,5	4,0
2006	23,3	33,6	19,0	2,0	14,9	7,3
2007	15,9	28,5	20,7	3,9	21,9	9,2
2008	14,4	21,8	20,5	3,7	29,7	9,9
2009	11,6	17,6	21,7	3,1	36,9	9,2
2010	8,6	10,2	24,1	4,7	44,8	7,7
2011	6,5	8,3	28,1	4,9	47,3	5,0
2012	7,0	5,5	29,1	3,8	51,6	3,1
2013	6,2	5,2	30,8	2,8	52,2	2,8

Heads made of alumina and biolox delta are marked with the initials "cer"; heads made of cobalt-based alloy and stainless steel are marked with the initials "met".

Orthopaedics & Traumatology: Surgery & Research 100 (2014) S317–S321

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Review article

Does Biolox® Delta ceramic reduce the rate of component fractures in total hip replacement?

P. Massin[a,*], R. Lopes[b], B. Masson[c], D. Mainard[d], the French Hip & Knee Society (SFHG)[e]

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[b] Hôtel-Dieu, université de Nantes, 1, place Alexis-Ricordeau, 44093 Nantes cedex 1, France
[c] 18, rue des Potiers, 31320 Vieille-Toulouse, France
[d] Université de Lorraine, hôpital Central, 29, avenue de Lattre-de-Tassigny, 54035 Nancy, France
[e] 56, rue Boissonade, 75014 Paris, France

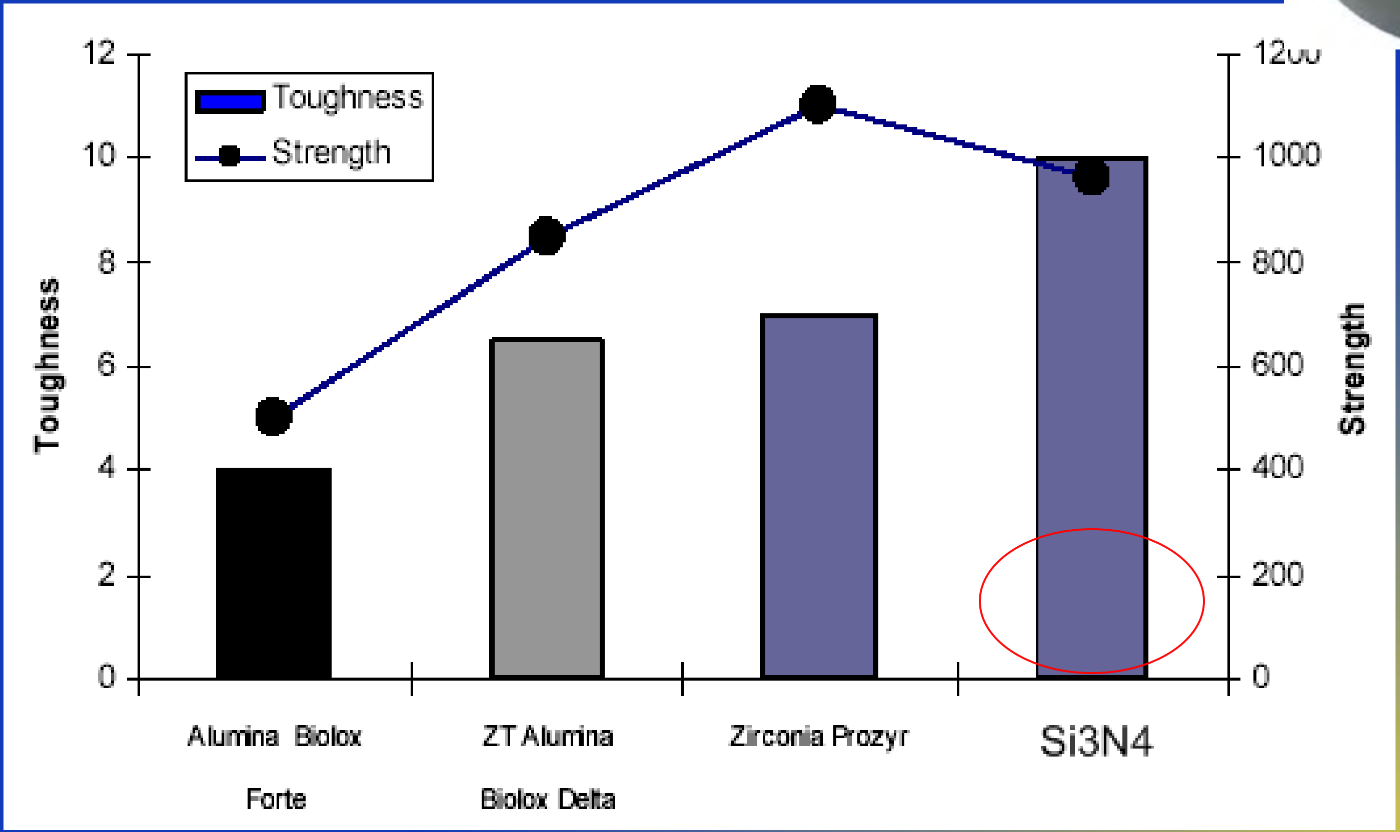
Fracture rate of third and fourth generation ceramic heads and liners from the manufacturer and the ANSM.

	Third generation		Forth generation	
	Liner	Head	Liner	Head
Manufacturer (%)	0.032	0.021	0.028	0.002
ANSM (%)	0.086	0.18	0.025	0.0013

ANSM: Agence nationale de sécurité du médicament et des produits de santé (National Agency for Safety of Drugs and Medical Products).

vs alumina 0,021%

Mechanical Properties



Excellent combination of strength and toughness

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Journal of Orthopaedic Research 22 (2004) 250–259

Journal of Orthopaedic Research

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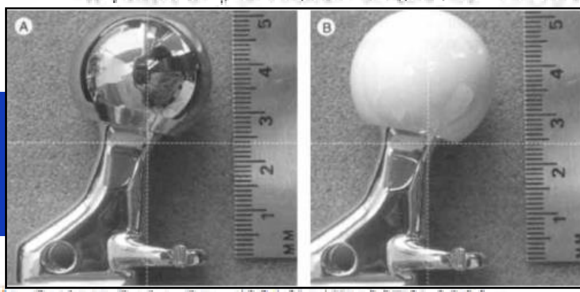
Differences in the fretting corrosion of metal–metal and ceramic–metal modular junctions of total hip replacements

Nadim James Hallab *, Carlo Messina, Anastasia Skipor, Joshua J. Jacobs

Department of Orthopedic Surgery, Rush Presbyterian St. Lukes Medical Center, 1653 W. Congress Parkway, Chicago, IL 60612, USA



risk of adverse local tissue reactions [3, 8, 16–18]. Our results suggest that by using a ceramic femoral head, Co and Cr fretting and corrosion from the modular head-neck taper may be mitigated, although not completely eliminated. However, implant component selection is but one

Clin Orthop Relat Res (2013) 471:3270–3282
DOI 10.1007/s11999-013-3096-2

Clinical Orthopaedics and Related Research®
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BASIC RESEARCH

Do Ceramic Femoral Heads Reduce Taper Fretting Corrosion in Hip Arthroplasty? A Retrieval Study

Steven M. Kurtz PhD, Sevi B. Kocagöz BS, Josa A. Hanzlik MS, Richard J. Underwood PhD, Jeremy L. Gilbert PhD, Daniel W. MacDonald MS, Gwo-Chin Lee MD, Michael A. Mont MD, Matthew J. Kraay MD, Gregg R. Klein MD, Javad Parvizi MD, Clare M. Rimnac PhD

ECONOMIC FEATURES

CONCLUSIONS

IS THERE ANY
EVIDENCE
THAT CERAMIC ON
POLY IS
BETTER THAN METAL
ON POLY?

NO, THERE IS NOT

INTERNATIONAL COMBINED MEETING

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SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

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Under the Patronage of

What to do in case of breakage?

Luigi Zagra

ISTITUTO ORTOPEDICO GALEAZZI
Istituto di Ricovero e Cura a Carattere Scientifico
Milan, Italy

Disclosure

- *Lima Corporate: grants for educational activity and research funds to the Hospital Department*
- *CeramTec, Biomet and DePuy: travelling and accommodation costs and grants for educational events*
- *Zimmer: travelling and accommodation costs for meetings*

Ceramic breakage is still a reason of concern, as revision in case of ceramic fracture has been affected by poor results and severe complications due to third body wear, caused by ceramic fragments.

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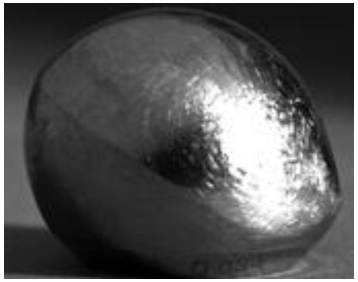
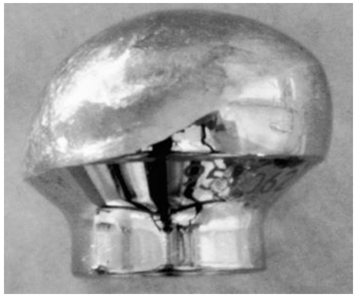
- Sharma, *Orthopaedics*, 2013





In vivo fracture rates of ceramic

(1/2003 – 6/2015)

Heads

- BIOLOX® *Forte*:
  21 per 100,000 (**0.021%**)
- BIOLOX® *Delta*:
  1 per 100,000 (**0.001%**)

Liners

- BIOLOX® *Forte*:
  46 per 100,000 (**0.046%**)
- BIOLOX® *Delta*:
  22 per 100,000 (**0.021%**)

(*CeramTec* data 2015)

Published data

Heads

- Occasional occurrence of case reports

Liners

- 0.013% - 1.1%

D'Antonio *Journal of American Academy Orthop Surg*, 17:63-68 (2009)

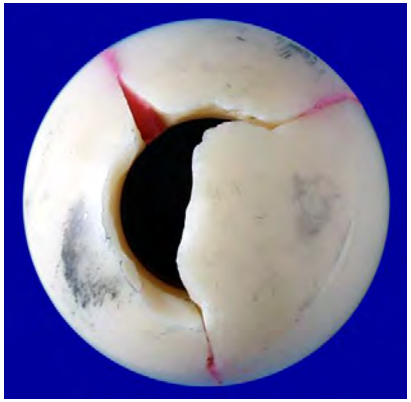
Hamilton *Clin Orthop Rel Res* 468:358-66 (2010)

The head

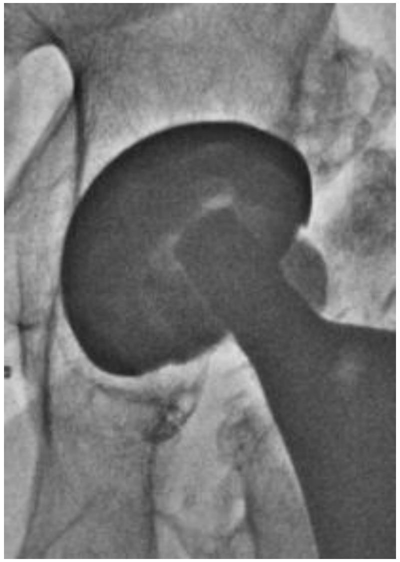
- Impact (very rare)
- Fatigue (conical coupling mismatch, scratches on the taper, third body)

Dalla Pria P, Zagra L Breakage and noises in ceramic on ceramic couplings. *Eur Orthop Traumatol*, 1:53-59 (2010)

The head



- The breakage is sudden and complete, noisy
- The patient immediately realizes that something has happened
- Clear evidence in X-rays



Dalla Pria P, Zagra L Breakage and noises in ceramic on ceramic couplings.
Eur Orthop Traumatol, 1:53-59 (2010)

The head

BioMed Research International
Volume 2013, Article ID 157247, 8 pages

Review Article

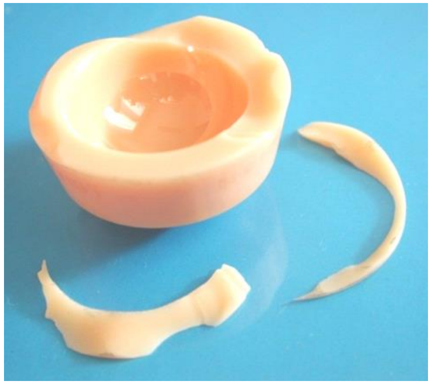
Fracture of Ceramic Bearing Surfaces following Total Hip Replacement: A Systematic Review

Francesco Traina,[1] Marcello De Fine,[1] Alberto Di Martino,[1,2] and Cesare Faldini[1]

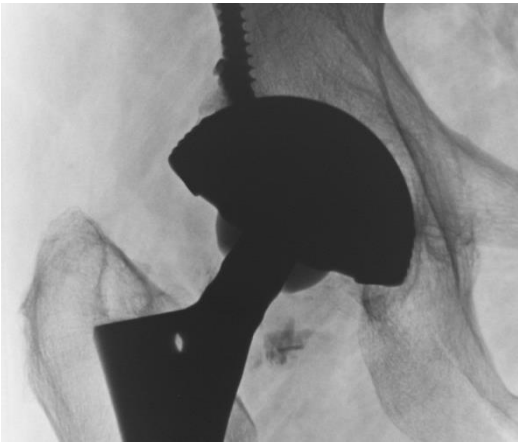
The only risk factor:

28 mm head with short neck

The liner

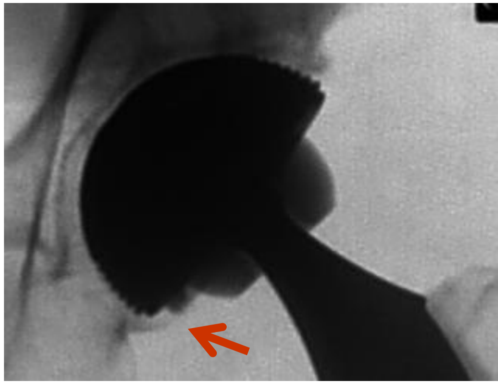


- Never related to trauma
- Subtle and underestimated event
- Not felt by the patient in the first stages
- Difficult to be detected on X-rays
- Can cause a secondary fracture of the head



Dalla Pria P, Zagra L Breakage and noises in ceramic on ceramic couplings. *Eur Orthop Traumatol*, 1:53-59 (2010)

The liner



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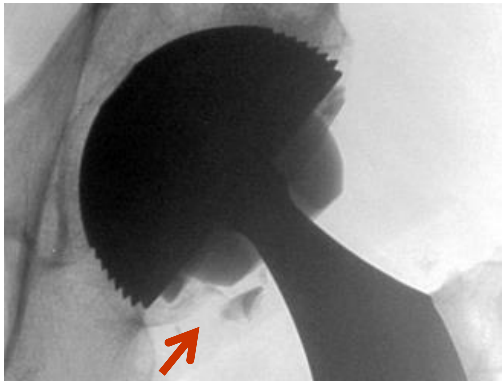
Fracture of Ceramic Bearing Surfaces following Total Hip Replacement: A Systematic Review

Francesco Traina,[1] Marcello De Fine,[1] Alberto Di Martino,[1,2] and Cesare Faldini[1]



Risk factors:

- Misalignment during insertion or metal back damage
- Cup malposition (impingement and edge loading)

The Journal of Arthroplasty Vol. 27 No. 4 2012

Fracture Propagation Propensity of Ceramic Liners During Impingement-Subluxation

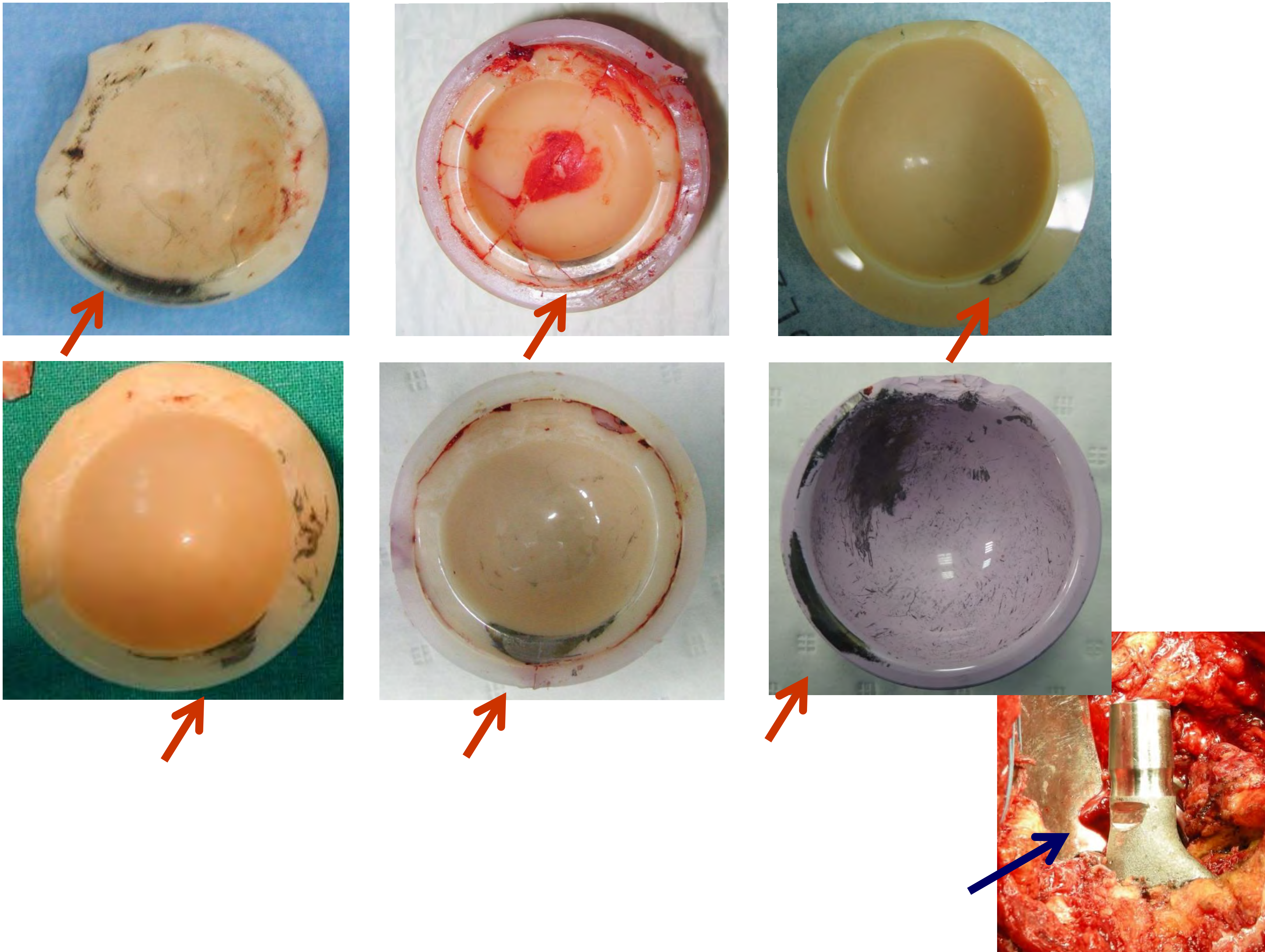
A Finite Element Exploration

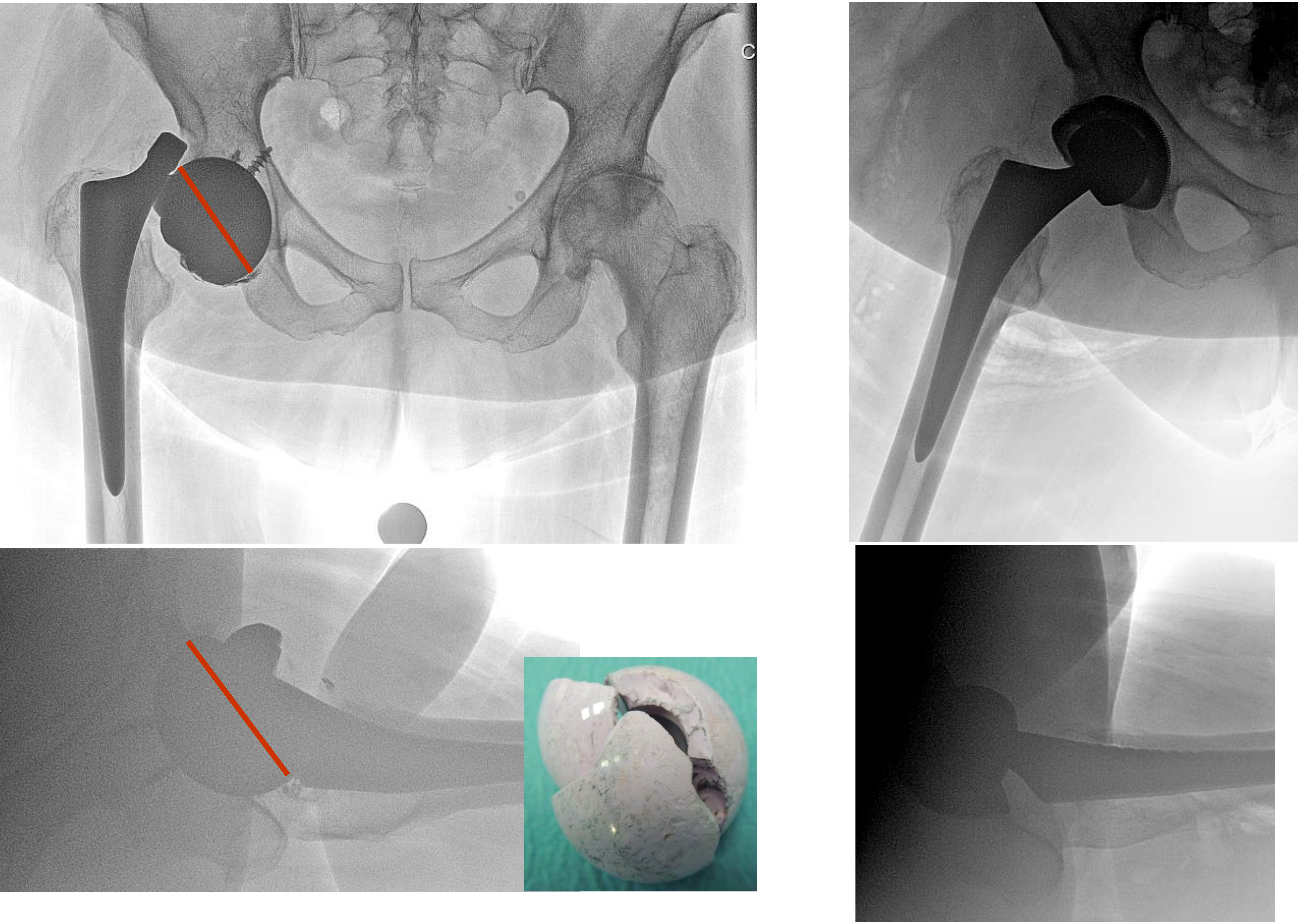
Jacob M. Elkins, MS,*† Douglas R. Pedersen, PhD,*†
John J. Callaghan, MD,*†‡ and Thomas D. Brown, PhD*†

Risk factors for ceramic liner fracture

	Fractured group (26 hips)	Non-fractured group (49 hips)	p
Abduction angle			
mean/range	43,8(25-60,6)	40(20,1-61,9)	0,09
n° cases outside the range (%)	9(34,6%)	14(28,6%)	0,5
Anteversion angle			
mean/range	25,11(3,5-50)	22,06(10,1-48,2)	0,25
n° cases outside the range (%)	13(59,1%)	15(30,6%)	**0,03**
Off-set(mm)			
mean/range	39,4(19,5-60)	36(18,1-49,7)	0,08
Height of the center of rotation(mm)			
mean/range	22(7,5-38,5)	23,8(9,9-48,7)	0,3
n°cases (%)	4(15,4%)	9(18,4%)	0,7

Traina et al. Hip Int 2012; 22(06): 607-14




C

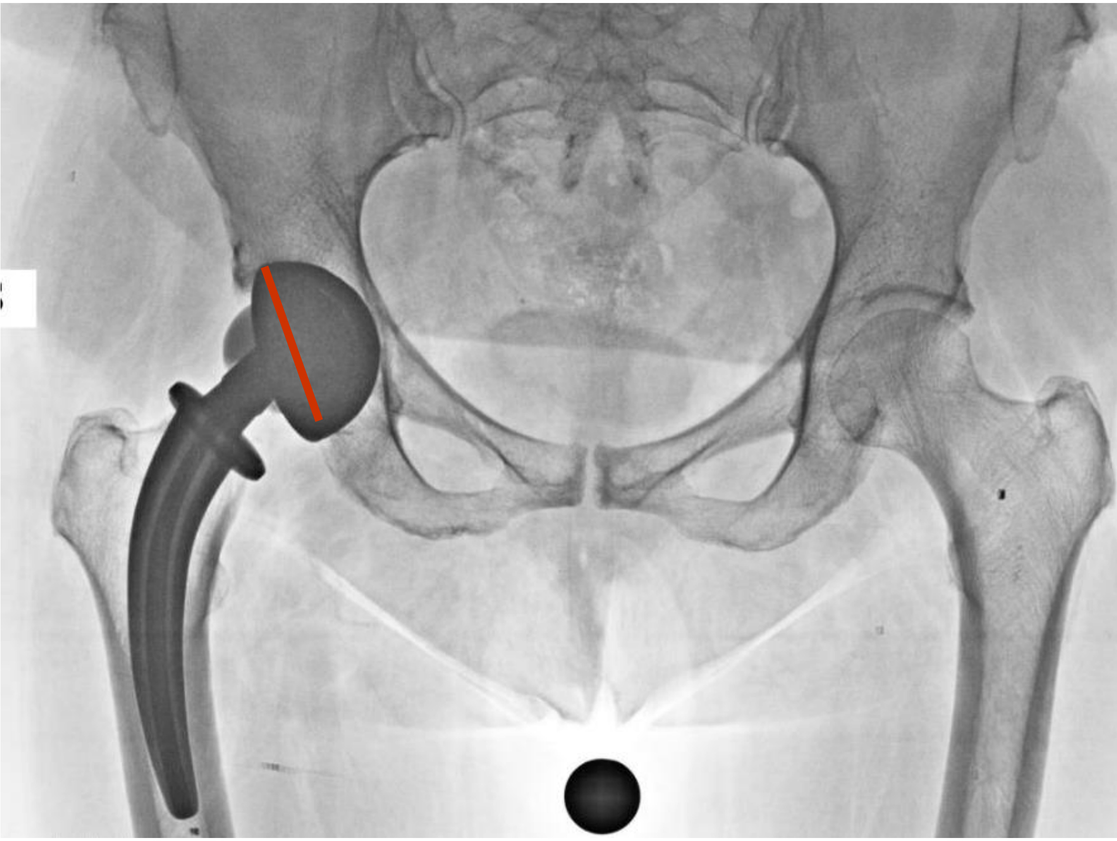
In case of sub-optimal positioning

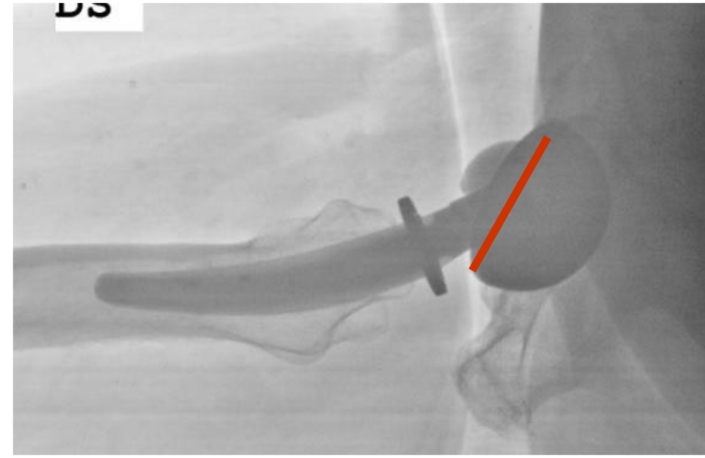
Strict clinical and X-rays f.u.

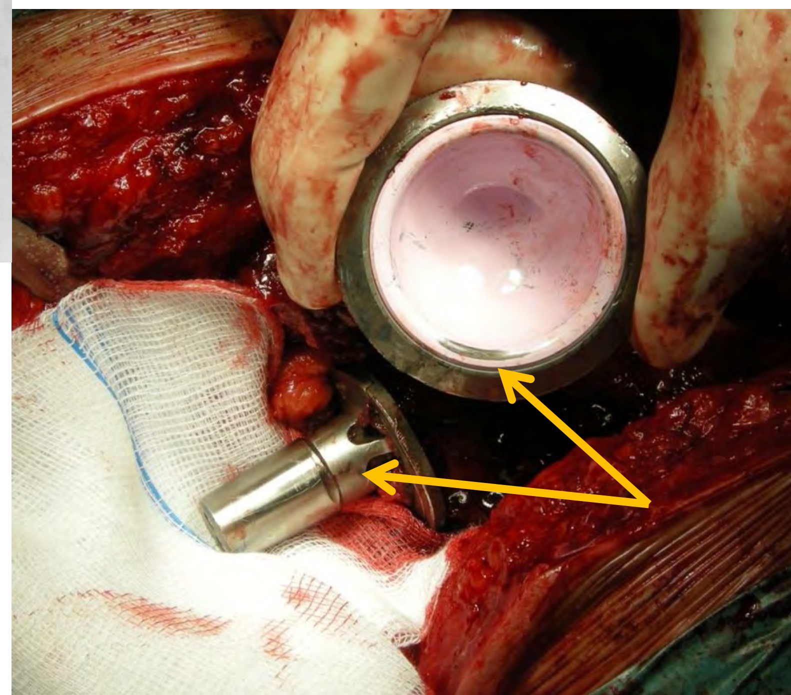
In case of pain, increasing or late noises or doubt

↓

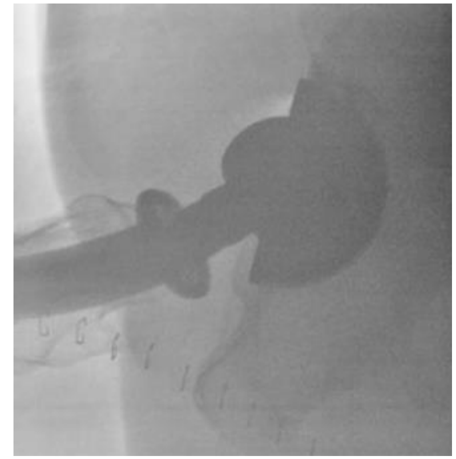
Early revision







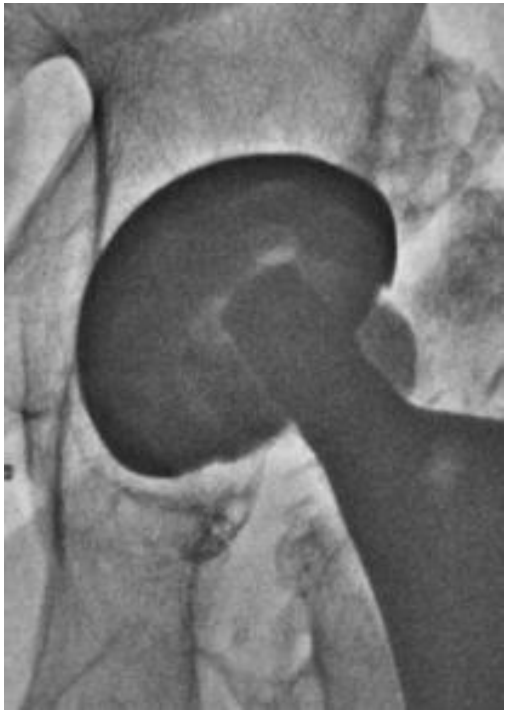
Female, 61 years
1,5 year post op. Pain, hip noises

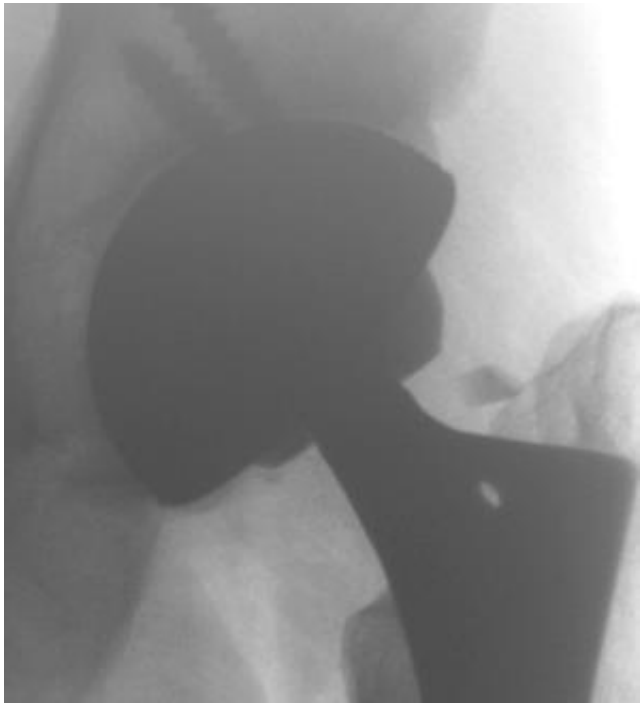


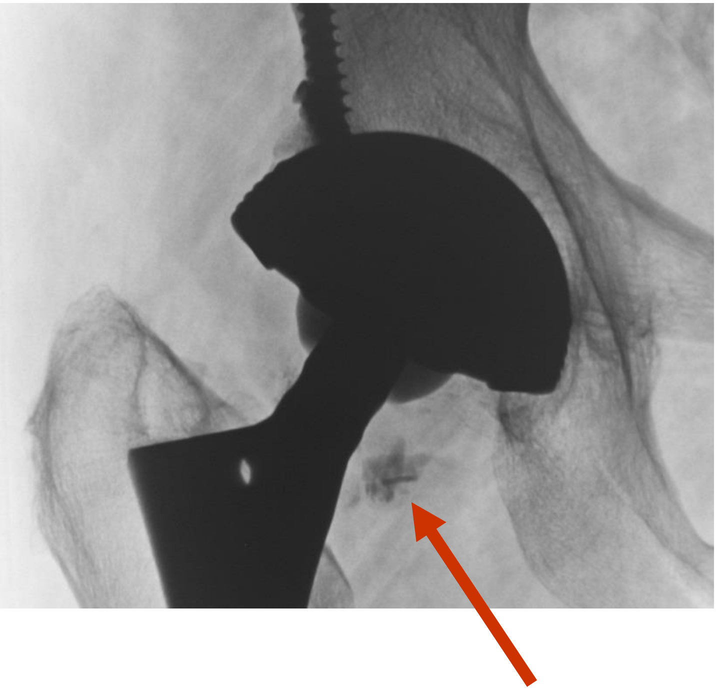
Correct orientation, Cer-XPE, 32 mm Biolox Option

1 year later

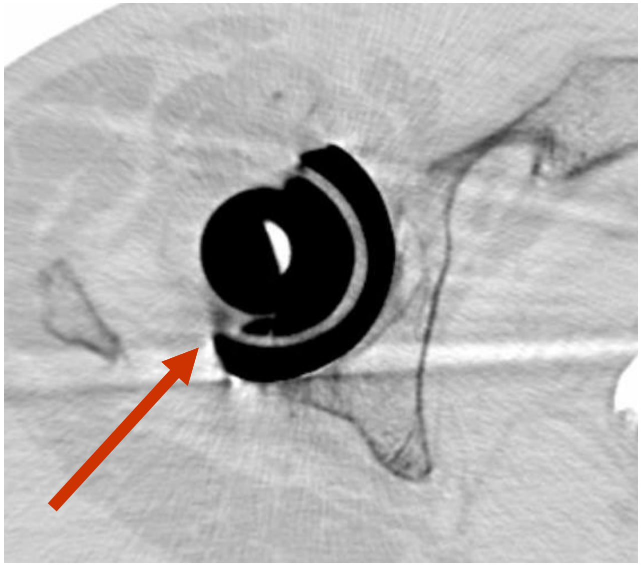
Diagnosis



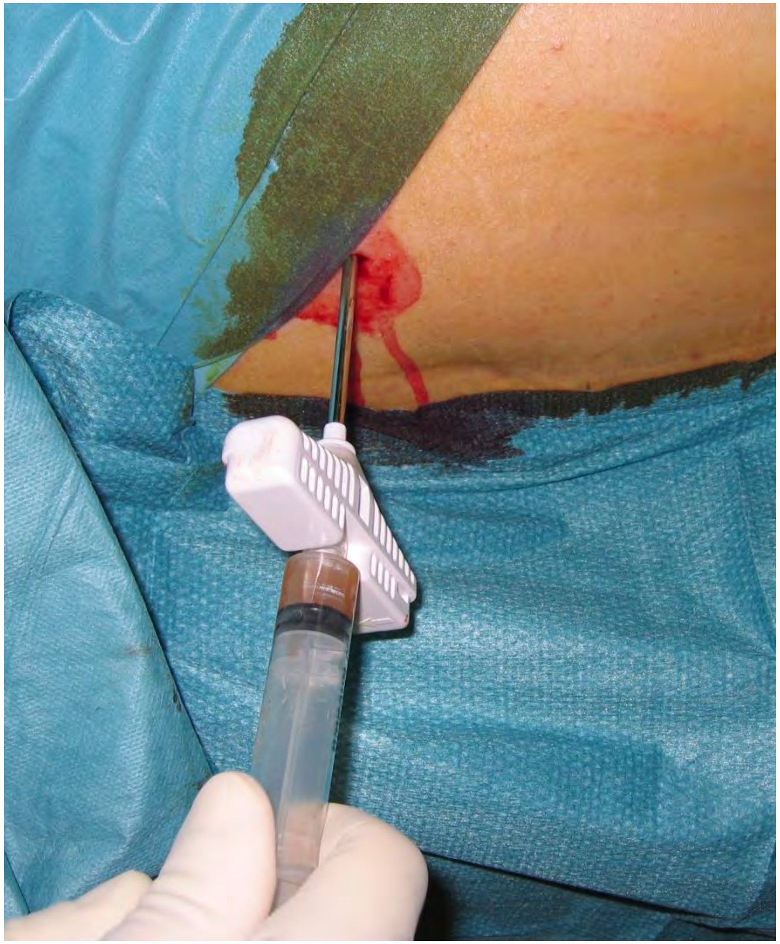




CT scan can be helpful



Joint aspiration
(late noise)



Size and number of particles
(SEM)

THE JOURNAL OF BONE & JOINT SURGERY · JBJS.ORG
VOLUME 88-A · SUPPLEMENT 4 · 2006

EARLY DIAGNOSIS OF CERAMIC LINER FRACTURE

GUIDELINES BASED ON A TWELVE-YEAR CLINICAL EXPERIENCE

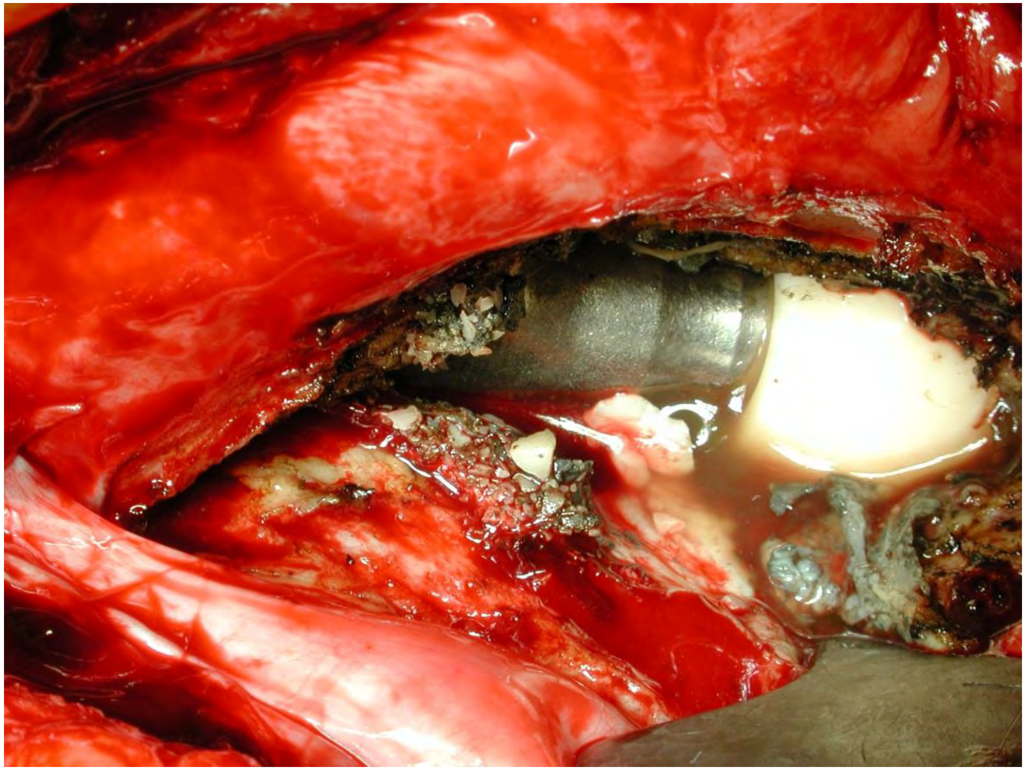
BY ALDO TONI, PHD, FRANCESCO TRAINA, MD, SUSANNA STEA, BSC, ALESSANDRA SUDANESE, MD, MANUELA VISENTIN, BSC, BARBARA BORDINI, MSC, AND STEFANO SQUARZONI, MD

JOURNAL OF ORTHOPAEDIC RESEARCH AUGUST 2012

Synovial Fluid Microanalysis Allows Early Diagnosis of Ceramic Hip Prosthesis Damage

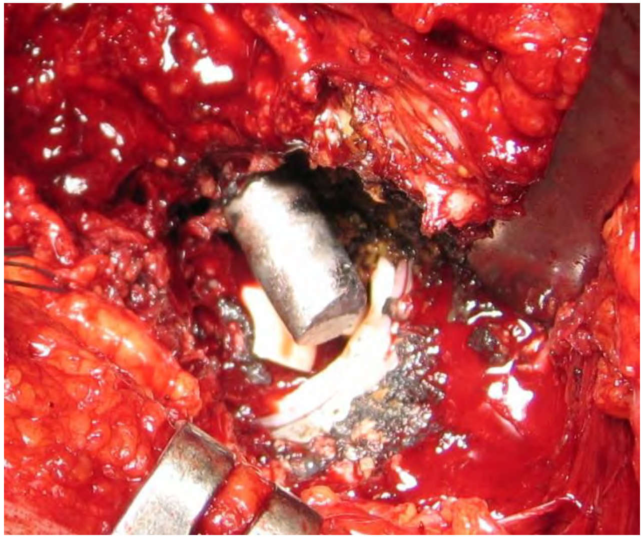
Susanna Stea,[1] Francesco Traina,[2] Alina Beraudi,[1] Monica Montesi,[1] Barbara Bordini,[1] Stefano Squarzoni,[3] Alessandra Sudanese,[2] Aldo Toni[1,2]

IT IS AN EMERGENCY!



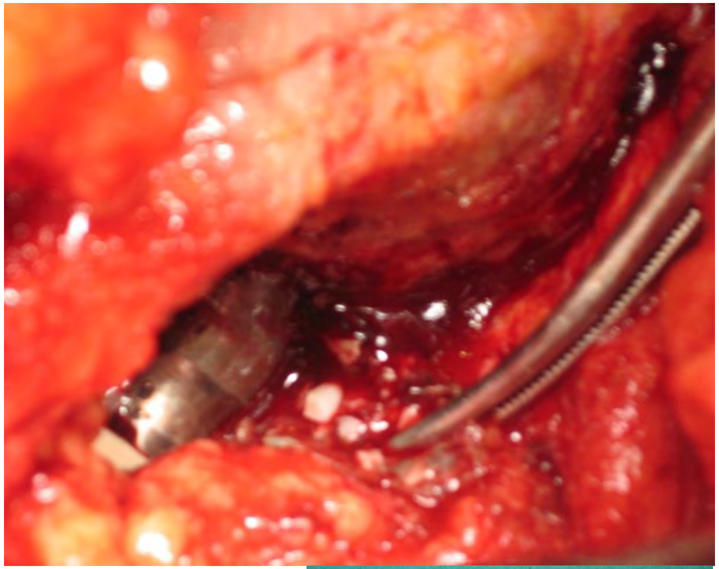
For two main reasons:

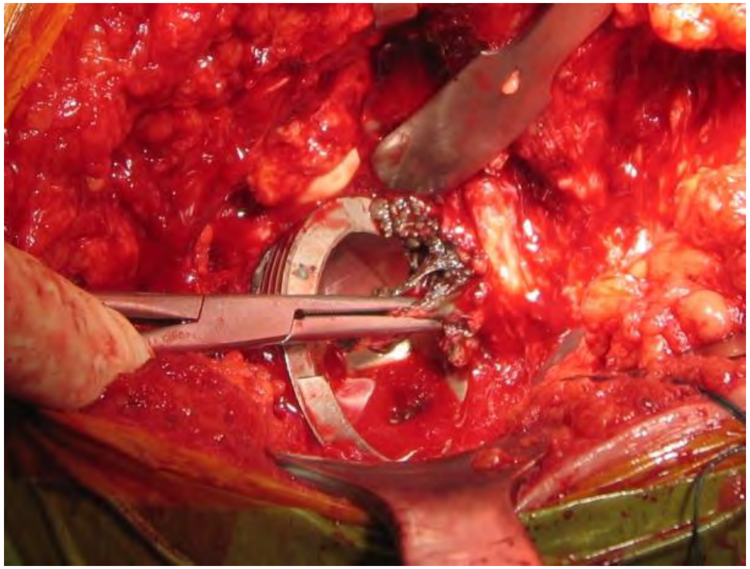
- The ceramic fragments can spread all around the tissues
- The metal components (taper) can be rapidly damaged with metallosis



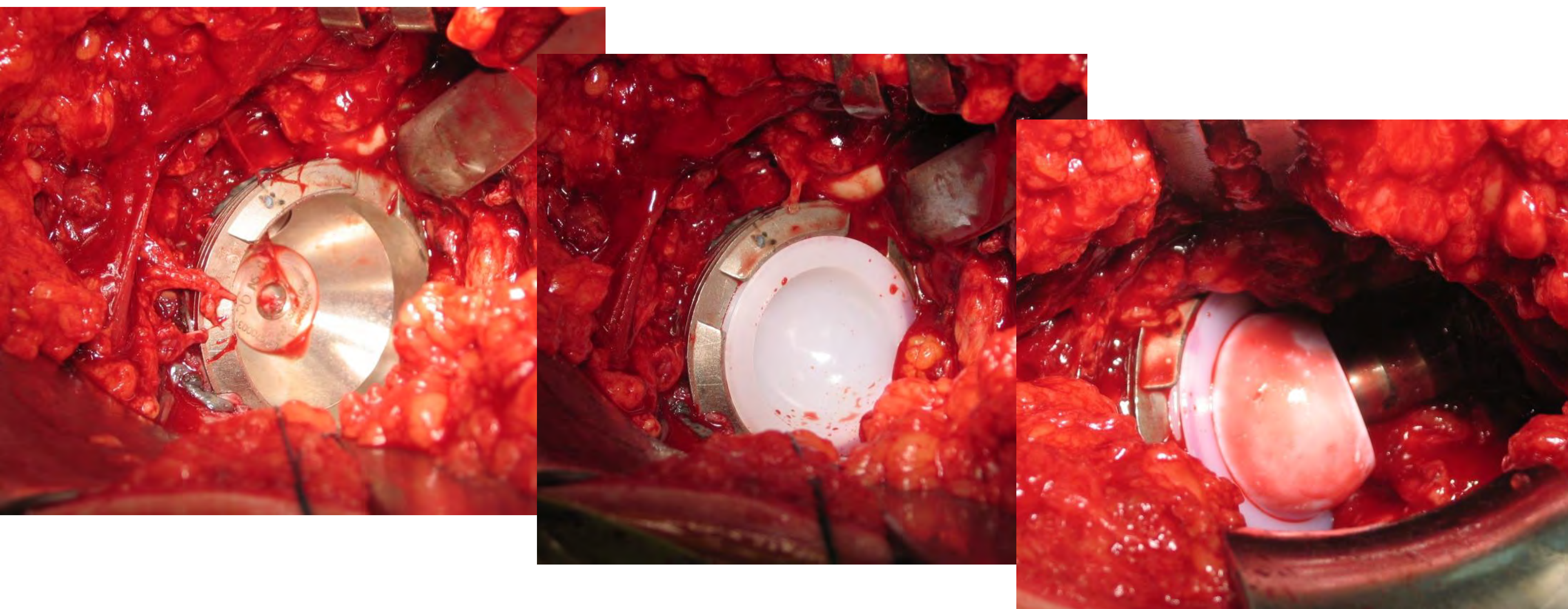
Surgical technique

- Removal of all the visible fragments
- "Aggressive" soft tissue debridement and synoviectomy





- In case of damaged metal back, of malposition or of a new ceramic liner: cup revision
- If the metal back is not damaged: new PE liner
- If the taper has not a major damage: new head on the stable stem



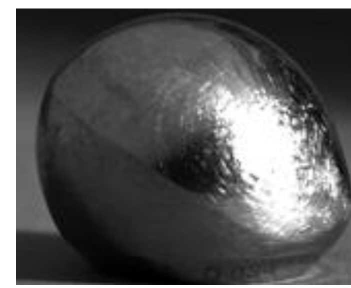
There is no consensus on the bearing of choice after ceramic fracture:

The Journal of Arthroplasty Vol. 25 No. 3 2010

Revision Total Hip Arthroplasty for Ceramic Head Fracture

A Long-Term Follow-Up

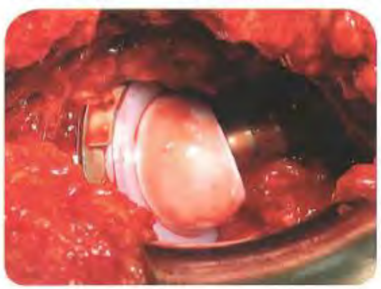
Vineet Sharma, MD, Amar S. Ranawat, MD, Vijay J. Rasquinha, MD, JoAnne Weiskopf, R-PAC, Holly Howard, BA, and Chitranjan S. Ranawat, MD



Metal on Poly

- Gozzini, *Hip Int*, 2002
- Hasegawa, *Acta Orthop*, 2006
- Ikeda, *Muscle Nerve*, 2010
- Sharma, *Orthopaedics*, 2013

Selection of a bearing couple in cases of revision after a fractured ceramic component.



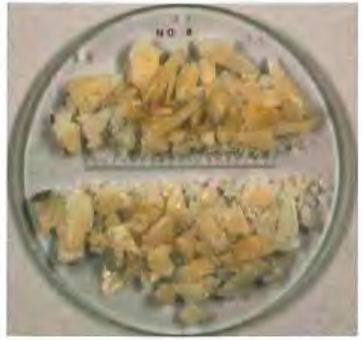


Fig. 1: Ceramic particles inserted between the sliding surfaces during the test

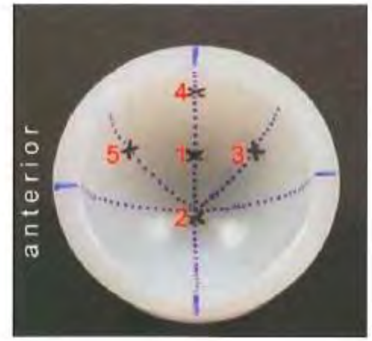


Fig. 2: Points 1–5, ceramic particles were inserted at these points before the start of the test

Fig. 3: Surface of BIOLOX®delta after 5 million cycles

“the use of Met-PE is contra-indicated”

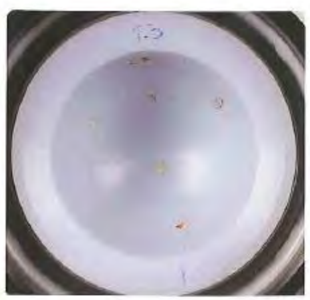
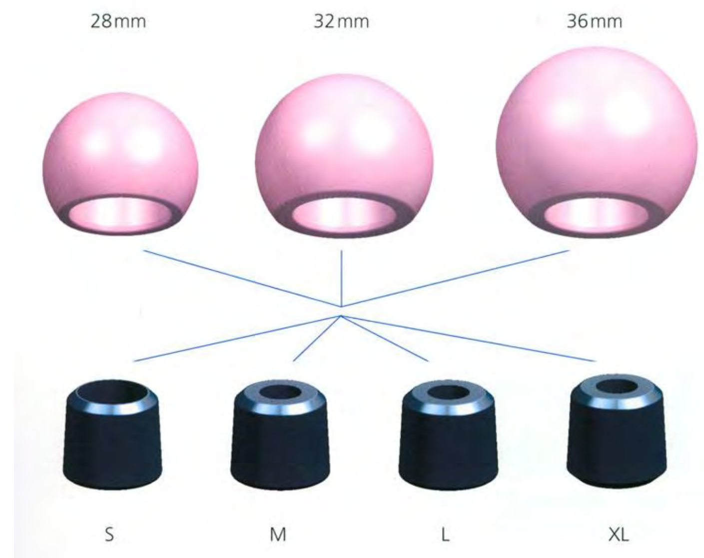


Fig. 4: Surface of XPE insert after 5 million cycles

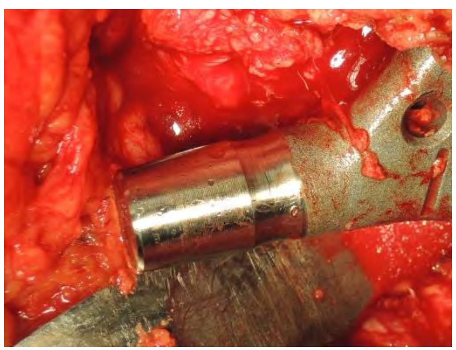
CeramTec
THE CERAMIC EXPERTS

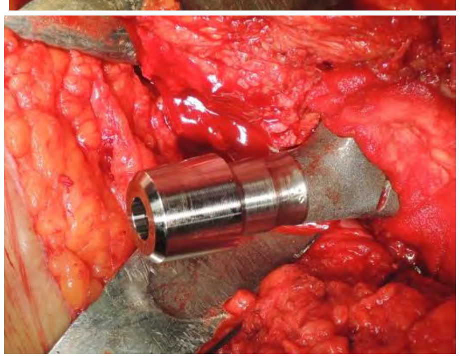
When the stem is retained:

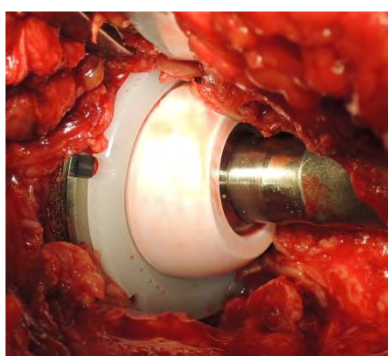
Revision ceramic heads



Biolox Option Delta®







International Orthopaedics (SICOT) (2013) 37:15–19
DOI 10.1007/s00264-012-1735-y

ORIGINAL PAPER

Modular sleeves with ceramic heads in isolated acetabular cup revision in younger patients—laboratory and experimental analysis of suitability and clinical outcomes

Peter Helwig · Lukas Konstantinidis · Anja Hirschmüller · Anke Bernstein · Oliver Hauschild · Norbert P. Südkamp · Björn G. Ochs

There is no consensus on the bearing of choice after ceramic fracture:

J Bone Joint Surg Am. 2011 Dec 21;93(24):e147.

Revision of ceramic hip replacements for fracture of a ceramic component: AAOS exhibit selection.

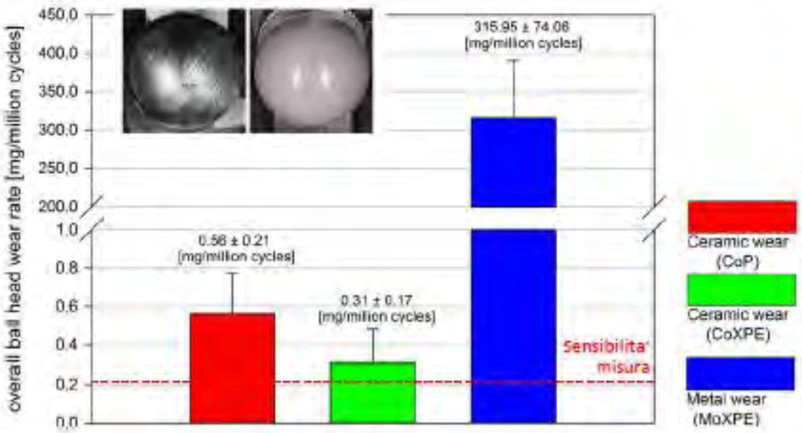
Traina F, Tassinari E, De Fine M, Bordini B, Toni A.
Laboratory for Medical Technology, Department of Hip and Knee Surgery, Rizzoli Orthopaedic Institute, Bologna, Italy. traina@tecno.ior.it

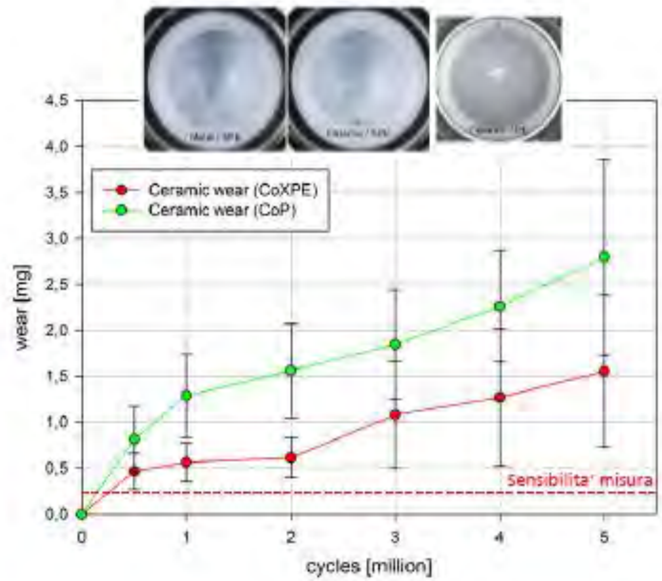
Couple chosen at revision	N. of patients	Average Follow-Up	Results	Case report
 Cer-Cer	30	3,3 Yrs (1-14)	No osteolysis No radiografic failures **93.3% good results**	
 Cer-Pol	2	7,5 Yrs (4-11)	No osteolysis No radiografic failures Both good results	
 Met-Pol	8	6,1 Yrs (4-9)	6 Poly wear + osteolysis 1 revision **87.5% bad results**	

Cer-Cer for the scratch resistance to third body wear

What an Orthopedic Surgeon Should Know: Selection of a Bearing Couple in Case of Revision After a Fractured Ceramic Component

Martin Hintner, MSc,* Christian Kaddick, PhD,* Sylvia Usbeck,† Leslie Scheuber† and Robert M. Streicher, PhD†





CeramTec

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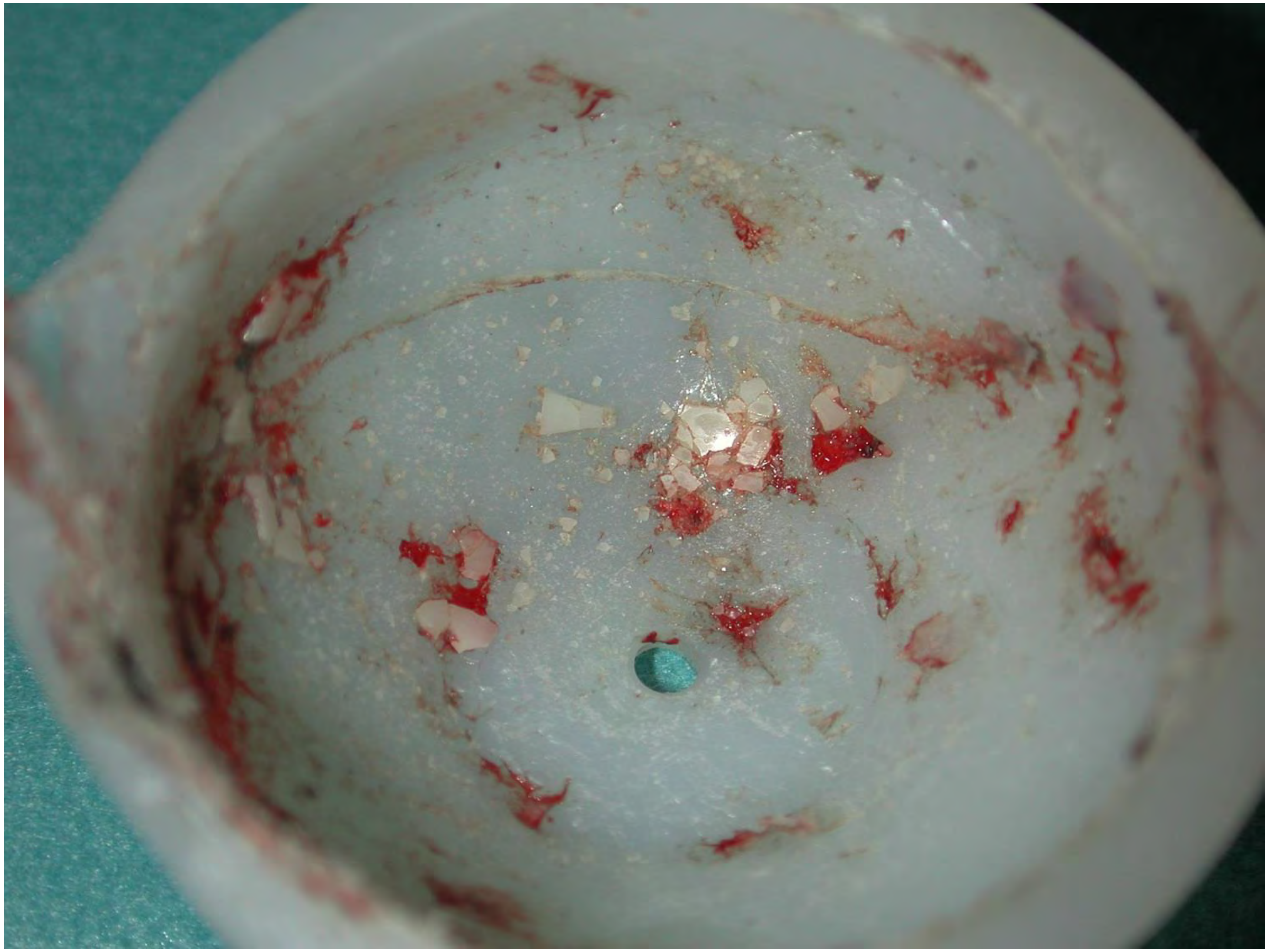
Cer-Poly

Ceramic on Poly

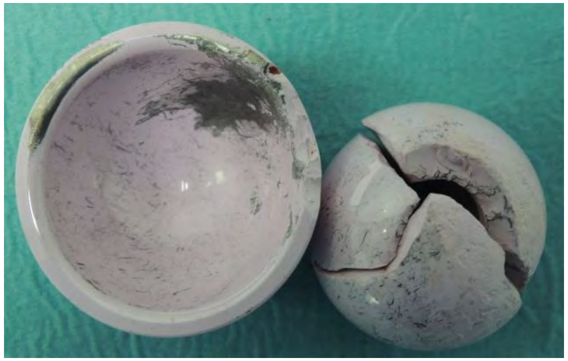


Small ceramic fragments can impact in PE, less damage

Ceramic on Poly

One more good reason:

Do not use a Tribology that already failed!



Materials and methods

Cases report:

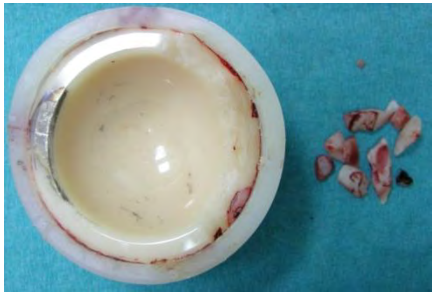
12 patients

revised for ceramic breakage between 2002-2013, with **Cer on PE**

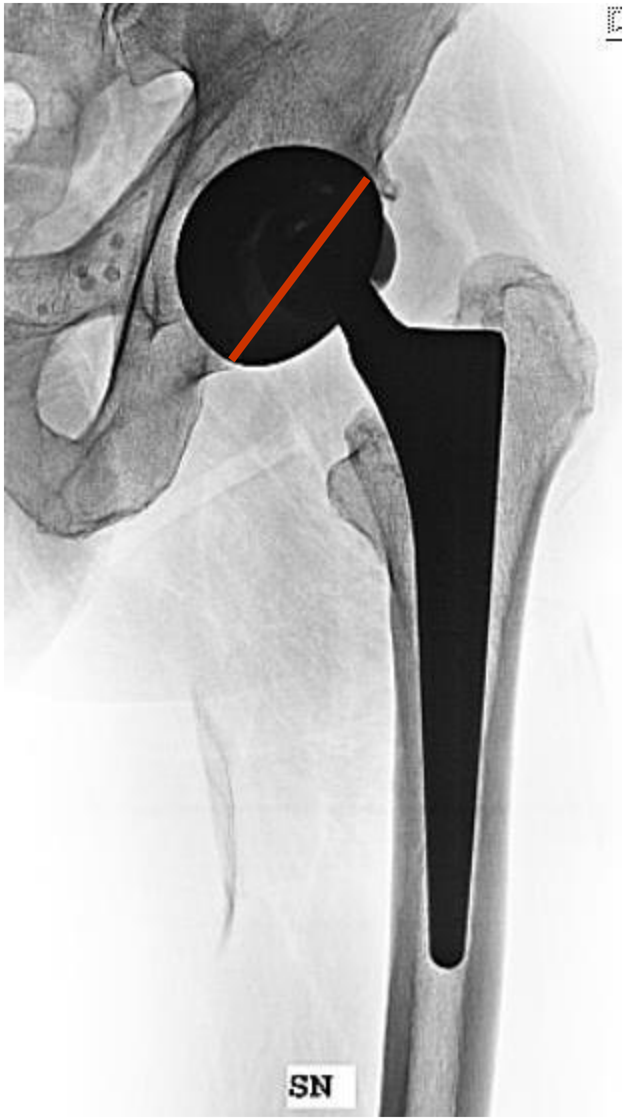
- 7 men and 5 women
- Mean age at revision 66,5 years (38-75)
- Mean of 9.1 (1.5-16) years after the indexed surgery

Breakage

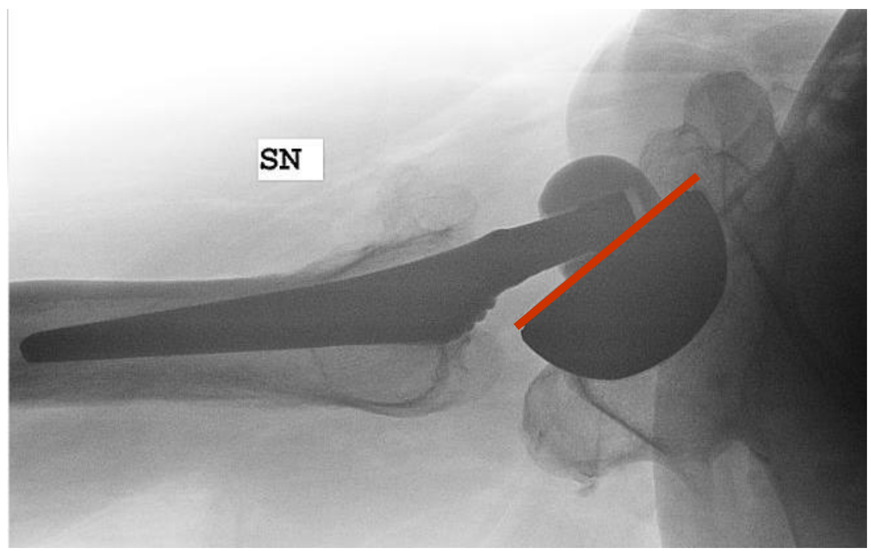
- 11 Biolox Forte, 1 Bionit
- All fractured liners:
  9: PE-cer sandwiches 28 mm,
  1: 32 mm,
  2: 36 mm



- 2 fractures also of head (28, 32 mm)
- 1 massive wear (Bionit, fracture and third body wear, "pseudotumor")

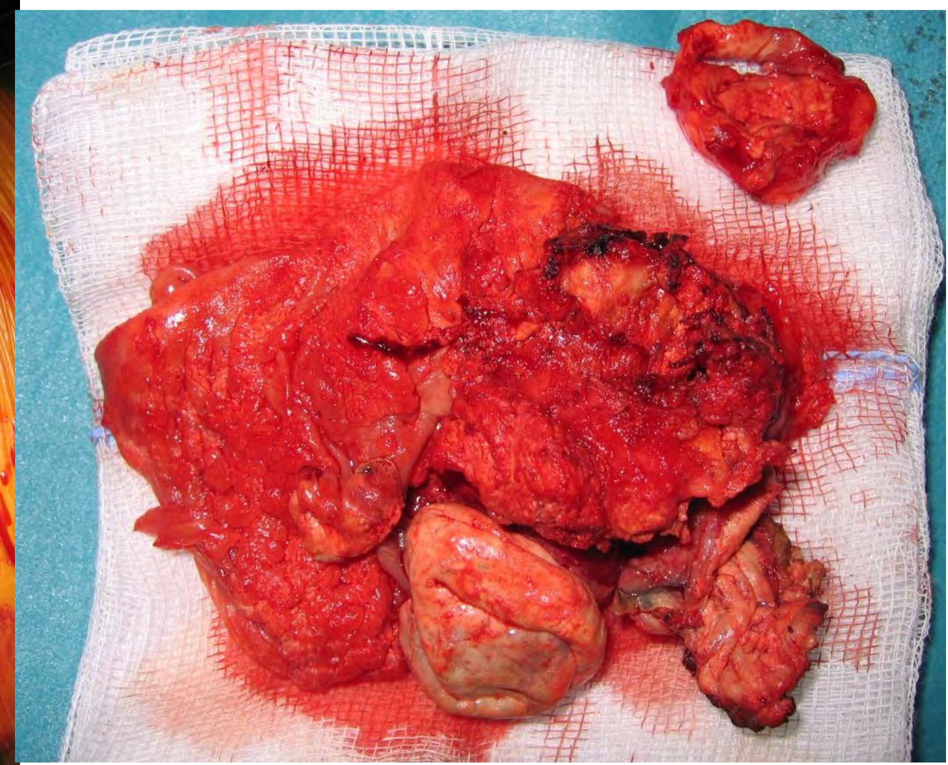


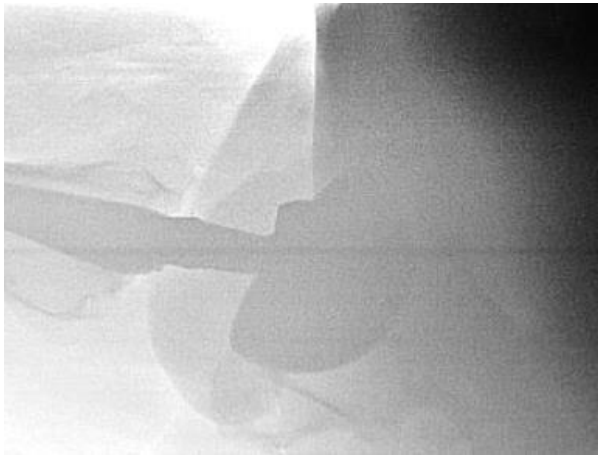
Malposition of the cup
(anteversion and inclination)



Male, 67 years, 36 mm
1,5 year post op. No pain, 2 dislocations





Cup revision: correct orientation, Cer-XPE (Biolox Option)

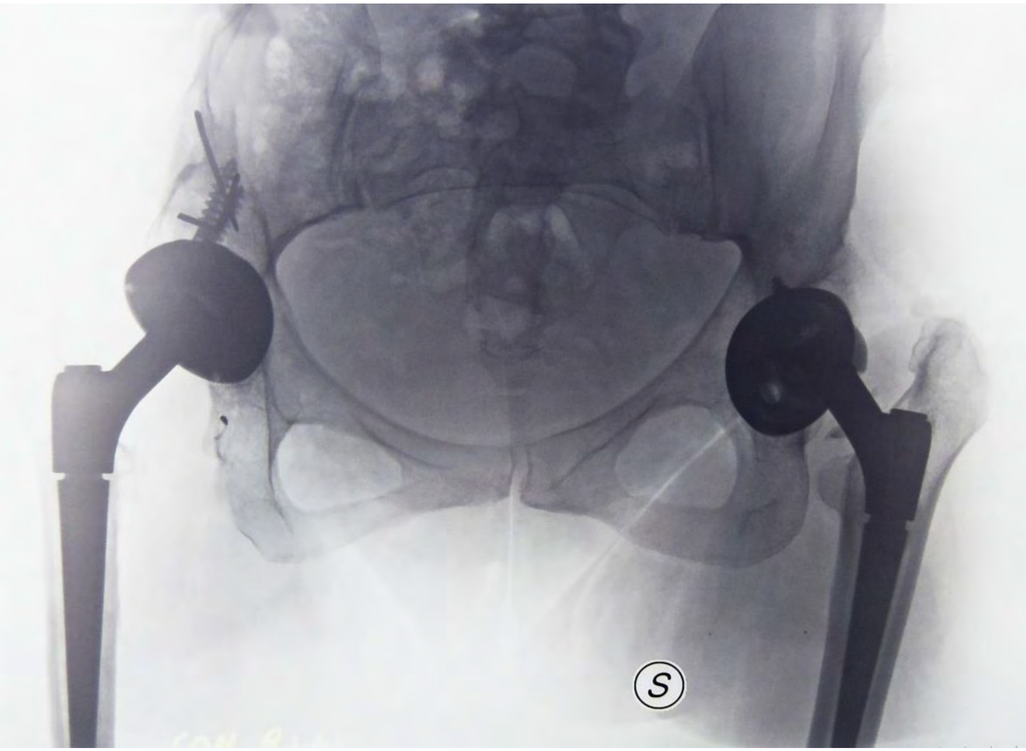
Treatment

- 4 cup revisions:
  (1 malposition, 2 loosening, 1 uncertain stability)
- 8 liner exchanges
  (stable cups)
- In all the cases the head was replaced:
  (no major damage of the cone): 4 Biolox Forte
  8 Biolox Delta Option

Results

Mean f.u. 6,0 years (range 1.5 - 13 years)

- No cases of breakage of the head
- 1 major wear after 9 years (8.3% of failure) (clear malposition)
- No other cases of major osteolysis



Female, 38 years old, bilateral DDH,
breakage of sandwich liner, 6 years post

PE Liner, Biolox Forte head

Wear 9 years later

Complications

- 4 cases of early dislocation (all in the liner exchange group, 50%, 1 revised)
- Probably due to underestimated impingement/malposition and aggressive soft tissues release

Conclusions

In case of ceramic breakage:

- Accurate fragments removal and synoviectomy,
- Replacement of damaged components,
- Correction of malpositioning and impingement are the key points

Conclusions

In case of ceramic breakage:

- At the moment there is no clear evidence of the bearing of choice, but <u>metal should be avoided</u>

Conclusions

In case of ceramic breakage:

- At the moment there is no clear evidence of the bearing of choice, but metal should be avoided

- Revision using Cer revision heads on PE liners (as alternative to Cer on Cer), can yield favorable results at mid-term f.u.

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

The Bearing is the Key!

Professor Fares S Haddad BSc MD (Res) MCh (Orth) FRCS (Orth) FFSEM
Consultant Hip and Knee Surgeon
Divisional Clinical Director Surgical Specialties
University College London Hospitals, UK
Director, Institute of Sport, Exercise & Health
University College London

Disclosures

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I receive Royalties from, and Consult for:

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MatOrtho

I receive Institutional and Research Support from:

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Corin

MatOrtho

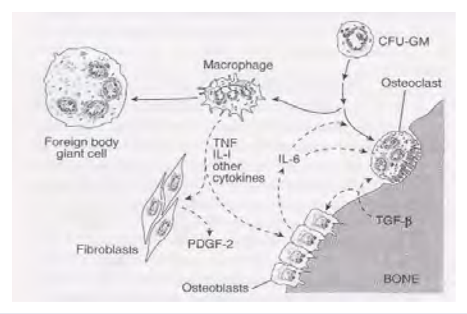
NIHR

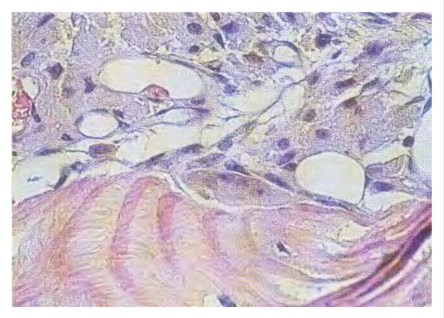
The Bearing in THA

- The Major Obstacle to the “Hip for Life”
- We have resolved FIXATION
- In the hip, Patient Selection and the Surgical / Rehabilitation PATHWAY are relatively straightforward
- There is noise around the APPROACH, but in comparison to the bearing surface, it is effectively just noise
- Corrosion brings us back to the BEARING

We have Struggled to Address Bearing Failure

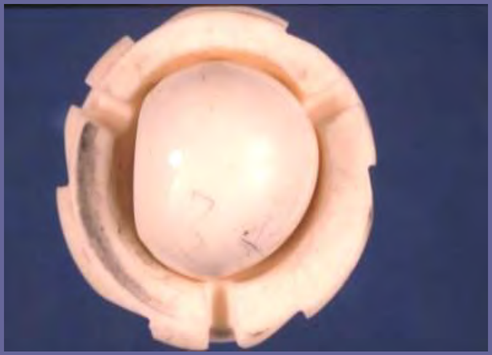
- Wear
- Osteolysis
- Aseptic Loosening

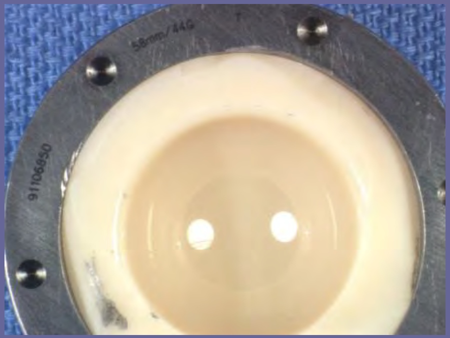




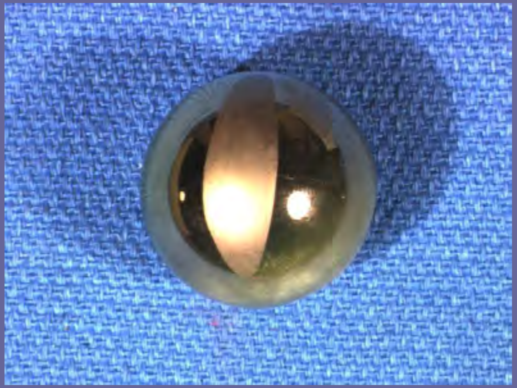
Some of our Recent Innovations have made the Matter Worse!

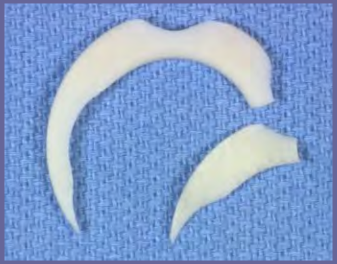
Even Ceramic has Failings





- UNFORGIVING
- Ceramic can wear
- Brittle - fracture risk
  - Rare but catastrophic
  - Ceramic particles
    - Future revisions compromised

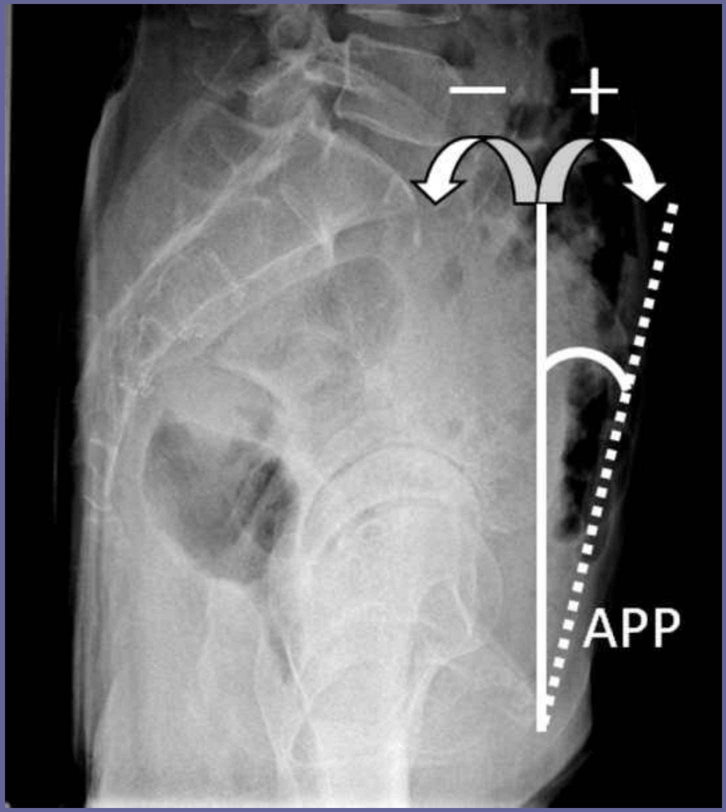




- Squeaking
- Limited versatility
- Liner impingement
  - Dislocation
- Few revision options

We are Still Struggling with the Target: We need Versatility

- Pelvic position changes when standing and in gait and in other activities
- The Target may be different for every patient



Bearing Surface Requirements

- **Low Wear**
- **Low Corrosion Potential**
- Allows for large head size up to 36mm
- Generalisable
  - Easy to insert – easily taught / learnt
  - Compatible with minimal incision
- Versatile - Intra-operative flexibility
  - Must have choices
- Familiar
- Biocompatible
- Revisable
- Affordable
- SAFE

Hard Bearings are Unforgiving & are Creating NEW Complications

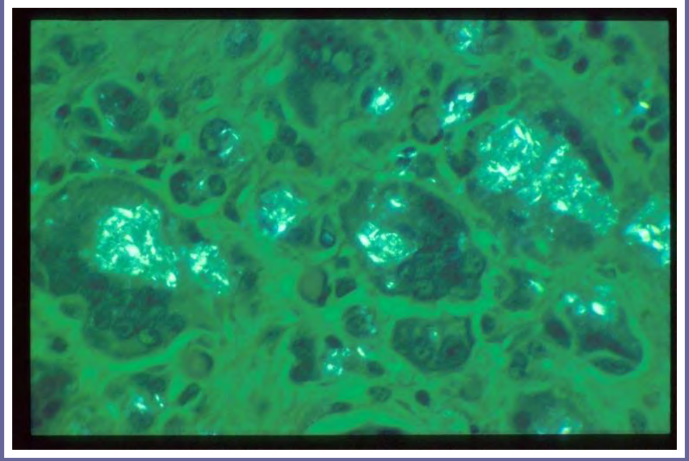
We Have a SAFE and VERSATILE Alternative

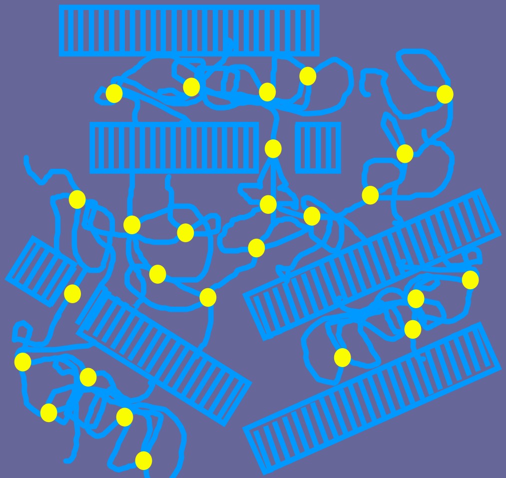
Oxinium

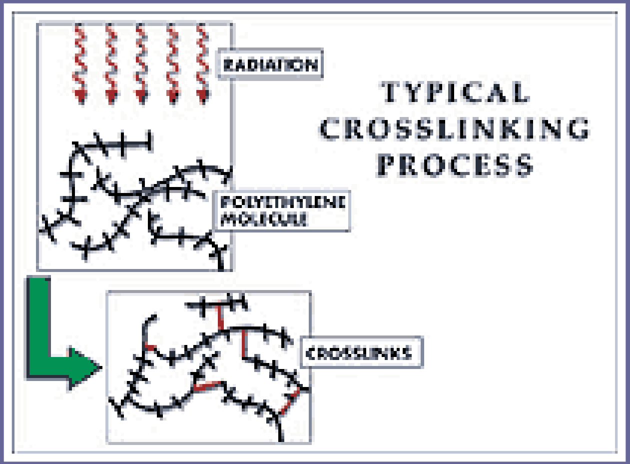
on

Cross Linked Polyethylene

The Data for Highly Cross Linked Polyethylenes is Compelling





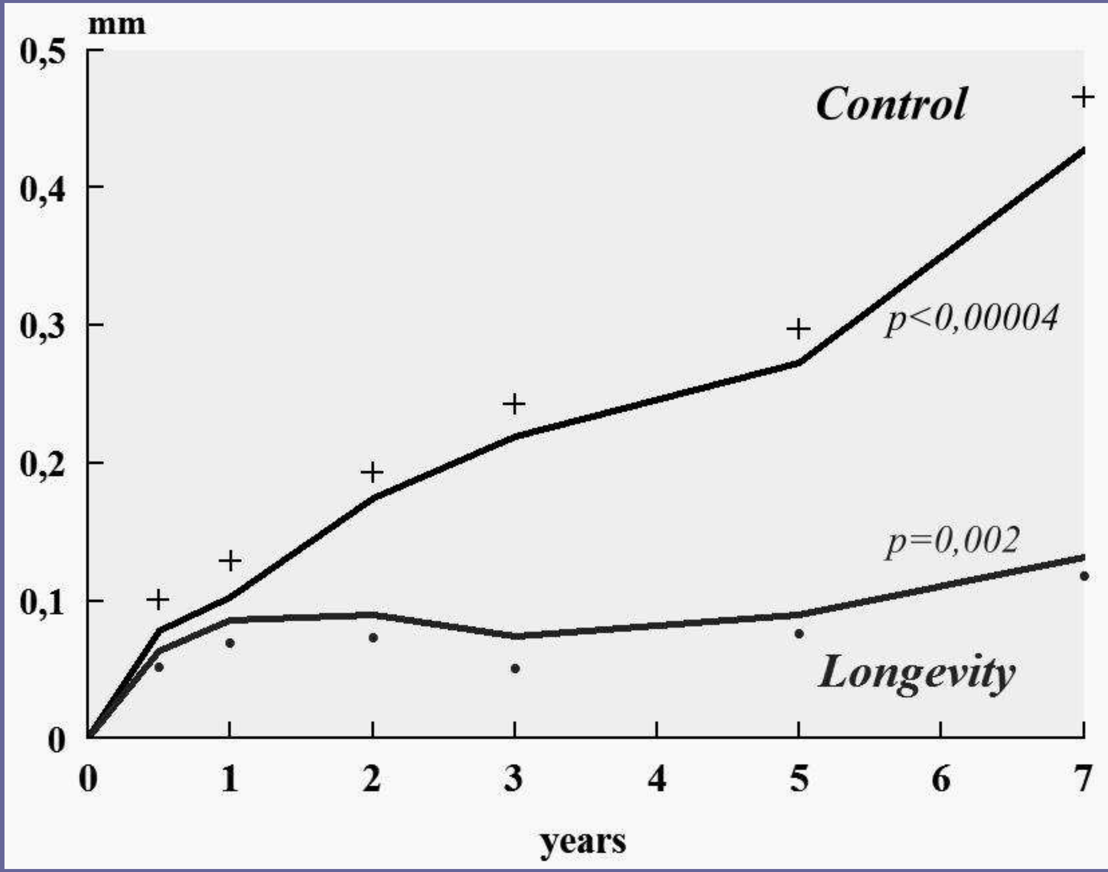


Clinical performance of highly cross-linked polyethylene

Johanson, P-E; Digas , G; Thanner; J; Herberts, P; Kärrholm, J

Total (3D) penetration

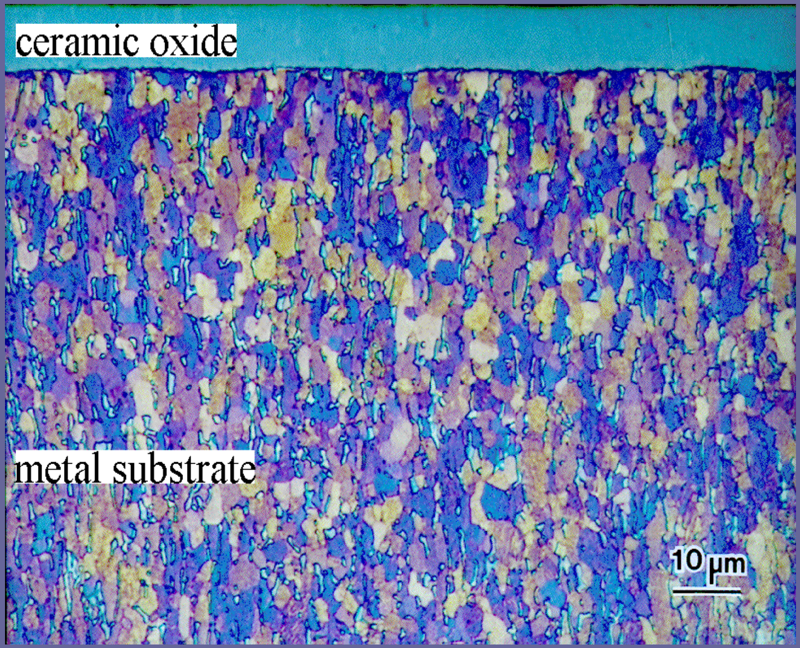
(Mean, SE; 7 years p<0,00001)



56th Annual Meeting of the Orthopaedic Research Society

Oxinium Femoral Heads

- Low friction
- High abrasion resistance
- Excellent damage tolerance
- No fractures



- Inert / Biocompatible

- **Low risk**
- **Low wear**

UK Clinical Data

- **Clinical Multi-centre Prospective Randomised Wear Study** set up in 2004

- UCH
- Bournemouth
- Yeovil
- Derby
- Liverpool

- 431 Hips recruited
  - Minimum 5 year F-up

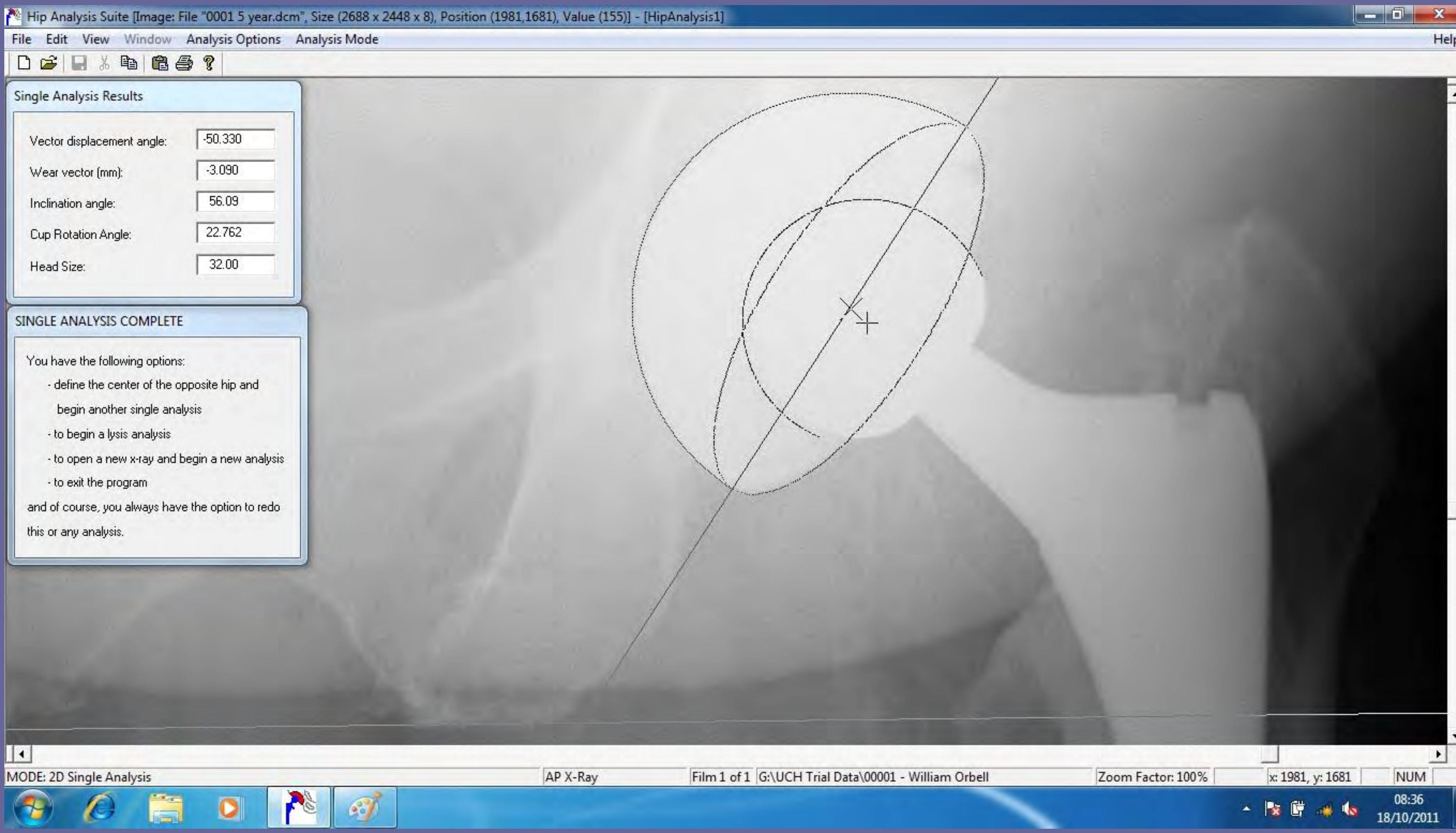
UK Clinical Data

- Randomisation to 3 groups
- 32mm head
- CoCr vs XLPE
- Oxinium vs XLPE
- Oxinium vs Conventional polyethylene
- CoCr vs Conventional polyethylene group not approved by ethics committee (high wear model)

Analysis

- Central data collection
- Clinical and activity data collected by "blinded" physiotherapists
- Radiographic data analysed by two Orthopaedic Surgeons
  - Digitised technique
  - CT data
  - Martell technique

Wear Measurement



Demographics

- 431 subjects
- 60% female
- 40% male

- Mean age 62.3 (range 29-85)
- LOS 5.022 days
  - Female 5.087
  - Male 4.903

Diagnoses

- 81% OA
- 5% AVN
- 4% RA
- 10% Perthes, prev #, CDH or "other"

- Race
  - 90% white
  - 7% black / afro-carribean
  - 2% asian
  - 1% other

Demographics

- 431 hips originally recruited
- 401(↓ 6.96%) are under review

- 401 patients have minimum 5 year data
  - Clinical data
  - Activity data
  - Radiographic data

Patients Withdrawn from Wear Study

- 14 deaths
- 6 new diagnoses (> 2 years post-op) of co-morbidities requested to withdraw

- 2 dislocations with revision to 36mm head
- 2 deep infections with revision
- 3 periprosthetic fractures revised

- 5 requests to withdraw from outcome score collection but happy to continue to attend clinic for radiographs

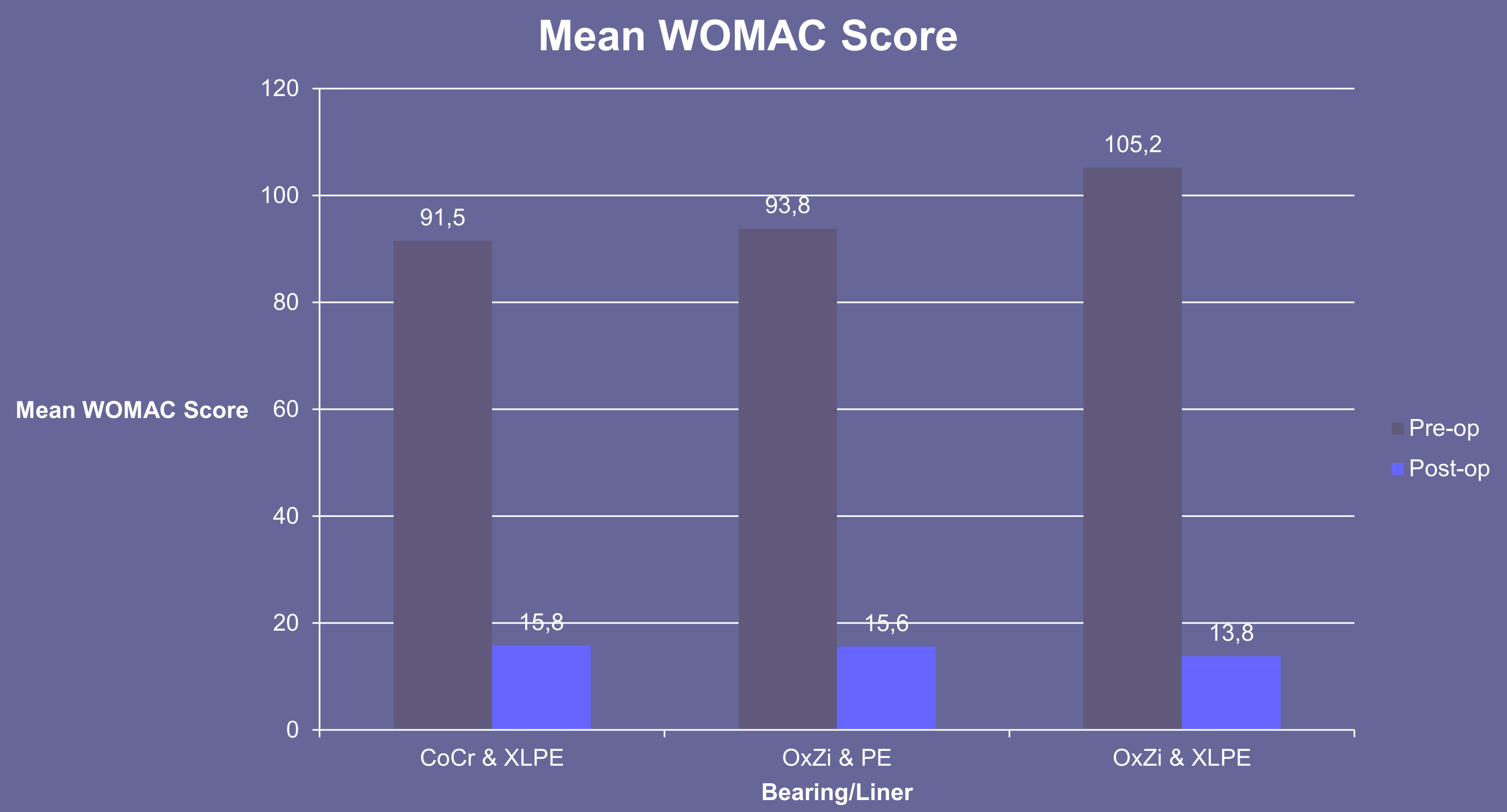
Safety

- No episodes
  - Implant fracture
  - Catastrophic wear
- No allergic phenomena
- No reported clicking / squeaking
- No masses
- Rates of infection/dislocation
  - < 1%

Baseline Data

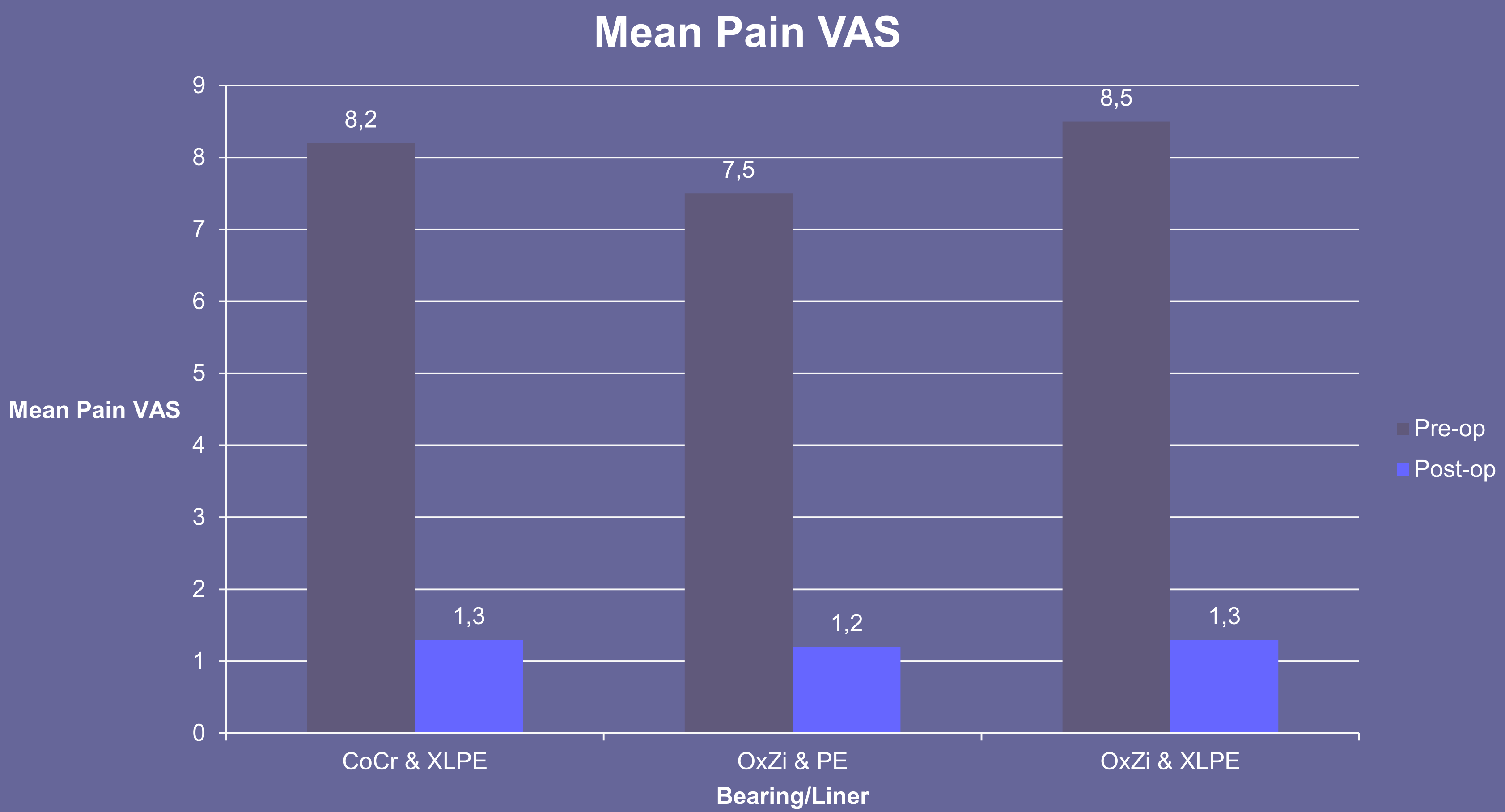
	CoCr & XLPE	OxZi & PE	OxZi & XLPE	Total
Number	129	136	136	**401**
Mean Age in Years (Range)	61 (42-73)	63 (53-73)	63 (47-85)	**62.3 (42-85)**
M:F	50:79	53:83	59:77	**162:239**

WOMAC



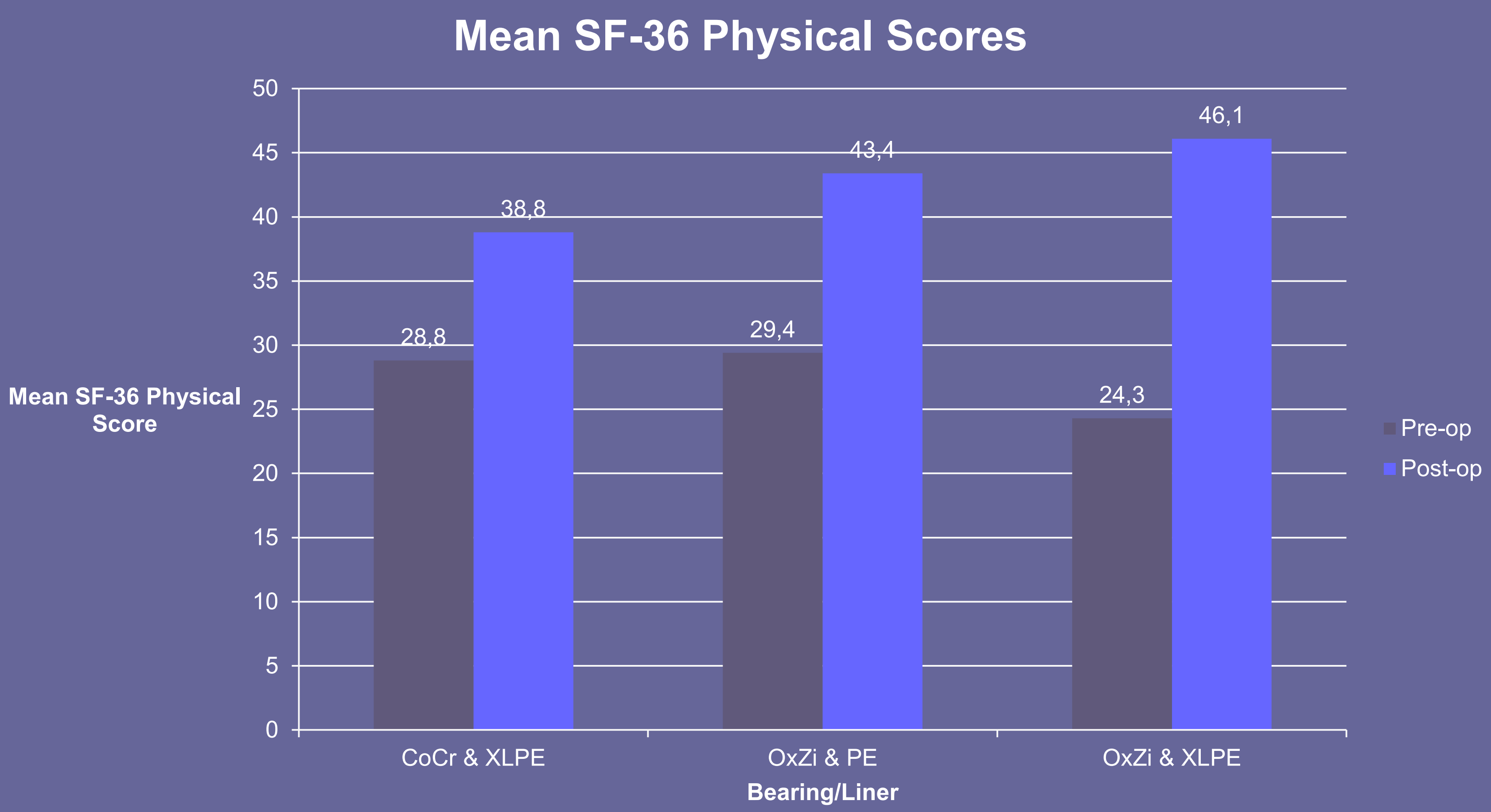
Mean WOMAC Score
120
100
80
60
40
20
0
Mean WOMAC Score
91,5
15,8
93,8
15,6
105,2
13,8
CoCr & XLPE
OxZi & PE
OxZi & XLPE
Bearing/Liner
Pre-op
Post-op

PAIN



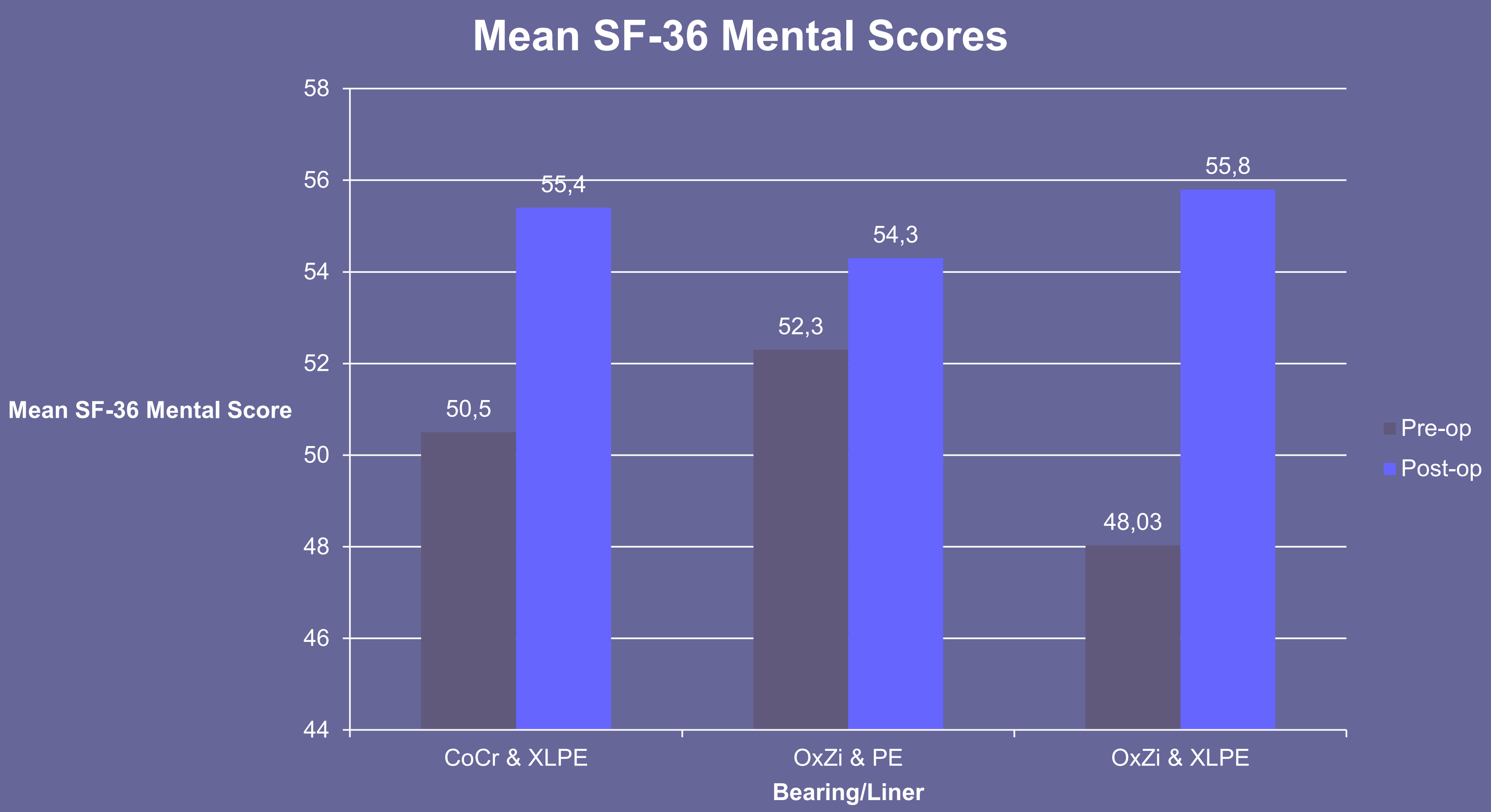
Mean Pain VAS
Mean Pain VAS
9
8
7
6
5
4
3
2
1
0
8,2
7,5
8,5
1,3
1,2
1,3
CoCr & XLPE
OxZi & PE
OxZi & XLPE
Bearing/Liner
Pre-op
Post-op

SF-36



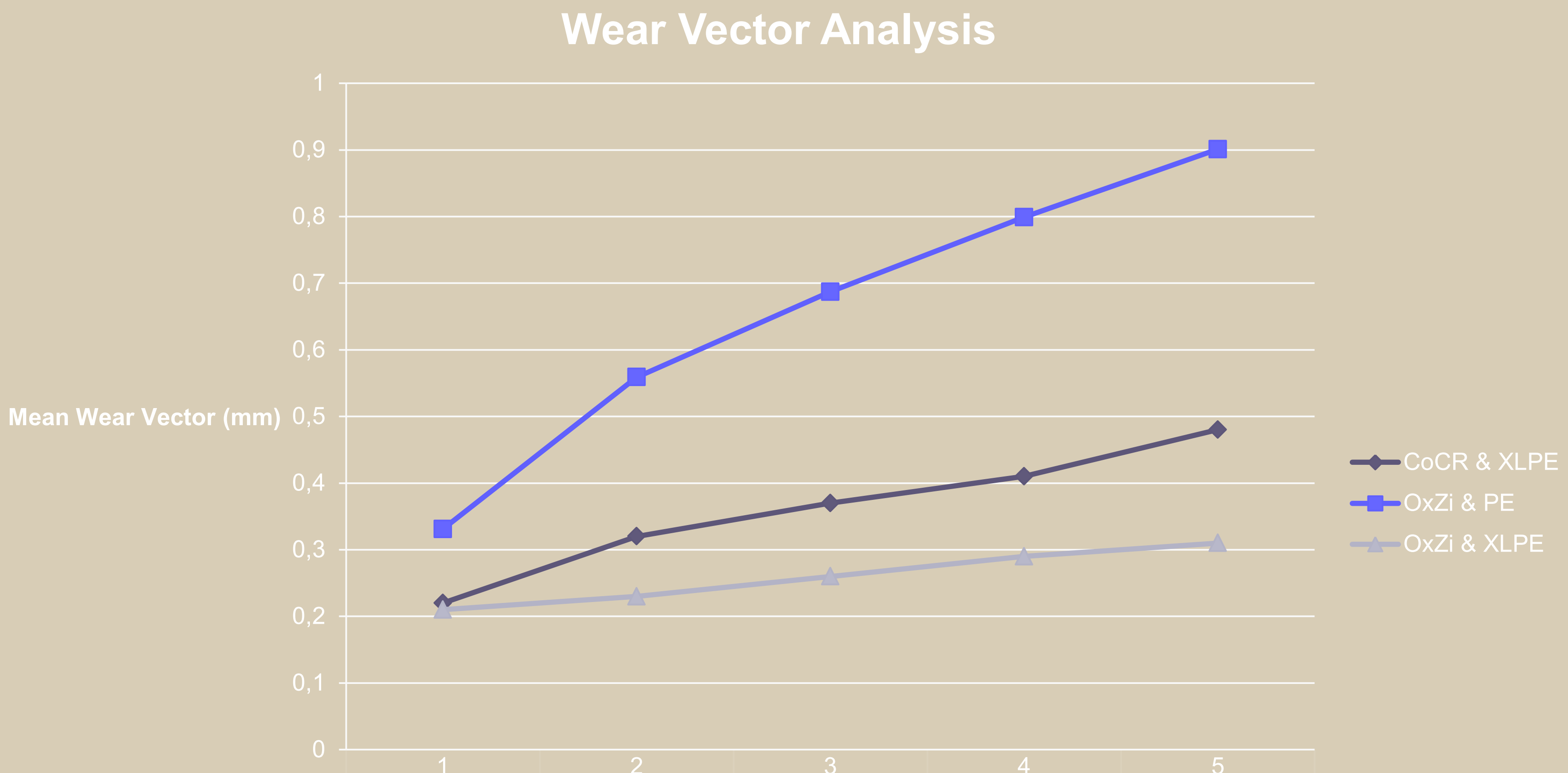
Mean SF-36 Physical Scores
Mean SF-36 Physical Score
50
45
40
35
30
25
20
15
10
5
0
28,8
38,8
29,4
43,4
24,3
46,1
CoCr & XLPE
OxZi & PE
OxZi & XLPE
Bearing/Liner
Pre-op
Post-op

SF-36



Mean SF-36 Mental Scores
58
56
54
52
50
48
46
44
Mean SF-36 Mental Score
50,5
55,4
52,3
54,3
48,03
55,8
CoCr & XLPE
OxZi & PE
OxZi & XLPE
Bearing/Liner
Pre-op
Post-op

Radiographic Data

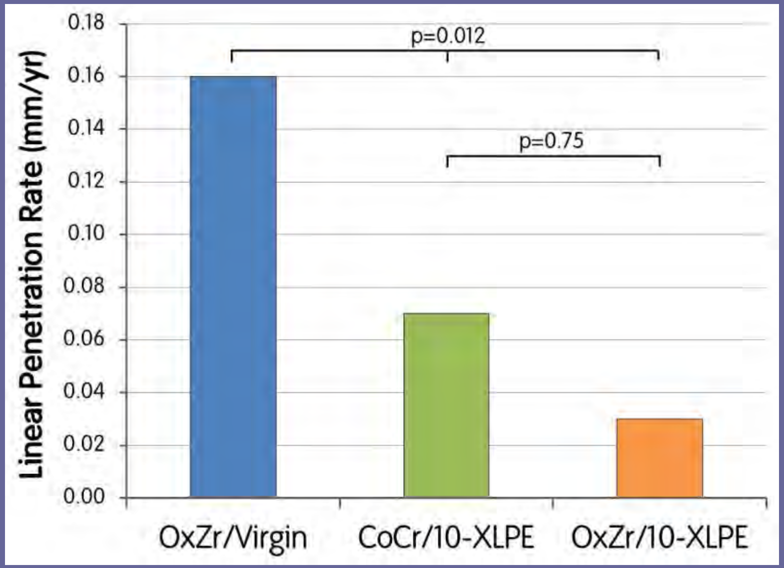


	1	2	3	4	5
CoCR & XLPE	0,22	0,32	0,37	0,41	0,48
OxZi & PE	0,331	0,559	0,687	0,799	0,901
OxZi & XLPE	0,21	0,23	0,26	0,29	0,31

Years Since Surgery

Radiographic Data

- Conventional polyethylene exhibits significantly greater wear than XLPE
- There is a trend towards lower wear with Oxinium vs XLPE at 5 years but values are very low
- Analysis ongoing



*Jassim et al., ISTA, 2012:136

PRCT – 22mm Heads
Moussa Hammadouche

- EtO group

  44 hips at a median FU of 6.8 years (5 – 8 years)

  Oxinium: 22 hips/ Metal: 22 hips

- XLPE group

  42 hips at a median FU of 6.0 years (4– 7 years)

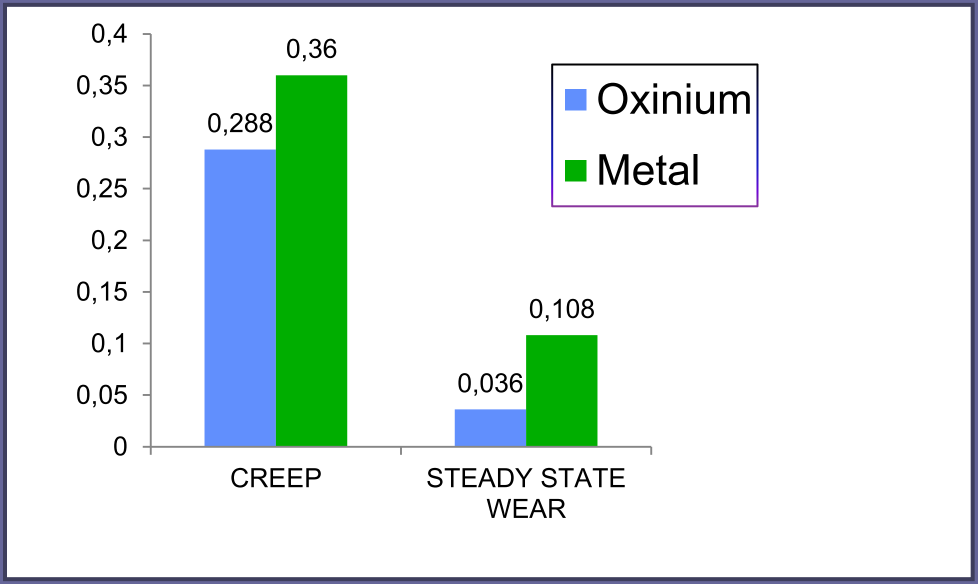
  Oxinium: 21 hips/ Metal: 21 hips

EtO group

- ***Steady state wear***:

  - Oxinium: 0.04 mm/y
  - Metal: 0.11 mm/y

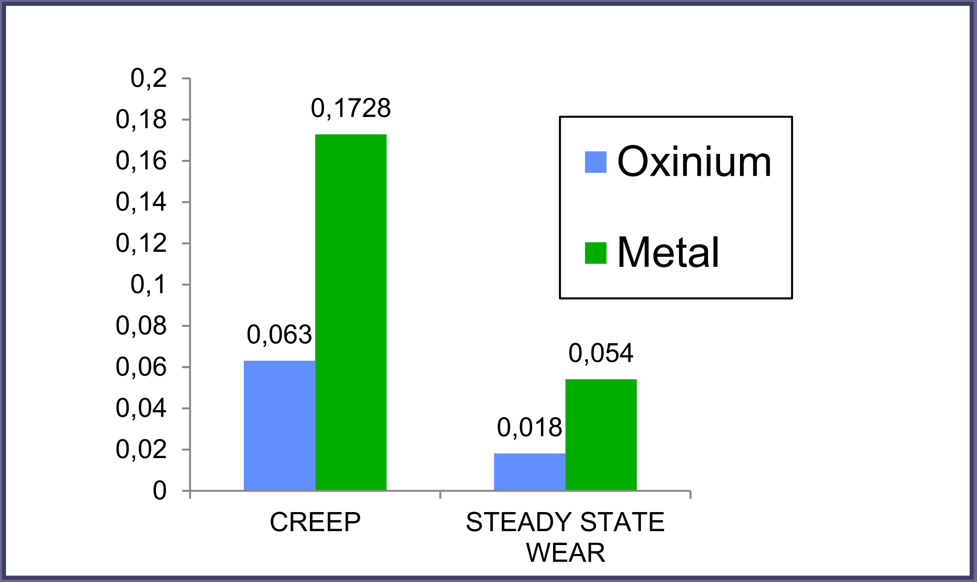
  p = 0.01



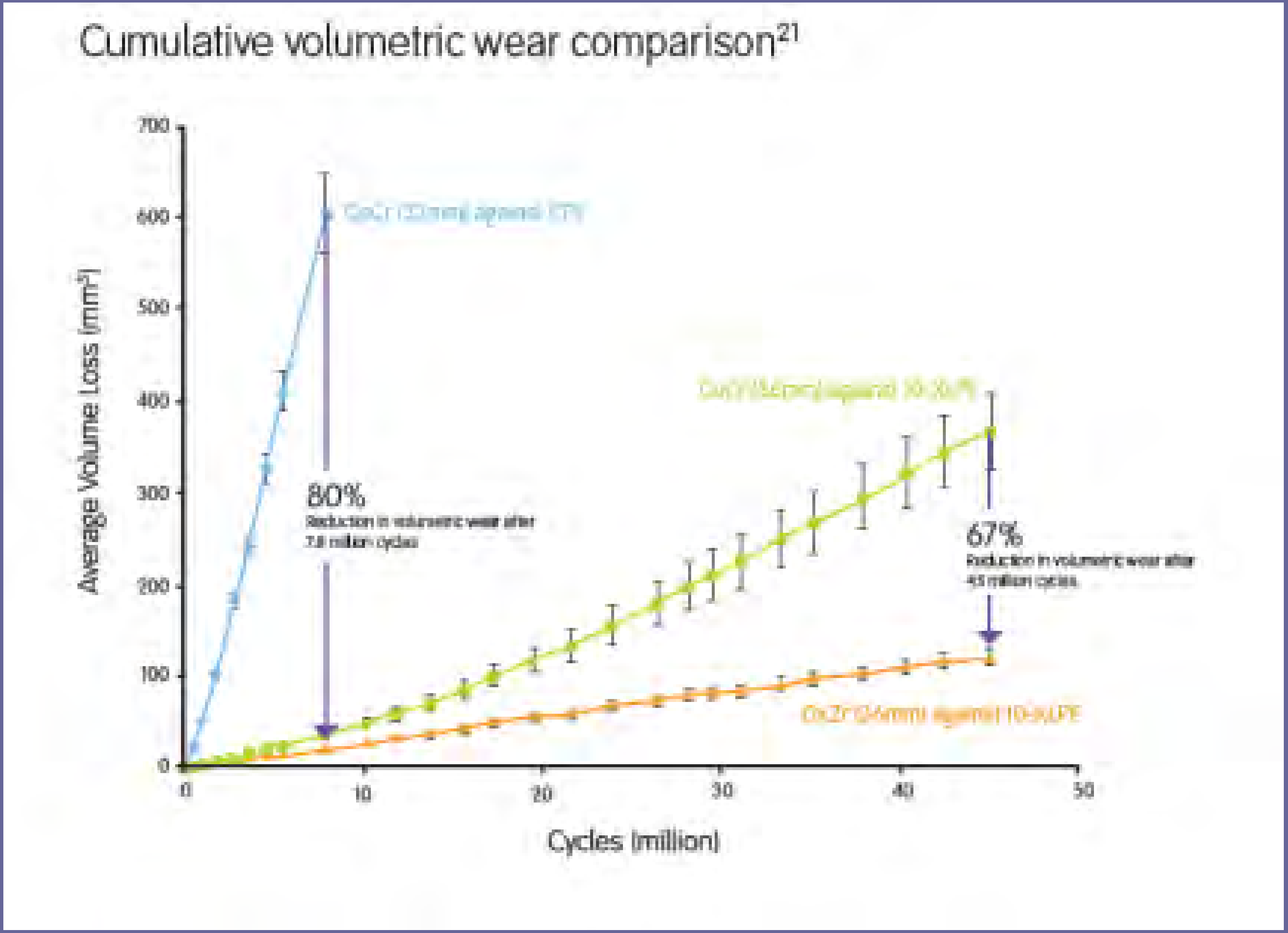
XLPE Group

- ***Steady state wear***:
  - Oxinium: 0.02 mm/year
  - Metal: 0.05 mm/year

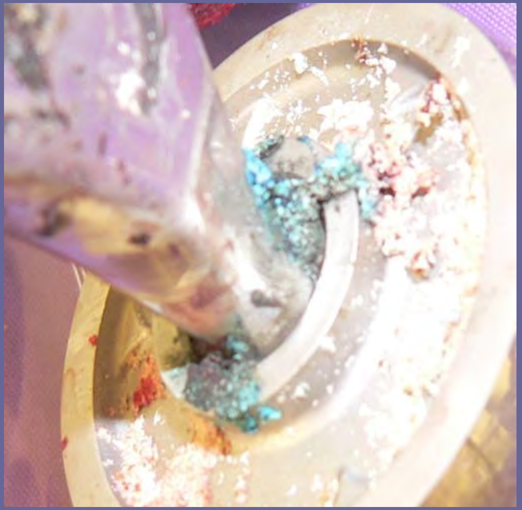
p = 0.006

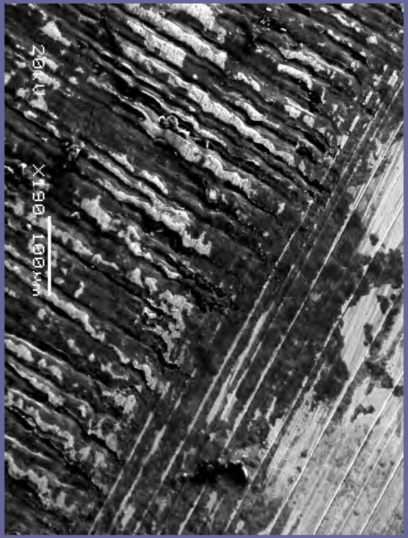


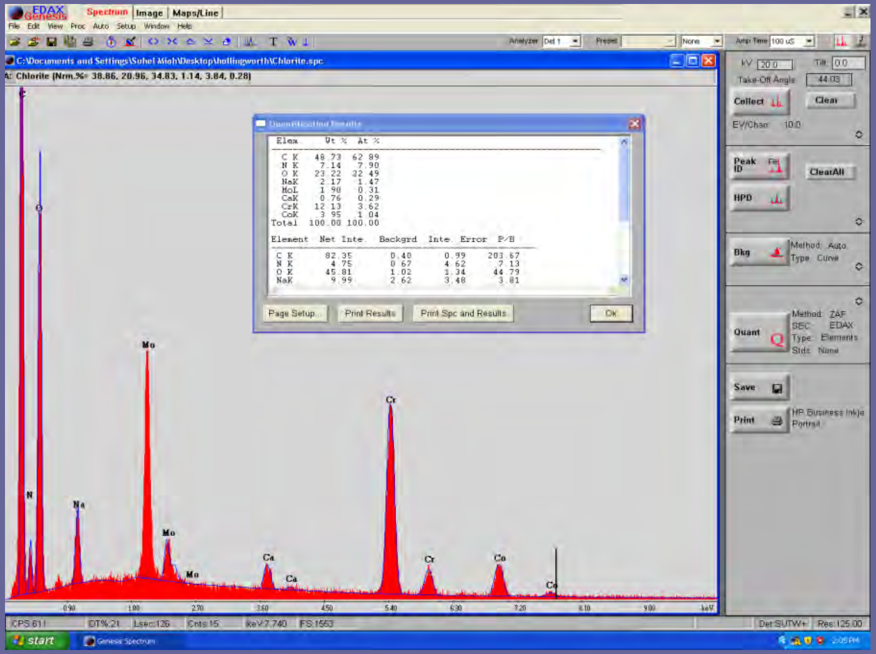
Fits in with the Laboratory Data



In 2015 Corrosion is a HUGE Issue



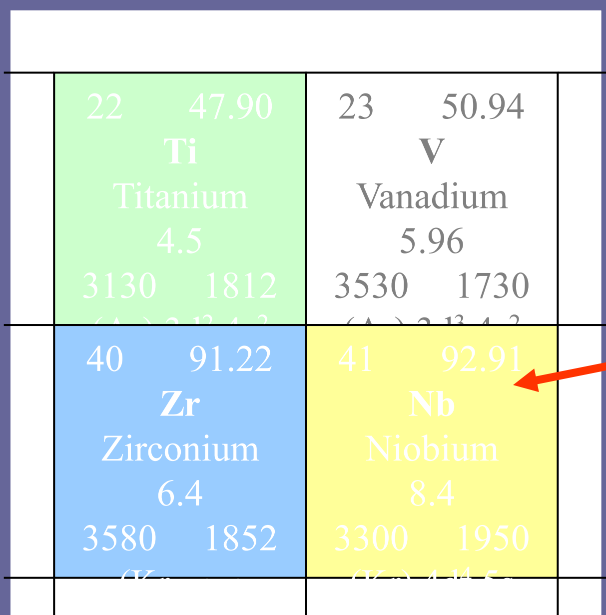


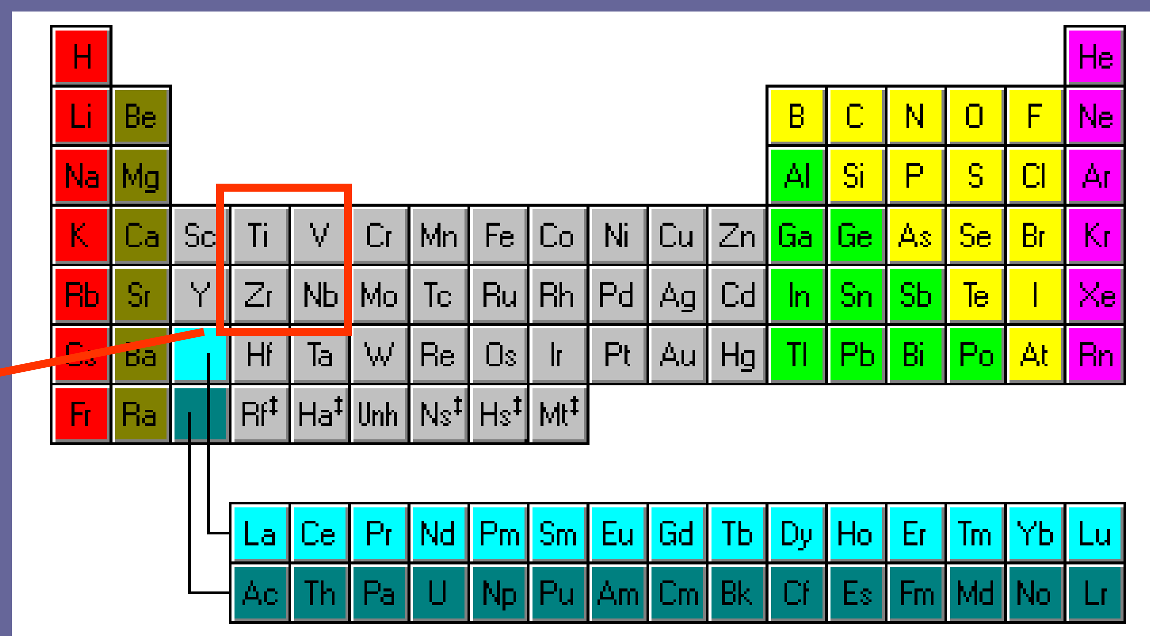


Biocompatibility / Metal Sensitivity

- Zirconium: one of most biocompatible metals
  - Ranked on passivation and biological response
  - Other four: niobium, titanium, tantalum, platinum

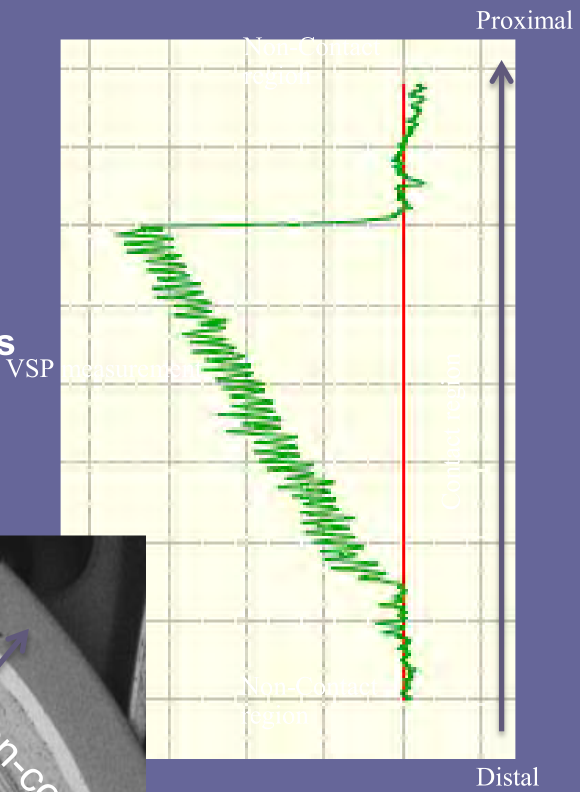
- Very low impurity content in Oxidized Zirconium
- Max specified impurity levels in alloys:
  - CoCrMo: 1% nickel
  - Ti-6Al-4V: 0.1% nickel
  - Zr-2.5Nb: Not detectable (0.0035% nickel)





Retrieval Analysis

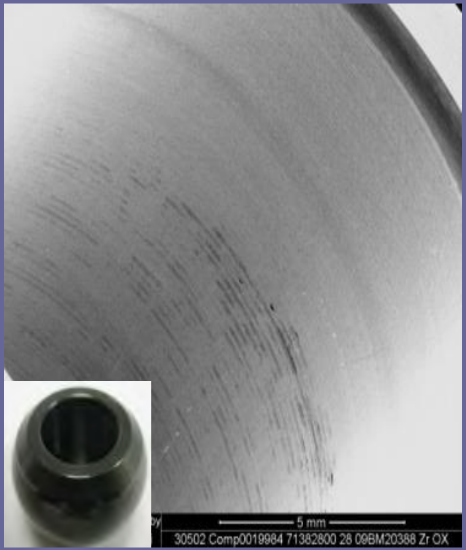
- Goldberg scoring (GS)
- SEM
- Vertical straightness profile (VSP)
  - VSP measures depth of material loss
  - Retrieved devices included Ti-6Al-4V and CoCrMo hip stems coupled with both CoCrMo and oxidized zirconium (OxZr) femoral heads
  - Exclusions
    - Less than 1 week in vivo
    - Ceramic heads



Retrieval Analysis

- 227 retrievals total with 190 meeting inclusion criteria
  - CoCrMo (n=166), OxZr (n=24)
- No correlation:
  - Head size and GS (n=183, R^2=0.23)
  - Time *in vivo* and GS (n=104, R^2=0.11)
- Correlation
  - Head material and GS
    - OxZr lower score (1.9 ± 0.6), CoCrMo higher score (2.5 ± 0.9) ($p<0.05$)
  - Shorter and longer head offsets and GS

- Material loss was higher for CoCrMo (1.4 – 102.6 μm), OxZr (0)



What is the Standard in 2015?

We have MANY Answers

- Selection
- Expectations
- Approach
- Fixation
- Rehabilitation
- Function

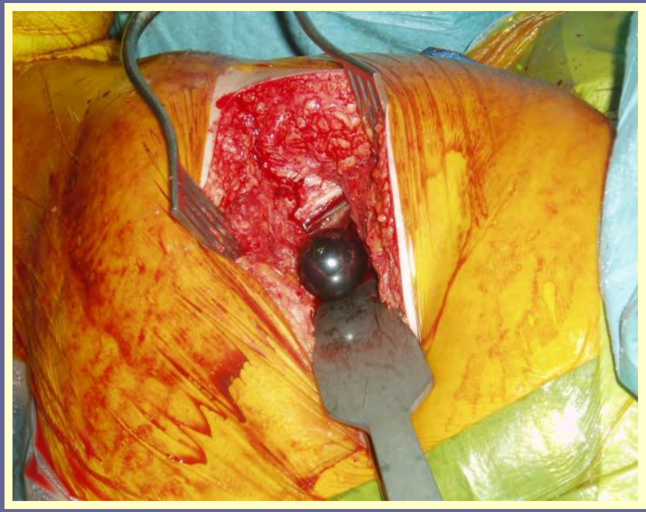
- WE just need to get the bearing RIGHT

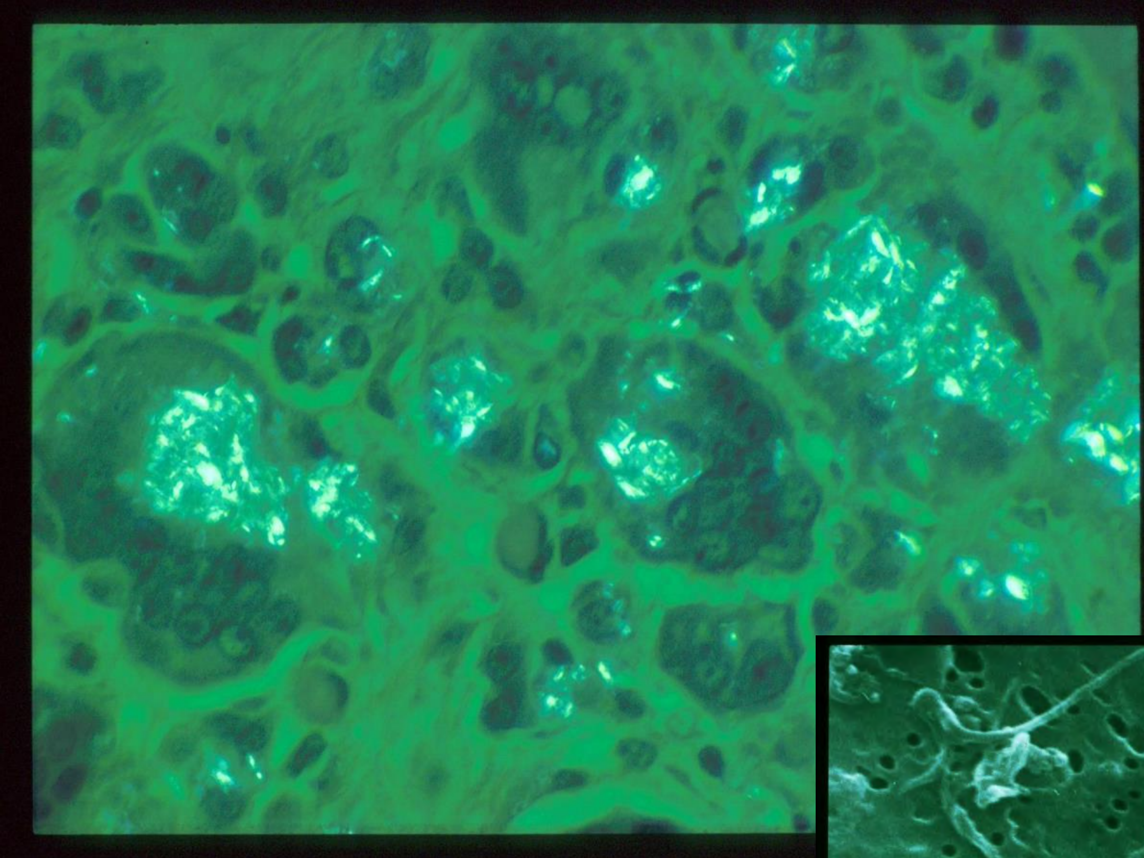
The Clinical Reality of Modern Bearings

- Modern Bearings have better wear properties
  - In the lab
  - Clinically
- The desire for larger head sizes has accelerated the need to improve the bearing
- Our knowledge is rapidly increasing
- Surgical technique remains critical
- There is no single perfect bearing couple yet
  - Units may use several bearing couples tailored to individual circumstances BUT we can make a very strong argument for VERILAST as the standard

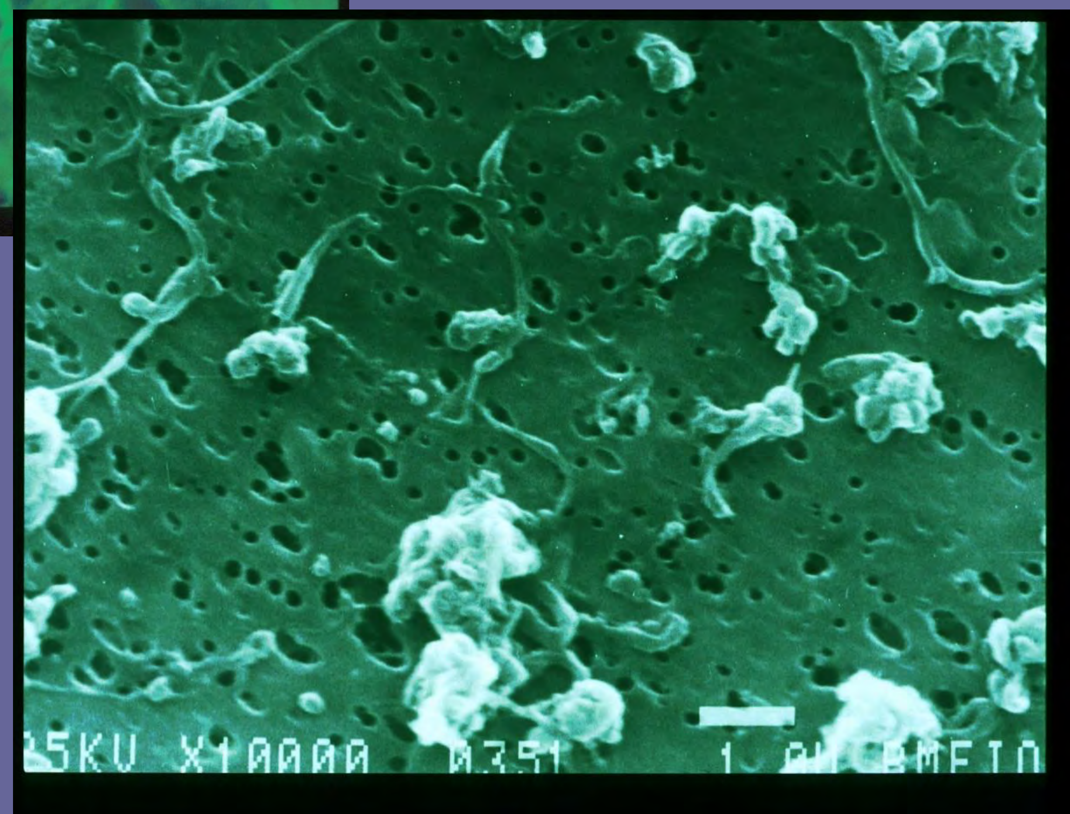
VERLIAST: Oxinium on XLPE

- Familiar
  - No learning curve
  - No special techniques
  - No need for higher precision
- Adaptable
  - Liner and head options
    - Head length / offset
  - Compatible with minimal incision
- Forgiving
  - Impingement more benign
  - No stripe wear
  - More generalisable
- Economically viable
- Revisable
- BIOCOMPATIBLE
- LOW WEAR IN VIVO
- SAFE





Thank you



INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

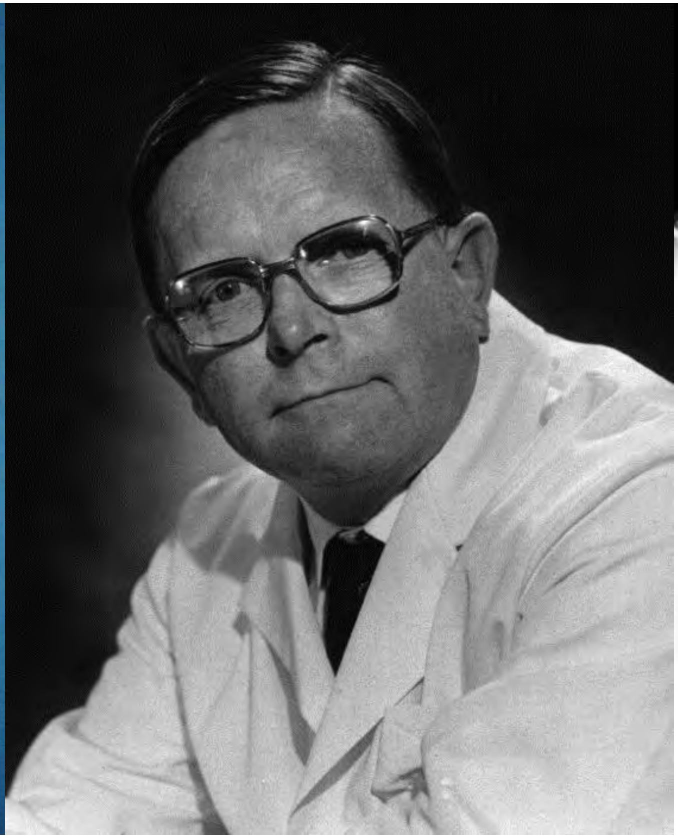
26-27 NOVEMBER 2015

MILAN, ITALY

XLPE: clinical implications of different polyethylenes

Patrizio Caldora MD
Chief Department Orthopaedic and Traumatology
S Donato Hospital Arezzo
S Margherita Hospital Cortona (Ar)

The Gold Standard in 1975



High Density Poly-(CH_2=CH_2)

Twenty-five-Year Survivorship of Two Thousand Consecutive Primary Charnley Total Hip Replacements

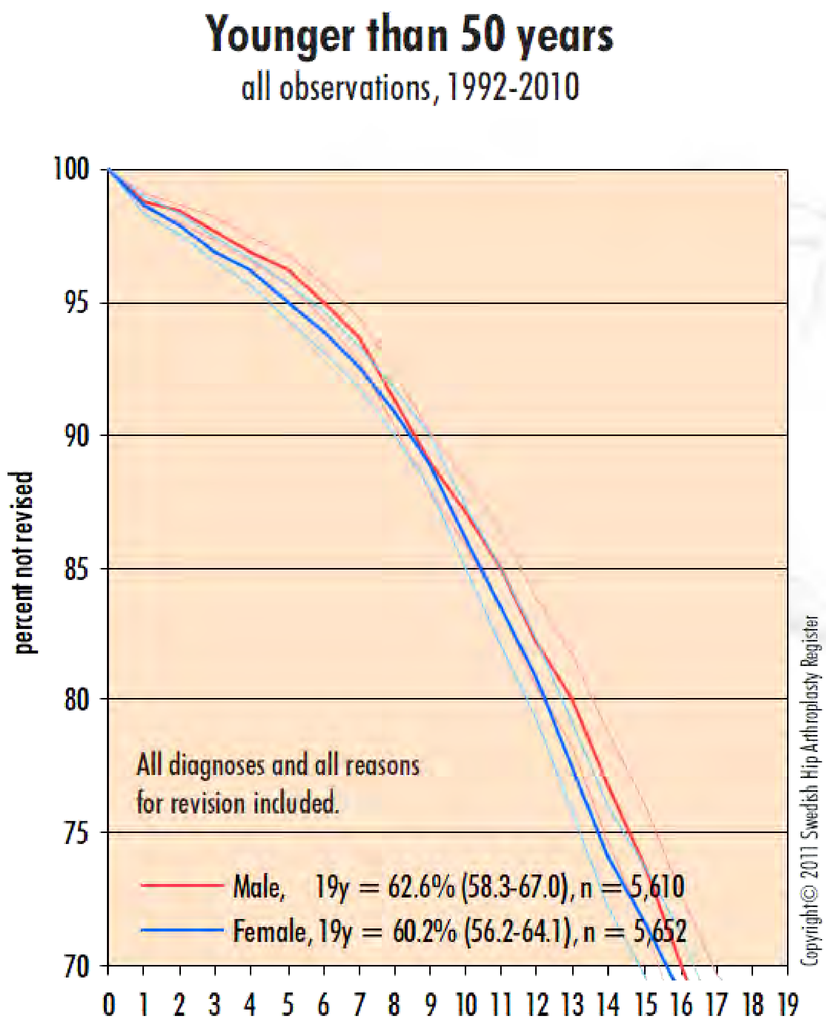
Factors Affecting Survivorship of Acetabular and Femoral Components

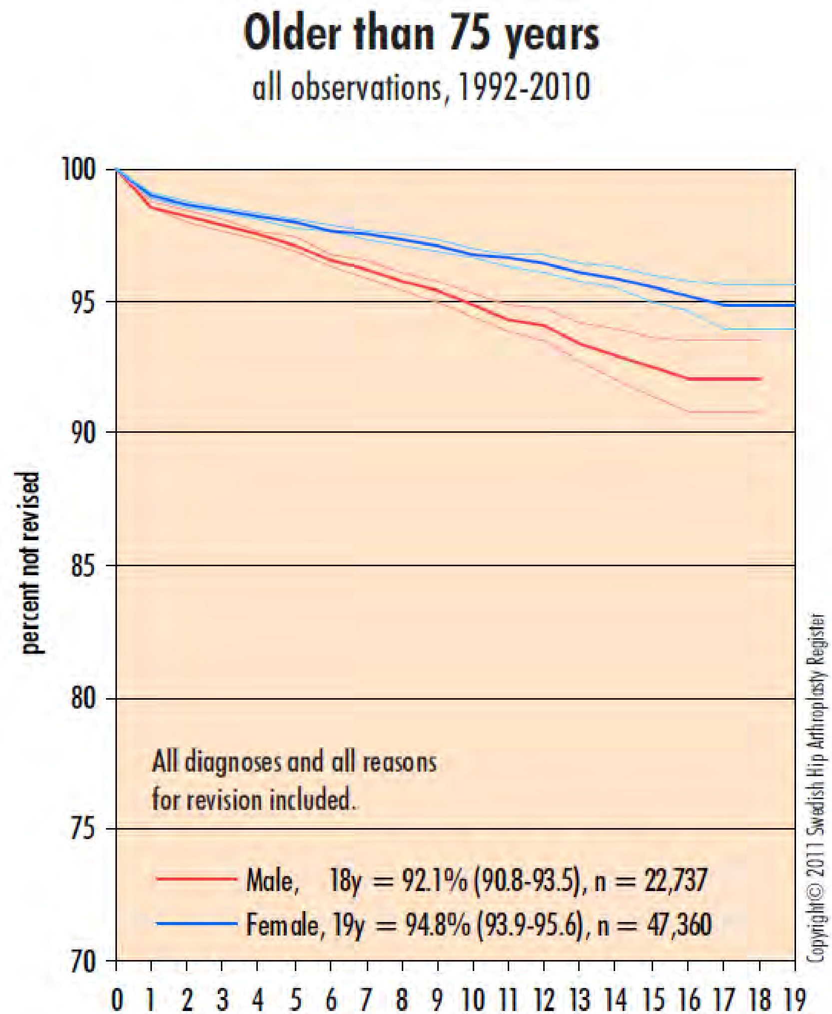
By Daniel J. Berry, MD, W. Scott Harmsen, MS, Miguel E. Cabanela, MD, and Bernard F. Morrey, MD

Investigation performed at the Department of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota

80% Survivorship

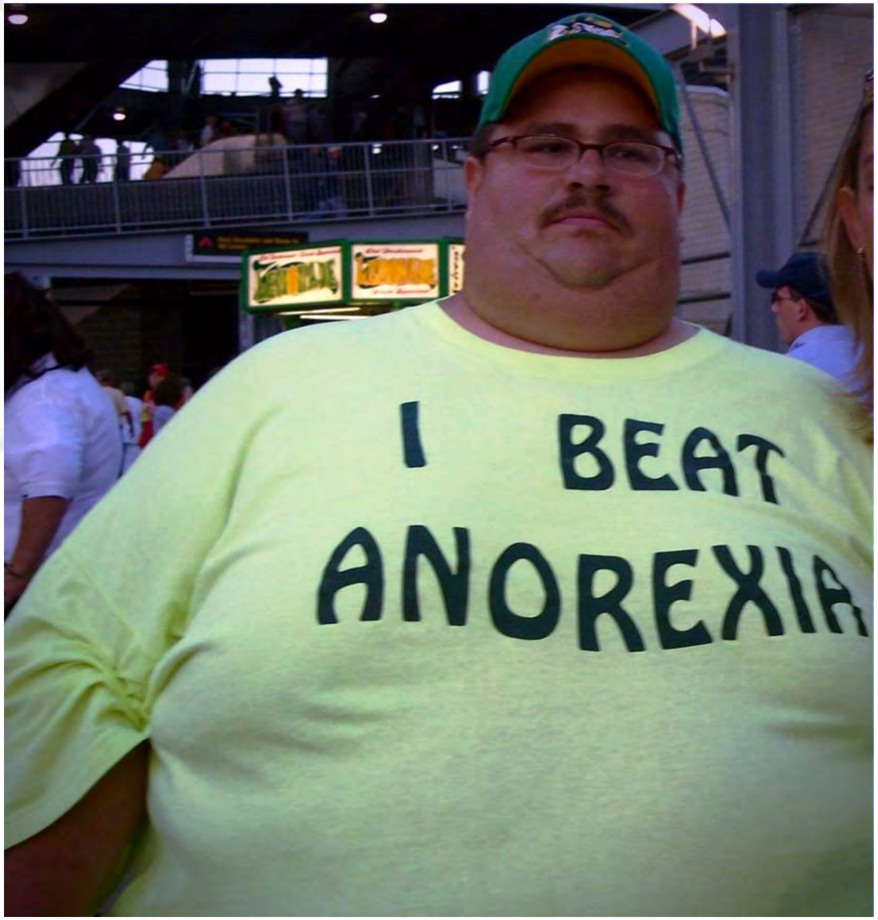
Clinical results for young patients





The New Orthopaedics Patient Weight

- **The mean BMI is steadily increasing in the Western population**



The New Orthopaedics Patient Activity

- As the mean age of the patients is steadily decreasing
- the mean activity level of the patients is increasing.

Conventional Poly (UHMWPE)

wear

ostheolysis

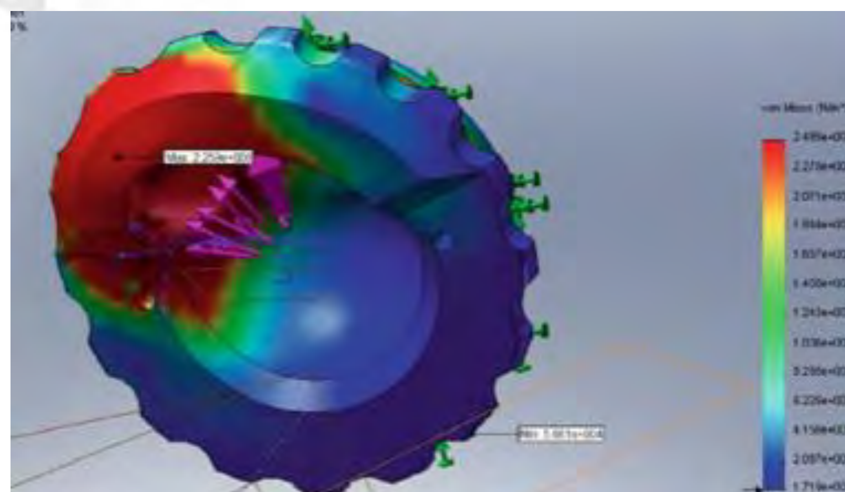
loosening

Modes of poly wear in THA

reduced by cross-linking

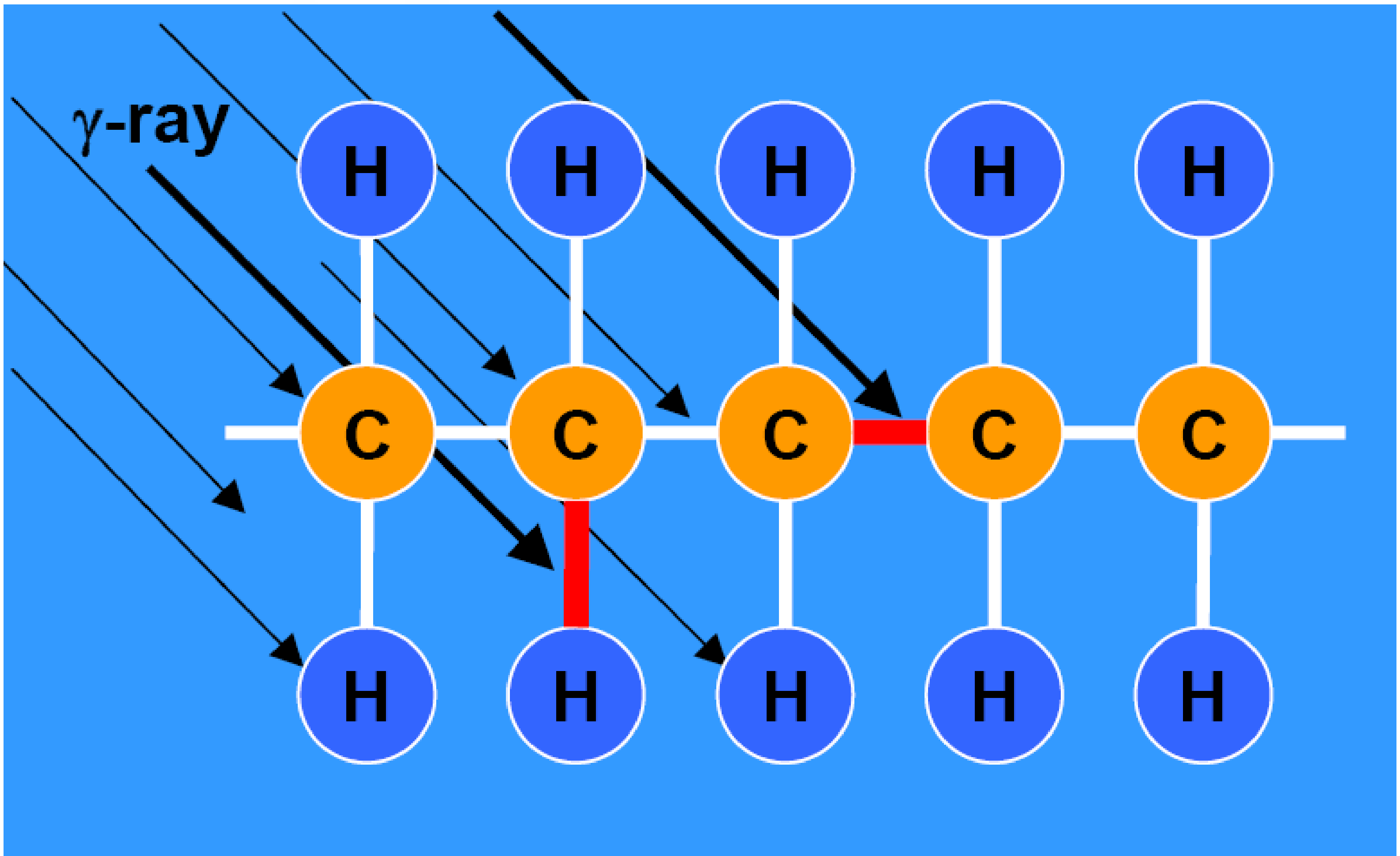
Other sources of debris

- **Modular junctions**
- **Impingement**
- **Instability**
- **Edge loading**



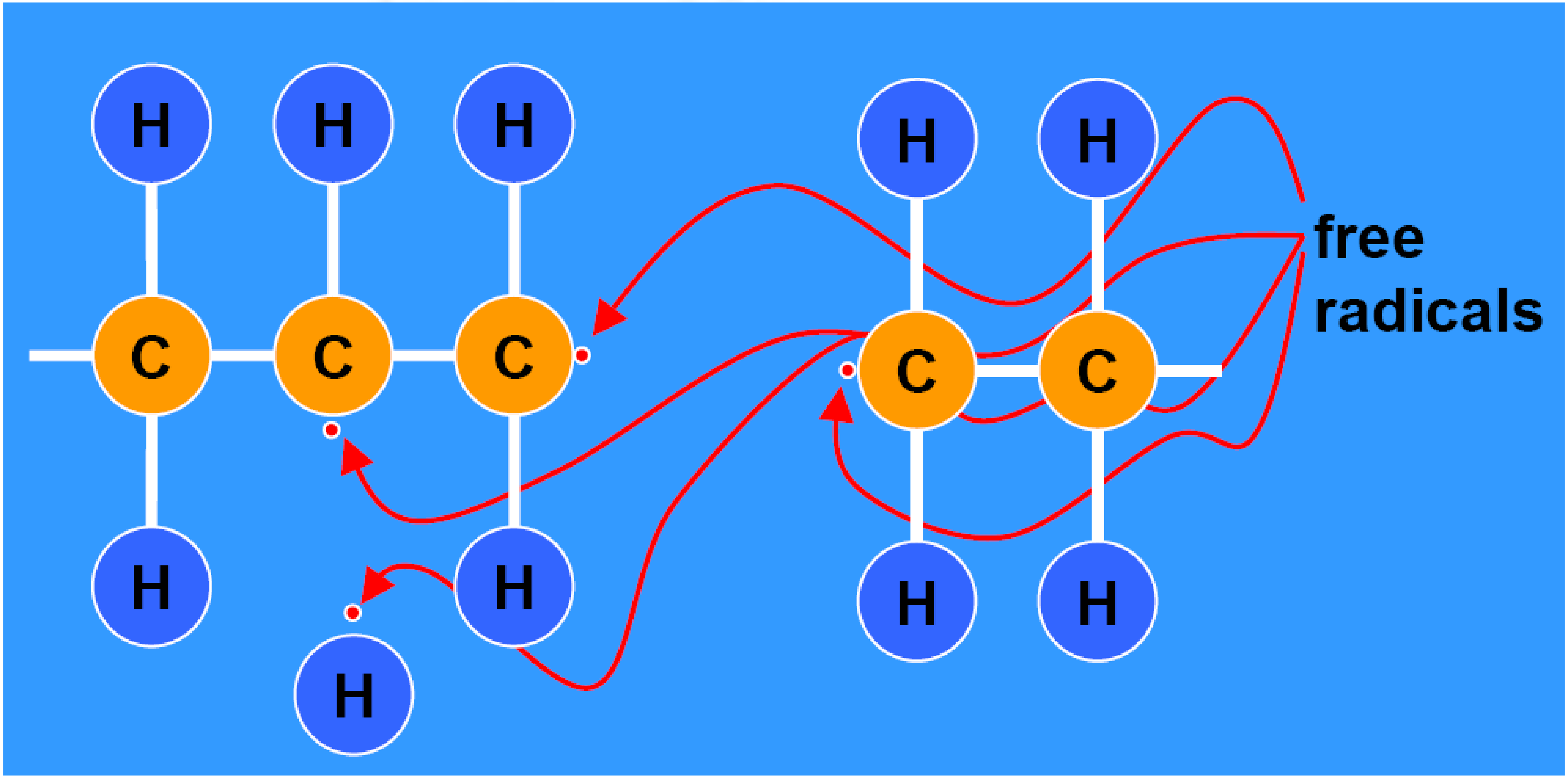
Conventional Poly (UHMWPE)

sterilization by gamma radiation in air
(2.5 – 4.0 Mrad)



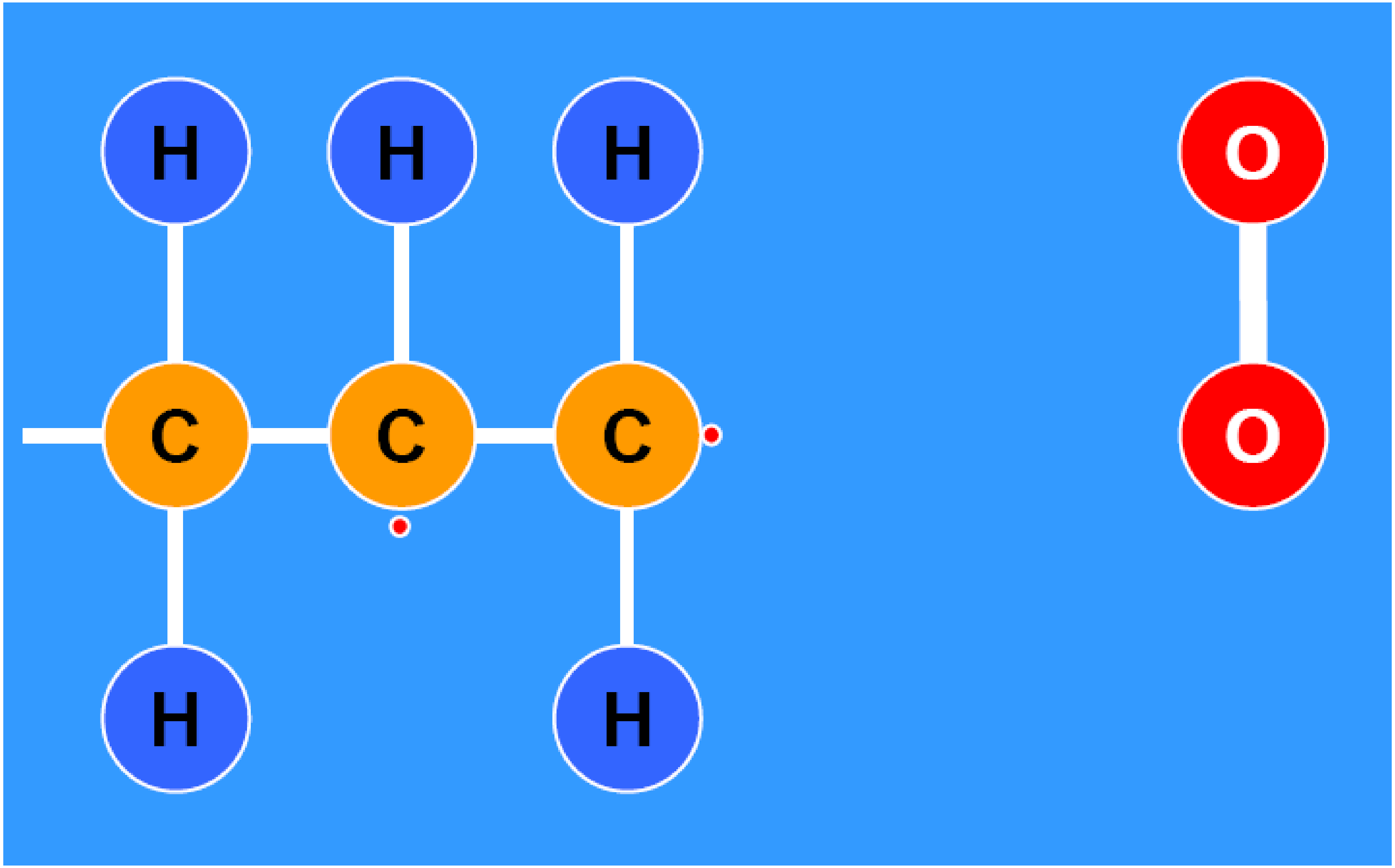
Conventional Poly (UHMWPE)

sterilization by gamma radiation in air
(2.5 – 4.0 Mrad)



Conventional Poly (UHMWPE)

sterilization by gamma radiation in air
(oxidative degradation)



Conventional Poly (UHMWPE)

sterilization by gamma radiation in air
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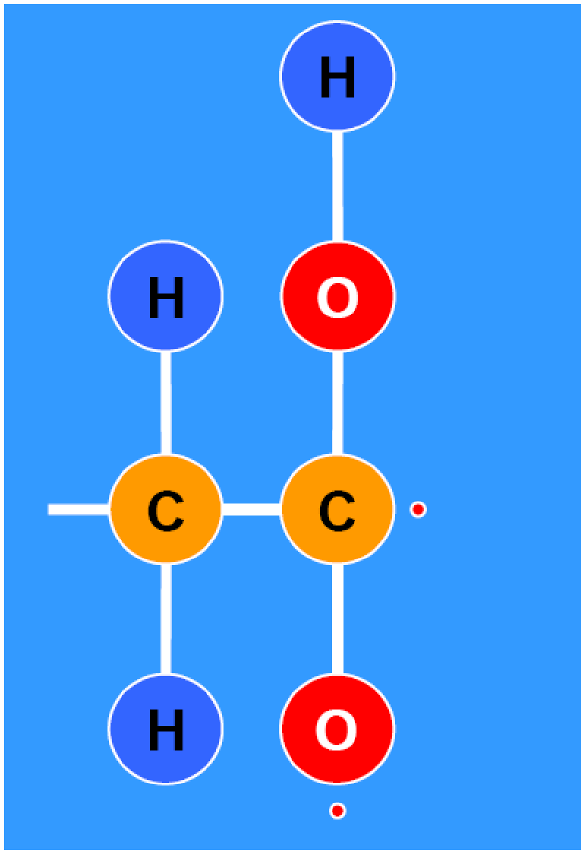


- High wear rate
- Delamination
- Gross fracture

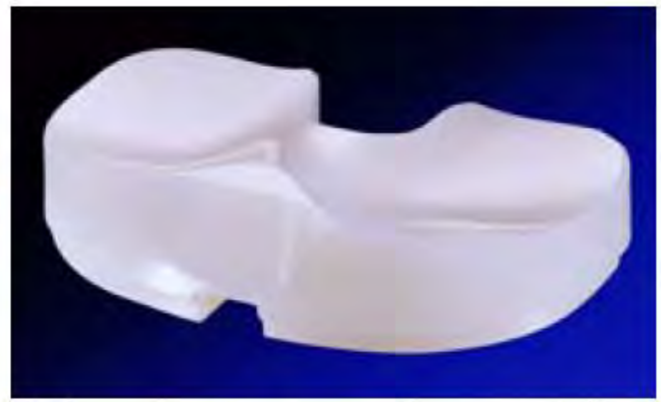
HXLPE (1998)

highly cross-linked polyethylene

radiation in inert atmosphere

(5 – 10 Mrad gamma or electron beem)

Calcium stearate-free UHMWPE

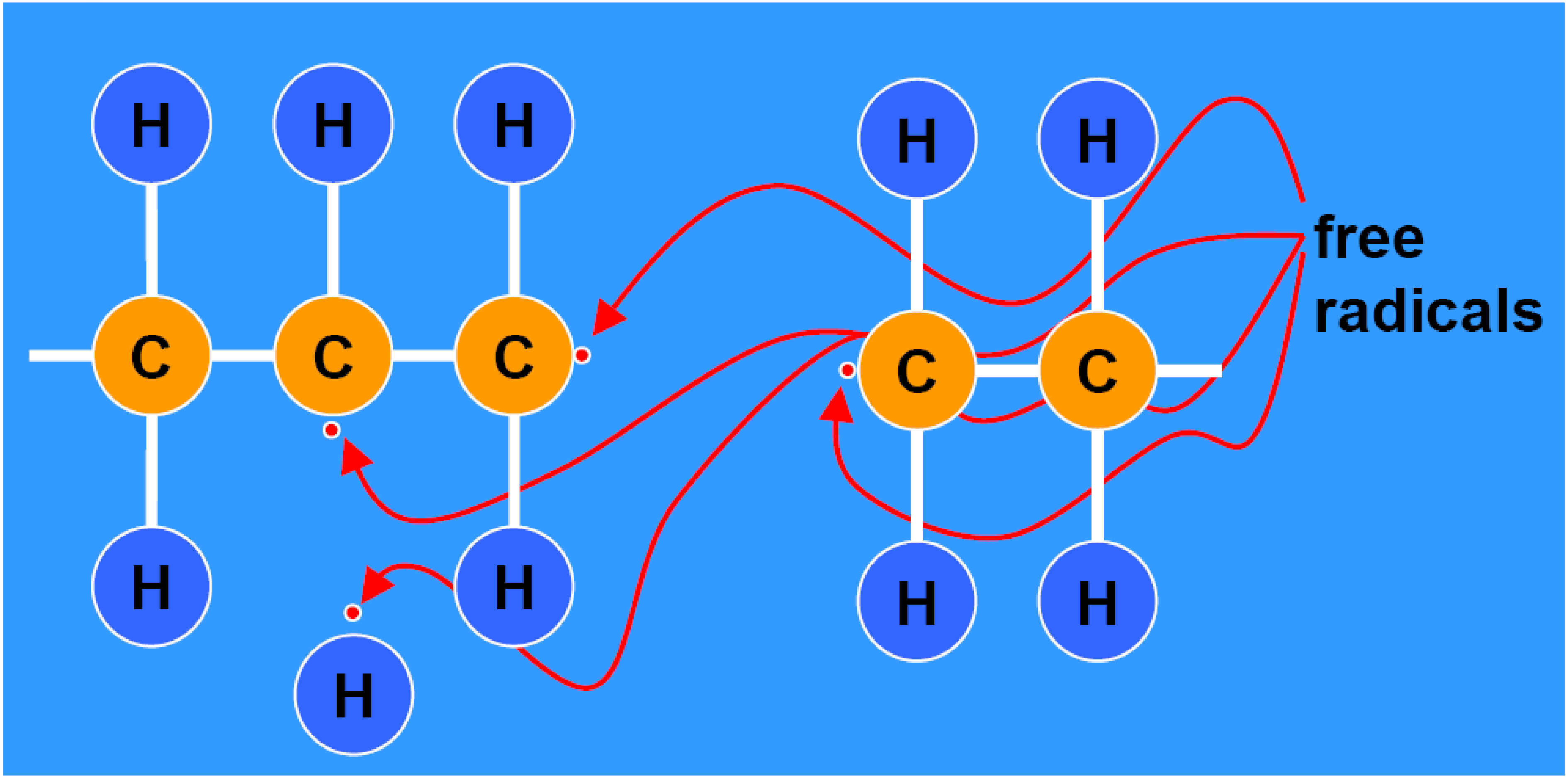


(Direct) compression molding

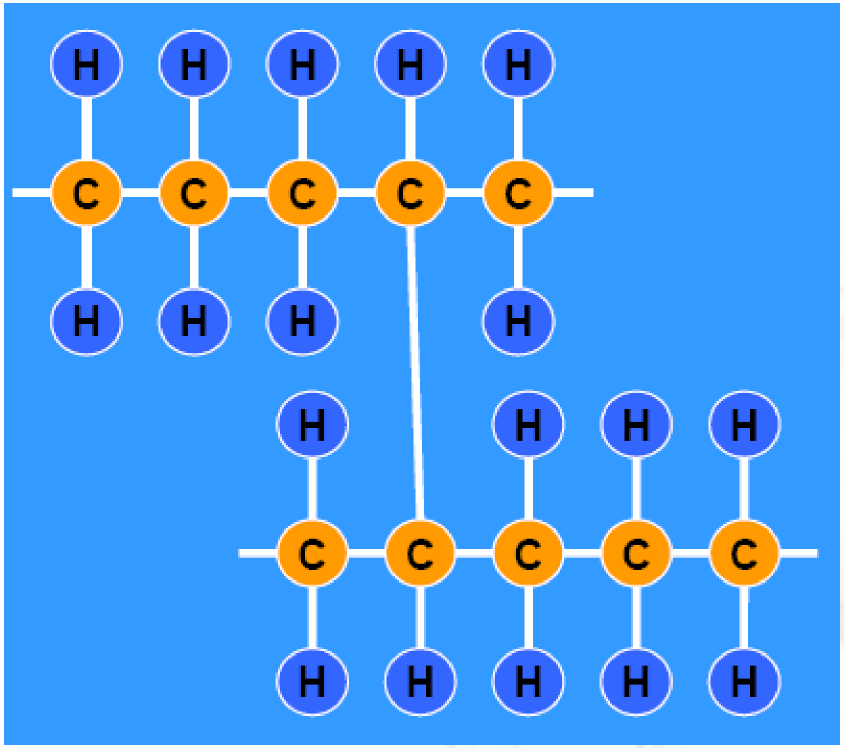
Well consolidated material

Oxygen-free γ-sterilization and packaging

HXLPE



HXLPE



Wear Reduction

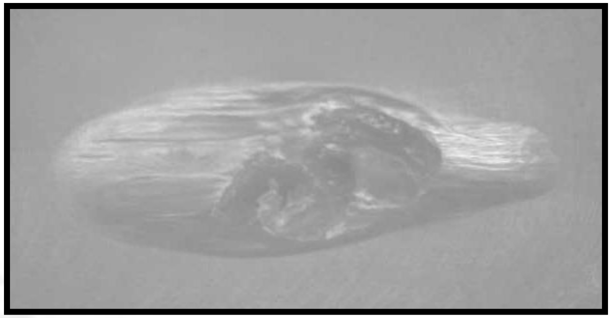
Liner wear rate lesser than 0.1mm\yr

➔ Very low risk of osteolysis-loosening

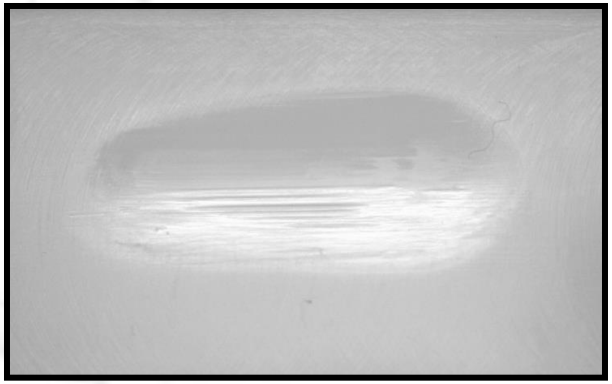
Fisher J: tribology in total hip arthoplasy, K. Knahar (Ed) 3-9; EFORT 2011

Wear Damage

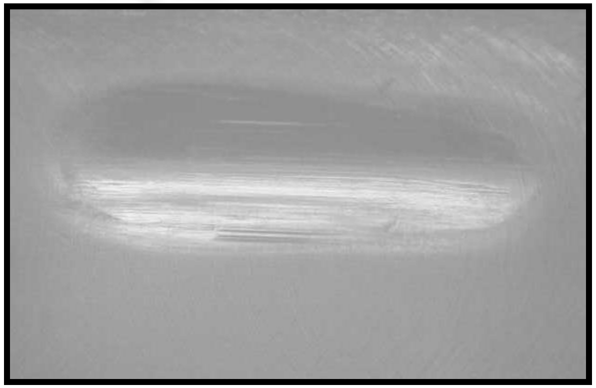
Control
pitting, cracking



65 kGy
burnishing only

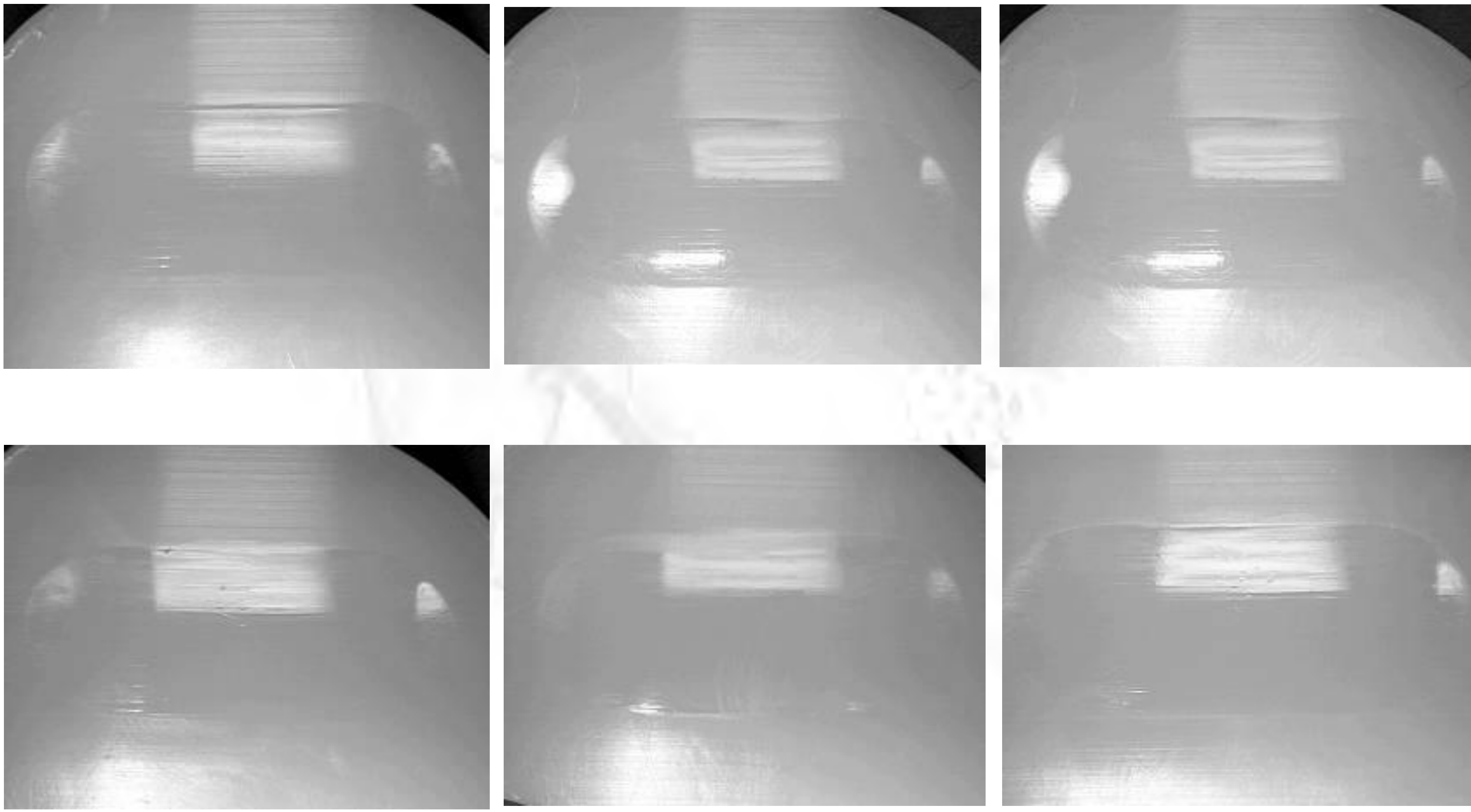


120 kGy
burnishing only



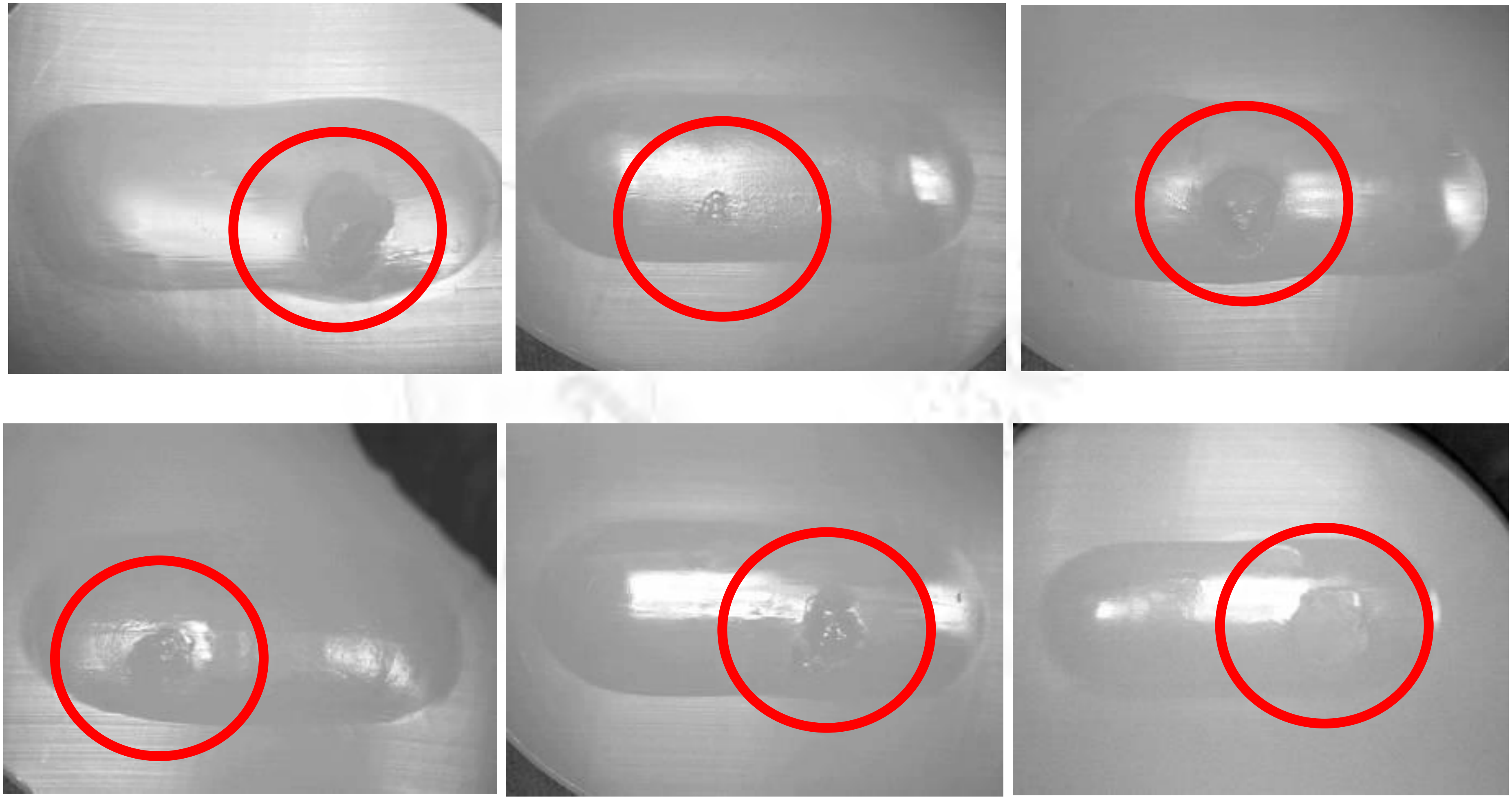
Kurtz SM: The UHMWPE Handbook. New York, Academic Press,2004

HXLPE: 72 kGy
No delamination at 8 M/c



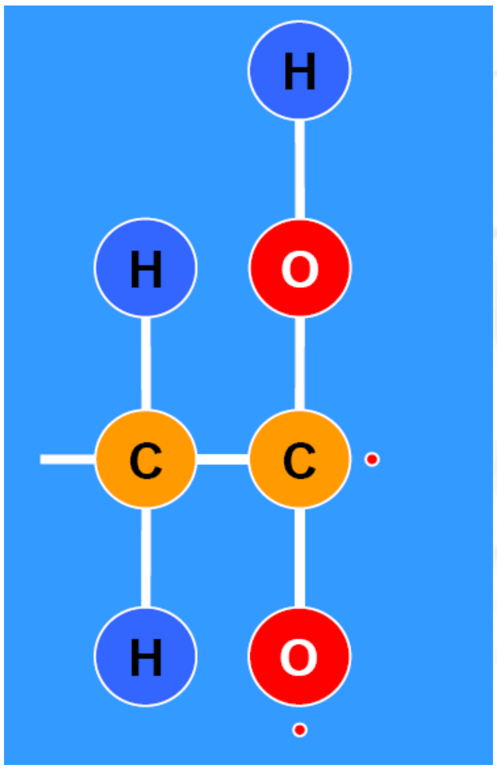
Kurtz SM: The UHMWPE Handbook. New York, Academic Press,2004

Control: 37 kGy
All delaminated at 2.7 M/c



Kurtz SM: The UHMWPE Handbook. New York, Academic Press,2004

HXLPE oxidation



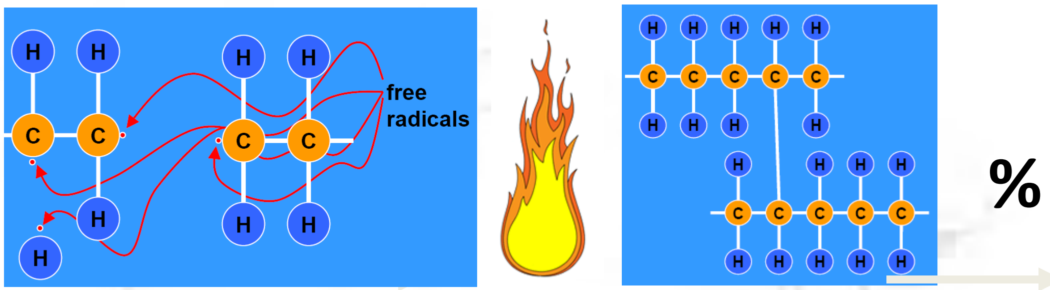
- Decreasing of mechanical properties
- Decreasing of wear resistence

HXLPE

Remelting or Annealing

Reduction of

Free Radicals



% crystal

% amorphous

%Crystal ± Amorphous%

- **Strenght**
- **Plasticity**
- **Hardness**

HXLPE features

- Radiation type
- Radiation dose
- Thermal stabilization
- Machining
- Terminal sterilization

Evolution of Polyethylenes for TJA

Technology	Name	Introduction year
Firts Gen Highly cross-linked	GUR 402/405 Sulene Hylamer Duration	1985-1996
Second Gen Highly cross-linked (annealed)	Crossfire	1998
Second Gen Highly cross-linked (re-melted)	Durasul Reflection Longevity Marathon	1999-2001
Third Gen Sequentially Highly cross-linked (annealed)	X3	2005
Third Gen Vitamin E doped Highly cross-linked (annealed)	E1	2007

Streicher R M: tribology in total hip arthoplasy, K. Knahar (Ed) 61-70; EFORT 2011

TABLE 1. Cross-linked Materials Tested

Manufacturer	Resin	Fabrication	Radiation Source	Dose to Cross-link	Anneal
Biomet ArCom®	1900H	Direct compression molded or machined from molded bar	Gamma	2.5–4 Mrad	None
DePuy/Johnson & Johnson Marathon™	1050	Machined from extruded bar	Gamma	5 Mrad	Above-melt temperature (150°C)
Smith & Nephew Reflection™ XLPE	1050	Machined	Gamma	5 Mrad	At-melt temperature (136°C)
Stryker Howmedica Osteonics Crossfire™	1050	Machined	Gamma	7.5 Mrad*	Below-melt temperature (>120°C)
Sulzer Orthopaedics Durasul™	1050	Machined from compression molded sheet	Electron beam	9.5 Mrad	Above-room temperature preheating before electron beam; melt anneal; controlled heat and cool rates; warm irradiation with adiabatic melting
Zimmer Longevity™	1050	Compression molded and machined	Electron beam	10 Mrad	Above-room temperature preheating before electron beam; process between cold irradiation with subsequent melting and warm irradiation with adiabatic melting

Clinical Studies: XLPE vs Conventional PE

TABLE 61-2 CLINICAL DETAILS OF PRIMARY, PEER-REVIEWED STUDIES INVOLVING CROSSFIRE CROSS-LINKED POLYETHYLENE (STRYKER ORTHOPEDICS, MAHWAH, NJ)

	Martell et al (2003)[29]	Rohrl et al (2005)[32]	Krushell et al (2005)[31]	D'Antonio et al (2005)[30]
Study type	RCT	Pcoh	Hcoh	Hcoh
Number of institutions	5	1	1	1
Cup design	Secur-Fit HA	Osteonics	Microstructured PSL	Microstructured PSL
Cup fixation	Noncemented	Cemented	Noncemented	Noncemented
Head size	28 mm	28 mm	28 mm	28 mm
Head material	CoCr L-Fit	CoCr	CoCr L-Fit	CoCr L-Fit
Average age	60	58	69	57.4
Age range	28-76	49-79	45-83	—
Number of hips	46 (24 Crossfire)	50 (10 Crossfire)	80 (40 Crossfire)	109 (56 Crossfire)
Follow-up in years	2.3	3	4	4.9
Range in follow-up	1.8-3.2	3	2.6-4.7	4-5.8
Number of device failures	None	None	None	None
Wear methodology	Martell	UmRSA	Ramakrishnan	Ramakrishnan
Two-dimensional linear penetration (mm/yr)*—cross-linked	0.12 ± 0.05	0.02	0.05 ± 0.02	0.06 ± 0.02
Two-dimensional linear penetration (mm/yr)*—control	0.20 ± 0.10	0.16	0.12 ± 0.06	0.14 ± 0.07
Percent reduction	42	85	58	72
Radiographic assessment of osteolysis	No	No	No	Yes

**The two-dimensional linear wear is listed for the longest follow-up period and includes the initial, bedding-in period.*

Hcoh, Retrospective cohort study (Level III); L-Fit, low-friction ion treatment; Pcoh, prospective cohort study; RCT, randomized controlled trial (Level I).

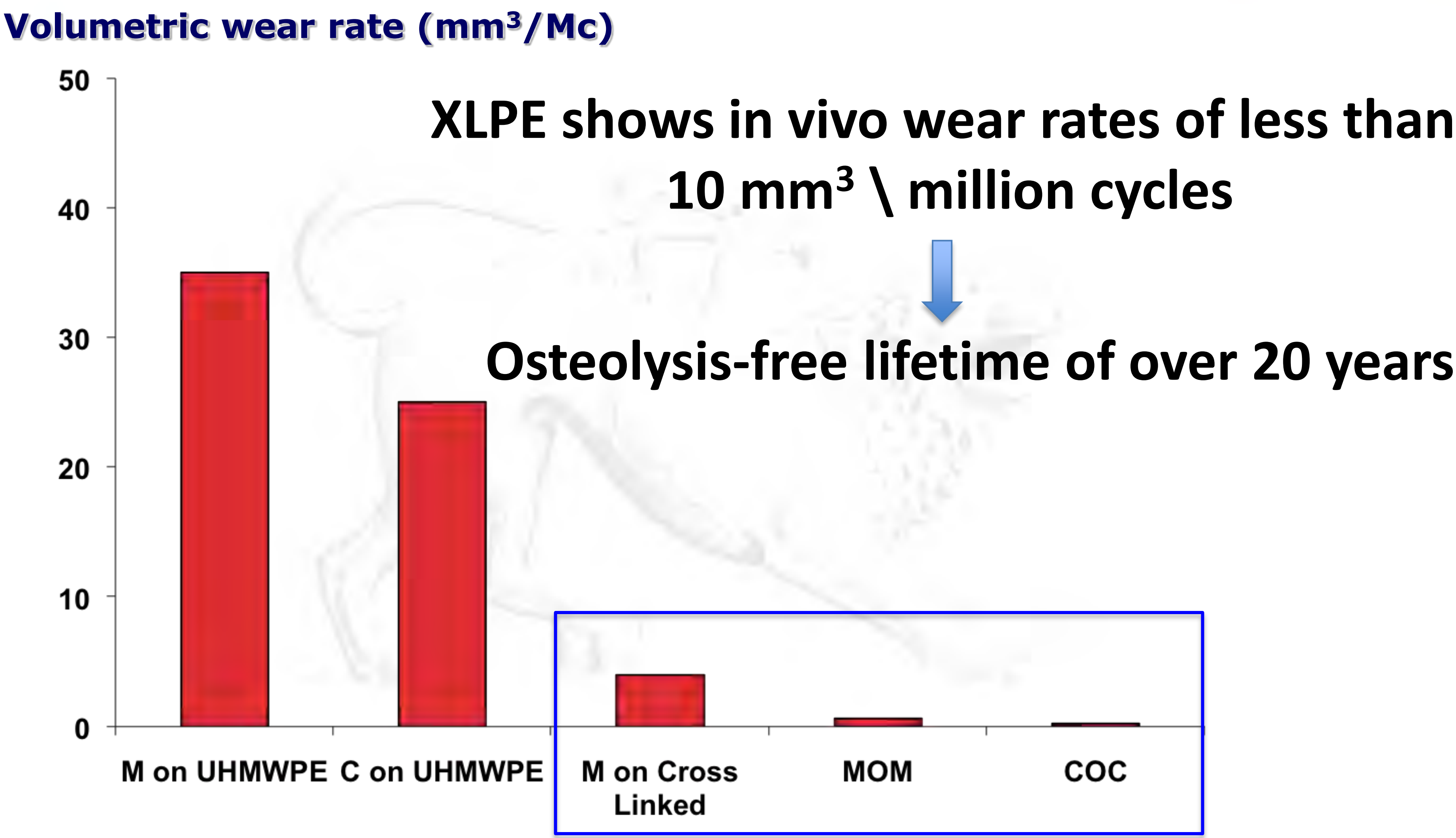
Clinical Studies: XLPE vs Conventional PE

- RCT: randomized controlled trial (Level I)
- Pcoh: prospective cohort study
- Hcoh: retrospective cohort study

Better performance of XLPE:

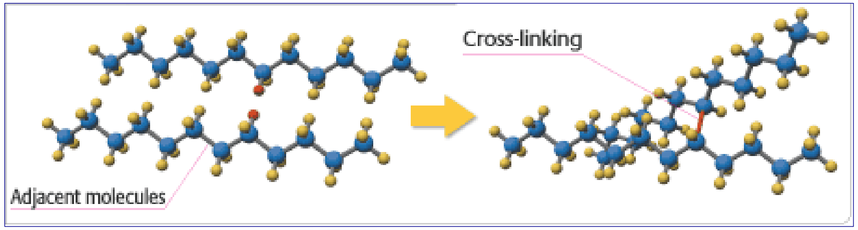
- Two dimensional head penetration (mm/yr)
- Wear percent reduction
- Radiographic assessment of osteolysys

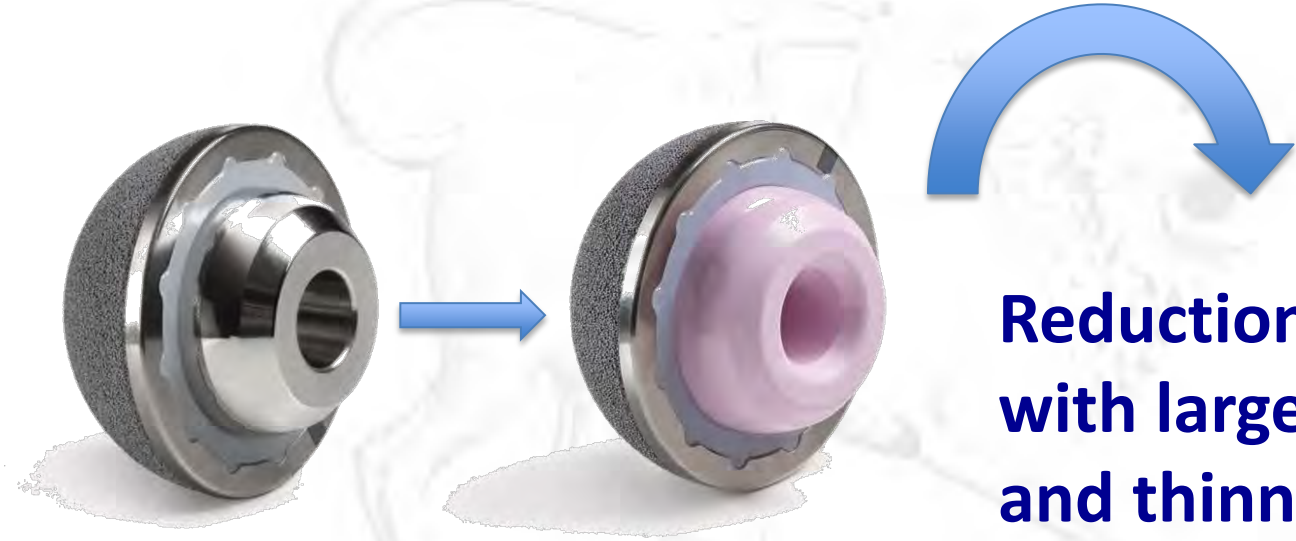
Traditional vs new couplings



Fisher J: tribology in total hip arthoplasy, K. Knahar (Ed) 3-9; EFORT 2011
Wang A: wear and structural fatigue simulation of HxPE for hip and knee bearing applications. ASTM STP 1445, 151(2003)

New Poly Wear





Reduction of wear rate with larger heads and thinner liners

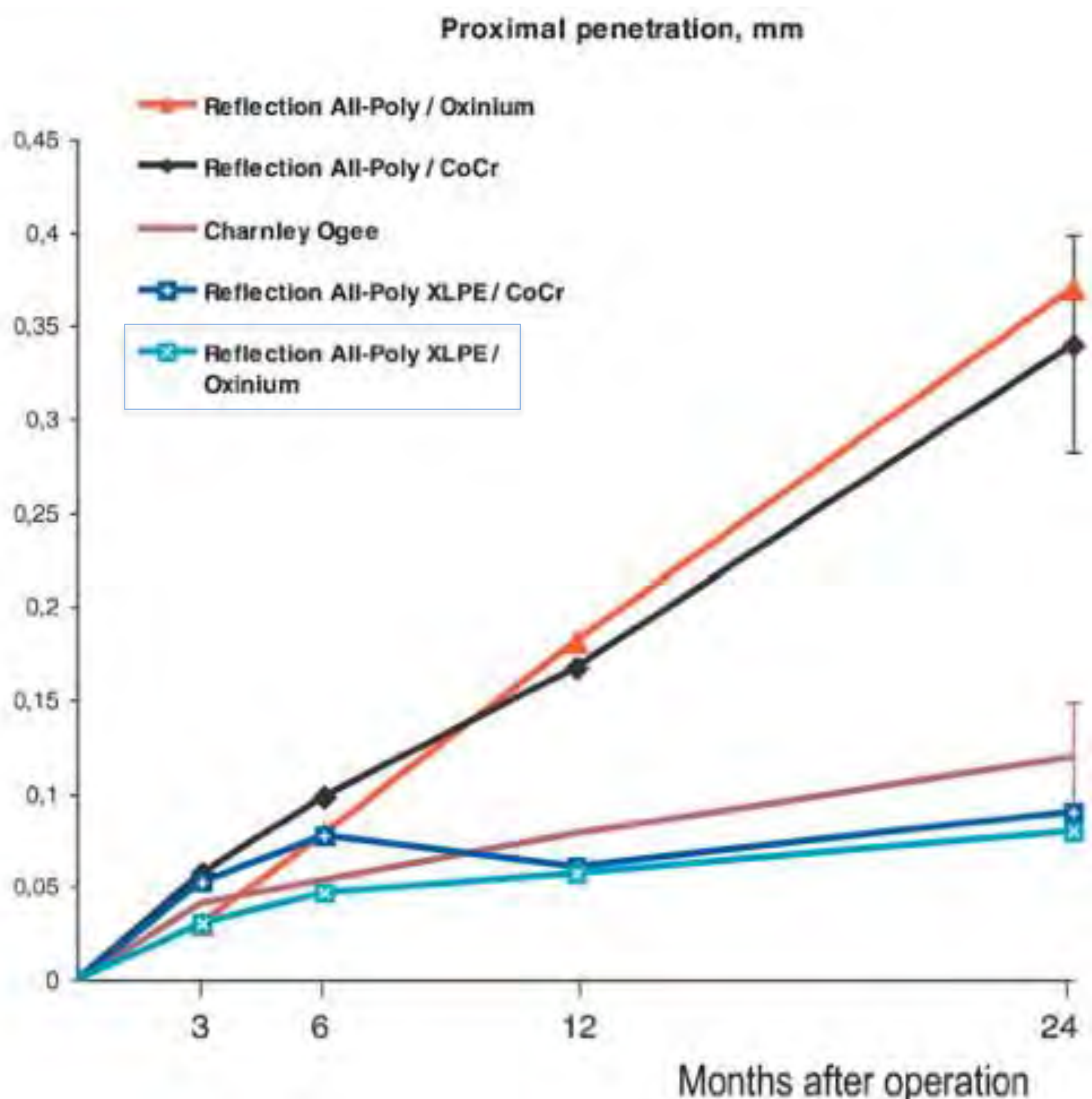
Herrera L: hip simulator evaluation of the effect of of femoral head size on sequentially cross-linked acetabular liners. Wear 263, 1034 (2007)
Galvin AL, Fisher J:wear of highly cross linked polyethylene against cobalt chrome and ceramic femoral head. Proc. Inst. Mech. Eng. H224. 1175-83 (2010)

New Poly Wear

Verilast Tchnology

Wear and Migration o
Cemented Polyethyler
Heads: A Randomized

Thomas Kadar,[1,2] Geir Hallan,[1] Arild A
Terje Stokke,[6] Kristin Haugan,[3] Birgitte



Smith & Nephew data.

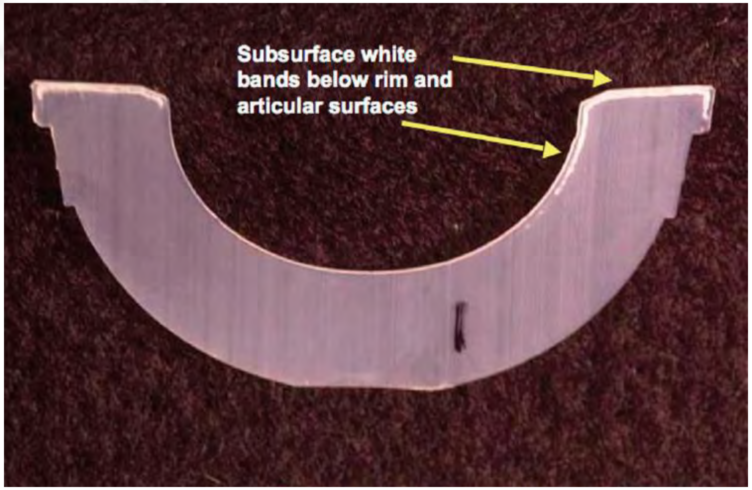
CURRENT CONTROVERSIES

- **In vivo Oxidation**
- Rim Brekeage

Evaluation of Oxidation and Fatigue Damage of Retrieved Crossfire Polyethylene Acetabular Cups

By Barbara H. Currier, MChE, John H. Currier, MS, Michael B. Mayor, MD,
Kimberly A. Lyford, BA, John P. Collier, DE, and Douglas W. Van Citters, PhD

Investigation performed at the Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire



Third Generation HXLPE

Two Method of fabrication/sterilization reducing wear with limited effect on mechanical properties

Sequential Irradiation and Anneling (3x3)

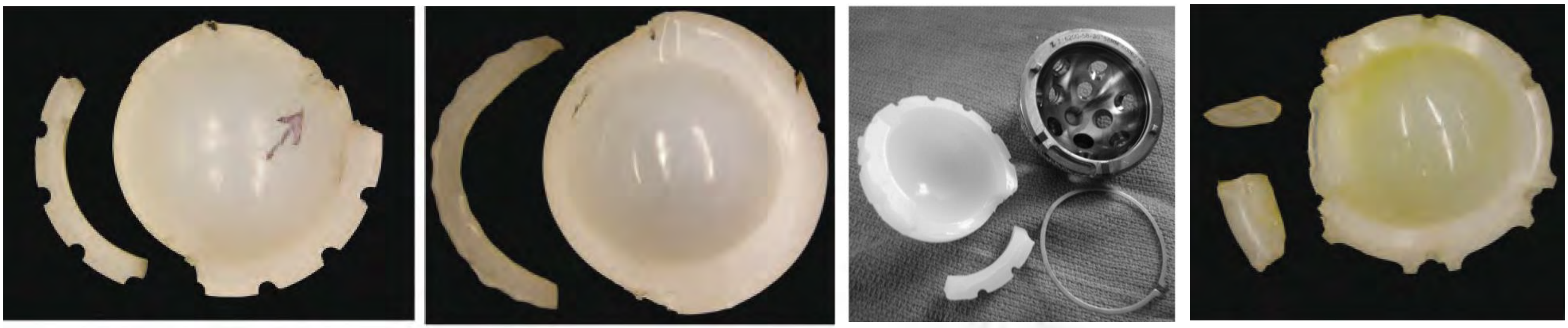
Vitamin E Doping below melting temperature

Oral-Muratoglu, J Arthropl 2008

CURRENT CONTROVERSIES

- In vivo Oxidation
- **Rim Brekeage**


XLPE: very low wear rate but with possible mechanical failure



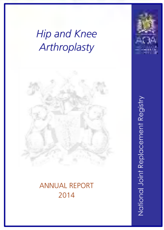
- **XLPE is mechanically inferior to conventional PE due to reduced toughness and strenght**
- **XLPE behaves like ceramic in case of instability and impingement**
- **XLPE breaks at the unsupported rims during impingement or subluxation**

Harris W: three revolutions in acetabular revision surgery. Abstract 16° ISTA: 24-28 (2003)

Ideal HXLPE liner

- Thickness > 5 mm
- No rim elevation
- Monoblok
- 32 – 36 head diameter
- Vit E ?

Bearing Surface Options Survivorship



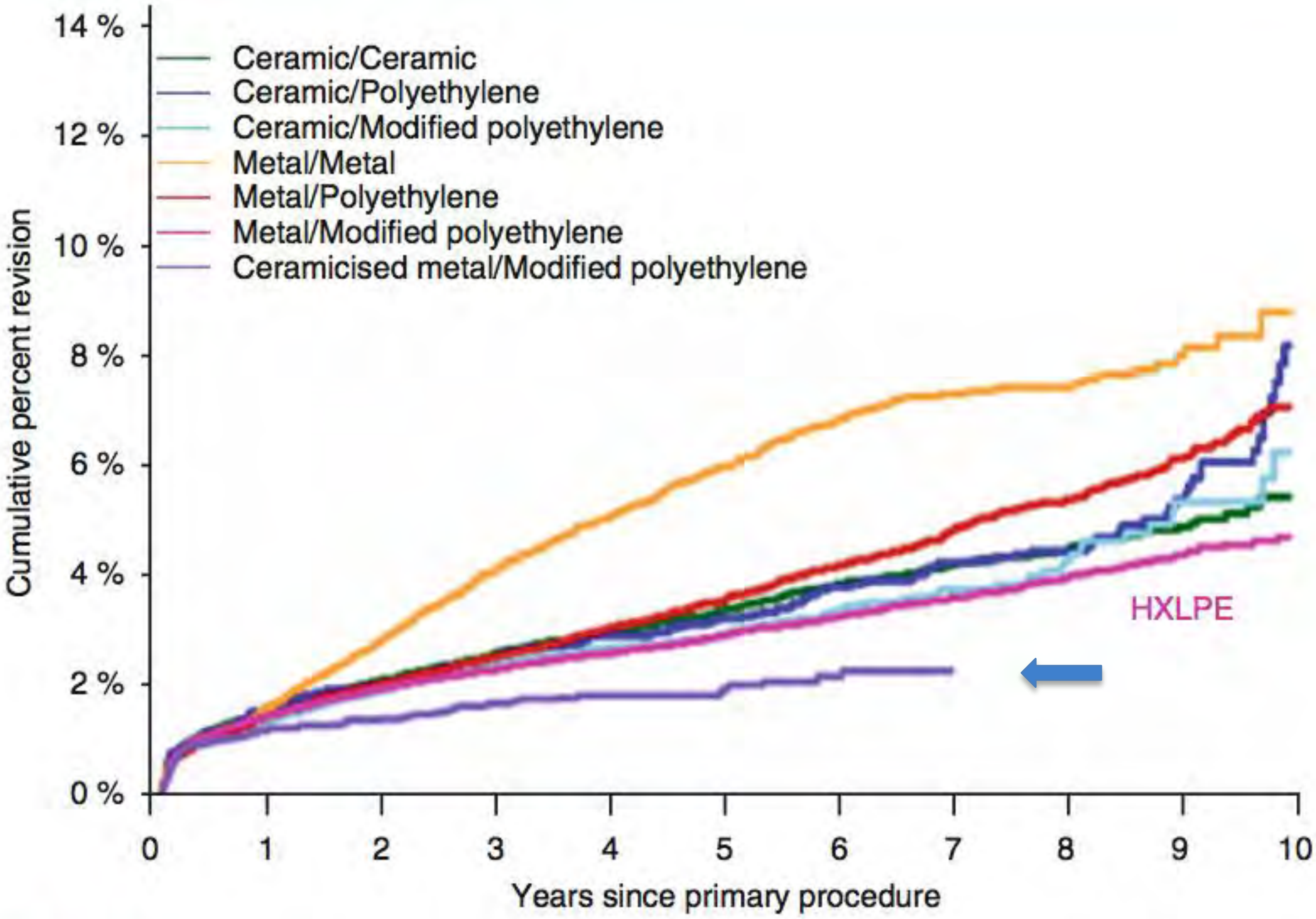


Fig. 11.6 10-year survival data for HXLPE from the Australian arthroplasty register

In Vivo Basic Wear Conditions
Technique Related

- **Impingment**
- **Edge loading**
- **Instability**

GOAL

CORRECT COMPONENTS POSITION

CONCLUSIONS

- ✓ ***Osteolysis has been the major cause of failure of the 20th century, but with the new bearing options it is clearly decreasing.***

- ✓ ***Second generation HXLPE are showing good performance in vivo after one decade follow-up.***

- ✓ ***Third generation HXLPE are promising for further better survivorships reducing oxidation and improving mechanical resistence.***

- ✓ ***Even with excellent bearing surfaces, the surgeon’s goal remains the correct components position.***

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

UNIVERSITY OF CATANIA

Orthopaedic and Traumatology Clinic

CHIEF: M.D. GIUSEPPE SESSA

METAL ON METAL TOTAL HIP REPLACEMENT: OUR EXPERIENCE AT MID-TERM FOLLOW-UP

S. Gioitta Iachino*, F.R. Evola, V. Pavone, L. Costarella, G. Sessa

BRITISH HIP SOCIETY

Società Italiana dell'Anca

26-27 NOVEMBER 2015 MILAN, ITALY

FOCUS ON METAL ON METAL

- ✓ Since 1996 more than **one million** metal-on-metal articulations have been implanted worldwide

- ✓ Highest wear rates occur during first year ***"run in phase"*** (8 mm_3/y) and followed by ***"steady state phase"*** (1 mm_3/y)

M. Hasegawa et all. Cobalt and Chromium Ion Release After Large-Diameter Metal-on-Metal Total Hip Arthroplasty. The Journal of Arthroplasty Vol. 27 No. 6 20

FOCUS METAL ON METAL

WEAR DEBRIS

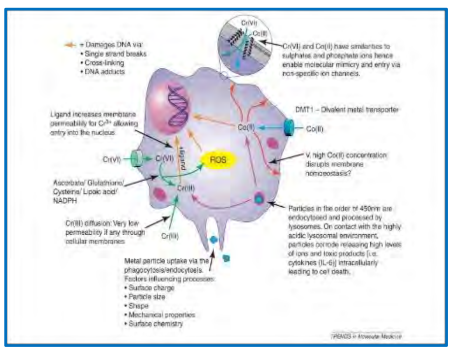
PARTICLES IN THE ORDER OF 450 nm ARE ENDOCYTOSED BY LYSOSOMES, RELEASING HIGH LEVELS OF IONS (20 nm diameter sizes) AND TOXIC PRODUCTS

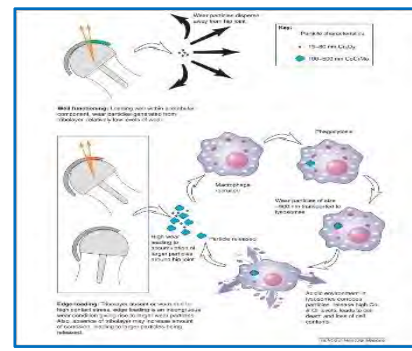
TOXICITY DIRECTLY

CELL NECROSIS

TOXICITY UNDIRECTLY

HYPERSENSITIVITY IV





OSTEOLYSIS AND LOOSENING

Chess DG, et al. *Metal-on-metal versus polyethylene in hip arthroplasty: a randomized clinical trial.* Clin Orthop Relat Res 2013

PATIENTS AND METHODS

December 2005 – April 2007

✓**13 PATIENTS** (4 FEMALE-9 MALE) UNDERWENT THR WITH

DUROM CUP

✓ AVERANGE AGE 52 YEARS OLD

✓ ANTERO-LATERAL ACCESS (W-J MODIFIED)

✓ CLINICAL AND RADIOLOGICAL YEARLY FOLLOWED

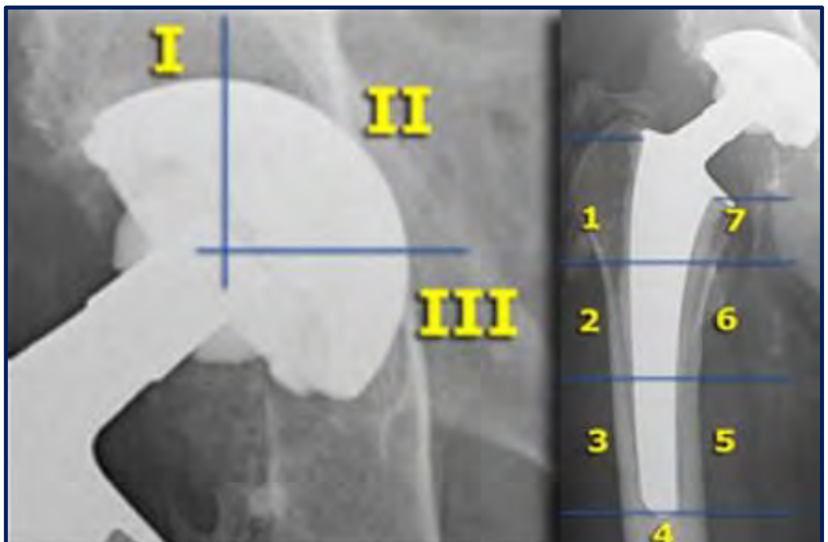
DURING 2015 ALL PATIENTS WERE RECALLED FOR *CLINICAL*, STRUMENTAL (RX-MRI); CR/ CO BLOOD EVALUATION

MAXIMUM FOLLOW UP 10 YEARS

STRUMENTAL EVALUATION

ANTEROPOSTERIOR AND LATERAL RADIOGRAPHS

RADIOLOGICAL ASSESSMENT WAS PERFORMING WITH *CHARNLEY DE LEE* (Modified by Beaulè-2004) **AND *GRUEN* SCORE**



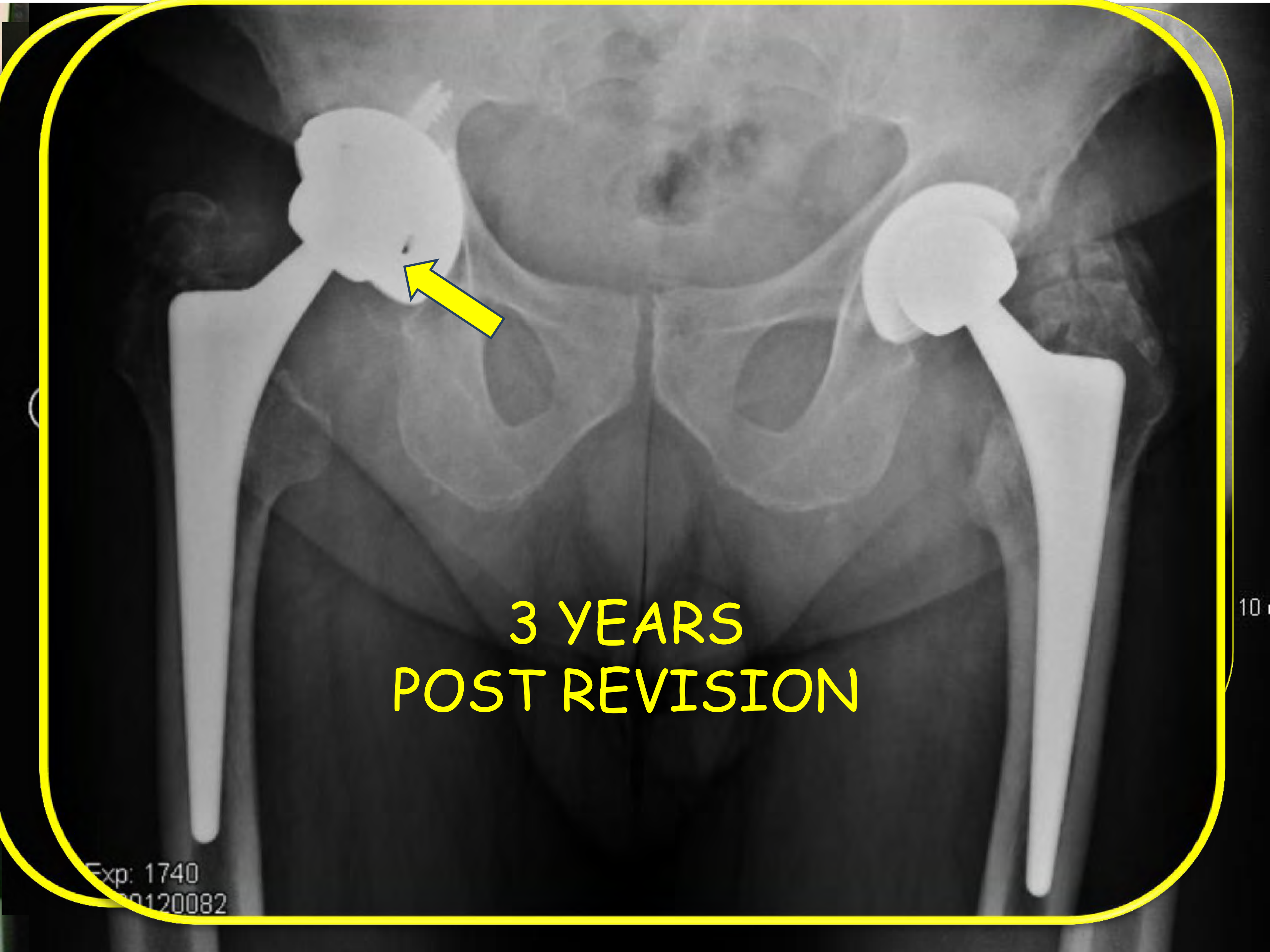
RX RESULTS

9 → **NO OSTEOLYSIS, STABLE IMPLANT**

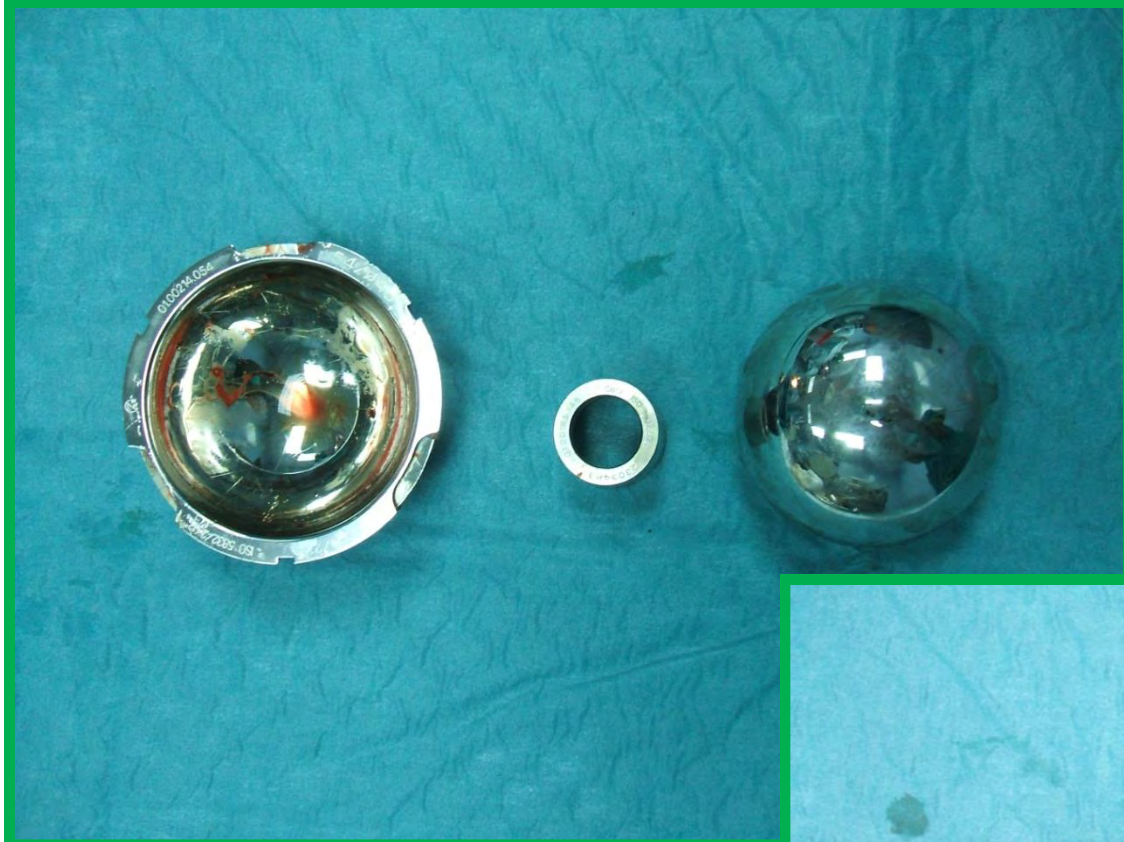
2 → ***1° e 2° BROOKER***

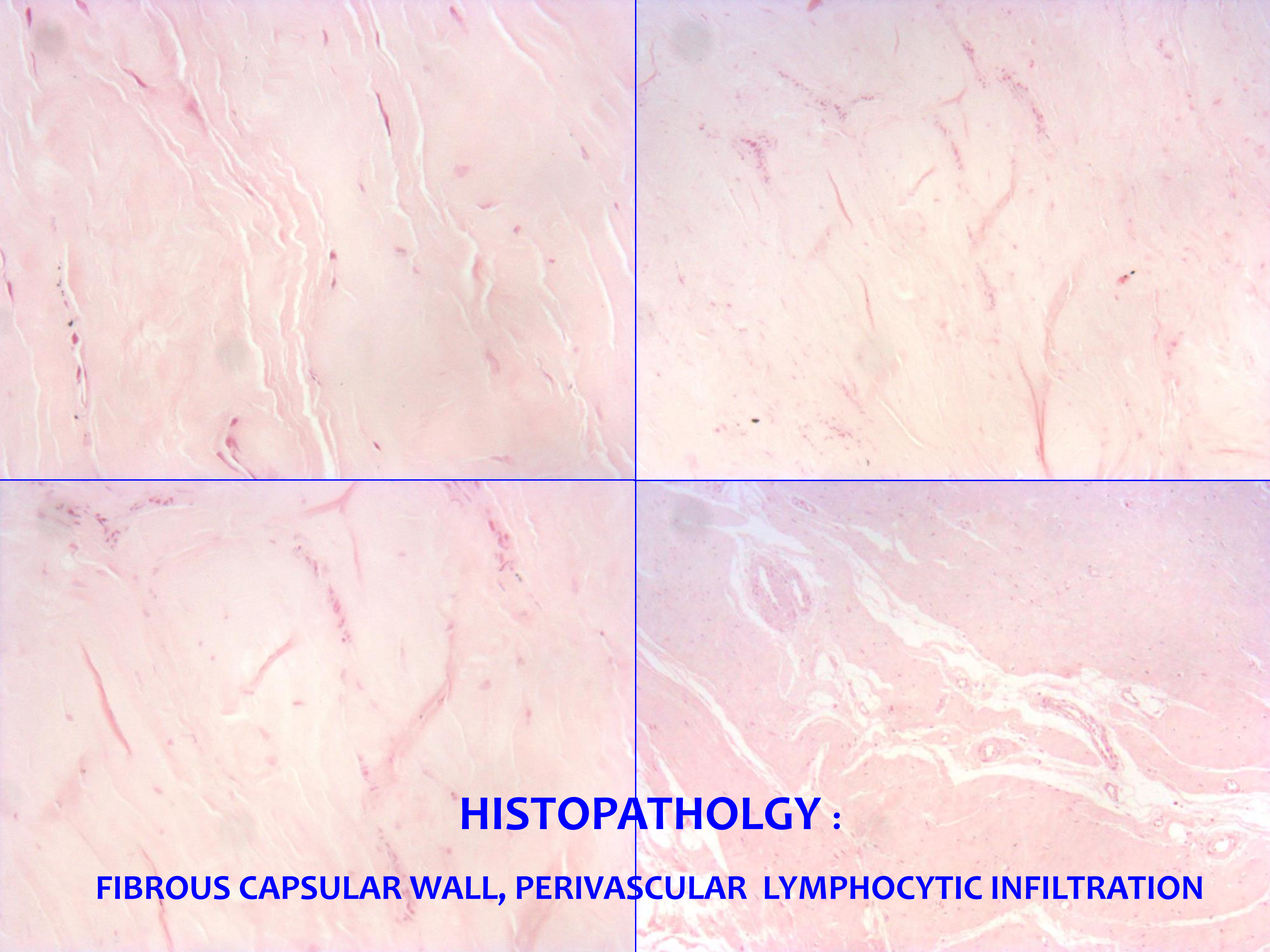
1 → **PATIENT UNDERGOING REVISION** ↓ ***ASEPTIC LOOSENING***

1 → ***CALCAR RESORPTION***


3 YEARS
POST REVISION
Exp: 1740

RETRIEVED CUP




HISTOPATHOLGY :
FIBROUS CAPSULAR WALL, PERIVASCULAR LYMPHOCYTIC INFILTRATION

RESULTS

statistical analyses

Inductively coupled plasma mass spectrometry

	n.	PATIENTS (Dev. Stand.)	n.	CONTROLS (Dev. Stand.)	*p* value	
Blood Nickel	13	3,09 (3,80)	11	3,62 (3,14)	n.s.	0,5 - 4,0
Blood Cobalt	13	4,36 (5,46)	11	0,28 (0,11)	<0,001	0,1 - 1
Blood Molibdeno	13	1,11 (0,46)	11	0,79 (0,21)	n.s.	-
Blood Chrome	13	5,19 (2,91)	11	1,45 (0,68)	<0,001	0,1 - 1
Blood Titanium	13	10,57 (4,89)	11	0,91 (1,36)	<0,001	-
Urine Nickel	13	4,97 (5,74)	6	3,00 (2,51)	n.s.	0,1 - 4,0
Urine Molibdeno	13	61,91 (43,52)	6	27,03 (22,10)	<0,001	11,1 - 156
Urine Cobalt	13	6,83 (5,36)	6	0,35 (0,27)	<0,001	0,2 - 2
Urine Chrome	13	4,01 (3,77)	6	0,65 (0,25)	<0,001	n.d. - 2
Urine Titanium	13	0,79 (0,49)	6	0,43 (0,18)	n.s.	-

***WILCOXON-MANN-WHITNEY* STATISTIC TEST**
SHOWS HIGHLY SIGNIFICANT LEVEL

M

Metal Arti

ANDERSON et all 20

WHAT IS

STAGING SYSTEM

WHICH SCORING

Table 2 The key features of the [redacted]

Grade	Description	Criteria
C1	Mild	Less than 5 cm maximal diameter
		attenuation
C3	Severe	Extension through deep fascia Tendon avulsion Marrow signal abnormality Fracture

A variety of techniques used for reducing metal artifacts at MRI =

- ✓ STIR for fat suppression (spectral fat suppression performs better in a homogeneous field)
- ✓ spin echo instead of gradient echo where possible
- ✓ shorter echo spacing
- ✓ smaller water-fat shift
- ✓ thinner slices
- ✓ maintain good SNR
- ✓ increase bandwidth during slice selection and readout
- ✓ view-angle-tilting (VAT)

Anderson H, et all. Grading the severity of soft tissue changes associated with metal-on-metal hip replacements: reliability of an MR grading system. Skeletal Radiol. 2011

M.A.R.S. RESULTS

Anderson C3

1

PSEUDOTUMOR

PAZIENTS WITH HIGHEST
CHROME VALUE
10 μg/L

SYMPTOMS

Anderson C1

6

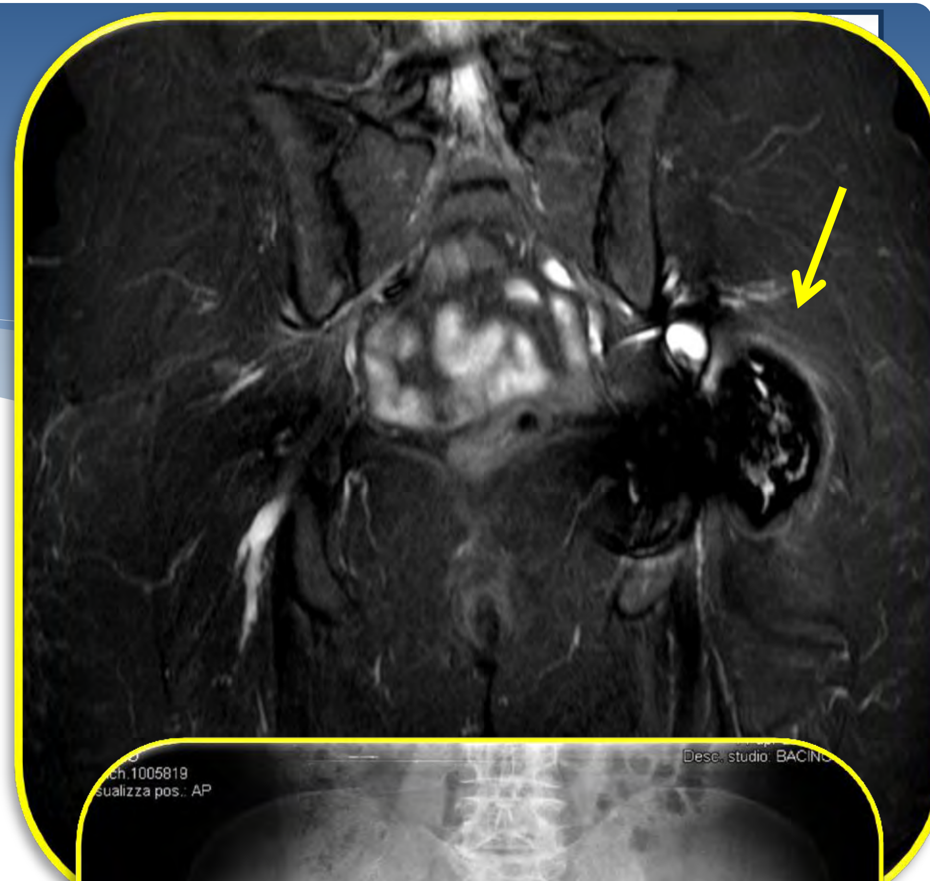
JOINT EFFUSION

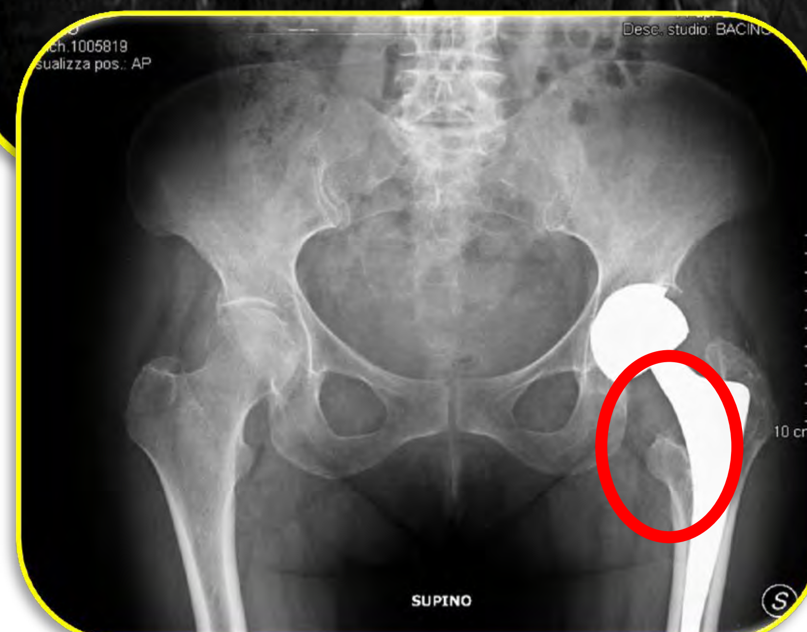
6

NO LESIONS

CHROME AVERAGE VALUE
5 μg/L

NO SYMPTOMS





PSEUDOTUMOR

Female, 61 years old

ANDERSON C3

CHROME **10 µL**

COBALT **9 µL**

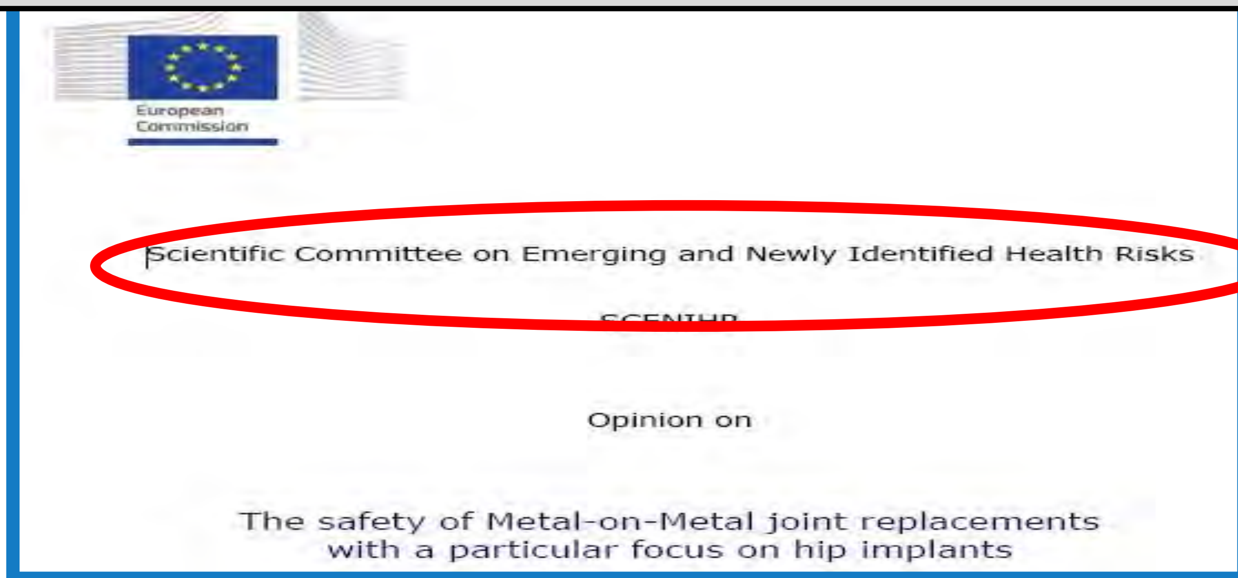
No systemic deseases

CONCLUSIONS

- Good results at mid term with Durom cup (wide ROM and stable implant, our metal ions values **5,5 µg/l** agreement with literature)

- Necessary strictly follow up: metal ions detection, mri mars, ultrasound.

- 5-7 µg/l is already attention threshold


European Commission

Scientific Committee on Emerging and Newly Identified Health Risks

SCENIHR

Opinion on

The safety of Metal-on-Metal joint replacements with a particular focus on hip implants


THANKS

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Clinica Ortopedica Università di Padova
Direttore Prof. P. Ruggieri

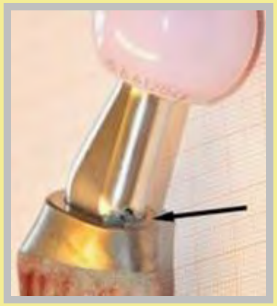
Metallosis in total hip arthoplasty: an experimental comparative study in three different bearings

A. Zaia – L. Todros – A. Pozzuoli – A. Berizzi – R. Marin – C. Iacobellis

INTERNATIONAL COMBINED MEETING
BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

WEAR → CORROSION → ALTERED LUBRICATION

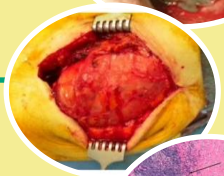
METAL DEBRIS



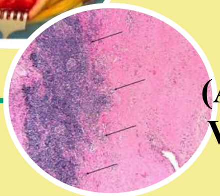
ARMD

Adverse Reaction to Metal Debris

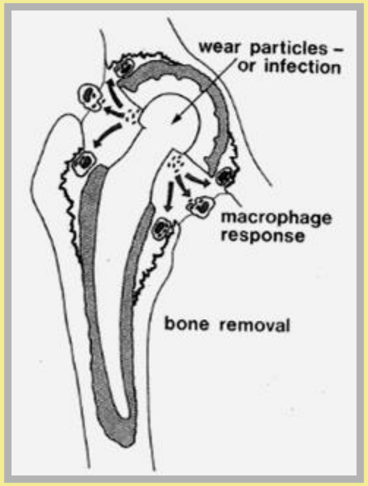
Metallosis



Pseudotumor

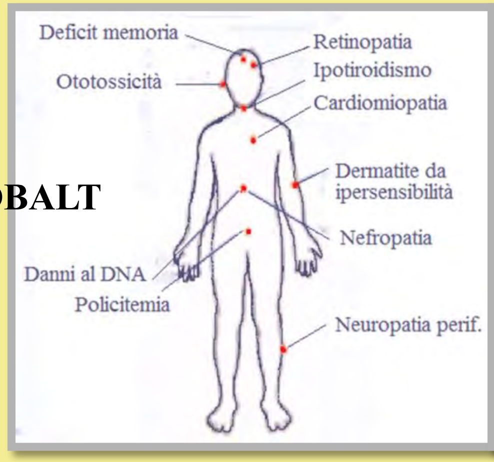


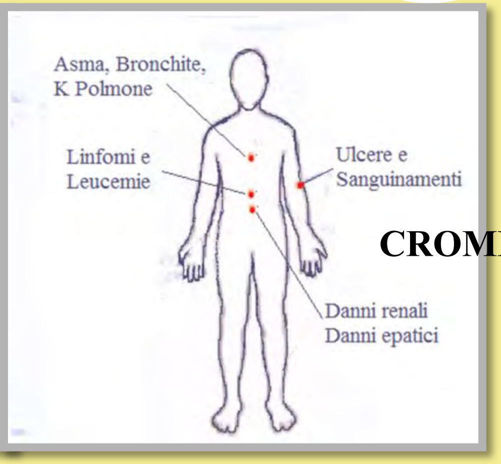
ALVAL
(Aseptic Lymphocytic Vasculitis-Associated Lesion)



Aseptic Loosening

COBALT





CROMIUM

OBJECTIVES

- Compare Cr-Co ion levels and ARMD incidence in 3 groups of THA
- Best prosthetic implant with regards to risk-benefit ratio
- Effectiveness of monitoring protocol
- Identify any risk factors associated to high levels of metal ions
- Correlation among [Cr]-[Co] and mechanical and bio-chimical parameters
- Influence of renal function in Cr-U e Co-U values

STUDY POPULATION

INCLUSION CRITERIA:

- ✓ THA MoM-CoC-TriboFit
- ✓ Written Consent
- ✓ Prolongued follow up

EXCLUSION CRITERIA:

- ☒ Professional exposure to metal ions
- ☒ Renal and immunological disease
- ☒ Severe disability

- **52** THA **MoM**
  - Controls: at recruitment, 6, 12 and 24 months

- **25** THA
  metal polycarbonate-urethane (**TriboFit©**)
  - Controls: at recruitment, 6, 12 and 24 months

- **50** THA **CoC**
  - Controls: at recruitment and at 24 months

STUDY POPULATION

	N°	Age	Gender		Diagnosis			Side		
			M	F	Fracture	Arthrosis	Other	R	L	R+L
MoM	52	65,2	18 (35%)	34 (65%)	28 (54%)	21 (40%)	3 (6%)	23 (44%)	24 (46%)	5 (10%)
Tribofit©	25	78,9	5 (20%)	20 (80%)	25 (100%)	/	/	13 (52%)	12 (48%)	/
CoC	50	67,7	20 (38%)	28 (58%)	30 (60%)	20 (40%)	/	20 (40%)	25 (50%)	5 (10%)

STUDY POPULATION

	N°	Age	Gender		Diagnosis			Side		
			M	F	Fracture	Arthrosis	Other	R	L	R+L
MoM	52	65,2	18 (35%)	34 (65%)	28 (54%)	21 (40%)	3 (6%)	23 (44%)	24 (46%)	5 (10%)
Tribofit©	25	78,9	5 (20%)	20 (80%)	25 (100%)	/	/	13 (52%)	12 (48%)	/
CoC	50	67,7	20 (38%)	28 (58%)	30 (60%)	20 (40%)	/	20 (40%)	25 (50%)	5 (10%)

STUDY POPULATION

	N°	Age	Gender		Diagnosis			Side		
			M	F	Fracture	Arthrosis	Other	R	L	R+L
MoM	52	65,2	18 (35%)	34 (65%)	28 (54%)	21 (40%)	3 (6%)	23 (44%)	24 (46%)	5 (10%)
Tribofit©	25	78,9	5 (20%)	20 (80%)	25 (100%)	/	/	13 (52%)	12 (48%)	/
CoC	50	67,7	20 (38%)	28 (58%)	30 (60%)	20 (40%)	/	20 (40%)	25 (50%)	5 (10%)

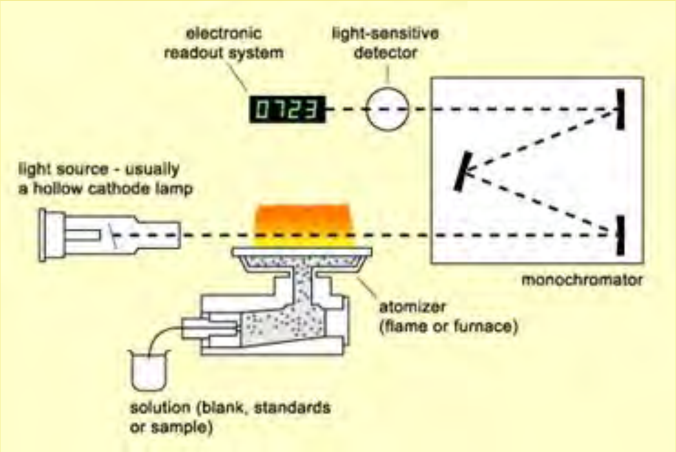
PATIENTS EVALUATION

- ***HHS***
- ***SF-36***
- ***RX***

Orthopaedic Evaluation

Toxicological Evaluation

Decisional Algorithm



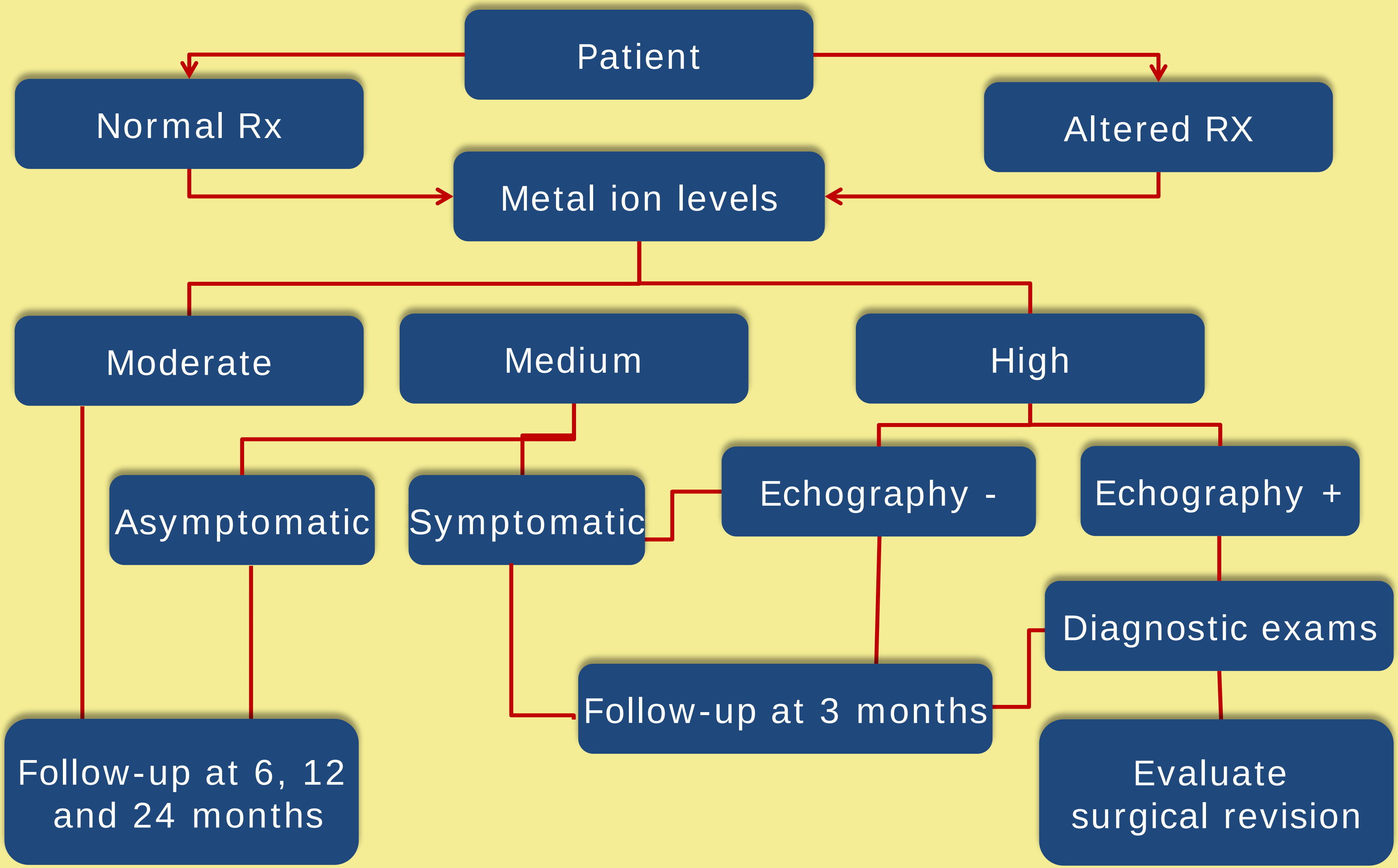
Atomic absorption spectrophotometry analysis

TOXICOLOGICAL EVALUATION

	SIVR, 2012 (µg/L)	(Italian society of reference values)
Co B	0.05 – 1	
Cr B	0,1 – 0,50	Normal population
Co U	0,1 – 1,50	
Cr U	0,05 – 0,35	

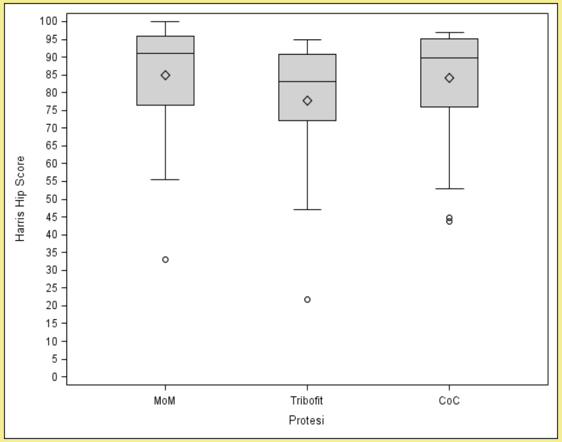
	CoB (µg/L)	CrB (µg/L)	CoU (µg/L)	CrU (µg/L)
Moderate	1 - 10	0,5 - 5	1,5 - 15	0,35 – 3,5
Medium	> 10	> 5	> 15	> 3,5
High	> 100	> 50	> 150	> 35

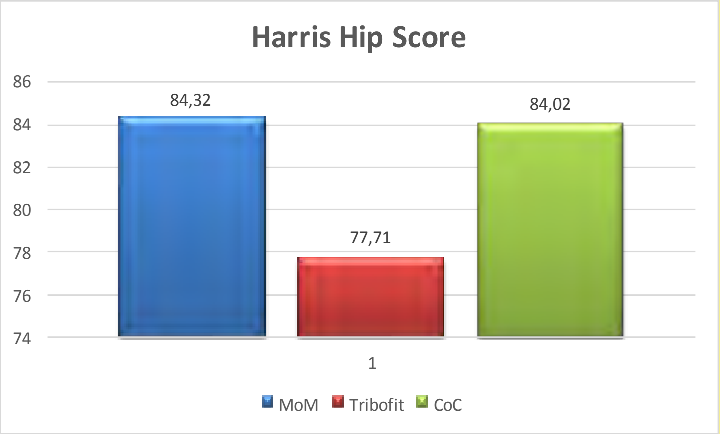
DECISIONAL ALGORITHM



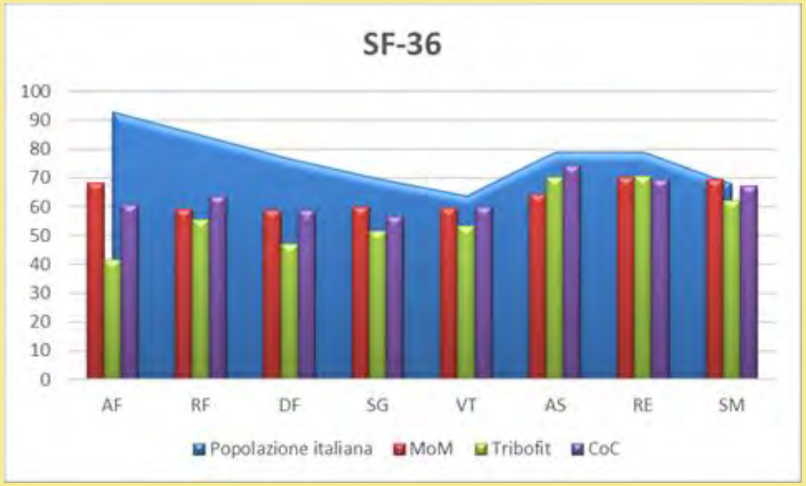
RESULTS

HHS

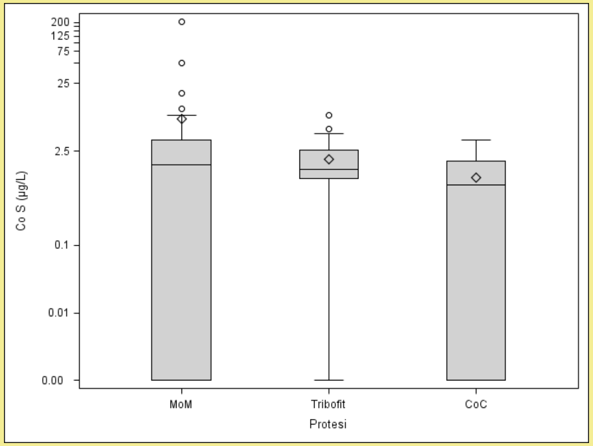




SF-36

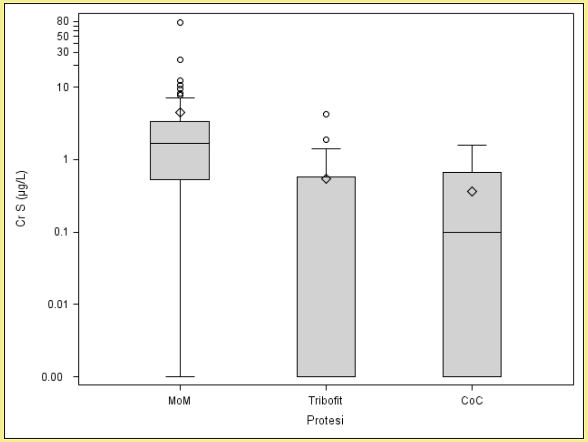


IONS CONCENTRATIONS

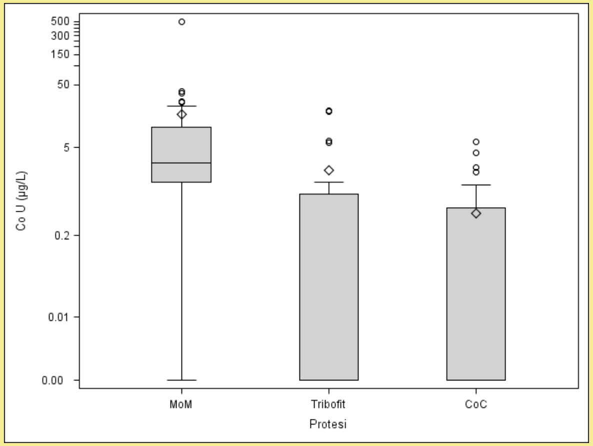


p=0,019

Co-S and Cr-S levels

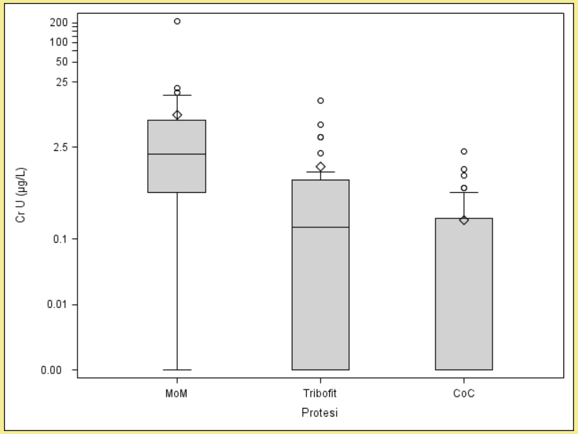


p<0,0001



p<0,0001

Co-U and Cr-U levels



p<0,0001

IONS CONCENTRATIONS

AVERAGE	MoM	Tribofit	CoC
CoB (µg/L)	7,45	1,90	1,00
CoU (µg/L)	16,93	2,21	0,45
CrB (µg/L)	4,45	0,54	0,36
CrU (µg/L)	7,95	1,27	0,19

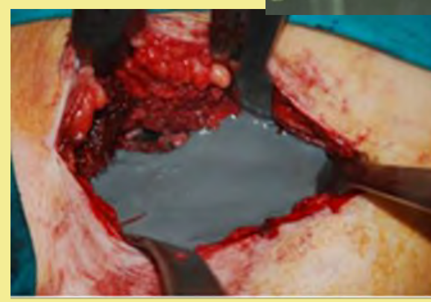
MEDIAN	MoM	Tribofit	CoC
CoB (µg/L)	1,58	1,35	0,79
CoU (µg/L)	2,82	0,10	0
CrB (µg/L)	1,69	0	0,10
CrU (µg/L)	1,96	0,15	0

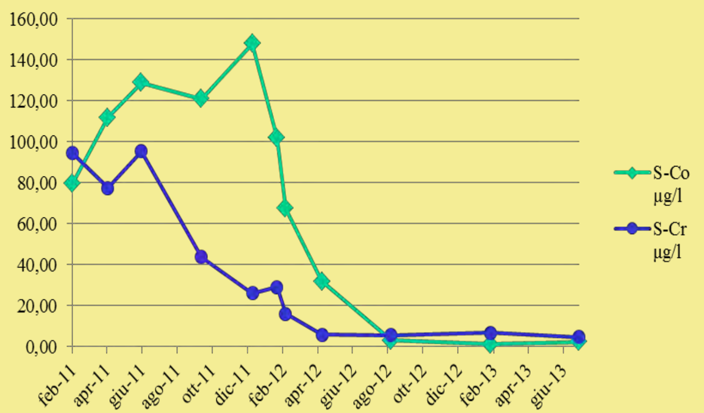
% of patients who exceeded SIVR values
(at least 1 value in 1 contol)

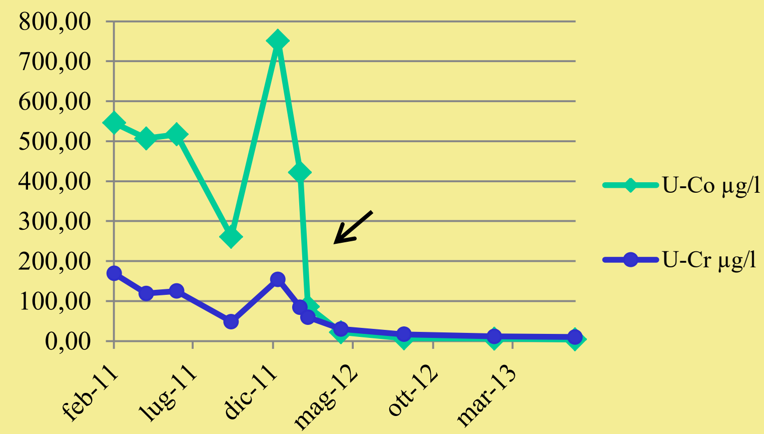
%	MoM	Tribofit	CoC
MODERATE	72%	39%	26%
MEDIUM	39%	14%	0
HIGH	6%	0	0

IONS CONCENTRATIONS

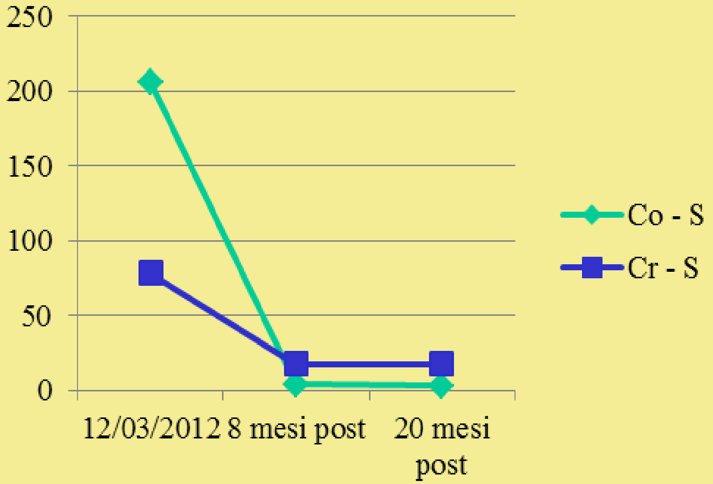
HIGH RELEASE (6%)	Average and Standard deviation
CoB (µg/L)	134,77 + 78,69
CoU (µg/L)	42,80 + 30,94
CrB (µg/L)	428,73 + 362,54
CrU (µg/L)	123,83 + 105,53

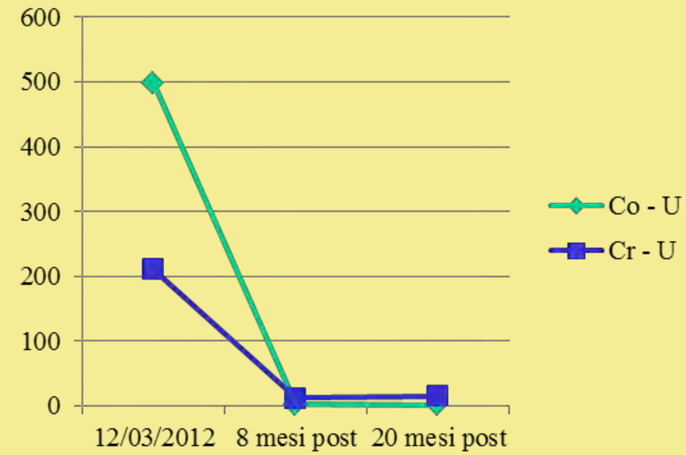


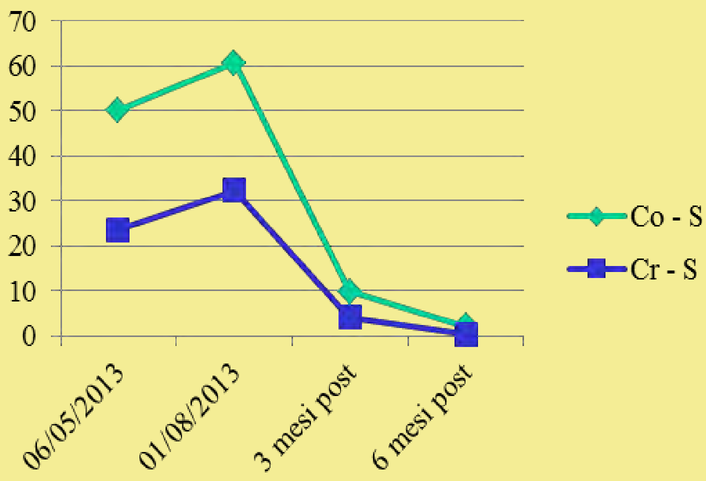


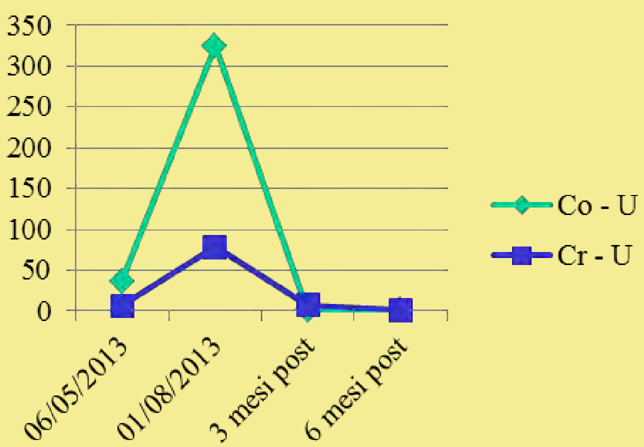


IONS CONCENTRATIONS

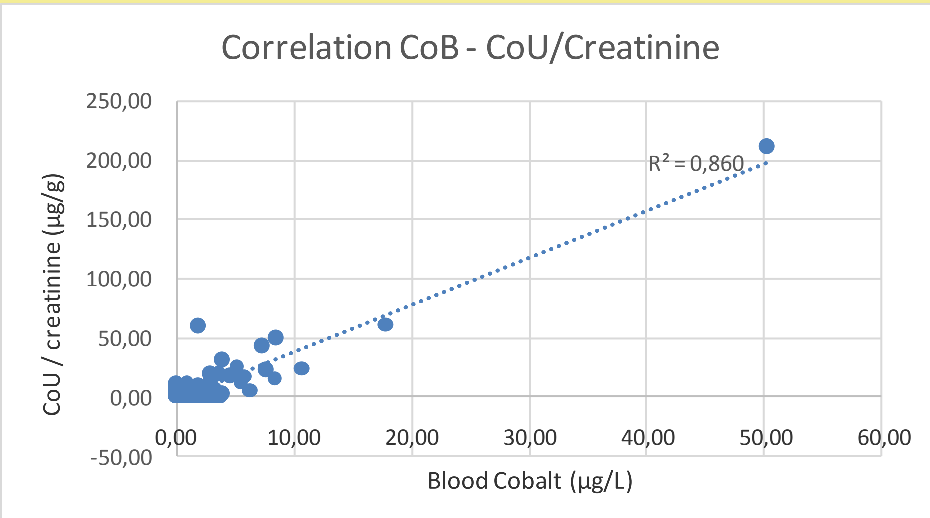


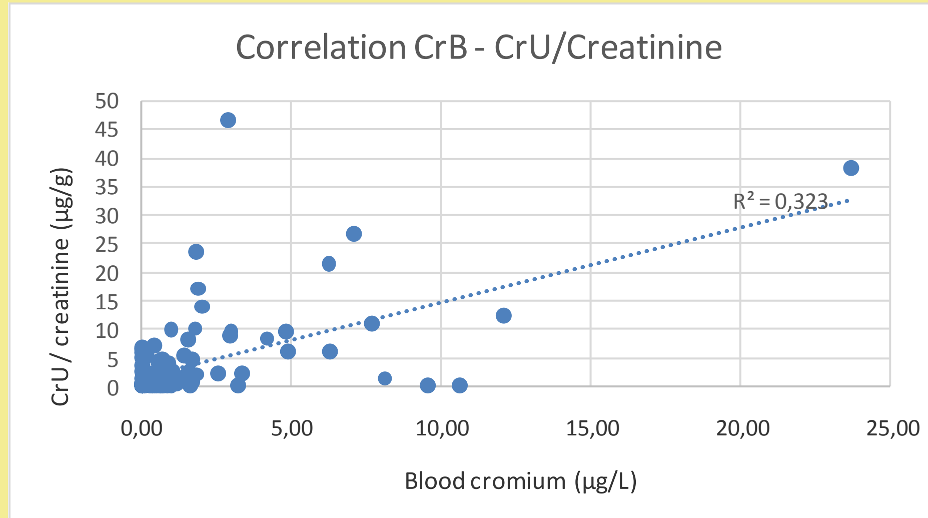


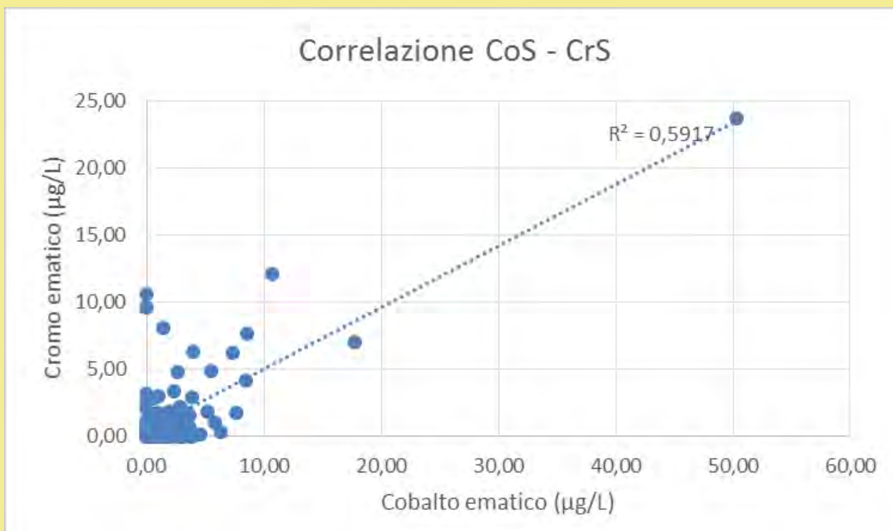




CORRELATION BETWEEN BLOOD AND URINE ION METAL CREATININE CORRECTED







Correction of urinary ions levels with creatinine improved the correlation with the blood ones.

The increase of ion blood level is always followed by an equivalent rise in urine level.

The correlation between CoB and CrB highlights the simultaneous release of both ionic forms

RESULTS

CORRELATION BETWEEN MECHANICAL/BIO-CLINICAL PARAMETERS AND METAL IONS LEVELS

Modular stems: MoM: CoB + CoU

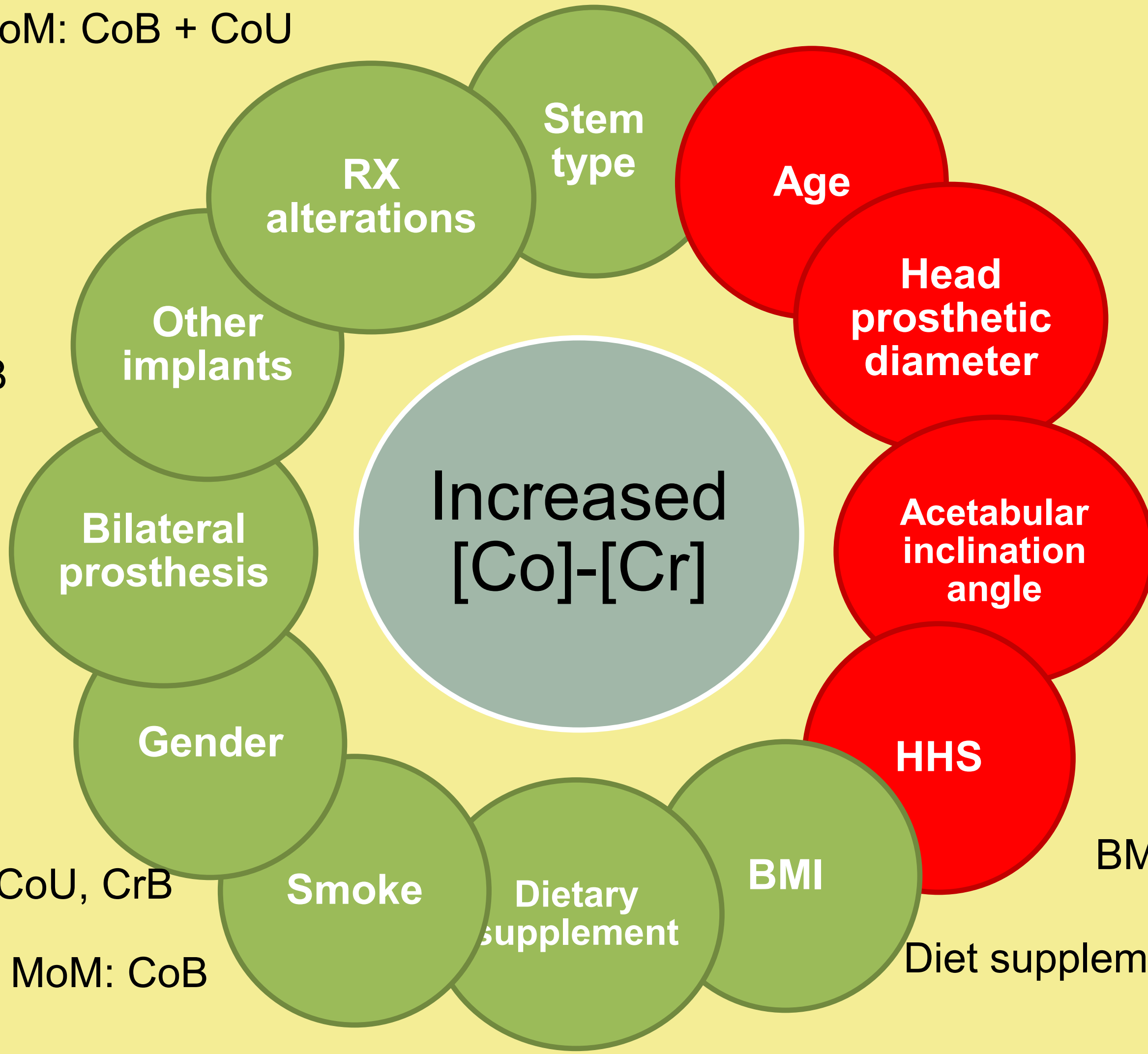
Rx: MoM: CoU

TriboFit: CoB

Other implant:

MoM: CoU, CrB

CoC: CrB



Gender: MoM: F, CoU, CrB

Smoke: MoM: CoB

BMI: MoM: CoU

Diet supplement: MoM: all

CoC: CrB

CONCLUSIONS

- The decisional algorithm used during the follow up has proved effective, identifying at early stage patients with ARMD in the MoM group.

- The levels of Co and Cr ions released from MoM implants were significantly higher than the two other groups, but we haven't identified any clear correlation between mechanical and bio-clinical parameters and the increased risk of ARMD

- The measurement uf urinary Cr and Co ions were also more related to the relative blood levels when corrected by creatinine

- The end of the two-years follow up of all patients recruited and the extension of the monitoring protocol will be useful for a better interpretation of these preliminary data.

CONCLUSIONS

- MoM implant show a disadvantageous risk-benefit ratio due to ions release and high revision rate.
- TriboFit© implants performed poorly from a mechanical and functional point of view
- CoC implant is indicated as a primary choice for THA

THANK YOU

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Trunnionosis in Metal on Polyethylene Uncemented Accolade-Trident Total Hip Replacements

Gee C, Poole W, Wilson D, Gibbs J, Stott P

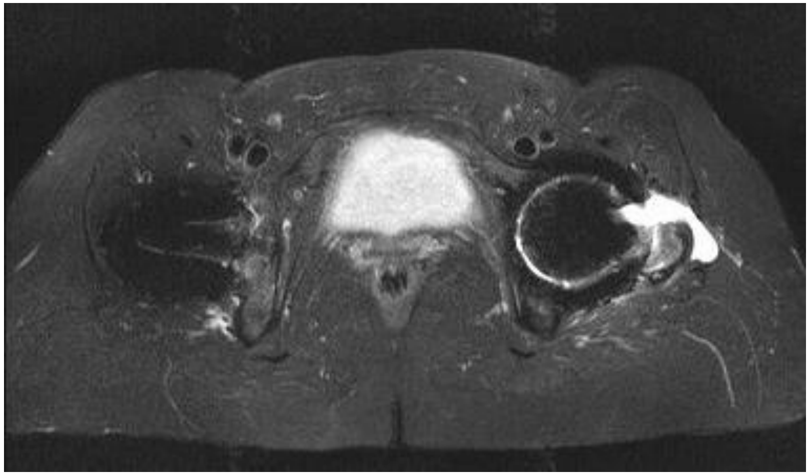
Brighton and Sussex University Hospitals NHS Trust

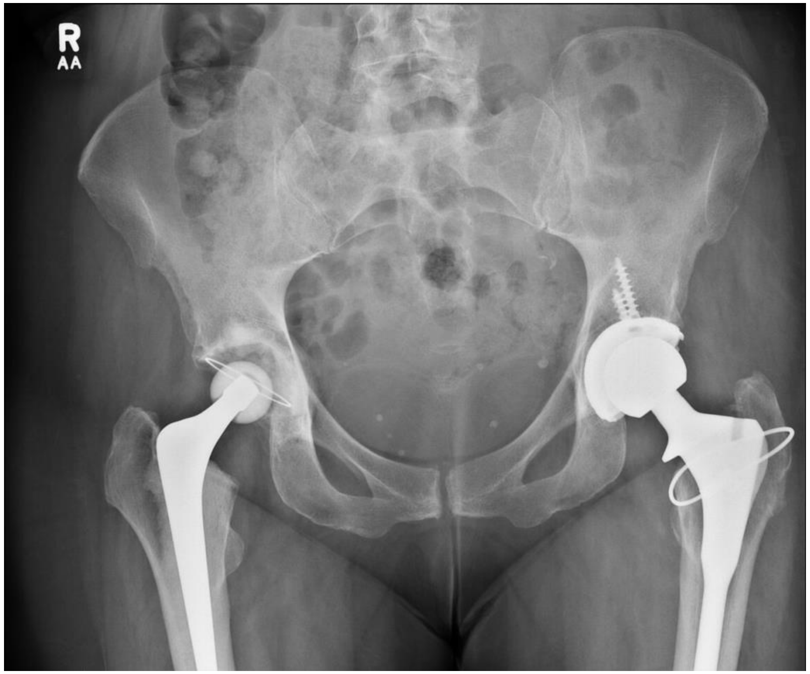
Adverse Reaction to Metal Debris (ARMD)

- Well recognized in large head metal on metal THRs
- Less well documented in metal on polyethylene THRs
- Present 3 cases (one bilateral) of trunnionosis in the Accolade Trident (*Stryker, Newbury, UK*) metal on polyethylene THR.
- In all cases the Accolade stem used was titanium based alloy uncemented stem, with V40 taper, and 36mm Co-Cr head

Case 1

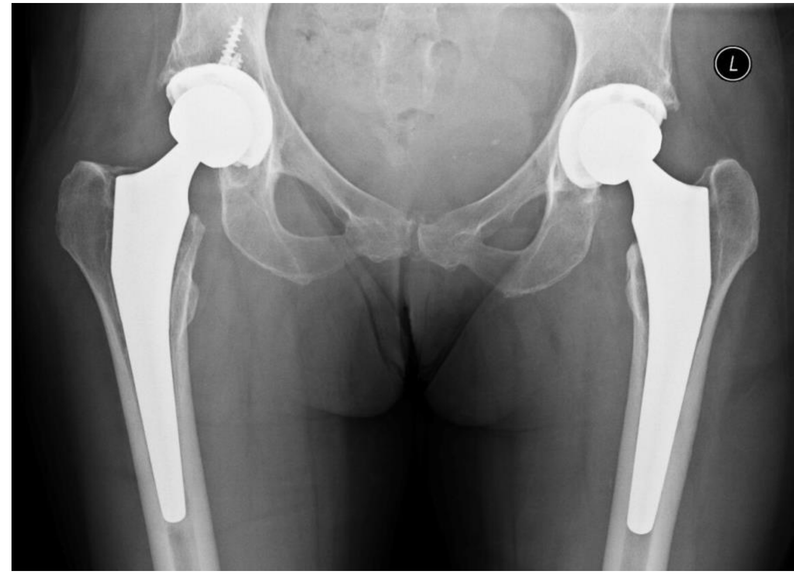
Age of patient	66 years
Time to revision	4 months
Inflammatory markers	WCC 3.5 CRP 1.1
Metal ions (*nmol/L*)	Co 10.3 Cr 13.3
Microbiology	Negative
Histology	Non specific chronic inflammatory response
Intra-operative	Large amount of cloudy fluid in joint, excessive trunnion wear





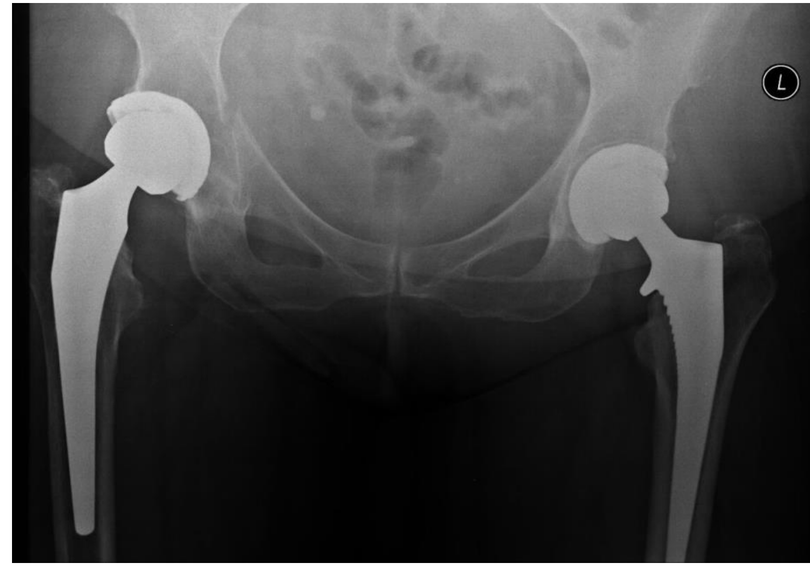
Case 2

Age of patient	65 years
Time of revision	L: 30 months R: 36 months
Inflammatory markers	WCC 5.4 CRP 2
Metal ions (*nmol/L*)	Co 161 Cr 12.1
Microbiology	Negative in both revisions
Histology	Not performed
Intra-operative	Black metal stained fluid in hip joint



Case 3

Age of patient	67 years
Time to revision	60 months
Inflammatory markers	Co 97 Cr 19.6
Metal Ions (*nmol/L*)	Co 97 Cr 19.6
Microbiology	Negative
Histology	Granulomatous reaction with lymphoid aggregates
Intra-operative	Large metal stained fluid collection, necrotic prox. femur with no attachments



Cases continued

- Represent a spectrum of the disease

- Fretting corrosion - mechanical forces
- Galvanic corrosion – metal mismatch
- ?Crevice corrosion – ‘female roughness’
- Head size

Conclusion

- Rare – 2 cases from our unit, implanting approx. 250 Accolades annually 2012, 2013
- Complex interaction of fretting, corrosive and galvanic corrosion + diameter of femoral head
- Clinically significant corrosion from head neck junction possible
- More work needed to identify those at risk and extent of the problem

Take Home Message

- Patients with painful Metal on poly THRs
  - investigation
  - XR, ion levels, MRI

Thank you

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Stem-neck modular total hip arthroplasty: possible mechanical effects!

P. Antinolfi[1], M. Chillemi[2], G. Placella[2], A. Caraffa[1] , G. Cerulli[2]

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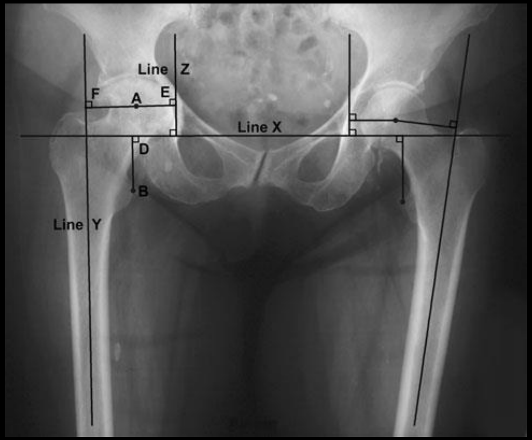
Perugia University Hospital, Perugia, Italy

Policlinico Agostino Gemelli
Università Cattolica del Sacro Cuore
Gemelli

[2]Orthopaedics and Traumatology Institute
Catholic University, Rome, Italy

Total Hip Arthroplasty



One of the main objectives of hip prosthesis is the recovery of biomechanical physiological conditions

Maloney and Keeney, 2004
Noble et al., 1998
Sarin et al., 2005

FEMORAL OFFSET

LENGTH OF LIMBS

CENTRE OF ROTATION

NECK VERSION

Asayama, 2005
Lecerf et al.,2009

Why these parameters are important?

- Reduce the imbalance abductor
- Relief pain
- Reduce wear
- Improve R.O.M.
- Prevent impingement
- Muscular strength
- Joint stability

Little et al 2009
Malik et al 2007
McGrory et al 1995

More satisfactory results for patients

MODULARITY

- Restore femoral offset
- Restore limb length
- Restore C. R.
- Femoral neck version

Femoral neck anteversion is important to restore the range of motion, especially for hip flexion, in post operative period.

- Risk of stress fractures
- Wear
- Fretting
- Corrosion
- Increased systemic exposure to metal ions and debris.

Srinivasan et al, 2012
Skendzel et al, 2011

Axial and bending forces

Krishnan et al 2013

The corrosion at the femoral – neck junction is greater than the head – neck junction for the highest mechanical stress and for an increase of the lever arm

Kretzer et al 2009

- CrCo resistance to high loads
- Ti corrosion resistance

Sarmiento et al 1979

Time dependent

Corrosion

Galvanic

Crevice

Fretting

- **Debris**
- **Release of metal ions**

Jacobs et al 1998

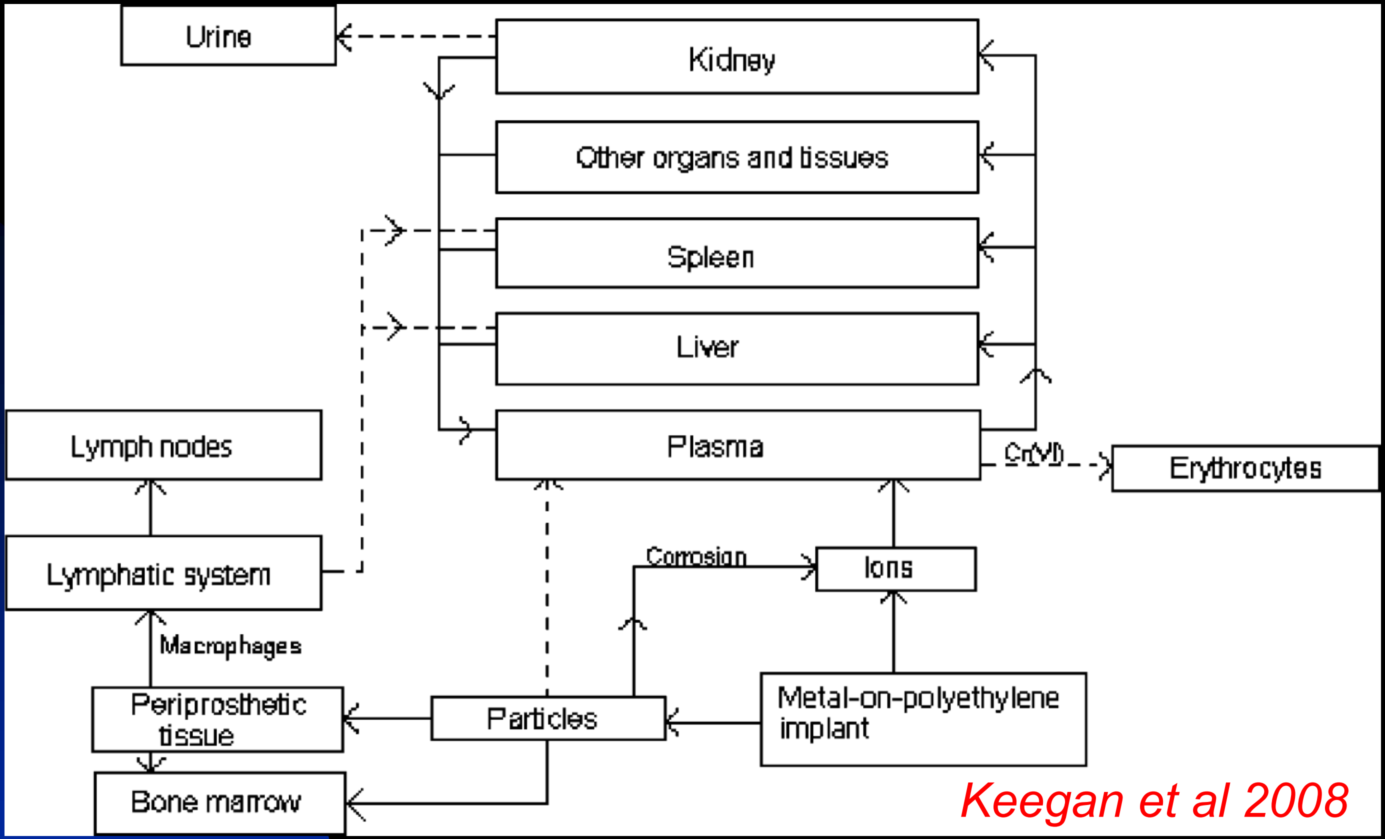
Pseudotumors

Campbell et al 2010
Pandit et al 2008
Watters et al 2010

Adverse local tissue reaction

Chronic inflammation

Cooper et al 2013
Langton et al 2011



Keegan et al 2008

The movement of the particles of debris from the periprosthetic tissue to systemic circulation is through the active transport through the cell-mediated and passive diffusion

There seems to be no increase in the incidence of cancer after metal-polyethylene or metal – metal implant

Visuri et al 1996

- The joint replacements in CoCr are not subject to biological standards monitoring and have yet to be established acceptable levels of CoCr in blood and urine.
- To date it is not common practice to measure the serum and urine levels of CoCr in patients undergoing revision surgery

It is not possible to correlate the values of CoCr and the outcome of the prosthesis

Reference average values		
	Serum	Urine
Cr	0,05 e 0,15 μgL^{-1}	0,1 e 0,5 μgL^{-1}

Cornelis et al 1995

Threshold Values

Meftah et al 2014
Van Der Straeten et al 2014

- Cr > di 2 µg/L
- Co > di 4 µg/L

Not all patients with high levels of metal ions were symptomatic

Not all symptomatic patients had high levels of metal ions

Not all patients with high levels of metal ions had an adverse local tissue reaction

In June 2012 the Stryker® recalled two prostheses with modular neck in CoCr (ABG II Modular Neck and Rejuvenate)

http://www.stryker.com/enus/products/Orthopaedics/modularneckstems/index.htm

Potential fretting and corrosion at the femoral – neck stem junction

ALTR Pain Swelling

Aim of the study

- Radiographic and values of chromium and cobalt in the blood and urine evaluation of patients with ABG II Modular Neck Stryker®.

The neck is made of an alloy of GADS Vitallio (Gas atomized dispersion Strengthened), an alloy of chromium and cobalt developed by Stryker®.

stem in TMZF, an alloy of titanium, molybdenum, zirconium and iron

Materials and Methods

Study Type: Case Series, Level 4 of Evidence

Participants: All patients admitted to the Hospital “Santa Maria della Misericordia” of Perugia, falling within the criteria for inclusion

Inclusion criteria	***Exclusion criteria***
• *Patients treated with ABG II Modular Neck Stryker® in the period from May 2011 to March 2012 without restriction for diagnosis.* • *First Artroplasty.* • *Polyethylene insert with metal femoral head* • *No contralateral implants or other prostheses in CoCr.* • *Patients undergoing controlled blood and urine.*	*These criteria are related to the risk of impairment of the results of our study:* • *Patients who use or have used Cr or Co for work or exposed to these metals in everyday life.* • *Patients without minimum follow-up of one year.* • *Patients with contralateral prosthesis.*

there is a correlation between the three groups and the release of chromium and cobalt in the blood and urine?

3 groups

Implant Design
- **Head Size**
- **Neck Length**

Patient
- **Age**
- **Symptoms**

Impant Biomechanics
- **Femoral Offset Restoration**
- **Osteolysis Areas**

Femoral Head

	Spearman's ρ	Significance α 0.05	Interval of Confidence 95%
Chromium serum VS Ellipsoid Volume of femoral head (mm^3)	-0,04895	No (P=0,8423)	-0,5031 < ρ <0,4264
Cobalt Serum VS [illegible]	[illegible]	No [illegible]	-0,5153 < ρ [illegible],4128
[illegible]	[illegible]	[illegible]	[illegible]627 < ρ [illegible],4685
[illegible]	[illegible]	[illegible]	[illegible]138 < ρ [illegible],5942

NO CORRELATION

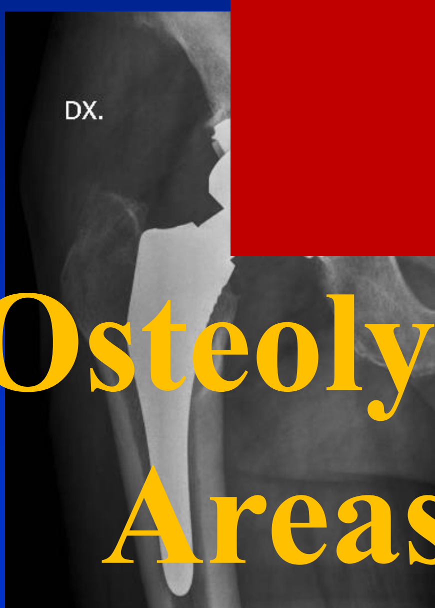
Femoral Neck

	[illegible]	[illegible]	[illegible]	[illegible]al of Confidence 95%
Chromuim Serum	0,8518	(P=0,4049)	NO	-0,7459 < t <0,3144
Cobalt Serum	0,0707	(P=0,9444)	NO	-1,790 < t <1,915
Chromium Urine	0,1218	(P=0,9043)	NO	-0,5577 < t <0,4963
Cobalt Urine	0,3442	(P=0,7345)	NO	-5,999 < t <8,361

Symptomatic

	T-Student	P Value	Significance	Interval of Confidence 95%
Chromuim Serum	0,9975	(P=0,3304)	NO	-0,8611 < t <0,3040
Cobalt Serum	0,6069	(P=0,5507)	NO	-2,691 < t <1,478
				t
				,80

NO CORRELATION



Osteolysis Areas

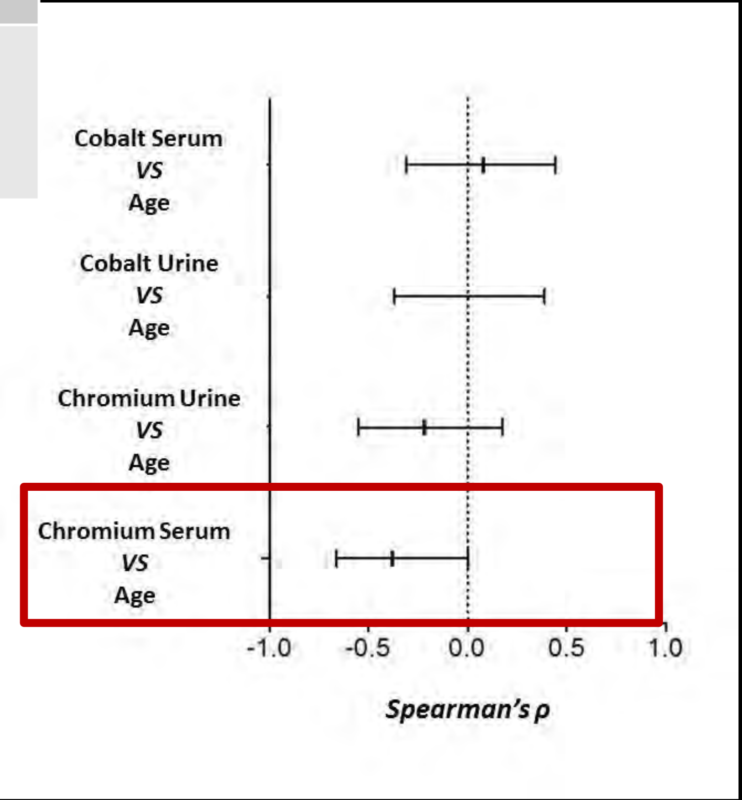
				of nce
				< t 3
Cobalt Serum Vs Osteolysis	0,9920	(P=0,7144)	NO	-0,9535< t < 2,660
Chrome Urine Vs Osteolysis	0,8577	(P=0,2153)	NO	-0,2711 < t <0,6451
Cobalt Urine Vs Osteolysis	1,720	(P=0,2061)	NO	-1,196 < t <12.00

	Spearman's ρ	Significance α 0.10	Interval of Confidence 90%
Chromium Serum VS Age	-0,3774	SI (P=0,0458)	-0,6619 < ρ <0,002
Cobalt Serum VS Age	-0,07807	No (P=0,3683)	-0,3103< ρ <0,442
Chromium Urine VS Age	-0,2173	No (P=0,1720)	-0,5511< ρ <0,1765
Cobalt Urine VS Age	0,01366	No (P=0,4766)	-0,3675 < ρ <0,3909

Age

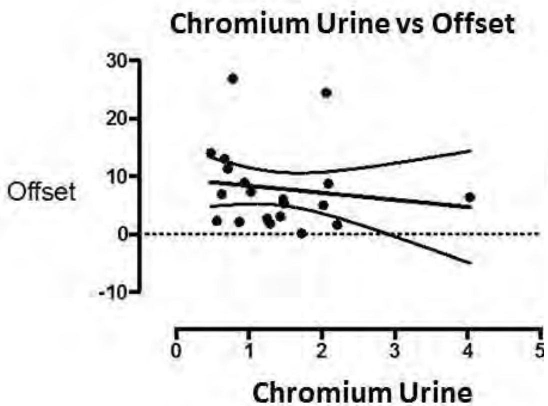
66,14

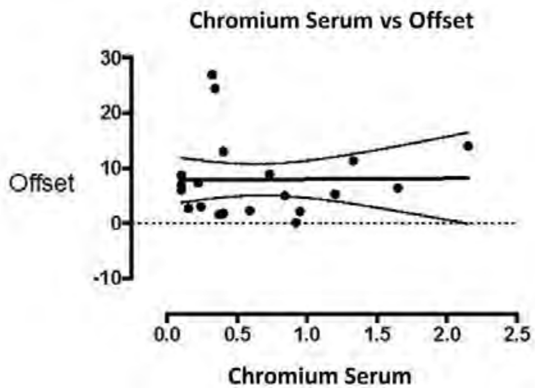
(range 27 - 83)

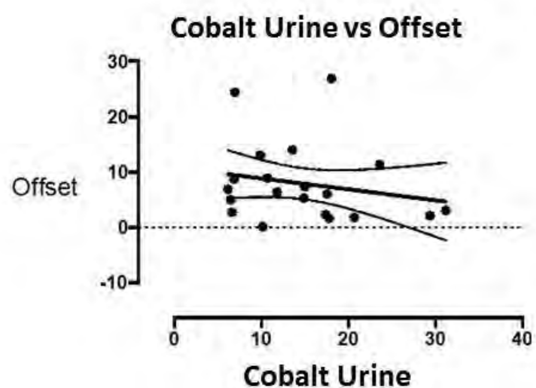


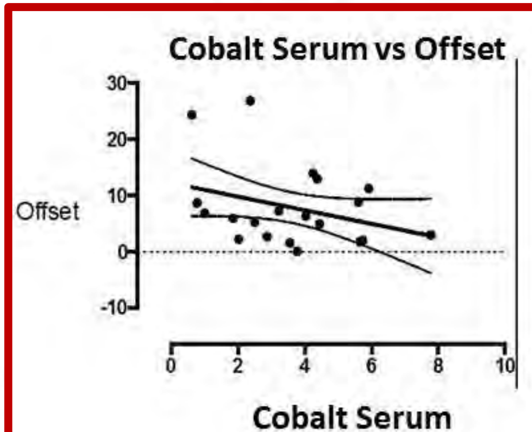
Restore Femoral Offset

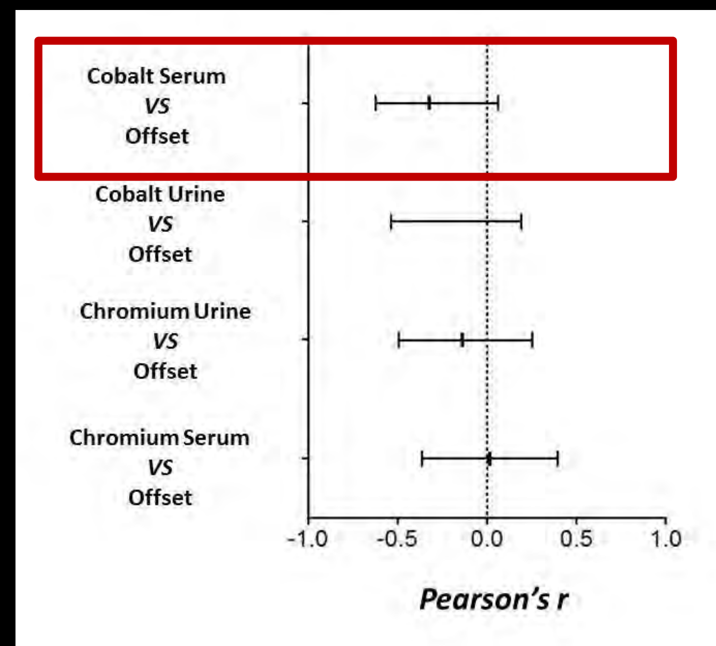
	Pearson's r	Significance α 0.10	Interval of confidence 90%
Chromium Serum VS Offset	0,01547	No (P=0,04742)	-0,3657 < ρ <0,3922
Cobalt Serum VS Offset	-0,3226	SI (P=0,0827)	-0,6252< ρ <0,06427
Chromium Urine VS Offset	-0,1412	No (P=0,2764)	-0,4938< ρ <0,2513
Cobalt Urine VS Offset	-0.2020	No (P=0,1965)	-0,5397< ρ <0,1917











Metal Ions

Age

Offset Restoration

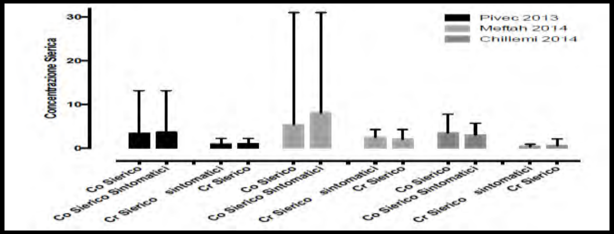
No revision surgery

in the literature???

Systematic review of the literature

Comparison of our study with all the litterature studies that evaluated the concentration of chromium and cobalt in serum in patients with prostheses with CoCr modular neck.

Lack of clear scientific evidence!



CoCr Modular Neck

Chromium and cobalt values in serum

Author	Pivec R	Meftah M	Chillemi M
Year	2013	2014	2014
Title	Modular taper junction corrosion and failure: how to approach a recalled total hip arthroplasty implant	Early corrosion-related failure of the rejuvenate modular total hip replacement	Sierologic and radiographic mid-term outcome of total hip arthroplasty with CoCr modular neck
Journal	The Journal of Arthroplasty	J Bone Joint Surg Am	
Level of Evidence	IV	IV	IV
Design	Case series	Case series	Case series
Number of patients	171 of 202	70 of 97	22 of 53
Follow Up	minimum 24 months	2,7 years +-0,6	14- 24 months
Prosthesis models	ABG II modular neck	Rejuvenate	ABG II modular neck
% of patients lost at F.U.	15.35%	27,84%	58,49
Principal Outcome			
Co levels	3,46 μgL^{-1} (range 0,1 μgL^{-1}to13,2 μgL^{-1})	5,4 μgL^{-1} +-5,7 (range 0,2to31 μgL^{-1})	3.50 μgL^{-1} (range 0,62 – 7,78 μgL^{-1}),
Cr levels	1,03 μgL^{-1} (range 0,1to2,3 μgL^{-1})	2,1 μgL^{-1}+-1,5 (range 0,1to4,3 μgL^{-1})	0,63 μgL^{-1} (range 0,1 – 2,15 μgL^{-1}),
Co levels symptomatic patients	3,67 μgL^{-1} (range 0,1to13,2 μgL^{-1})	8,1 μgL^{-1}+-7,4 (range 0,4to 31 μgL^{-1})	3,03 (range 0,62 - 5,74)
Cr levels symptomatic patients	0,98 μgL^{-1} (range 0,1to 2,3 μgL^{-1})	2,5 μgL^{-1}+-1,1 (range 0,2to4,3 μgL^{-1})	0,42 (range 0,1 - 0,94)
Age		64+-12 (28-89 yearsi)	66,14 (range 27 - 83)
Sympomatic patients	45%	30%	22,72%
Pseudotumor		9% of revisions surgery	
Revision in Co>4 μgL^{-1}		91,30% of revisions surgery	
Revision in Cr >2 μgL^{-1}		91,30% of revisions surgery	
Revision	15 patients 9%	23 patients. 28%	0%
Cause of revision	corrosion related symptoms	Pain	

Limits of the study

- High percentage of patients lost to follow-up
- Short follow-up
- Lack of an MRI evaluation to search periprosthetic lesions
- Surgical treatment was performed by several operators
- No restrictions in the diagnosis

Conclusions

Important

Know the causes of corrosion

Know the factors that influence the corrosion

Absence in the litterature of studies that correlate the values of metal ions with the design and function of the prosthesis and the characteristics of the patient

The femoral offset and age play an important role

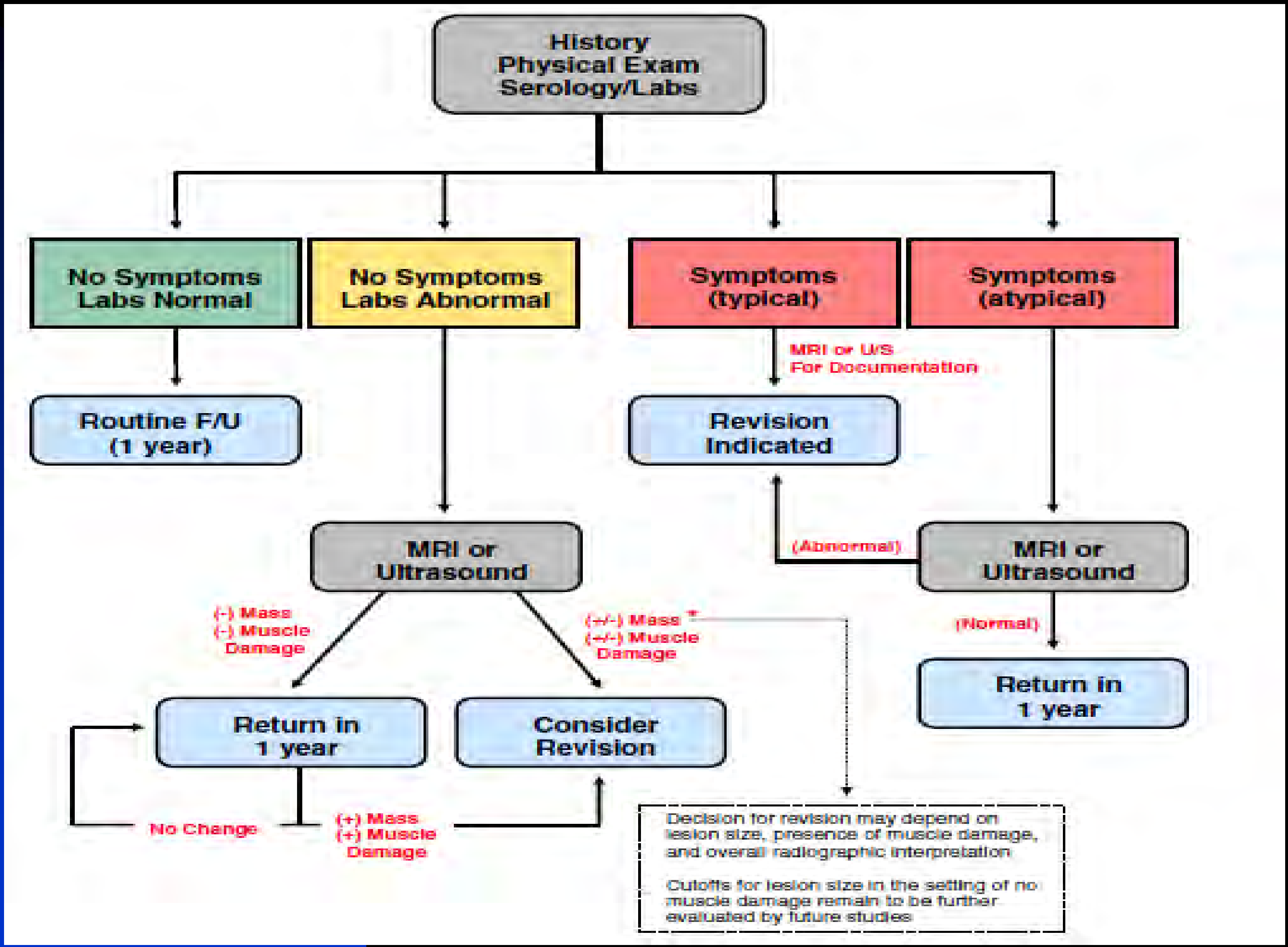
Conclusions

There is no evidence of malignant tumors in peri-prosthetic tissue

There is no studies with long follow-up

Is necessary to have guidelines on the treatment and management of patients

Treatment Algorithm



Pivec et al 2014

...Thank you

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INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

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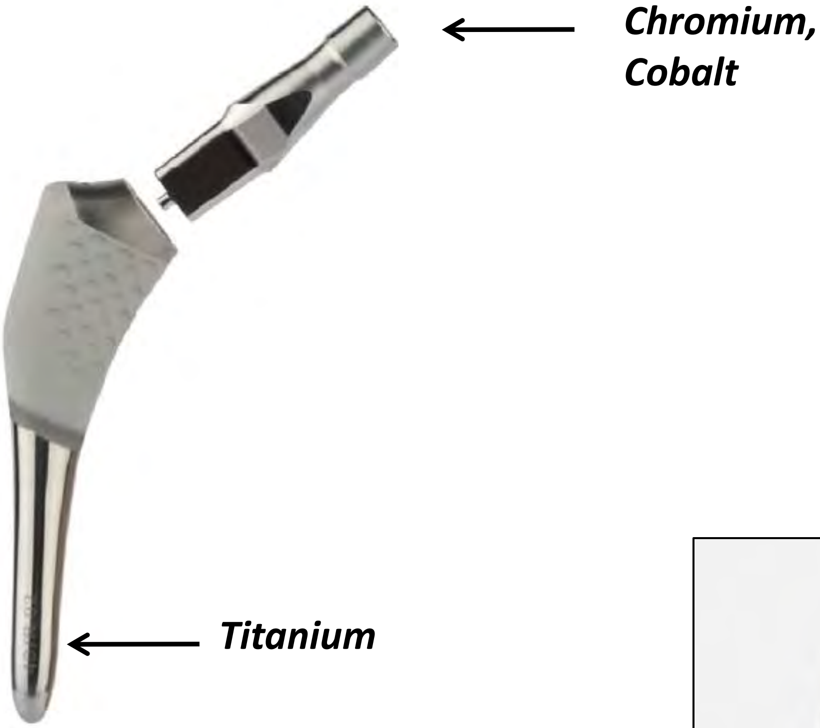
Umberto I Policlinico di Roma
Carità e Scienza

Dr.ssa Sara Sarti
Dr. Alessandro Calistri
Dr.ssa Valentina Calistri
Dr. Giancarlo Giuliani
Dr. Oreste Moreschini
Prof. Ciro Villani

Dipartimento di Scienze
dell'Apparato Locomotore

Recall ABG II Modular System: Kaplan Meyer at maximum of 6 years in a series of 151 consecutive patients: clinical results, MRI study, Metal Ions and patient-oriented results.

ABG II Modular System



ADVANTAGES:

- *Intra-operative accuracy*
- *Solution for complicated cases*
- *Easy for revision*

Australian Registry, 2015

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Table HT26 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using an Exchangeable Femoral Neck by Prosthesis Type (Primary Diagnosis OA)

Femoral Neck	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
ABGII	46	228	4.0 (2.1, 7.5)	10.2 (6.9, 15.0)	18.3 (13.4, 24.7)			
Adapter	40	374	3.8 (2.2, 6.3)	7.3 (5.1, 10.5)	10.1 (7.3, 13.8)	13.3 (9.7, 18.2)		
Apex	105	2163	2.7 (2.1, 3.5)	4.1 (3.3, 5.0)	5.1 (4.2, 6.3)	6.3 (5.1, 7.8)		
F2L	62	687	3.2 (2.1, 4.8)	5.4 (4.0, 7.4)	6.8 (5.1, 9.0)	7.6 (5.8, 9.9)	8.6 (6.7, 11.0)	
Femoral Neck (Amplitude)	14	442	0.9 (0.3, 2.4)	2.4 (1.2, 4.8)	5.4 (3.0, 9.5)			
H-Max	0	68	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
M-Cor	6	110	0.0 (0.0, 0.0)	2.8 (0.9, 8.4)	4.7 (2.0, 11.0)			
M/L Taper Kinectiv	95	2575	2.2 (1.7, 2.8)	3.4 (2.8, 4.3)	5.1 (4.1, 6.4)			
MBA	47	630	2.1 (1.2, 3.5)	4.2 (2.8, 6.1)	6.1 (4.4, 8.4)	7.1 (5.2, 9.7)	9.7 (7.2, 13.1)	
MSA	17	174	7.6 (4.5, 12.7)	9.5 (5.9, 15.0)				
Margron	76	552	5.3 (3.7, 7.5)	7.3 (5.4, 9.9)	9.4 (7.2, 12.2)	12.5 (10.0, 15.6)	14.3 (11.5, 17.6)	
Metha	11	84	10.7 (5.7, 19.6)	11.9 (6.6, 21.0)	15.6 (8.2, 28.3)			
Profemur	52	932	3.0 (2.1, 4.3)	4.7 (3.5, 6.3)	5.5 (4.2, 7.3)	6.7 (4.9, 9.0)		
R120	5	171	1.2 (0.3, 4.6)	2.6 (1.0, 6.8)	2.6 (1.0, 6.8)			
Other (5)	5	99	1.0 (0.1, 7.0)	3.3 (1.1, 10.0)	5.9 (2.5, 13.8)	5.9 (2.5, 13.8)		
TOTAL	581	9289						

Note: Only Femoral Neck Prostheses with over 60 procedures have been listed.
All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Revision rate:

*After one year: **3.9 %***

*After three years: **10.3 %***

*After five years: **18.3%***

Hip and Knee Arthroplasty

AOA

Replacement Registry

Recall ABG II Modular System

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Revision rate

10,3% after three years

Recall ABG II Modular System and Rejuvenate

Monitoring Patients

Recall Market

Objective

Evaluate ABG II Modular System survivorship used at Orthopaedic Clinic of Sapienza.

Material and methods

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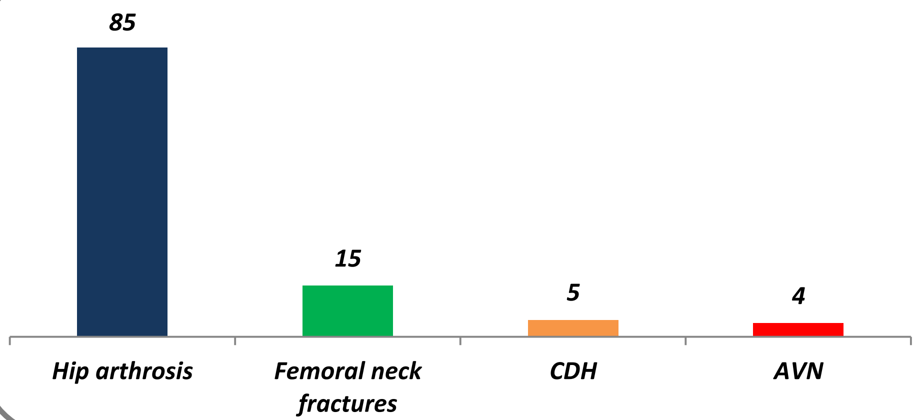
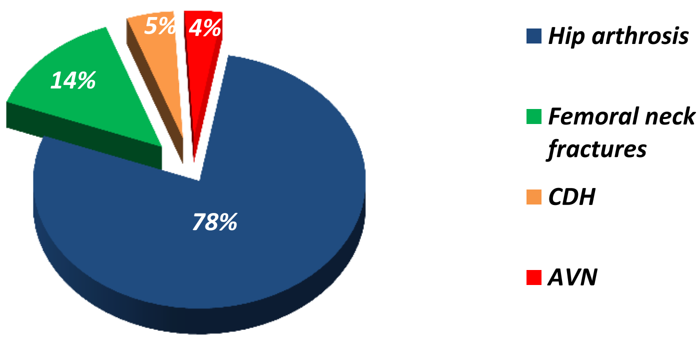
Patients

- ✓ *Tot. patients called - 151 (n°13 bilateral)*
- ✓ *Tot. Patients evalueted - 100 (n°9 bilateral)*
- ✓ *Average age - 75,2 years*
- ✓ *Average follow-up - 5,6 years*

51 pt, 55 hips lost at F-U

Diagnosis





Material and method 2

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Clinical Evaluation

- *Objective Exam*
- *Questionnaires*

Images

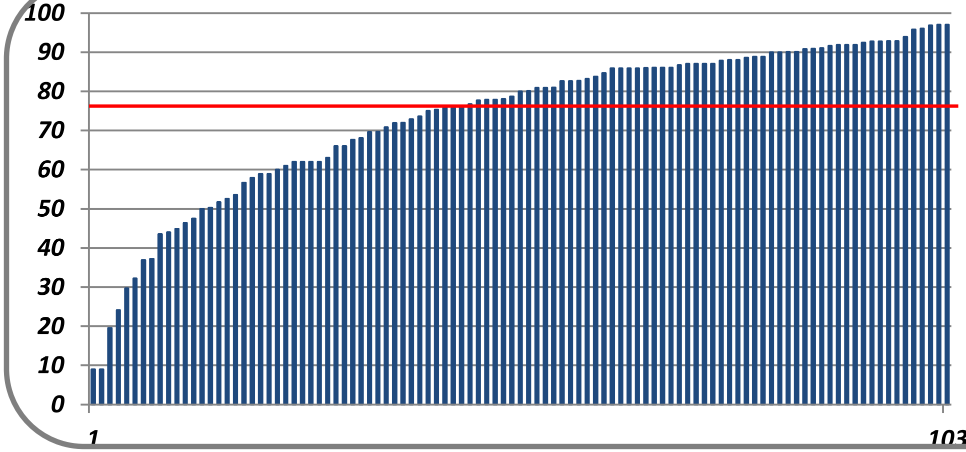
- *X-Ray*
- *MRI with MARS sequences*

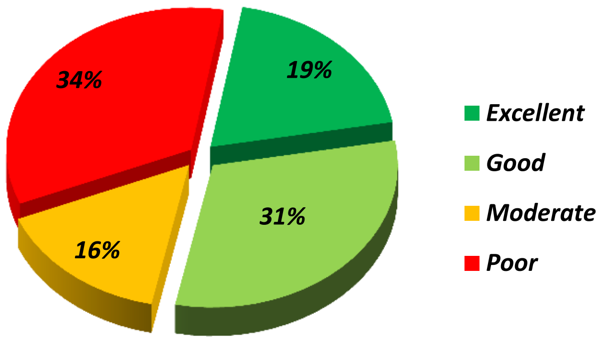
Laboratory Tests

- *Chromium 0-9 µg/L*
- *Cobalt (0-1 µg/L)*

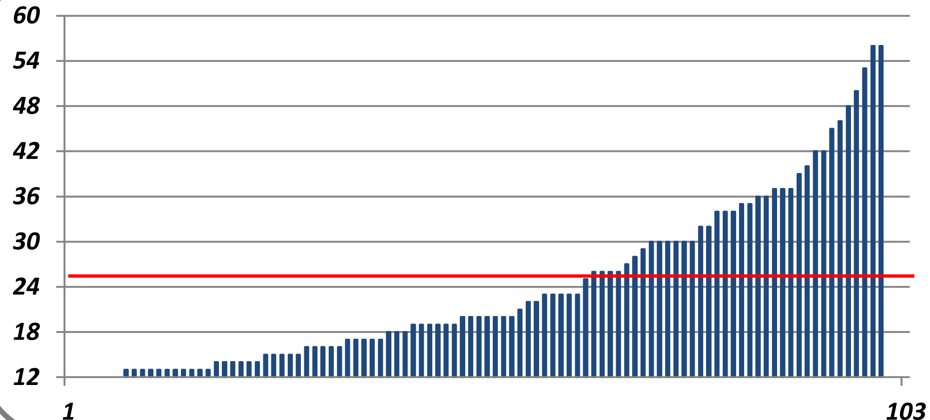
Functional results

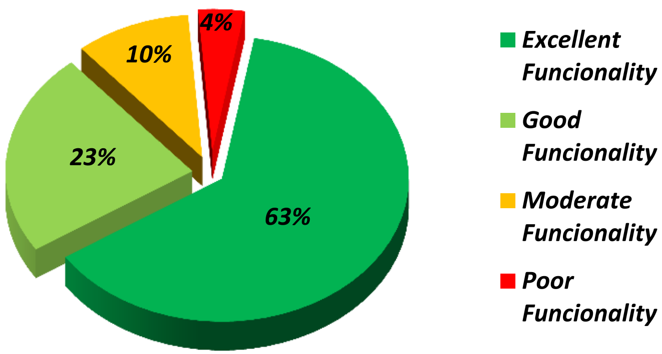
Harris Hip Score





Oxford Hip Score





Level of Chromium and Cobalt

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Algorithm

Classification of the metal ions levels (Cr and Co) for use with the diagnostic and therapeutic algorithm by Van Der Straeten

Cr-Co	
< 4 µg/L	Normal ***steady state***, in the absence of clinical and radiographic symptoms → routine follow-up regime
4 – 10 µg/L	***Moderately elevated levels***, additional investigations advocated; if no abnormalities are found and the patients is asymptomatic → a close clinical follow-up and remeasurement of metal ion levels is advisable
10 – 20 µg/L	Sign of ***increased wear***: repeated thorough diagnostic investigations
> 20 µg/L	Concerning as sign of ***high wear*** even in the absence of clinical or radiographic symptoms around the hip; Co >20 µg/L may be associated with systemic toxicity: revision has to be considered

Metal Ions Results

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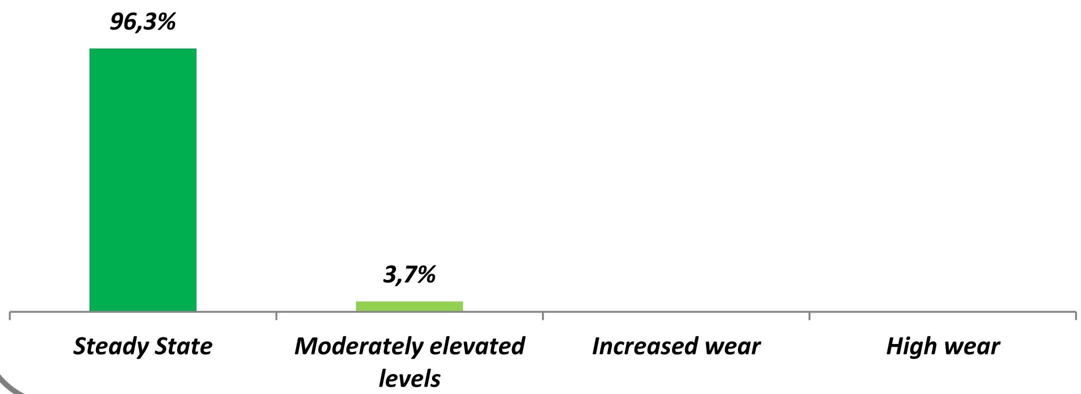
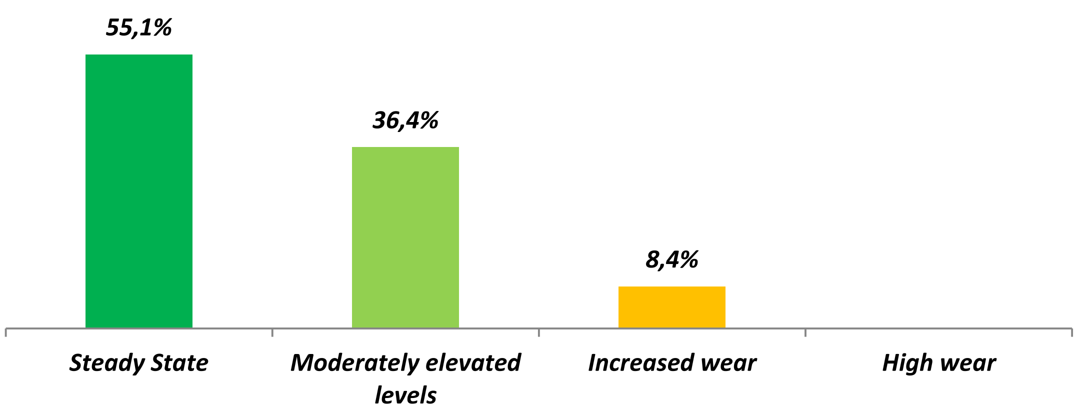
Chromium



Mean: 1,45 μg/L

Range: 0,05-9,2 μg/L

Cobalt

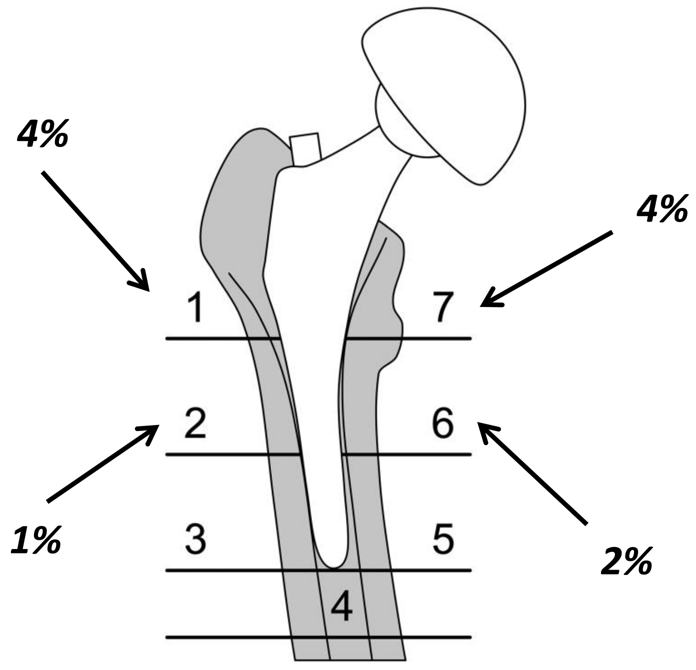


Mean: 4,89 μg/L

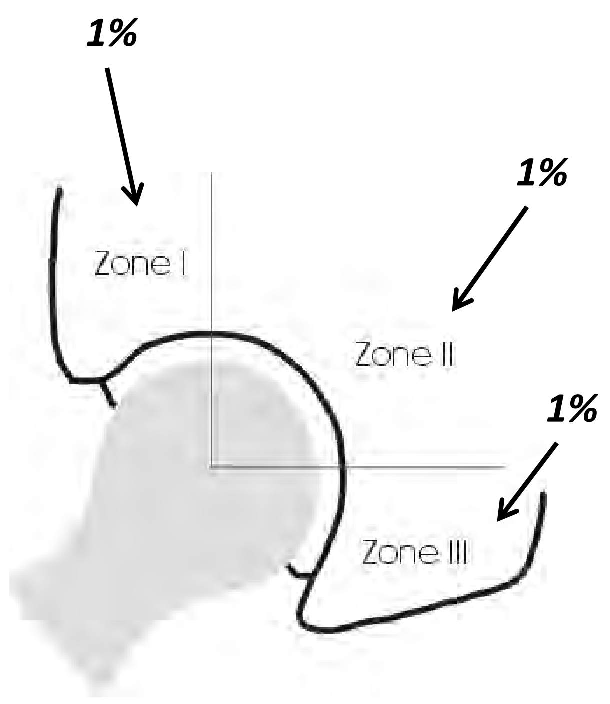
Range: 0,01-18 μg/L

X-ray Results

Amstutz, Gruen's areas



DeLee and Charney



MRI results

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Pseudotumor Classification by Grammatopoulos

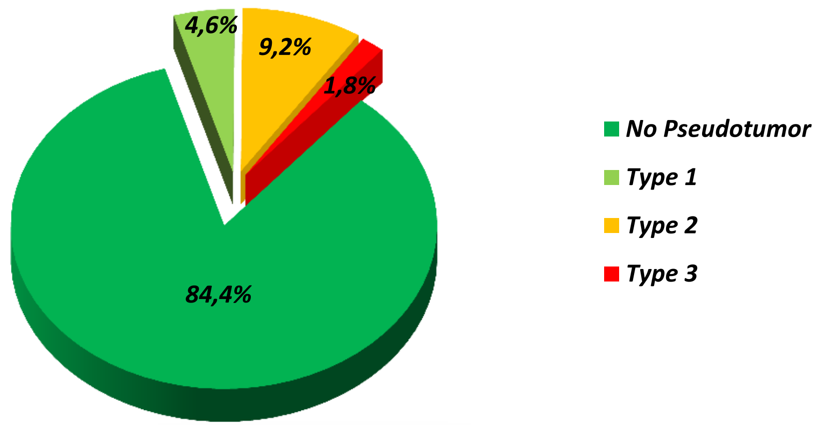
Type 1: Thin-walled cystic mass (cyst wall < 3mm)

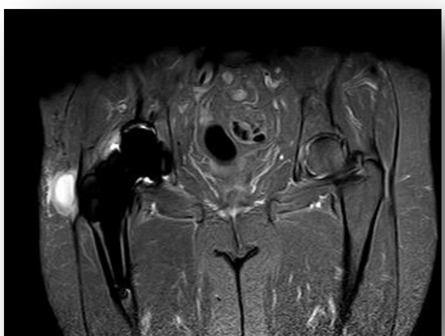
Type 2: Thick-walled cystic mss (cyst wall > 3mm)

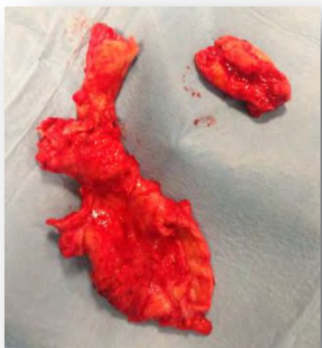
Type 3: A predominantly solid mass

A MRI classification of periprosthetic soft tissue masses (pseudotumours) associated with metal-on-metal resurfacing hip arthroplasty

Jennifer Hauptfleisch · Hemant Pandit · George Grammatopoulos · Harinderjit S. Gill · David W. Murray · Simon Ostlere

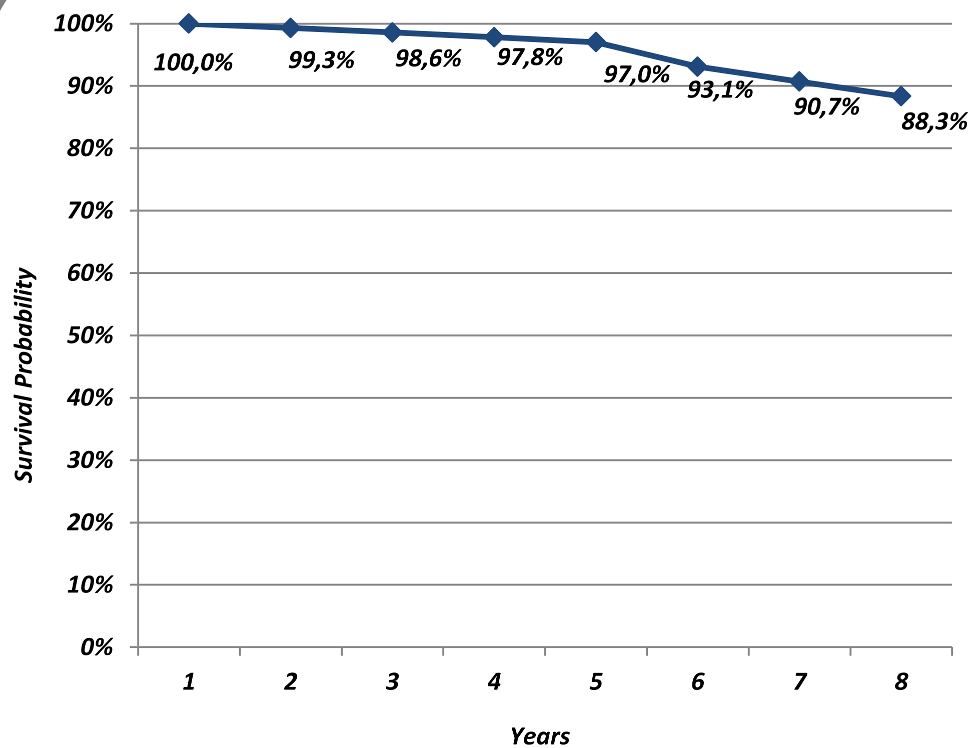






Kaplan Meier curve

Kaplan Meier curve



Summary of the Number of Censored and Uncensored Values			
Total	Failed	Censored	Percent Censored
164	45	119	72.60

- 6 revision cases:

  1 year F-U → 1 pt
  3 year F-U → 1 pt
  4 year F-U → 2 pt
  5 year F-U → 2 pt

SURVIVAL RATE:
88,3% after eight years

REVISION RATE:
11,7% after eight years

Discussion

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A few months ago we started the second evaluation of these patients:

X-Ray

One patient with medial calcar erosion, a sign that was absent at first evaluation

MARS MRI

Increased number of patients with fluid collections and one patient with pseudotumor type 2 turn into type 3

Cr and Co

Slight decline in the levels of ions

Are these datas useful?

Conclusions

Research limitations:
- *large number of patients lost to follow-up*

Revision rate of 11.7% after eight years of follow-up → UNACCEPTABLE

For the future:
- *improving the knowledge of corrosion and wear*
- *monitoring the patients about the evolution of symptoms.*

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

How should we follow-up asymptomatic metal-on-metal hip resurfacing patients?

A prospective longitudinal cohort study

GS Matharu, AK Low, SJ Ostlere, DW Murray, HG Pandit

Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Nuffield Orthopaedic Centre, Oxford, UK

International Combined Meeting 2015
British Hip Society and the Società Italiana dell'Anca
Milan, Italy

Conflicts of interest

GSM

- Fellowships: (1) The Royal College of Surgeons of England and The Arthritis Research Trust, (2) Arthritis Research UK
- Research grants: (1) The Orthopaedics Trust, (2) The Royal Orthopaedic Hospital Hip Research and Education Charitable Fund

AKL & SJO No conflicts of interest

DWM

- Royalties & paid speaker: Zimmer Biomet
- Research grants: (1) Zimmer Biomet, (2) Stryker

HGP

- Paid speaker: Zimmer Biomet
- Research grants: (1) Zimmer Biomet, (2) Stryker

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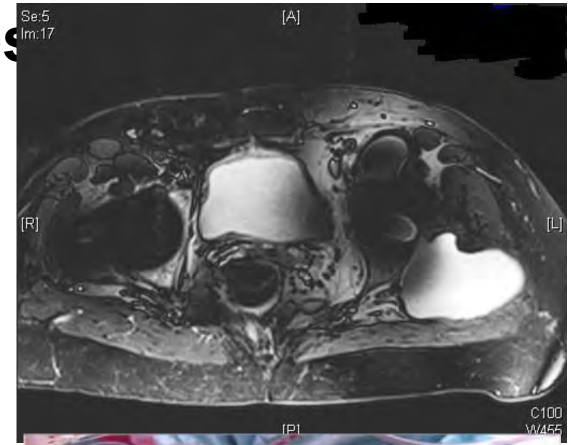
Background

- **Over 1 million metal-on-metal (MoM) hips**



- **Pseudotumours**
  - Mode of failure **(ASR ≤50% at 6-yr)**
  - Poor short-term outcomes following revision

- **Response to problem**
  - Regulatory authorities worldwide published follow-up guidance
  - Early detection → Early revision → Improved outcome

Asymptomatic hip resurfacings (HRs)

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Follow-Up of Metal-on-Metal Hip Arthroplasty Patients Is Currently Not Evidence Based or Cost Effective

Gulraj S. Matharu, BSc (Hons), MBChB, MRCS, Stephen J. Mellon, PhD, David W. Murray, MD, FRCS (Orth), Hemant G. Pandit, DPhil, FRCS (Orth)

Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Nuffield Orthopaedic Centre, Oxford, United Kingdom, OX3 7LD

Current MoM patient follow-up

Not evidence based – lack of longitudinal studies

Very costly – up to £8,300,000 (€11,800,000) for annual follow-up of asymptomatic HRs in UK

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Study Aims

To assess factors associated with:

1. Ultrasound finding progression

2. Developing new pseudotumours

In asymptomatic HRs undergoing repeat assessment

Patients and Methods

Prospective longitudinal cohort study

2007 / 2008

- Recruited 201 asymptomatic MoM HRs (158 patients) *Kwon 2011*
- Asymptomatic – denied pain & OHS $\geq$ 34 (good to excellent)
- Ultrasound + blood metal ions + x-ray + OHS (/48) + UCLA (/10)

2012 / 2013

- 152 MoM HRs (122 patients) recruited
- Repeated investigations (apart from blood metal ions)

Exclusions: revised (n=16), declined/failed to attend (n=29), died (n=4)

Ultrasound assessment

- Performed by 1 experienced radiologist blinded to clinical data
  - Sonoline Antares - Siemens Medical Solutions, USA
  - Systematic approach / technique as recommended by the European Society of Skeletal Radiology

- All scans graded and lesion volume measured

Grading system *(Matharu 2015, Low 2015)*

1 Normal

2 Bursa (psoas bursa, trochanteric bursa/thickening)

3 Pathological effusion (> 15 mm fluid in joint)

4 Pseudotumour (cystic, mixed, solid) – *communicating with joint*

Outcomes of interest

1. Progression of ultrasound findings between repeat scans

2. Development of new pseudotumours between repeat scans

<u>Evidence of progression if at least 1 of:</u>

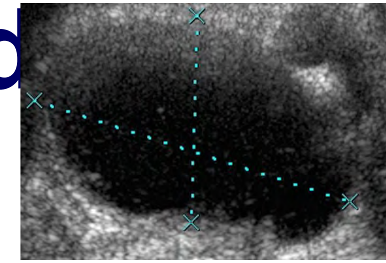
- Increase in scan grade
- Increase in lesion volume but same grade
- Change in pseudotumour consistency (liquid to solid)
- Need for revision surgery

Groups compared using t-test, Wilcoxon rank sum test, and Chi-squared test

Results

	152 Hips in 122 Patients
Gender, male/female	99 (65%)/53 (35%)
Age at first ultrasound (y), mean (range)	60.7 (33.3 to 74.7)
Patients with unilateral or bilateral MoM hips, unilateral/bilateral	92 (75%)/30 (25%)
Hip resurfacing design	
Birmingham Hip Resurfacing (Smith & Nephew, Warwick, UK)	82 (54%)
Conserve Plus (Wright Medical, Memphis, TN)	64 (42%)
Recap (Biomet, Bridgend, UK)	6 (4%)
Time between hip resurfacing and first ultrasound (y), mean (range)	3.9 (3.0 to 7.4)
Time interval between repeat ultrasounds (y), mean (range)	4.3 (3.2 to 5.0)
Acetabular component position	
Inclination (°), mean (range)	46.2 (21.3 to 65.5)
Anteversion (°), mean (range)	15.9 (2.0 to 33.0)
Blood metal ion concentration (μg/L), median (IQR)	
Cobalt	2.3 (1.5 to 4.2)
Chromium	2.4 (1.3 to 4.9)
OHS (0-48 scale)	
Median (IQR)	
- 2007/2008 score	47.0 (45.0 to 48.0)
- 2012/2013 score	46.0 (42.8 to 48.0)
Mean (range)	
- Change in score	−0.9 (−17 to 7)
UCLA score (1-10 scale), mean (range)	
- 2007/2008 score	7.2 (3 to 10)
- 2012/2013 score	7.2 (2 to 10)
- Change in score	0.1 (−4 to 5)
Hips with pseudotumors revised after repeat ultrasound	4 (3%)

Change in ultrasound grade and volume



Ultrasound Grade 2007/2008	Total number of hips (%)	Ultrasound Grade 2012/2013			
		1	2	3	4
Total number hips (%)	152 (100)	102 (67)	17 (11)	6 (4)	27 (18)
1	110 (72)	97 (64)	6 (4)	3 (2)	4 (3)
2	23 (15)	3 (2)	11 (7)	1 (1)	8 (5)
3	7 (5)	2 (1)	0 (0)	2 (1)	3 (2)
4	12 (8)	0 (0)	0 (0)	0 (0)	12 (8)

Change in grade: p = 0.00018

- 17% (25) increased, 80% (122) no change, 3% (5) decreased

Change in volume: p = 0.0058

- Mean volume increase = 5.9 cm^3 (range, −21.8 cm^3 to 392 cm^3)

Factors predicting ultrasound progression (19%)

Factors predicting development of new pseudotumours (10%)

Factor	Hips With Progression (n = 29)	Hips Without Progression (n = 123)	P
Gender			
Female	12 (41%)	41 (33%)	.548
Male	17 (59%)	82 (67%)	
Age at first ultrasound (y), mean (range)	62.2 (52.7-74.7)	60.3 (33.3-73.1)	.237
Unilateral or bilateral MoM hips			
Bilateral	11 (38%)	49 (40%)	1.00
Unilateral	18 (62%)	74 (60%)	
Hip resurfacing design			
BHR	14 (48%)	68 (55%)	.756
Conserve	14 (48%)	50 (41%)	
Recap	1 (4%)	5 (4%)	
Time between hip resurfacing and first ultrasound (y), mean (range)	3.9 (3.0-7.4)	3.9 (3.0-7.0)	.947
Time interval between repeat ultrasounds (y), mean (range)	4.2 (3.2-5.0)	4.4 (3.2-5.0)	.080
Acetabular inclination (°), mean (range)	47.2 (27.8-62.6)	46.0 (21.3-65.5)	.501
Acetabular anteversion (°), mean (range)	14.8 (2.7-32.0)	15.3 (2.0-33.0)	.783
Blood cobalt concentration (μg/L), median (IQR)	3.8 (2.6-6.3)	2.0 (1.3-3.6)	.00013[a]
Blood chromium concentration (μg/L), median (IQR)	4.1 (2.5-7.5)	2.0 (1.2-3.9)	.00065[a]
Initial OHS (0-48 scale), median (IQR)	47.0 (45.0-48.0)	47.0 (45.0-48.0)	.775
Change in OHS, mean (range)	−3.6 (−10 to 5)	−0.3 (−2 to 7)	.043[a]
Initial UCLA score (1-10 scale), mean (range)	6.9 (4-9)	7.3 (3-10)	.208
Change in UCLA score, mean (range)	−0.1 (−3 to 4)	0.1 (−4 to 5)	.534
Initial scan volume (cm^3), mean (range)	5.9 (0-60.0)	1.4 (0-100.0)	.036[a]
Initial scan grade			
1	13 (45%)	97 (79%)	.003[a]
2	9 (31%)	14 (11%)	
3	3 (10%)	4 (3%)	
4	4 (14%)	8 (7%)	

High blood cobalt (p=0.006) and chromium (p=0.023)

Only factors predicting new pseudotumour formation

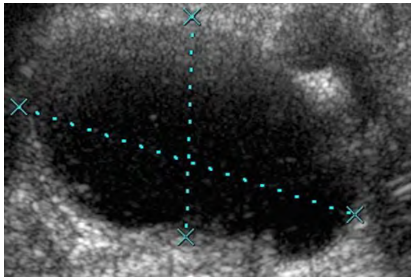
Diagnostic test characteristics for no evidence of ultrasound progression

Optimal results obtained when
Normal initial ultrasound AND blood metal ions <2 µg/l = 33% of asymptomatic HR cohort

	Normal Initial Ultrasound and Initial Blood Metal Ions <2 µg/L	Normal Initial Ultrasound Alone	Initial Blood Metal Ions <2 µg/L Alone
No. of hips (% of cohort)	50 (33)	110 (72)	62 (41)
Sensitivity	40 (31-49)	79 (70-85)	48 (39-57)
Specificity	97 (80-100)	55 (36-73)	90 (72-97)
PPV	98 (88-100)	88 (80-93)	95 (85-99)
NPV	27 (19-37)	38 (24-54)	29 (20-40)
LR +	11.6 (1.6-80.2)	1.8 (1.2-2.7)	4.6 (1.6-13.8)
LR −	0.6 (0.5-0.7)	0.4 (0.3-0.6)	0.6 (0.5-0.7)

All diagnostic test characteristic values are provided as percentages with 95% confidence intervals provided in brackets.

Diagnostic test characteristics for not developing new pseudotumours



Optimal results obtained when

Normal initial ultrasound AND blood metal ions <2 µg/l = 33% of asymptomatic HR cohort

	Normal Initial Ultrasound and Initial Blood Metal Ions < 2 µg/L	Normal Initial Ultrasound Alone	Initial Blood Metal Ions < 2 µg/L Alone
No. of hips (% of cohort)	50 (33)	110 (72)	62 (41)
Sensitivity	37 (29-45)	77 (69-84)	44 (35-52)
Specificity	100 (75-100)	73 (45-91)	87 (58-98)
PPV	100 (91-100)	96 (90-99)	97 (88-99)
NPV	15 (9-23)	26 (14-42)	14 (8-24)
LR+	Infinity (N/A)	2.9 (1.2-6.7)	3.3 (0.9-12.1)
LR−	0.6 (0.6-0.7)	0.3 (0.2-0.4)	0.6 (0.5-0.8)

All diagnostic test characteristic values are provided as percentages with 95% confidence intervals provided in brackets.

Discussion

- Largest MoM HR cohort undergoing re-assessment within 5-yr
  - *Previous studies*: small (4-53 HR) and short FU ($\leq$2.2-yr) *Almousa 2013, Reito 2015*

Asymptomatic + normal ultrasound + ions <2 µg/l <u>(33% hips)</u>

- Very little risk of progression of ultrasound findings (2%)
- No risk of developing new pseudotumours (0%)

- Guide worldwide follow-up + financial savings **(£2.7 million/yr)**
- **All patients need baseline assessment** = **imaging + ions**
  - Imaging or ions alone not as effective for excluding pt from FU

Limitations

Not applicable: other designs/THRs and >5-yr follow-up

Conclusions

- Asymptomatic MoM HR patients **DO NOT** require repeat follow-up within 5 years if they have:

Normal ultrasound <u>AND</u> Normal blood metal ions (<2 µg/l)

- Annual European follow-up of asymptomatic MoM HRs
  - Costly and unnecessary

UNIVERSITY OF OXFORD

Acknowledgments

- The authors would like to thank The Royal College of Surgeons of England and The Arthritis Research Trust for providing one author with funding in the form of a Surgical Research Fellowship

RCS
ADVANCING SURGICAL STANDARDS

ELSEVIER

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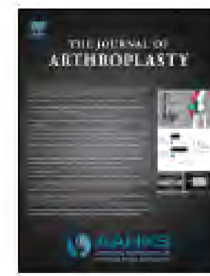


How Should We Follow-Up Asymptomatic Metal-on-Metal Hip Resurfacing Patients? A Prospective Longitudinal Cohort Study

Adrian K. Low, MBBS, PhD, FRACS, Gulraj S. Matharu, BSc (Hons), MRCS, MRes, Simon J. Ostlere, FRCP, FRCR, David W. Murray, MD, FRCS (Orth), Hemant G. Pandit, DPhil, FRCS (Orth)

Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Nuffield Orthopaedic Centre, Oxford, United Kingdom, OX3 7LD

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

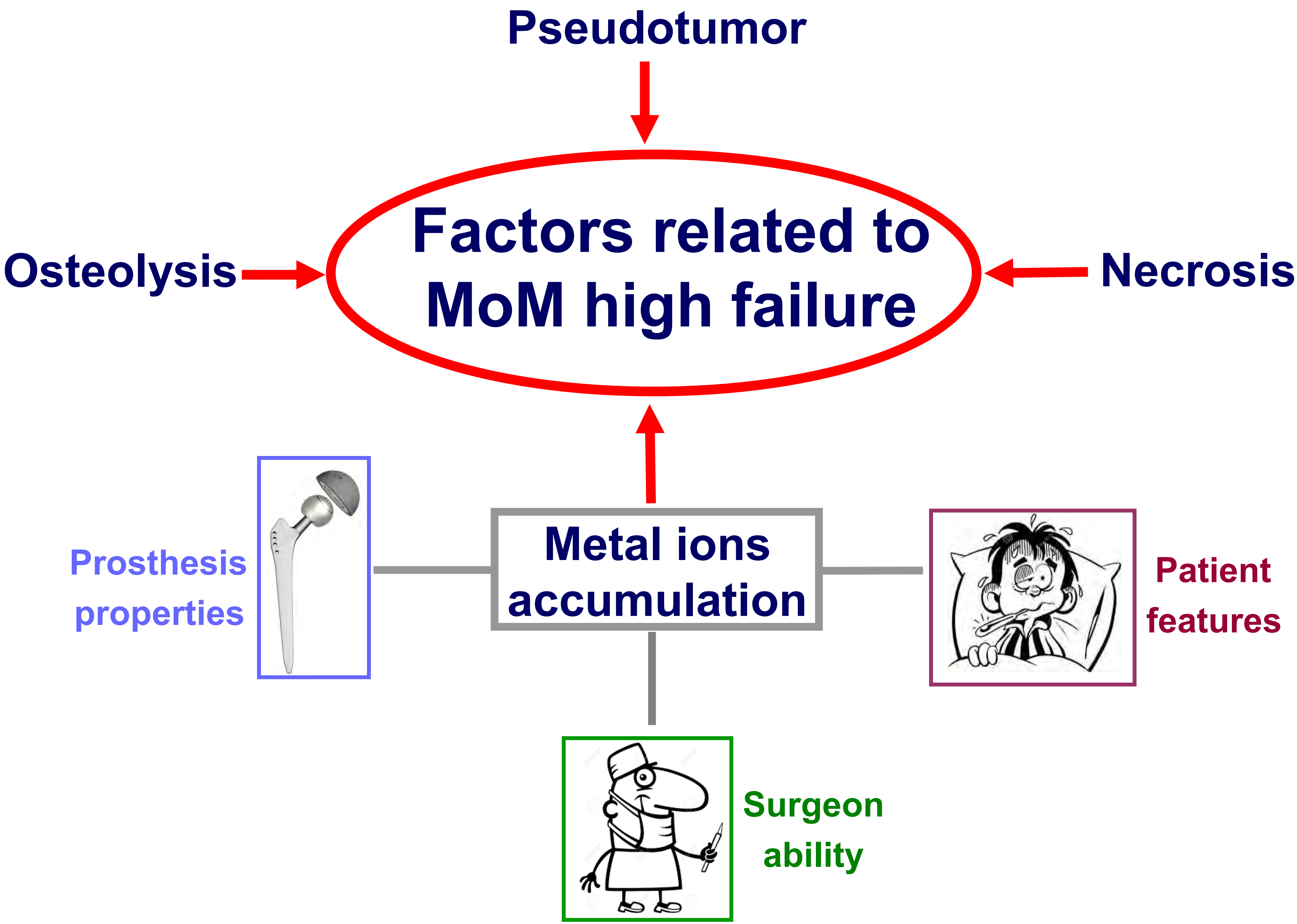
26-27 NOVEMBER 2015

MILAN, ITALY

Conditions influencing cobalt and chromium circulating ions level in metal-on-metal patients

A. Beraudi, S. Stea, D. De Pasquale, S. Catalani, M. Baleani, B. Bordini, M. Amabile, S. Canaider, E. Guerra, A. Toni

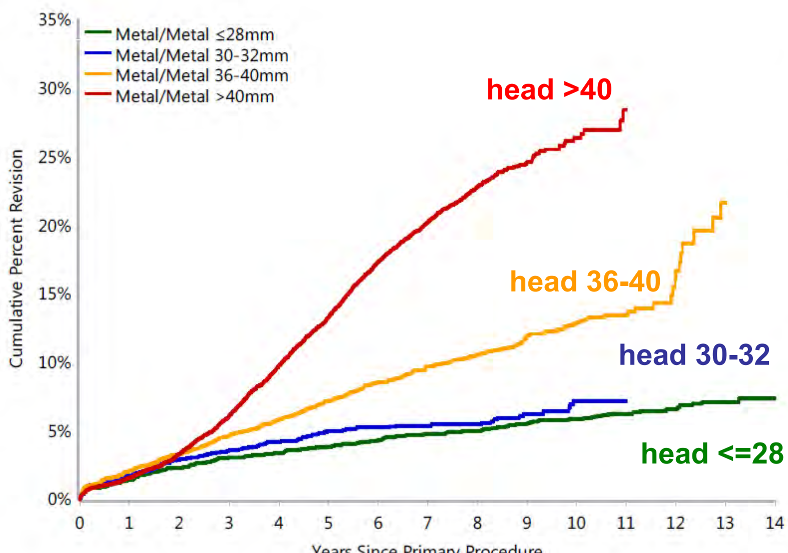
Medical Technology Laboratory
Rizzoli Orthopaedic Institute
Bologna


Pseudotumor
Osteolysis
Factors related to MoM high failure
Necrosis
Prosthesis properties
Metal ions accumulation
Patient features
Surgeon ability

Cup covering

2010
August:
DePuy
Recall

Head dimension



HR - adjusted for age and gender

Metal/Metal 30-32mm vs Metal/Metal ≤28mm
Entire Period: HR=1.24 (0.98, 1.56),p=0.079

Metal/Metal 36-40mm vs Metal/Metal ≤28mm
0 - 4.5Yr: HR=1.75 (1.41, 2.17),p<0.001
4.5Yr+: HR=3.48 (2.66, 4.56),p<0.001

Metal/Metal >40mm vs Metal/Metal ≤28mm
0 - 1.5Yr: HR=1.40 (1.10, 1.77),p=0.005
1.5Yr - 2Yr: HR=2.67 (1.83, 3.90),p<0.001
2Yr - 2.5Yr: HR=4.06 (2.78, 5.94),p<0.001
2.5Yr - 3Yr: HR=3.96 (2.74, 5.74),p<0.001
3Yr - 4.5Yr: HR=6.72 (5.19, 8.71),p<0.001
4.5Yr+: HR=9.78 (7.72, 12.38),p<0.001

AOA
AUSTRALIAN ORTHOPAEDIC ASSOCIATION

2015
stemmed
MoM
higher failure
for bigger head

The Trunion role: a proof

Same prosthesis: resurfacing vs stemmed
Different ions level detected

Fig. 1A–B The figure shows (A) the Durom® (Zimmer Inc., Warsaw, IN) acetabular cup and Durom® resurfacing femoral component; (B) the M/L Taper® (Zimmer Inc.) stem, Metasul® (Zimmer Inc.) large femoral heads, and Cr-Co alloy metal sleeve adaptors.

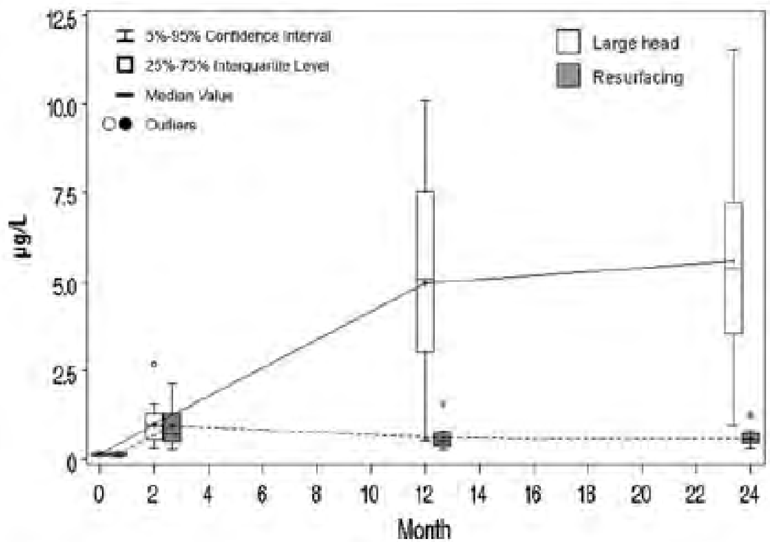
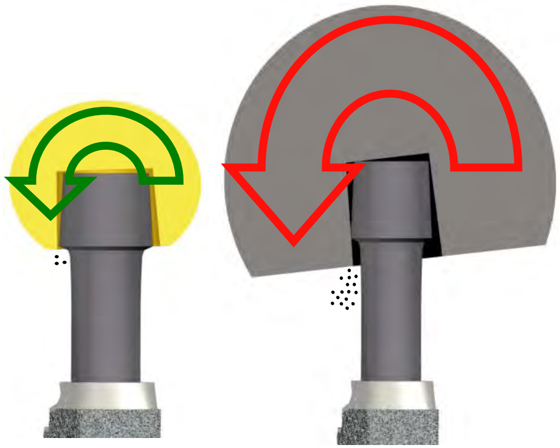


Fig. 2 The graph shows serum cobalt in the large-head metal-on-metal total hip and resurfacing groups preoperatively, at 2 months, 1 year and 2 years postoperatively. Boxes are joined by lines through their means.

DS Garbuz, et al
Clin Orthop Relat Res (2010) 468:318–325

Trunion role

The problem mainly occurs in big head due to its bigger torsional moment



1- A Toni, et al, Seminars in Arthroplasty (2012) 23(4), 248–250
2- M Baleani et al, Abstract AAOSS 2013

Our experience: prosthesis properties

International Orthopaedics (SICOT)
DOI 10.1007/s00264-013-2137-5

ORIGINAL PAPER

Metal-on-metal hip prostheses: Correlation between debris in the synovial fluid and levels of cobalt and chromium ions in the bloodstream

Dalila De Pasquale · Susanna Stea · Stefano Squarzoni · Barbara Bordini · Marilina Amabile · Simona Catalani · Pietro Apostoli · Aldo Toni

Received: 26 July 2013 / Accepted: 19 September 2013

Biomarkers

http://informahealthcare.com/bmk
ISSN: 1354-750X (print), 1366-5804 (electronic)

Biomarkers, Early Online: 1–7
© 2013 Informa UK Ltd. DOI: 10.3109/1354750X.2013.846413

informa
healthcare

Detection of cobalt in synovial fluid from metal-on-metal hip prosthesis: correlation with the ion haematic level

Alina Beraudi[1], Simona Catalani[2], Monica Montesi[1], Susanna Stea[1], Alessandra Sudanese[1,3], Pietro Apostoli[2], and Aldo Toni[1,3]

40 coupled patients

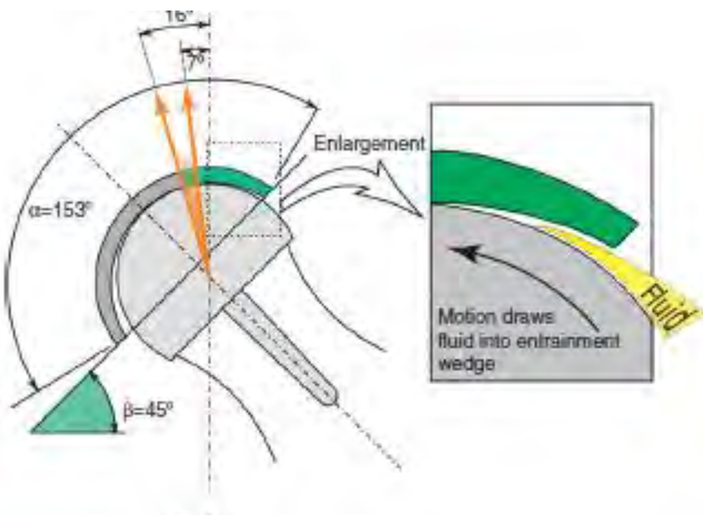
Articular metal debries presence correlates with metal ions level

54 patients

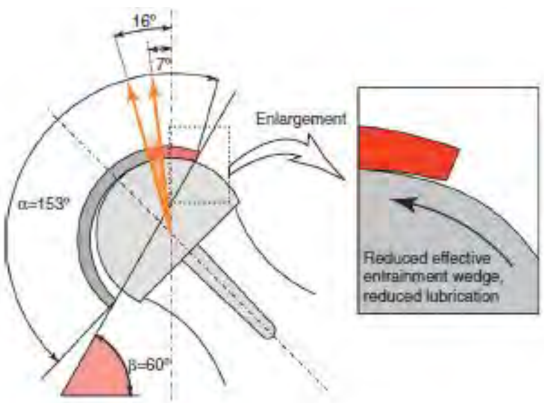
Articular cobalt ions level correlates with haematic cobalt ions level

Blood is the mirror of articular status

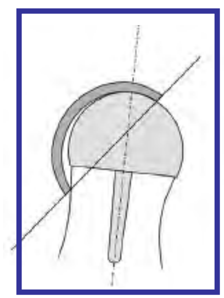
Positioning of the cup



Cup angle 45°
Correct lubrification
Restrained damage

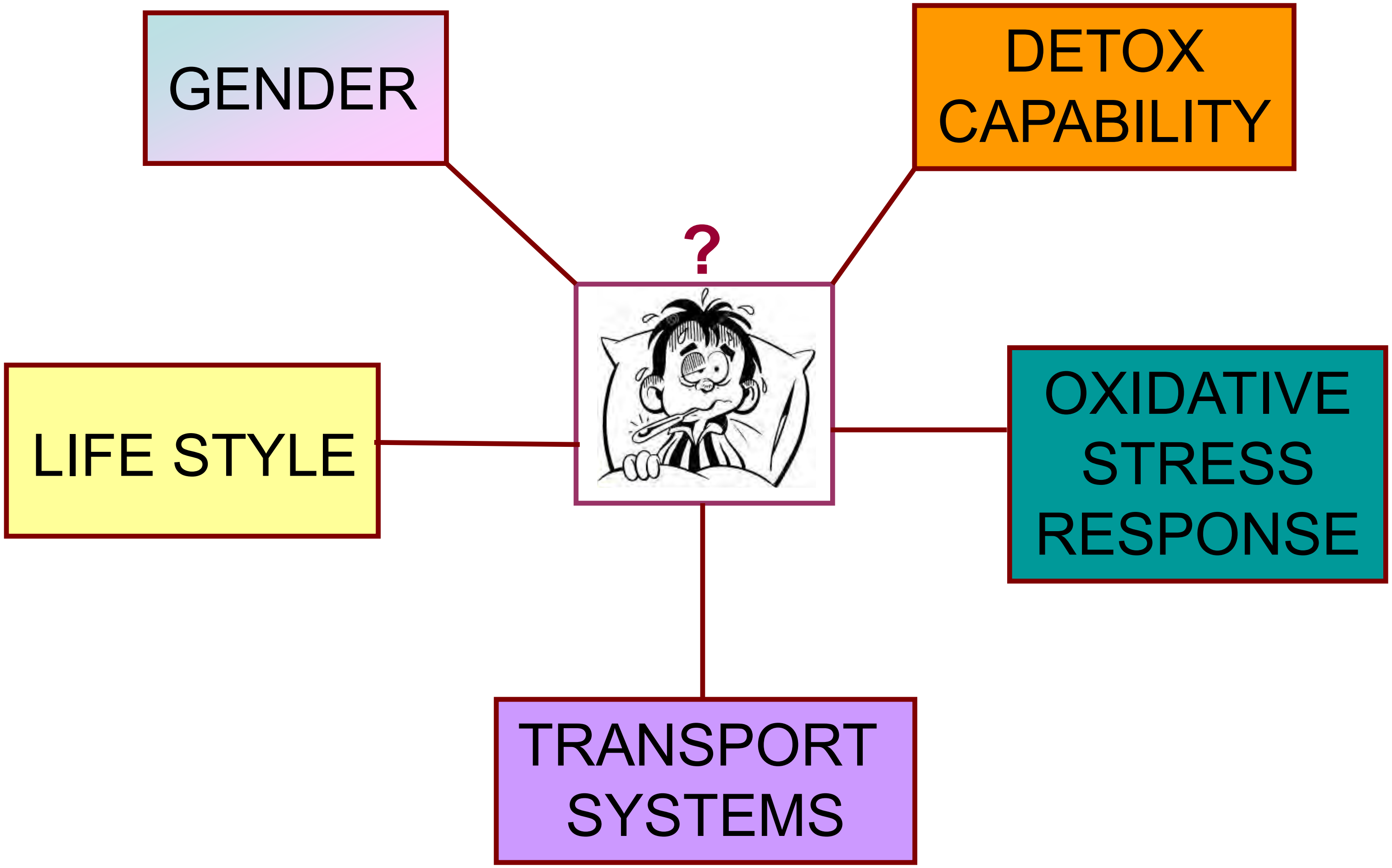


Cup angle 60°
Localized damage
Increased ions release

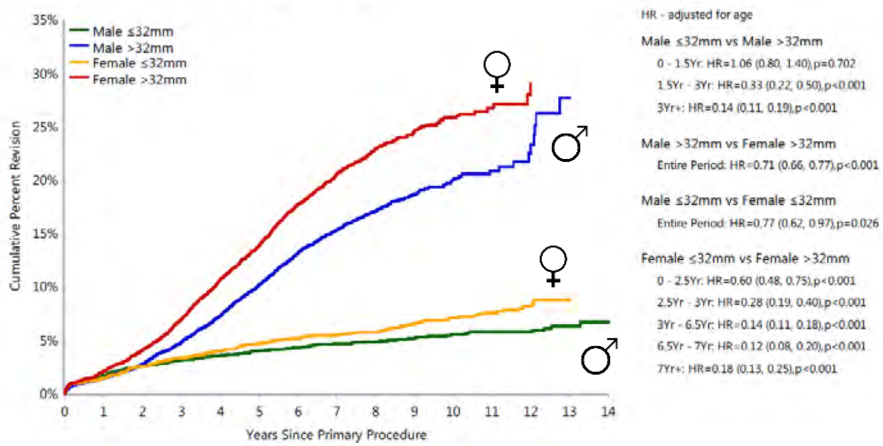


Impingment
Hard damage

Which are the patient features involved in metal ions management?



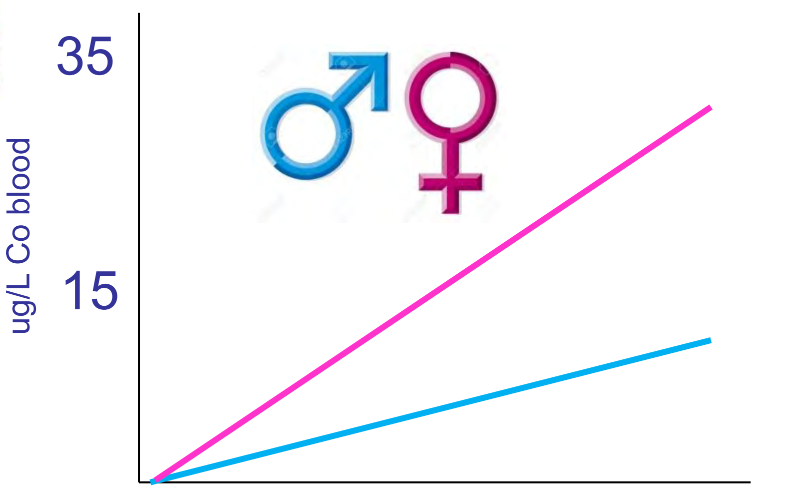
GENDER



AOA AUSTRALIAN ORTHOPAEDIC ASSOCIATION

2015 stemmed MoM higher failure in women

1 mg/die Cobalt for 1 month, per os



2500 $

Cobalt management is different between genders

Finley et al, 2013, J Toxicol Environ Health A, 76, 1210– 24

Our experience

200 MoM patients collected for their haematic and urinary values of Cr and Co

•Stemmed and resurfacing
•Primary or revised THA
•ASR included
•Symptomatic and not
• Different follow up
•Male and female
•Large and small heads

Cut off assumed as warning for safety
7µg/l in whole blood for both ions

OUR EXPERIENCE
200 MoM

DETOX CAPABILITY

OXIDATIVE STRESS RESPONSE

TRANSPORT SYSTEMS

12

44

40

Elimination rate of Co and Cr blood and urine

Heme oxygenase 1 (HMOX 1)

Accepted July 2015 Molecular Medicine Reports

Albumin and modified albumin (IMA)

Submitted to
Molecular Diagnosis & Therapy, Nov 2015

OUR EXPERIENCE

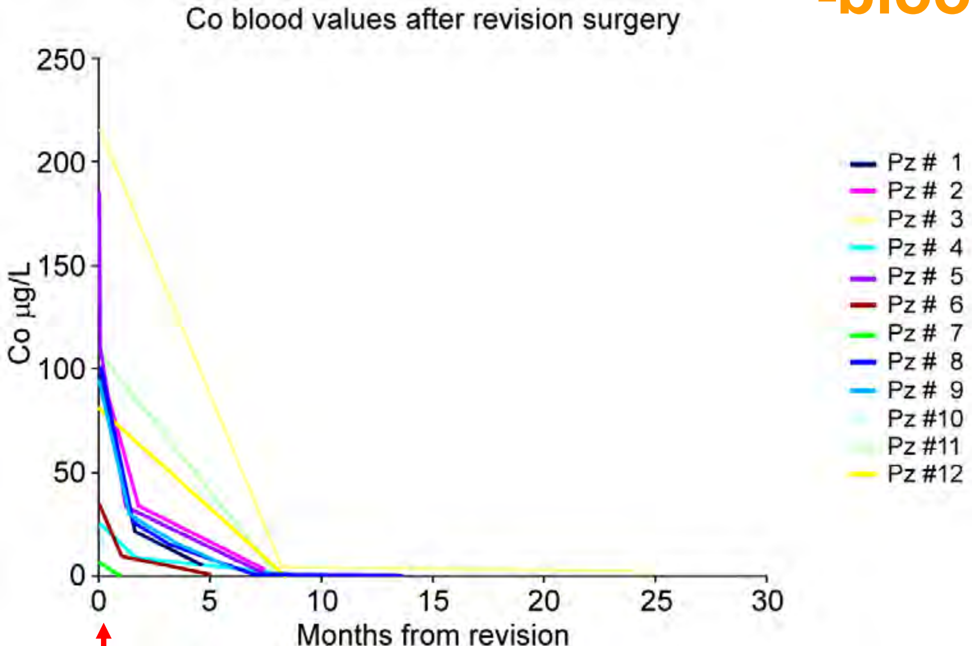
DETOX CAPABILITY

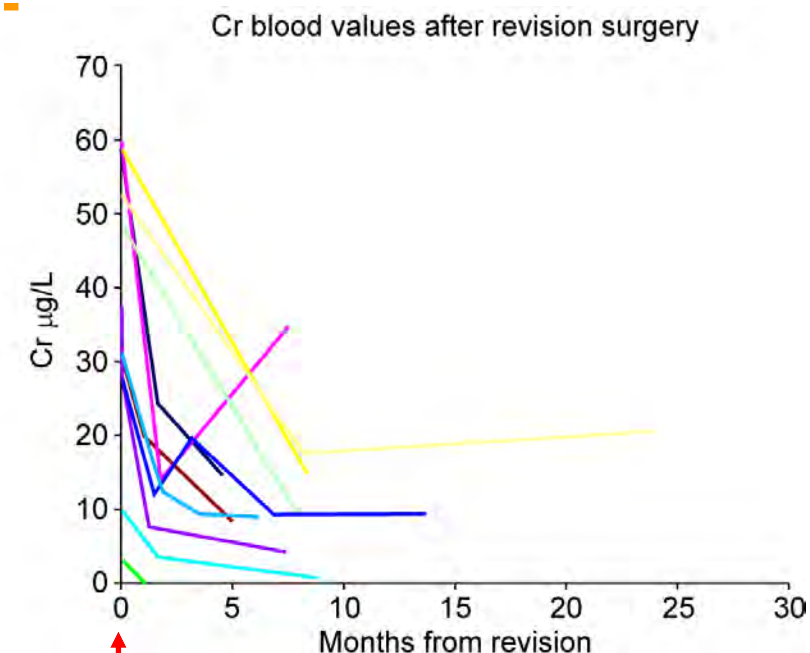
For those patients in which it was possible to detect ions levels during serial visits…

OUR EXPERIENCE

DETOX CAPABILITY

Elimination rate of Cobalt and Chromium -blood-





Revision time

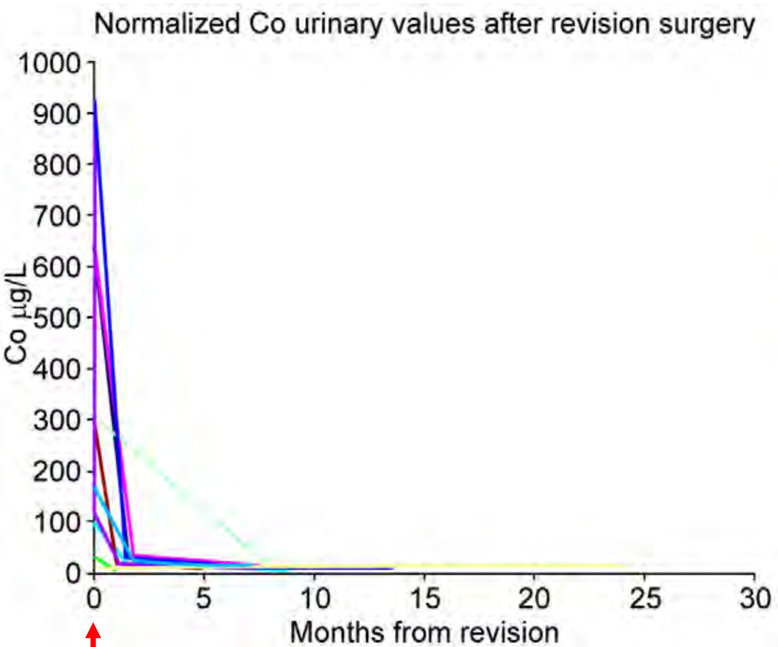
Revision time

Cobalt in blood reaches 7 µg/l in about seven months after revision surgery. For Chromium it doesn't happen

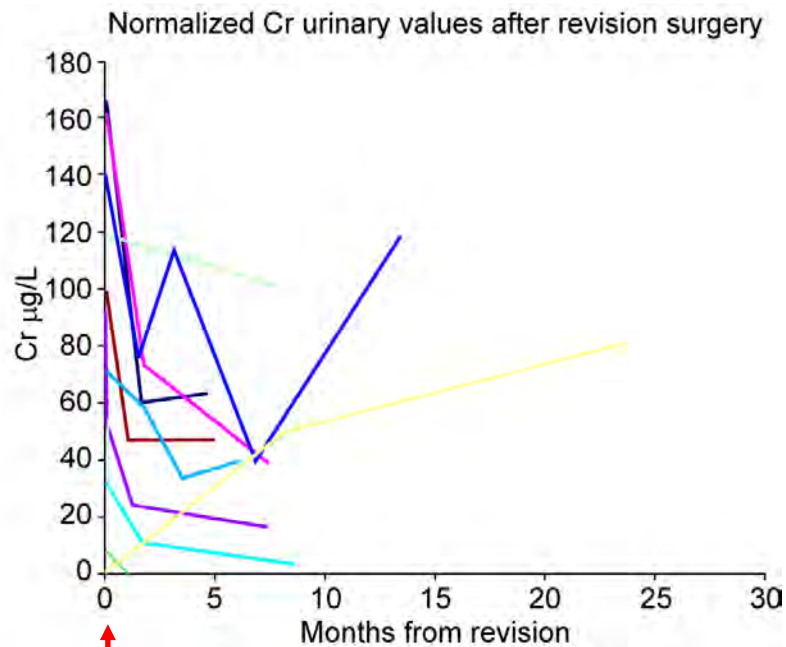
OUR EXPERIENCE

DETOX CAPABILITY

Elimination rate of Cobalt and Chromium -urine-



Revision time



Revision time

Cobalt in urine reaches 7 µg/l in about seven months after revision surgery. For Chromium it doesn't happen

LTM
Laboratorio di Tecnologia Medica

OUR EXPERIENCE

Background for studies HMOX-1 and Albumin

•Cobalt is vehiculated by **albumin**

•Ischemia Modified Albumin (**IMA**) is a form of albumin modified in the site of linkage with cobalt

•Many studies have correlated the presence of these ions, besides other factors, to the induction of oxidative stress response

•Heme-Oxygenase-1 (**HMOX-1**) is one of the most important enzyme involved in oxidative stress response

OUR EXPERIENCE

Aims

Investigate:

TRANSPORT SYSTEMS

the subject specific capability to transport metal ions (ALBUMIN study)

OXIDATIVE STRESS RESPONSE

the subject specific capability to manage the response to them (HMOX-1 study)

TRANSPORT SYSTEMS

The subject specific capability to transport metal ions (ALBUMIN study)

MUTATIONAL SCREENING OF *ALBUMIN:*

in MoM prosthetic patients
results in the **absence** of nucleotidic changes compared to the *ALB* reference sequence

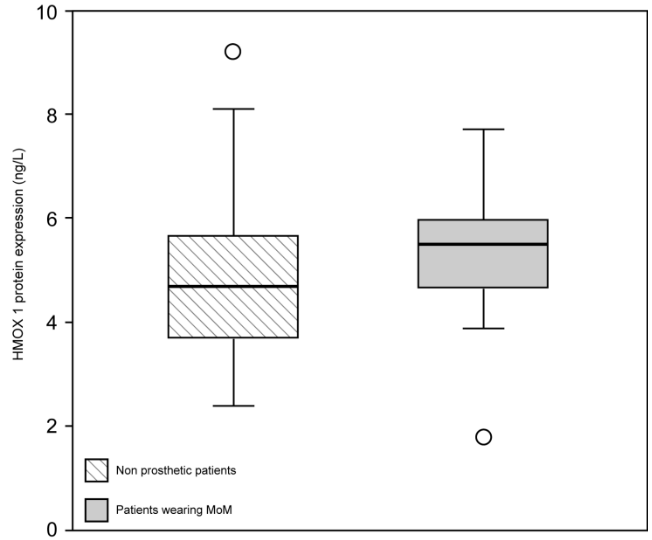
DETERMINATION OF ALBUMIN AND IMA:

IMA and ALB **are not correlated** to Cobalt and Chromium values in blood, serum and urine, and they are not statistically different between patients with high or low metal ions

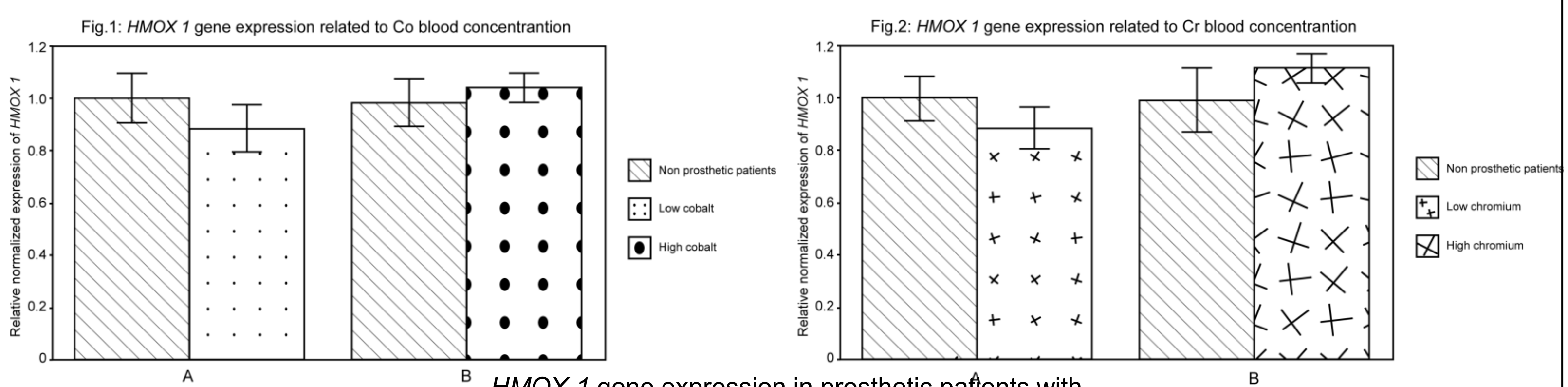
The subject specific capability to manage the response to Cr and Co (HMOX-1 study)

OXIDATIVE STRESS RESPONSE

No statisitcally significant differences between prosthetic and non prosthetic patients as well as between patients with high and low ions levels



HMOX 1 protein expression in prosthetic and non prosthetic patients



HMOX 1 gene expression in prosthetic patients with
low levels of Co or Cr (<7ug/L) (A) and high levels of Co or Cr (>7ug/L) (B)
compared with their non prosthetic controls
Y axis: fold change (±Standard Error of the Mean)

OUR EXPERIENCE

Conclusions

The two different elimination rates for Cr and Co seem to have a similar trend in all the patients

The investigated proteins/gene involved in transport and oxidative stress response are not correlated neither to metal ion levels nor to specific critical symptomatology

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY

SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

The Problem of Metal-on-Metal Total Hip Arthroplasty. Our experience in 59 cases

G. Zarattini*, A.Spreafico*, C.Castelli, G.Perino*****

UE Pazzaglia*

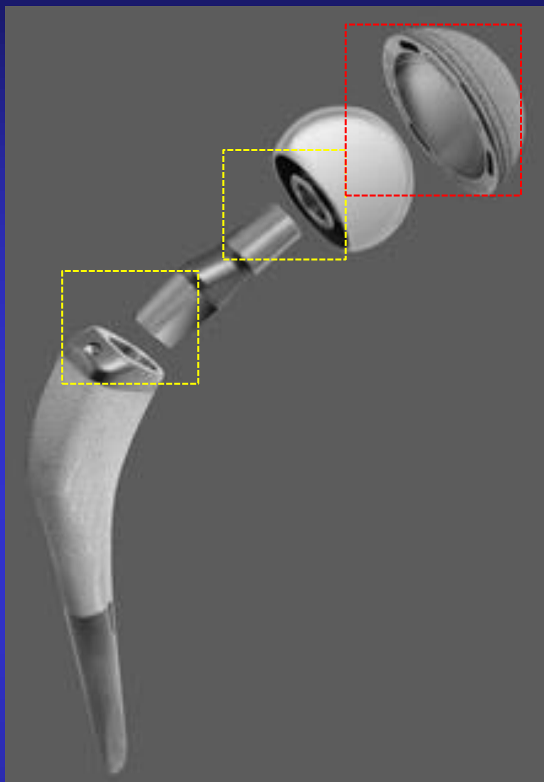
***Clinica Ortopedica Università di Brescia**

**** U.S.C. Ortopedia e Traumatologia, Azienda Ospedaliera «Papa Giovanni XXIII» di Bergamo**

*****Hospital for Special Surgery, NY, NY**

BACKGROUND

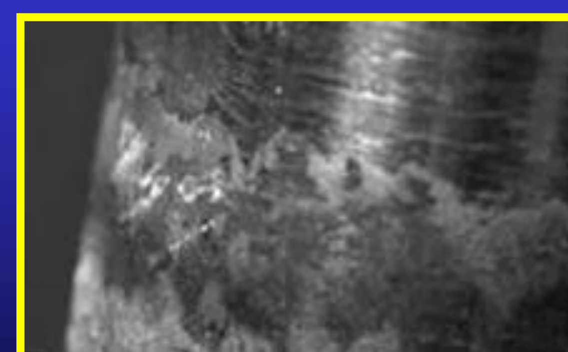
PROSTHETIC WEAR



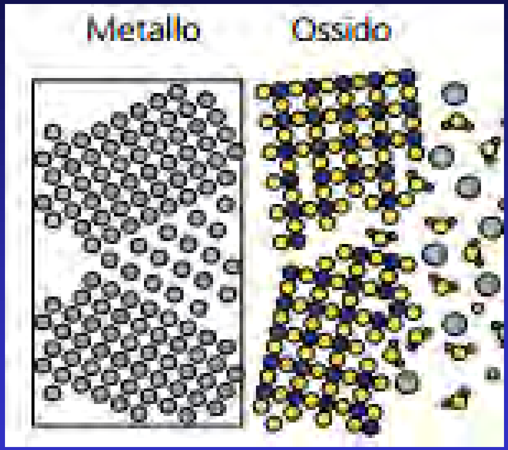
sliding tribocorrosion

abrasion wear

fretting corrosion



COMPLICATIONS OF *CoCrMo ALLOY*



Systemic

Apostoli et al., 2013
Co cause problem in :
Liver, Kidney,
Lungs, Heart,
Pancreas and Nervous System

Adverse Local Tissue Reactions

Langton et al., 2010
Cr in periprosthetic tissue

Corrosion
Electrochemical Phenomenon

Goldberg et al., 2002; Burroughs et al., 2006
Fricka et al., 2012; Langton et al., 2012

Wear
Physical Phenomenon

In case of metallic ion intoxication due to implant malfunction it is recommended:

1. to remove the prosthesis,
2. copious irrigation of the periprosthetic tissues
3. resection of the periprosthetic tissues

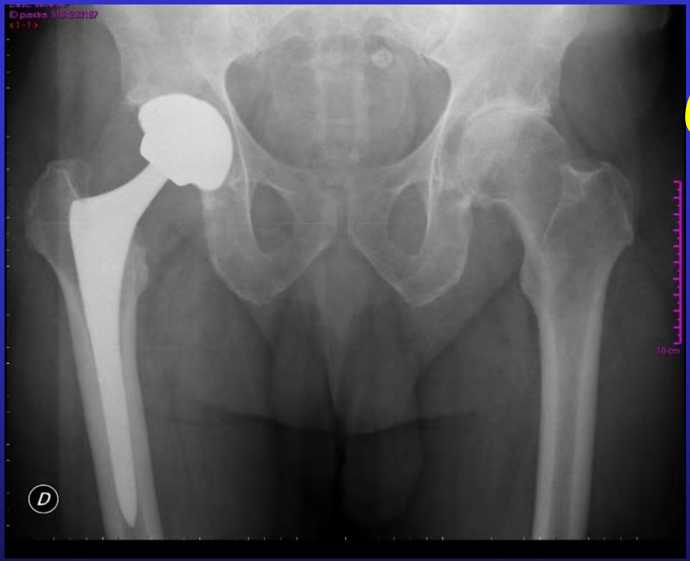
With these measures it was possible to halve blood concentrations of Co e Cr in about 50 days (Durrani et al., 2014)

In severe cases with neurological complications, it is recommended the use of chelating agents
(Pazzaglia et al., 2011)

STUDY DESIGN

Evaluation of a population of 57 patients, with 59 MoM (CoCrMo) *Primary Total Hip Arthroplasty* performed in our orthopaedic department from 2004 to 2009

DePuy Orthopaedics (Warsaw, Indiana, USA)



Biomet-Orthopaedics (Dietikon, Switzerland)

56 patients - 58 THR

1 patient - 1 THR

MATERIALS AND METHODS

Diagnostic-therapeutic protocol

- *Orthopedic outpatient visit*
- *Hip radiographs*
- *Ionic dosage of Co and Cr* by *Inductively Coupled Plasma -Mass Spectrometry*

↓

MRI with
Metal Artifact Reduction Sequence

↓

Implant revision

INDICATIONS TO REVISION

Radiographic signs of mobilization

Pseudotumor at MRI

Co and Cr: >**7µg/l**

Oxford Hip Score < 30

1. **During the past 4 weeks**, how would you describe the pain you **usually** had from your hip?

None[1]	Very mild[2]	Mild[3]	Moderate[4]	Severe[5]

2. **During the past 4 weeks**, have you had any trouble with washing and drying yourself (all over) **because of your hip**?

No trouble at all[1]	Very little trouble[2]	Moderate trouble[3]	Extreme difficulty[4]	Impossible to do[5]

3. **During the past 4 weeks**, have you had any trouble getting in and out of a car or using public transport **because of your hip**?

No trouble at all[1]	Very little trouble[2]	Moderate trouble[3]	Extreme difficulty[4]	Impossible to do[5]

4. **During the past 4 weeks**, have you been able to put on a pair of socks, stocking or tights?

Yes, easily[1]	With little difficulty[2]	With moderate difficulty[3]	With extreme difficulty[4]	No, impossible[5]

5. **During the past 4 weeks**, could you do the household shopping **on your own**?

Yes, easily[1]	With little difficulty[2]	With moderate difficulty[3]	With extreme difficulty[4]	No, impossible[5]

6. **During the past 4 weeks**, for how long have you been able to walk before **pain from your hip** becomes severe (with or without a stick)?

No pain/more than 30 minutes[1]	16 – 30 minutes[2]	5 – 15 minutes[3]	Around the house only[4]	Not at all – pain severe on walking[5]

7. **During the past 4 weeks**, have you been able to climb a flight of stairs?

Yes, easily[1]	With little difficulty[2]	With moderate difficulty[3]	With extreme difficulty[4]	No, impossible[5]

8. **During the past 4 weeks**, after a meal (sat at a table), how painful has it been for you to stand up from a chair **because of your hip**?

Not at all painful[1]	Slightly painful[2]	Moderately painful[3]	Very painful[4]	Unbearable[5]

9. **During the past 4 weeks**, have you been limping when walking **because of your hip?**

Rarely/never[1]	Sometimes, or just at first[2]	Often, not just at first[3]	Most of the time[4]	All of the time[5]

10. **During the past 4 weeks**, have you had any sudden or severe pain – 'shooting', 'stabbing', or 'spasms' – **from the affected hip**?

No days[1]	Only 1 or 2 days[2]	Some days [3]	Most days[4]	Every day[5]

11. **During the past 4 weeks**, how much has **pain from your hip** interfered with your usual work (including housework)?

Not at all[1]	A little bit[2]	Moderately[3]	Greatly[4]	Totally[5]

12. **During the past 4 weeks**, have you been troubled by **pain from your hip** in bed at night?

No nights[1]	Only 1 or 2 nights[2]	Some nights [3]	Most nights[4]	Every night[5]

7 patients → 8 prosthesis → implant revision

MATERIALS AND METHODS

Population study

Entire population	Value
Number of patients	**57**
Number of prosthesis	**59**
Male/Female	53/4
Average age (Years)	59.3

Revised population	Value
Number of patients	**7**
Number of prosthesis	**8**
Male/Female	4/3
Average age (years)	65,12
Average length (months)	68,75

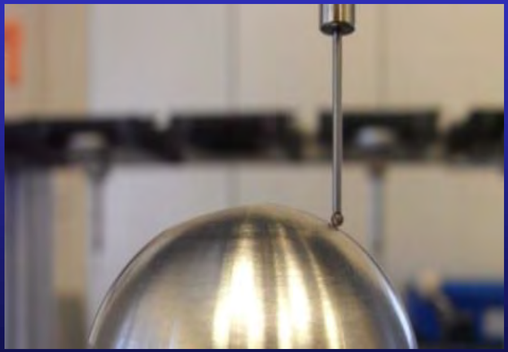
Case	Implant life time (months)	Reason for revision	Oxford Hip Score (OHS)
n.1	89	Local tissue reaction	48
n.2	51	Aseptic loosening	(7)
n.3	74	Local tissue reaction	30
n.4	89	Local tissue reaction	46
n.5	52	Local tissue reaction	29
n.6	91	Local tissue reaction	46
n.7	52	Local tissue reaction	15
n.8	52	Local tissue reaction	20

OHS evaluation: 48-41 excellent; 40-34 good, 33-27 moderate, below 27 poor. (Murray et al., 2007)

MATERIALS AND METHODS

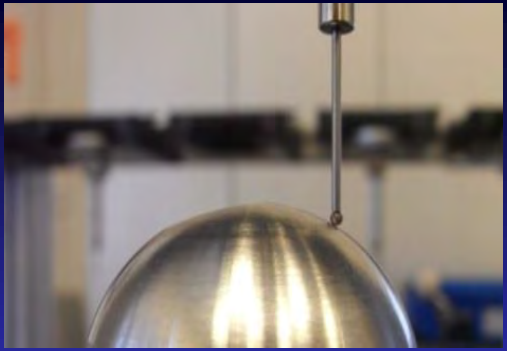
Study population

- **Hystological Analysis**: tissues were fixed in 10% buffered formaldehyde, processed, cut, and stained with hematoxylin-eosin and Prussian Blue. Histological analysis was performed by an experienced consultant orthopedic pathologist (GP).
- **Prosthetic analysis**: ultrasonic cleaning, stereo microscope observation and *analysis profilometric* at independent laboratories.



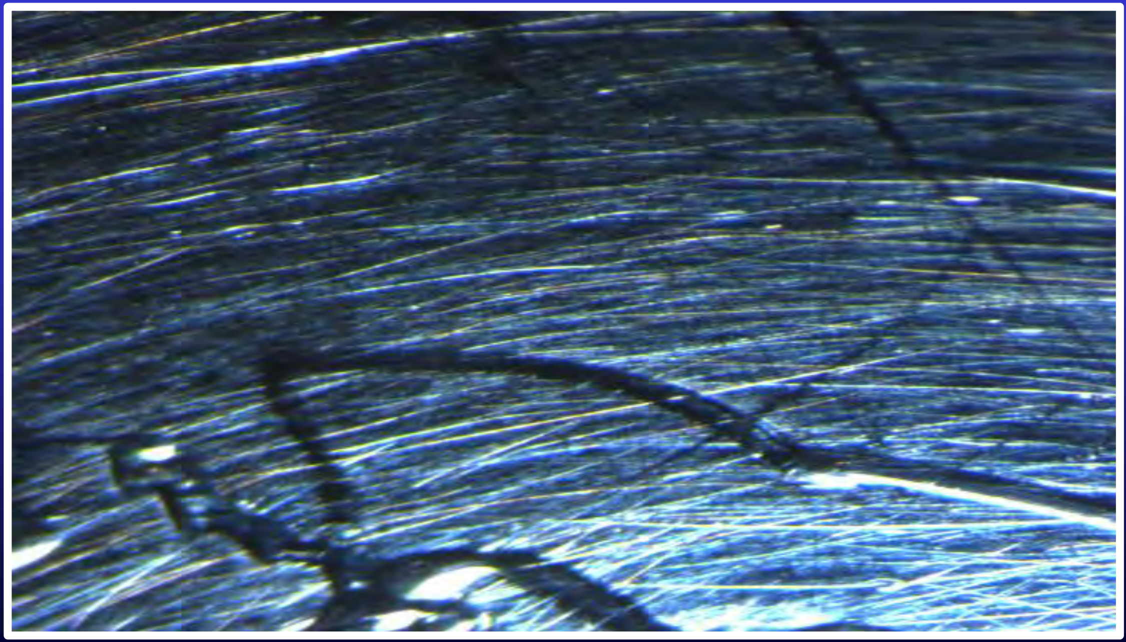
RESULTS

Implant profilometric analysis on head surfaces



Value	Head abrasion wear (µm/year)	Cup abrasion wear (µm/year)
Min	0,41	0,1
Average	**2,42**	**1,27**
Max	10,41	2,98

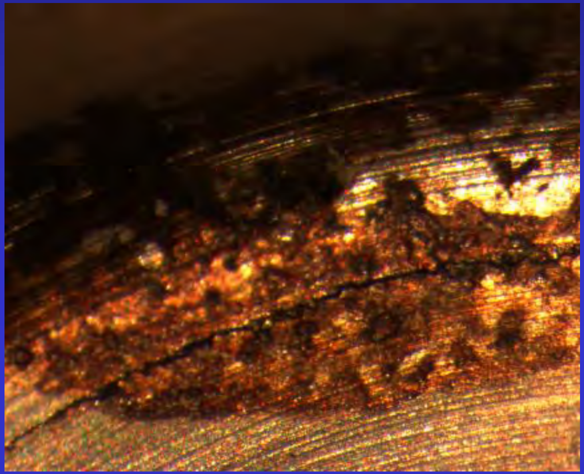
Mean normal value: **≈1 µm/year**

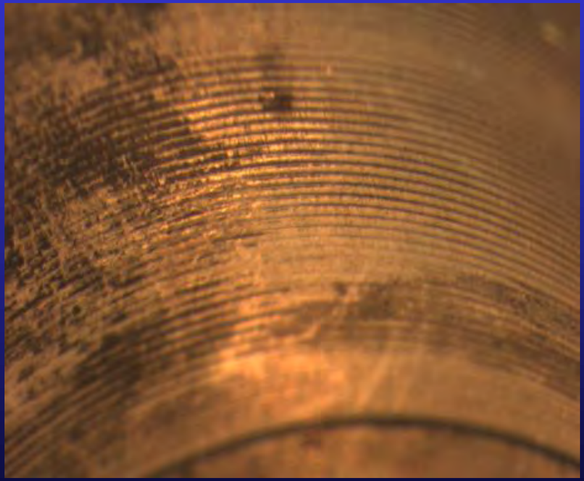


RESULTS

Implant analysis

7 metallic implants with fretting corrosion of morse taper junction





RESULTS

Dose ion in whole blood of reviewed population

Value	Cobalt (µg/l)	Chromium (µg/l)
Min.	0,16	0,35
Average	**5,35**	**4,53**
Max.	11,95	18,7

Case	Cobalt (µg/l)	Chromium (µg/l)
n.1	**8,8**	3,10
n.2 (bilateral)	**11,95**	5,20
n.3	4,04	3,27
n.4	0,16	0,35
n.5	**9,2**	**18,7**
n.6	2,35	3,06
n.7	4,97	0,95
n.8	1,4	0,40

Threshold for Co and Cr: **7µg/l**

(Medicines and Healthcare Products Regulatory Agency, 2010)

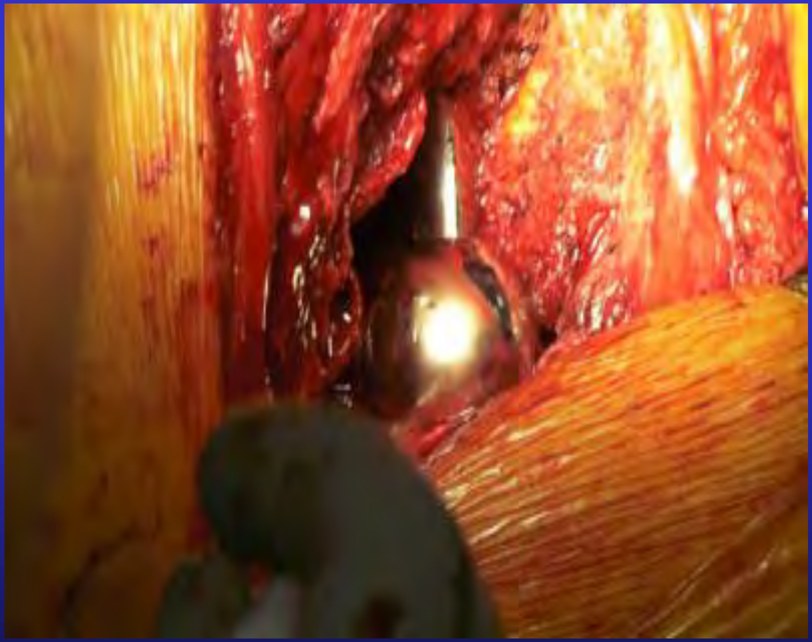
RESULTS

Local tissue reactions

6 patients

Pseudotumor

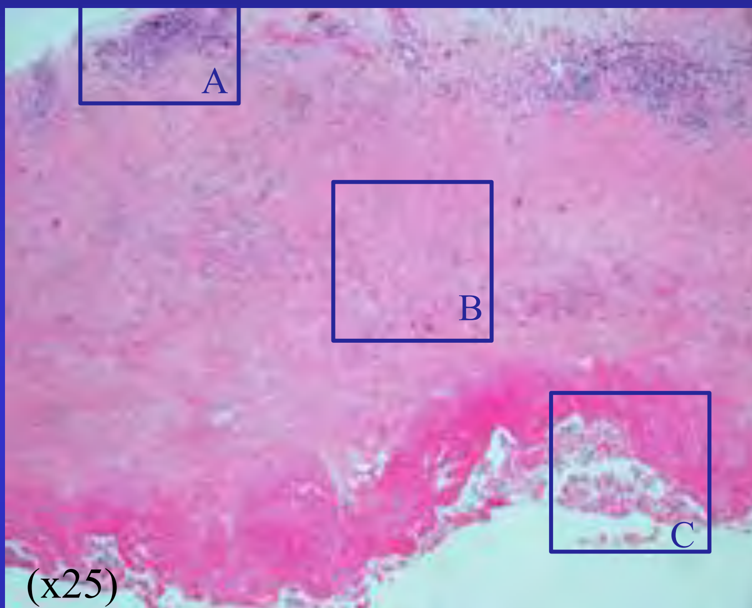
Pandit et al., 2008



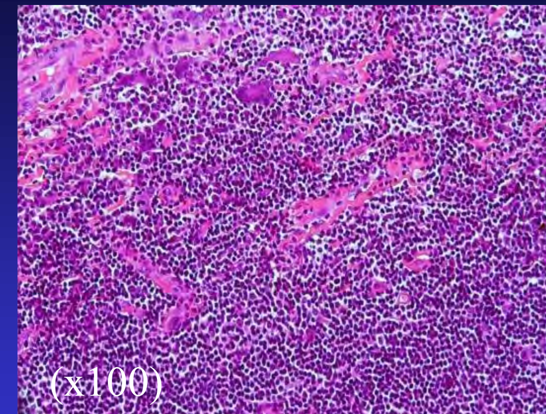
pathogenetic mechanism still debated

RESULTS

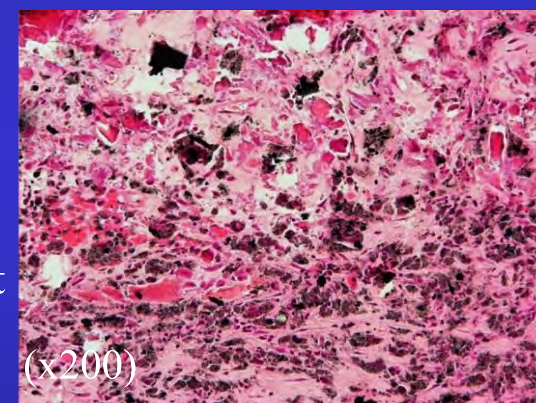
Local tissue reactions



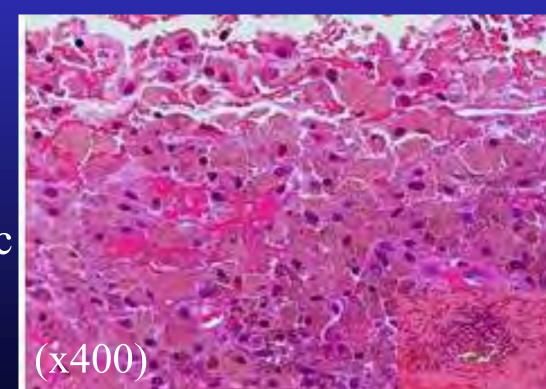
A) Lymphocytic infiltrate



B) Macrophage infiltrate containing products derived from the implant



C) Cell Necrosis
Luminal expholiation of necrotic macrophagic forms



RESULTS

A.L.V.A.L. Score

Aseptic
Lynphocytis
Vasculites
Associate
Lesion

Average = 6

Points	Synovial lining
0	Intact synovial lining
1	Focal loss of synovial surface, fibrin attachment may occur
2	Moderate to marked loss of synovial surface, fibrin attachment
3	Complete loss of synovium, abundant attached fibrin and /or necrosis of lining tissue
Points	**Inflammatory infiltrate**
0	Minimal inflammatory cell infiltrates
1	Predominantly macrophages, occasional lymphocytes may occur
2	Mix of macrophages and lymphocytes, either diffuse and/or small (< 50% of hpf) perivascular aggregates
3	Mix of macrophages and lymphocytes, large (> 50% hpf) perivascular aggregates may occur
4	Predominantly lymphocytes, mostly in multiple, large (> 50% hpf) perivascular aggregates, follicles may be present
Points	**Tissue organization**
0	Normal tissue arrangement
1	Mostly normal tissue arrangement, small areas of synovial hyperplasia, focal necrosis may occur
2	Marked loss of normal arrangement, appearance of distinct cellular and acellular zones, thick fibrous layers may occur
3	Perivascular lymphocytic aggregates mostly located distally, thick acellular areas may occur
	Sum
	Low = 0–4
	Moderate = 5–8
	High = 9–10

ALVAL = aseptic lymphocytic vasculitis-associated lesion; hpf = high-power field.

CONCLUSIONS

1. The head-neck junction is an important site of metallic generation
=> *-Watch modularity implant -*

2. Ions dosage in whole blood is not directly correlated to the immunological reaction (pseudotumor) in periprosthetic tissue
=> *Use MRI to evaluate the inflammatory periprosthetic reaction*

3. The main adverse reaction begin from immunological response to the metal particulate

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

5 year clinical outcomes of 601 metal-on-metal total hip replacements with 36mm heads

AMIT ATREY ORTHOPAEDIC CONSULTANT
WEST SUFFOLK HOSPITAL UK

NASIR HUSSAIN MEDICAL STUDENT
MICHIGAN UNIVERSITY

ANDREW SHEPHERD ORTHOPAEDIC CONSULTANT
WARWICK

STEVE YOUNG ORTHOPAEDIC CONSUTLANT
WARWICK

METAL ON METAL

- MoM 35% of ALL BEARING SURFACES IN THE US

- 32,000 MoM on the English NJR

METAL ON METAL

Study Group	Number of implants	Type of implant	Mean time of follow up (years)	Number of Revisions
Lailiana et al.	**203**	36mm Corail-Pinnacle	6.3	**17%**
Hug et al.	**190**	ASR THA	3.3	**13%**

This study

- Corail-Pinnacle implant
- Most implanted THA in the UK
  - MoM
  - bigger head
  - ? Less dislocation
  - ? Less wear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(PRWEB) NOVEMBER 22, 2013
New details have come to light in the multibillion dollar DePuy AS
announced this week, including the specifics of eligibility to file a
the settlement. The Rottenstein Law Group LLP, which maintains
informational website http://www.depuyhiprecallnewscenter.co
other details of the settlement.
The DePuy Hip Litigation Guide
THE EXPERT INSTITUTE
93,000 People
received DePuy implants in USA
15,000 People
will require revision surgery
Metal Poisoning (Metallosis)
observed in 5% of metal joint implant patients
Metal-on-Metal Hips: Highest Failure Rates
An analysis of 402,051 hip replacements showed these failure rates:
metal-on-metal 6.2%
ceramic-on-ceramic 2.3%
metal-on-plastic 1.7%
FDA Complaints
Since the recalls, the FDA received 400 complaints involving hip implant failure (coupled with the almost 900 complaints received prior to the device recalls).
2006 12
2007 87
2008 239
2009 424
2010 (August) 125
Pseudotumors
Dutch research suggest peudotumors are 10x more likely in patients with metal-on-metal hip implants.
Risk of Osteolysis
metal-on-metal devices cause significant friction and metal debris

Clinic based on MHRA guidelines 2012

Lecture, consultation, pain scores, metal ion levels & imaging

PATIENTS PUT INTO TWO GROUPS

SYMPTOMATIC

ASYMPTOMATIC

This study - Warwick Hospital 2006 - 2011

601

(585 patients)

19

lost

46

Died

36

Declined clinic

328 females

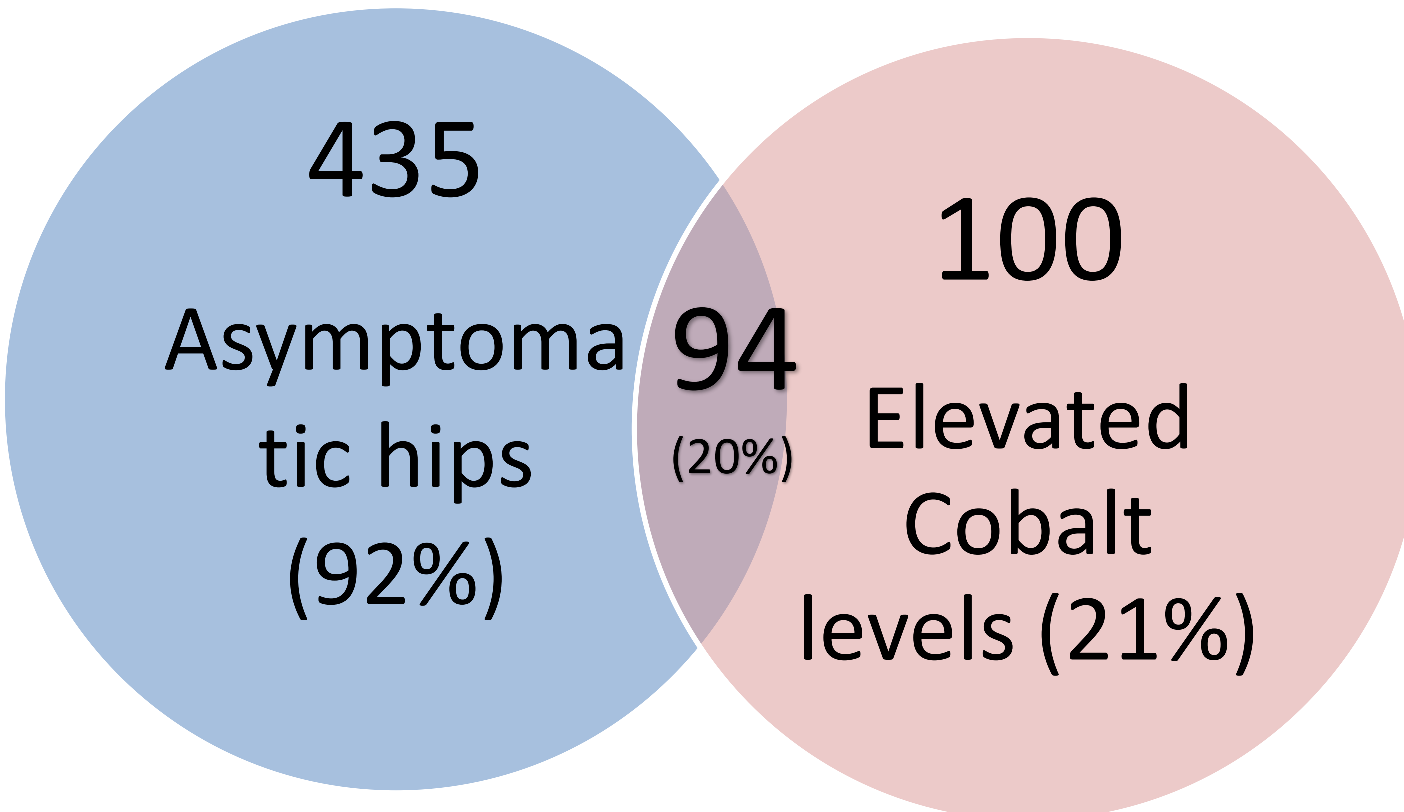
141 males

32 bilaterals

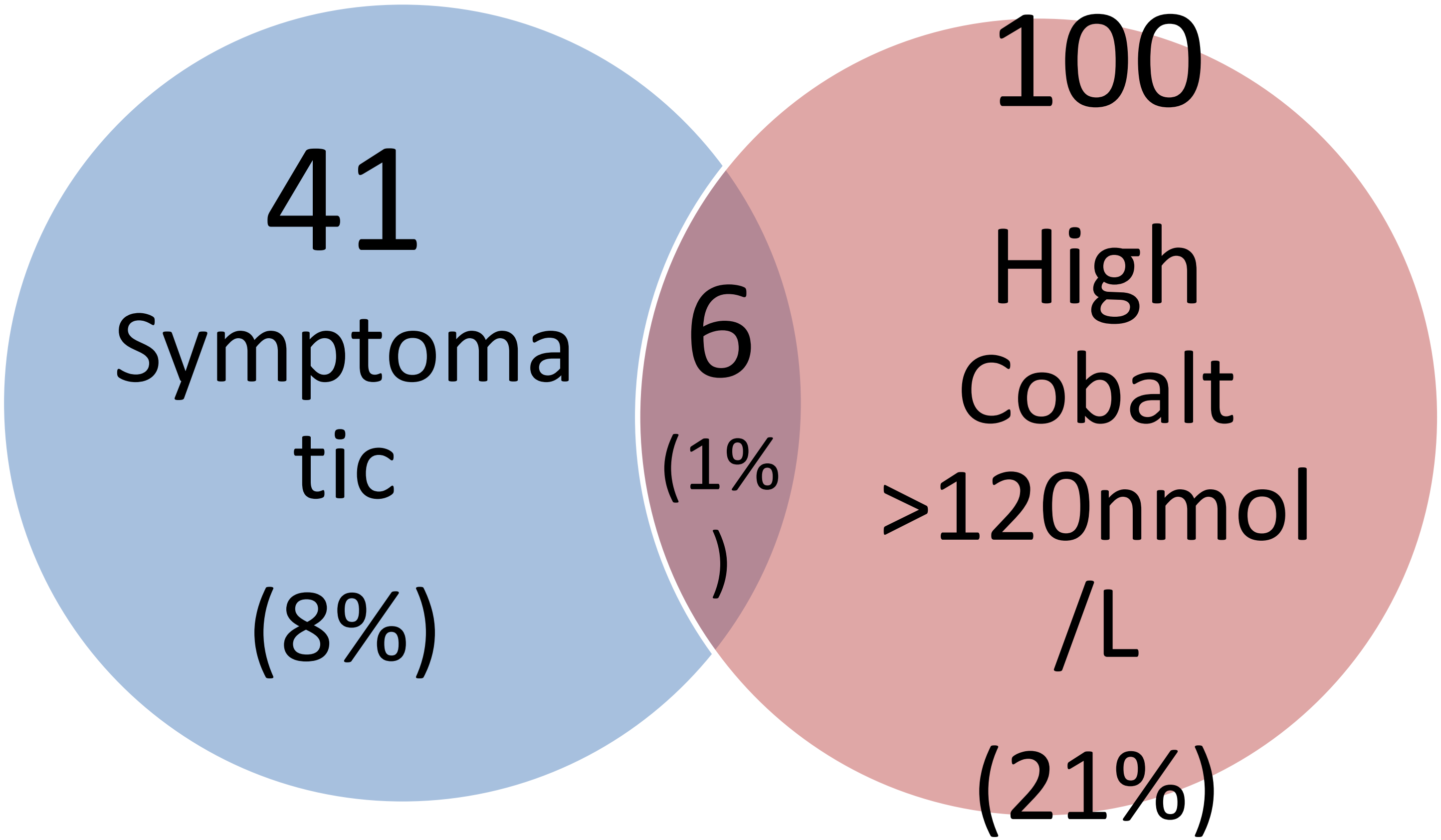
476

seen in clinic

Of the 476 patients



Of all 476 patients in clinic



All 100 symptomatic patients

- ALL HAD USS
  - 5 SHOWED PSEUDOCYST/ CAPSULE
  - 2 HAD EVIDENCE OF SOFT TISSUE DESTRUCTION
  - ALL 7 REVISED

ALL REVISION

REASON FOR REVISION	NUMBER REVISED
Dislocation	6
Infection	4
Patient Request	1
Leg length discrepancy	2
ARMD	12
Aseptic Loosening	4

Oxford Hip Score

- OHS is a good predictor of SYMTOMATIC patients

- Correlation with revision – $p < 0.01$

BUT

- NO correlation with Co or Chromium levels (coefficient of 0.05)

Size of Stem

- Every stem size increase -> ⬇ 11nmol/L cobalt

- ? Increased stiffness of the implant

Cobalt & Chromium

- Cobalt was more often ↑– without chromium
- Chromium was **NEVER INDEPENDENTLY** ↑
- Confirms what Garbuz (Vancouver) has proven
  - MoM resurfacings - Co and Cr ↑ together
  - MoM THAs - Co is solely elevated (wear at the trunion)

COMPARATIVE DATA

Study Group	Number of implants	Type of implant	Mean time of follow up	Revisions directly due to ARMD
This study group	476	36mm Corail-Pinnacle	5.6 years	12 (2.2%)
Lailiana et al.	203	36mm Corail-Pinnacle	6.3	29 (14%)
Hug et al.	190	ASR resurfacing and THA	3.3years	14 (%)

Conclusions

- 7 years survivorship is 94.8%
- Better than that of the large Head MoM/ ASR
- OHS and symptoms are the only predictors of revision
- Cobalt and Chromium levels are NOT predictive of ARMD

Conclusions

- Co (the active element in tissue destruction) is COMMONLY ELEVATED – WITHOUT Cr
- ? MACC AT THE TAPER
- THE MHRA PROGRAMME OF FOLLOW UP PROVIDES A GOOD FRAMEWORK

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26-27 NOVEMBER 2015

MILAN, ITALY

Azienda Ospedaliera
Papa Giovanni XXIII
Bergamo

Sistema Sanitario Regione Lombardia

Dott. **Rudy SANGALETTI**
Dott. **Flavio BARBIERI**
Chiar.mo **Prof. Claudio Carlo CASTELLI**

Hip arthroplasty with metal-on-metal tribology:

10-YEAR FOLLOW-UP AND IONIC RELEASE TREND IN 36MM HEAD IMPLANTS

Metal-on-Metal total hip arthroplasty

54 patients enrolled in 2004-2006

5 pz. died

4 pz. not avaiable

45 avaiable

6 gave no reason

9 pz. excluded themselves from screening

4 pz. went through revision surgery

3 for several comorbidities

Informed consent obtained from 32 pz.

From May 2004 to May 2006:
54 patients operated consecutively were enrolled for a prospective study

Homogeneous sample

Mean Follow up:
10,1 years

Demographics	
No. patients	32
Mean age (range)	58 (44-70)
Mean BMI (range)	27 (22-33)
Mean height (range)	172 (160-182)
Sex	.
• **Male (%)**	31 (96.9%)
• **Female (%)**	1 (3.1%)

DePuy Orthopaedics® (Warsaw, Indiana, USA):

Acetabular cup Pinnacle®,
uncemented stem Summit®,
Ultamet Liner,
Head Cr-Co-Mo 36mm.

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AIMS

- Study outcome of implants with large diameter heads MOM in young men with great functional requirements.
- Study trends of ionic release and wear
- Study incidence of ARMD and correlation with the concentration of Cr-Co in the circulation

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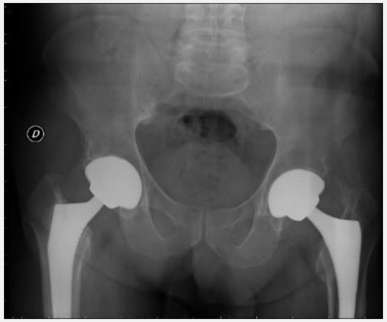
Outcome

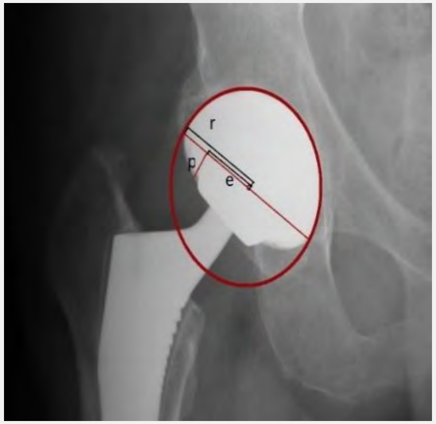
Methods

- Physical Examination
- OHS (Oxford hip score)
- HHS (Harris hip score)
- UCLA activity score

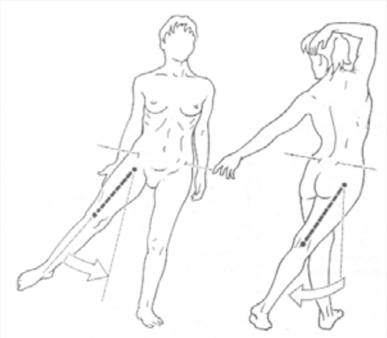
(University of California , Los Angeles)

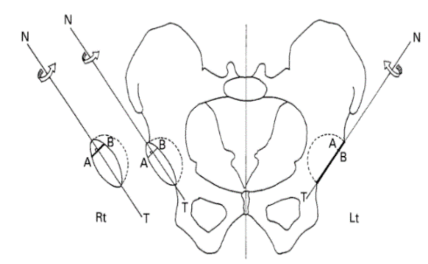
- Radiological RX standard AP and Axial assessed with:
  - Engh score
  - Osteolysis and radiolucent areas Gruen
  - Tilt anteversion : Reito at al.
  - acetabular inclination
  - OFFSET





$$antiversione = \sin^{-1}\frac{p/e}{\sqrt{(r/e)^2 - 1}}$$





Outcome

In a population with large functional requirements:

- 60 months : 100 % UCLA≥ 6/72 % UCLA≥8
- Men : 97 %
- mean age at operation : 58 years
- Average BMI : 27

- **97%** ideal clinical outcome (EO - OHS - HHS
- **93.5 %** clinical- radiological outcome good / excellent (ENGH- osteolysis)
- **12.5%** Focal osteolysis rate
- No case of prosthetic dislocation

Implant survival rate:

5 years : 96 % (52/54)

10 years : 93.2 % (41/44)

NHS
National Institute for Health and Clinical Excellence

	2 years	5 years	6 years	7 years	8 years	9 years	10 years
Engh et Al.		2%					
Barrett et Al.		3%					
Bernasek et Al.						4,2%	
Mokka et al.				4%			
Alison et al.		3.2%					
Varnum et al.				7%			
Bergamo		4%					7.7%

Cr-Co : Trend of ionic release

Methods

	COBALT (μG/L)						
	Pre-op	Post-op	6m	12m	24m	60m	120 m
MEAN	0,11	0,19	0,47	0,63	0,91	1,48	3,12
MEDIAN						0,77	2,20

	60m	120 m
MEAN	0,60	0,85
MEDIAN	0,44	0,70

GF-AAS (Graphite Furnace Atomic Absorbion Spectrometry) on whole blood

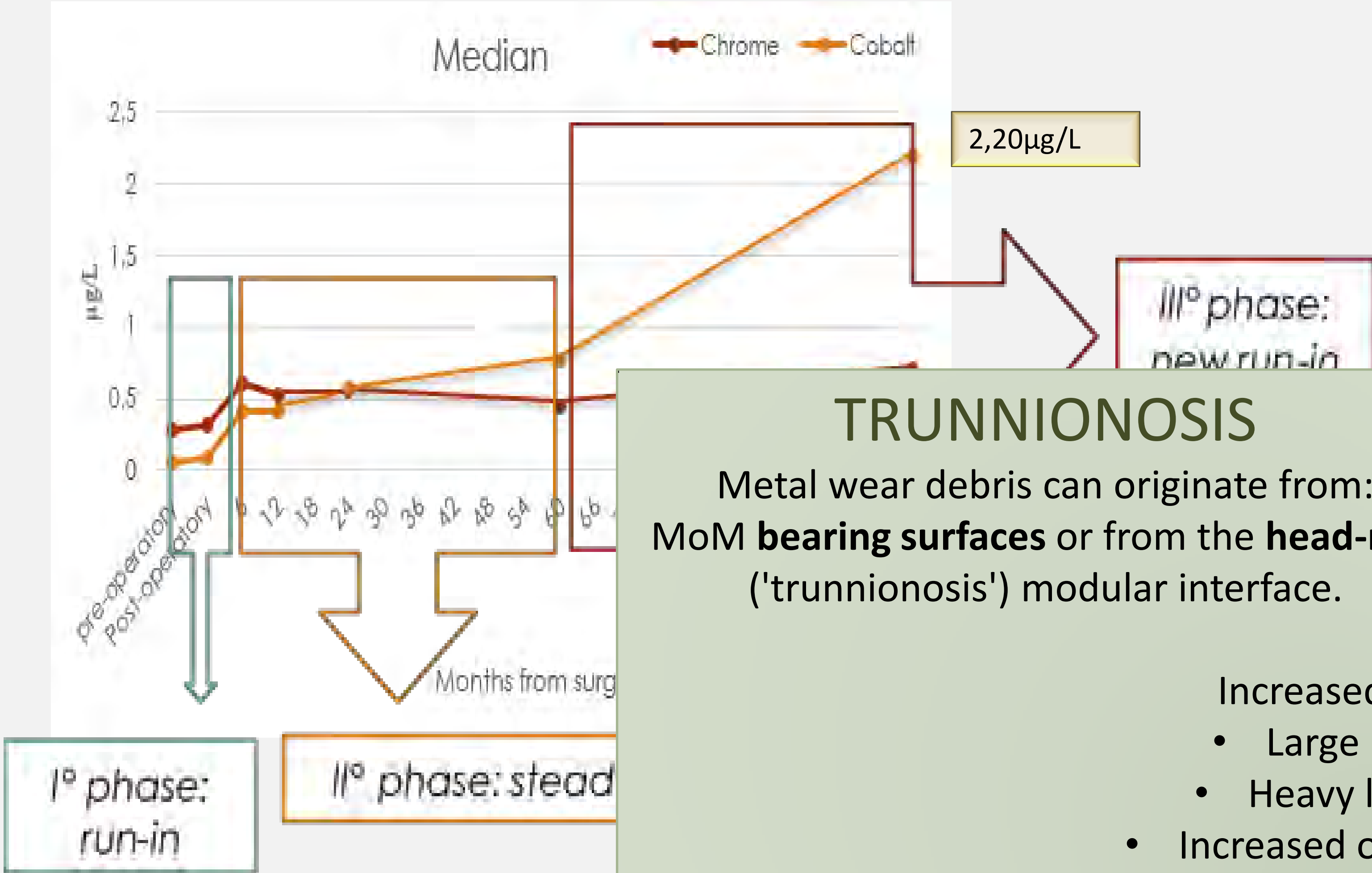
For all patients to 120 months.

Compared with:

- Berfore surgery
- 7 days
- 6/12/24/60 months

Ion concentration Cr-Co is correlated to the rate of wear, fretting and corrosion

Cr-Co : Trend of ionic release



TRUNNIONOSIS

Metal wear debris can originate from:
MoM **bearing surfaces** or from the **head-neck** ('trunnionosis') modular interface.

Increased for:

- Large head
- Heavy loads
- Increased offset
- Long modular necks

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ARMD

MHRA, EFORT and SIOT indicate advanced imaging in high risk patients:

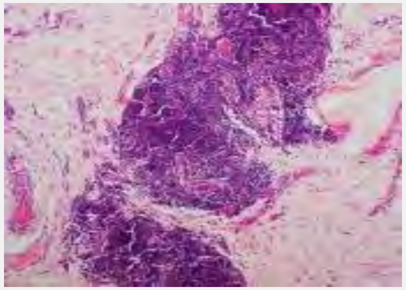
	Low risk	High risk
• HHS • OHS	Asymptomatic - >80 - >40	Symptomatic - <79 - <29
Clinical exam	Negative	Groin pain, palpable mass, tension feeling, lameness feeling.
radiology	Engh > 0 No osteolysis o radiolucent lines	Engh < 0 Osteolysis Radiolucent lines
Ionic levels Cr-Co	<2 µg/L o <7 µg/L without increase between the checks	>7 µg/L o >2 µg/L increase between 2 checks (MHRA indications)

30% High-risk patients:
US or MARS RMI in all high-risk patients .

Rate of ARMD from

8,6 to 14,3%

included patients that underwent revision surgery



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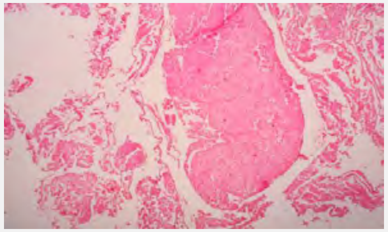
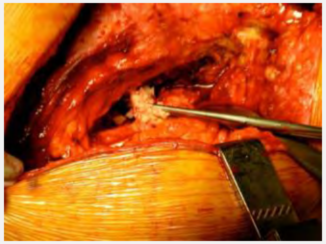
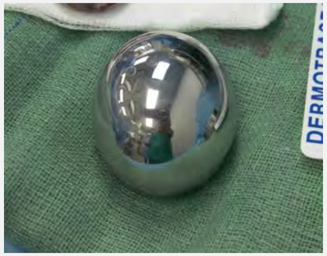
ARMD







3 patients reviewed for ARMD :

2 = Co < 2µg / L

1 = Co < 5µg / L

None of the patients reviewed for pain showed concentrations of Cr - Co exceeding the alert thresholds (SIOT / MHRA = 2/7 mg/L)

There is no correlation between the concentration of Cr / Co and incidence of ARMD

From these data it appears that the detection of ions concentrations in circle does not represent a good screening test

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Hip arthroplasty with metal-on-metal tribology:

10-YEAR FOLLOW-UP AND IONIC RELEASE TREND IN 36MM HEAD IMPLANTS

Dott. Rudy SANGALETTI
Dott. Flavio BARBIERI
Prof. Claudio Carlo CASTELLI

Conclusions

- Outcome
- Cr-Co : Trend of ionic release
- Follow-up MoM

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Metasul 28 mm MoM total hip replacements: Adverse reaction to metal debris incidence & outcome at 10 years

S Singh
R Kotwal
P Roberts
Royal Gwent & St Woolos Hospital
Newport, United Kingdom

Declaration: None of the authors have any commercial interest in the product or company discussed..

28mm Metal-on-Metal Metasul Bearing

- Introduced in 1988.

- Metasul bearing - cobalt-chromium-molybdenum alloy with a high carbide content of 0.20- 0.25% .*

- Wrought forged alloy

MHRA Guidance 2012

Issued: 25 June 2012 at 11:00 Ref: **MDA/2012/036**

Appendix

Management recommendations for patients with metal-on-metal hip replacement implants

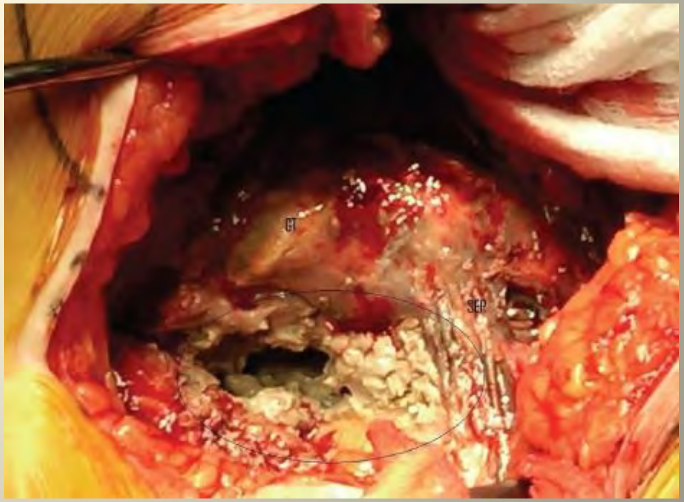
	MoM hip resurfacing (no stem)		**Stemmed MoM total hip replacements – femoral head diameter <36mm**		**Stemmed MoM total hip replacements – femoral head diameter ≥36mm**		**DePuy ASR™ hip replacements (all types)**	
	Symptomatic patients	**Asymptomatic patients**	**Symptomatic patients**	**Asymptomatic patients**	**Symptomatic patients**	**Asymptomatic patients**	**Symptomatic Patients**	**Asymptomatic patients**
Patient follow-up	Annually for the life of the implant	According to local protocols	Annually for the life of the implant	According to local protocols	Annually for the life of the implant	Annually for the life of the implant	Annually for the life of the implant	Annually for the life of the implant
Imaging: MARS MRI or ultrasound	Recommended in all cases	No - unless concern exists for cohort or patient becomes symptomatic	Recommended in all cases	No - unless concern exists for cohort or patient becomes symptomatic	Recommended in all cases	Recommended if blood metal ion levels rising	Recommended in all cases	Recommended in all cases
1st blood metal ion level test	**Yes**	No - unless concern exists for cohort or patient becomes symptomatic	**Yes**	No - unless concern exists for cohort or patient becomes symptomatic	**Yes**	**Yes**	**Yes**	**Yes**
Results of 1st blood metal ion level test	*Blood metal ion level >7ppb indicates potential for soft tissue reaction*		*Blood metal ion level >7ppb indicates potential for soft tissue reaction*		*Blood metal ion level >7ppb indicates potential for soft tissue reaction*	*If blood metal ion level >7ppb then second blood test required 3 months later*	*Blood metal ion level >7ppb indicates potential for soft tissue reaction*	*If blood metal ion level >7ppb then second blood test required 3 months later*
2nd blood metal ion level test	**Yes** - 3 months after 1st blood test if result was >7ppb		**Yes** - 3 months after 1st blood test if result was >7ppb		**Yes** - 3 months after 1st blood test if result was >7ppb	**Yes** - 3 months after 1st blood test if result was >7ppb	**Yes** - 3 months after 1st blood test if result was >7ppb	**Yes** - 3 months after 1st blood test if result was >7ppb
Results of 2nd blood metal ion level test	*Blood metal ion level >7ppb indicates potential for soft tissue reaction especially if greater than previously*		*Blood metal ion level >7ppb indicates potential for soft tissue reaction especially if greater than previously*		*Blood metal ion level >7ppb indicates potential for soft tissue reaction especially if greater than previously*	*If blood metal ion levels rising - further investigation required including imaging*	*Blood metal ion level >7ppb indicates potential for soft tissue reaction especially if greater than previously*	*Blood metal ion level rising indicates potential for soft tissue reaction*
Consider need for revision	If imaging is abnormal and/or blood metal ion levels rising		If imaging is abnormal and/or blood metal ion levels rising		If imaging is abnormal and/or blood metal ion levels rising	If imaging is abnormal and/or blood metal ion levels rising	If imaging is abnormal and/or blood metal ion levels rising	If imaging is abnormal and/or blood metal ion levels rising

Notes and guidance on next page

Aims

- Primary aim:
  - Determine incidence of Adverse Reaction to Metal Debris (ARMD)

- Secondary aim:
  - assess survival of implant
  - complications
  - revision rates and causes.



Material & Methods

- Prospectively collected data
- Single surgeon series
- Patients followed-up in MoM clinics and arthroplasty clinics.
- Whole blood metal ion (cobalt & chromium) checked in patients who came to clinic.
- Magnetic resonance imaging (MRI) performed on those with raised metal ion levels or were symptomatic

Material & Methods

- Total hips implanted = 70
- Total patients = 60
- Mean age = 61.4 years
- Male: Female = 1:3
- Mean follow-up = 10 years (range 6-15 years)

Material & Methods

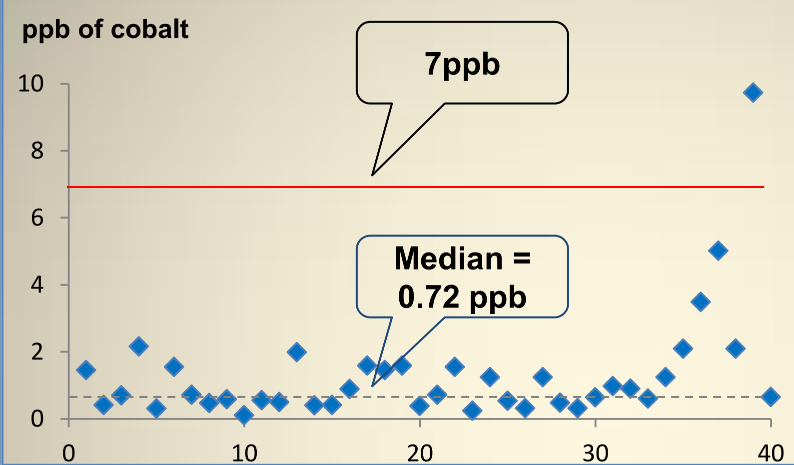
- All had uncemented Allofit cup (Zimmer)
- Cemented MS 30 stem (Zimmer) = 44
- Uncemented CLS stem (Zimmer) = 26

Results

Indications for hip arthroplasty	Numbers
• Osteoarthritis	48
• Inflammatory arthritis	2
• Dysplasia	4
• Slipped upper femoral epiphysis	1
• Perthes	1
• Native hip infection (TB)	1
• Hip fracture	1
• Hip metastatic	1
• Avascular necrosis	1

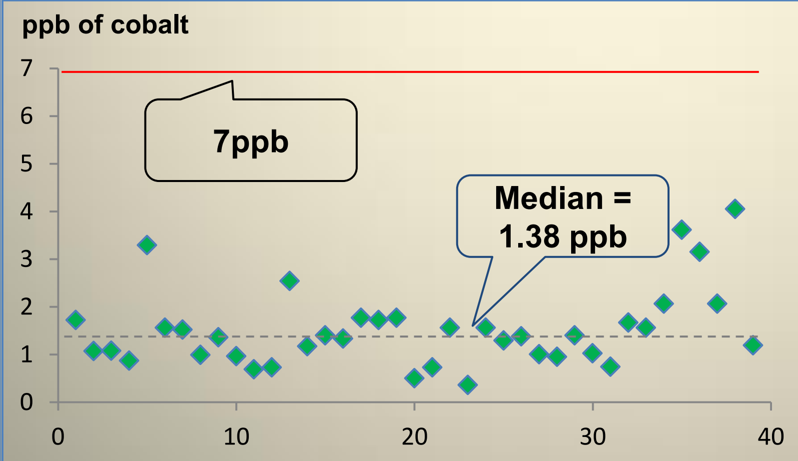
Distribution of blood metal ion levels

Cobalt levels



- **N = 40**
- **Median = 0.72 ppb**
- **Min = 0.11 ppb**
- **Max = 9.73 ppb**

Chromium levels



- **N = 40**
- **Median = 1.38 ppb**
- **Min = 0.36 ppb**
- **Max = 4.05 ppb**

Metal artefact-suppressed MRI

- MRI indicated in only two patients
- Both reported as normal with decreasing subsequent blood metal ions.
- No evidence of Adverse Reaction to Metal Debris on MRI

Complications

- Dislocations = 3
  - 2 stable after MUA
  - 1 revised and stable after extended neck femoral stem
- Deep vein thrombosis (DVT) – 1
- No infections
- No aseptic loosening

Implant Survival

- Implant survival with ARMD as end-point = 100%
- Implant survival with end-point revision for any-cause = 98.6%

Summary/Discussion

- Excellent results with Metasul 28mm bearing in our cohort
- Zero incidence of ARMD
- Metal ions levels within acceptable limits in all except for one patient
- Are routine blood metal ion level checks necessary?
- Is there still a role for MoM bearings in hip arthroplasty ?

ARMD incidence Metasul 28mm

Hwang et al 2013	**2/195 at 18 years**
Sugano et al 2014	**7/1535 at 10 years**
Lubbeke et al 2014	**6/663 at 10 years**
Lass et al 2014	0/52 at 18 years
Innmann et al 2013	0/100 at 10 years
Venditolli et al 2013	0/100 at 9 years
Halma et al 2013	0/137 at 5 years

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26-27 NOVEMBER 2015

MILAN, ITALY

Taperosis – what is the problem? Patient evaluation

Jeremy Latham
Orthopaedic Surgeon
Southampton UK

Disclosures

Consultancies with:

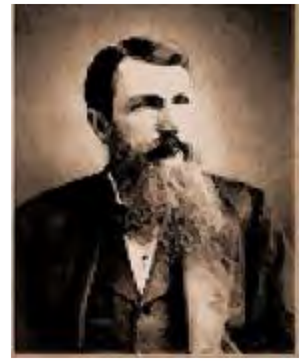
- Biomet
- DePuy
- LIMA LTO
- Zimmer

Research team

- Richard Cook (Research Fellow, nCATS)
- Ben Bolland (Orthopaedic surgeon)
- Sam Yasen (Orthopaedic registrar)
- Christian Maul (CEO Redlux)

Modularity

- Stephen Morse (1864) invented the twist drill
- Coupling device to join two rotating machine components
- Compressive axial load
- Intimate contact
- Ease of assembly/disassembly

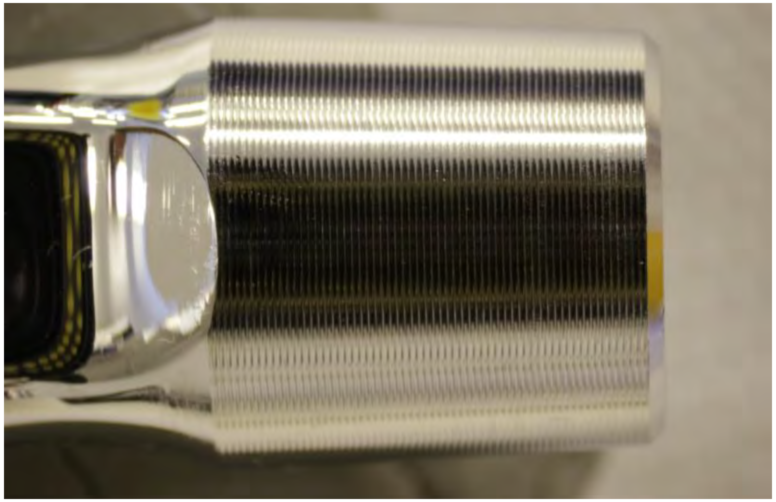


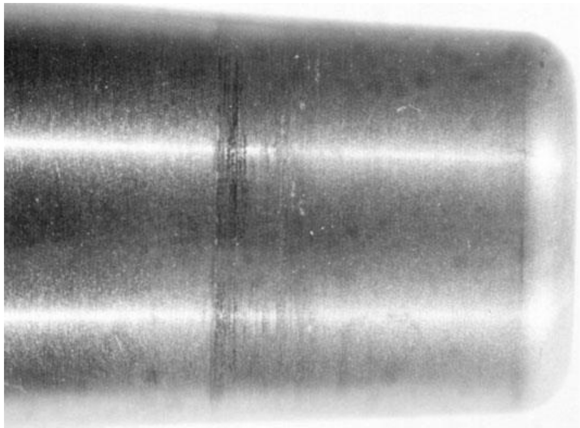
Orthopaedics and modularity

- Boutin (1971)
- Ceramic on ceramic
- High failure rate with adhesives/thread
- Mittelmeier (1974)
- Modular cups
- Modular necks
- Overcoming technical errors

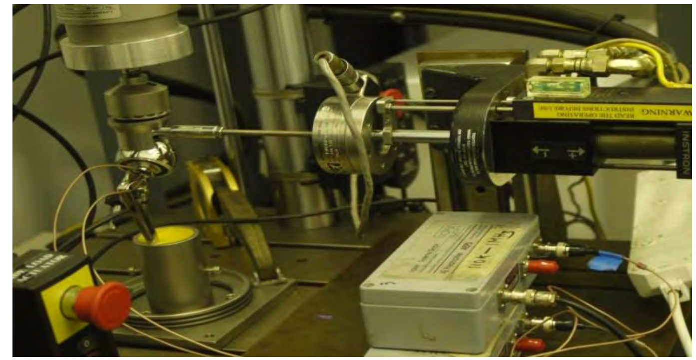
Trunnion issues

- 12/14 not all the same
- Change in length
- Machining for ceramic heads – plastic deformation
- Stiffness
- Variability in manufacturing tolerances





Taper/trunnion movement



- Frictional torque, load, offset, varus neck
- Assembly force
- Taper mismatch
- Micromotion – axial and lateral

  Yasen (2013), Bishop et al (2013)
- Damage to surface layer of taper (fretting)
- Mechanically assisted crevice corrosion (MACC)

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The effect of frictional torque and bending moment on corrosion at the taper interface

AN IN VITRO STUDY

A. Panagiotidou, J. Meswania, K. Osman, B. Bolland, J. Latham, J. Skinner, F. S. Haddad, A. Hart, G. Blunn

From The Royal National Orthopaedic Hospital, Stanmore, United Kingdom

The aim of this study was to assess the effect of frictional torque and bending moment on fretting corrosion at the taper interface of a modular femoral component and to investigate whether different combinations of material also had an effect. The combinations we examined were 1) cobalt-chromium (CoCr) heads on CoCr stems 2) CoCr heads on titanium alloy (Ti) stems and 3) ceramic heads on CoCr stems.

In test 1 increasing torque was imposed by offsetting the stem in the anteroposterior plane in increments of 0 mm, 4 mm, 6 mm and 8 mm when the torque generated was equivalent to 0 Nm, 9 Nm, 14 Nm and 18 Nm.

In test 2 we investigated the effect of increasing the bending moment by offsetting the application of axial load from the midline in the mediolateral plane. Increments of offset equivalent to head + 0 mm, head + 7 mm and head + 14 mm were used.

Significantly higher currents and amplitudes were seen with increasing torque for all combinations of material. However, Ti stems showed the highest corrosion currents. Increased bending moments associated with using larger offset heads produced more corrosion: Ti stems generally performed worse than CoCr stems. Using ceramic heads did not prevent corrosion, but reduced it significantly in all loading configurations.

Cite this article: *Bone Joint J* 2015;97-B:463–72.

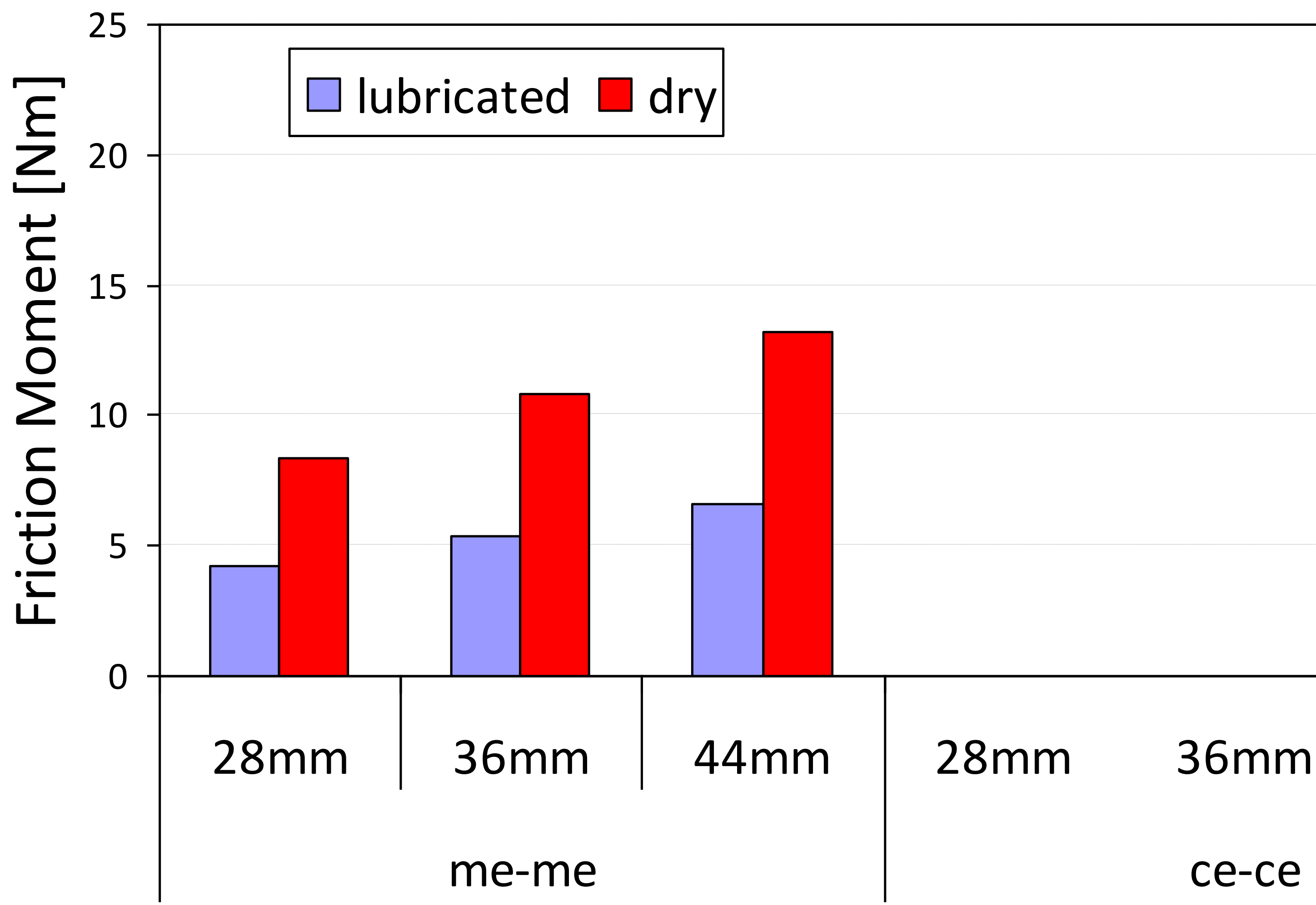
Modular femoral components, comprising a head and stem linked by a Morse taper, have been used successfully in orthopaedic surgery for more than 30 years. Modularity, as well as reducing the inventory and thereby saving cost, allows the surgeon to use femoral heads of various materials, diameter and offset to achieve the best possible outcome.[1] Despite the many practical advantages of modular systems, there is evidence that the modular interface may increase fretting and crevice corrosion[2-8]

The identification of macroscopic corrosion on retrieved hip prostheses was first reported in the early 1990s. The potential for the degradation of metal-on-metal (MoM) hip replacements arises from three processes: electrochemical dissolution, mechanical wear and a combination of the two. Metallic alloys used in orthopaedics rely on a protective oxide layer (passivation), which forms spontaneously when the surface of the prosthesis reacts with oxygen. Removal of this protective layer leads to the immediate onset of corrosion.[4,5]

Corrosion at the modular interface is usually due to mechanical action (fretting corrosion), localised attack in crevices or cracks (crevice corrosion) or between dissimilar metals (galvanic corrosion).[9,10] Suboptimal taper design and high contact stresses have also been implicated as potential mechanisms for the failure of the modular head-stem junction.[10,11] Poor lubrication of large femoral heads results in increased frictional forces, which can be transmitted to the taper junction and increase the torque at the modular interface. Poor lubrication may also occur with edge loading and on initiation of movement.[12,13]

Recent publications from the National Joint Registries of England & Wales, Sweden and Australia have reported the poor performance of large head MoM modular total hip arthroplasties (LH-MoM-THAs), with failure rates exceeding those of hip resurfacings, which suggests that the head-stem interface may contribute to the failure of these modular THAs.[14] A number of retrieval studies have also focused on the modular head-stem interface of LH-MoM-THAs.[15-17] Corrosion at this interface has been well described. The clinical effects of the release of corrosion products from this interface include adverse local tissue reactions, systemic toxicity, muscle atrophy, the development of pseudotumours and osteolysis.[18-20] Cooper et al[21] have also reported local tissue reactions secondary to metal debris as a result of corrosion of the modular head-stem taper

(3) Large Me-Me: Friction Moments ?

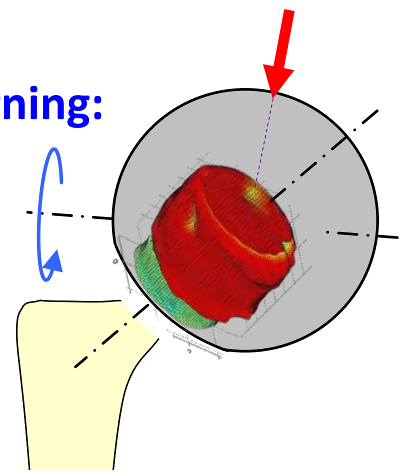


(2) Large Me-Me: Taper Wear

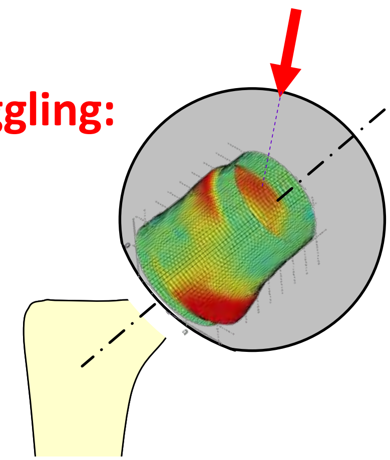
Implant Type

Type 1	Type 2	Type 1&2	Type 3	Type 3
CoCr Head	CoCr Sleeve	Ti Stem	Ti Sleeve	Ti Stem

Turning:



Toggling:



■ HIP

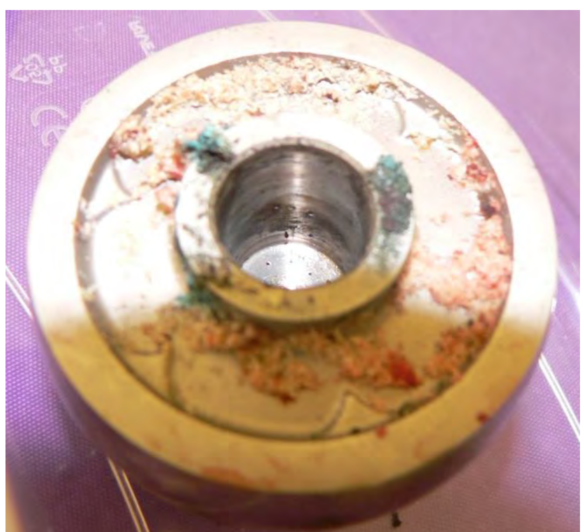
High failure rates with a large-diameter hybrid metal-on-metal total hip replacement

CLINICAL, RADIOLOGICAL AND RETRIEVAL ANALYSIS

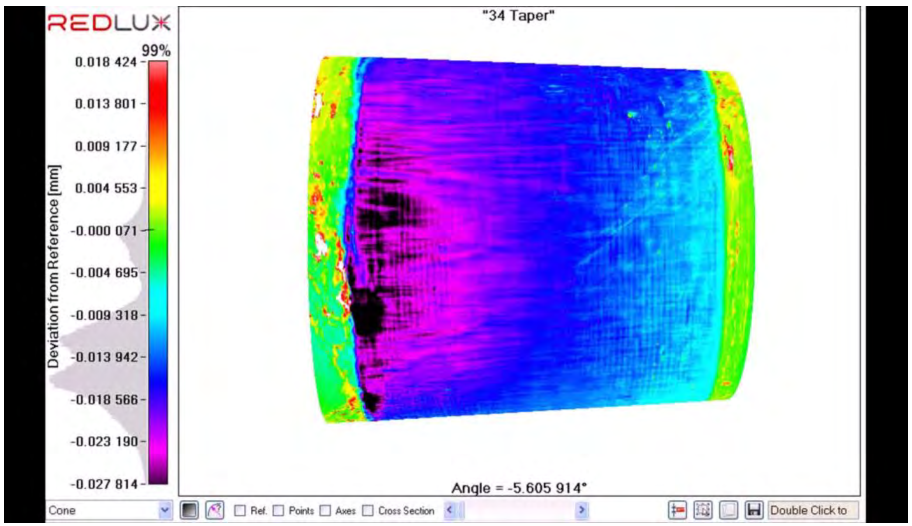
B. J. R. F. BOLLAND, D. J. CULLIFORD, D. J. LANGTON, J. M. LATHAM

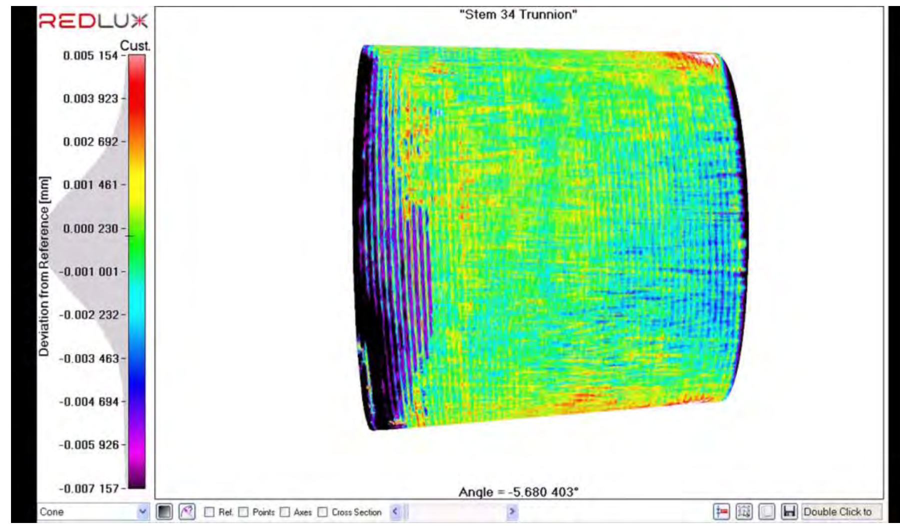
JBJS BR VOL. 93-B, No. 5, **MAY 2011** PAGES 608-615

Revision Rate
20% at 5yrs



Bad Damage

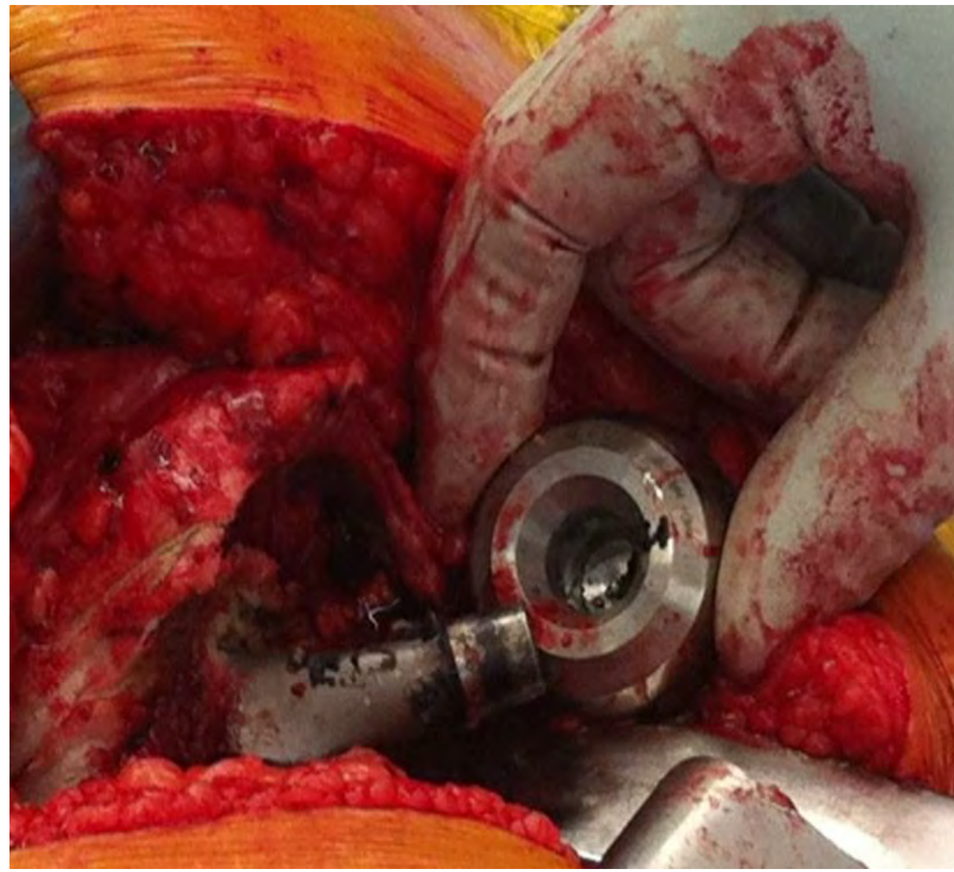




60 year old Female: 7 years 7 months in-vivo,
42 (+3.5) mm BHR on CPT stem
Volume Loss: 7.996 mm^3

Similar problems with metal on PE

- Two cases
- Accolade/Trident LFIT on X3 PE
- 40mm/44mm
- Time to failure 4y
- Presented with pain
- Pseudotumour



Metal Hips Research Group

Stem corrosion with big head

- 19 CPT stems with LD heads
- Palacos cement
- Surface damage
- Opacifier (ZrO_2)
- Complex tribolayer in interface
- Another source of Co/Cr

Lots of devices……

- Langton et al (2011)
  ASR XL 50% failure
  Metal ions lower in big diameter SR

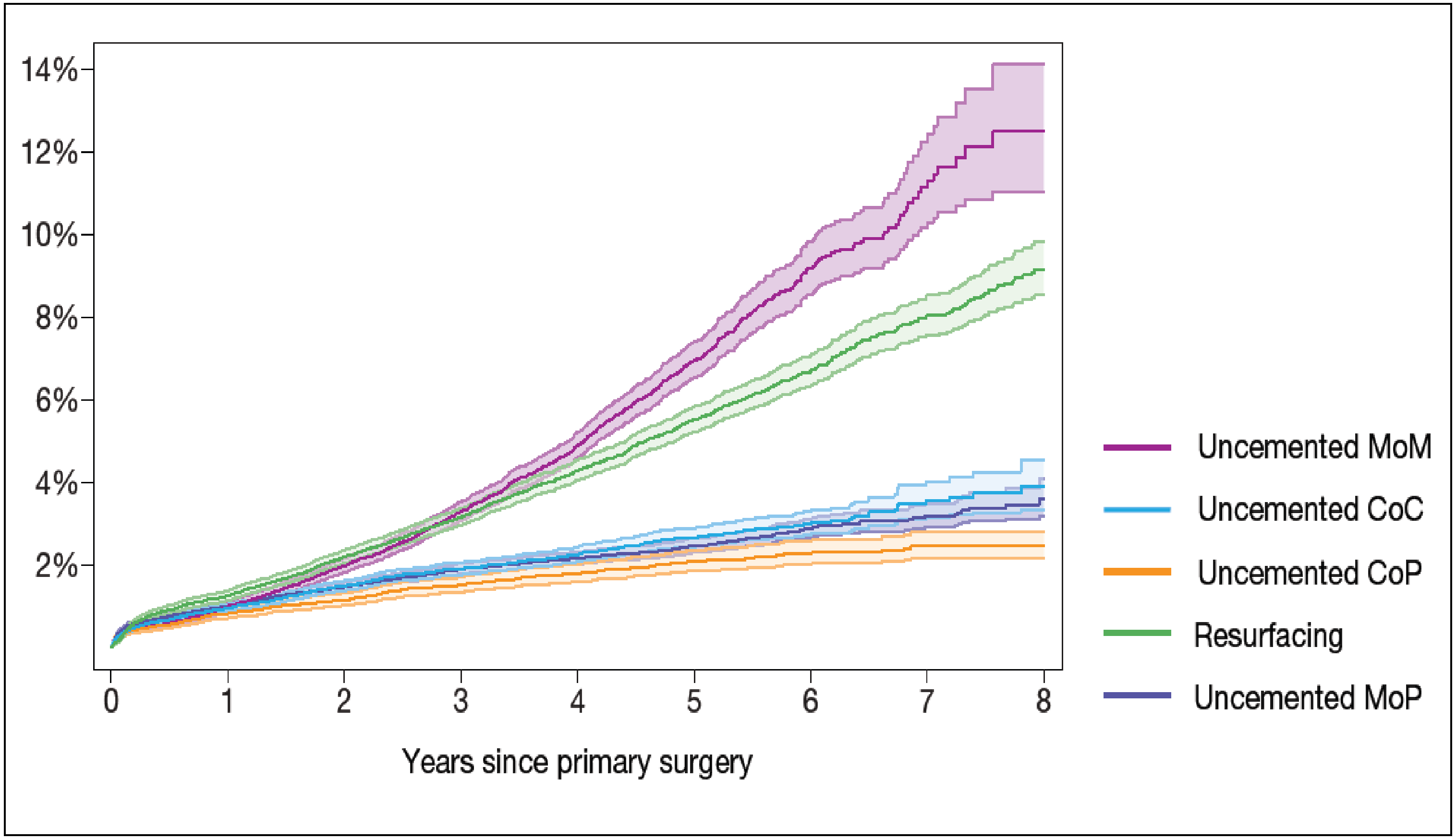
- Bosker et al (2012)
  Biomet M2A; 39% PT
  40% Co>5µg/l
  Co>5µg/l = X4 revision risk

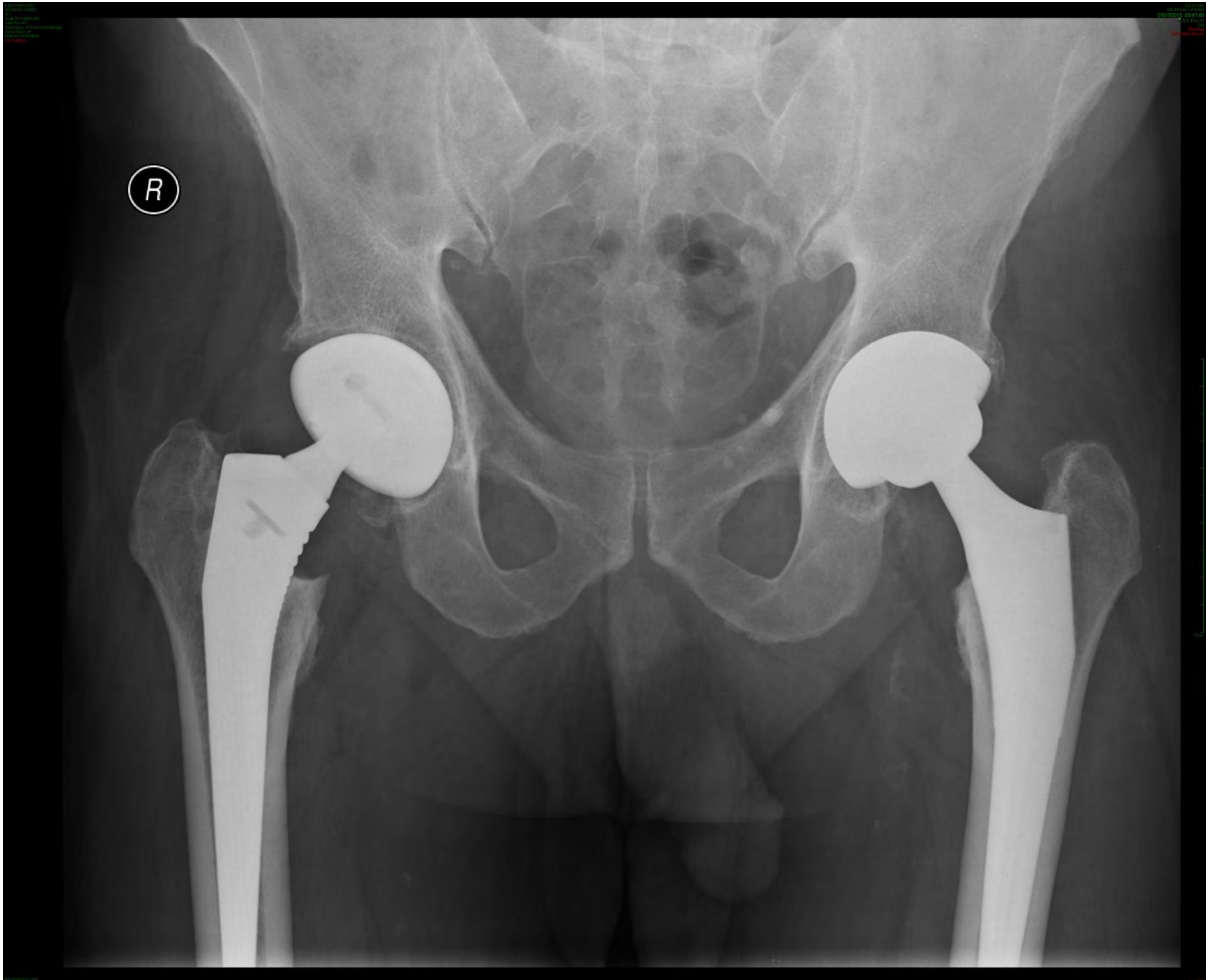
- Garbuz et al (2009)
  Zimmer Durom resurf vs THR
  Co X 10 higher @ 1y

- Malviya et al (2011)
  S&N CPCS BHR modular vs MoP
  20% Co >7µg/l

- Beaulé et al (2011)
  Wright Conserve+ vs Profemur LD THR
  Rising Co up to 2y

Revision risk NJR 2011




R

Typical clinical features

- Be aware of high risk implants!
- Important to ask about new symptoms
- Awareness of hip
- Gluteal discomfort
- Noise
- Rarely nerve pain
- Systemic effects eg cardiac, hearing, vision

Metal Hips Research Group

Clinical assessment vital

Pain / Swelling / Limp

Acetabular osteolysis

Jan 2006

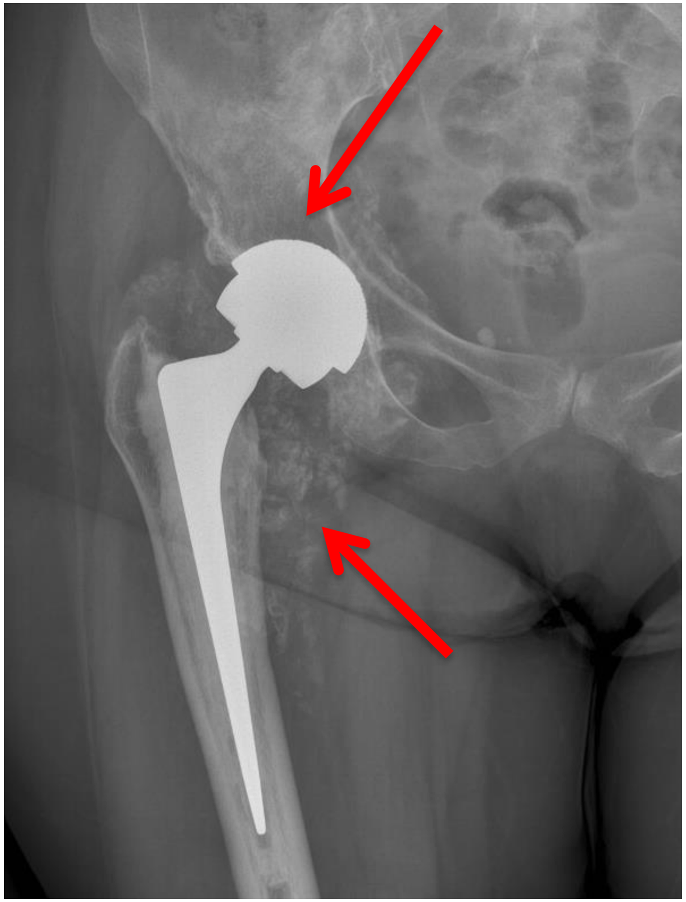
Jan 2007

Jan 2009

Jan 2010

Proximal femoral osteolysis

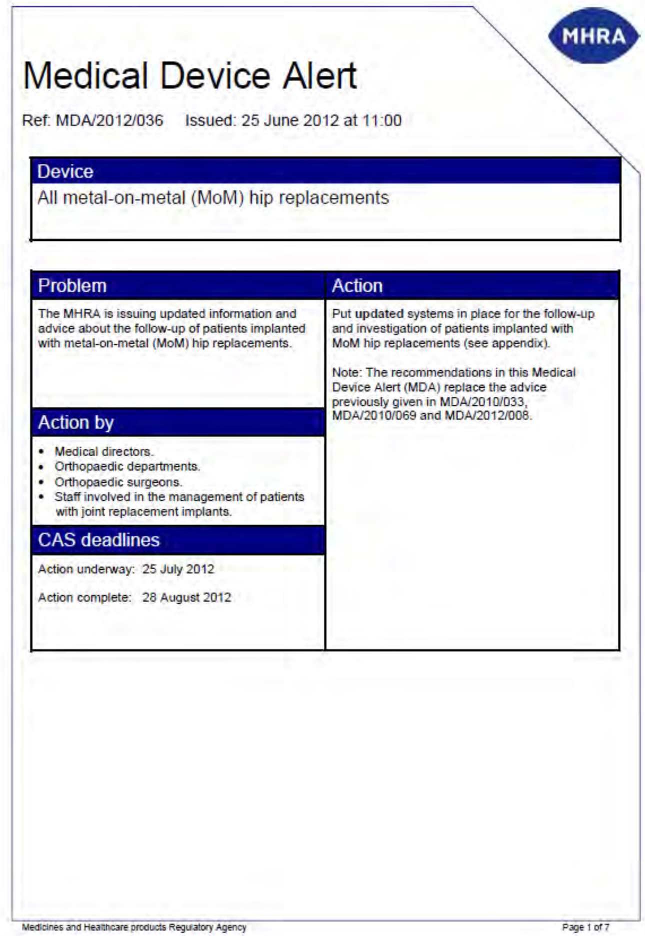
Dislocation in Large Diameter MoM Bearings



Adverse Reaction to Metal Debris until proven otherwise!

MHRA guidelines

- 2012
- Guidance on all MoM hips
- Resurfacing/stemmed THR (36mm)
- Symptoms/MRI/bloods
- 7ppb Co/Cr
- Emphasizes dynamic nature of follow-up



MHRA

Medical Device Alert

Ref: MDA/2012/036 Issued: 25 June 2012 at 11:00

Device
All metal-on-metal (MoM) hip replacements

Problem	Action
The MHRA is issuing updated information and advice about the follow-up of patients implanted with metal-on-metal (MoM) hip replacements.	Put **updated** systems in place for the follow-up and investigation of patients implanted with MoM hip replacements (see appendix). Note: The recommendations in this Medical Device Alert (MDA) replace the advice previously given in MDA/2010/033, MDA/2010/069 and MDA/2012/008.

Action by

- Medical directors.
- Orthopaedic departments.
- Orthopaedic surgeons.
- Staff involved in the management of patients with joint replacement implants.

CAS deadlines

Action underway: 25 July 2012

Action complete: 28 August 2012

Typical protocol for high risk implants

- Annual review for life of implant
- Assessment of symptoms
- Blood tests
- Imaging
- Revision for symptoms, rising metal ions, abnormal imaging

Action

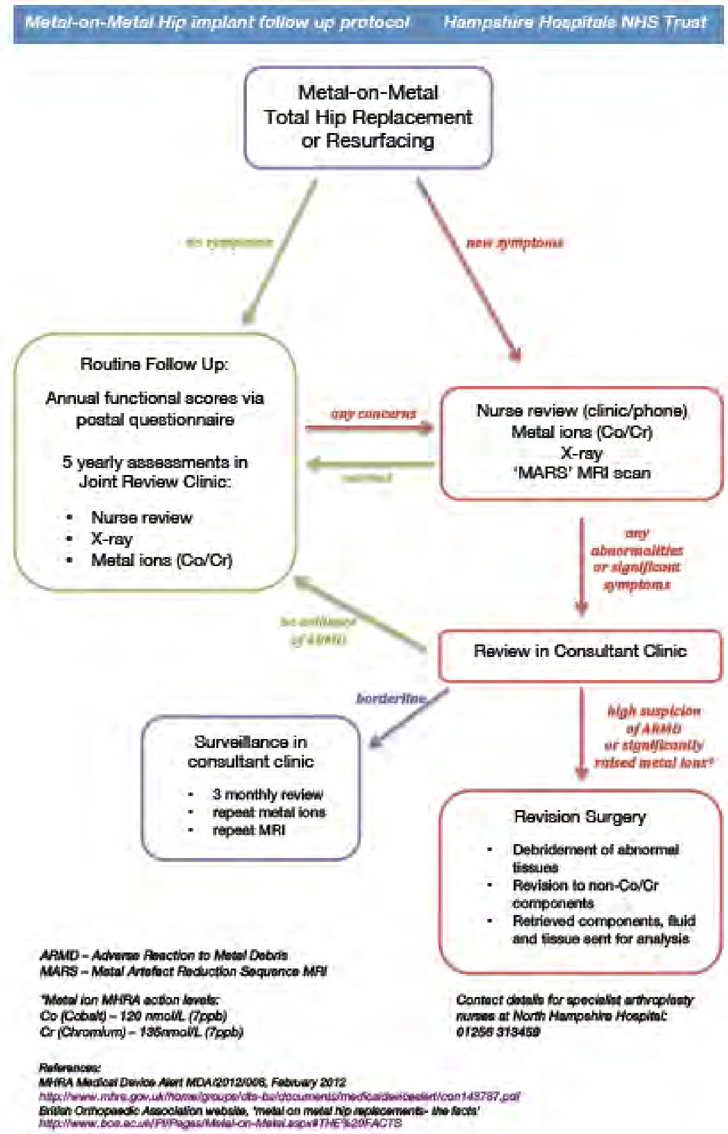
Management recommendations for patients with stemmed MoM total hip replacements – femoral head diameter ≥36mm (extracted from the table within the MHRA's MDA/2012/036)

	Stemmed MoM total hip replacements – femoral head diameter ≥36mm	
	Symptomatic patients	Asymptomatic patients
Patient follow-up	Annually for the life of the implant	Annually for the life of the implant
Imaging: MARS MRI or ultrasound	Recommended in all cases	Recommended if blood metal ion levels rising
1st blood metal ion level test	Yes	Yes
Results of 1st blood metal ion level test	Blood metal ion level >7ppb indicates potential for soft tissue reaction	If blood metal ion level >7ppb then second blood test required 3 months later
2nd blood metal ion level test	Yes - 3 months after 1st blood test if result was >7ppb	Yes - 3 months after 1st blood test if result was >7ppb
Results of 2nd blood metal ion level test	Blood metal ion level >7ppb indicates potential for soft tissue reaction especially if greater than previously	If blood metal ion levels rising - further investigation required including imaging
Consider need for revision	If imaging is abnormal and/or blood metal ion levels rising	If imaging is abnormal and/or blood metal ion levels rising

Common sense

- 'Risk assessment'
- Annual clinical and radiological review
- Annual metal ions
- MRI if symptoms, high or rising ions, high risk implant (brand, cup position)

- Most of the bad hips have failed already
- Host factors not understood
- We don’t yet know the ‘end game’
- Better to be safe than sorry.....



What next?

- Screen patients for hypersensitivity pre-op?
- Improve surgical techniques
- Better control of new technology
- Stop using CoCr in joint replacements?

Thanks!

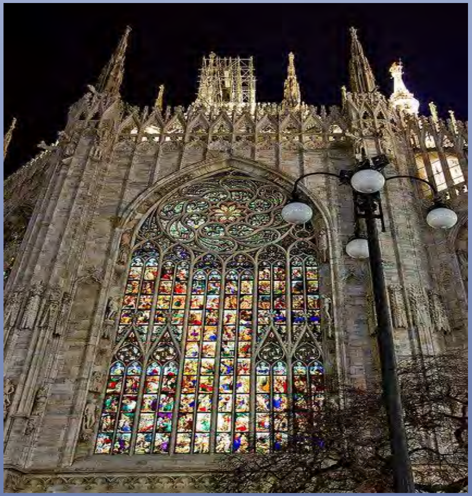
INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

INTERNATIONAL COMBINED MEETING
BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA
26-27 NOVEMBER 2015
MILAN, ITALY



"Taperosis": Insights for Clinical Practice from Histological Analysis

Giorgio Perino, M.D.
Hospital for Special Surgery, NY, NY

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HSS educational activities are carried out in a manner that serves the educational component of our Mission.

As faculty we are committed to providing transparency in any relevant external relationships prior to giving an academic presentation.

Giorgio Perino, MD

Disclosure:

I **do not** have a relevant financial relationship and will not be discussing products/services of commercial interest

Disclaimer

All implants and systems shown in this presentation are used only as examples of different designs with adverse reactions, without implications regarding their overall performance or specific cause of failure

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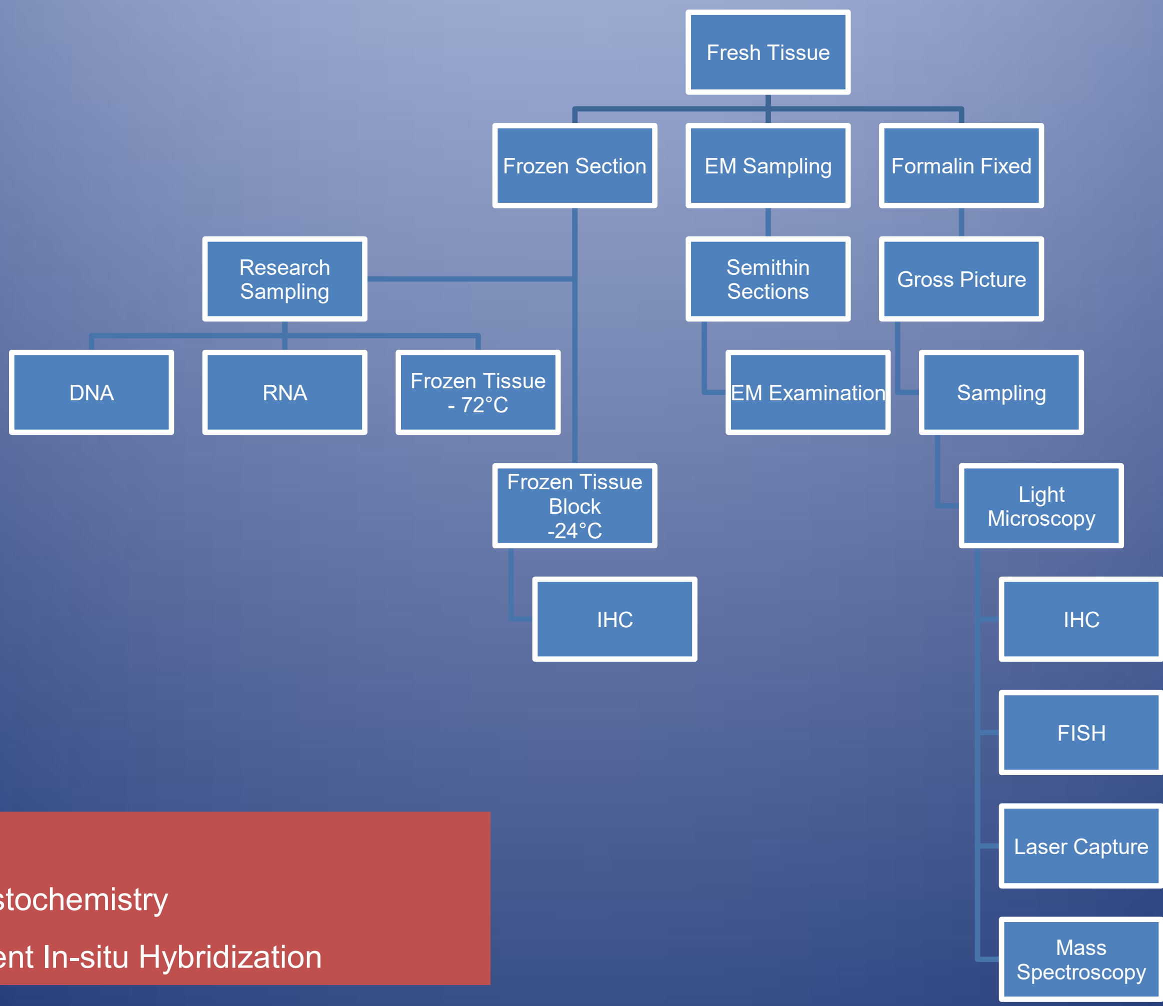
Acknowledgements

- Radiology Pictures Courtesy of:
  - Hollis Potter, MD, Radiologist-in-Chief
- Technical Assistance for Histology Preparations:
  - Irina Shuleshko
  - Yana Bronfman
- Technical Assistance for the Presentation:
  - Philip Rusli

Periprosthetic Tissue Sampling HSS Dpt. of Pathology Protocol

- Collection of fresh tissue on ice in the OR with MRI guidance for areas of inflammation when available
- Soft tissue samples from multiple areas including pseudocapsule, neo-synovium, bursal synovium, and adjacent skeletal muscle labeled accordingly
- Bone sampling from acetabulum and/or femur, core biopsies of osteolytic areas, reamings
- Extensive sampling performed at macroscopic examination

Pathological Examination of Revision Specimen



Legend:

IHC – Immunohistochemistry

FISH – Fluorescent In-situ Hybridization

Pathology Report

The Hospital for Special Surgery
Department of Orthopedic Pathology

535 East 70th Street
New York, NY 10021

Michael J. Klein, M.D., Director
Phone: 212-606-1259

PATHOLOGY CONSULTATION REPORT

Case Number: S2012-0044

Patient Name:
Date of Birth: 07 30 1940
Gender: M Age: 71
Location: 8EN 807 1

Medical Record #:
Account Number:
Accession Date: 03 23 2012
Operative Date: 03 23 2012

Pathologist: PERINO M.D., GIORGIO
Report Date 04 02 2012
Report Time 09:31

Physicians

Clinical Information
PRE-OPERATIVE DIAGNOSIS: Failed Right Total Hip Replacement. H/O right THR in 09/2007. Multiple MRI performed at HSS with progression of synovial reaction since 07/2010 with difficulty in walking
OPERATION PERFORMED: Revision, Right Total Hip Replacement
POST-OPERATIVE DIAGNOSIS: Same as pre-operative diagnosis

Final Anatomic Diagnosis
1. JOINT, HIP, IMPLANT INTERFACE, RIGHT
   Inflammatory Implant Reaction - Soft Tissue, Consistent with Immunologic Reaction *(see case comment)*
2. JOINT, HIP, IMPLANT INTERFACE, RIGHT
   Macrophagic Reaction to Particulate Implant Material - Bone Marrow: -- Metallic Partiuclate Debris. No Evidence of Infection
3. BONE, PELVIS, ACETABULUM, RIGHT
   Macrophagic Reaction to Particulate Implant Material - Cancellous Bone: -- Metallic Particulate Debris. No Evidence of Infection
4. JOINT, HIP, RIGHT
   Inflammatory Implant Reaction - Soft Tissue, Consistent with Immunologic Reaction

Comment on Case
The histological findings are consistent with an immunologically mediated reaction to implant debris macrophagic reaction to particles of corrosion products and metallic particulate debris. The ALVAL score, according to the classification system proposed by Campbell et al (2010) Clin Orthop Relat Res 468: 2321-2327, is 8/10 (synovial lining, 3; inflammatory infiltrate, 3; tissue organization, 2)

Gross Anatomic Description
1. Specimen Label: Pseudotumor
   In formalin: The specimen consists of a portion of fibromenbranous tissue covered by a thin green area of friable material measuring approximately 3 x 2 x 0.5 cm in greatest dimension. The entire specimen is submitted.
2. Specimen Label: Cyst membrane, left hip
   In formalin: The specimen consists of a portion of red green soft tissue measuring approximately 1 x 1 x 0.5 cm in greatest dimension. The entire specimen is submitted.
3. Specimen Label: Bone cyst
   In formalin: The specimen consists of fragments of bony tissue measuring aggregate approximately 0.3 x 0.2 x 0.2 cm in aggregate dimension. The entire specimen is submitted.
4. Specimen Label: Right hip removed hardware
   In formalin: The specimen consists of multiple fragments of thick fibromenbranous tissue with focal greenish pigmentation

Gross Anatomic Description (continued)

measuring approximately 3.5 x 1.5 x 0.8 cm in greatest dimension. Also present is a Smith & Nephew metallic cup measuring approximately 52 mm in diameter and a metallic femoral head with inserted circulo-trapezoidal metallic sleeve measuring 46 mm in diameter and weighing approximately 229 grams. The entire specimen is submitted. The hardware is submitted to Biomechanics.
(GP/wj)

Material Submitted

	Code Description	*Code*	*Type Description*	*Type*	*Count*
1.	Undesignated	U	Soft Tissue, Routine	STR	1
2.	Undesignated	U	Soft Tissue, Routine	STR	1
3.	Undesignated	U	Soft Tissue, Routine	STR	1
4.	Undesignated	U	Soft Tissue, Routine	STR	7

Microscopic Description
1. The section is of fragments of synovium showing loss of superficial layer replaced by adherent fibrinous exudate and necrotic macrophages, dense sclerosis with clusters of macrophages loaded with particles of corrosion products and metallic particulate debris (2+, discreet granules resolved x100), and moderate band-like and perivascular lymphocytic infiltrate. The inflammatory infiltrates usually associated with infection are not identified.
2. The section is of fragments of largely necrotic tissue, with macrophage infiltrate loaded with particles of corrosion products and metallic particulate debris (see part 1). The inflammatory infiltrates usually associated with infection are not identified.
3. The section is of fragments of sclerotic cancellous bone containing large clusters of macrophages loaded with particles of corrosion products and metallic debris. The inflammatory infiltrates usually associated with infection are not identified.
4. The section is of fragments of synovium and bone marrow. The fragments of synovium show diffuse loss of lining with large amount of necrotic macrophages admixed to adherent fibrinous exudate and focal necrosis of the underlying superficial layer with deep, macrophagic infiltrate loaded with corrosion particles and metallic debris (2+) with occasional giant cells, and marked perivascular and band-like lymphocytic infiltrate with occasional plasma cells. The bone marrow shows hematopoietic marrow within normal limits and several small and large clusters of macrophages loaded with particles of corrosion products and metallic particulate debris, without evidence of formation of lymphocytic aggregates. An aggregate of large pale yellow corrosion products is also identified. A section of pale yellow material accumulated in the metallic femoral head shows necrotic macrophages and numerous particles of corrosion products and metallic particulate debris. The inflammatory infiltrates usually associated with infection are not identified.

GIORGIO PERINO M.D.
(Case signed 04 01 2012)

Definition of Pseudotumor

- The pseudotumor is a mass of variable size formed by the thickening of the joint pseudocapsule and neo-synovial membrane with frequent papillary or polypoid configuration with an absence or presence of a layer of necrosis/infarction of variable thickness filled with a variable amount of synovial fluid ranging from liquid to creamy

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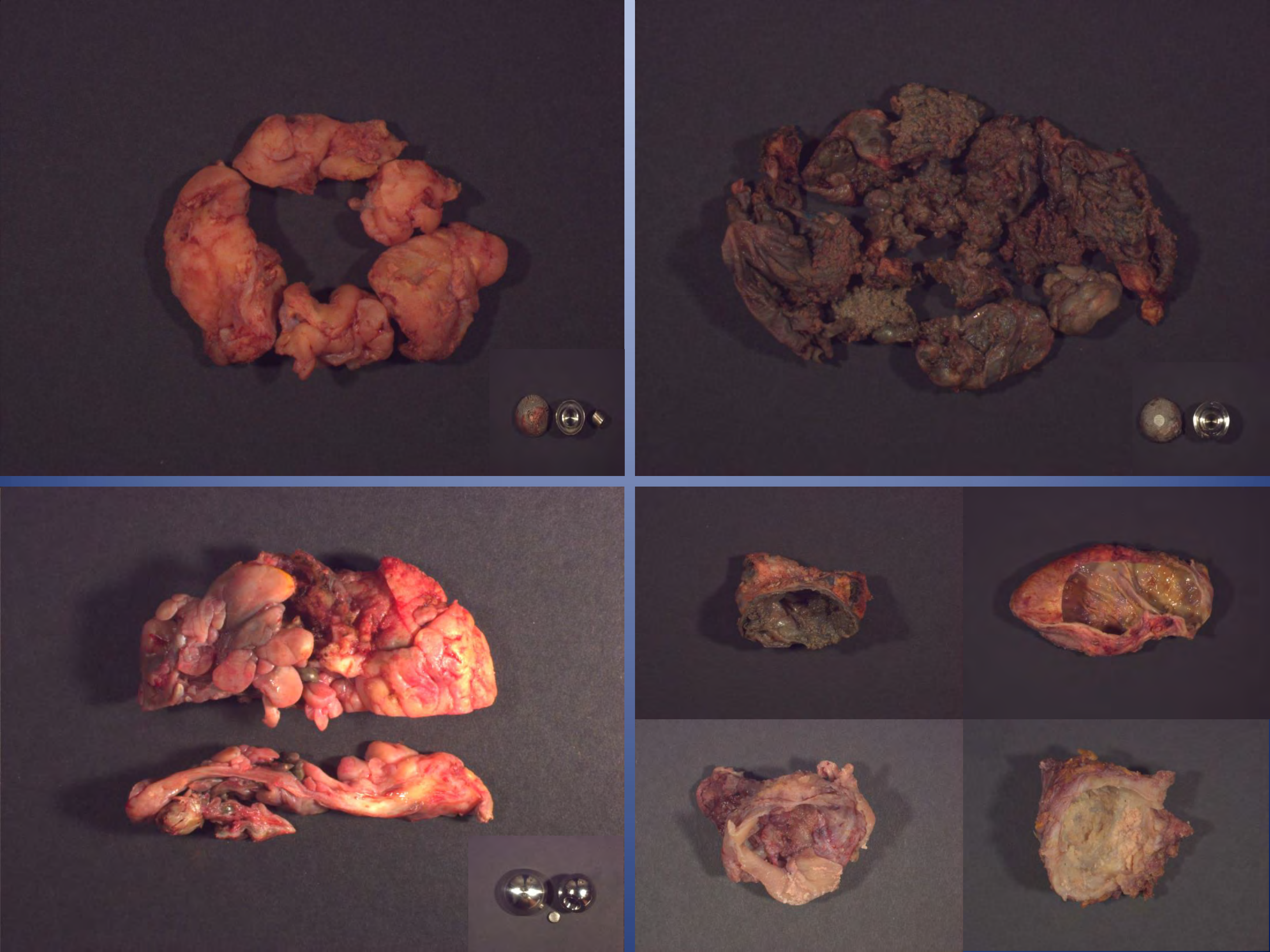


Terminology for adverse reaction to implant metallic wear debris

- ALVAL (aseptic lymphocytic vasculitis associated lesion)
- ALTR (adverse local tissue reaction)
- ARMD (adverse reaction to metallic debris)
- “Metallosis” should be erased from the medical literature because it is not a disease

Classification of Histological Patterns of Adverse Reactions to Corrosion Products

1. Pattern 1: purely macrophagic containing particles of corrosion products +/- conventional metallic particles with occasional lymphocytes

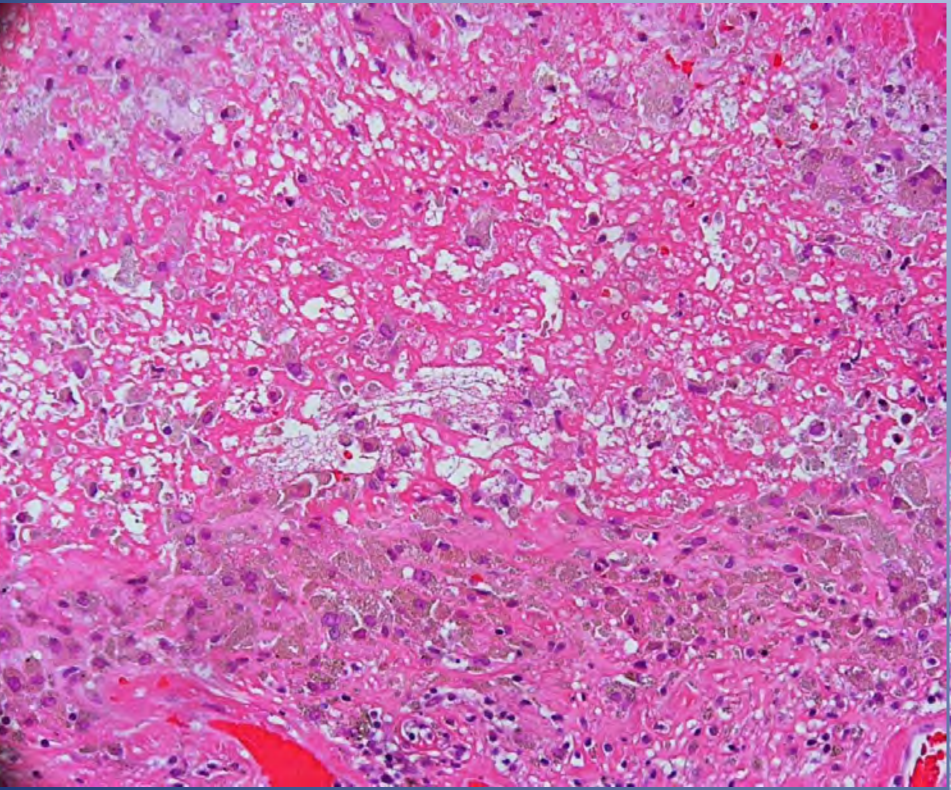
2. Pattern 2: mixed macrophagic and lymphocytic: a. with stratification of superficial necrosis, deep-seated band of mixed macrophagic/lymphocytic infiltrate and perivascular lymphocytic infiltrate; b. presence of perivascular germinal centers +/- plasma cells; c. presence of large number of mast cells and eosinophils

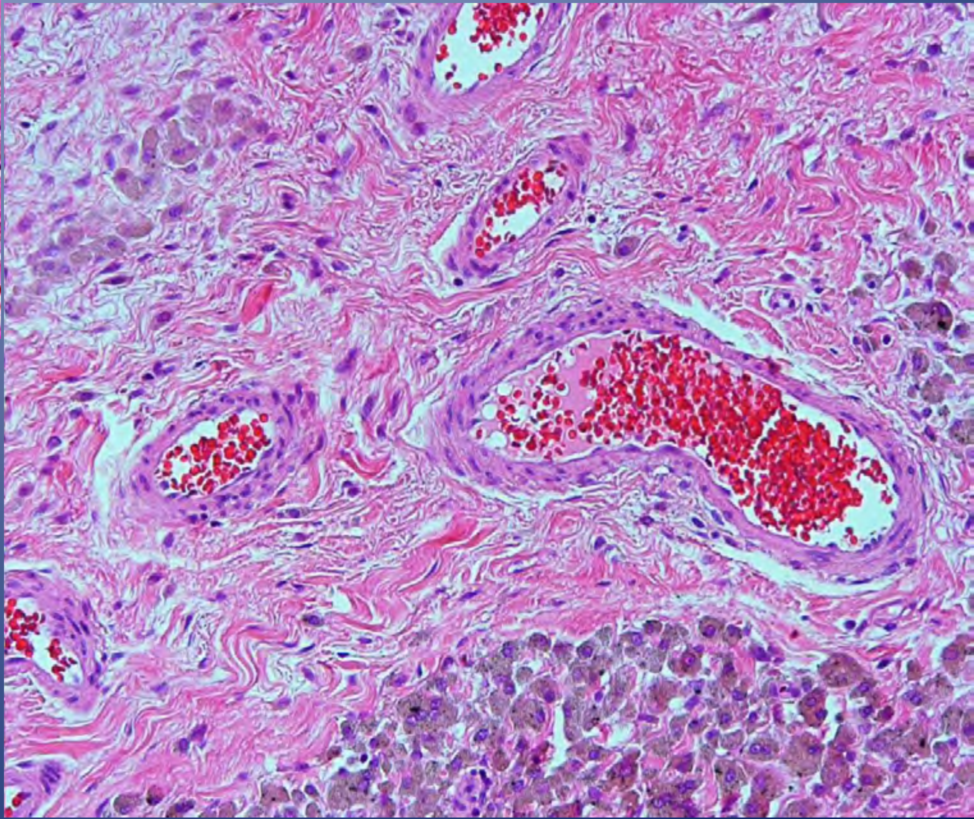
3. Pattern 3: predominantly granulomatous composed of epithelioid macrophages and giant cells around large particle aggregates of corrosion products with lymphocytic cuffing +/- perivascular lymphocytic infiltrate of variable intensity

4. Any pattern with superimposed acute infection

5. Any pattern with bone marrow involvement by particle loaded macrophages +/- formation of reactive lymphocytic aggregates

Pattern 1 Macrophagic





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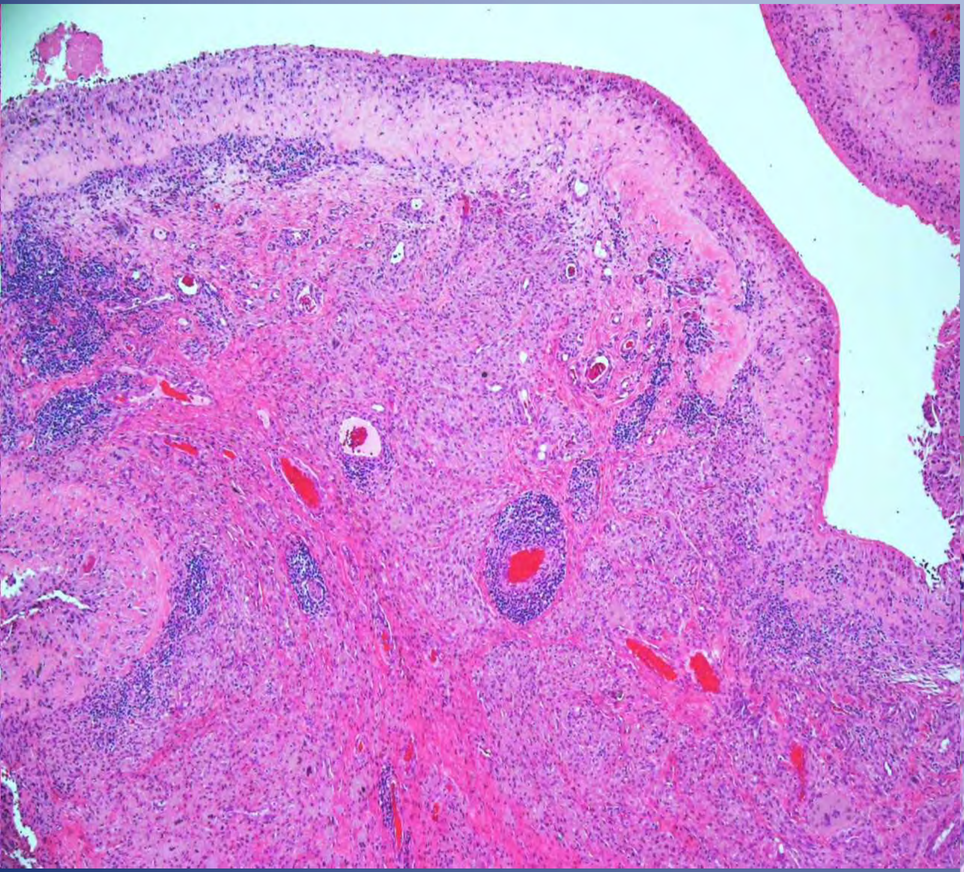
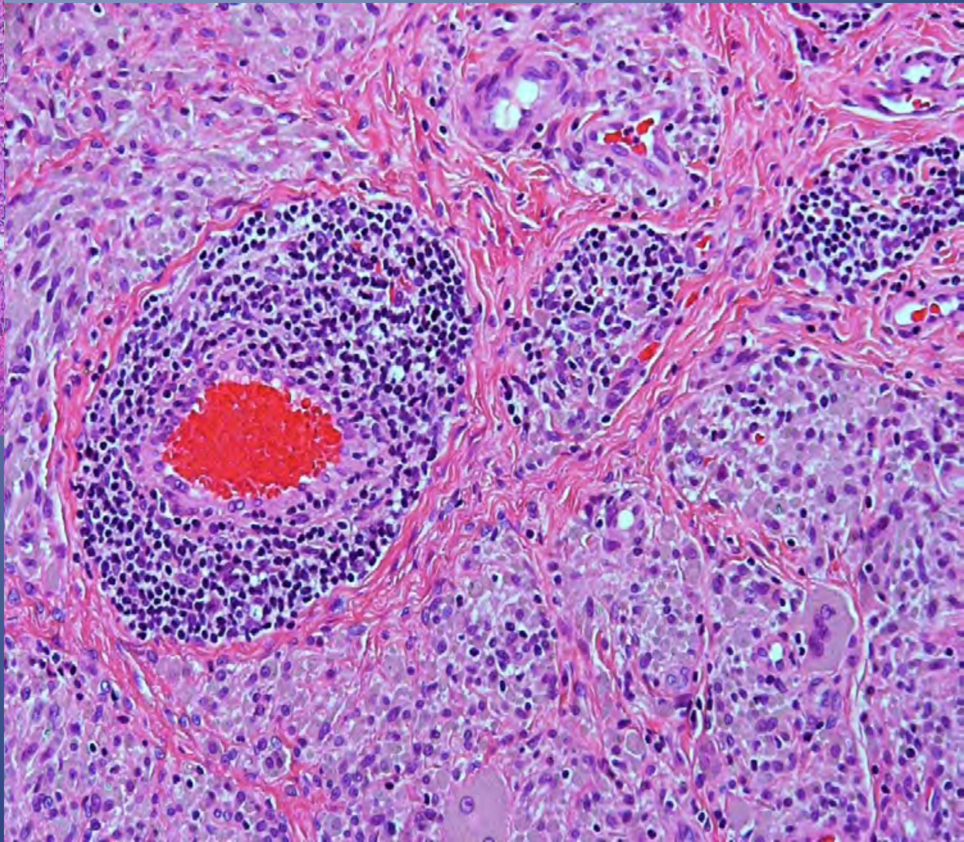
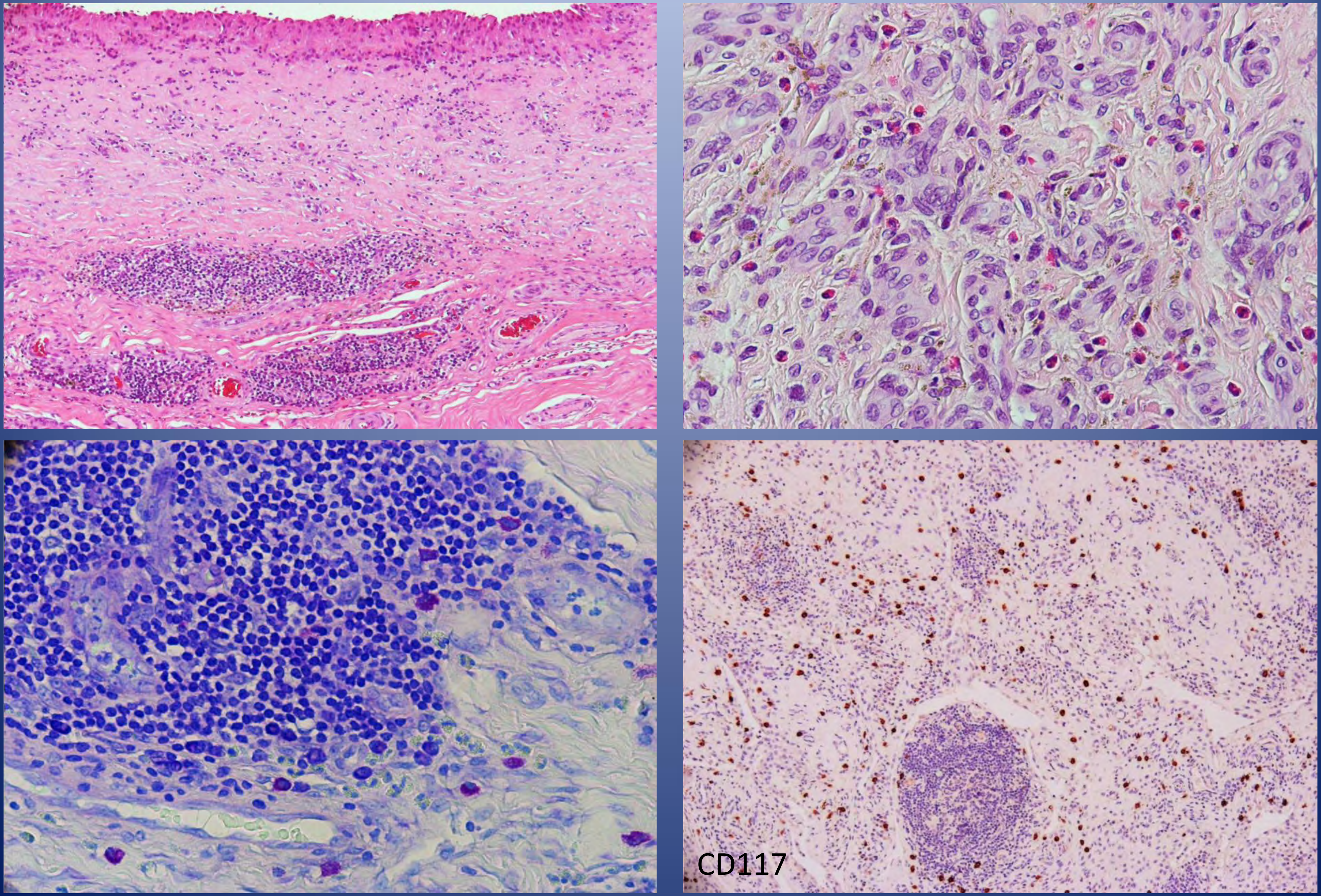
Pattern 2: Macrophagic/Lymphocytic

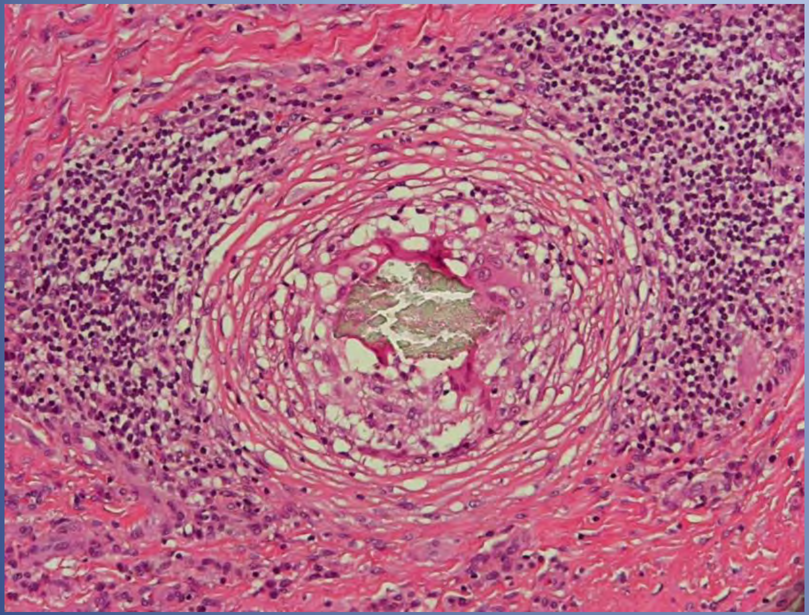


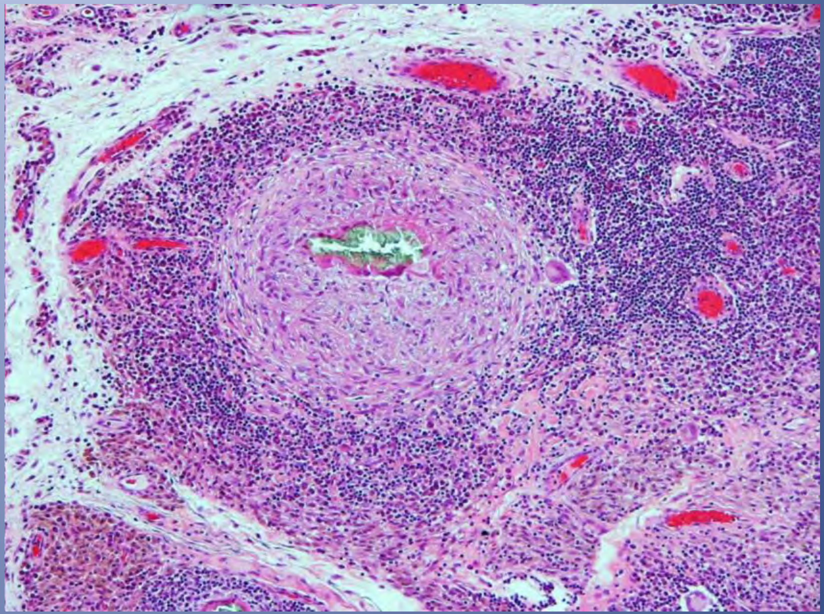


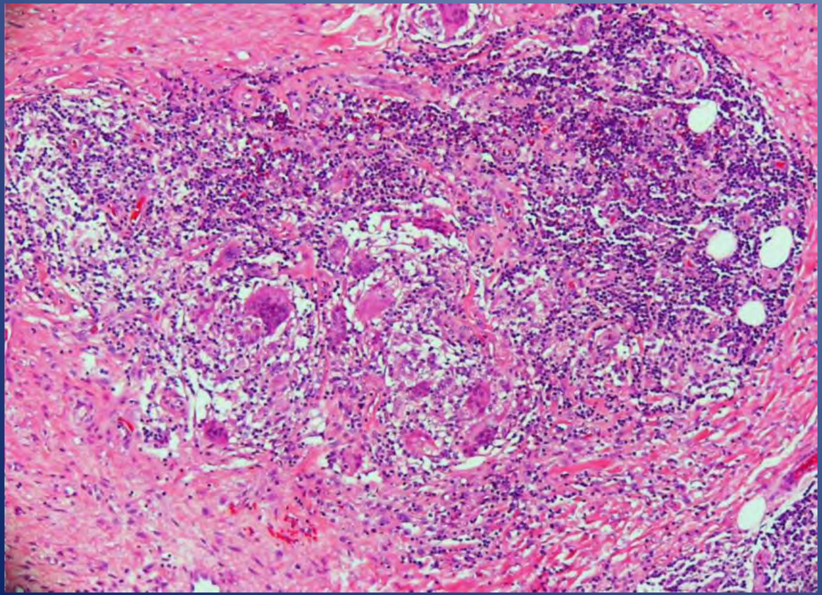
Pattern 2: Macrophagic/Lymphocytic

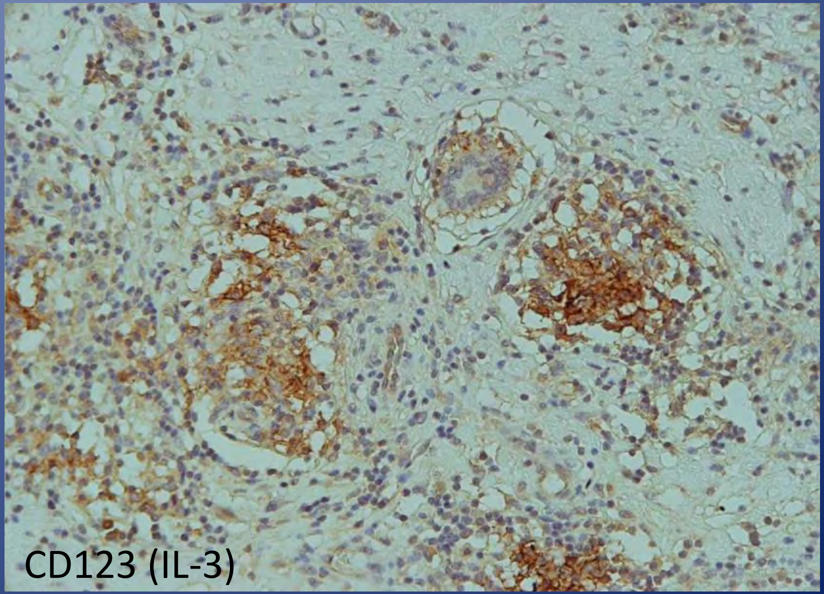


Pattern3: Granulomatous

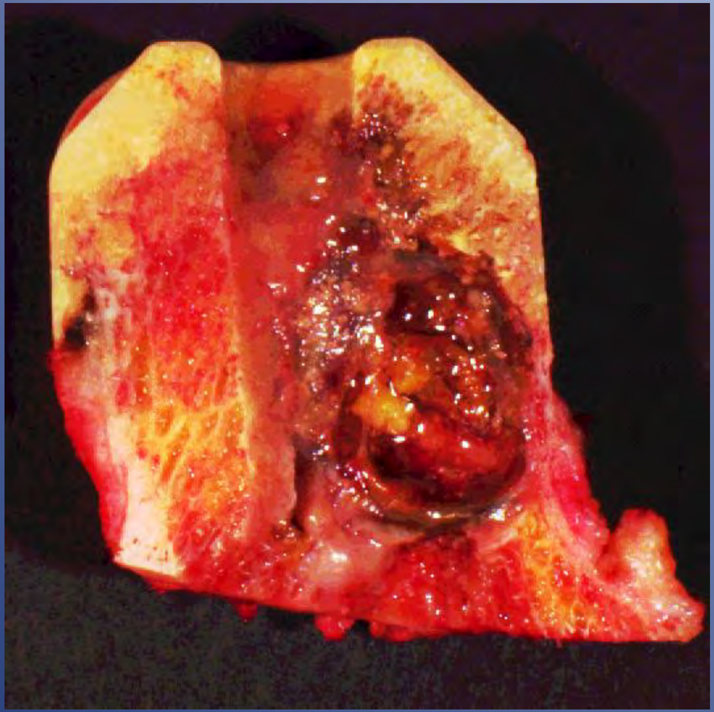


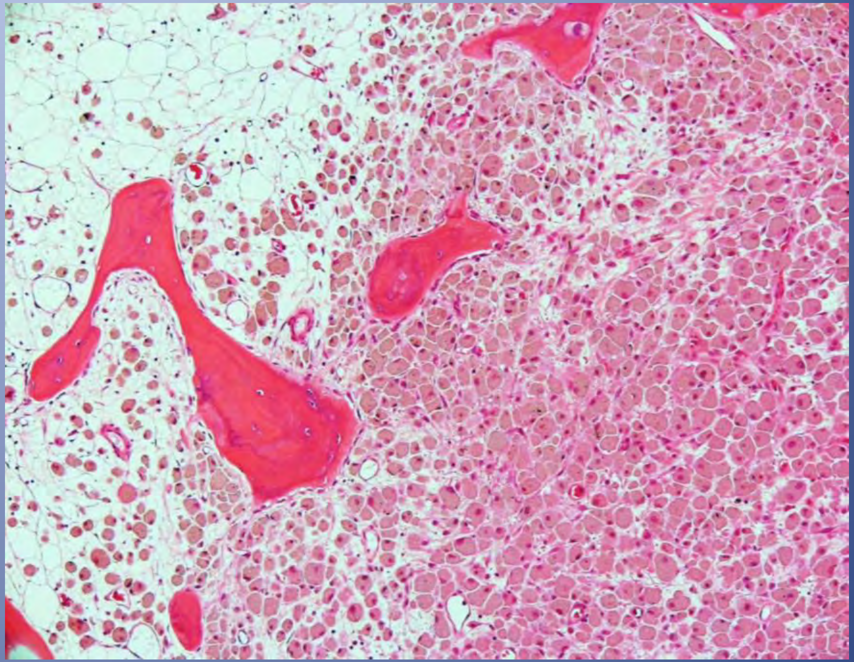


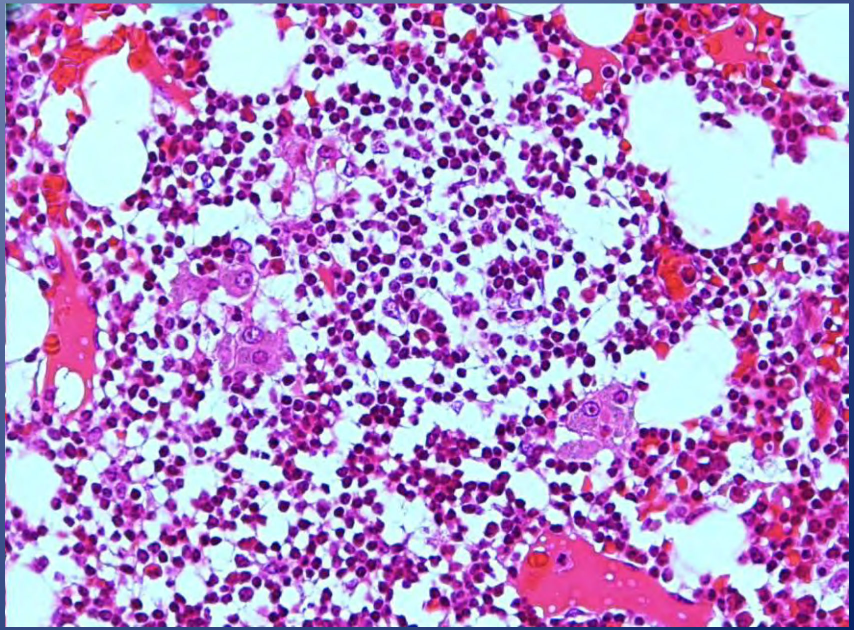




Bone Involvement







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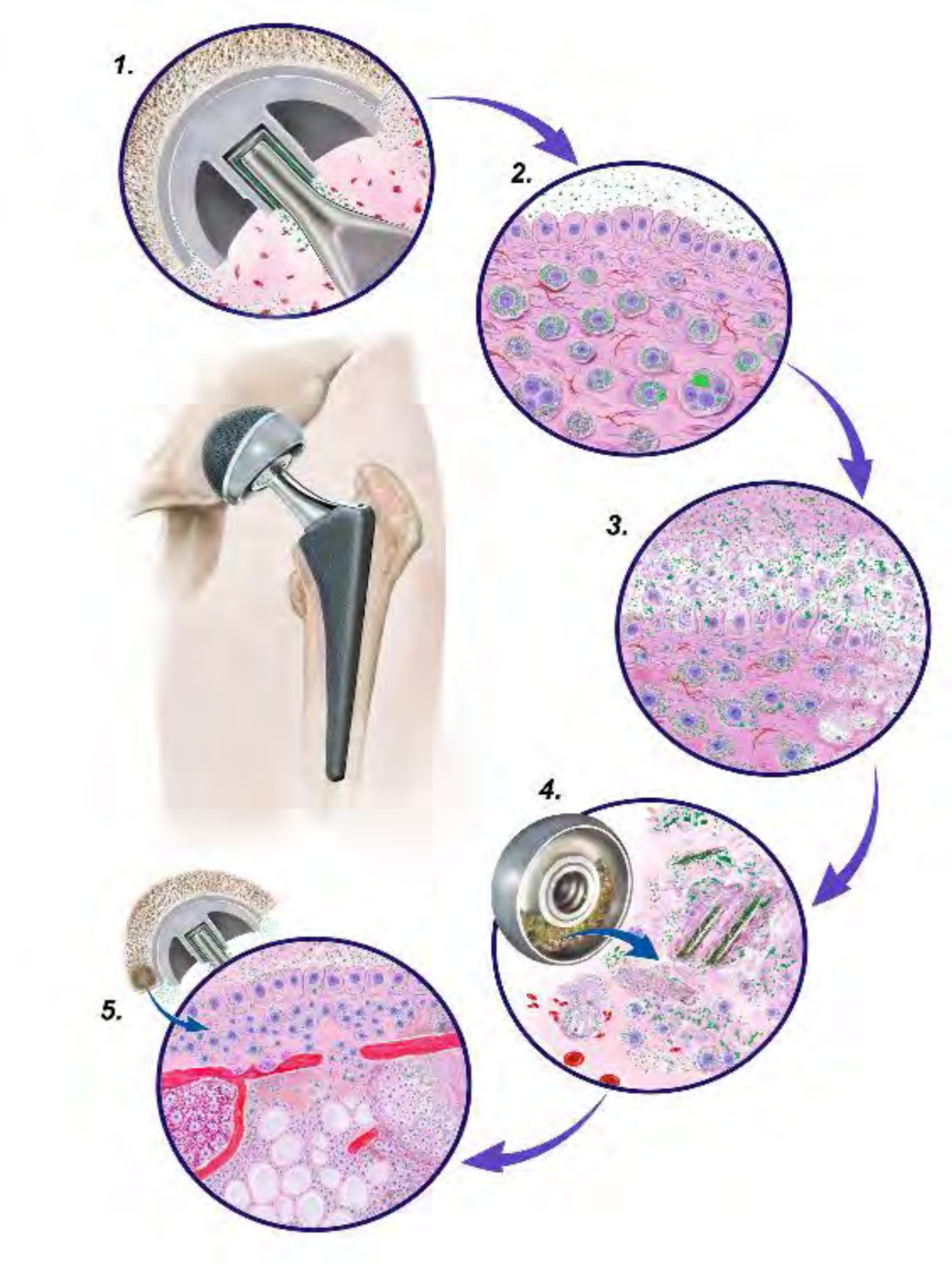
Cellular Mechanisms of Failure

- Immunological: Macrophages, Lymphocytes, Plasma Cells, Mast Cells, Eosinophils
- Macrophagic: Tribology Modifications and Osteolysis

Macrophagic Mechanism



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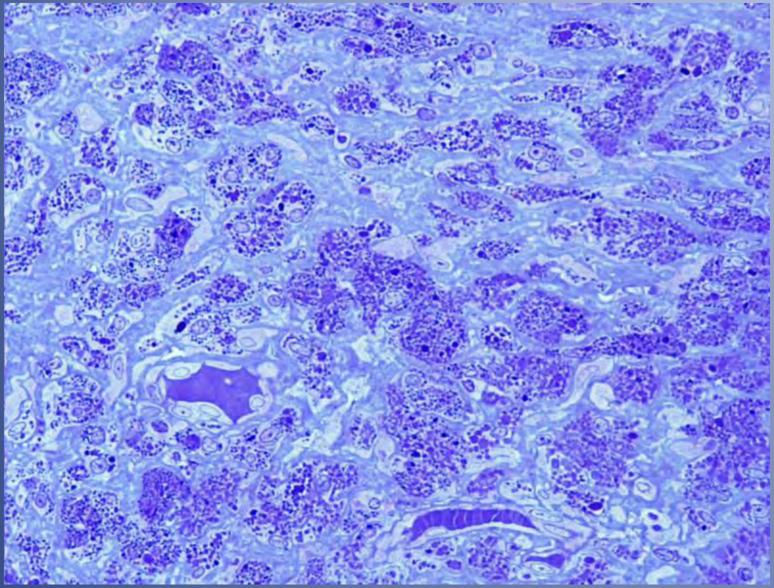
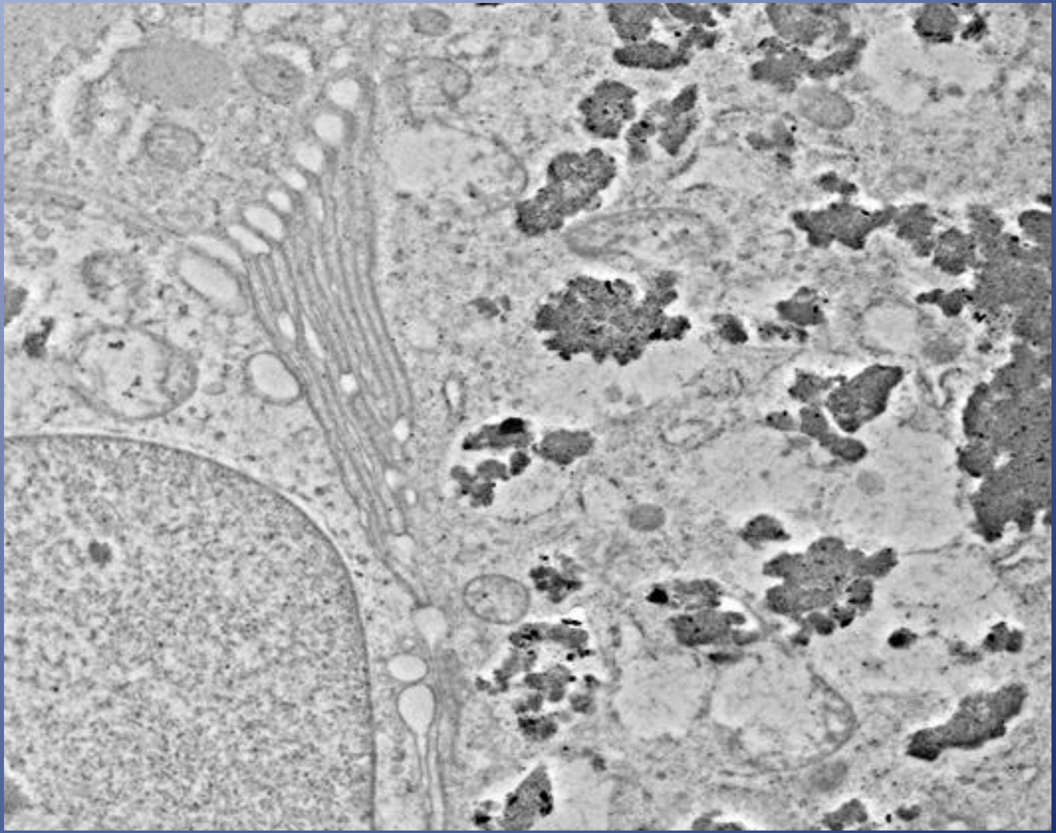
Electron Microscopy and Particle Analysis

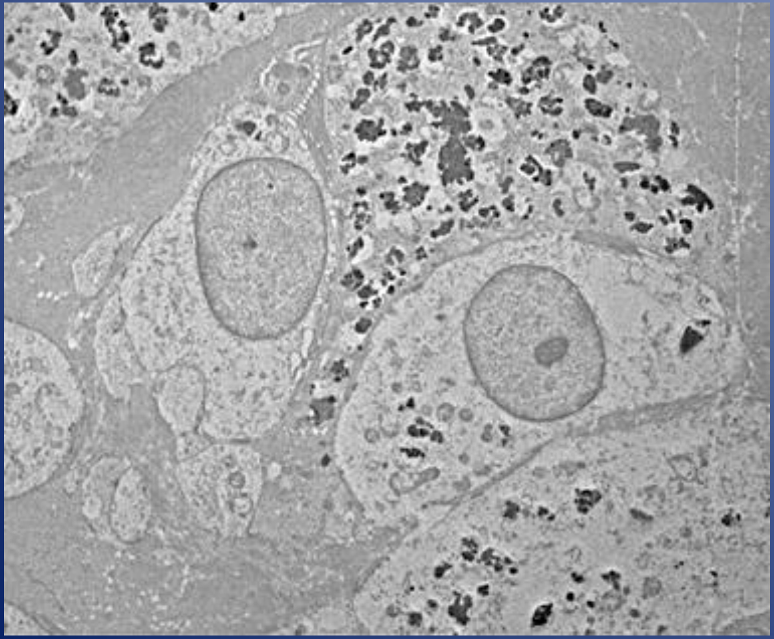
Zhidao Xia, PhD, Center for Nanohealth, Swansea University, Swansea, UK

- Transmission EM (TEM)
- Scanning EM (SEM)
- Back-scattered electron detector (BSE) and energy dispersive spectroscopy (EDS)
- TEM-EDS mapping
- X-ray Diffraction Spectrometry (XDS)

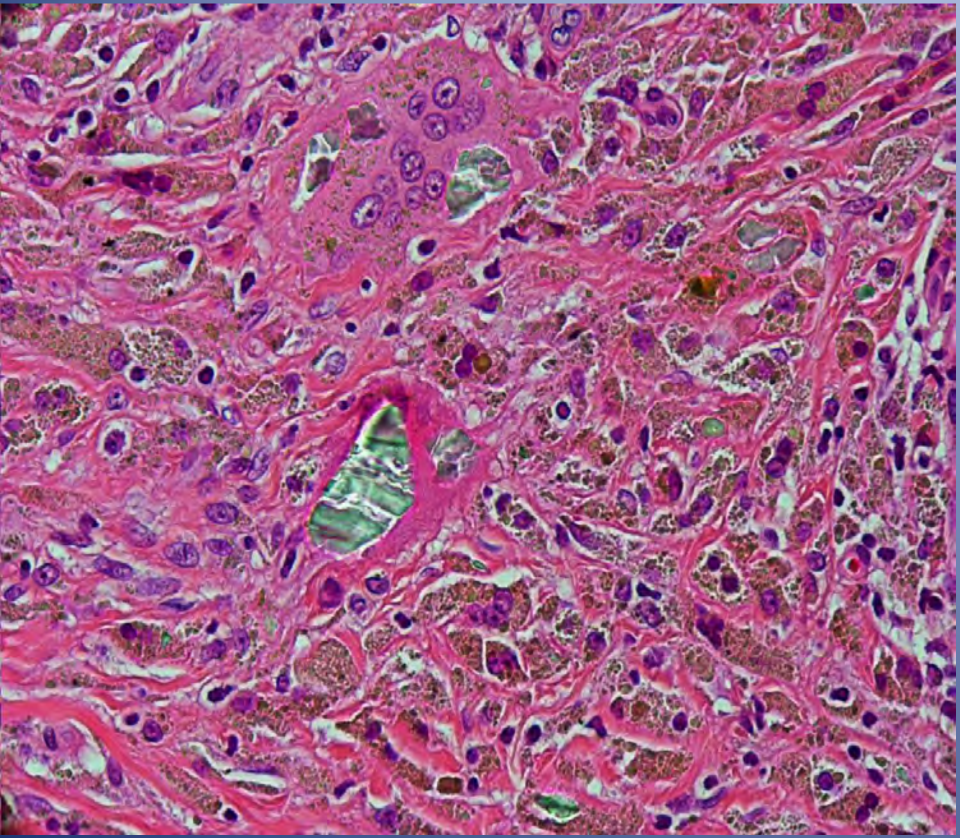
MoM THA w MAS

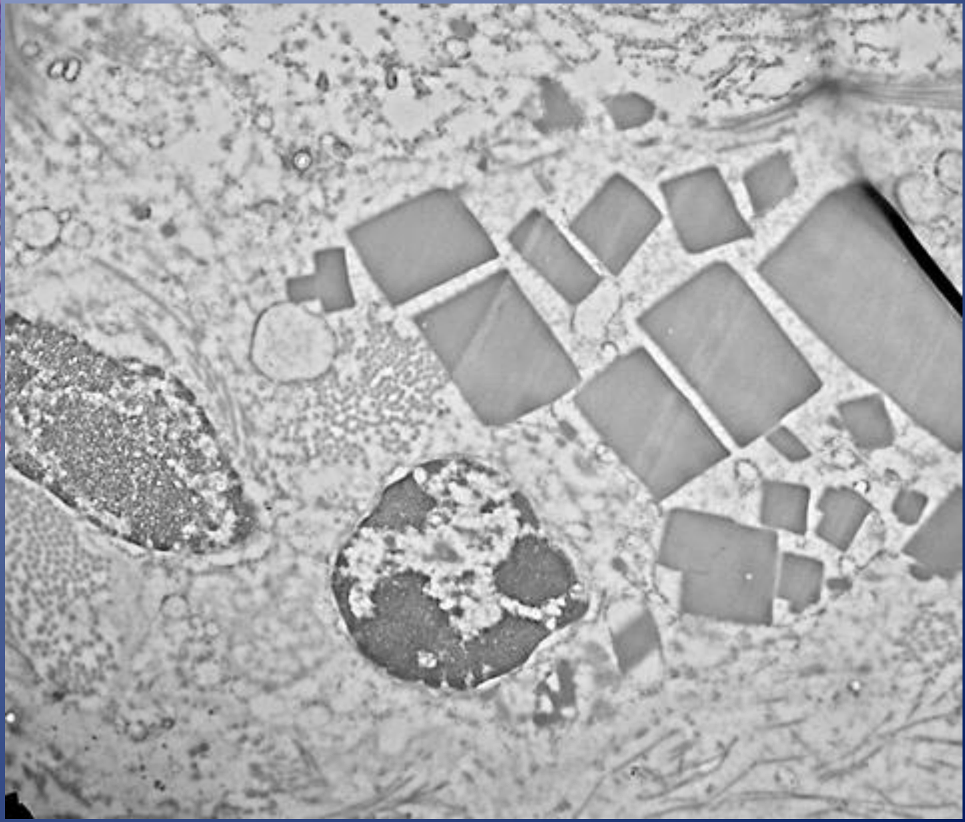




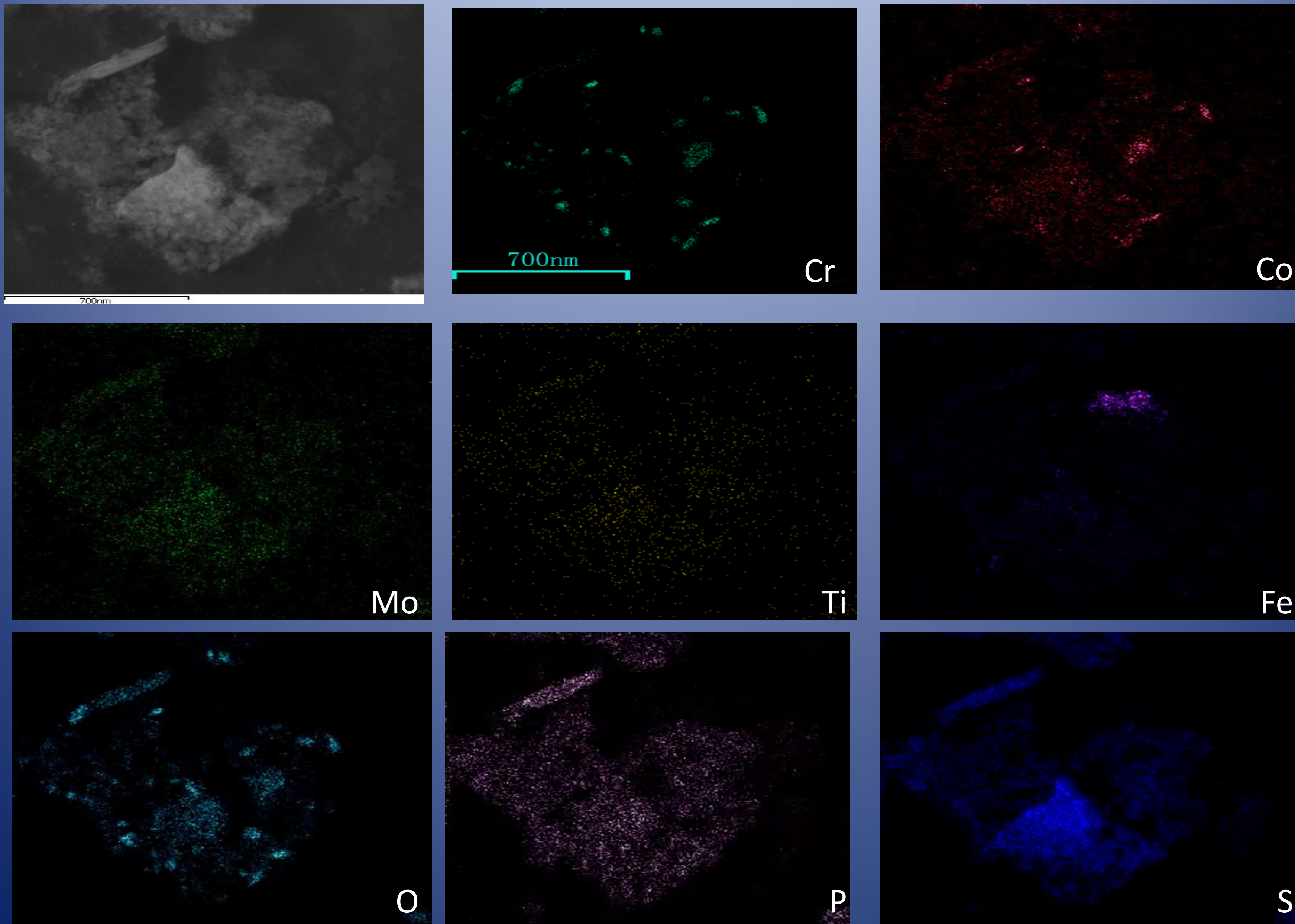


MoM THA with MAS





Particle Element Analysis



Corrosion of orthopaedic implants remains a serious clinical concern. Even though the freely corroding implant materials used in the past have been replaced with modern corrosion-resistant superalloys, deleterious corrosion processes have been observed in certain clinical settings. There is reason to believe that attention to variables related to metallurgical processing, tolerances of modular connections, surface-processing modalities, and appropriate selection of materials can decrease the rate of corrosion and minimize the potential for adverse clinical outcomes.

Jacobs JJ, Gilbert JL, Urban RM. Corrosion of metal orthopaedic implants. J Bone Joint Surg Am. 1998;80(2):268-82.

MoP Bearing Surface
Skirted Metallic Head

Review

Aseptic loosening of total joint replacements: mechanisms underlying osteolysis and potential therapies

Yousef Abu-Amer[1], Isra Darwech[2] and John C Clohisy[2]

[1]Department of Orthopaedic Surgery and Department of Cell Biology & Physiology, Washington University School of Medicine, Barnes Hospital Plaza, Saint Louis, Missouri 63110, USA
[2]Department of Orthopaedic Surgery, Washington University School of Medicine, Barnes Hospital Plaza, Saint Louis, Missouri 63110, USA

Corresponding author: Yousef Abu-Amer, abuamery@wudosis.wustl.edu

Published: 29 June 2007

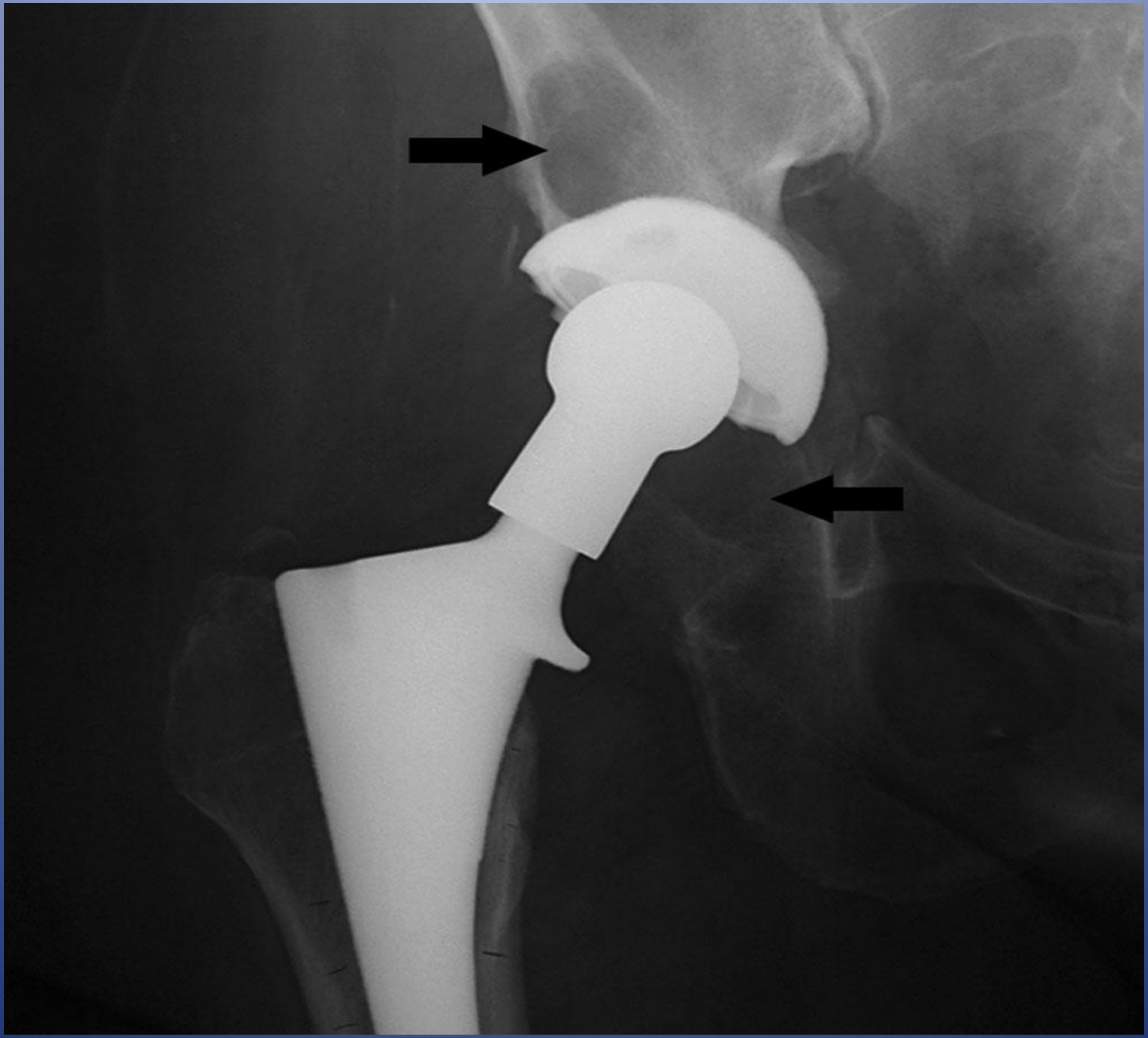
Arthritis Research & Therapy 2007, **9(Suppl 1):**S6 (doi:10.1186/ar2170)

This article is online at http://arthritis-research.com/content/9/S1/S6

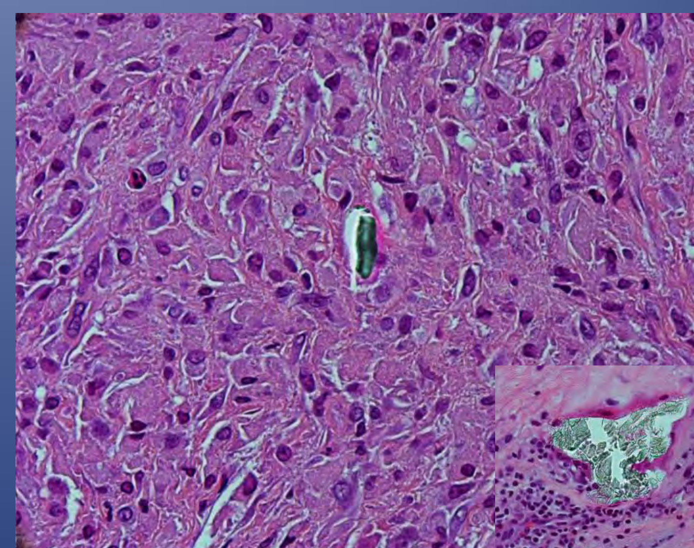
The Journal of Arthroplasty Vol. 28 No. 2 2013

Acetabular Alignment and Primary Arc of Motion for Minus, Skirtless, and Skirted 28-, 32-, 36-, and 40-mm Femoral Heads

Yona Kosashvili, MD, MHA, Daniel Omoto, MD,
David Backstein, MD, MEd, FRCSC, Oleg Safir, MD, FRCSC,
Dror Lakstein, MD, and Allan E. Gross, MD, FRCSC

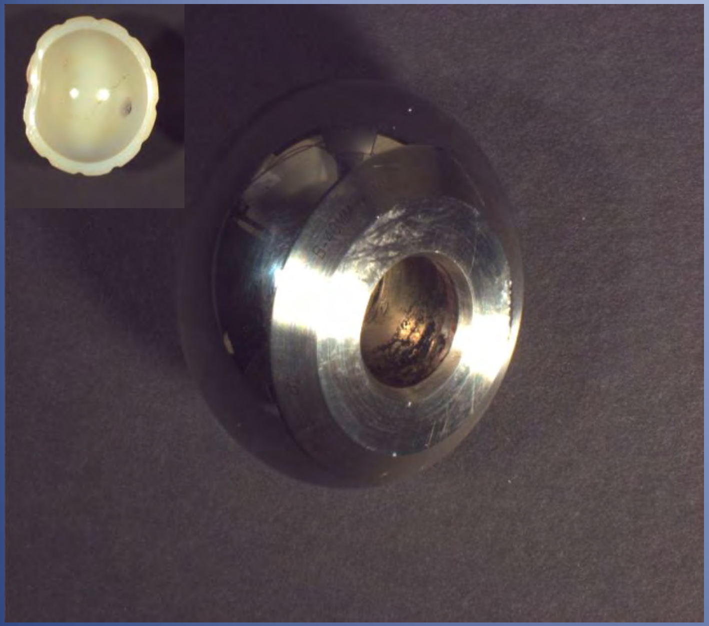


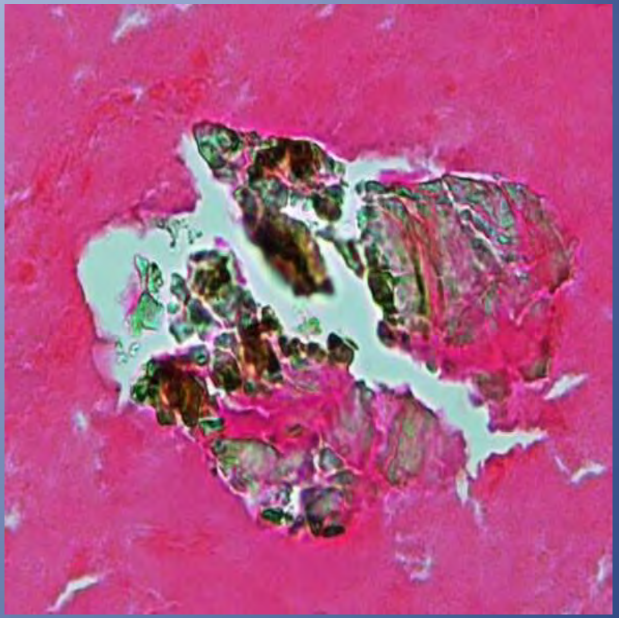
Implanted 08/96; Revised 09/13



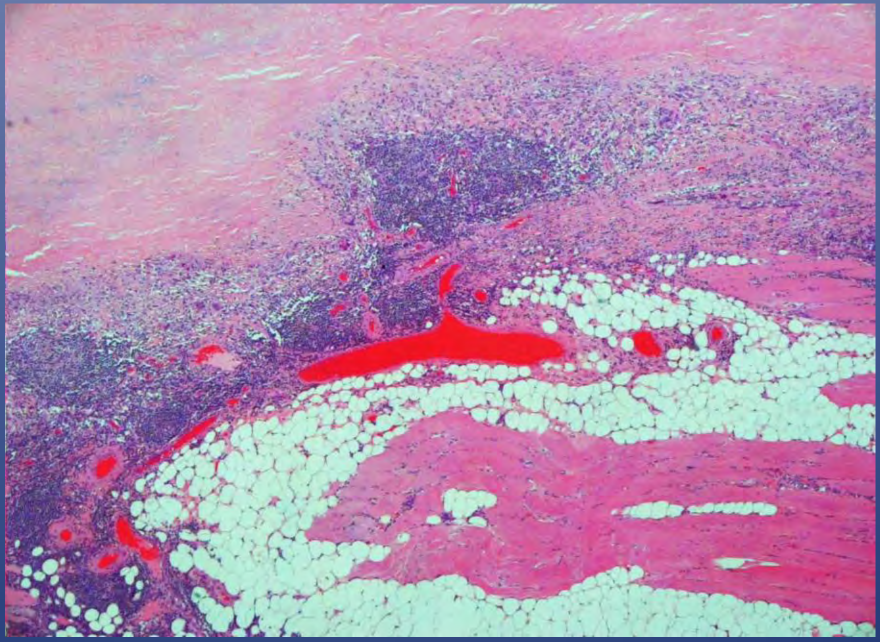



Implanted 12/07; Revised 03/13



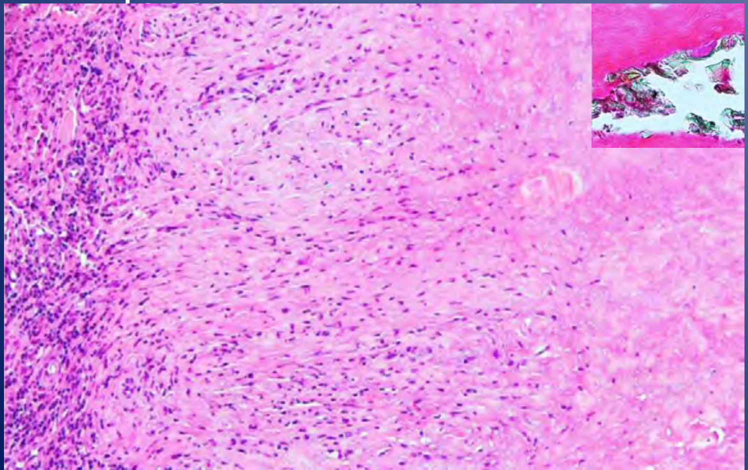


40 mm metallic head
246.5 g

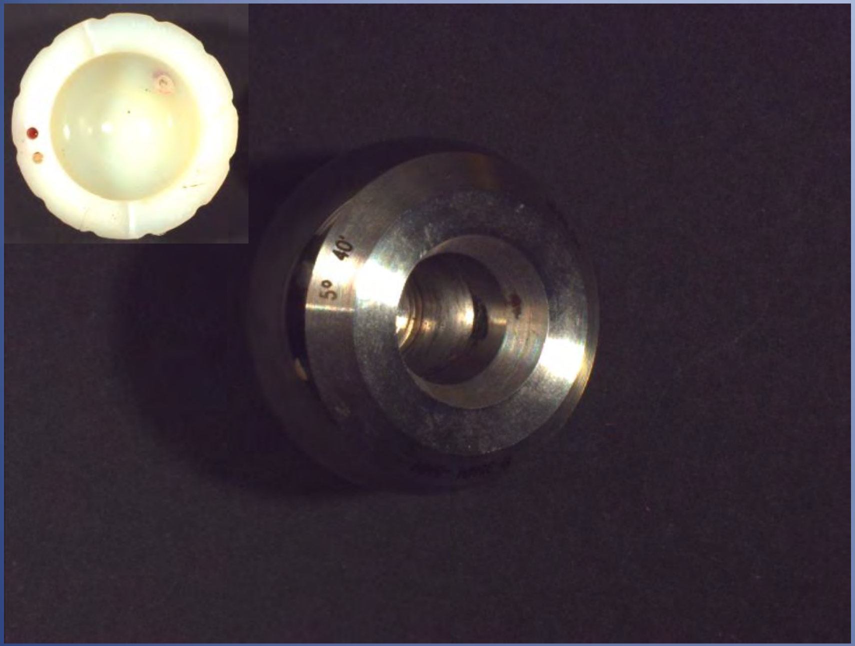


Implanted 12/10; Revised 04/12

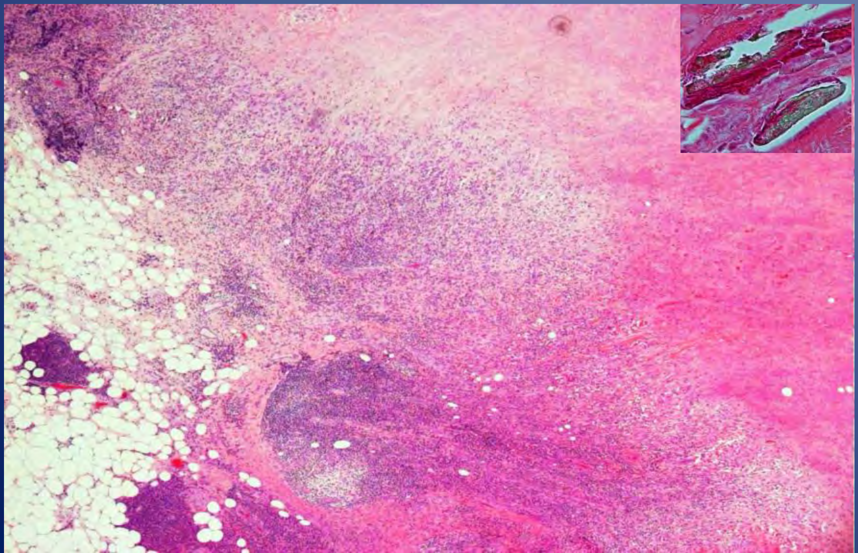
32 mm metallic
head,
threaded neck

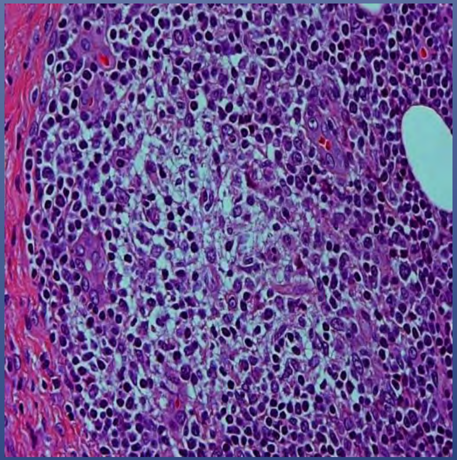


Implanted 10/09; Revised 04/12



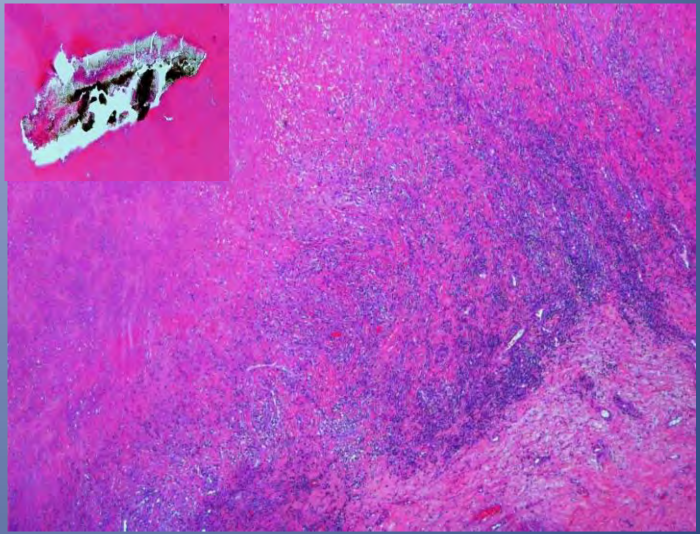
36 mm metallic head

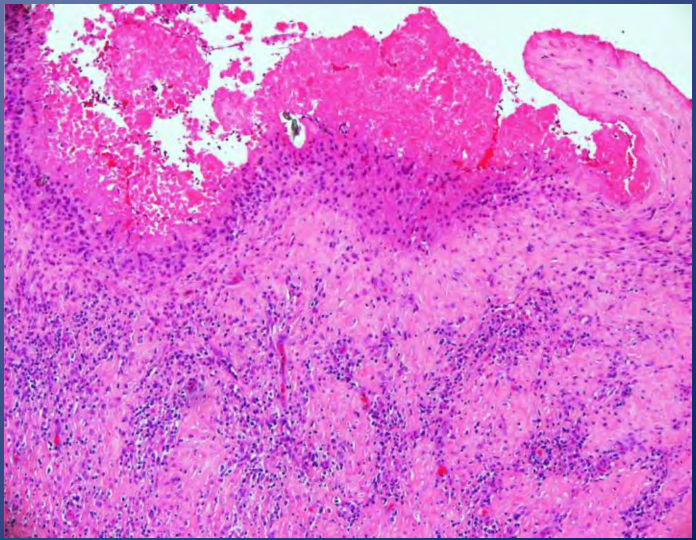




Non-MoM Bearing Surface
Dual Modular Neck

Implanted 03/04; First revision 03/10; Second revision 04/12; Third revision 08/12

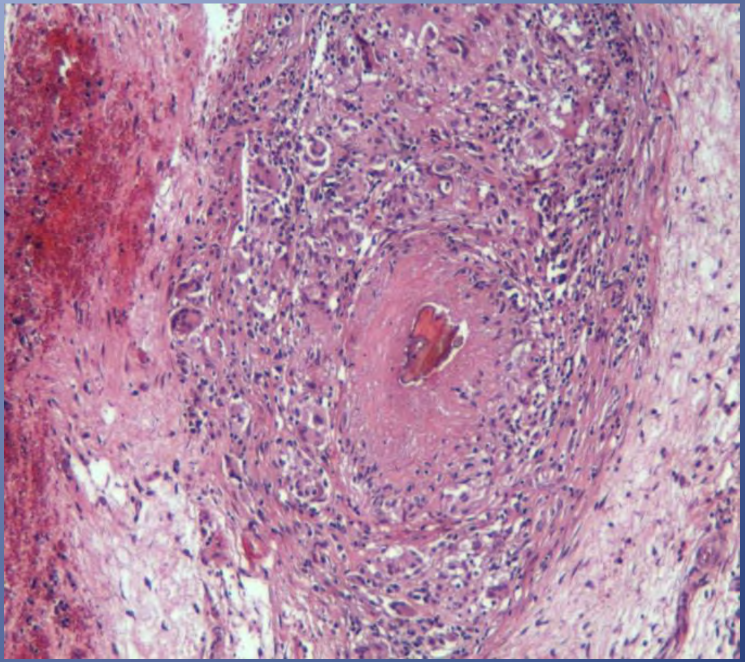




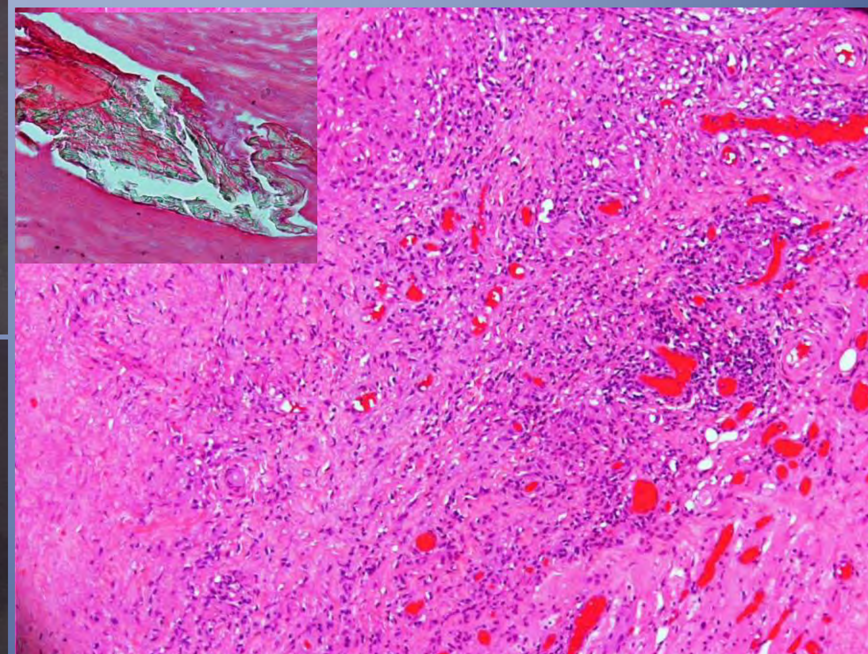
Smith and Nephew
Redapt with CoCr
Dual Modular Neck

Implanted 09/07; 01/10 First hip Dislocation; 03/10 Second hip Dislocation; First Revision 05/10 ; Second Revision 09/11

AG Braun Aesculap Metha Short Hip Stem System with Dual Modular Neck of Isodur cobalt-chromium forged alloy (CoCr29Mo)

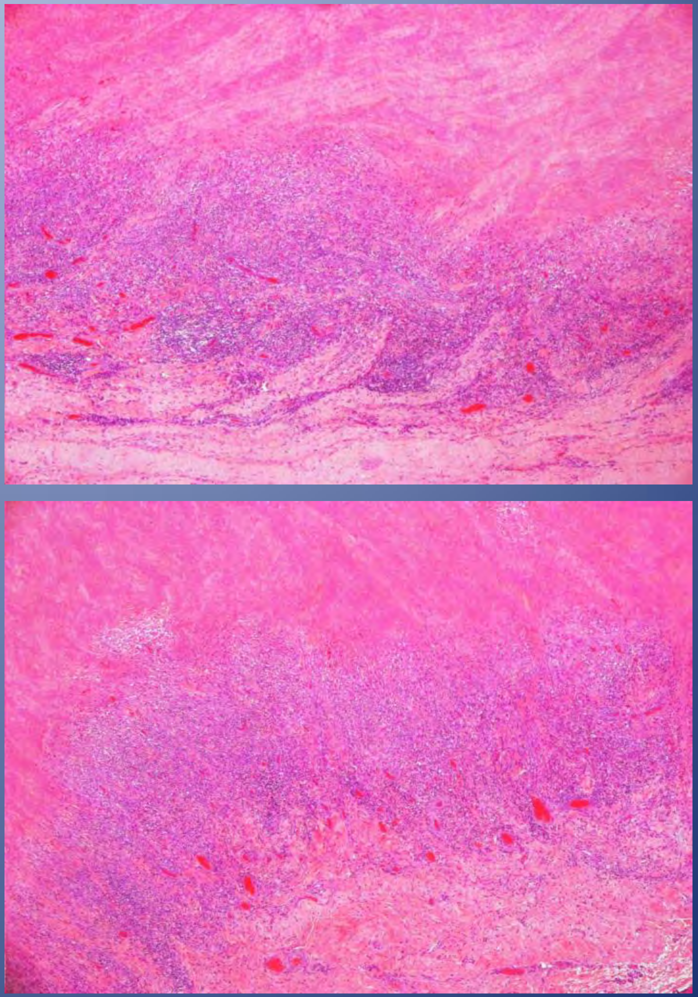


Implanted 07/10; Revised 07/13



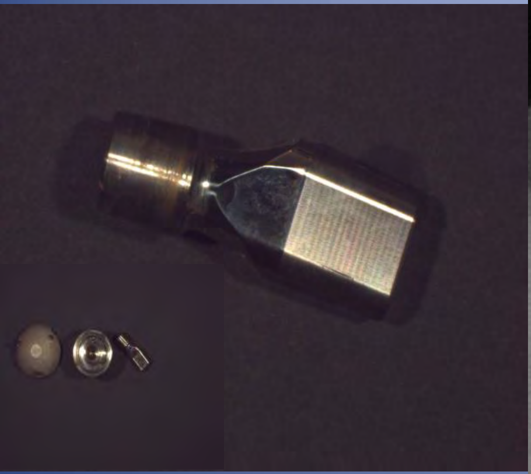
Smith and Nephew SMF with CoCr Dual Modular Neck

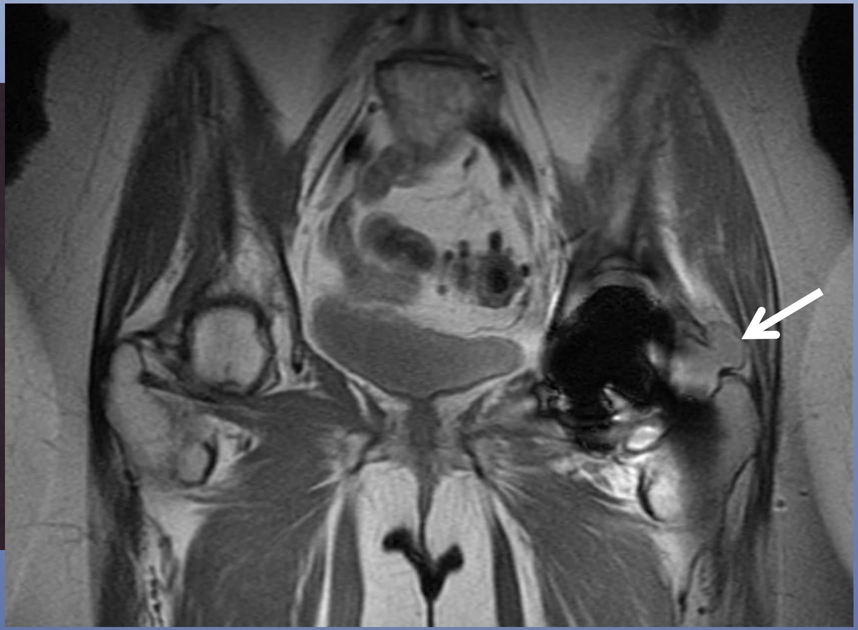
Implanted and Revised: Rt 06/11 and 09/13; Lt 10/11 and 05/13



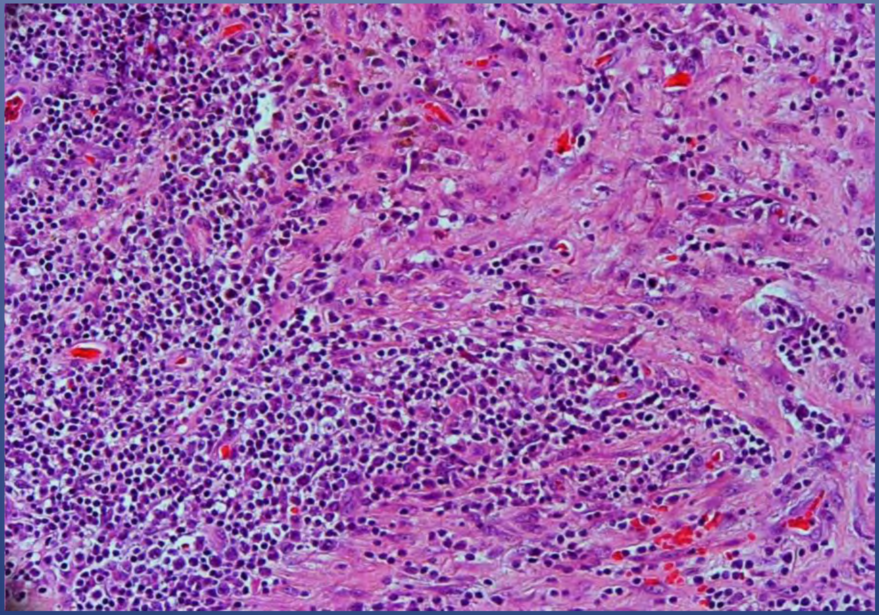
Stryker Rejuvenate with CoCr Dual Modular neck

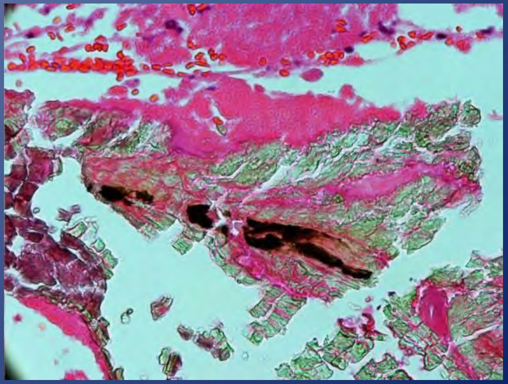
Implanted 03/10; MRI 06/11





Wright Medical Technology Pro femur **Z #2 stem; 54 mm** spiked THF cup; 48 mm head; Ti dual modular neck





Mistakes Have Consequences

The Journal of Arthroplasty 29 (2014) 1–6

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journal homepage: www.arthroplastyjournal.org

Modular Taper Junction Corrosion and Failure: How to Approach a Recalled Total Hip Arthroplasty Implant

Robert Pivec, MD [a], R. Michael Meneghini, MD [b], William J. Hozack, MD [c], Geoffrey H. Westrich, MD [d], Michael A. Mont, MD [a]

[a] Center for Joint Preservation and Replacement, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore, Baltimore, Maryland
[b] Department of Orthopaedic Surgery, Indiana University School of Medicine, Indianapolis, Indiana
[c] Rothman Institute, Thomas Jefferson University, Philadelphia, Pennsylvania
[d] Department of Orthopaedic Surgery, Adult Reconstruction and Joint Replacement Service, Hospital for Special Surgery, New York, New York

Case series

- 215 ABGII modular stems in 202 patients (03/09- 06/11) 50 patients (30.1%) with symptoms consistent with ALTR, 15 revised and 5 awaiting revision
- 216 Rejuvenate stems, 199 modular 03/09-06/11, 67 patients (33.7%) revised for ALTR

HSS HOSPITAL FOR SPECIAL SURGERY

Conclusions

- Histological examination provides a more precise diagnosis and it is clinically relevant
- Histological examination identifies sentinel cases of ALTR providing useful information for implant class and/or specific implant surveillance
- Histological diagnosis should be part of implant registries as it is of tumor registries with modalities to be determined by consensus of a multidisciplinary expert panel
- Histological analysis is the first step in the identification of particle related implant failure and should be integrated by molecular characterization and particle analysis for the identification of clinically relevant biomarkers for patient's risk stratification.

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Taperosis : Treatment & Outcomes

Stephen A Jones

GIG CYMRU NHS WALES | Bwrdd Iechyd Prifysgol Caerdydd a'r Fro
Cardiff and Vale University Health Board

BHS/SIDA Congress Milan – 2015

Disclosures

- Institution
  - Funding received Depuy, Zimmer Biomet & Lima

- Individual
  - **Consultant agreements**
  - Zimmer Biomet, Smith & Nephew, Depuy & Lima
  - **Design agreements & Royalties**
  - Smith & Nephew, Lima & Adler Orthopaedics

Taperosis : Treatment & Outcomes

Modern Assessment – Methodology of Analysis & Planning

What are the clinical, biological and mechanical problems that characterize failure?

Initial Approach to Patient

Uniform to all Bearing Surfaces

- Extrinsic to the hip
  - Spine / Vascular Disease / Malignancy
- Intrinsic to the hip
  - Intra-capsular - Infection / Loosening
  - Extra-capsular - Bursitis / Tendonitis

ARMD varied clinical presentation / Dual pathology !

Patient Assessment

- **Symptomatic vs Asymptomatic**
  - Pain / Swelling / Limp
  - Change in symptoms
  - Decrease in function
  - Especially very active
  - Ceiling effect of Hip scores a limitation

- **Radiology**
  – X-Ray / MARS MRI / USS
- **Metal ion levels**

Benefits of MARS MRI
“ the route map to revision”
John Skinner Sept 2014

- Unlike Not operator dependent
- Can be reviewed by surgeon & shown to patient
- Very reproducible images for F/U & comparison
- Extent of ARMD especially anterior extension
- Relationship to neurovascular structures

Revision Strategy – Key Principals

- Avoid all Cobalt/Chromium in revision implant
- Minimize Modularity & Material Conflict
- Highly Porous In-growth Surface
- Liner options – largest head size possible
- Bearing – COC or COP
- Constrained option on stand-by
- Taper Assessment – Occurs **AFTER** head removed

Component Revision vs Modular Exchange

"the perfect storm"

- Small Component Size
- Sub-optimal component position
- Revision after neck fracture (2nd bearing run-in phase)
- Modular neck LDMoM
- Off label (Zimmer stem with S&N head)

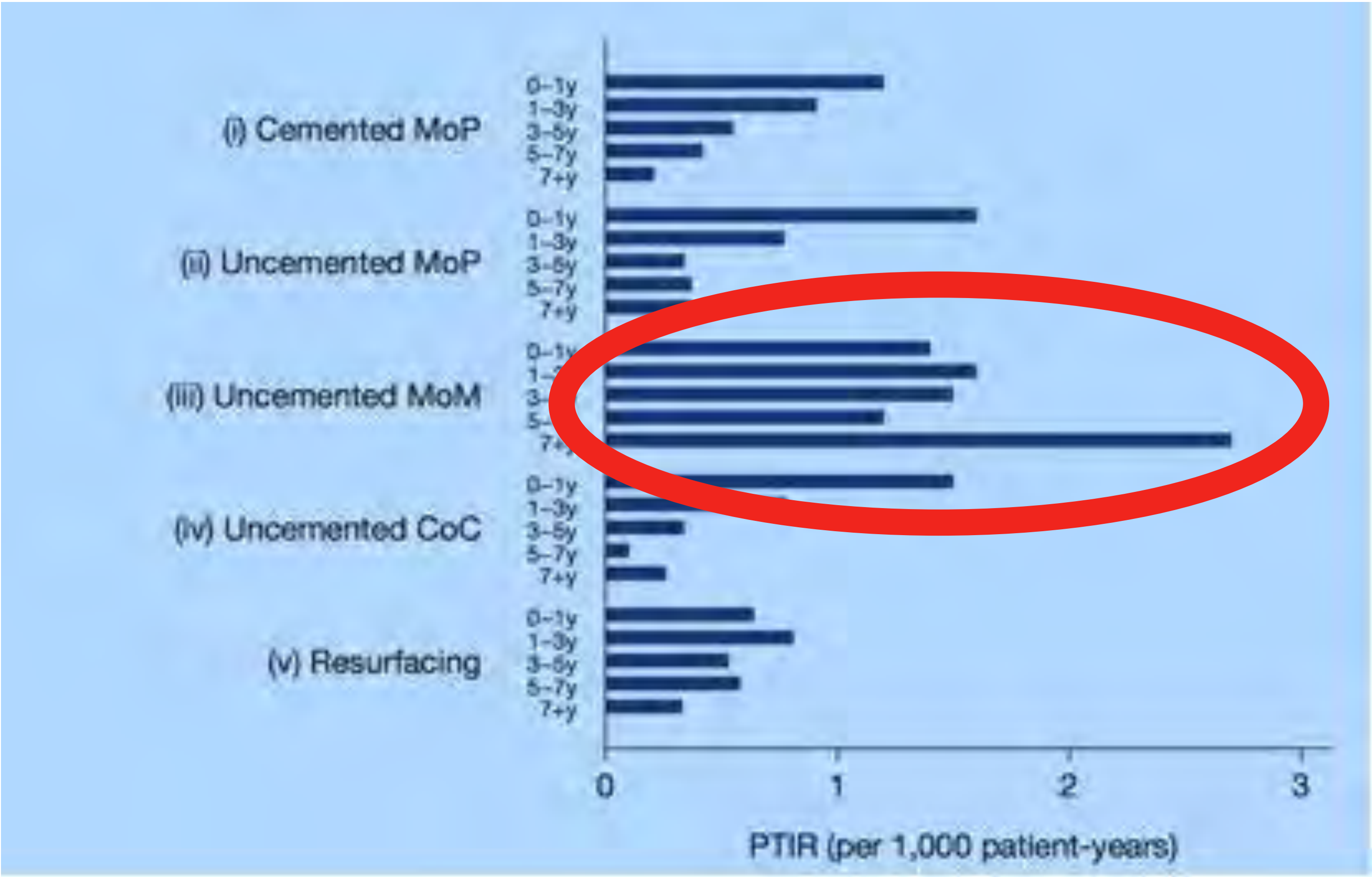
Indications for Stem Revision

- Infection
- Adverse stem radiographic features
- Modular neck components
- Component mal-position
- Unacceptable Taper damage

Indications for Stem Revision

- **Infection**
- Adverse stem radiographic features
- Modular neck components
- Component mal-position
- Unacceptable Taper damage

NJR 11th Annual report 2014



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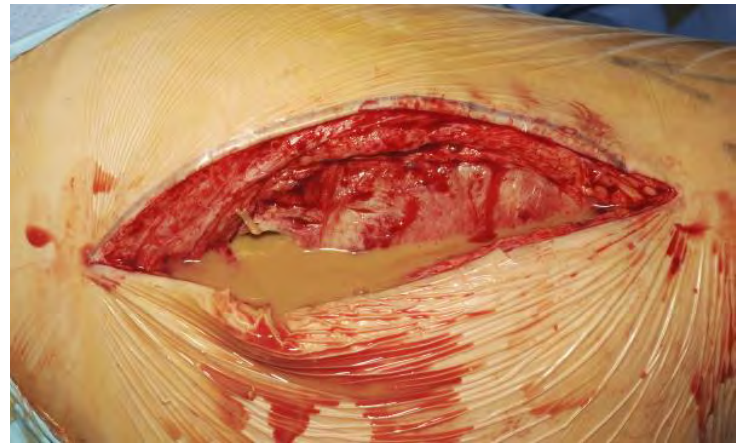
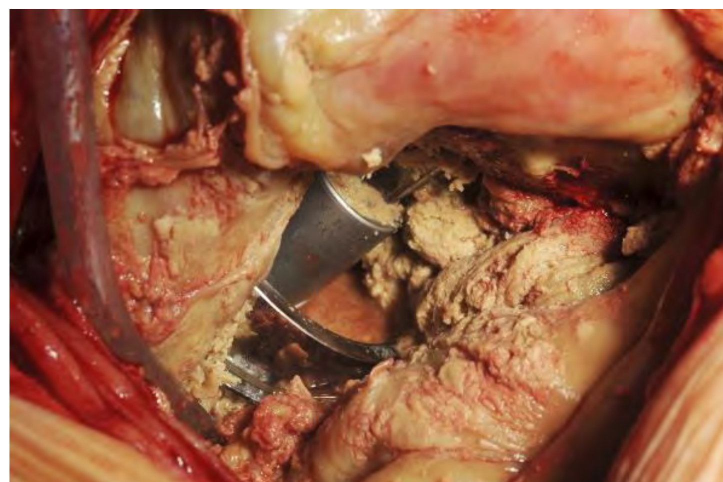
Dual Pathology
ARMD +/- Infection





Challenges in Diagnosis of Infection

- Premature failure
- May have been unhappy from outset
- Non-specific symptoms
- Effect inflammatory markers
- Effect of definitive diagnosis on medico-legal aspects

Aspiration - Mandatory

Aspiration

Synovial WBC Count >3,000 cells per µL

Synovial PMN % > 80%

Microbiological assessment

Failed MoM or Corrosion Reaction

- Monocytes with phagocytosed metal particles may be read as PMN's by automated machines.
- May result in marked variability and lead to false +ve result.
- **Manual Cell Counts** in these patients

Utility of synovial fluid aspirations in failed metal-on-metal total hip arthroplasty.
Wyles C, Larson D, Houdek M, Sierra R, Trousdale R
J Arthroplasty 2013;28(5):818-823

Infection - Challenge of diagnosis in ARMD

"the diagnosis of PJI is extremely difficult in patients with MoM bearings or corrosion"

"A more aggressive approach to pre-operative evaluation for PJI is recommended in these patients"

Do Serologic and Synovial Tests Help Diagnose Infection in Revision Hip Arthroplasty With Metal-on-metal Bearings or Corrosion?

Clin Orthop Relat Res (2015) 473:498–505

Craig J. Della Valle & Co-workers

Indications for Stem Revision

- Infection
- **Adverse stem radiographic features**
- Modular neck component
- Component mal-position
- Unacceptable Taper damage

Radiographic Changes Associated with Failed Metal-on-Metal THA

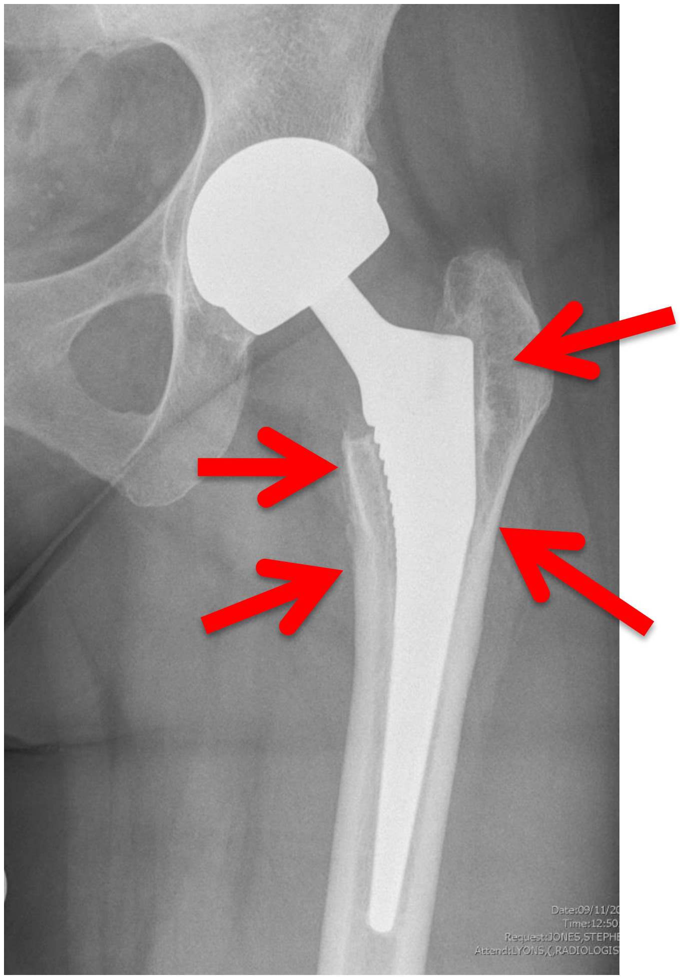
S A Jones, A Dramis, A John

British Hip Society 2014

- Consecutive cohort 304 cases had undergone revision surgery ARMD

- Inclusion criteria produced a study cohort 267 cases and in
  - Total **49%** (131/267) had adverse plain film radiographic changes.
  - Majority occurred in femur only (39%)
  - 10% demonstrating socket abnormalities
  - 9% both.

Adverse Stem Radiographic Features



- When only distal fixation remains
- Often not overtly loose at time of surgery

Risk of stem Fracture

Loss of Proximal Fixation +/-support

Cantilever Failure

Stem Fracture

Modular Neck Stems – Adverse Features

Indications for Stem Revision

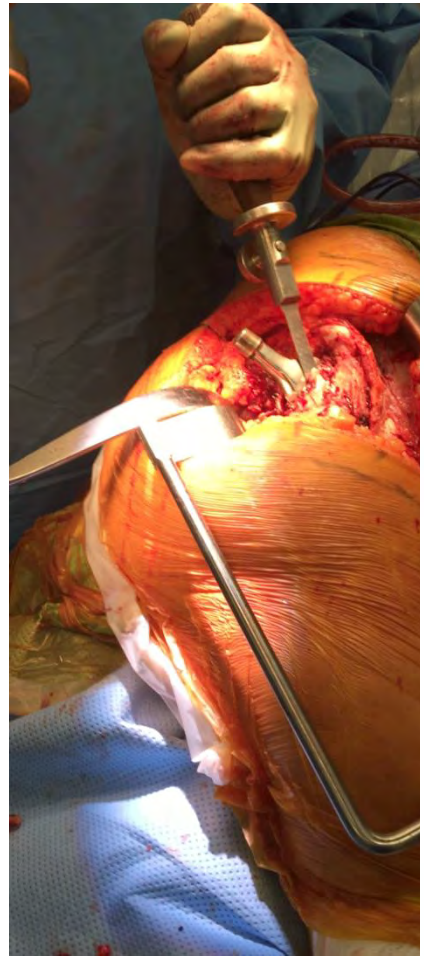
- Infection
- Adverse stem radiographic features
- **Modular neck components**
- Component mal-position
- Unacceptable Taper damage

Modular Neck Stems

July 2012 – Stryker Product Recall

ABG II Modular & Rejuvenate

Implant Removal instruments



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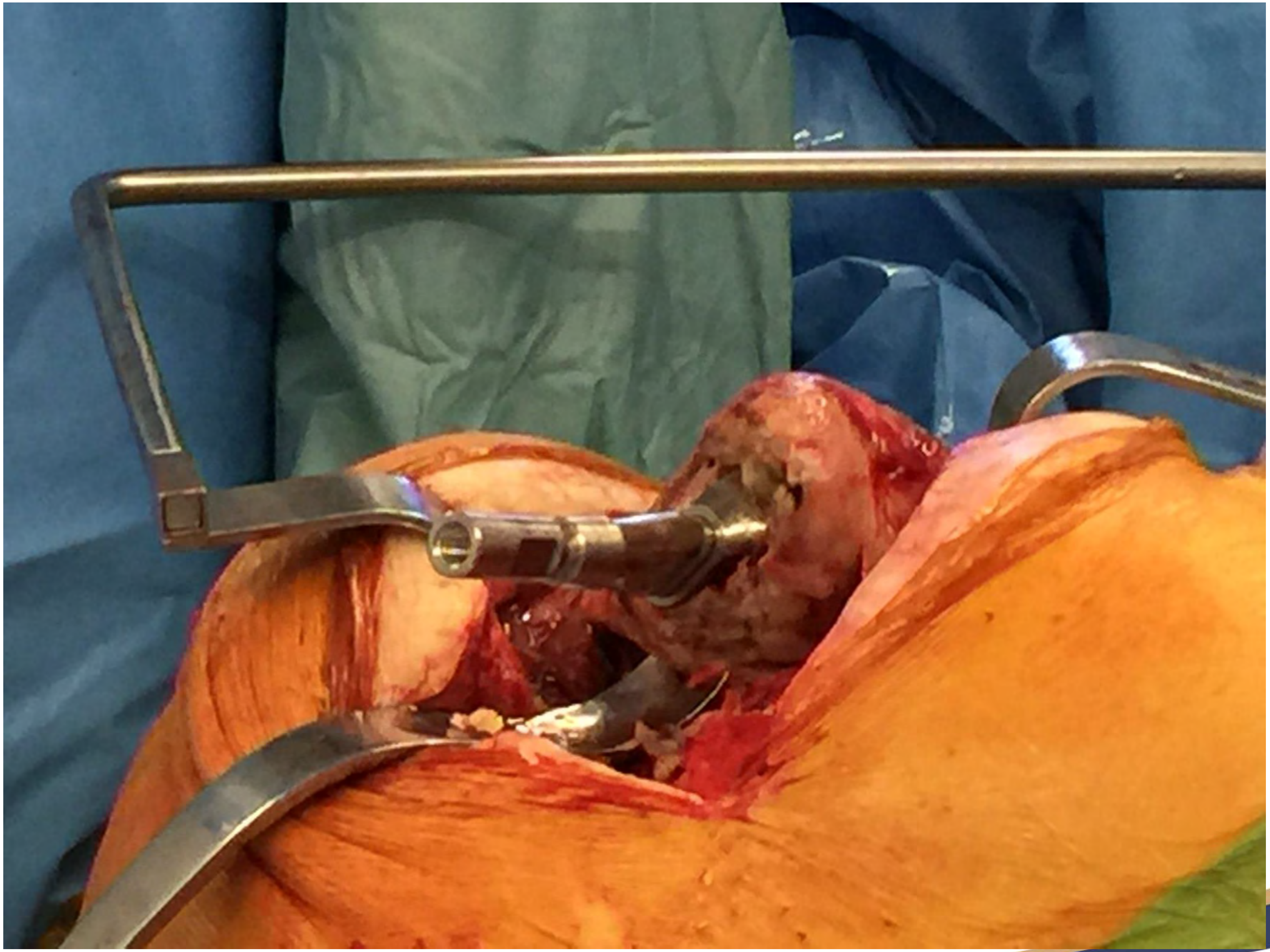

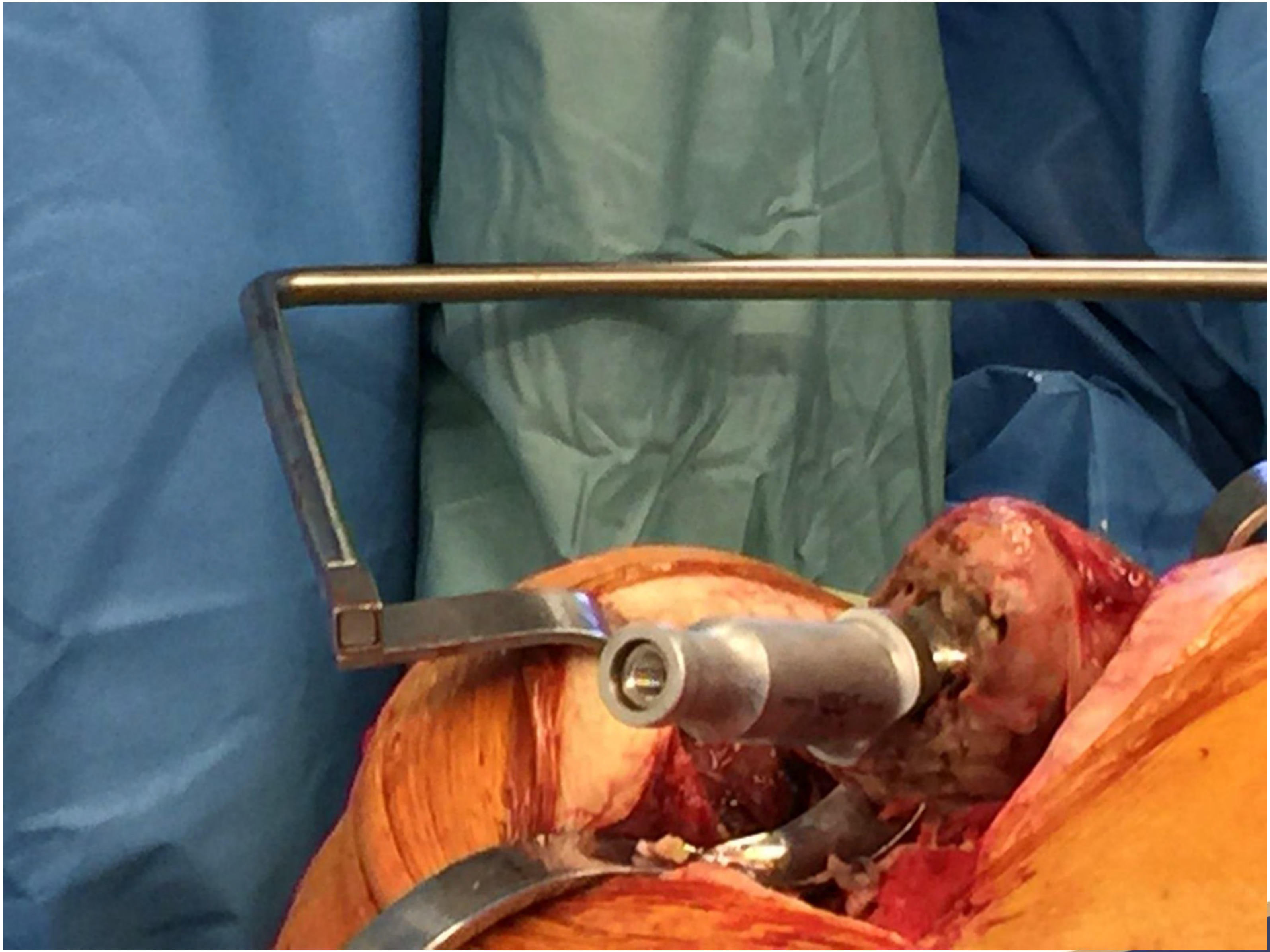

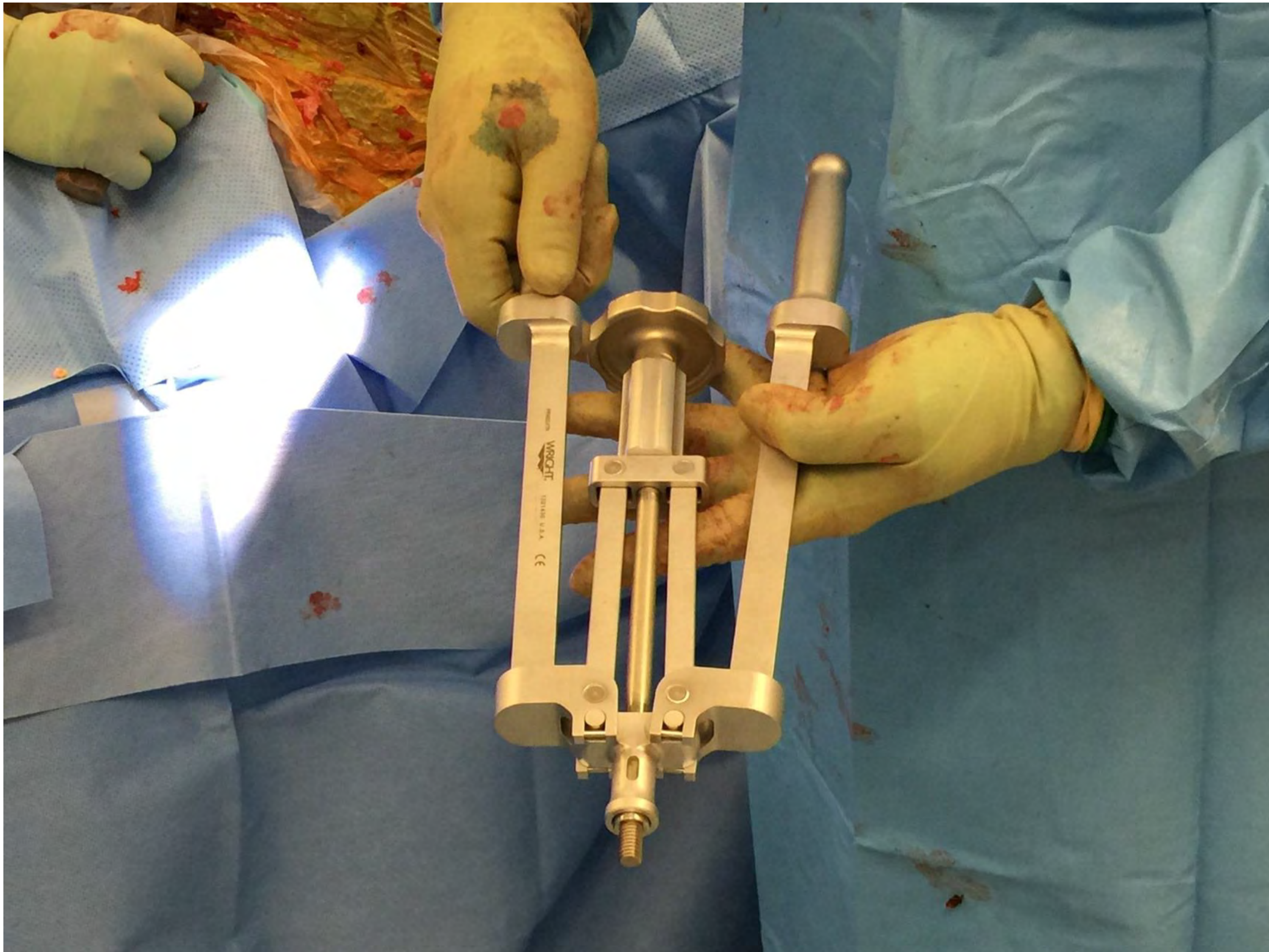
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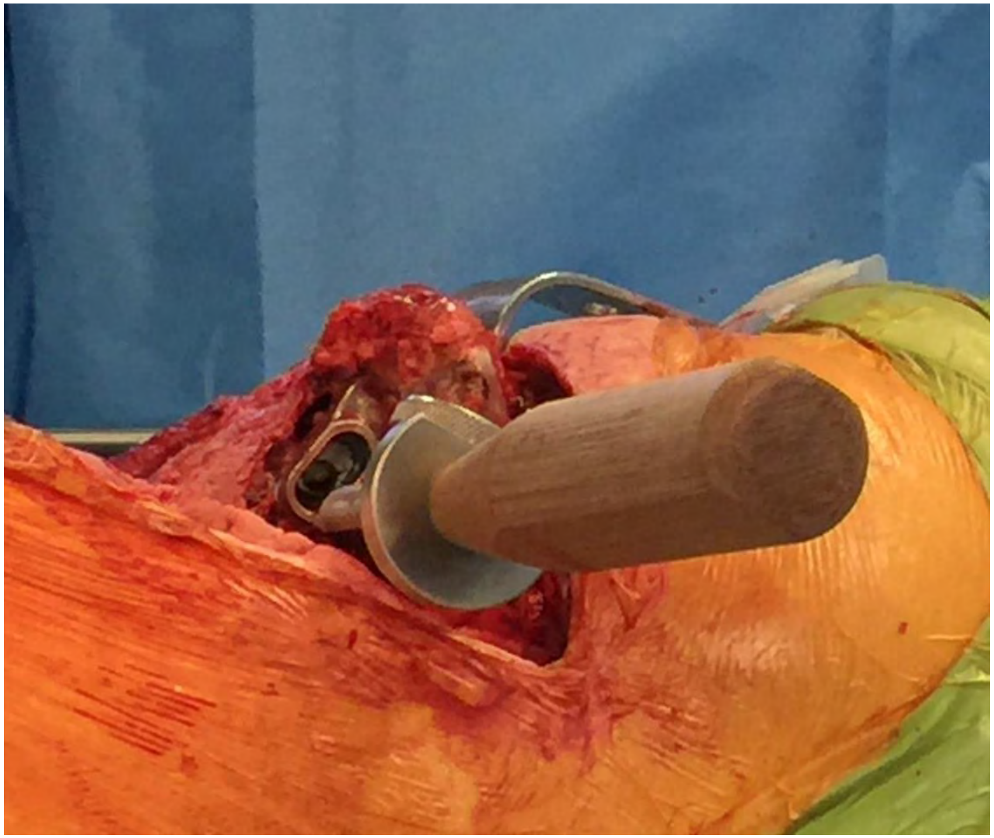
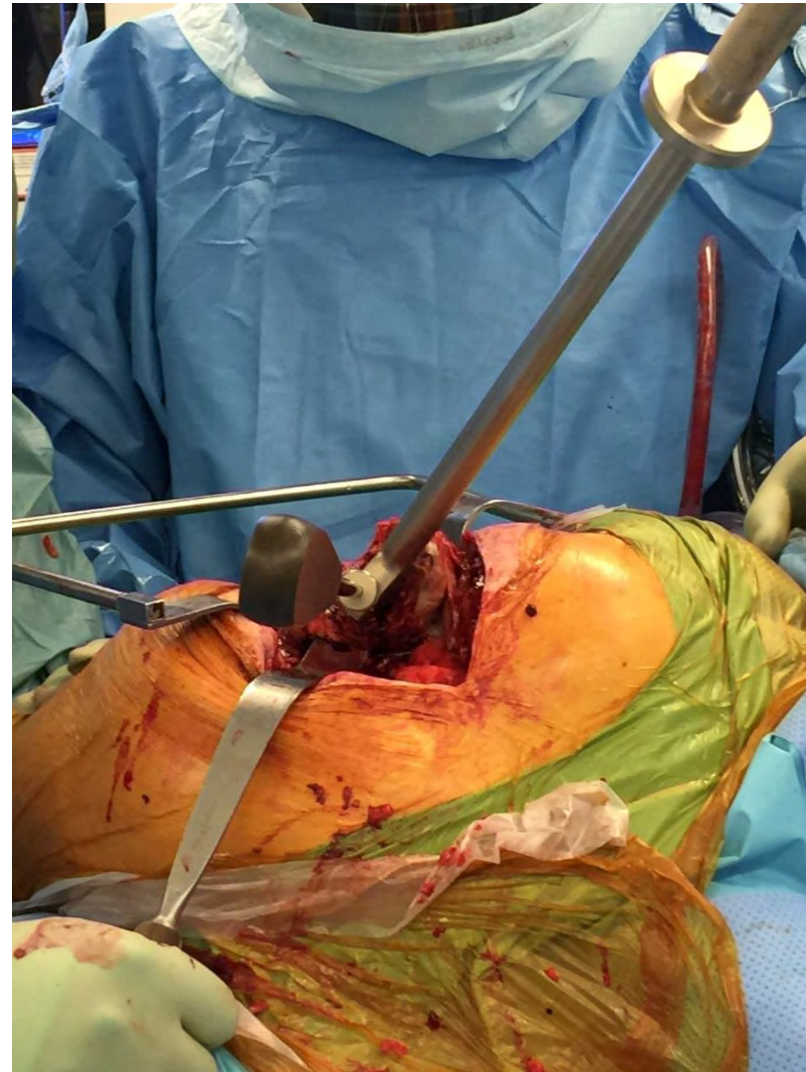




Proximal Fixation Stem

Fully Coated Stem

Indications for Stem Revision

- Infection
- Adverse stem radiographic features
- Modular neck components
- **Component mal-position**
- Unacceptable Taper damage

Results of Socket Only Revision or Modular Bearing Exchange

- 69 Isolated Acetabular Revisions
  20% Dislocation rate

- 142 Both Component Revisions
  8% Dislocation rate

Factors influencing the longer-term survival of uncemented acetabular components used in total hip revisions.

J Bone Joint Surg Am. 2004;86-a:342- 347.

Jones CP, Lachiewicz P.

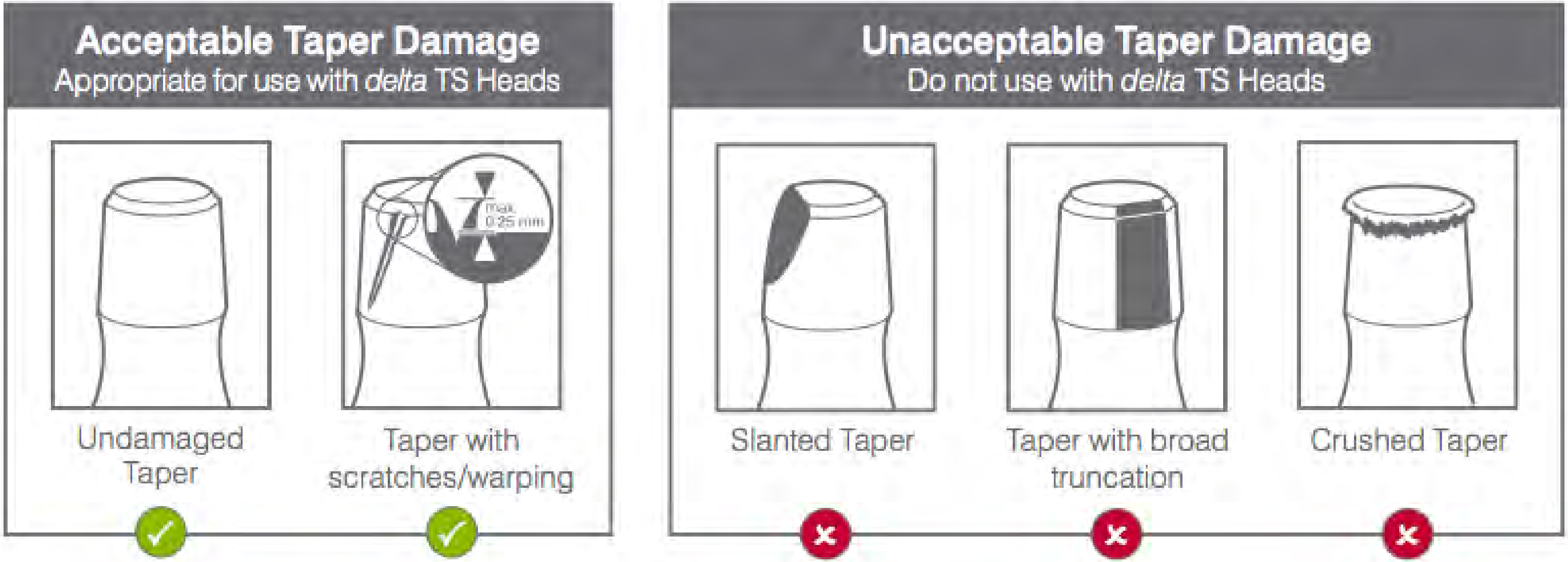
Indications for Stem Revision

- Infection
- Adverse stem radiographic features
- Modular neck components
- Component mal-position
- **Unacceptable Taper damage**

Modular Taper Adapters

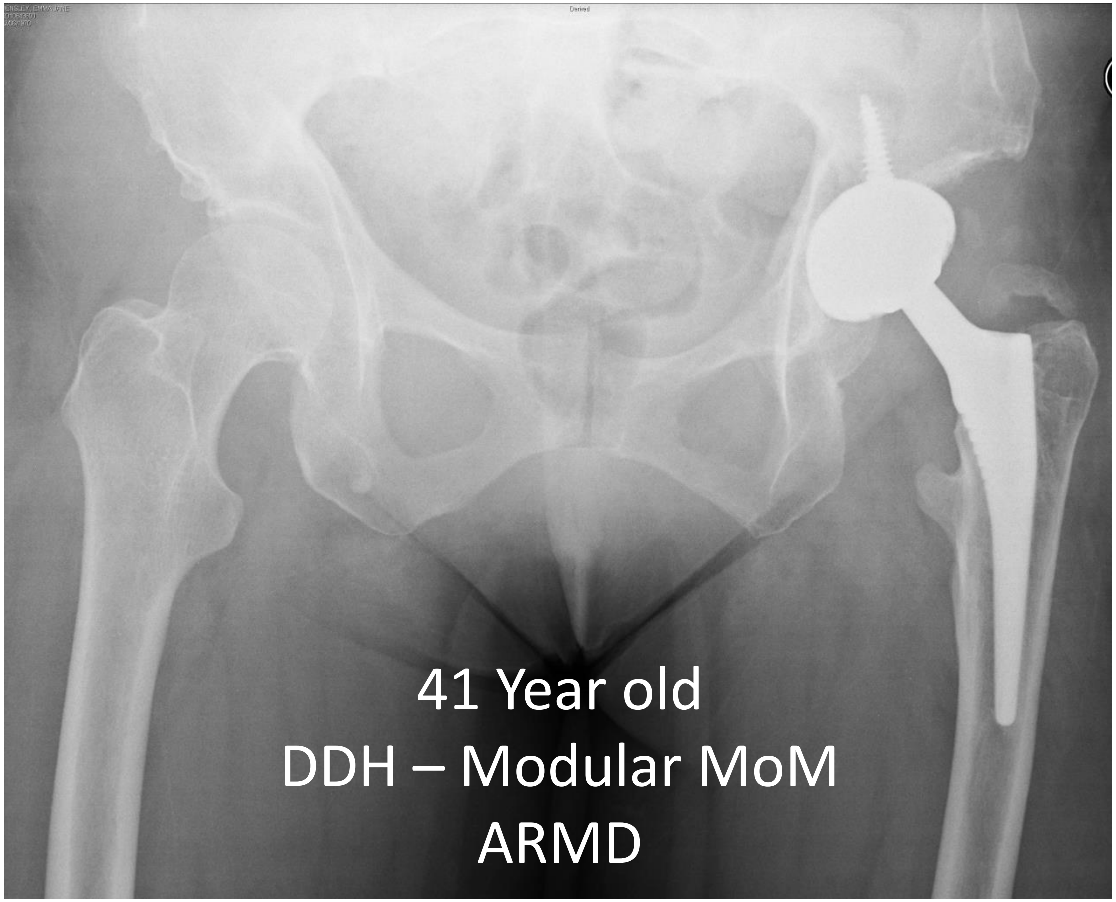
- made of forged titanium alloy Ti6Al4V
- increase the strength of the ceramic head for taper conditions encountered during revision surgery

Taper Damage Assessment

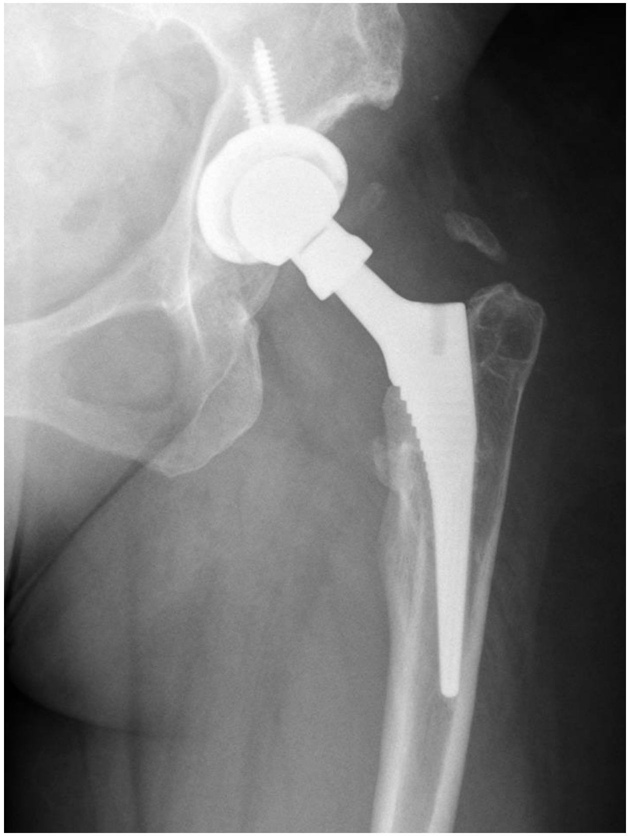


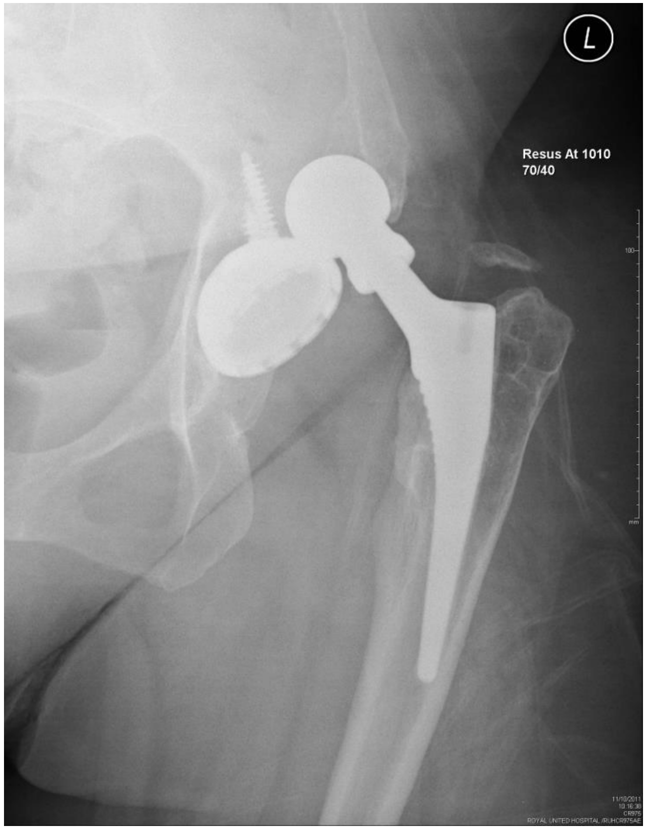
Adapter sleeve levels out irregularities on the cone minimizing interface stress concentration

Case Example – Recurrent Instability



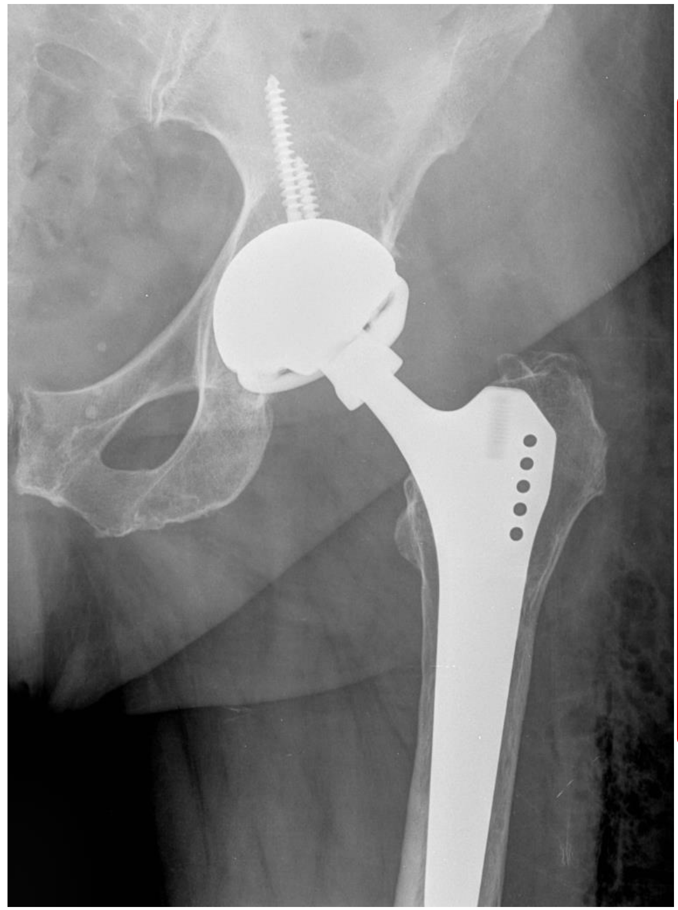
Limitations - Effect on head neck Ratio

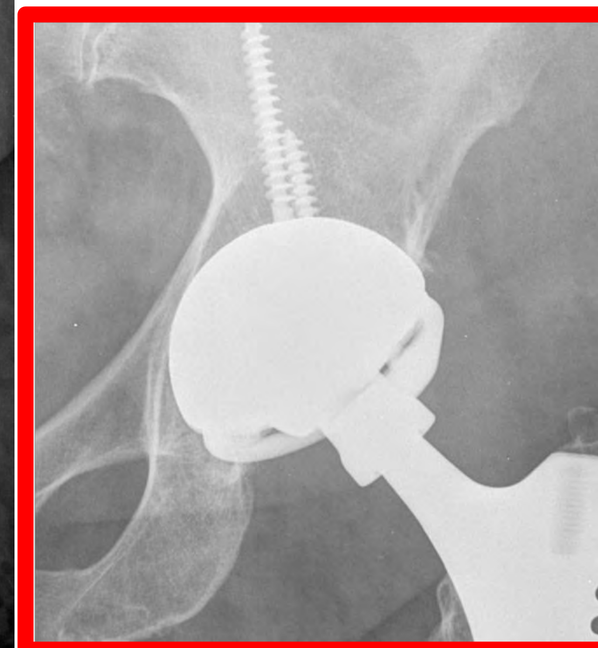




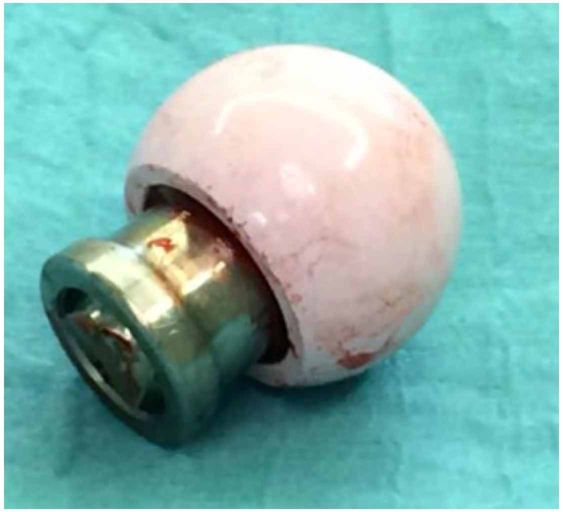
Caution – Isolated Modular Exchange

Caution – Sleeve Adapters & Constrained Liners





Caution – Effect on overall femoral construct



A New case of a Modular Femoral Neck Device After THA
Klemens Trieb and Nicola Stadler
Orthopaedics 2015, 9, 126-128

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Results & Outcome

- **Cross-over between LDMoM**

  - Bearing surface vs taper failure

- **Isolated Taper Failure (Non-MoM)**

  - Dominated by case reports

  - Recalled modular neck components

  - 27 cases MOP (Chicago group)

Outcome of Revision Surgery – Systematic Review

- Only 6 studies were eligible for inclusion with 216 hips revised for ARMD
- **Complication rate 68%** for THR.
- **Re-revision rates were 21%** for THR.
- Dislocation most common complications and indication for re-revision.

Revision of metal-on-metal hip replacements and resurfacings for adverse reaction to metal debris: a systematic review of outcomes

Gulraj S. Matharu, Paul B. Pynsent, David J. Dunlop

Hip International Vol. 24 Issue 4 p 311-420.

MoM THA Revision Experience

- Single Surgeon Consecutive Series 158 cases
- 36 & 40mm COC or COP
- 6 cases as 2 stage procedures
- 11% Constrained Liners
- 76% cases retained femoral stem

Outcome Series MoM Revision

Author & Institution	Number of Cases	Dislocation	Infection	Failure of Fixation	Re-revision Rate
Grammatopoulus et al **Oxford**	53	19%	5%	13%	40%
Garbuz et al **Vancouver**	32	28%	3% Superficial 0% Deep	12.5%	18.7%
Trousdale et al **Mayo Clinic**	58	4%	13%	-	14%
Jones **Cardiff**	158	5%	2% Superficial 1% Deep	2%	4%

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MoM Revision - Lessons learnt instability

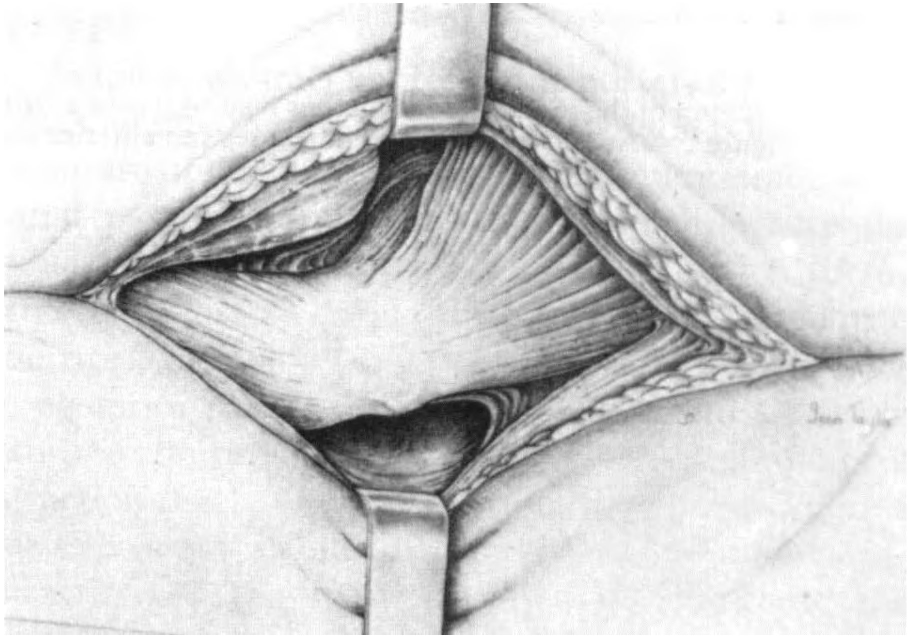
- When SERs & capsule only destroyed no dislocations

  Conclusion - 36 & 40mm heads solution

- All patients who dislocated had abductor damage

- Only recurrent dislocations had > 50% and posterior abductors destroyed

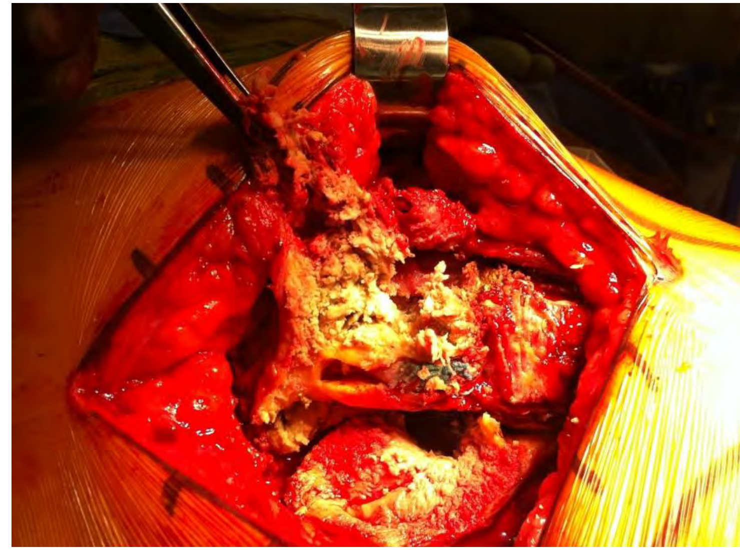
Abductor Muscle

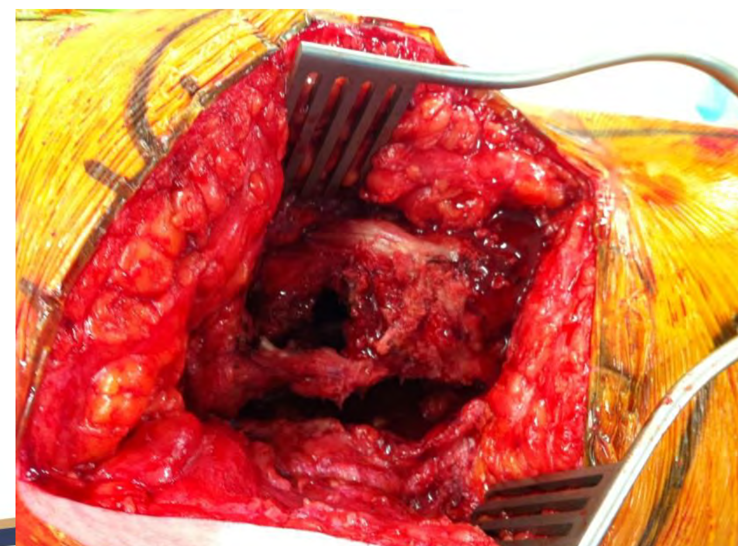


Vertical fibers of posterior border have greatest role as lateral stabilizer

When these damaged have greatest effect on stability

Constrained Bearing





MoM Revision Complications

- 9 Dislocations **(5%)**
    - 7 Single events
- Re-operation – 9 cases **(6%)**
    - Recurrent Dislocation (2 patients)
    - Cup Migration
    - Stem Subsidence
    - Deep Infection
    - Type B2 fracture at one year

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ELSEVIER

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

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GIG CYMRU NHS WALES | Bwrdd Iechyd Prifysgol Caerdydd a'r Fro
Cardiff and Vale University Health Board

- **27 patients** with ALTR secondary to corrosion at the head-neck junction with **MoP bearings**.
- Modular bearing exchange using a ceramic head with a titanium sleeve in 23 of 27 cases
- Only one recurrence of ALTR in patient with metal head
- Complications requiring re-operation (**18%**)
  - One PJI (two-stage revision)
  - Recurrent instability 2 cases
  - One nerve palsy
- Resolution of symptoms and decreases in metal levels.

Taperosis : Treatment & Outcomes

**Modern Assessment –
Methodology of Analysis & Planning**

Surgeons require a clear strategy for management & prevention of dislocation

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Justification of Modularity. Monoblocks

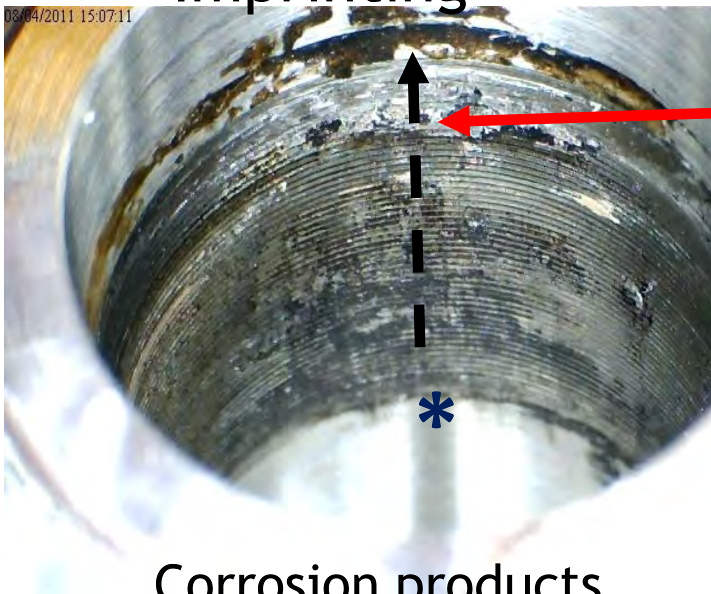
Gordon Blunn

Institute of Orthopaedics and Musculoskeletal Science,
Royal National Orthopaedic Hospital, Stanmor,
University College London.
England

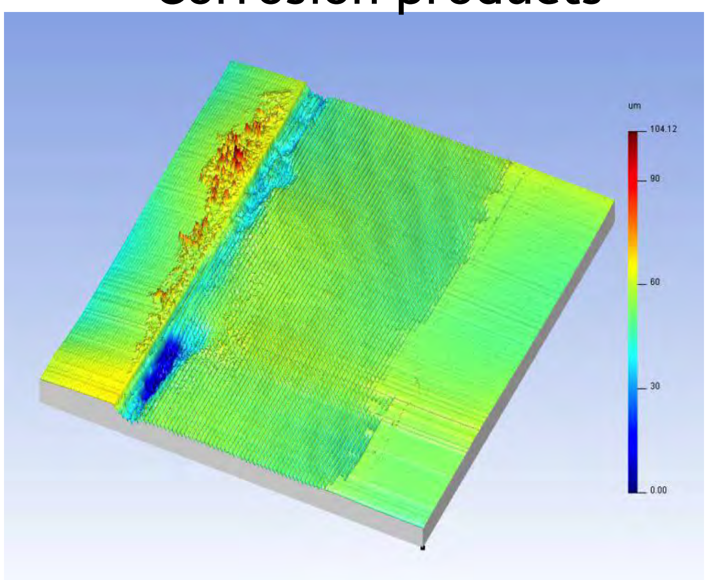
NTERNATIONAL COMBINED MEETING BRITISH HIP SOCIETY +SOCIETÀ
ITALIANA DELL'ANCA 2627 NOVEMBER 2015
MILAN, ITALY

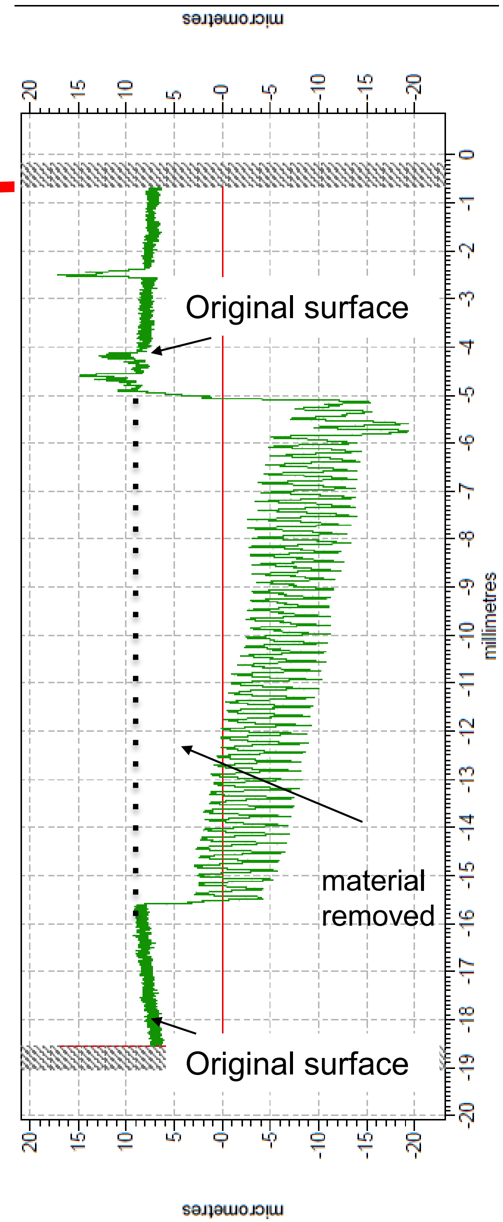
Trunnionosis = Mechanically Assisted Crevice Corrosion

Imprinting



Corrosion products





Head neck junction

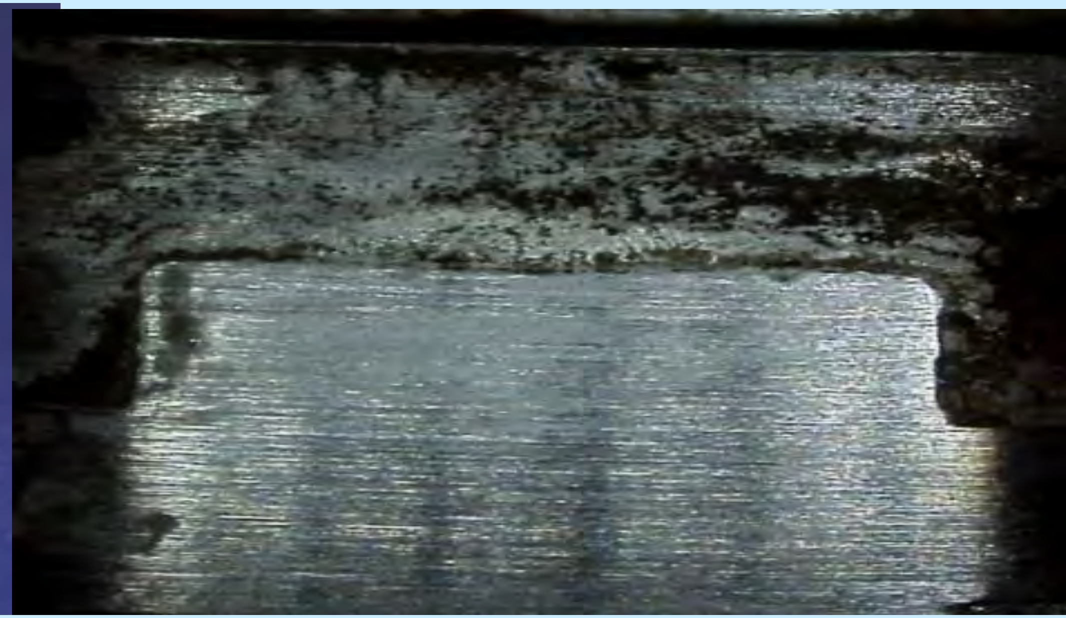
Imprinting

Loss of CoCr

Formation of corrosion products around the taper

Metal on metal Modular acetabular cups – A step to far for modularity?

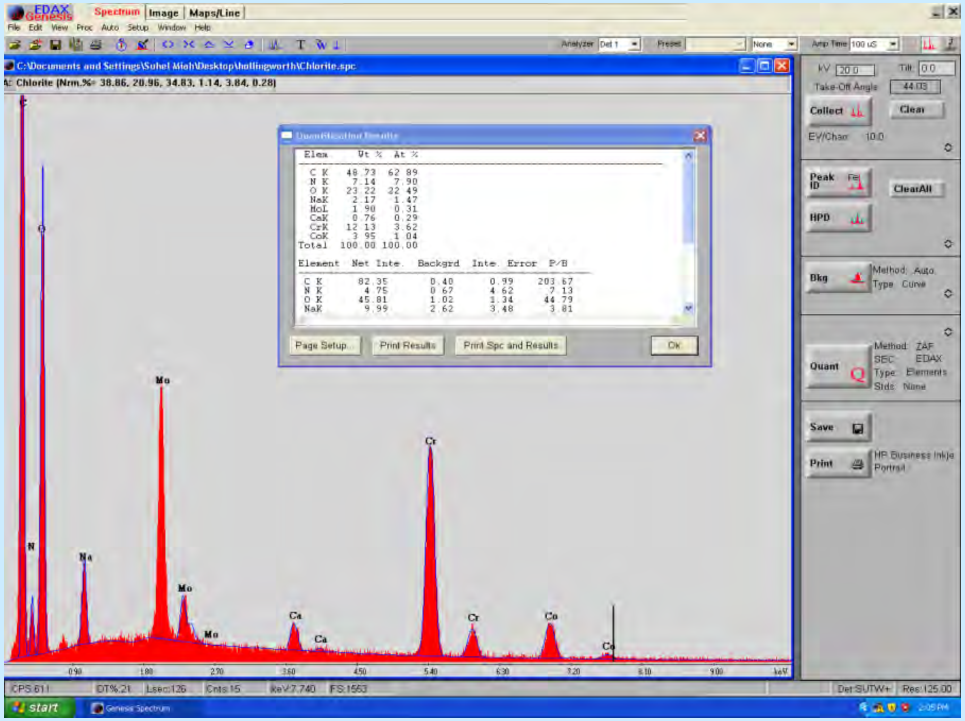
Trunnionosis - Mechanically Assisted Crevice Corrosion



Modular cup insert

MACC around the location lugs on the metal liner

Modular necks - a step to far



Modular femoral necks used in a number of different designs – modularity a step to far

Fig. 4a Fig. 4b Fig. 4c Fig. 4d

Fig. 4e Fig. 4f Fig. 4g Fig. 4h Fig. 4i

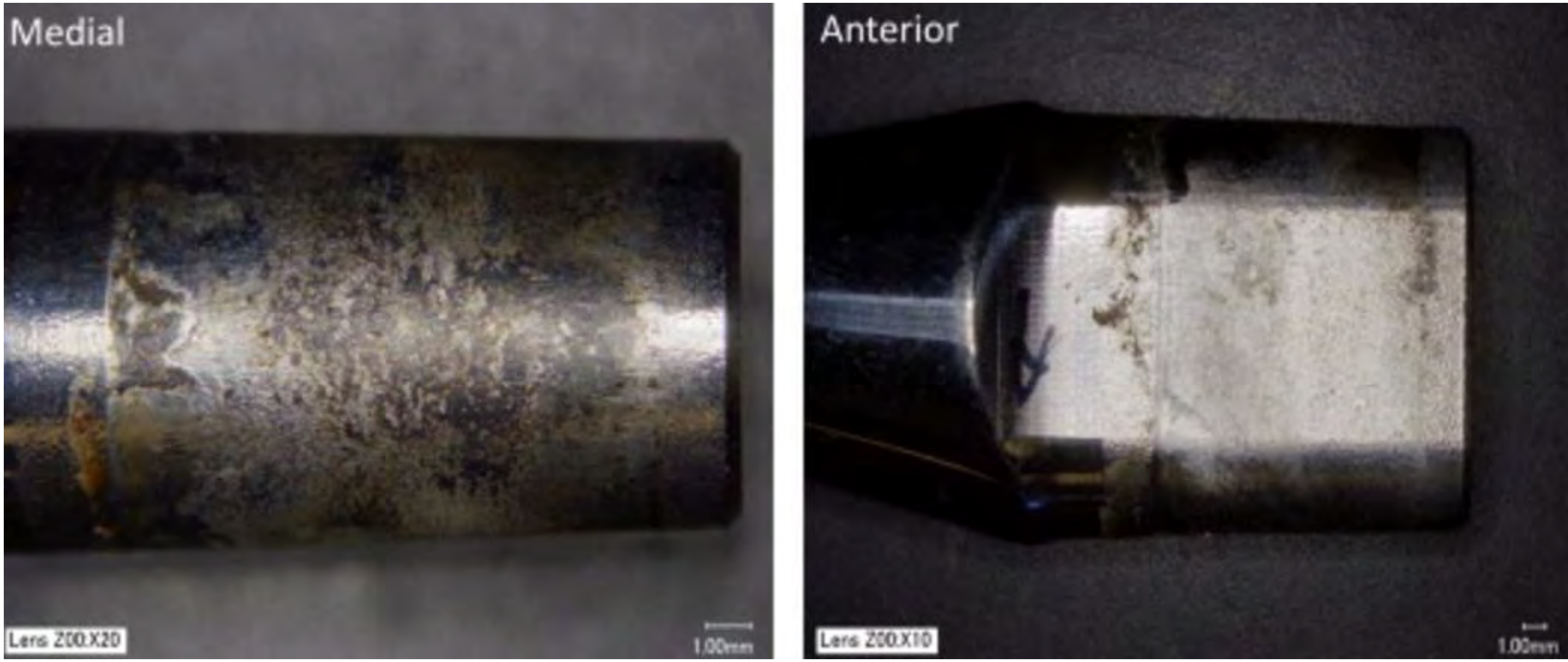
Images showing various examples of modular neck femoral stems: a) DTC Margron modular hip prostheses (Portland Orthopaedics Pty Ltd, Matraville, Australia); b) ABG II (Stryker, Kalamazoo, Michigan); c) Rejuvenate (Stryker); d) Modular supercharged SC (Adler Ortho, Milan, Italy); e) M/L Taper Kinectiv (Zimmer, Warsaw, Indiana); f) ANCA-Fit (Wright Medical Technology, Arlington, Tennessee); g) Profemur E (Wright Medical Technology); h) Profemur Z (Wright Medical Technology); and i) Profemur R (Wright Medical Technology).

Material used and mechanisms of failure for the components of modular-neck hips

		Material[†]		
Prosthesis[*]	**Site of modularity**	**Neck**	**Stem**	**Reasons for failure**
Profemur Z[87]	Neck/stem	Ti6Al4V	Ti6Al4V	F
Metha Short Hip System[76]	Neck/stem	Ti6Al4V	Ti6Al4V	F
Adaptor GHE/s short stem[88]	Neck/stem	CoCr	CoCr	C
DTC Margron[51]	Neck shoulder/stem	CoCr	Ti6Al4V	C
ABG II and Rejuvenate[1]	Neck/stem	CoCr(GADS)	TiMo12Zr6Fe2	C
Alpha II[84]	Neck/stem	CoCr	CoCr	D

F= fracture , C = corrosion D = dissociation

Rejuvenate neck stem junction



- Fretting corrosion greater on the medial and lateral aspects than on the anterior or posterior aspect
  - Fretting scores increased with the length of implantation

Corrosion and Fretting of a Modular Hip System: A Retrieval Analysis of 60 Rejuvenate Stems
De Martino et al. Journal of Arthroplasty 30 (2015) 1470–1475

Adverse Clinical Outcomes in a Primary Modular Neck/Stem System   Restrepo et al The Journal of Arthroplasty 29 Suppl. 2 (2014) 173–178

195 hips with 2 years follow-up (rejuvinate)

56% had no clinical symptoms, 26% had groin pain (typical of corrosion), and 17% had other symptoms.

Cobalt levels were comparable between asymptomatic (3.4 μg/L, range 0.7–7.3 μg/L) and symptomatic patients (4.0 μg/L range 0–13.2 μg/L).

Revision for corrosion was undertaken or scheduled in 13% of the hips

Some modular junctions may not be justified (neck/stem junction)

- Very difficult to justifying complete monoblocks designs
  - Increase in inventory
  - Dislocation?
  - Leg length?
  - Range of motion?
  - Micro separation-increased wear?
  - Stress shielding

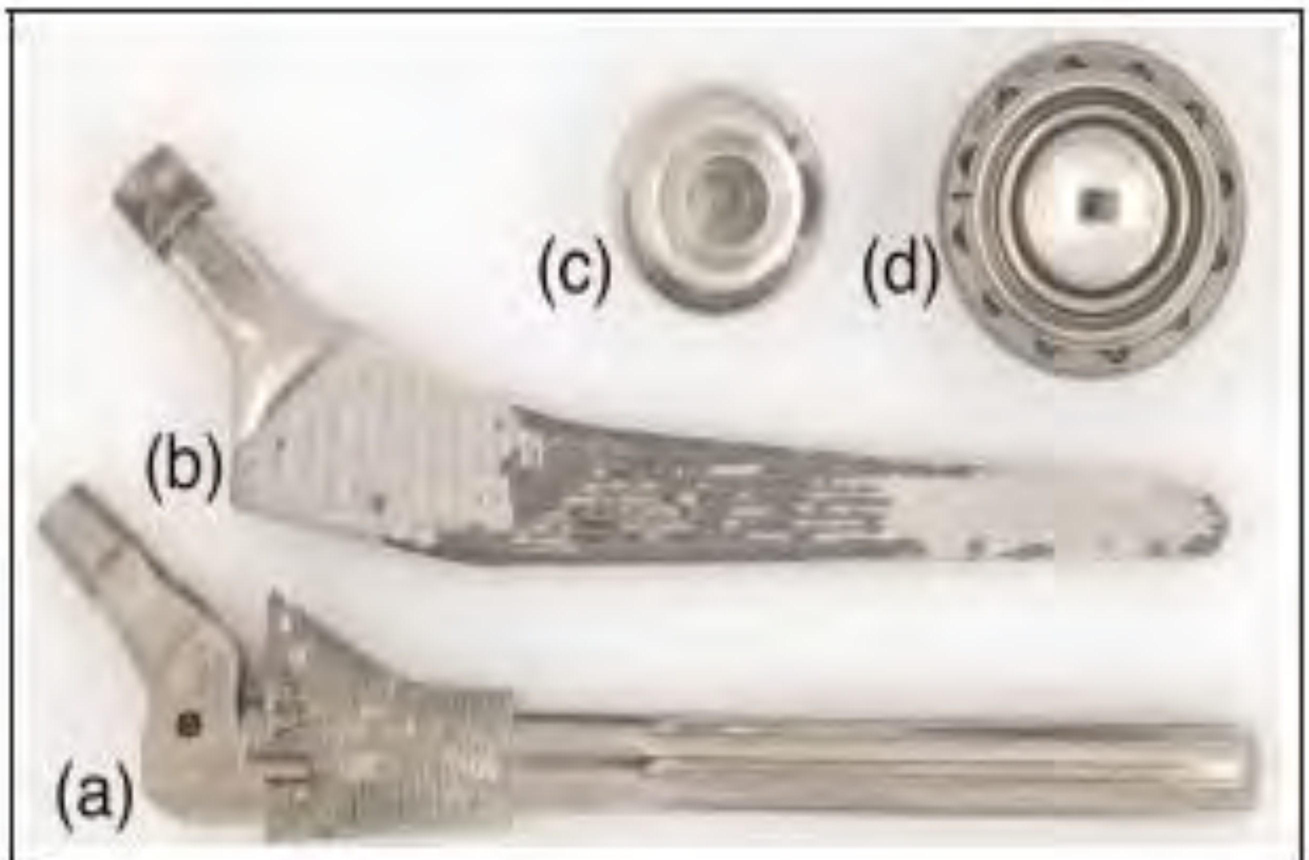
Get the modular interface right

- ***Better preclinical testing of tapers***
- ***Design of tapers***
- ***Surgical Techniques***

The importance of taper design

Design of the taper effects MACC

Panagiotidou A, Meswania J, Hua J, Muirhead-Allwood S, Hart A, Blunn G. Enhanced wear and corrosion in modular tapers in total hip replacement is associated with the contact area and surface topography. J Orthop Res. 2013 Dec;31(12):2032-9.



S-rom 11/13 larger engagement - smooth
Corail 12/14 small engagement- rough

•10 Million Cycle Loading Test

•Based on the ISO standards for fatigue testing
Implants for surgery - Partial and total hip joint prostheses – ISO 7206 Part 4:
Endurance Performance of stemmed femoral components with application of torsion

Test 1

12/14 rough small spigot (n =3).
12/14 rough standard spigot (n = 3).

Same finish male taper : different engagement length

Test 2

small spigot - male taper -smooth finish (n=3)
small spigot- male taper – rough finish (n= 3)

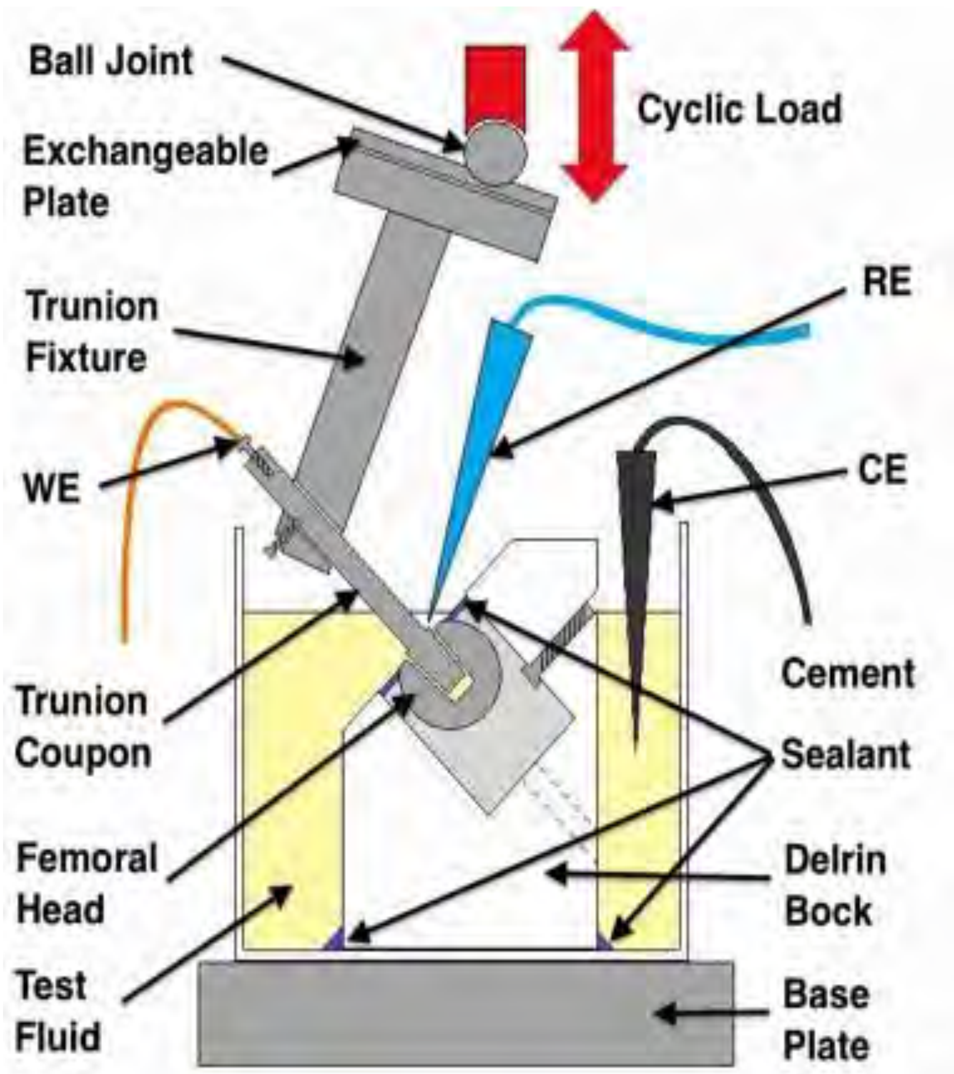
Same engagement : different finish male taper

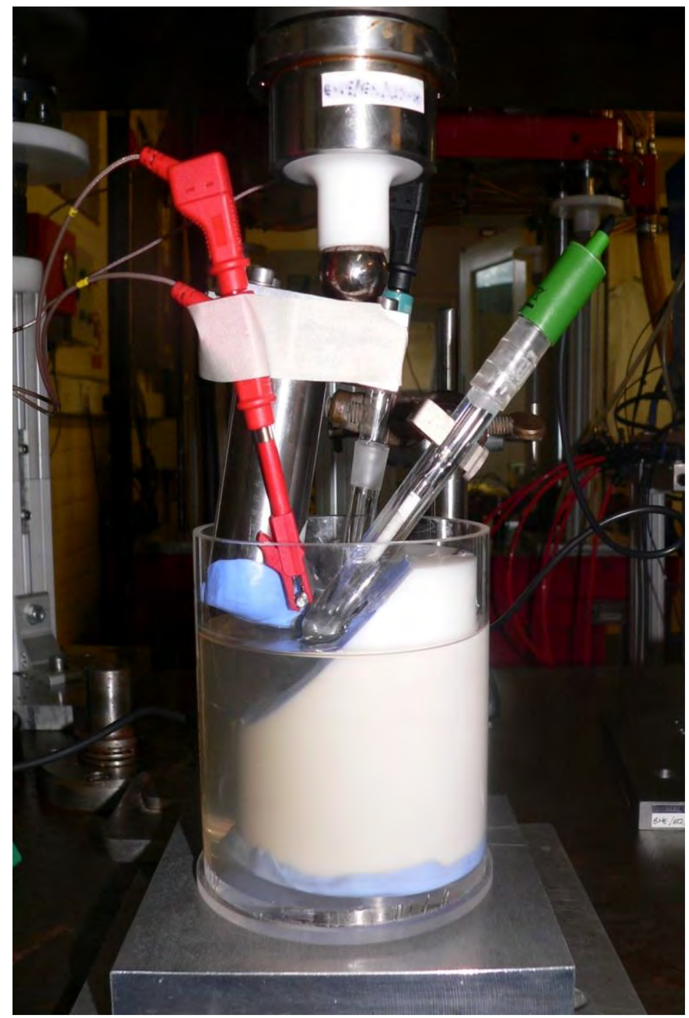
•Monitored Corrosion Current in a short term cyclic loading test

•ASTM F1875: Standard practice for testing modular implant interfaces: Hip femoral head bore and cone taper interface. Short term cyclic tests where the corrosion current between the head and trunion were measured.

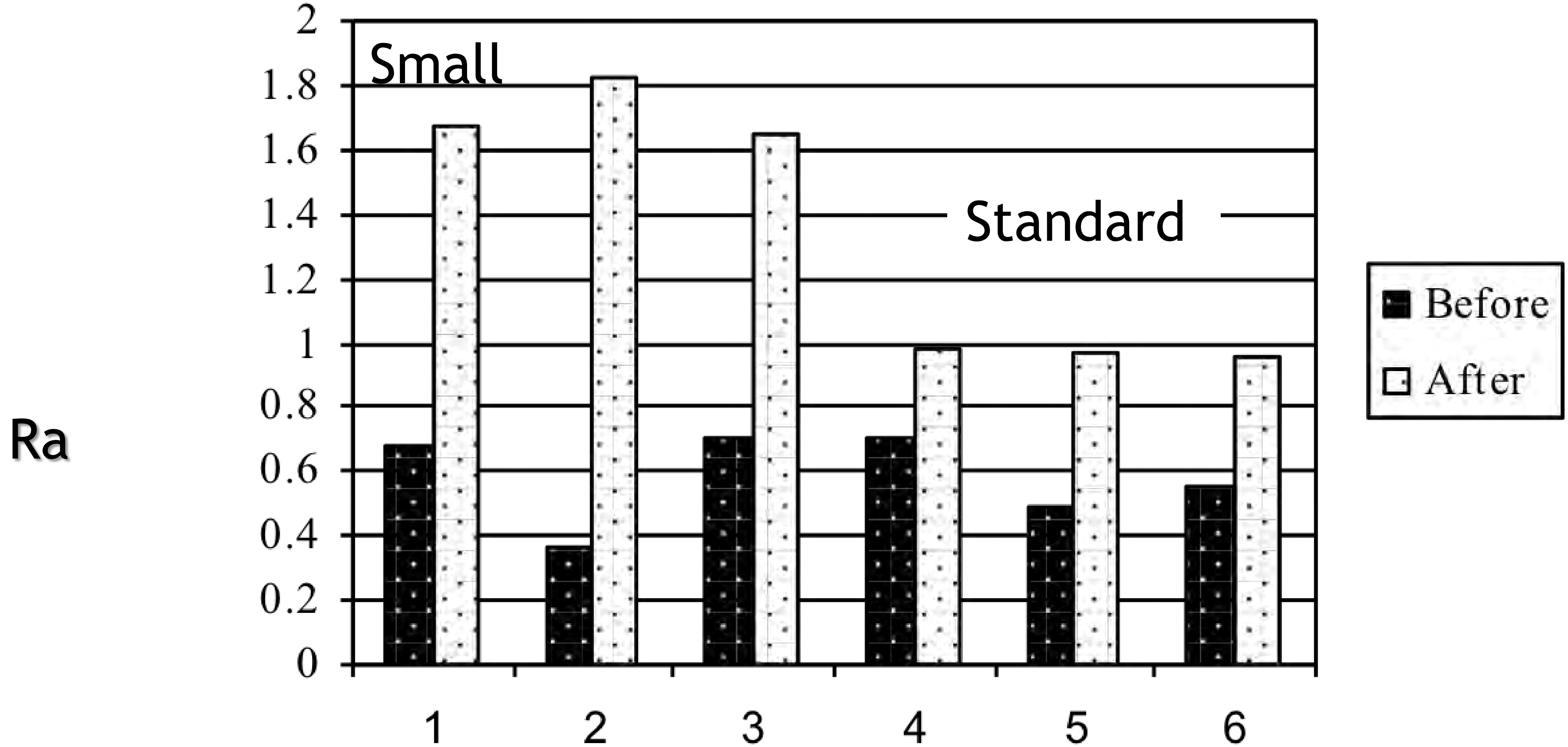
Preclinical in vitro testing to measure taper wear and corrosion

Standard Practice for Fretting Corrosion Testing of Modular Implant Interfaces (ASTM F1875-98)





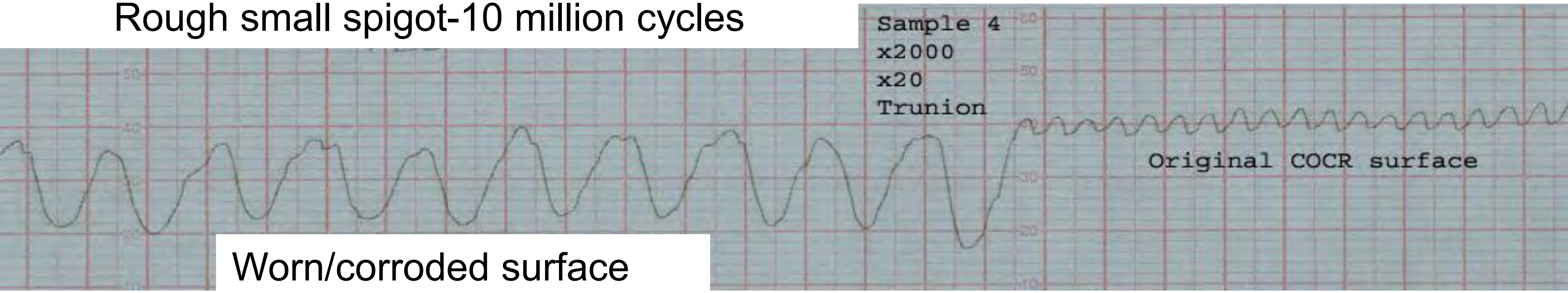
Test 1 :Same finish : different engagement length



roughness was greater in the small spigot group with higher Ra values (1.65-1.83 μm), compared to the standard spigot group (0.96-0.98 μm). The male tapers showed negligible difference before and after testing in all specimens.

Imprinting

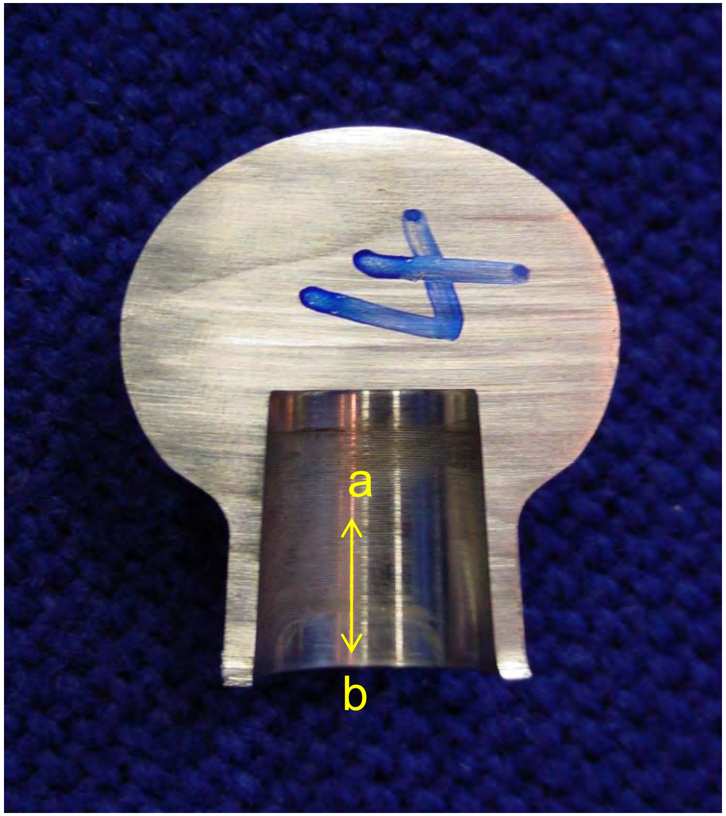
Rough small spigot-10 million cycles

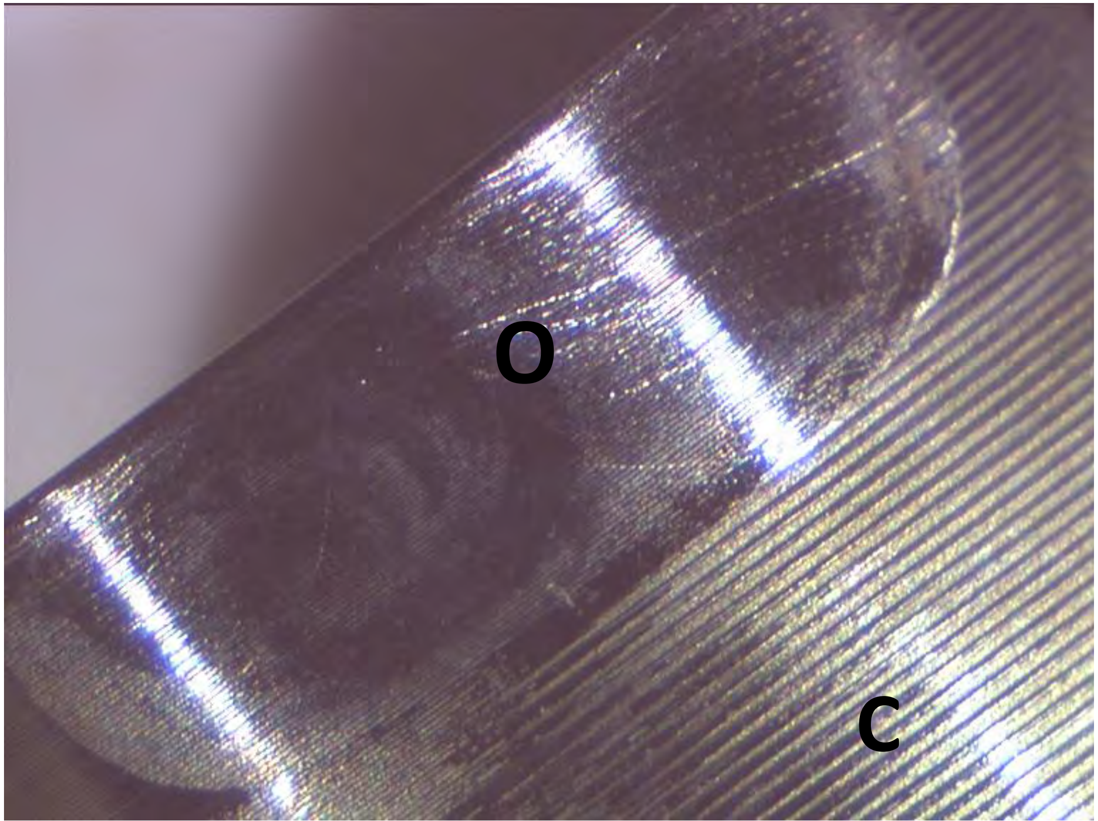


Worn/corroded surface

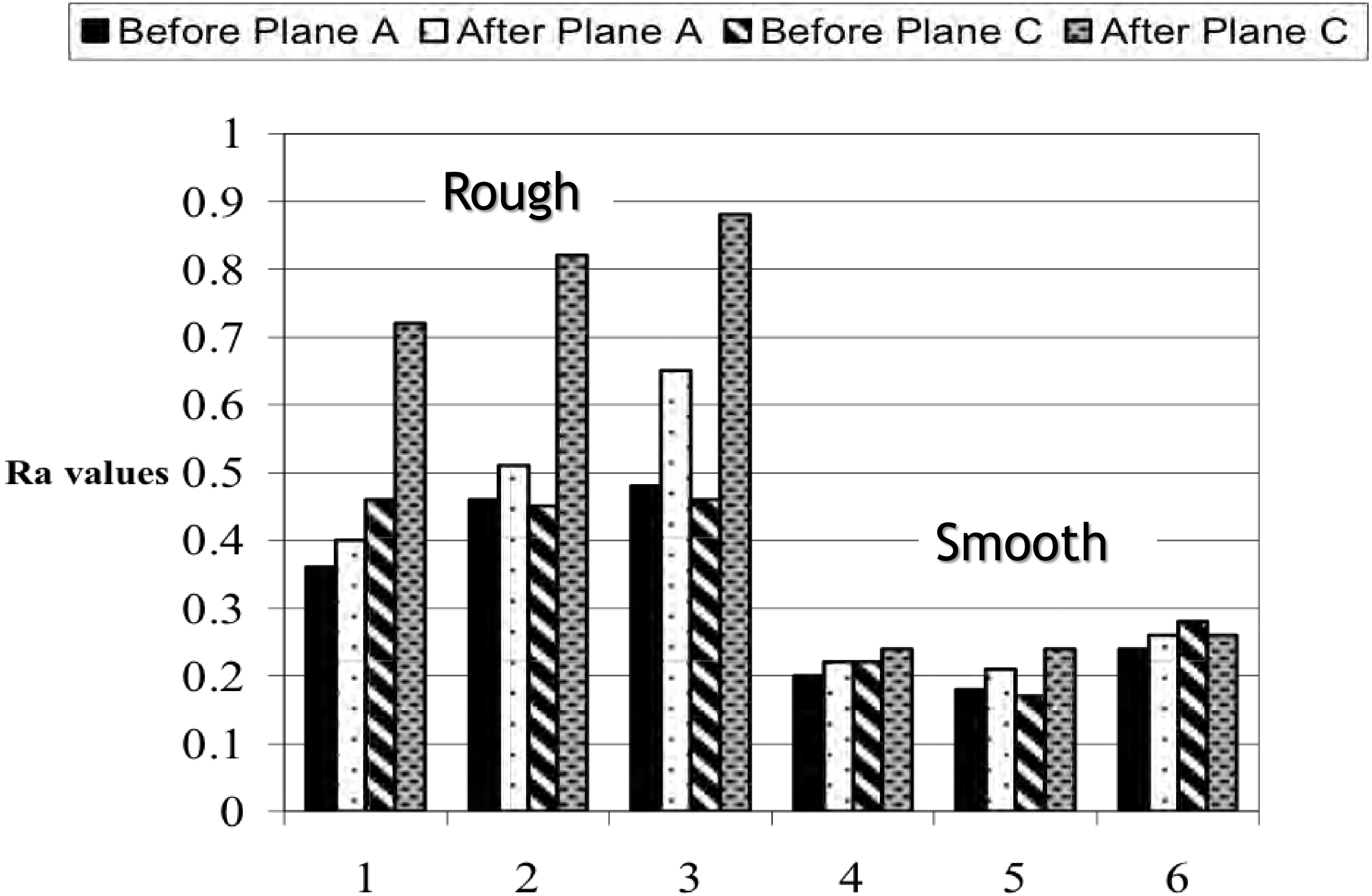
a

b





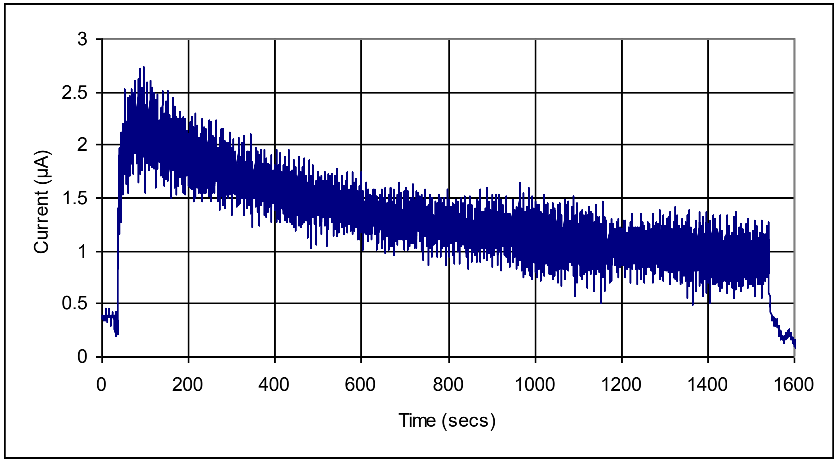
Same small spigot : different finish



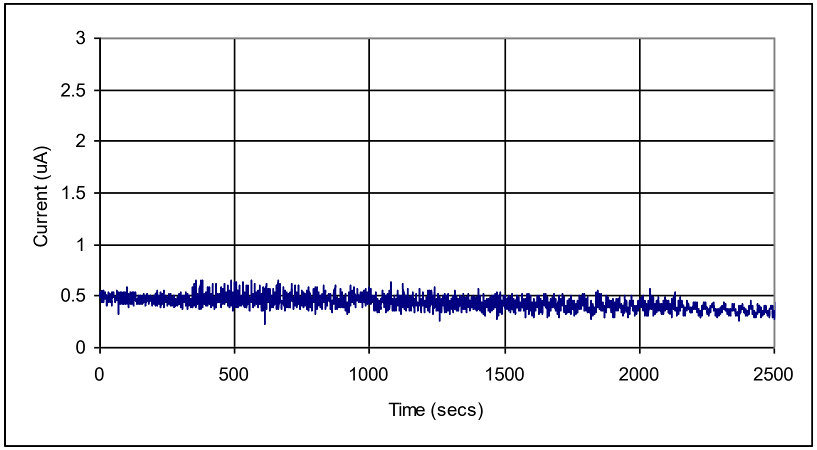
Specimens 1-3 rough minispigots and 4-6 were the smooth minispigots.
Greater wear with rough minispigots.
Plane C superior plane - Plane A 90^0 to this.
Difference in the region of corrosion.

Potentiostatic Tests –
Current response of loading at applied potential of 200mV

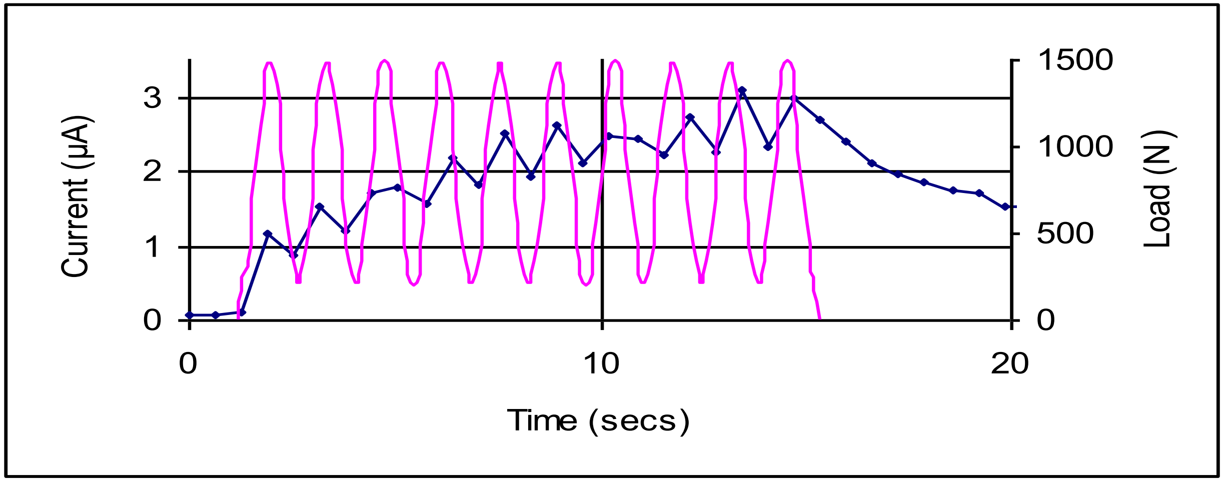
small spigot coarse finish on taper



small spigot smooth finish on taper

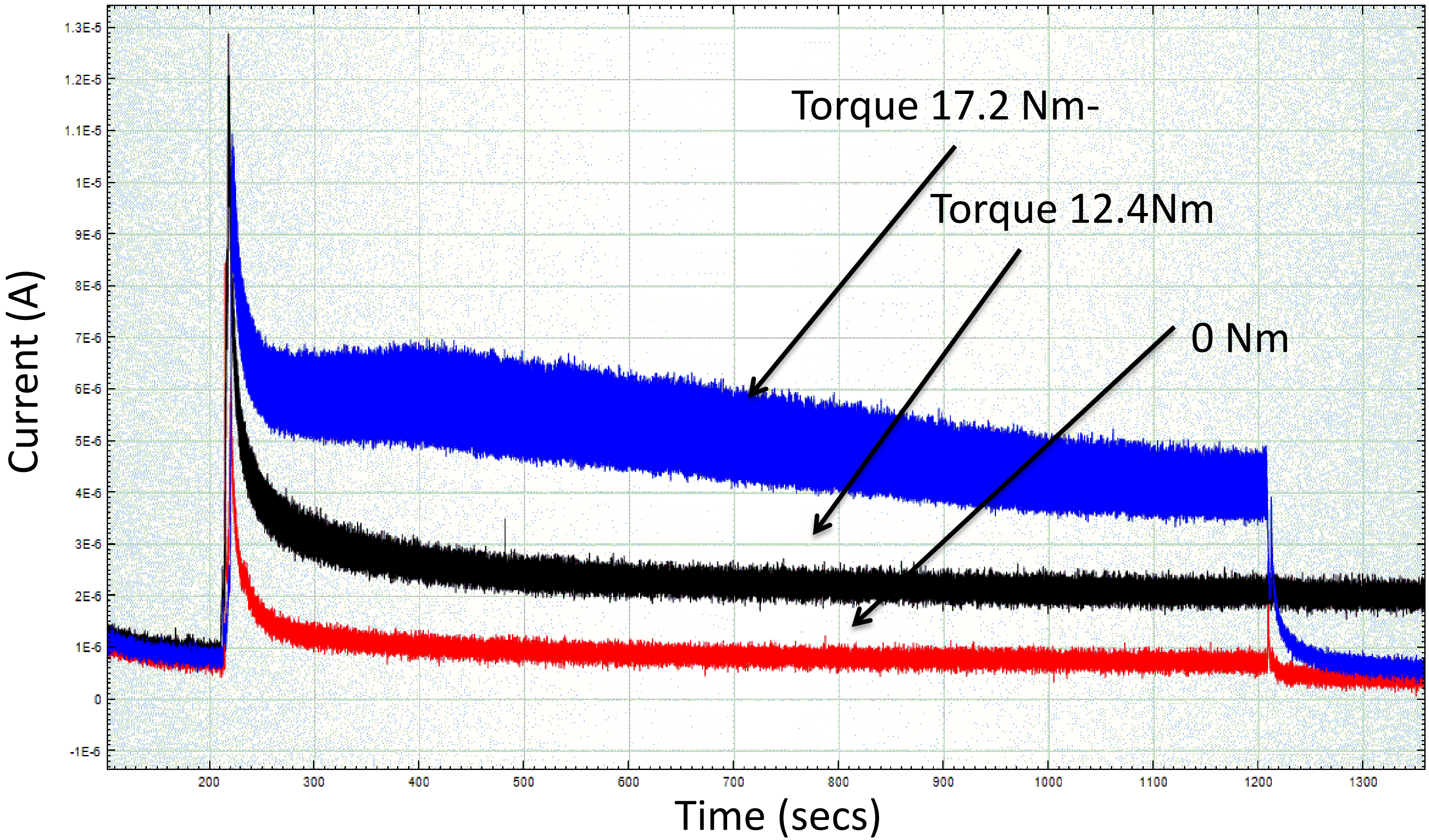


small spigotCurrent for 10 cycles of load



An implant alloy will spontaneously form a protective oxide layer on its surface and acts as a semiconductor in the circuit, and therefore if this layer is damaged or removed a spike in the current will be observed.

Increased Torque effects MACC
Cobalt chrome head/Ti stem



Panagiotidou A, Meswania J, Osman K, Bolland B, Latham J, Skinner J, Haddad FS, Hart A, Blunn G. The effect of frictional torque and bending moment on corrosion at the taper interface : an in vitro study. Bone Joint J. 2015Apr;97-B(4):463-72.

Surgical technique can influence MACC?

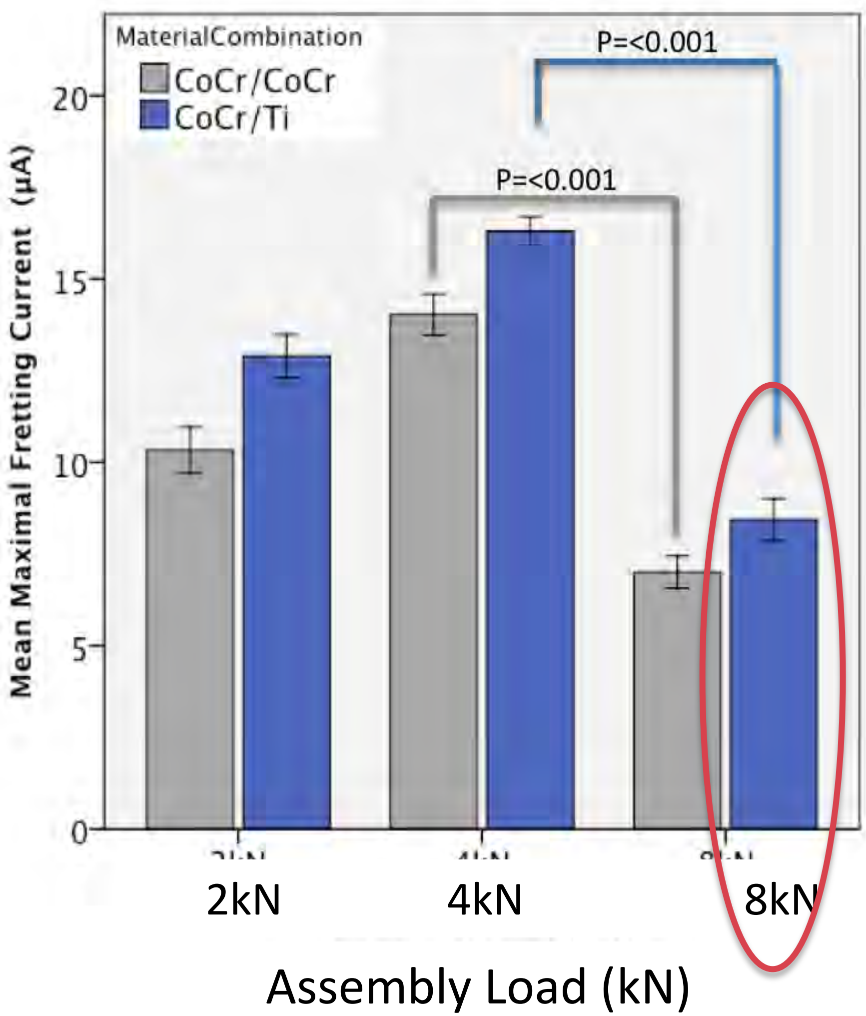
Investigated Impaction force at 2,4 and 8 kN in
Short rough tapers (worst case scenario)
Smooth tapers with longer engagement lengths

CoCr heads Ti alloy stems
CoCr heads CoCr stems

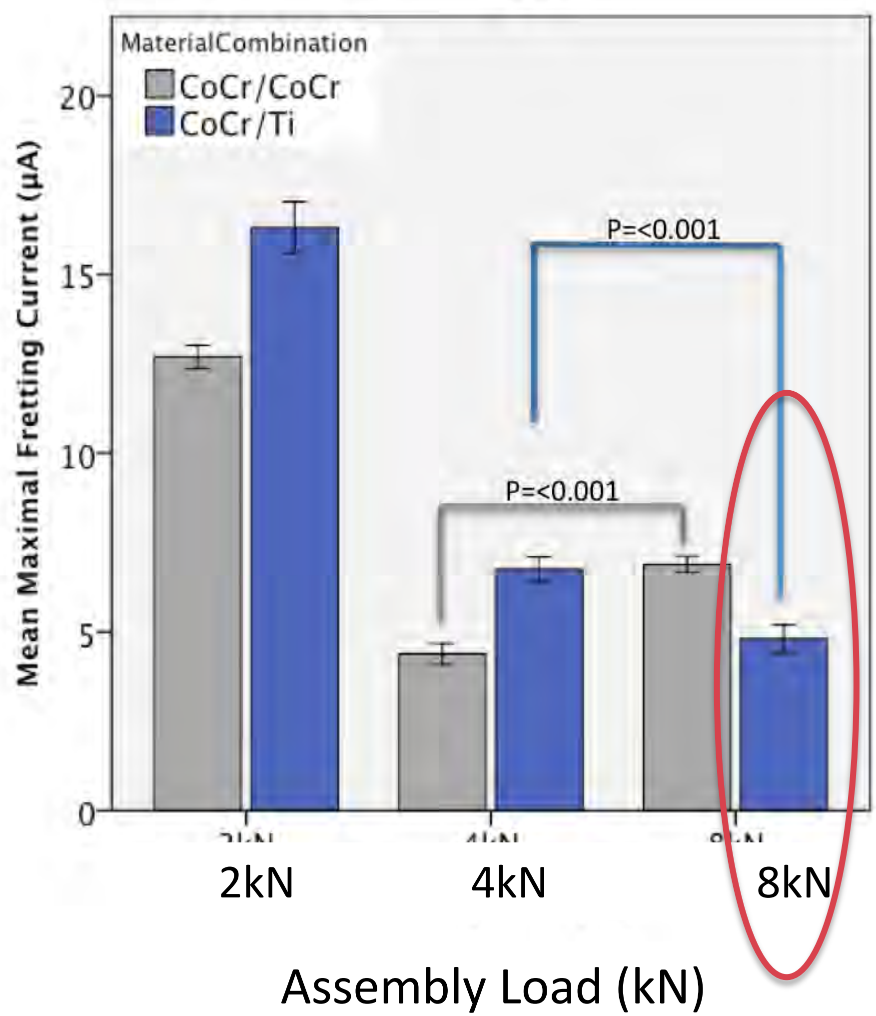
Short Term – 1000 Cycles

Effects of assembly load on fretting currents depends on taper design

Rough-Short



Smooth-Standard



Conclusions

•Very difficult to justify going back to monoblocks designs

• Inventory and also performance

• However some modular junctions may be a step to far

Get the modular interface right

Better preclinical testing of tapers

Design of tapers

Surgical Techniques

LIRC
London Implant Retrieval Centre

-Thank you-

Acknowledgements

- Alister Hart
- John Skinner
- Anna Panagiotidou
- Harry Hothi
- Jay Meswania
- Tim Cobb
- Sarah Muirhead-Allwood
- Fares Haddad
- Ben Bolland
- Jeremy Latham

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INTERNATIONAL COMBINED MEETING:
BRITISH HIP SOCIETY – SOCIETÀ ITALIANA DELL’ANCA

26-27 NOVEMBER 2015 MILAN, ITALY

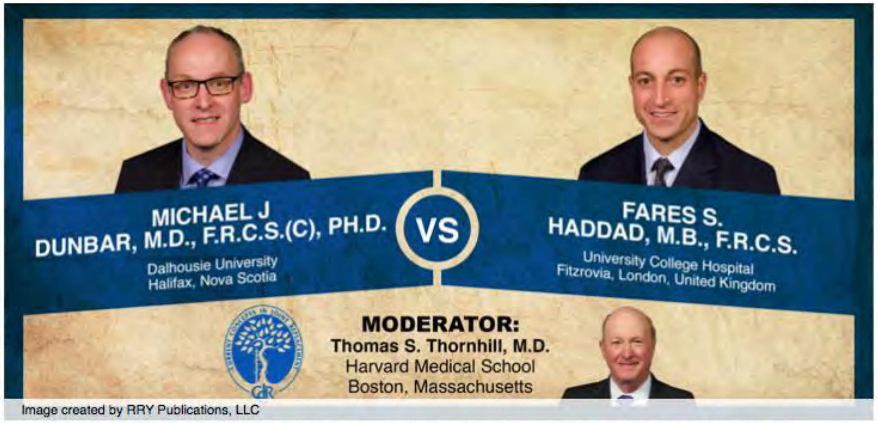
CROSS-FIRE
Femoral neck modularity: still justified?

P. Cavaliere - F. De Meo

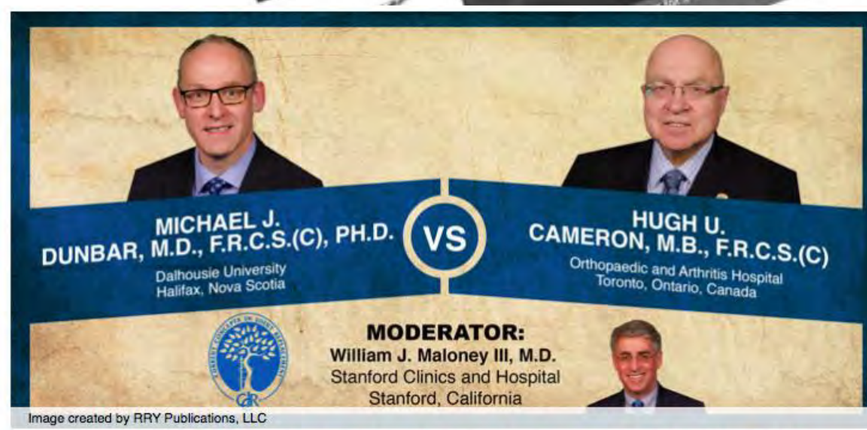
Institute GIOMI “ F. Faggiana”, Reggio Calabria – “F. Scalabrino”, Messina ITALY

FINANCIAL DISCLOSURE

- Dr. Cavaliere Pietro
  - Lima Coorporate: consultant
  - Gruppo Bioimpianti: royalties for implants design
  - Biomet / Zimmer: consultant
- Dr. De Meo
  - none declared



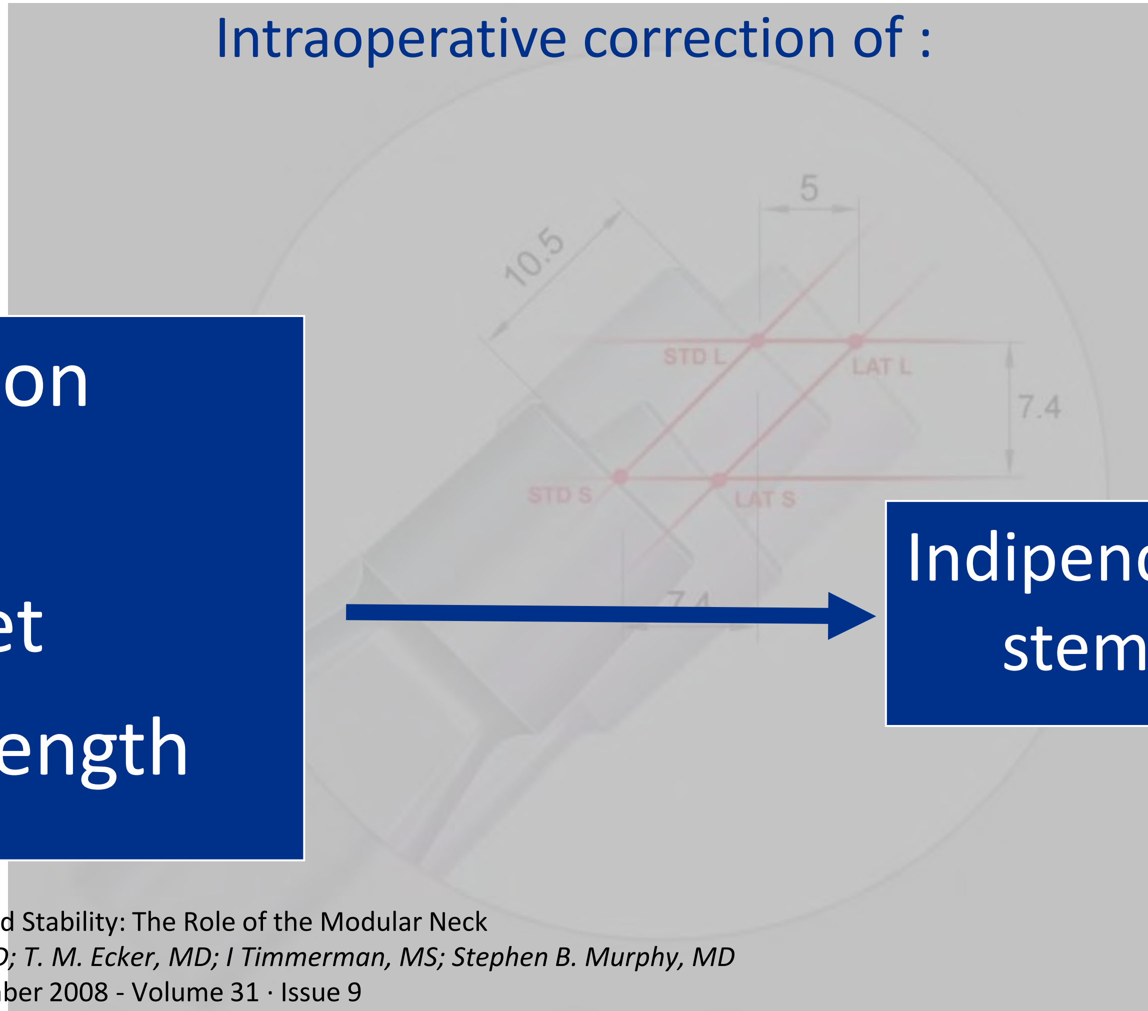
DUNBAR, HADDAD DEBATE FEMORAL NECK MODULARITY IN PRIMARY THA



DUNBAR, CAMERON DEBATE MODULAR NECKS

Why modular necks ?

Intraoperative correction of :



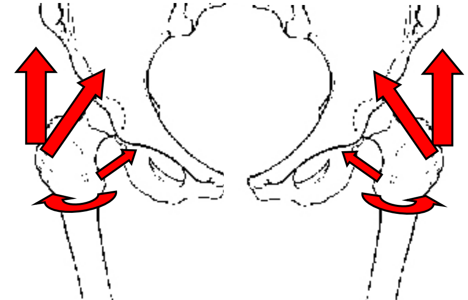
- Version
- CCD
- Offset
- Leg length

→ Indipendently of stem fixation

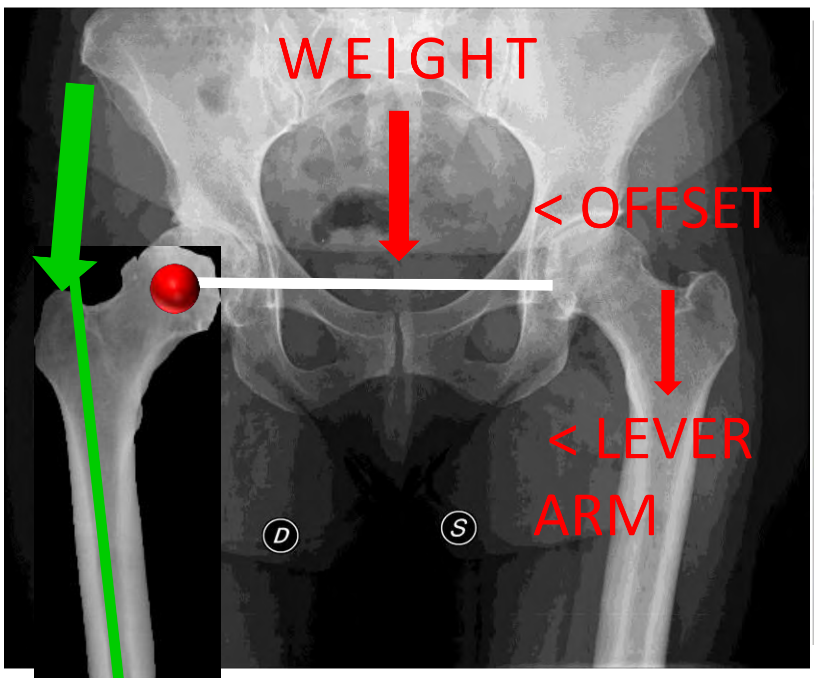
Managing Length and Stability: The Role of the Modular Neck
S. D. Steppacher, MD; T. M. Ecker, MD; I Timmerman, MS; Stephen B. Murphy, MD
Orthopedics September 2008 - Volume 31 · Issue 9

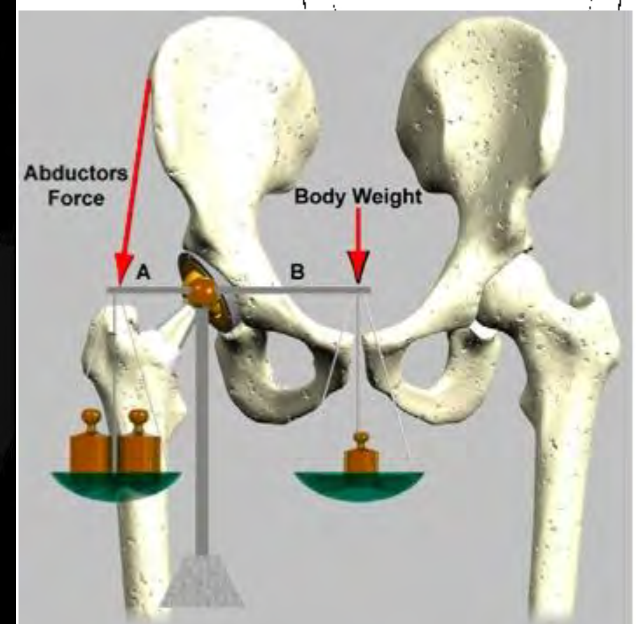
Why modular necks ?

- The hip muscles work on a rotation center
- Each muscle works on a specific lever arm



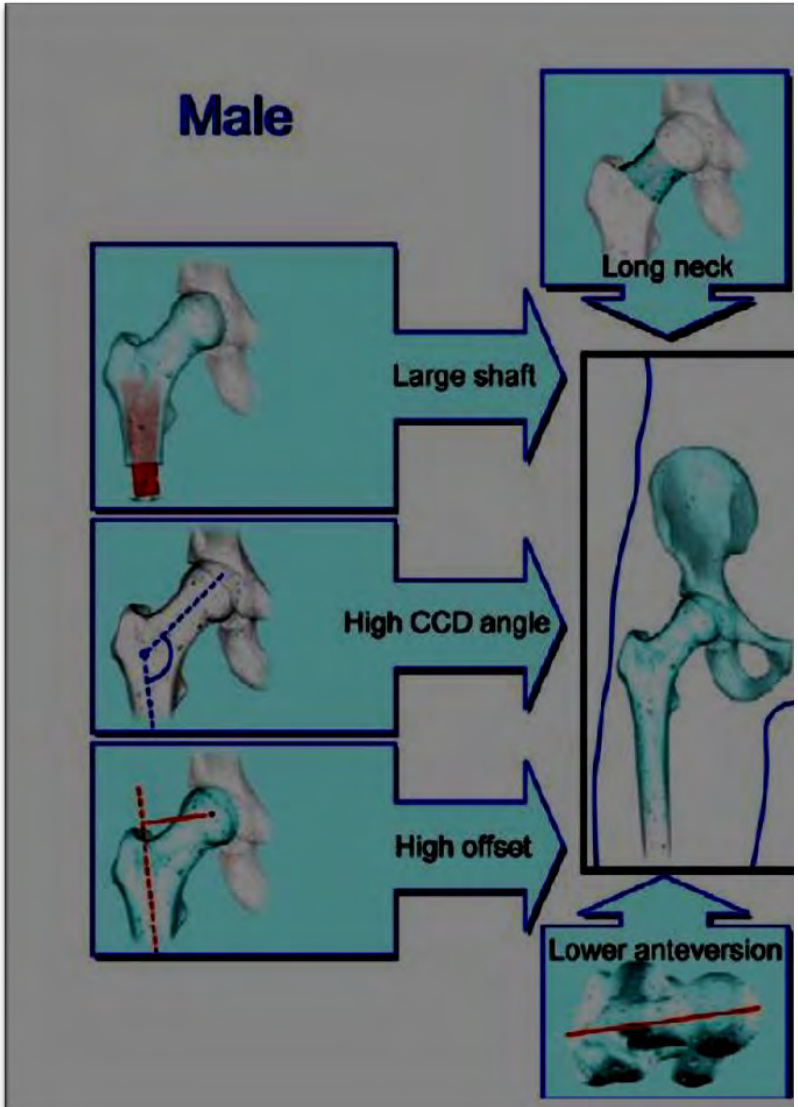
LEVER ARM





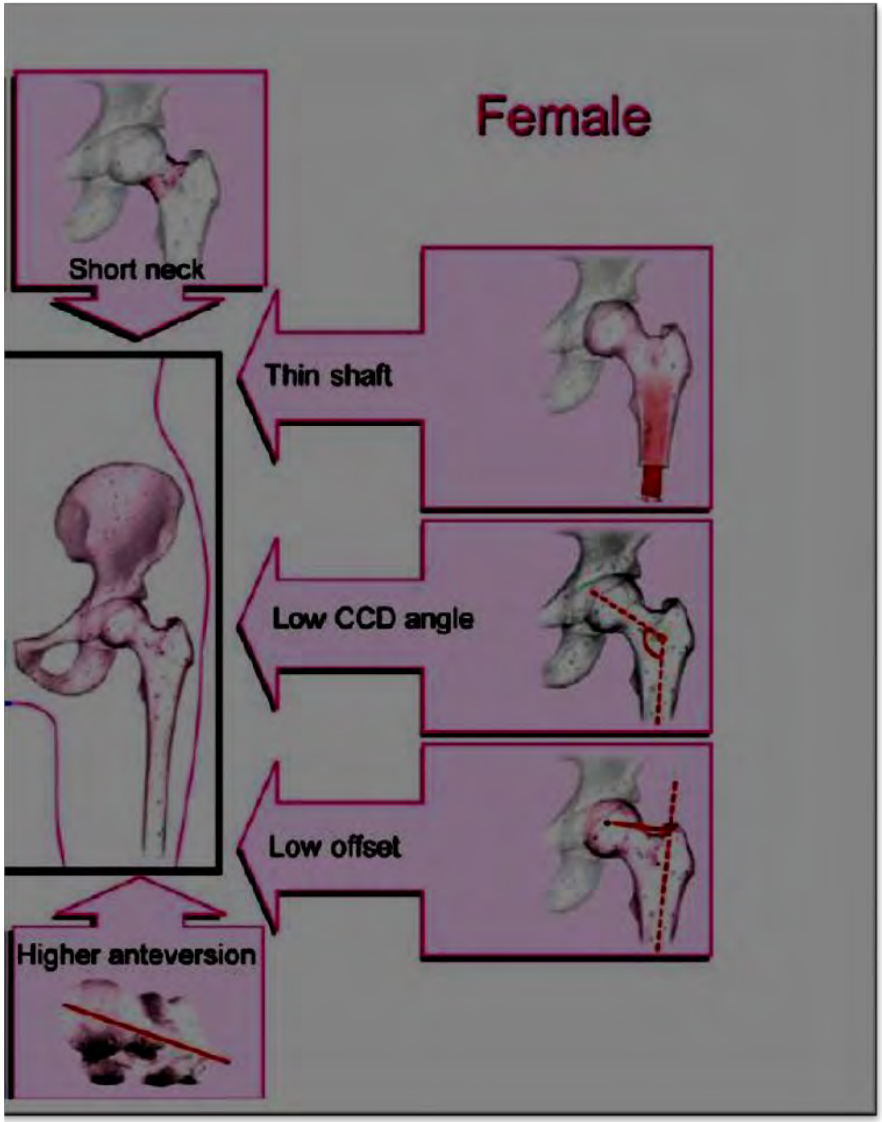
Proximal femur: high anatomical variability

1. Offset: 27-57mm (Davey J.R. AAOS 2003)
2. CCD angle : 105.7° - 154.5° (Noble P.C. CORR 1988)
3. Low correlation upper femur with canal. (Noble P.C. CORR 1988)
4. Significant anatomy differences between male and female anatomy (Wang SC, Ass.Ad.Autom.med, 2004; Traina F, JBJS 2009)



1. Wider inner canal
2. High CCD angle
3. Long femoral neck
4. Increased offset
5. Less antetorsion

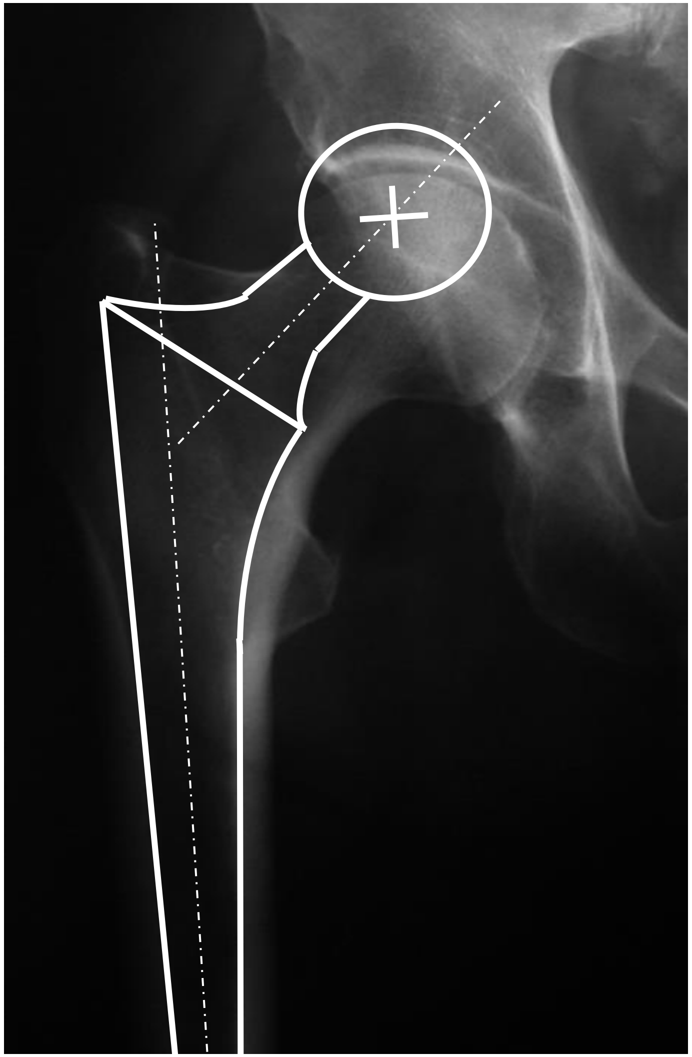
Sex Differences in Hip Morphology: is stem modularity effective for THA?
F. Traina, M. De Clerico, F. Biondi, F. Pilla, E.Tassinari, A. Toni. *JBJS Am. 2009;91: 121-128*



1. Narrower inner canal
2. Low CCD angle
3. Short femoral neck
4. Less offset
5. Higher antetorsion

Sex Differences in Hip Morphology: is stem modularity effective for THA?
F. Traina, M. De Clerico, F. Biondi, F. Pilla, E.Tassinari, A. Toni. *JBJS Am. 2009;91: 121-128*

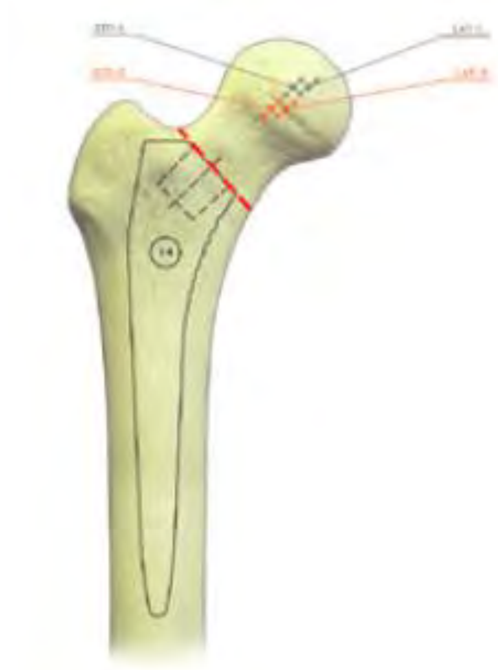
Monoblock stem limitations



- Patient's anatomy is forced to implant design
- Decentered femoral canal preparation for proper version
- Lengthening is needed to obtain stability
- Lever-arm alteration
- To adjust offset different implants are required
- ROM may result reduced
- Higher impingement risk

Combination of pre-operative planning and intraoperative modularity is our gold standard

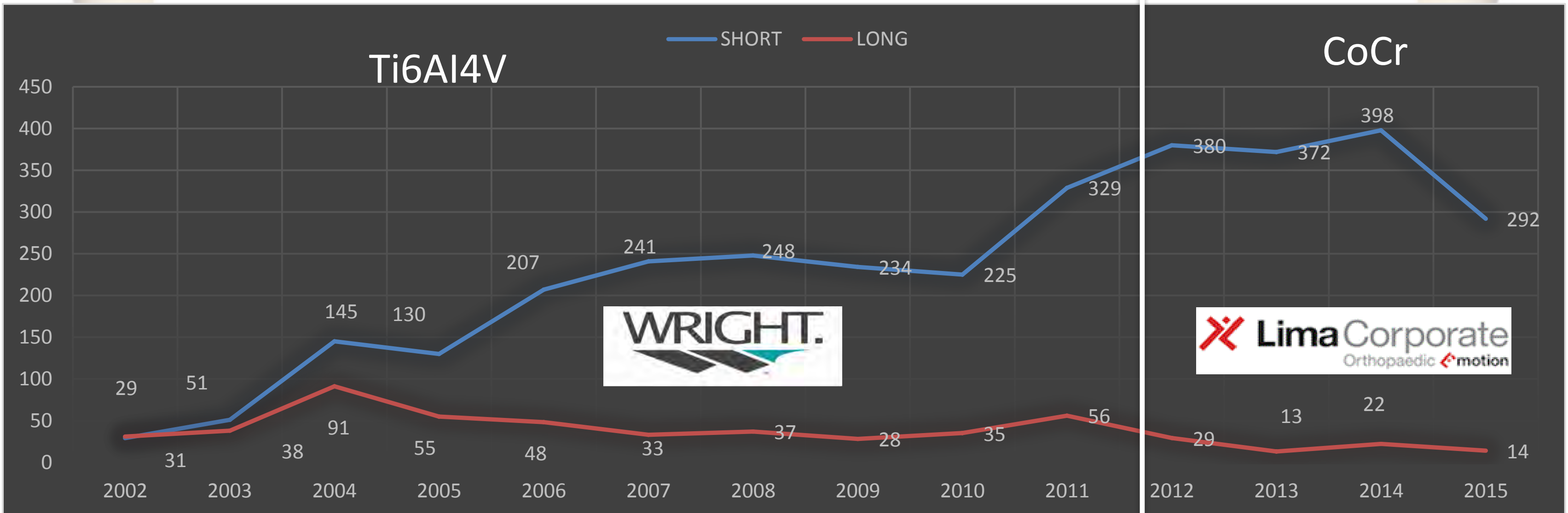
- Proximal femur and/or pelvic deformities
- Flexion contractures
- General or regional anesthesia



MATERIALS AND METHODS

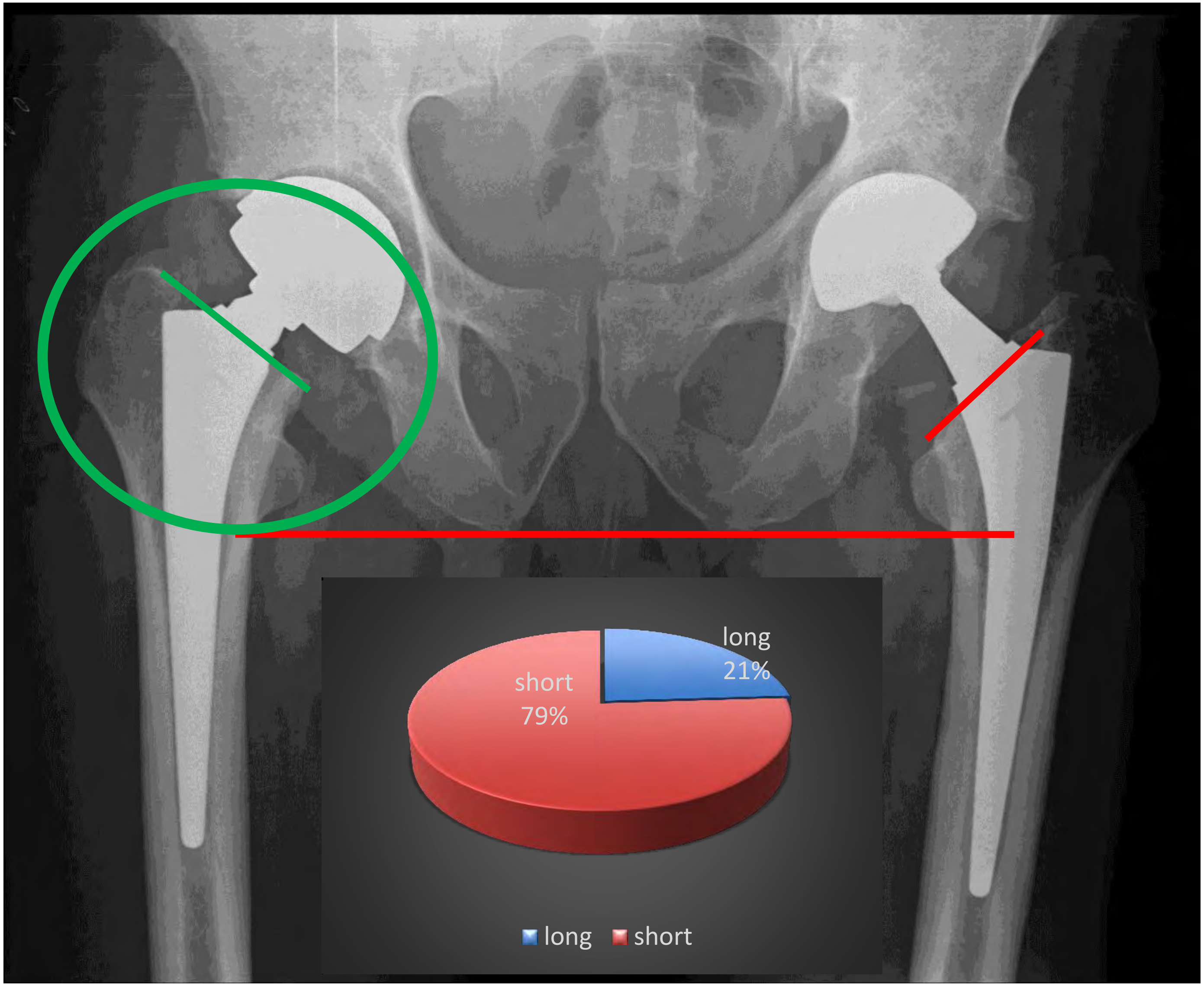
Our experience with modular necks starts in 2002

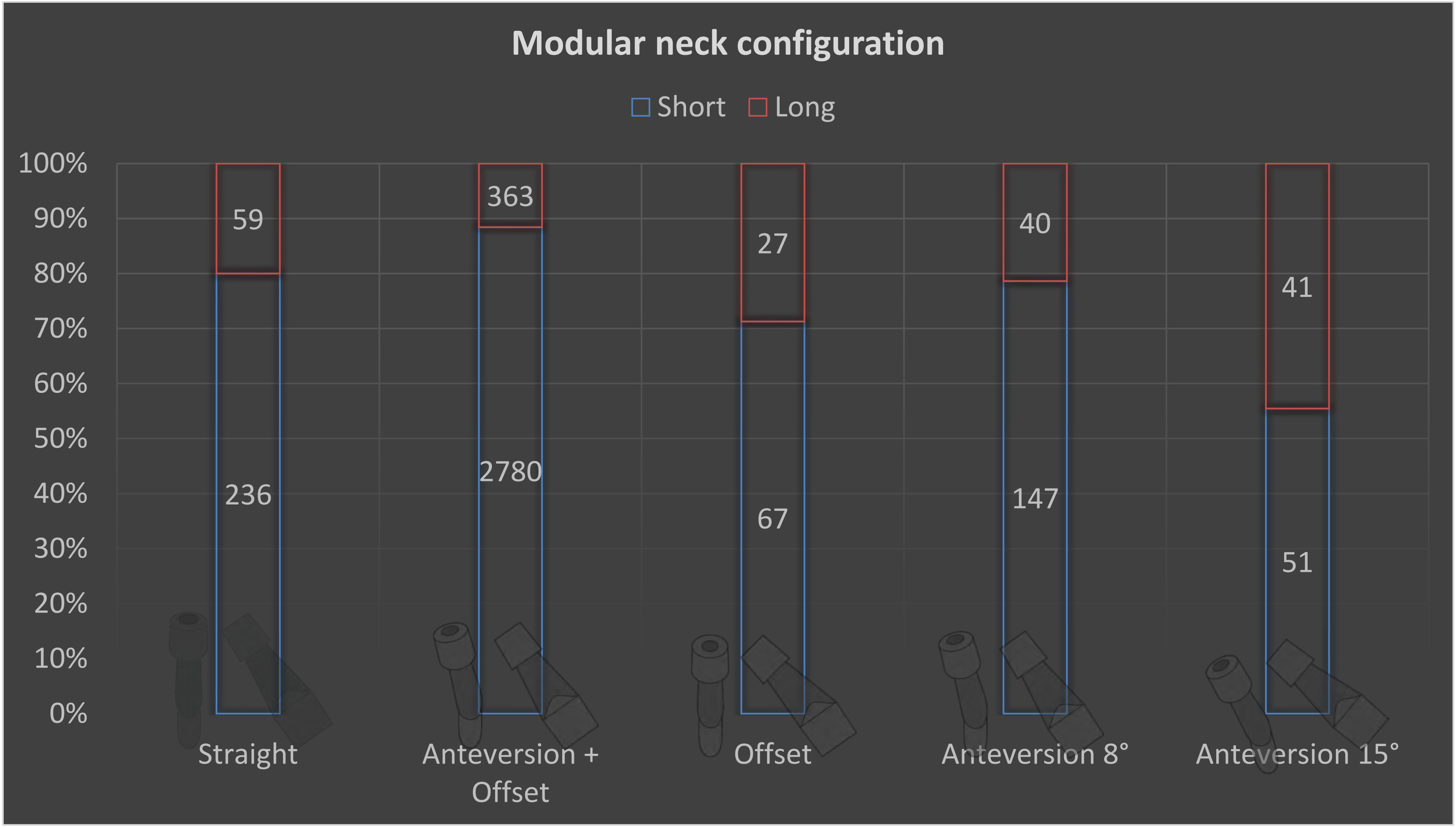
3811 modular neck



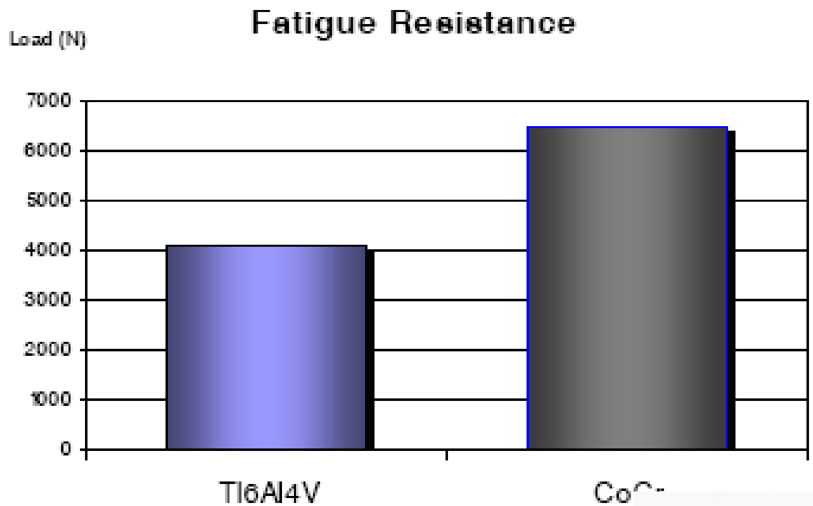
2725

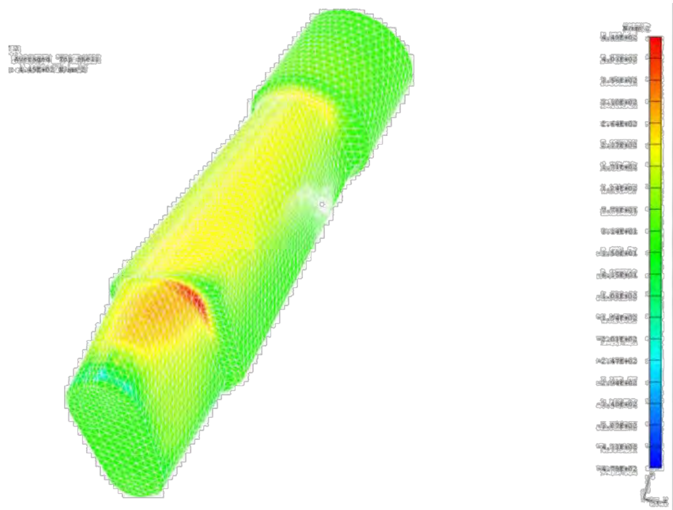
1086

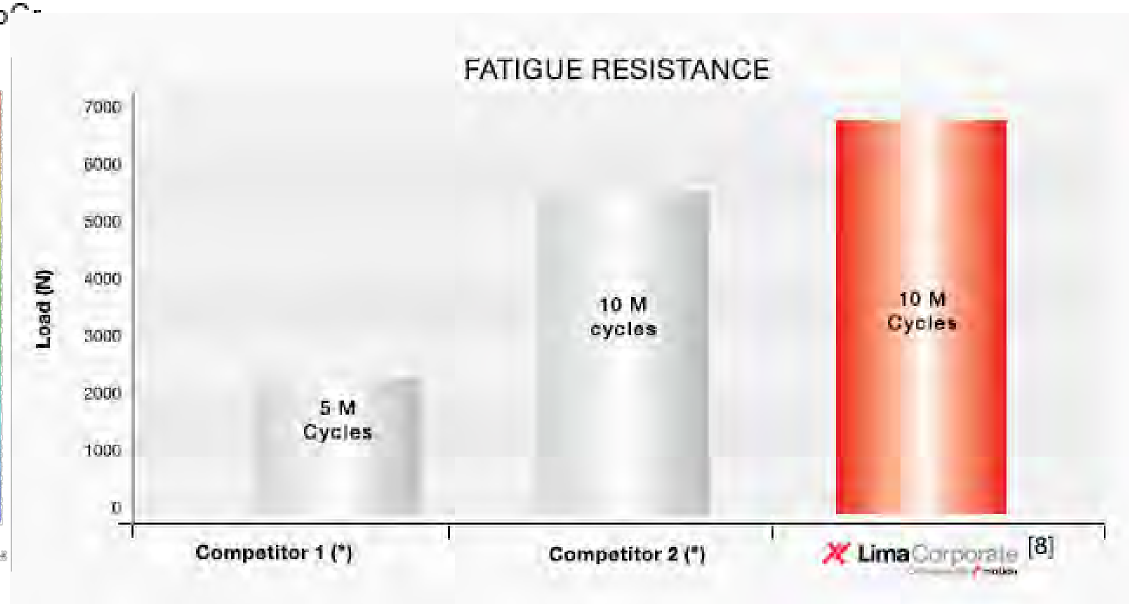

long
21%
short
79%
long
short



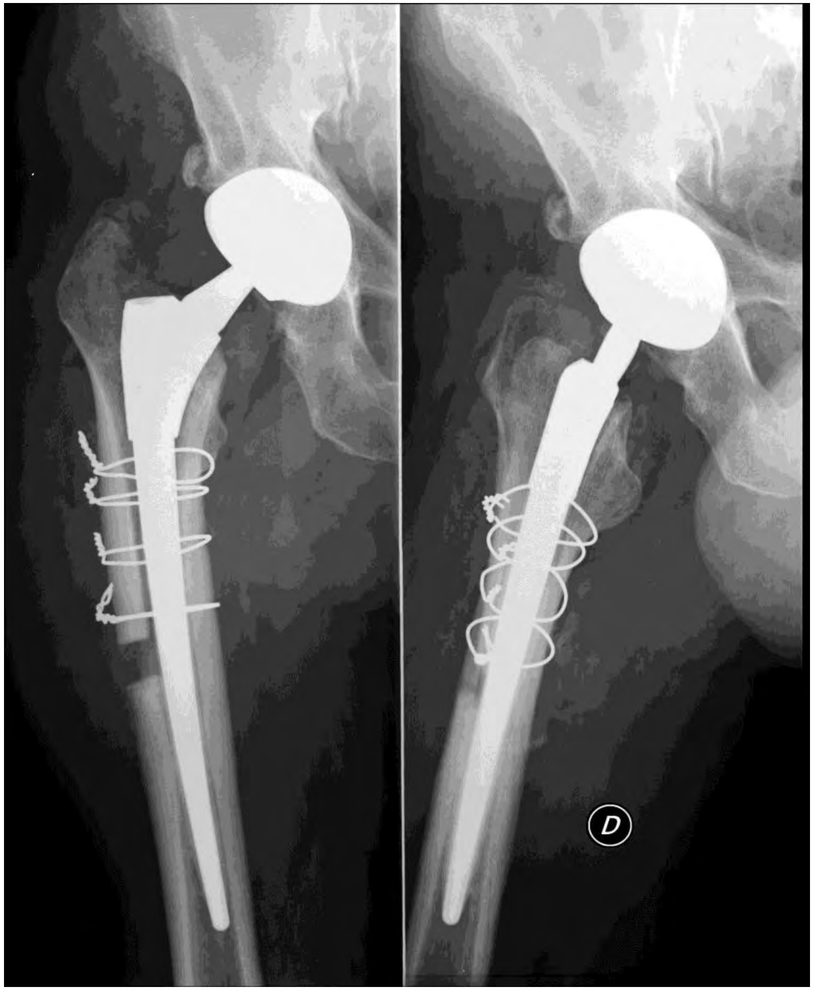
72,9% of necks used between 2002-2015 were short anterverted and with offset





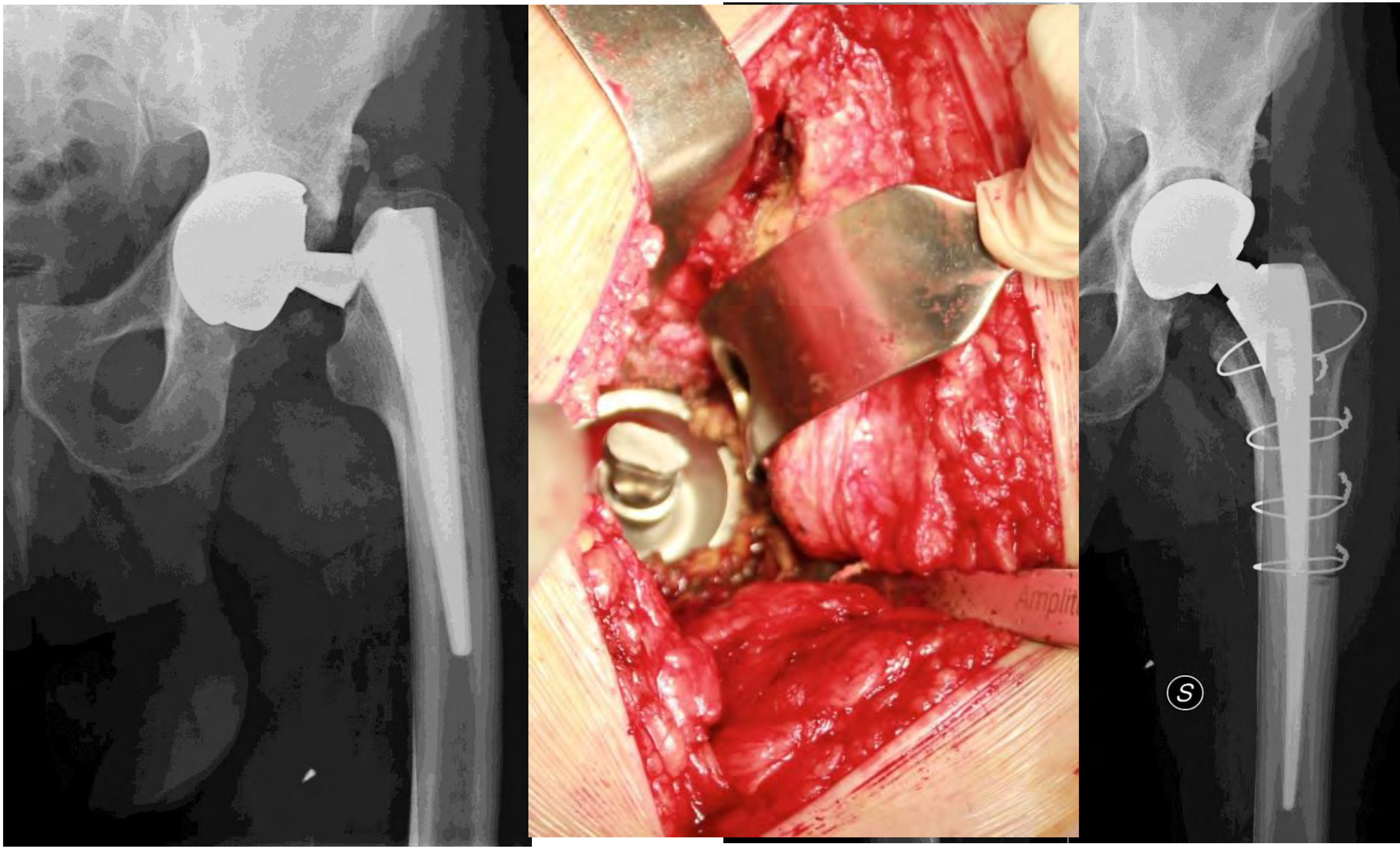


J Orthop Res. 2013 Aug;31(8):1165-71. doi: 10.1002/jor.22354. Epub 2013 Apr 1.
Micromotions at the taper interface between stem and neck adapter of a bimodular hip prosthesis during activities of daily living.
Jauch SY1, Huber G, Sellenschloh K, Haschke H, Baxmann M, Grupp TM, Morlock MM.



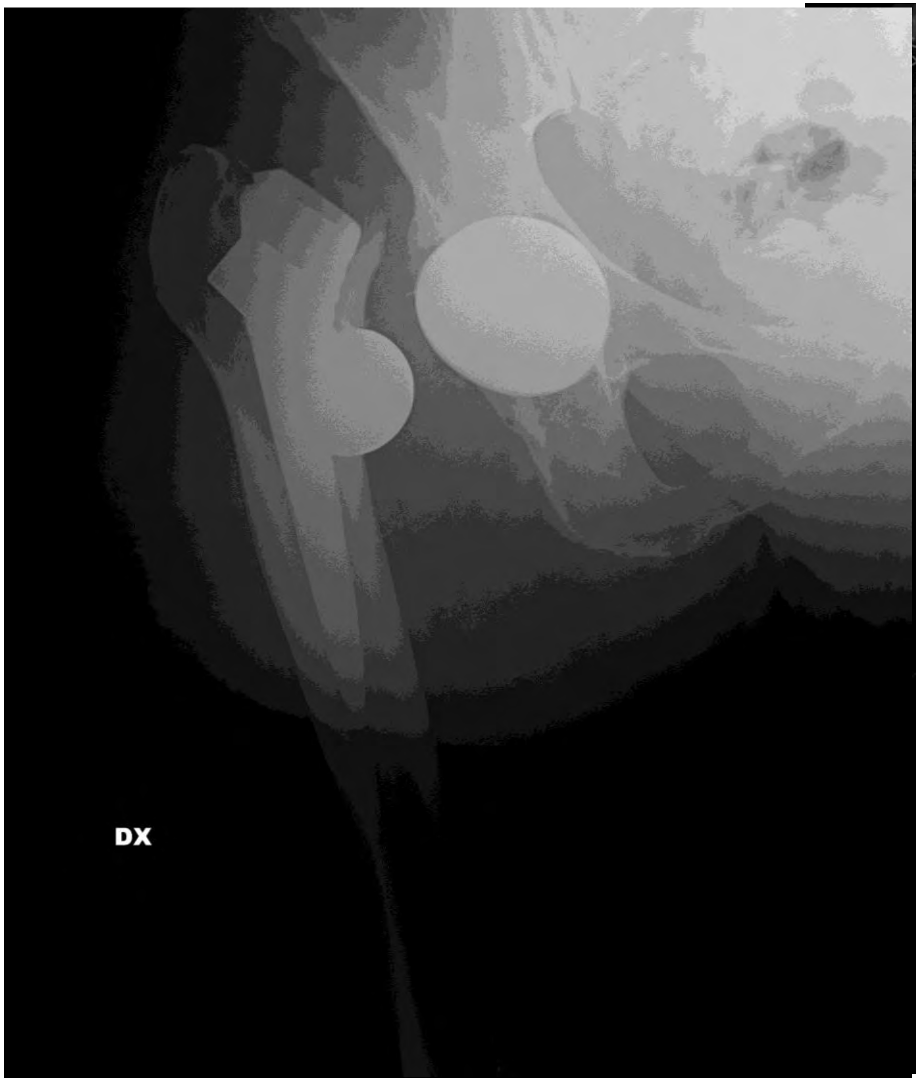
20.04.09 - ♂ 58 years BMI 38,4 Long neck AR / VV 1

COMPLICATION RELATED TO MODULARITY



07.09.12 - ♂ 63 years BMI 42 Long neck VV

COMPLICATION RELATED TO MODULARITY



01.04.15 - ♂ 50 years BMI 36

COMPLICATION RELATED TO MODULARITY

- Ti6Al4V neck fracture: 2/2725 (0,07%)
- CoCr neck fracture : none 0/1086
- Neck / Stem disassembly : 1/3811 (0,02%)
- ALVAL – ARMD : not observed

Clin Orthop Relat Res (2014) 472:1240–1245
DOI 10.1007/s11999-013-3361-4

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

CLINICAL RESEARCH

Modular versus Nonmodular Neck Femoral Implants in Primary Total Hip Arthroplasty: Which is Better?

Paul J. Duwelius MD, Bob Burkhart PA, Clay Carnahan PA, Grant Branam BSc,
Laura Matsen Ko MD, YingXing Wu MD, Cecily Froemke MS,
Lian Wang MS, Gary Grunkemeier PhD

Item	Nonmodular	Modular	p value
Number of patients	284	594	
Surgery date	August 1, 2005, to September 8, 2009	May 9, 2007, to December 22, 2009	
Age (years)	62 ± 11	62 ± 10	0.65
Male sex	52% (148)	53% (312)	0.91
Diabetes	9% (25)	14% (81)	0.04
Side (left/right)	46%/54% (131/153)	49%/51% (291/303)	0.43
Preoperative diagnosis			0.01
Osteoarthritis	90% (212)	95% (558)	
Avascular necrosis	6% (14)	2% (11)	
Other	4% (9)	3% (20)	
Head size			< 0.01
32 mm	59% (169)	9% (56)	
36 mm	39% (110)	51% (302)	
40 mm	2% (5)	40% (236)	

- no fractures or stem failures in this large and relatively unselected series
- modular neck stems did not lead to improved clinical hip scores, reduction in complications
- there are known risks of modularity (pseudotumors, implant fractures, fretting, third-body wear, and trunnion corrosion)

HIP
ISSN 1120-7000

Hip Int 2015; 25 (5): 484-487
DOI: 10.5301/hipint.5000257

ORIGINAL ARTICLE

Metal ion levels in ceramic-on-ceramic THR with modular necks: analysis of cobalt and chromium serum levels in 30 healthy hip patients

Jan F.A. Somers

Department of Orthopaedics, Jan Yperman Hospital, Ypres - Belgium

- no patient had measurable chromium levels
- no differences in cobalt levels for hips with short necks versus hips with long necks
- excellent long-term clinical outcomes

Instructional Review: Hip Modular necks femoral stems
H. Krishnan, S. P. Krishnan, G. Blunn, J. A. Skinner, A. J. Hart
The Bone & Joint Journal VOL. 95-B, No. 8, AUGUST 2013 1011

Grupp *et al. BMC Musculoskeletal Disorders* 2010, **11**:3
http://www.biomedcentral.com/1471-2474/11/3

BMC
Musculoskeletal Disorders

RESEARCH ARTICLE Open Access

Modular titanium alloy neck adapter failures in hip replacement - failure mode analysis and influence of implant material

Thomas M Grupp[1*†], Thomas Weik[1†], Wilhelm Bloemer[1], Hanns-Peter Knaebel[2]

- combination of the cobalt-based alloy and the titanium alloy of the shaft shows a considerably higher rigidity. The smaller micro-movements reduce abrasion.

- the highly stable passive layer of the cobalt-based alloy provides an improved resistance against fretting.

- the cobalt alloy has a much lower notch sensitivity compared to the titanium alloy. This enhances fatigue strength.

- Identified risk factors of implant failure :
    - particle contamination of the cone connection
    - excessive loading due to a patient weight above 100 kg
    - high activity level and male gender.

LITERATURE REVIEW

Fracture of a Modular Femoral Neck After Total Hip Arthroplasty

A Case Report

By Commander Geoffrey Wright, MD, Scott Sporer, MD, MS, Robert Urban, PhD, and Joshua Jacobs, MD

Investigation performed at the Department of Orthopedics, Rush University Medical Center, Chicago, Illinois

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Early Failure of a Modular Femoral Neck Total Hip Arthroplasty Component

A Case Report

By David A.J. Wilson, MASc, BEng, Michael J. Dunbar, MD, FRCSC, PhD, John D. Amirault, MD, FRCSC, and Zoheir Farhat, PhD, PEng

Investigation performed at QEII Health Sciences Centre, Halifax, Nova Scotia, Canada

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Corrosion-Induced Fracture of a Double-Modular Hip Prosthesis

A Case Report

By Sara A. Atwood, MS, Eli W. Patten, MS, Kevin J. Bozic, MD, Lisa A. Pruitt, PhD, and Michael D. Ries, MD

Investigation performed at the University of California at Berkeley, Berkeley, California

LITERATURE REVIEW

1. **A Case of Disassociation of a Modular Femoral Neck Trunion After Total Hip Arthroplasty**
   Scott M. Sporer, Craig DellaValle, Joshua Jacobs, Markus Wimmer
   The Journal of Arthroplasty
   September 2006 (Vol. 21, Issue 6, Pages 918-921)
   Abstract | Full Text | Full-Text PDF (294 KB)

2. **Total Hip Arthroplasty Modular Neck Failure** *Corrected Proof*, 12 April 2010
   Jack G. Skendzel, J. David Blaha, Andrew G. Urquhart
   The Journal of Arthroplasty
   DOI: 10.1016/j.arth.2010.03.011
   Abstract | Full Text | Full-Text PDF (140 KB)

3. **Failure of the Modular Neck in a Total Hip Arthroplasty** , 19 October 2009
   Chris J. Dangles, Carl J. Altstetter
   The Journal of Arthroplasty
   October 2010 (Vol. 25, Issue 7, Pages 1169.e5-1169.e7)
   Abstract | Full Text | Full-Text PDF (351 KB)

4. **Influence of Technique With Distally Fixed Modular Stems in Revision Total Hip Arthroplasty** , 03 September 2009
   Preetesh D. Patel, Alison K. Klika, Trevor G. Murray, Karim A. Elsharkawy, Viktor E. Krebs, Wael K. Barsoum
   The Journal of Arthroplasty
   September 2010 (Vol. 25, Issue 6, Pages 926-931)
   Abstract | Full Text | Full-Text PDF (507 KB)

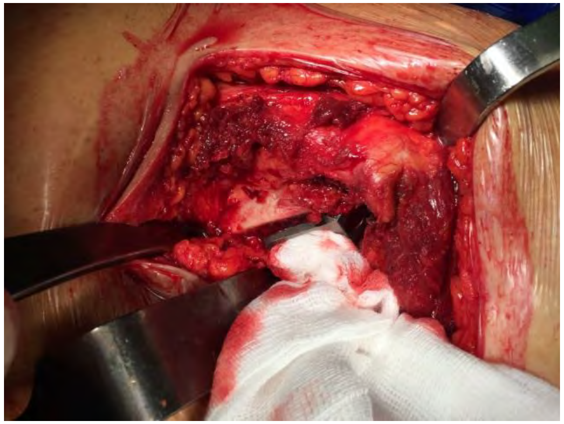
TAKE HOME A MESSAGE

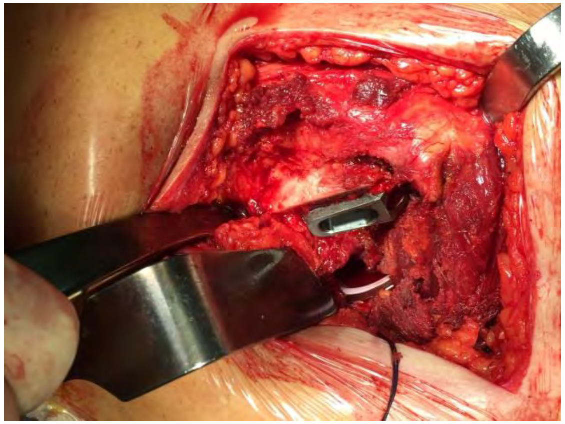
- Consider neck modularity as a fine tuning of the THA

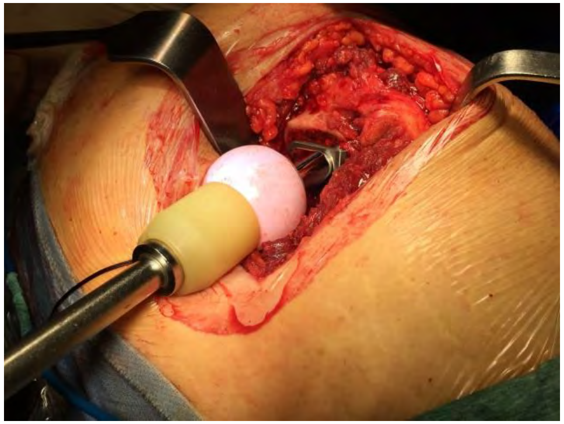
- Don't use long necks in overweight patients (BMI >35)

- Avoid intraoperative particle contamination of the cone connection

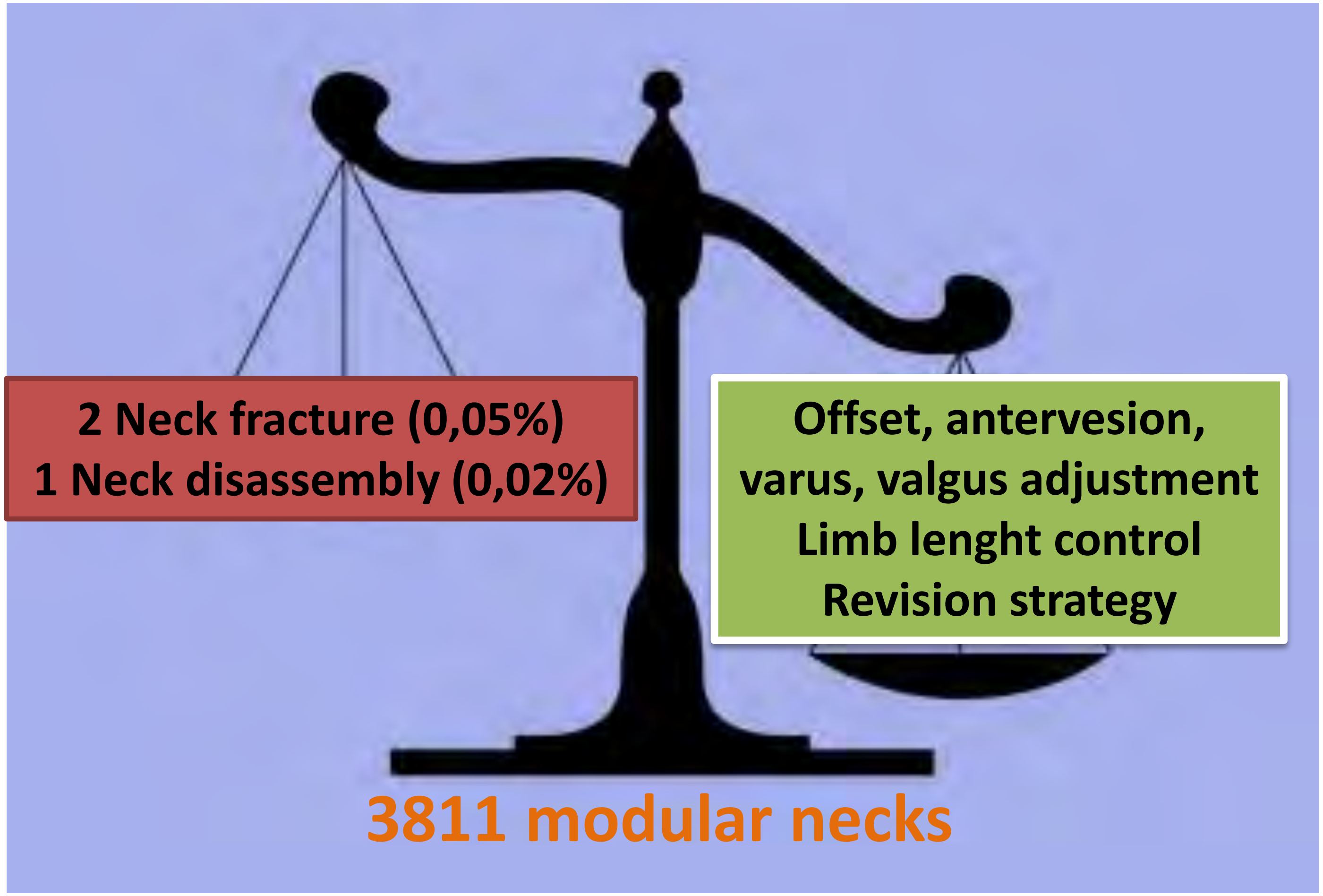
Always wash and dry !







TAKE HOME A MESSAGE



STILL JUSTIFIED ? YES


Thank you

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

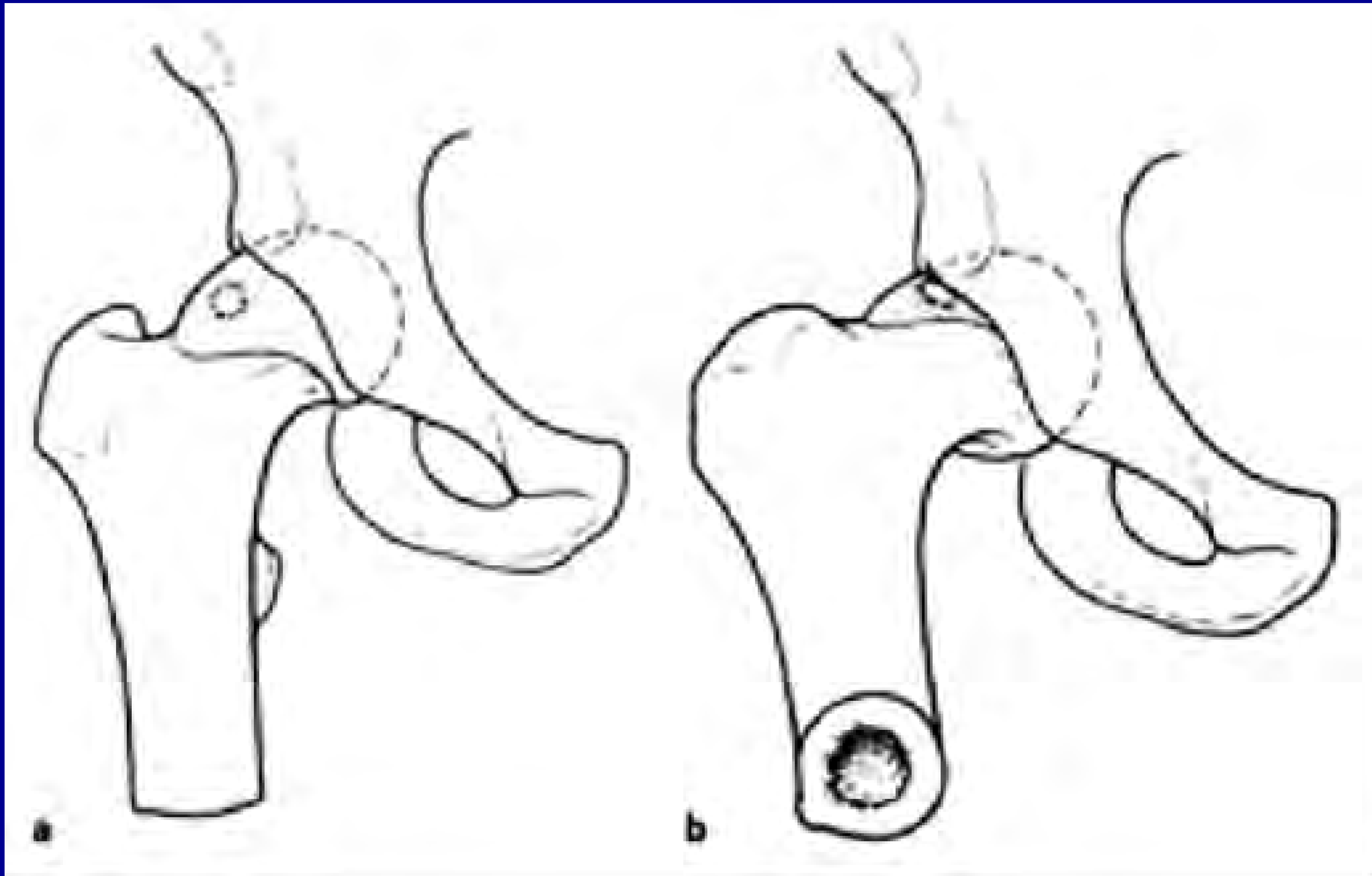
26-27 NOVEMBER 2015

MILAN, ITALY

FAI and lumbar stiffness

A. Aprato

University of Turin, ITALY

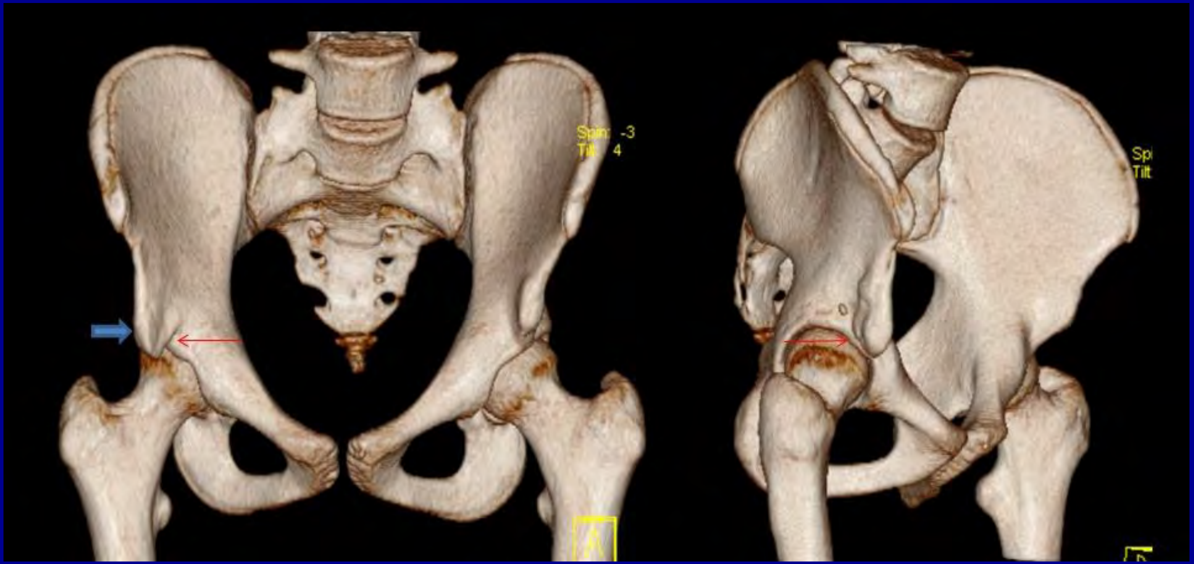

a
b

Lumbar Lordosis

Good Posture

Dynamic changes in pelvic tilt significantly influence the functional orientation of the acetabulum and must be considered. Dynamic anterior pelvic tilt is predicted to result in earlier occurrence of FAI in the arc of motion

Am J Sports Med. 2014 Oct;42(10):2402-9



Dynamic anterior pelvic tilt is predicted to result in earlier occurrence of FAI in the arc of motion

Am J Sports Med November 2014 vol. 42 no. 11 2649-2653

AIMS:

1. to evaluate lumbar hyperlordosis and range of motion in patients with arthroscopically treated FAI

2. to compare those results with healthy subjects.

MATERIALS AND METHODS:

17 healthy volunteers (control group)

21 patients with surgically treated FAI (FAI Group)

VARIABLE	GFAI	GC	p
Age, years (SD)	35 (10)	34 (10)	0,70[a]
Gender **n (%)**			
M	9 (42,9)	8 (47,1)	0,80[b]
F	12 (57,1)	9 (52,9)	
Sport, n (%)			
Yes	10 (47,6)	14 (82,4)	0,06[b]
No	11 (52,4)	3 (17,6)	
N of sport days/a week, mean (SD)	3,10 (1,60)	2,93 (1,07)	0,88[a]
N of sport hours/a week, mean (SD)	1,61 (0,78)	1,45 (0,50)	0,75[a]

a= U Mann Withney
b= Chi Squared test

1. Hip range of motion
2. quality of life (SF-12 and EQ5D)

3. flexibility tests (Sit and Reach test)
4. spine morphological analysis with Spinal Mouse;

Tabella n.1 Test U Mann Withney

Variabile	N (GFAI)	N (GC)	Media (GFAI)	Media (GC)	Mediana (GFAI)	Mediana (GC)	Dev. St (GFAI)	Dev St. (GC)	Intervallo (GFAI)	Intervallo (GC)	Z	p	ES
VAS	21	17	68.65	84.65	75.50	85	20.90	8.77	81	35	-2.933	0.003	1.00
SIT and REACH	21	17	26.02	33.48	26.35	36.60	9.76	9.81	32.10	36.70	-2.393	0.017	0.76
Rot. Ext. SX	21	17	28.55	37.94	28	40	9.08	8.72	33	36	-2.692	0.007	1.44
Rot. Ext. DX	21	17	30.35	36.41	30	36	9.77	8.02	39	29	-1.837	0.066	0.68
Rot. Int. DX	21	17	32.50	40.06	30.50	40	10.49	5.43	40	20	-2.601	0.009	0.91
Rot. Int. SX	21	17	30.30	38.71	31	38	9.86	6.10	44	22	-3.059	0.002	1.03
Abduzione DX	21	17	31.35	42.06	32	40	11.53	8.85	43	37	-2.736	0.006	1.04
Abduzione SX	21	17	29.85	42.41	30	44	8.14	9.01	33	34	-3.676	0.000	1.46
FABER DX	21	17	4.30	0.53	4	0	3.25	1.18	10	3	-4.029	0.000	1.54
FABER SX	21	17	5.35	0.35	6	0	2.80	0.86	10	3	-4.905	0.000	2.41
FADIR DX	21	17	4.55	0.82	4	0	3.15	1.98	10	8	-3.653	0.000	1.42
FADIR SX	21	17	5.80	0.65	6	0	2.93	1.22	10	4	-4.611	0.000	2.29
SF12 Tot.	21	17	24.95	30.06	27.50	30	7.10	3.83	22	14	-2.552	0.011	0.94
Salute Fisica	21	17	10.35	14.24	11.50	15	3.90	1.82	12	7	-3.692	0.000	1.28
Spinal: Sagittale: Flex – Ext (ROM) LSp	21	17	63.20	72.65	60	74	14.50	11.87	52	45	-2.000	0.046	0.71
Spinal: SagittaleFlessione: LSp	21	17	20.70	27.76	20.50	27	9.06	9.95	39	38	-2.136	0.033	0.74

EXTERNAL ROTATION

LEFT:
CONTROL GROUP: 37,94 ± 8,72;
FAI GROUP: 28,55 ± 9,08.
(p:0,007)

RIGHT:
CONTROL GROUP: 36,41 ± 8,02
FAI GROUP: 30,35 ± 9,77.
(p: 0,066).

INTERNAL ROTATION

RIGHT:

CONTROL GROUP: 40,06 ± 5,43

FAI GROUP: 32,50 ± 10,49

(p: 0,009)

LEFT:

CONTROL GROUP: 38,71 ± 6,10

FAI GROUP: 30,30 ± 9,86

(p: 0,002)

ABDUCTION

RIGHT

CONTROL GROUP: 42,06 ± 8,85

FAI GROUP: 31,35 ± 11,53

(p: 0,006)

LEFT

CONTROL GROUP: 42,41 ± 9,01

FAI GROUP: 29,85 ± 8,14

(p< 0,001)

EQ5D

CONTROL GROUP: 84,65 ± 8,77

FAI GROUP: 68,65 ± 20,90

(p: 0,003)

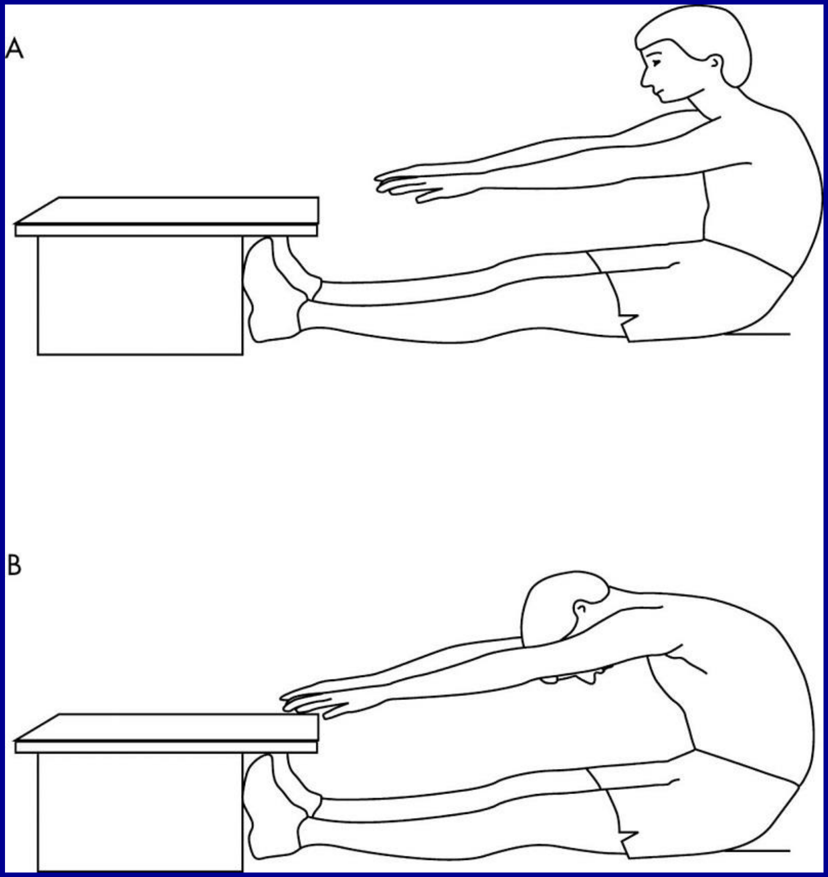
SF-12

CONTROL GROUP: 30,06 ± 3,83

FAI GROUP: 24,95 ± 7,10

(p: 0,011)

SIT AND REACH TEST

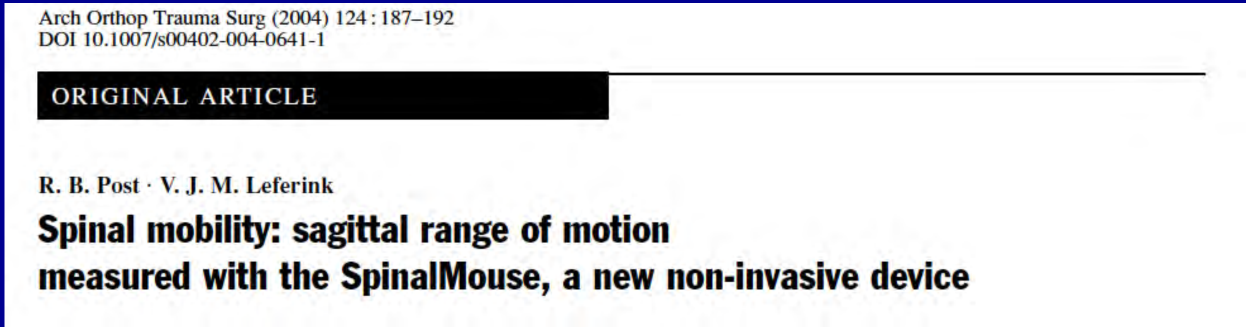


CONTROL GROUP:
33,48 ± 9,81

FAI GROUP:
26,02 ± 9,76

(p: 0,017)

SPINAL MOUSE:



Arch Orthop Trauma Surg (2004) 124 : 187–192
DOI 10.1007/s00402-004-0641-1

ORIGINAL ARTICLE

R. B. Post · V. J. M. Leferink

Spinal mobility: sagittal range of motion measured with the SpinalMouse, a new non-invasive device

Segment	Static test data			Range of motion data		
	Upright	Flexion	Extension	Flex-upr	Upr-ext	Flex-ext
Th1/2	9	0	4	–8	5	–3
Th2/3	6	4	3	–2	3	0
Th3/4	4	5	9	0	–4	–4
Th4/5	3	3	5	0	–2	–2
Th5/6	4	1	3	–3	1	–2
Th6/7	5	4	6	–1	–2	–2
Th7/8	4	6	4	2	0	2
Th8/9	5	8	3	3	2	5
Th9/10	3	13	4	11	–1	9
Th10/11	–1	8	4	9	–4	5
Th11/12	–3	5	–3	7	1	8
Th12/L1	–1	6	–3	7	1	9
L1/2	–1	7	–1	8	0	8
L2/3	–2	10	–4	12	2	13
L3/4	–4	10	–7	15	3	17
L4/5	–4	4	–7	8	3	11
L5/S1	–7	1	–7	8	–1	7
Sac/Hip	10	57	–8	47	18	65
Thor.Sp	39	58	41	19	–3	16
Lum.Sp	–21	37	–29	58	8	66
Inclin	0	103	–23	103	23	126
Lth	569	704	557	135	12	147

SPINAL MOUSE: STATIC SAGITTAL PLANE ANGLES

NO DIFFERENCES BETWEEN THE TWO GROUPS

(all p> 0,05)

SPINAL MOUSE:
FLEXION ON SAGITTAL PLANE (LSp)

CONTROL GROUP: 27,76 ± 9,95

FAI GROUP: 20,70 ± 9,06

(p: 0,033)

SPINAL MOUSE:
ROM SAGITTAL PLANE

CONTROL GROUP:
72,65 ± 11,87

FAI GROUP: 63,20 ±
14,50

(p: 0,046)

CONCLUSIONS:

Two groups were comparable in terms of age and sex.

Hip ROM was significantly lower in GFAI,

this group showed lower results at Sit and Reach tests

lower lumbar ROM,

higher values of lumbar stiffness


THANKS

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Does the femoral head/neck contour in the skeletally mature change over time?

Luca Gala MD
Vickas Khanna MD FRCSC
Kawan Rakhra MD FRCPC
Paul E. Beaulé MD FRCSC

uOttawa
L'Université canadienne
Canada's university

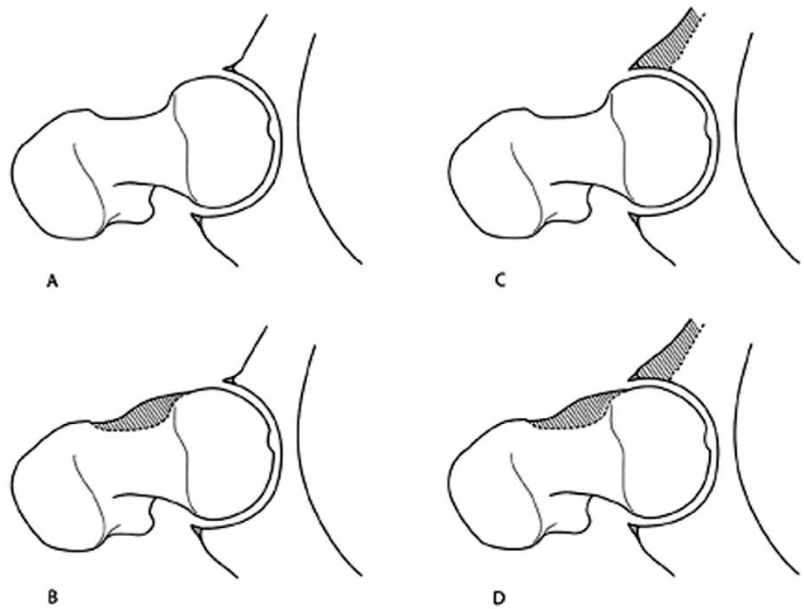
Società Italiana dell'Anca

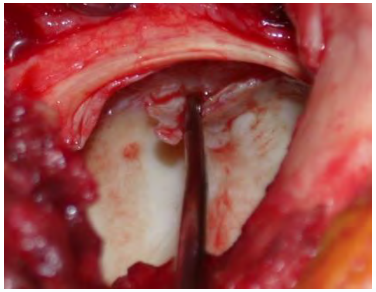
Azienda Ospedaliera Istituto Ortopedico GAETANO PINI

Sistema Sanitario Regione Lombardia

Introduction

- Cam-type impingement refers to alterations in the osseous contour at the level of the femoral head-neck interface
- Abnormal contact between femoral head and neck
- Hip pain, labral tears, cartilage delamination and potentially osteoarthritis later in life





Ganz et al 2001

Incidence

- 10% to 15% in young active patients

Hack et al JBJS'10

- 94% of young patients with hip pain

Grossman et al, JAAOS'01

- **Unclear when or how this deformity is acquired**:
  - *Developmental*
  - *Reactive*
  - *Part of OA*

Developmental Origin

- Link between aggressive adolescent sport training and the development of bony changes of FAI

Murray et al BrJR'65

- Chronic overuse of the proximal femur might represent repetitive indirect trauma
- Stimulate a similar growth plate extension with resultant metaphyseal deformity

Previous study (Hack et al. 2010)

- 200 asymptomatic volunteers
- Bilateral hip MRI
- Alpha angle > 50.5˚ = CAM
- 14% with CAM (10.5% one hip, 3.5% both)
- 24.7% males / 5.4% females

Purpose Of Study

- Radiographically determine whether Cam lesions of the hip are a static or dynamic deformity

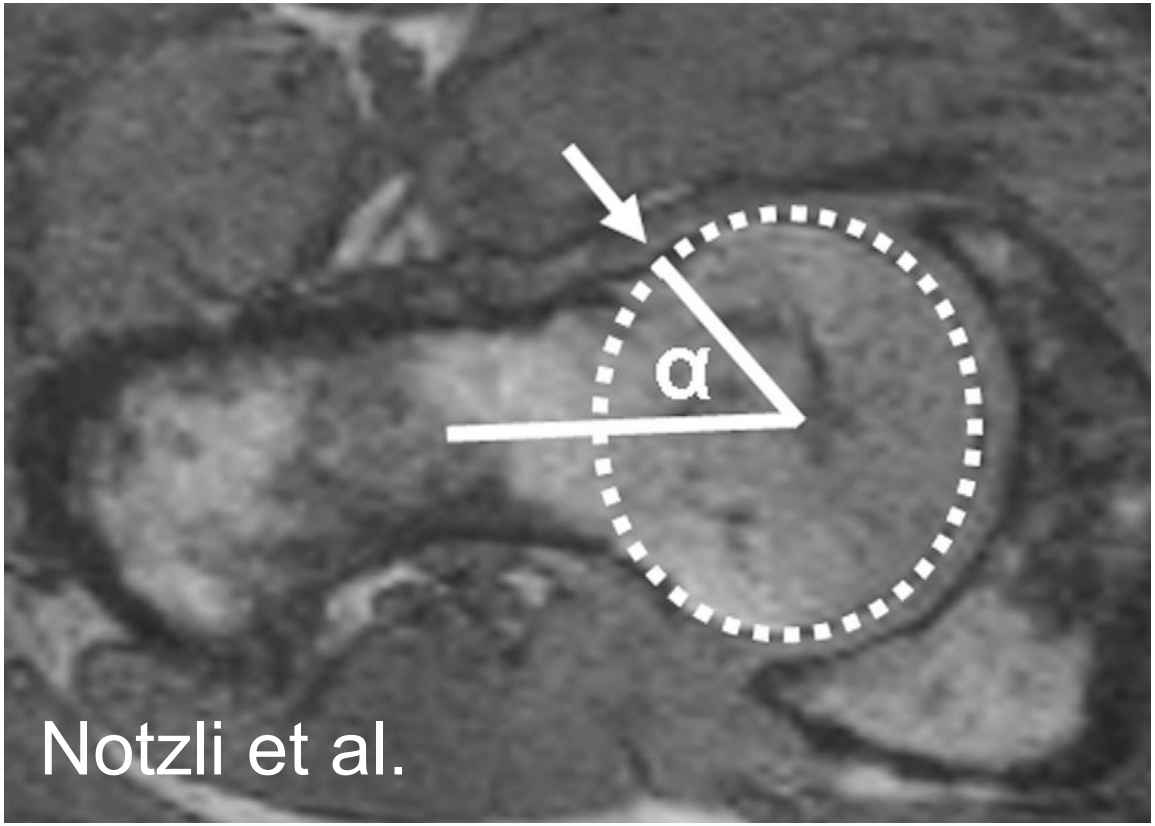
- The results were compared to the original MRI findings to identify any difference in alpha angle using a paired t-test evaluation, with clinical significance set as $p < 0.05$.

Materials & Methods

- 23 patients prospectively selected (MRI or CT)
- 10 patients CAM pos.
- 13 CAM neg. (control group)
- 16 males and 7 females
- Mean age 37.5 (30-56)

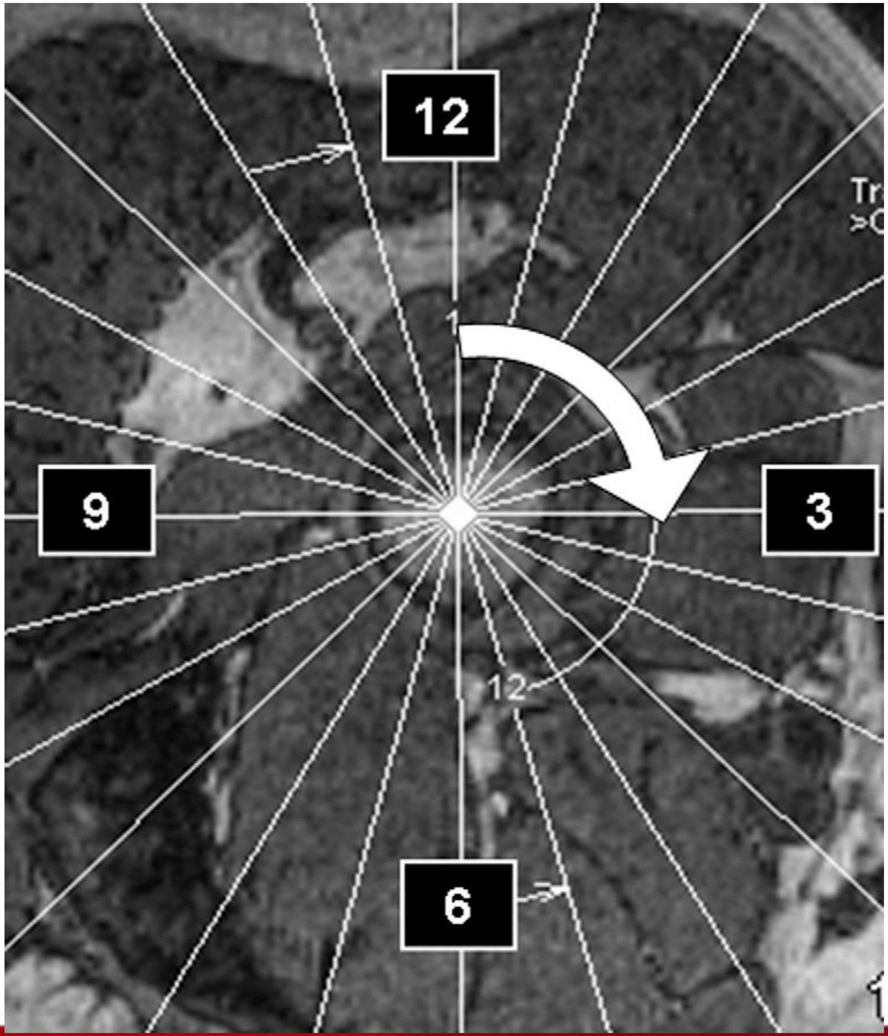
Materials & Methods

Power analysis 80% (expected mean alpha angle difference 5°)



Alpha Angle

- Oblique axial 3:00 and radial 1:30
- MSK radiologist
- Ortho Fellow
- Inter-observer reliability 0.95



RESULTS

		Mean	N	Std. Deviation	p-values
Pair 1	R Axial 3 FIRST READING	45.2	18	7.3	
	R Axial 3 FOLLOW-UP	47.7	18	8.8	.1640
Pair 2	R Radial 1.30 FIRST READING	54.5	18	9.1	
	R Radial 1.30 FOLLOW-UP	55.6	18	8.7	.3640
Pair 3	L Axial 3 FIRST READING	43.8	18	7.7	
	L Axial 3 FOLLOW-UP	47.4	18	9.9	.0680
Pair 4	L Radial 1.30 FIRST READING	55.2	18	10.4	
	L Radial 1.30 FOLLOW-UP	54.9	18	11.5	.8960

4 Pairs were created so the first readings were compared to the follow-up measurements for every hip at the 3 and 1.30 position

NO SIGNIFICANT CHANGES

DISCUSSION

- This study showed that the alpha angle of the volunteers didn’t change at the follow-up
- So is Cam a static deformity after the end of the skeletal growth?

Developmental origin

- **Carsen et al 2014**
  - 44 volunteers (88 hips); 23 open physes vs. 21 closed physes
  - None of the 23 (0%) patients prephyseal closure had cam morphology vs. 14% postclosure
  - Daily activity level was higher ($p = 0.02$) for pts with cam
- **Siebenrock et al. 2012**
  - 37 elite basketball players vs. 38 controls; Age range 9-22 yrs
  - Athletes had greater epiphyseal extension than control subjects at all positions
  - Epiphyseal extension in the control was greater in the subgroup with a closed physis versus the subgroup with an open physis.

DISCUSSION

- At least other 2 papers studied the remodelling of the osteochondroplasty site after surgery
- No significant changes at a mean 2 years follow-up
- Other studies showed osteophyte formation around or on the bony prominence but only in patients with previous signs of OA

Limitations

- CT and MRI for the follow-up → possible bias
- Mean follow-up 3.8 years → is it enough to see a statistically significant change?

CONCLUSION

- If Cam-deformity is acquired during growth then after physis closure it is a static deformity
- We would be able to screen the population to identify the patients “at risk” at a precise point in time i.e. *17-18 for males; 16 for females*
- Because most of patients with CAM FAI present with significant acetabular cartilage damage earlier intervention maybe needed

THANK YOU

uOttawa

L'Université canadienne
Canada's university

Azienda Ospedaliera
Istituto Ortopedico
GAETANO PINI

Sistema Sanitario
Regione Lombardia

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Initial stability of a new dual mobility cup model: a prospective study compared with European register findings

ANDRÉ FERREIRA & QUATTRO GROUP

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WWW.CHIRURGIE-HANCHE-GENOU.FR

The Quattro Band

Grenoble-Lyon-Nice

DISCLOSURES

Royalties

Groupe Lépine

DISLOCATION : *the main PROBLEM*

- **3 to 8 % in primary THA in literature**
- **50% occur during first 3 months**
- **75% occur during first year**

=> **2/3 closed reduction**
1/3 need revision

SWEDISH HIP REGISTER: Reasons for revision

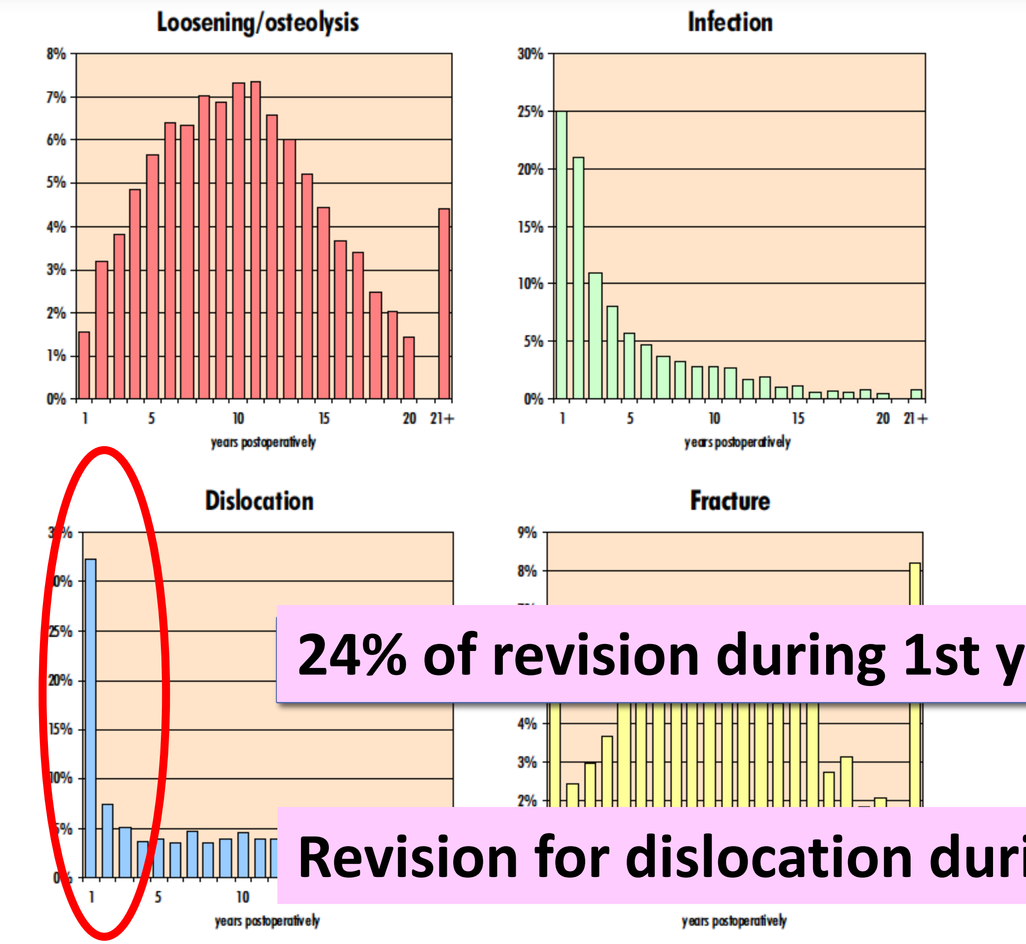


Figure 3a-c. Time after primary operation for first-time revision related to cause of revision.

24% of revision during 1st year due to dislocation

Revision for dislocation during 1st year: 0.4%

NHS : Reasons for revision

Analysis by time of the 6 main reasons for revision

		Years since operation													
		0	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	Count	281	65	102	64	48	27	34	27	16	17	4	11	2	698
	%	40.26	9.31	14.61	9.17	6.88	3.87	4.87	3.87	2.29	2.44	0.57	1.58	0.29	100
2	Count	60	31	49	45	44	41	36	54	45	45	49	26	9	534
	%	11.24	5.81	9.18	8.43	8.24	7.68	6.74	10.11	8.43	8.43	9.18	4.87	1.69	100
3	Count	30	19	48	42	38	37	38	46	32	28	26	14	2	400
	%	7.50	4.75	12.00	10.50	9.50	9.25	9.50	11.50	8.00	7.00	6.50	3.50	0.50	100
4	Count	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	Count	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100
6	Count	76	22	19	23	13	17	13	6	8	7	9	3	1	217
	%	35.02	10.14	8.76	10.60	5.99	7.83	5.99	2.76	3.69	3.23	4.15	1.38	0.46	100

20% of revision during 1st year due to dislocation

1 = Dislocation, 2 = Loosening acetabular component, 3 = Loosening femoral component. 4 = Deep Infection, 5 = Pain, 6 = Fractured femur

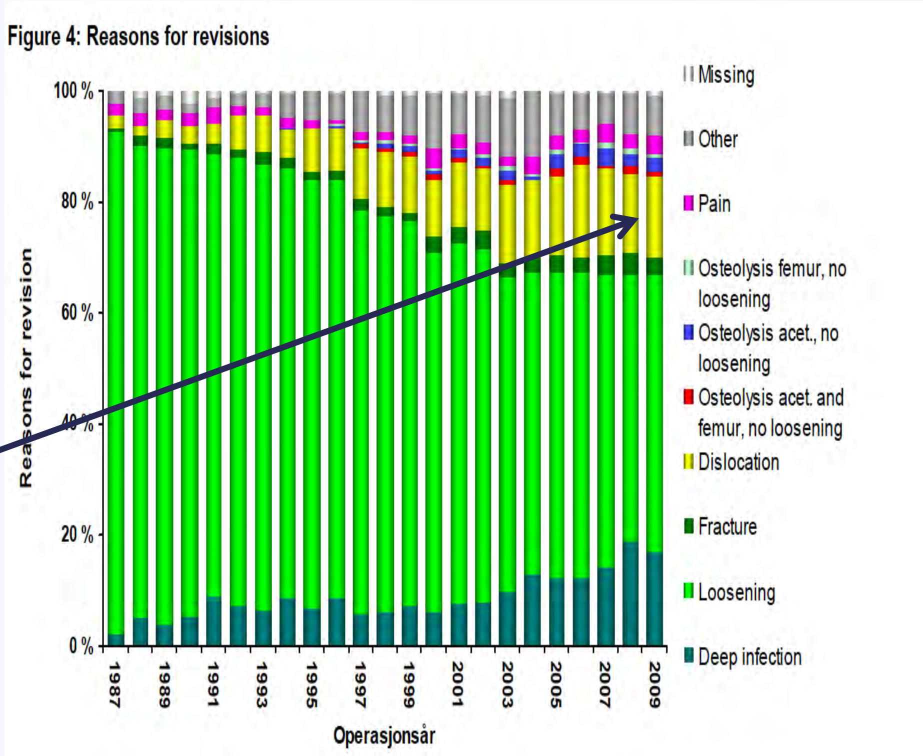
73% of revisions for dislocation, 69% for deep infection,65% for femoral #s and 51% for pain are within 4 years of primary arthroplasty compared to just 35% for femoral and acetabular loosening.

Prosthesis instability: 2.32% of revisions in 1st year

NORWEGIAN JR REPORT 2010: reasons for revision

2009 data

- 7029 THA
- 1195 revisions
- 213 for instability (18%)



18% of revision during 1st year due to dislocation

PROSPECTIVE MULTICENTRE STUDY QUATTRO CUP

4 centres

7 senior surgeons

May 2012 to October 2013

634 THA

Minimum FU: 1 year

Average: 1,8 years

groupe lépine

depuis 1714

Quattro VPS dual mobility cup

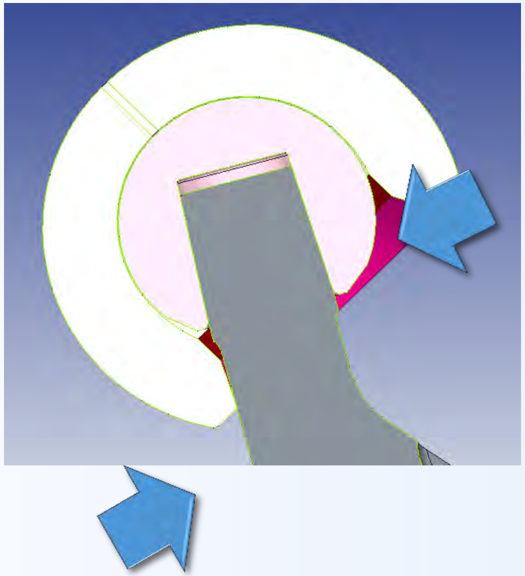
- Third generation of DM
- Cementless cup:
  Cobalt/Chrome
- Primary fixation through
  - 6 equatorial fins
  - ± 4 apical spikes
- Secondary fixat. through
  - bilayer coating

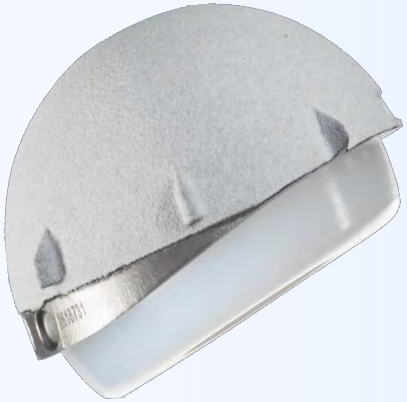
    Porous titanium under-layer of decreasing thickness + HA

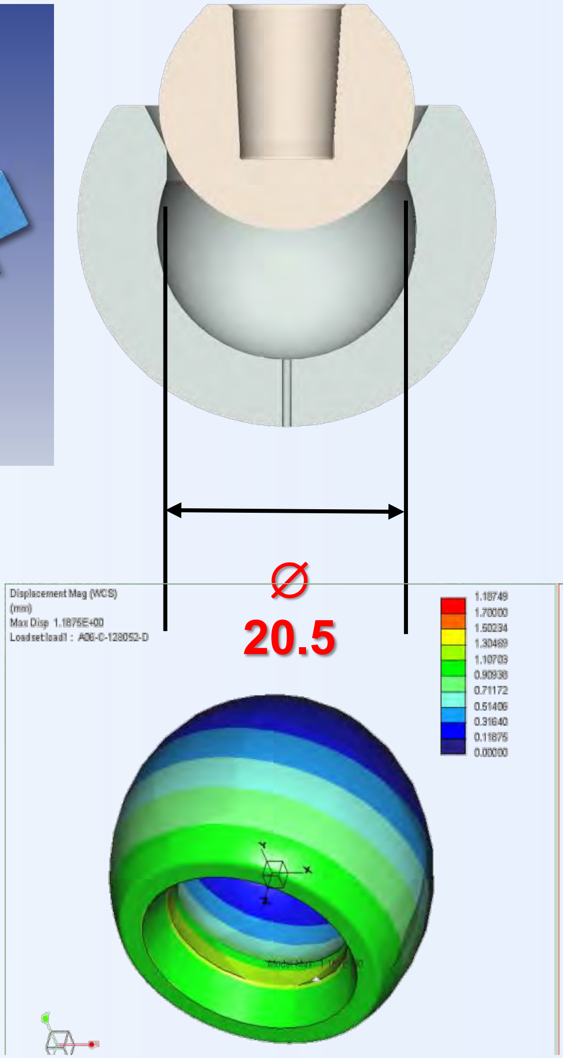
Quattro VPS dual mobility cup

groupe lépine

- Inner surface is **ultra polished without** any hole
- Cup design **hemispheric** to avoid conflict
- **Chrome cobalt** to avoid deformation & blocage
- **EtO** sterilised UHMWPE
- Design of liner **(chamfers)** reduce contact between the narrowed part and the femoral neck







High covering insert : Under PE elastic limit

Material and methods

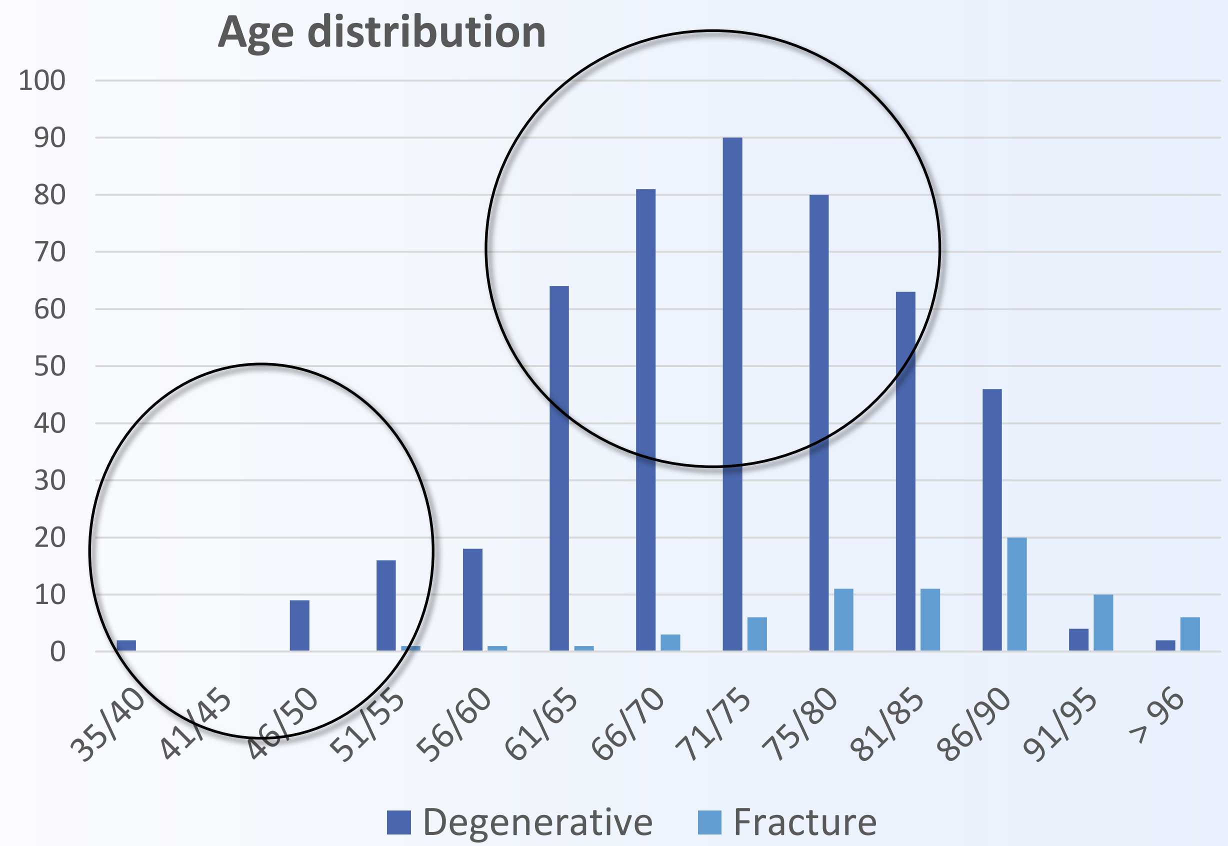
Material & Method

- Cohort characteristics:
  - Age, gender, ASA score
  - Etiology
    - Degenerative hip disease
    - fracture

		Global	Degenerative	Fracture
N° cases		634	551	**83**
gender (% women)		63.4%	61.2 %	**77.1 %**
Mean age		72.6 (36-99)	71.2 (36-98)	**81.7 (51-99)**
ASA	I	17.1 %	19.9 %	**0 %**
	II	61.0 %	65.2 %	**33.6 %**
	III	20.1 %	14.7 %	**57.7 %**
	IV	0.8 %	0.2 %	**4.7 %**

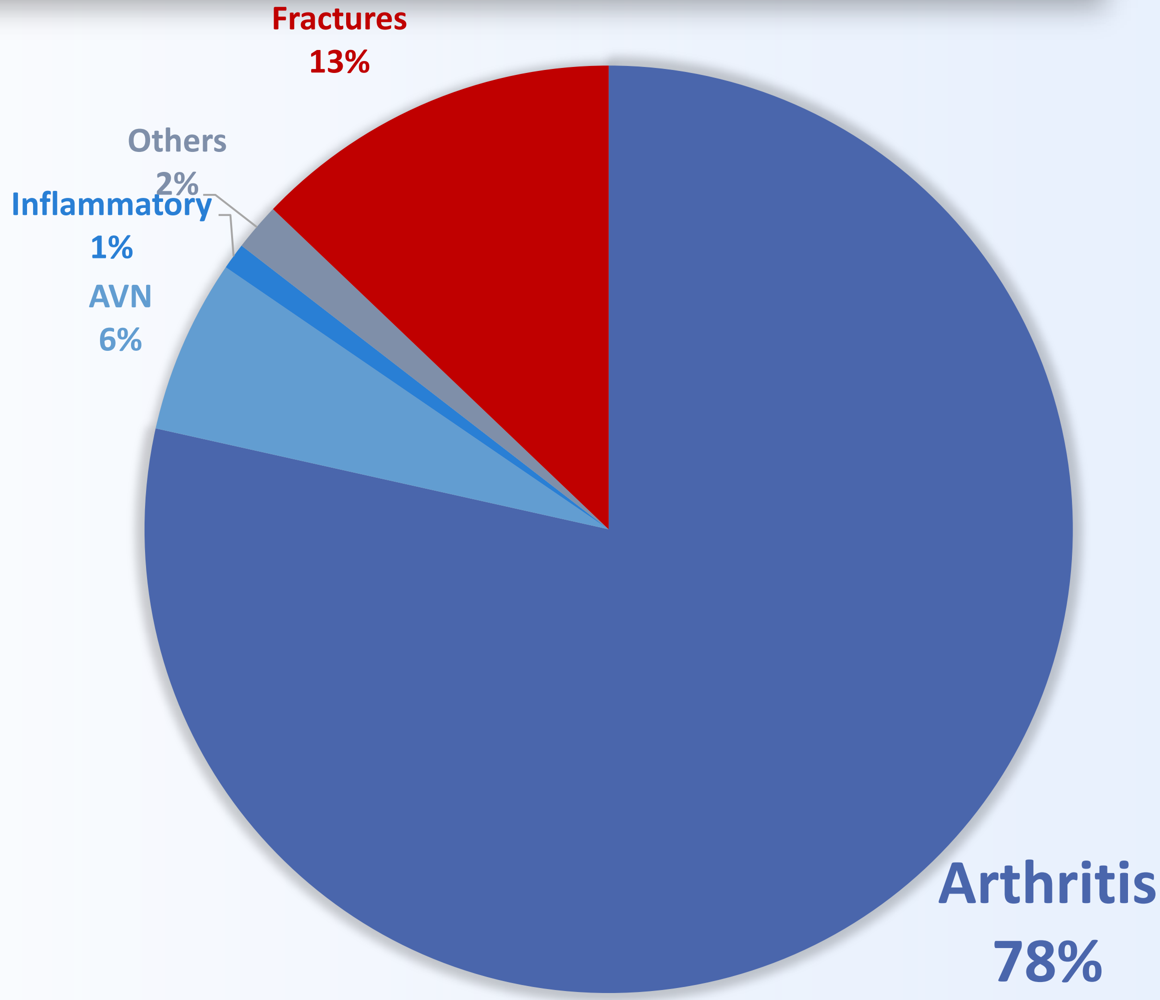
Material and methods

- **Cohort description**
  - **Age**, gender, ASA score
- Etiology
  - Degenerative & traumatic
- Approach
- Implants



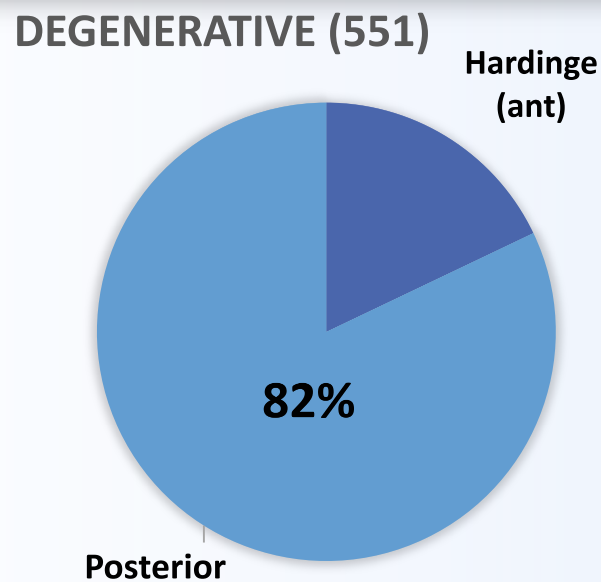
Material and methods

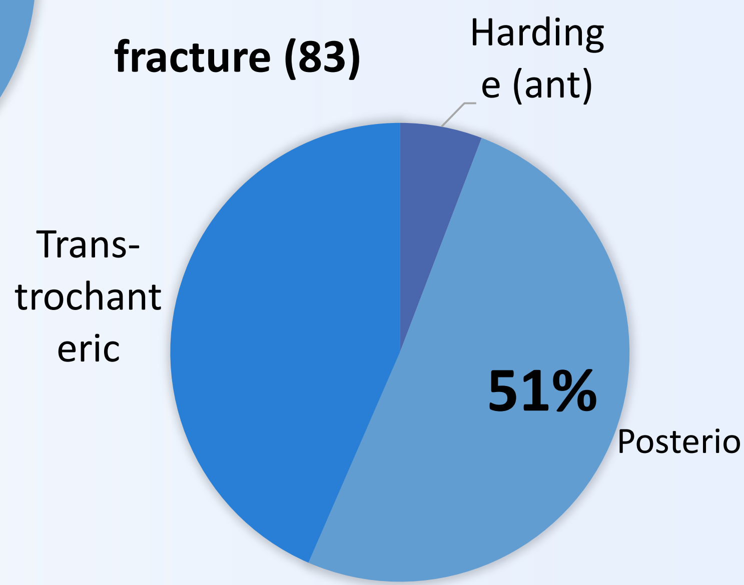
- Cohort description
- **Etiology**
- Approach
- Implants



Material and methods

- Cohort description
  - Age, gender, ASA score
- Etiology
  - Degenerative & traumatic
- **Approach**
- Implants





Material and methods

- Cohort description
  - Age, gender, ASA score
- Etiology
  - Degenerative & traumatic
- Approach
- **Implants**

		Degenerative (553)	Fracture (81)
Bearing	M/PE	28,9 %	**92,8 %**
	C/PE	**71,1 %**	7,2 %
Head	22 mm	23,7 %	**72,5 %**
	28 mm	**76,3 %**	27,5 %
Stem	cemented	21,1 %	18,6 %
	cementless	**35,9 %**	**72,9 %**
	Cementless short	**43 %**	8,6 %

Results

Lost to follow up: 0

	Degenerative	**Fracture**
Numbers	552	80
Dead	0	17
Lost of view	0	1
Survivorship	99%	100%
Revision	2 (infection & groin pain)	0
Dislocation	**0 (0%)**	**1 (1.3%)**
Treatment		Early dislocation (M1) Closed reduction No recur

Global dislocation rate: 0.15%

Comparison

Dislocation rate

- **Prospective series: 0.15%**
- No rate in registries
- Berry (JBJS am 2004): 1.8%
- Caton (Hip int 2004): 3.8%

Instability Revision

- **Prospective series: 0%**
- 2012 Swedish register: 0.40%
- 2013 NHS register: 2.32%
- 2010 Norwegian report: 3%
- *2013 Australian register: 1.6% < 80y 2% ≥ 80y*

Conclusion: Dual Mobility Cup

- **Low dislocation rate in a prospective, multi-surgeon study: 0.15%**
- **Whatever indications – age – approach**
- **No revision for instability at 1 year**
- **Registries data with Standard Cups**
  - **0.40 to 3% of revision for instability of all THA**
  - **15 to 24% of revision due to instability during 1st year**

Third generation of Dual Mobility

proves concept efficacy and benefit in primary THA

THA ... ON

P

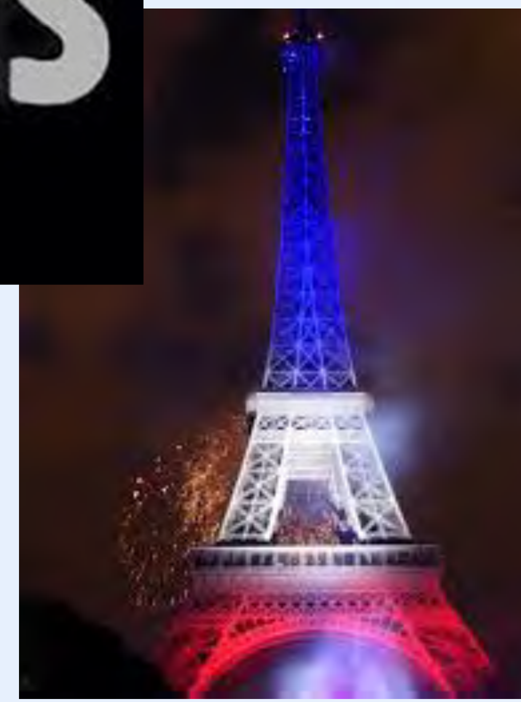
2 ... !

LYON Hip Arthroplasty

Instability

Lyon – April 13 & 14 2017

To all the victims of attempts….



To be stronger than barbarism, we must stand up

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Dislocation: Diagnosing Instability

Stephen A Jones

Bwrdd Iechyd Prifysgol Caerdydd a'r Fro
Cardiff and Vale University Health Board

BHS/SIDA Congress Milan – 2015

Disclosures

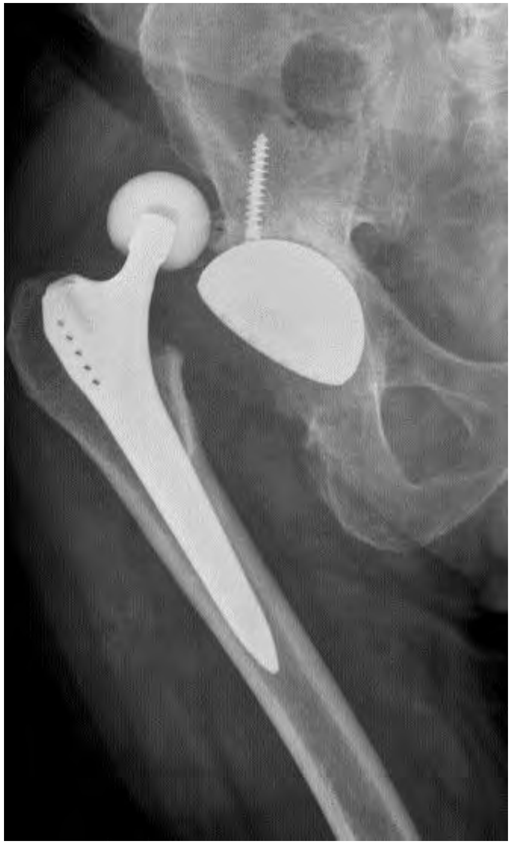
- Institution
  - Funding received Depuy, Zimmer Biomet & Lima
- Individual
  - **Consultant agreements**

  \- Zimmer Biomet, Smith & Nephew, Depuy & Lima
  - **Design agreements & Royalties**

  \- Smith & Nephew, Lima & Adler Orthopaedics

Diagnosing Instability

Instability following THA



- Dislocation rate 0.09% to 8%
- Recurrent dislocation rate 16% to 64%
- Recurrence dislocation following revision for instability 27% to 34%

Woo RY, Morrey BF.
Dislocations after total hip arthroplasty.
JBJS(A) 1982;64: 1295-306.

Natural History of Hip Instability

- Continued sub-optimal result
- Significant risk of continued instability
- Need for revision surgery (>50%)

Outcome of Closed Reduction For Dislocation Following Primary Total Hip Arthroplasty
RS Kotwal, M Ganapathi, A John, M Maheson, S Jones
Journal Bone & Joint Surgery 2009 Vol 91-B, Issue 3,321-326

Prevention - Optimal index surgery

Long Term Revision Burden for Instability

- Retrospective analysis of **539 THA** under-going revision for instability
  - **35% re-dislocation & 45% re-operation all causes**

- Multi-variate analysis risk factors
  - **History >2 previous surgeries**
  - **Use of head size <36mm**
  - **Cup retention at time of revision**

The Cumulative Risk of Re-dislocation After Revision THA Performed for Instability Increases Close to 35% at 15 years
Journal of Arthroplasty 30 (2015) 1177-1182
Suenghwan J. Jimenez Almonte J. Sierra R

Why it is Unstable ?

- Aetiology of Instability.
- Mechanism.
- Time Scale from Index Surgery.

WC – 72yr Male OA following previous acetabular fracture.


1
R
W 1.420 : L 1.852

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Revision Surgery

Increased Head Size

Increased Neck Length

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Revision Surgery
Cup Revision
Constrained Liner


1
LT
W 1672 : L 2264


1
W 164 : L 158


1
R
*
W 2279 : L 1473

Revision Surgery

Retained Cup

Cemented Liner

Large diameter MoM

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Why is the THA Unstable ?

AETIOLOGY IS MULTI-FACTORIAL

CONSIDERED AS FIVE MAJOR SUB-GROUPS

Patient Factors
Surgeon Factors
Implant Orientation
Implant Design
Soft Tissue Factors

Instability - Patient Factors

- Age & Sex.
- Alcoholism.
- Neurological conditions.
- Previous Hip Trauma
- Previous Hip Surgery.
- Revision Hip Arthroplasty.
- Medical Co-morbidly
- Compliance

Risk Factors – Age & Sex

- Data on age as independent risk factor is inconclusive.

Dislocation after total hip arthroplasty.
J Am Acad Orthop Surg 2004;12:314-321
M Soong, H Rubash, W Macaulay

- Two large series on gender differences report that women have twice rate of men.

Effect of femoral head diameter and operative approach on risk of dislocation after primary hip arthroplasty.
D.Berry et al. JBJS(Am) 2005;87:2456-2463
Late instability following total hip arthroplasty.
L Pulido et al Clin Med Res 2007;5:139-142

- Consider **advanced age (>80 years) & gender together**
Reported up to 15% acute & 9% chronic instability

Primary total hip replacement in patients over 80 years of age.
JBJS(Br) 1990;72(3):450-2.
D Newington, G Bannister, M Fordyce

Risk Factor – Patient Co-morbidity

- Dislocation x10 higher in patients with high ASA scores

Factors predisposing to dislocation after primary total hip arthroplasty: a multivariate analysis.

B Jolles et al. Journal Arthroplasty 2002 April;17(3):282-8

NJR Statistics 10th Report

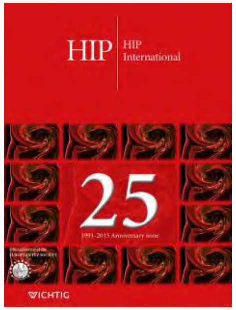
- Number of patients undergoing THR who are ASA 1

  2003 = 37% and this had decreased in 2008 = 14%

This group can least tolerate implications of instability

The future for Non-modifiable factors - Risk Stratification

Define specific patient populations
Used throughout healthcare
- Save lives / time / money

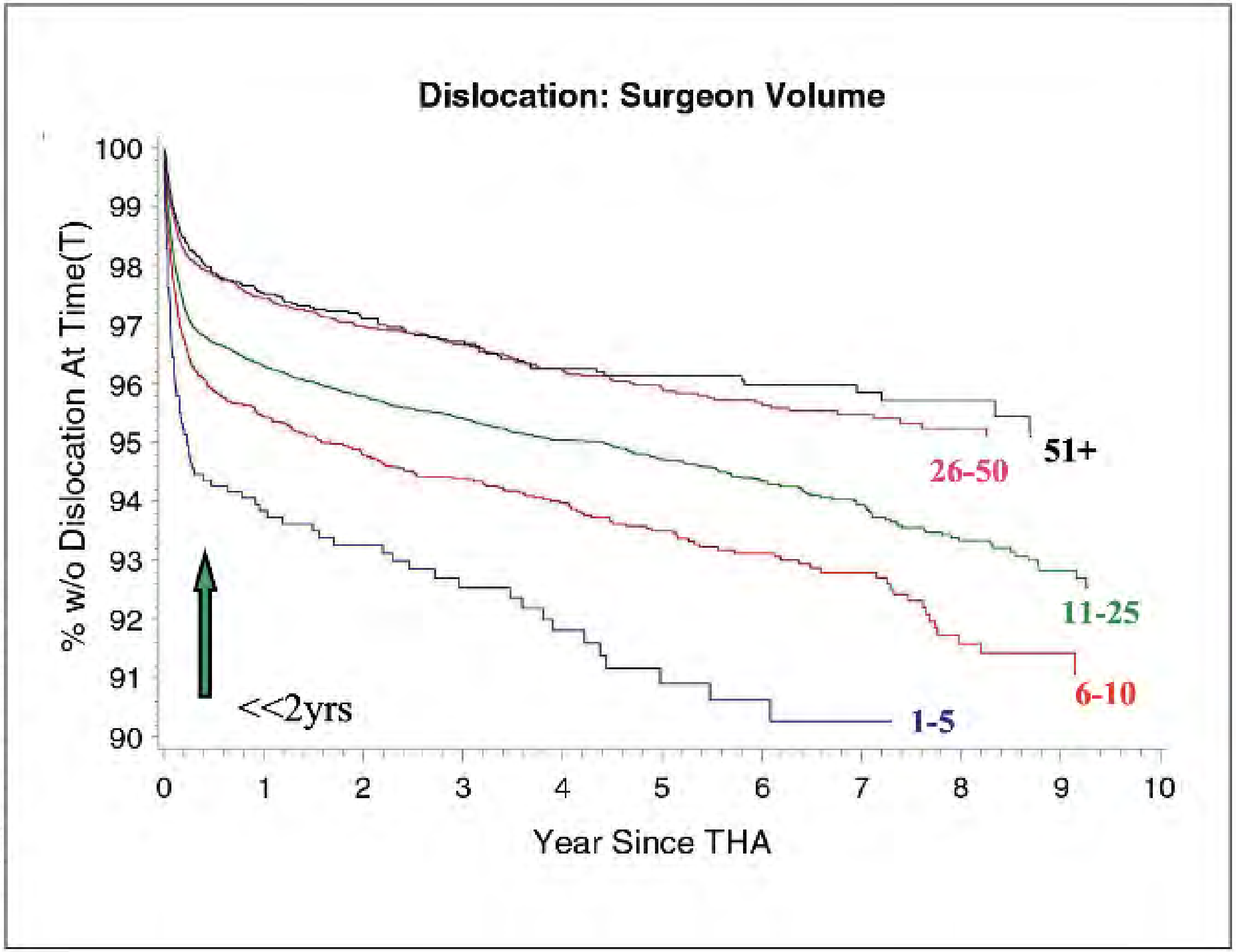


The prevention and treatment of dislocation following total hip arthroplasty: efforts to date and future strategies
Stephen A Jones
Hip Int 2015; 25(4): 388 – 392.

Instability - Surgeon Factors

- Experience
- Volume
- Surgical Approach
- Surgical Technique
- Implant Selection

Surgeon Factors - Volume



Courtesy of Alfred L. Malkani, MD

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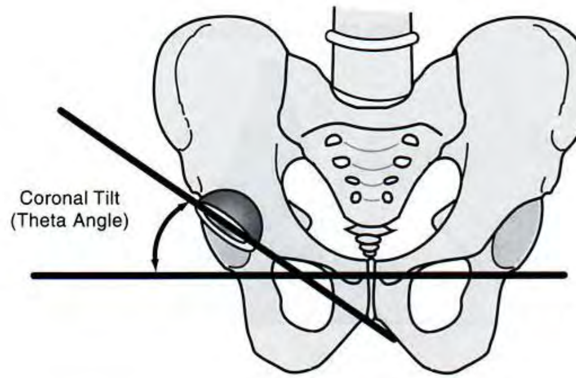
Component Position

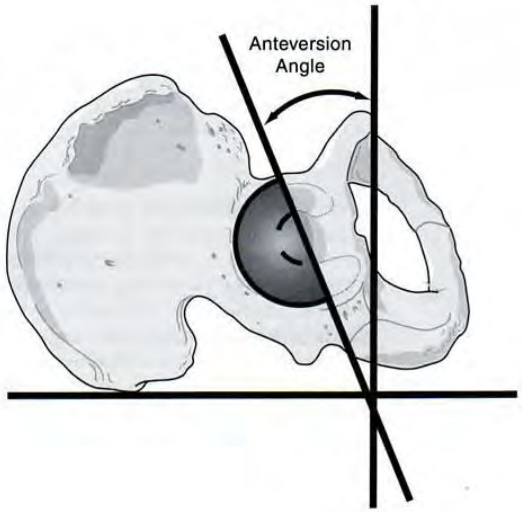
"Safe-zone"

40 +/- 10 degrees abduction

15 +/- 10 degrees anteversion

Lewninneck et al JBJS(Am) 1978; 60:217.





Six fold **reduction** in dislocation

Does not prevent it !

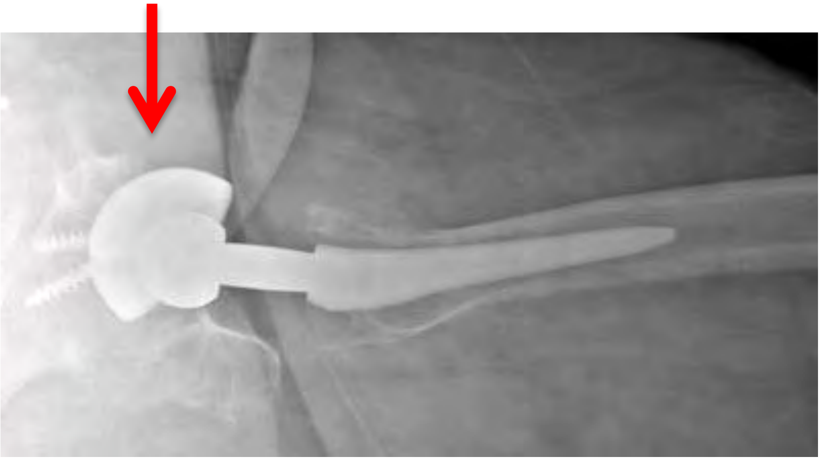
“Safe zone” – Outdated Concept

- Only considers radiographic cup position
- Femoral anteversion not considered
- Changes in pelvic orientation with supine, standing, and sitting positions.

Cup Position Alone Does Not Predict Risk of Dislocation After Hip Arthroplasty.
Journal of Arthroplasty Vol 30:1 January 2015, Pages 109–113
Esposito C. Gladnick B. Lee Y.

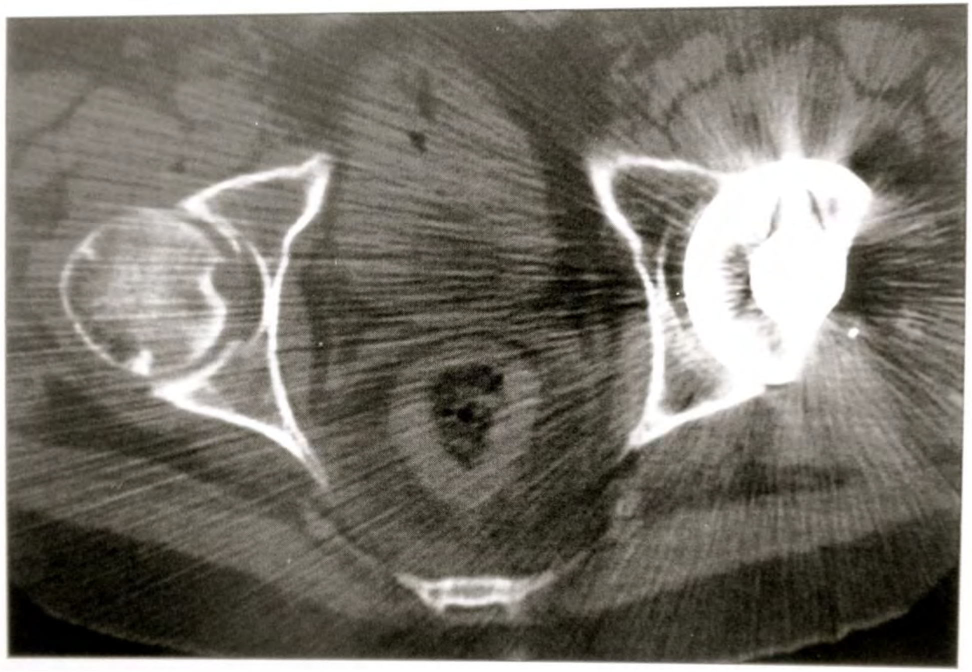
Reinforces the principal that instability following THA is multi-factorial and no implant position guarantees stability.

Radiographic Assessment of THA Component Position



Horizontal Beam Lateral best for anteversion of socket

Component Position – CT Scan



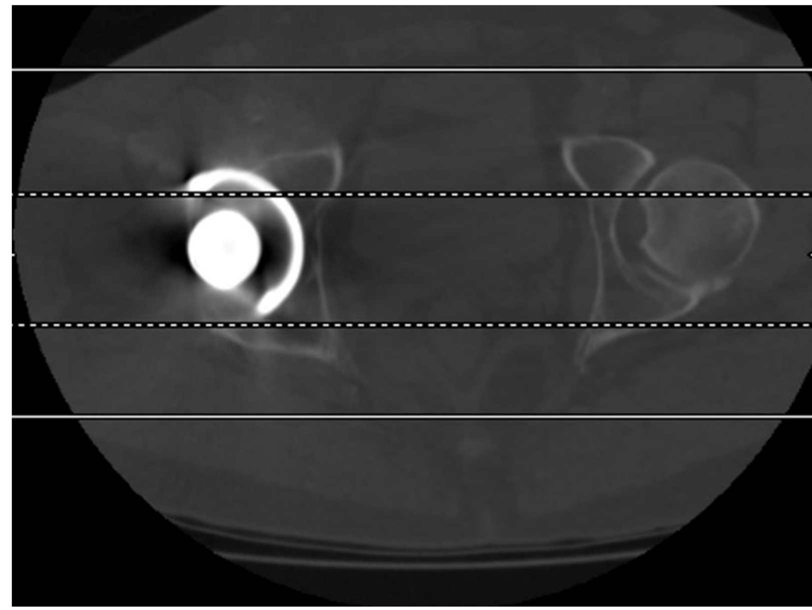
- Key factor is the Accurate assessment of Component Orientation.

CT measurement of the accuracy of component version in total hip arthroplasty

Wines & McNicol. Journal of Arthroplasty 2006;21:696-702

Component Position - Accurate assessment

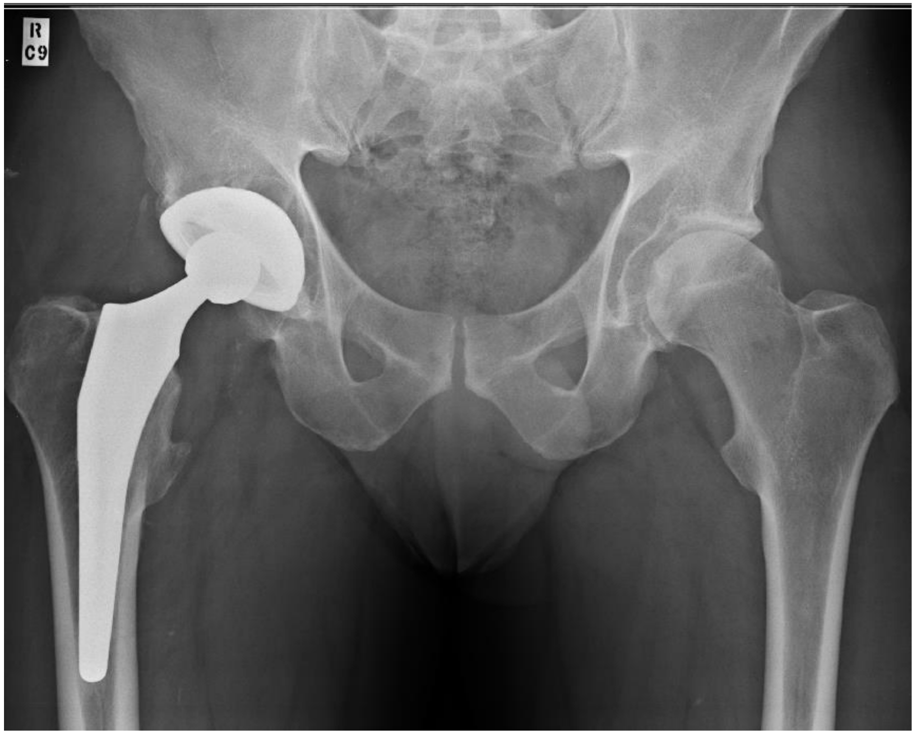
Component Position - Accurate assessment

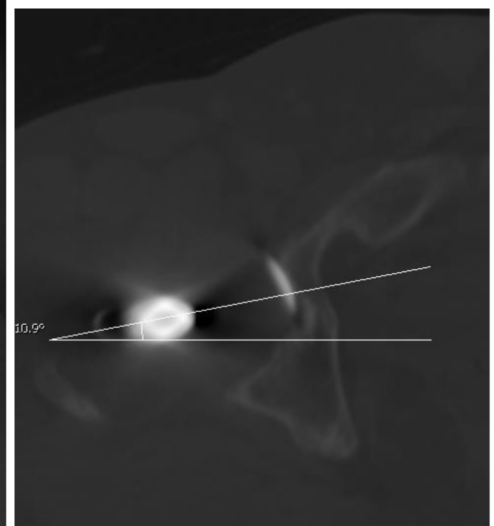


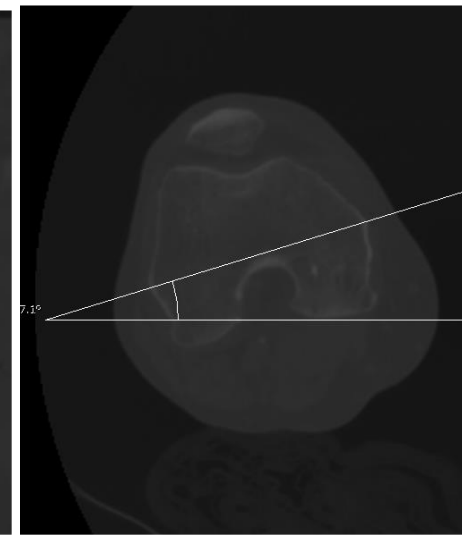
40° retroversion

- **Acetabulum**

Component Position - Accurate assessment







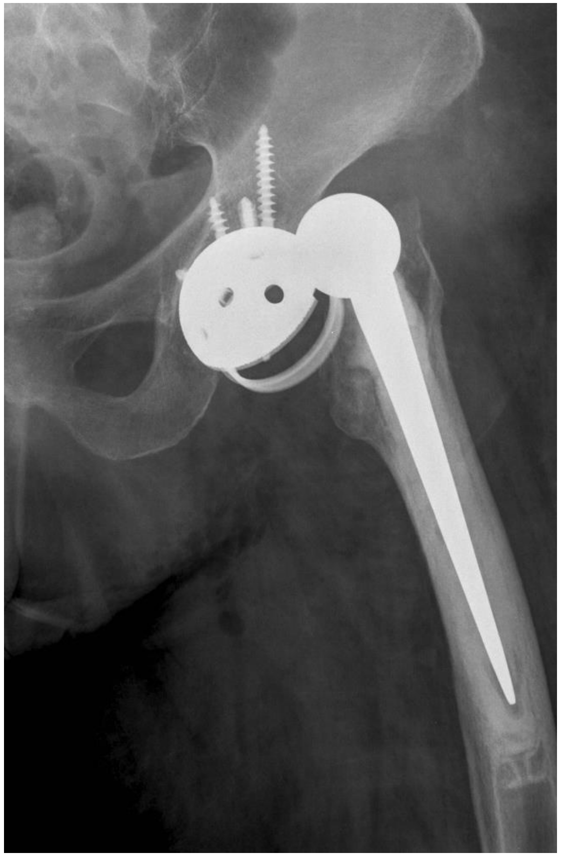
7° retroversion

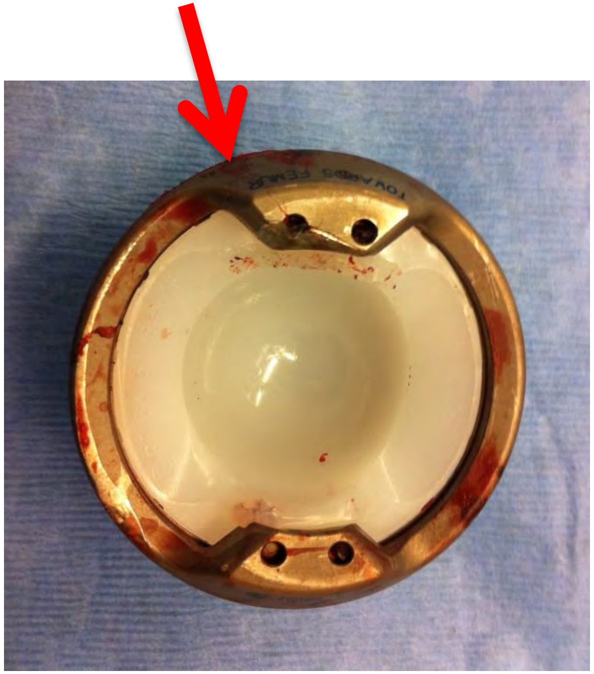
- **Femur**

Solution – Revise Both Components

Constrained Liners – “Overuse Syndrome”

Constrained Liners are NOT a substitute for poor component position !!





Long-term Results of Constrained Liners

- The use of a constrained liner **was protective against re-dislocation.**
  - However a constrained liner **was only effective at preventing re-revision when the cup also exchanged.**

"essential to optimize other factors that may contribute to instability in order to decrease the mechanical failure of constrained liner"

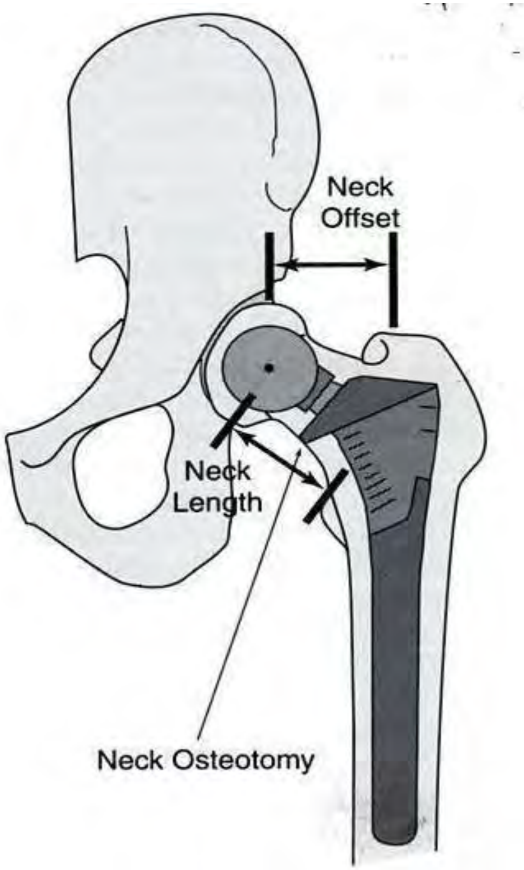
The Cumulative Risk of Re-dislocation After Revision THA Performed for Instability Increases Close to 35% at 15 years
The Journal of Arthroplasty 30 (2015) 1177–1182
S. Jo et al.

Component Design

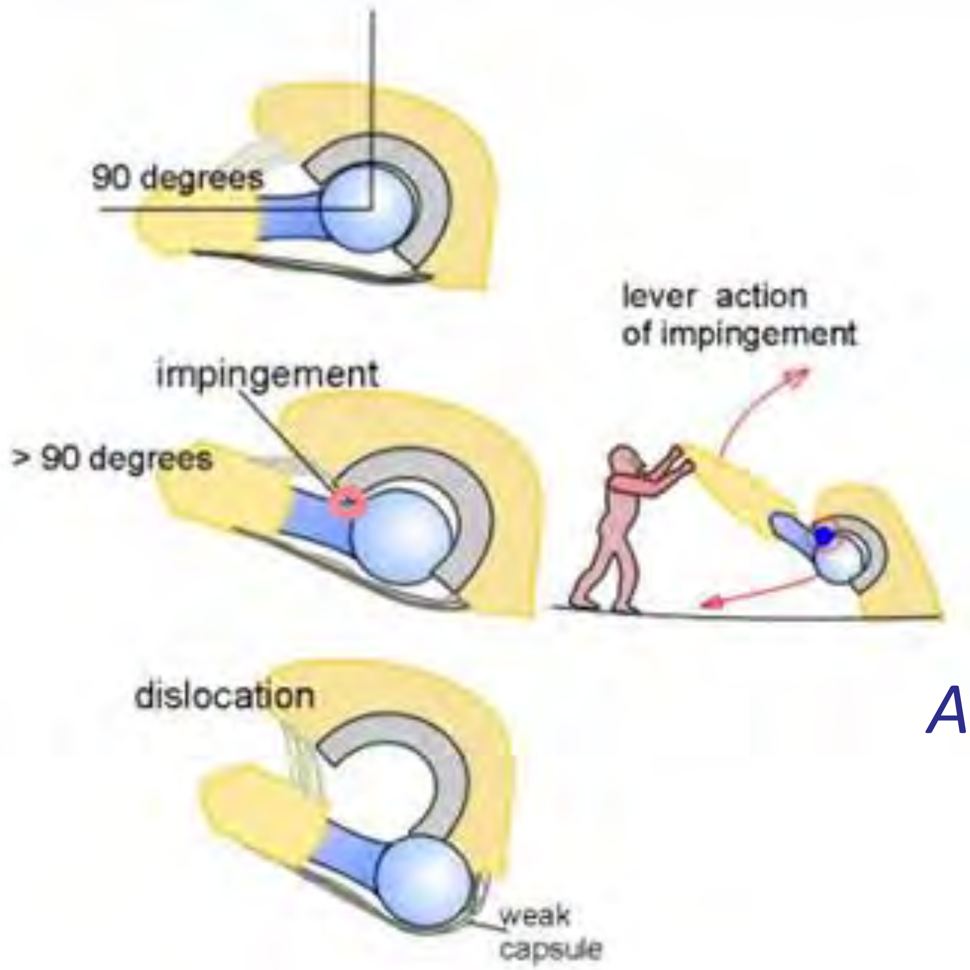
Femoral off-set & Neck length.

Determines abductor lever arm

“soft tissue balancing of the hip”



Impingement-Levering Out-Dislocation



Primary Arc Affected by:

Head Size

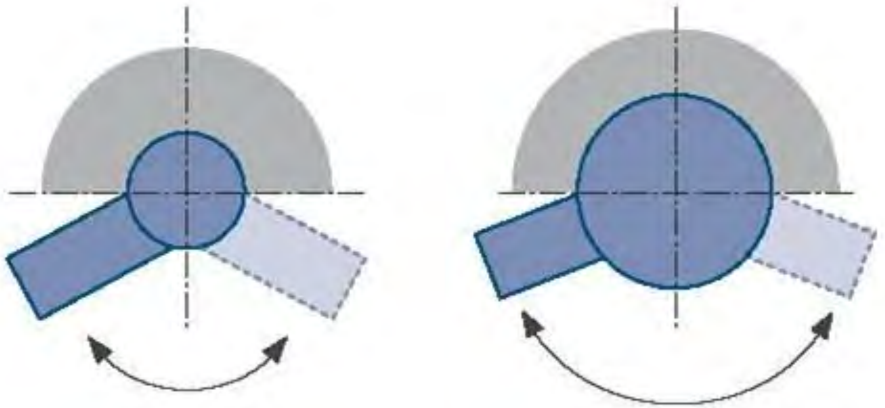
Neck Geometry

Skirted Femoral Heads

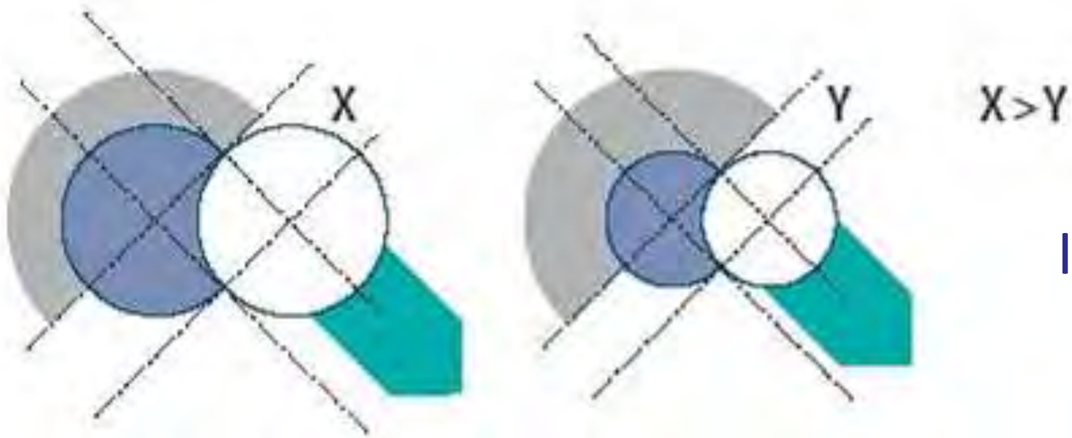
Acetabular Liner Elevated Rims

Component Orientation

Advantages of Large Diameter Heads



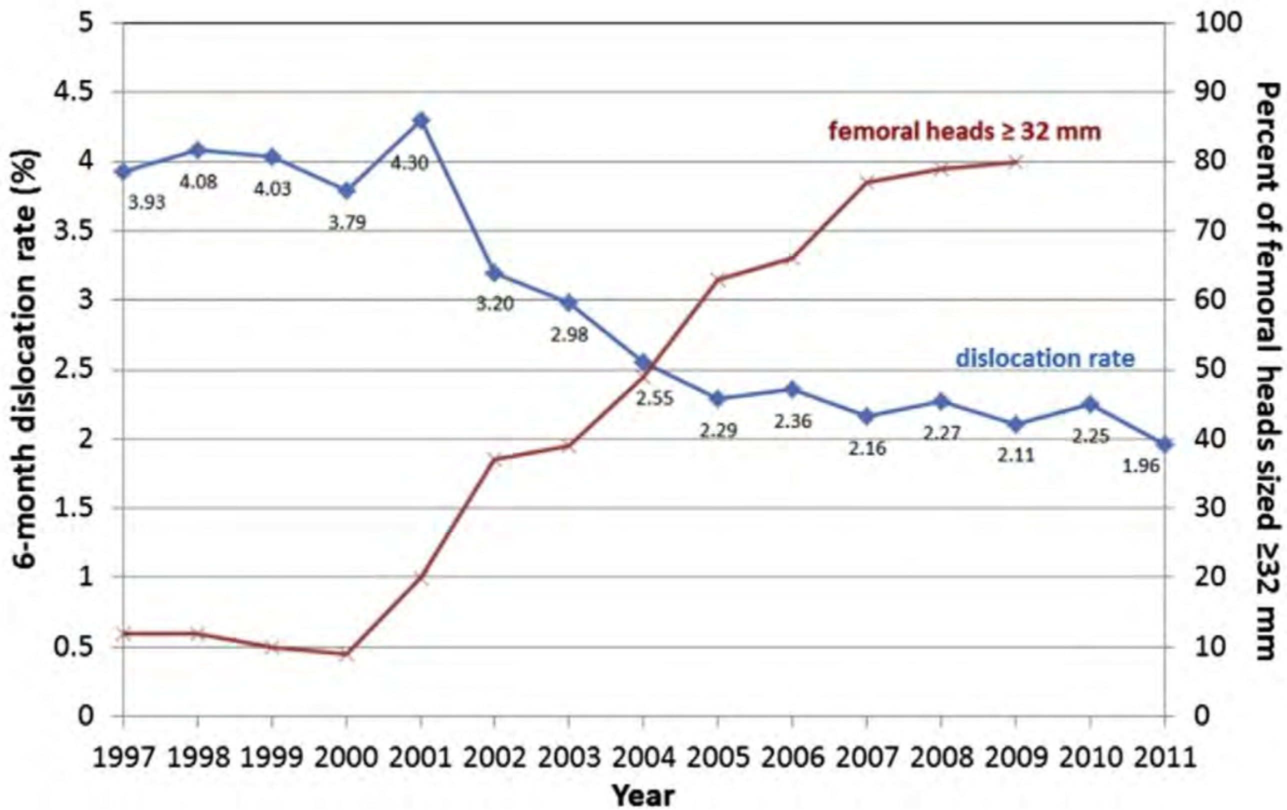
Increased ROM
greater primary Arc
before impingement &
levering out.



Increased jump distance

Large Femoral Heads & Dislocation

Indirect Evidence – Observed trends



Dislocation Rates Following Primary Total Hip Arthroplasty Have Plateaued in the Medicare Population
The Journal of Arthroplasty 30 (2015) 743–746
Goel et al.

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Cardiff and Vale University Health Board

Large Diameter Heads – Level 1 Evidence

- 644 patients in 14 centers undergoing THA

Dislocation **0.8% in 36 mm vs 4.4 % in 28 mm** group

Large Femoral Heads Decrease the incidence of Dislocation after Total Hip Arthroplasty;A RCT, Howie DW,Holubowycz OH, Middleton R. JBJS(A) 2012; 94: 1095-1102

- 184 patients in 7 Centers undergoing Revision THA

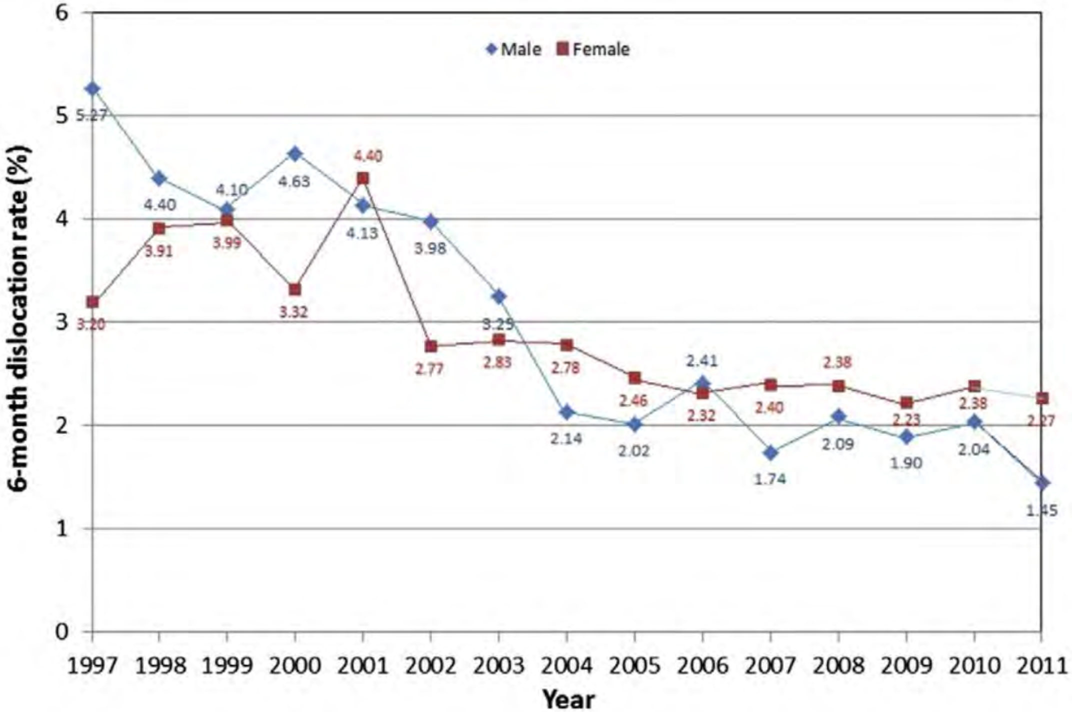
1.1% (36 & 40mm heads) versus 8.7% (32mm)

Dislocation in revision THA: Do large heads (36/40mm) result in reduced dislocation rates in a randomized clinical trial.

Garbuz DS et al Clin Orthop Relat Res.

Larger femoral heads & Modern Practice

- 51,901 patients undergoing primary THA
- From 2005-11 dislocation rates plateau in US at **2%**.



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Instability – Soft Tissues Factors

- **Abductor failure**

Greater Trochanter / Muscle & SGN/ Attachment

- **Posterior soft tissue envelope**

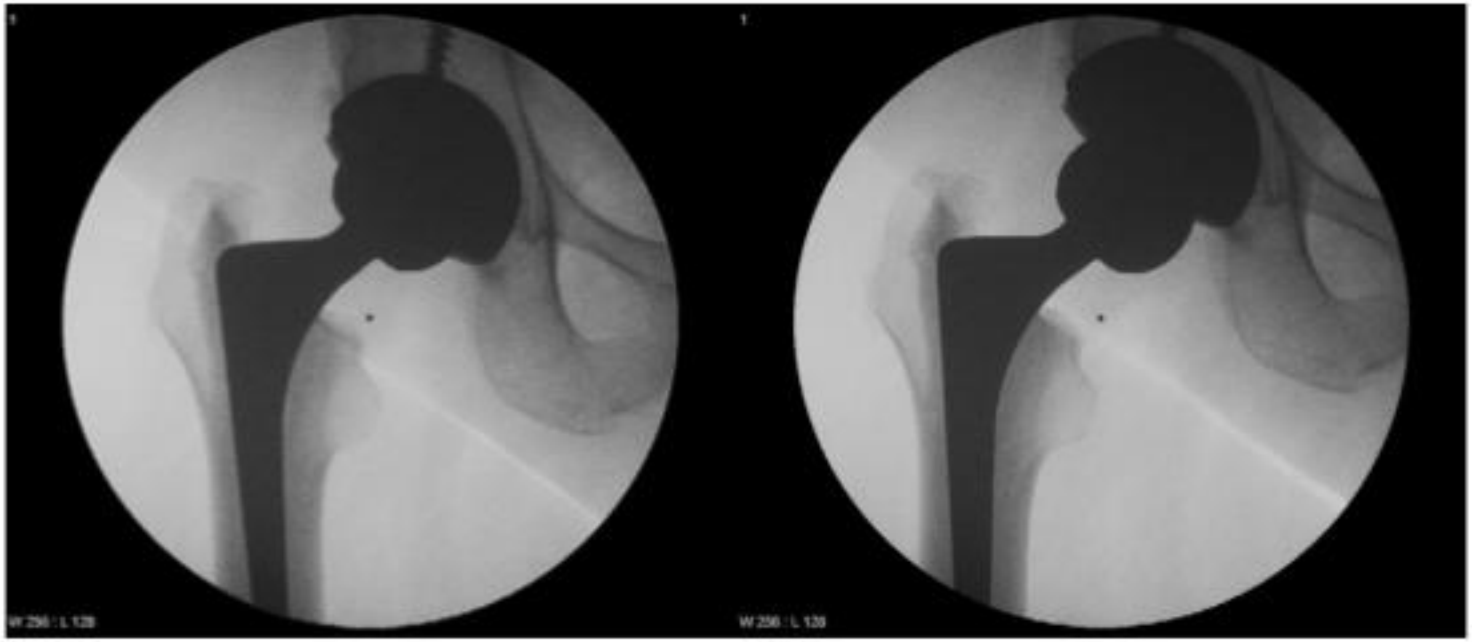
Capsule & SER’s

- **Soft tissue laxity**

Local / Generalized

Soft Tissue Factors

Soft Tissue Factors



- Can be difficult to assess
- EUA & Fluoroscopy Screening can be helpful

Treatment – c/f Shoulder

- **Static Stabilisers**
  - Capsule
  - Component Orientation
  - Component Design
- **Dynamic Stabilisers**
  - Abductors
  - Integrity & Biomechanics of Greater Trochanter
  - Neuromuscular function

Instability - Mechanism

- Clinical History – Provocative Mechanism
- Key to successful closed reduction
- Aid understanding of Aetiology
- Major clue to which soft tissues disrupted

Instability - Time Scale from Index Surgery

- **Majority of early dislocations**
  - Incomplete healing of soft tissue envelope
  - Most common reason is component malposition

- **Late dislocation**
  - More often associated with symptoms of subluxation
  - Wear & Loosening commonplace
  - Don’t forget change in patient (eg cognitive/neurological)

Early Dislocation – Socket Malposition

Late Instability – Component Wear

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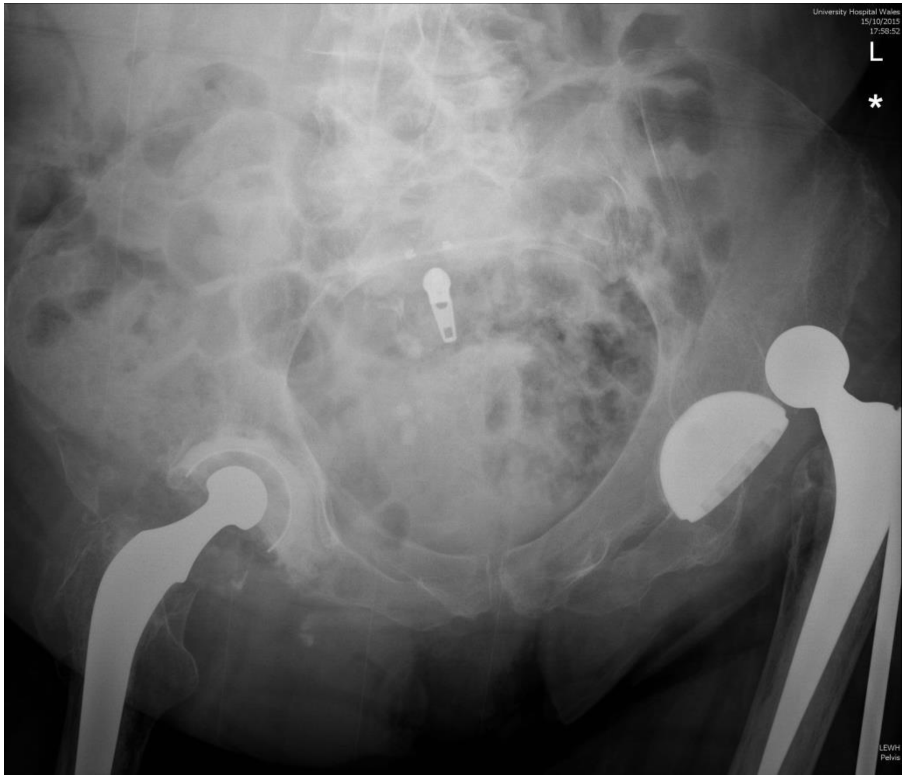
Late Instability – Check radiographs



Late Instability – Soft Tissue Damage

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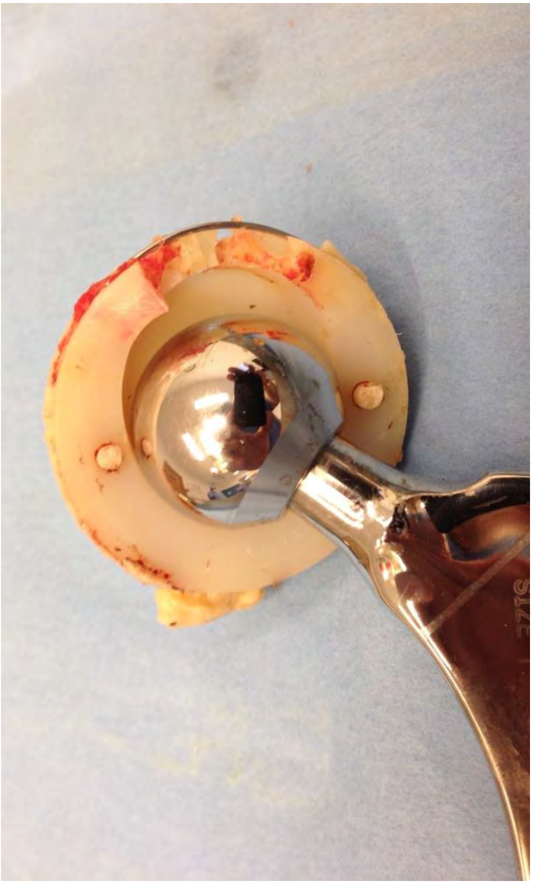
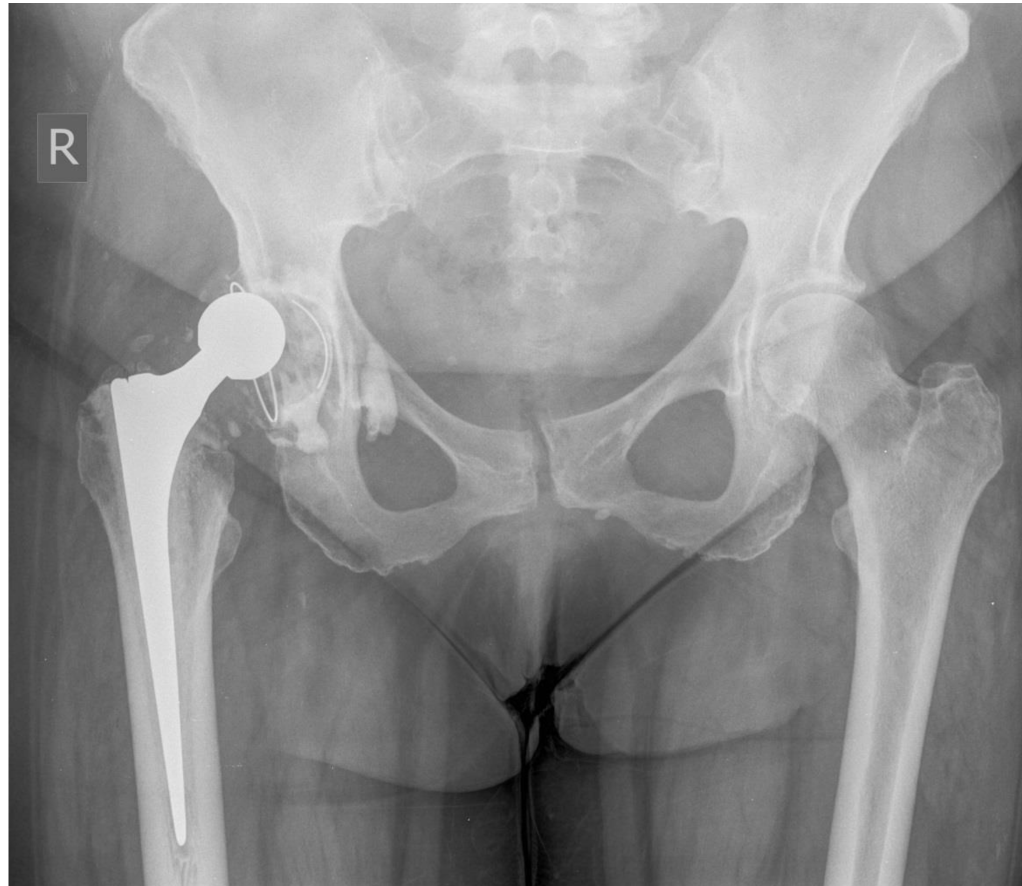
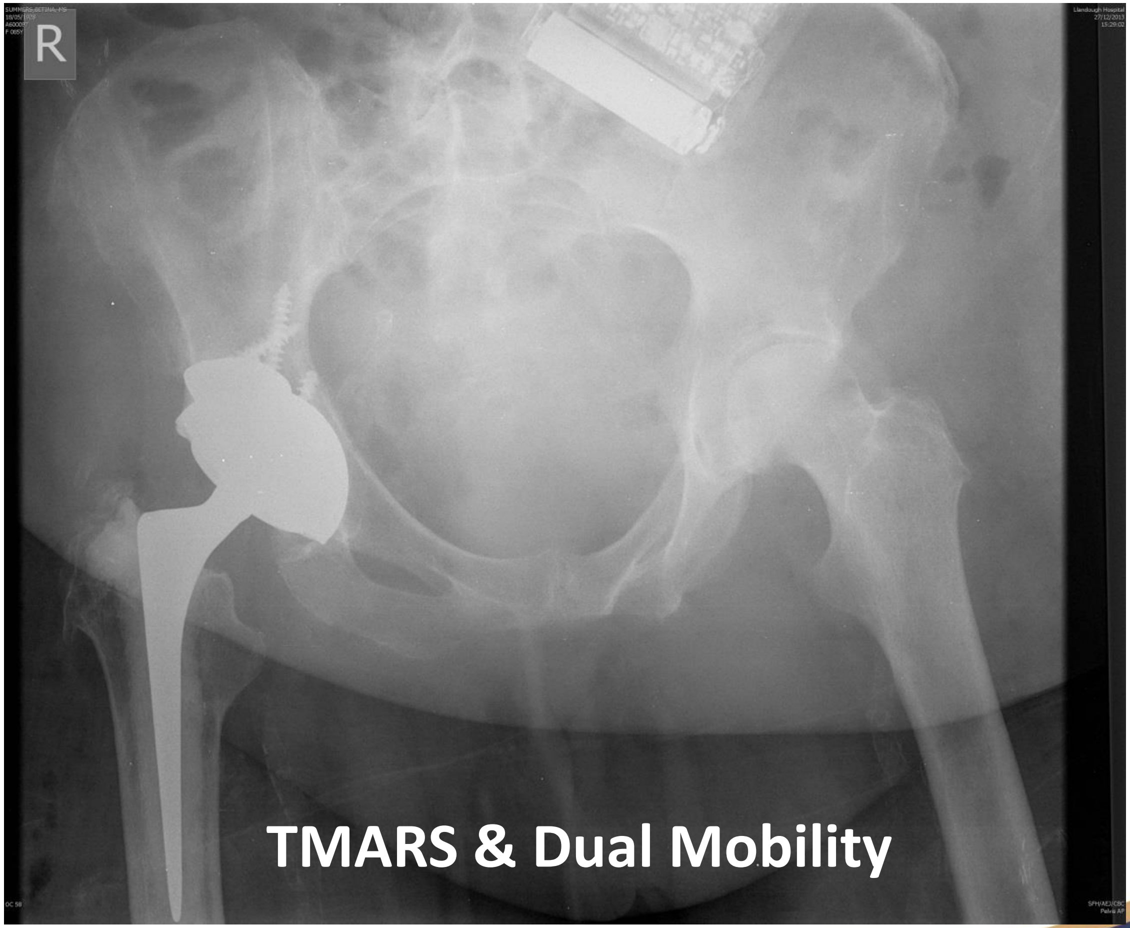
Late Instability – Component Wear & Loosening

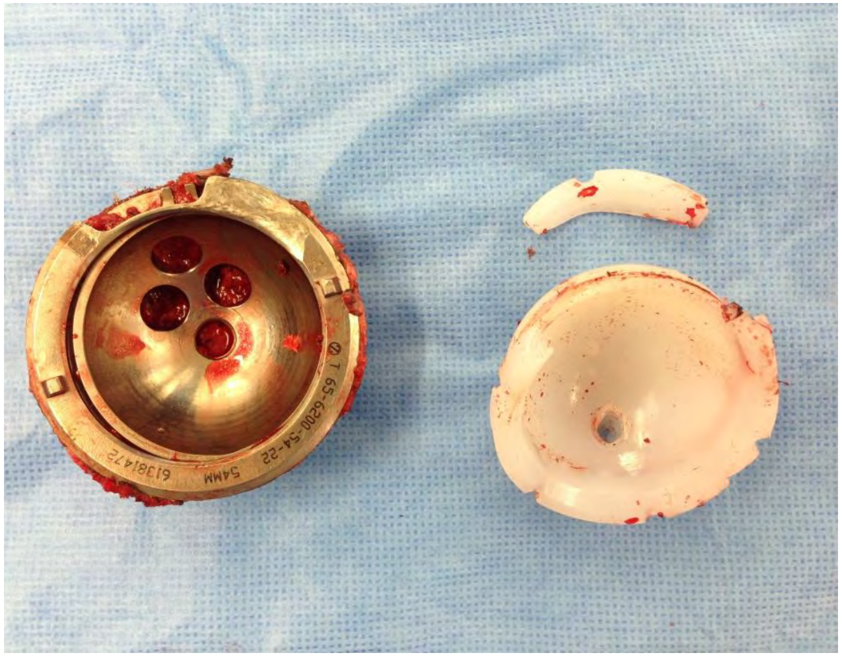




Late Instability –
Component Loosening & Major Bone Loss



Late Instability – Component Fracture



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4th Revision Surgery – Planning

Multi-factorial

Patient factors: Compliance & undiagnosed neurological condition
Surgeon factors: multiple surgeries but focused on single issue
Implant Orientation: Stem not been addressed
Implant Design: Maximize Head-Neck ratio
Soft Tissue factors: result > 30 dislocations

4th Revision Surgery - The Solution

Component Revision Cup & Stem

Constrained Bearing

36mm head

Slender neck

Trochanteric advancement

8 Year F/U
No Further Instability

Diagnosing Instability

Patient Factors
Surgeon Factors
Implant Orientation
Implant Design
Soft Tissue Factors

Accurate Assessment is the key !

INTERNATIONAL COMBINED MEETING

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MILAN, ITALY

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY

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26-27 NOVEMBER 2015

MILAN, ITALY

THA Dislocation: Diagnosis and Prevention

D'Angelo F., Serrao L.

Department of Orthopedics and Traumatology

University of Insubria - Varese

Director: Prof. P. Cherubino

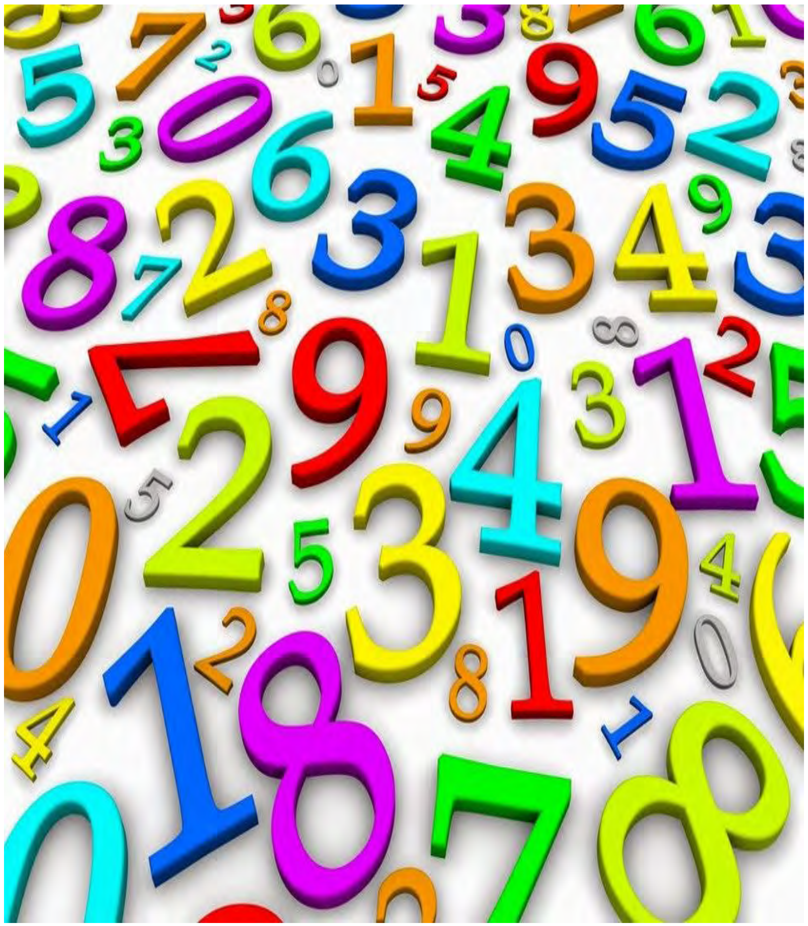
Dislocation

Complete loss of contact between the femoral head and acetabular component that requires intervention for reductions

Classification

- Time of dislocation
  - Early (Within the first 3 months)
  - Late (5 or more years later than surgery)
- Recurrency
  - Single dislocation
  - Recurrent dislocation
- Direction
  - Anterior
  - Posterior
  - Superior

Epidemiology



- Second cause of revision surgery
- Various Rates of dislocation from 0,3% to 10%
- Higher rates in revision surgery (up to 28%)
- Late dislocation is associated with increased risk for recurrency (odds 5) and with implant loosening

Risk Factors

- Patient's Factors

- Surgery Factors
  - Surgical approach
  - Implant Positioning

Patient's Factors

	Parameter	OR	P-value	Source
Age	>70 y vs <70y	1,2	0,05	Berry et al., 2005
	>80y vs <80	1,5		Hernigou et al., 2013
Gender	Female vs male	1,2	<0,05	Berry et al.,2005
		2,1		Hernigou et al., 2013
Weight	BMI >30	3,7	<0,05	Azodi et al., 2009
		2,3	<0,05	Lubbekke et al.,2007
Comorbidities	ASA 3 o 4	10	<0,05	Jolles et al., 2002
Abductor deficency	Trendelemburg +	2,67	<0,05	Wetters et al., 2013

Patient's Factors

- Previous Surgery
- Pre-operative diagnosis and range of motion
  - Arthroplasty on neck Fracture

Authors	OR	P-value
Berry et al. , 2005	1,8	<0,001
Hailer et al. 2012	3,9	<0,001
Conroy et al, 2008	2,03	<0,001

OR for THA dislocation in patient with pre-operative diagnosis of femoral neck fracture

Surgical Factors

- Surgeon Experience
- Surgical Approach
- Component position
- Impingement of bony and soft tissues

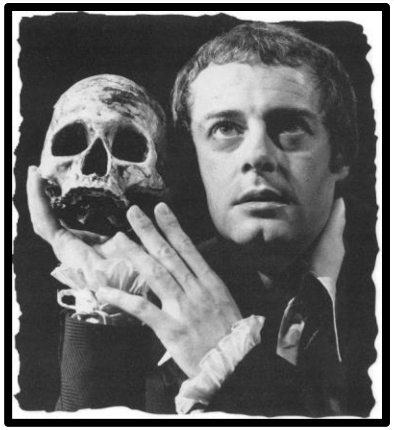
Surgeon Experience

Hospital Volume	Surgeon Volume	Dislocation Rate	Dislocation Adjusted Odds Ratio† (95% Confidence Interval)
26-50	1-5	3.7%	1.0
	6-10	3.0%	0.83 (0.66, 1.05)
	11-25	2.5%	0.69 (0.54, 0.89)
	26-50	2.9%	0.84 (0.53, 1.31)
	>50	1.3%	0.34 (0.10, 1.13)
51-100	1-5	3.2%	1.0
	6-10	3.4%	1.1 (0.81, 1.45)
	11-25	2.2%	0.70 (0.52, 0.95)
	26-50	2.1%	0.65 (0.46, 0.92)
	>50	1.1%	0.33 (0.19, 0.59)
>100	1-5	2.5%	1.0
	6-10	2.5%	1.2 (0.57, 2.45)
	11-25	2.6%	1.2 (0.61, 2.20)
	26-50	2.6%	1.2 (0.68, 2.20)
	>50	1.7%	0.95 (0.51, 1.77)

*The results were restricted to hospitals in which more than twenty-five elective primary total hip replacements were performed in Medicare beneficiaries from July 1995 through June 1996. †Each odds ratio is adjusted for gender, age, comorbidity, Medicaid eligibility, and arthritis diagnosis.

Katz et al. **Association Between Hospital and Surgeon Procedure Volume and Outcomes of Total Hip Replacement in the United States Medicare Population.** The Journal of Bone and Joint Surgery-American Volume
Issue: Volume 83-A(11), November 2001, pp 1622-1629

Surgical Approach



One of the most controversial factor influencing hip stability after surgery

Masonis JL et al., Clin Orthop Relat Res, 2002

Surgical approach	Rate of dislocation
Transtrochanteric	1.27%
Anterolateral	2.18%
Direct lateral	0.55%
Posterior with capsular repair without c. repair	3.23% 2.03% 3.95%

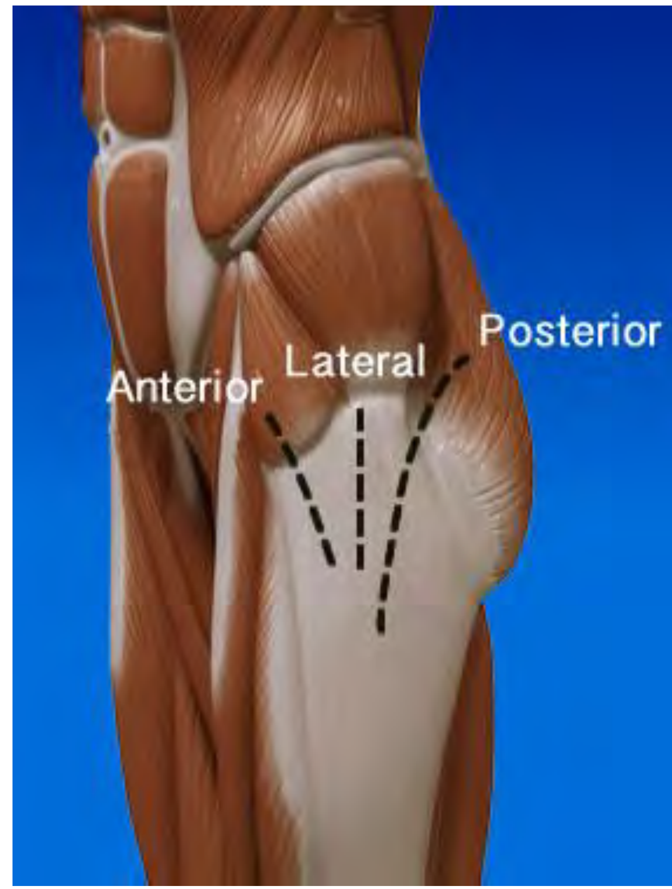


TABLE 1. Surgical Approach and Dislocation

Author/Reference	Number of Primary THA	Approach/THA	Dislocation
Eftekhar[11]	1560	TT—1560	0.5%
Fackler and Poss[13]	1224	Posterior*—1224	1.8%
Roberts et al[33]	175	Posterior—100	4.0%
		Anterolateral—75	1.3%
Woo and Morrey[38]	2459	TT—1241	2.2%
		Posterior—588	5.6%
		Anterolateral—660	2.2%
Vicar and Coleman[37]	269	TT—136	2.2%
		Posterior*—42	9.5%
		Anterolateral—91	2.2%
Frndak et al[14]	50	Lateral—50	2.0%
Horwitz et al[23]	100	TT—51	0%
		Lateral—49	0%
Turner[35]	477	Posterior*—477	3.98%
Moskal and Mann[29]	306	Lateral—306	0%
Pellicci et al[31]	519	Posterior*—519	0.2%
	555	Posterior—555	4.68%
Mallory et al[27]	1518	Lateral—1518	0.79%
Woolson and Rahimtoola[39]	315	Posterior—315	4%
Yuan and Shih[40]	2161	Posterior—2161	3.29%
Demos et al[8]	1515	Lateral—1515	0.4%
Totals	13,203	TT—2988	1.27%
		Anterolateral—826	2.18%
		Lateral—3438	0.55%
		Posterior (all)—5981	3.23%
		Posterior—3719	3.95%
		Posterior*—2262	2.03%

Masonis et al. **Surgical Approach, Abductor Function, and Total Hip Arthroplasty Dislocation**, CLINICAL ORTHOPAEDICS AND RELATED RESEARCH, 2002, N° 405, Pag 46-53

Surgical Approach

Influence of postero-lateral capsular repair on dislocation rates in posterior approach

Pellicci PM et al., Clin Orthp Relat Res, 1998

395 patients

4.68% ➔ 0.2%

Goldstein WM et al., J Bone Jint Surg Am, 2001

1515 patients

4.8% ➔ 0.7%

White Jr RE et al., Clin Orthp Relat Res, 2001

1000 patients

2.8% ➔ 0.6%

Surgical Factors

Implant Positioning

Lewinnek's Safe Zone:

- Abduction 30°-50°
- Anteversion 5-25°

Anteversion 10-25°

Redefining the Acetabular Component Safe Zone for Posterior Approach Total Hip Arthroplasty

Jonathan R. Danoff, MD, Jacob T. Bobman, BS, Gregory Cunn, MD, Taylor Murtaugh, BS, Prakash Gorroochurn, PhD, Jeffrey A. Geller, MD, William Macaulay, MD

Center for Hip & Knee Replacement, Department of Orthopaedic Surgery, New York Presbyterian Hospital/Columbia University Medical Center, New York, New York

Journal of Arthroplasty ,sept 2015

Surgical Factors

Implant Positioning

Femoral Offset

Centre of Rotation

Soft Tissue Balance

Reduced Impingement

Diagnosis

Is THA dislocated?

What Kind of dislocation is it?

Why THA dislocated?

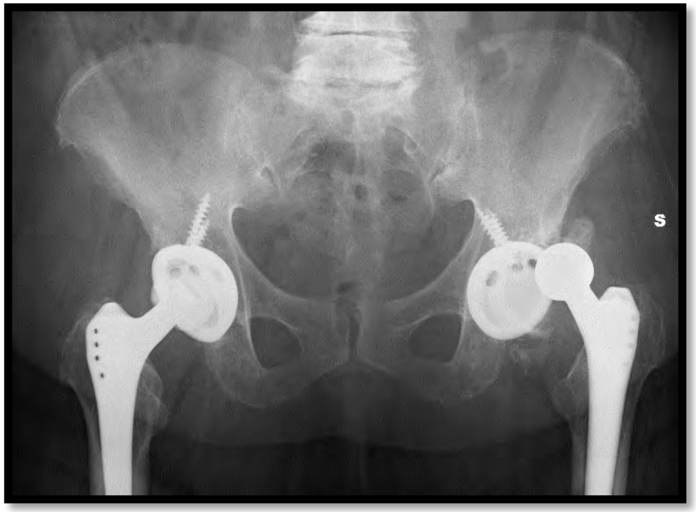
Why THA Dislocated?

- Trauma
- Patient's Movements
- Component Malpositioning
- Soft-tissue Imbalance
- Implant Impingement
- Implant loosening

Diagnosis

Anamnesis

Clinical Exam



Imaging

Diagnosis

Anamnesis

- Searching for Patient's Risk Factor
- History of dislocation
- Number of dislocation
- Time from surgery

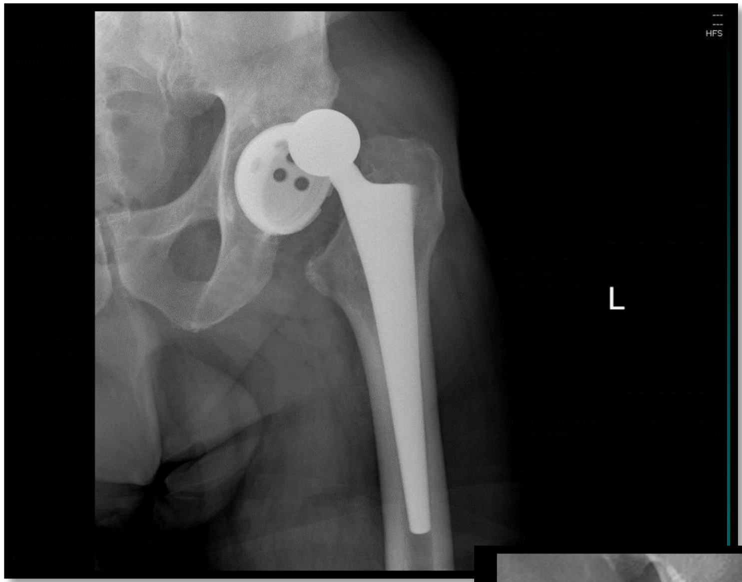
Diagnosis

Clinical Exam

- PAIN
- Flexion, adduction and internal Rotation (more frequent)
- Flexion, abdction and external rotation (rare)
- Possible Neurologic lesion (Sciatic Nerve)
- Scar analysis ➔ Identify surgical approach
- Legs lenght difference
- Abductor strenght

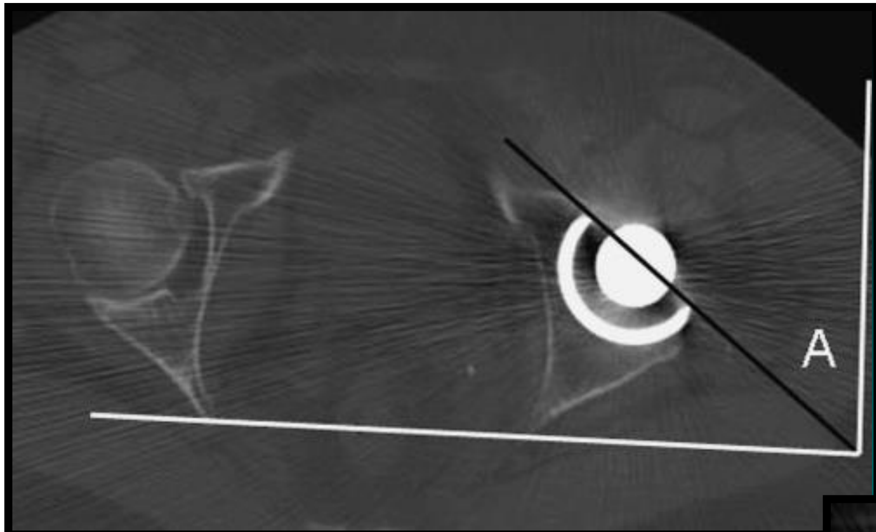
Diagnosis

X-Ray



Diagnosis

Tc → To evaluate cup positioning



Low anteversion of the acetabular component

What's the best treatment for THA Dislocation?

PREVENTION

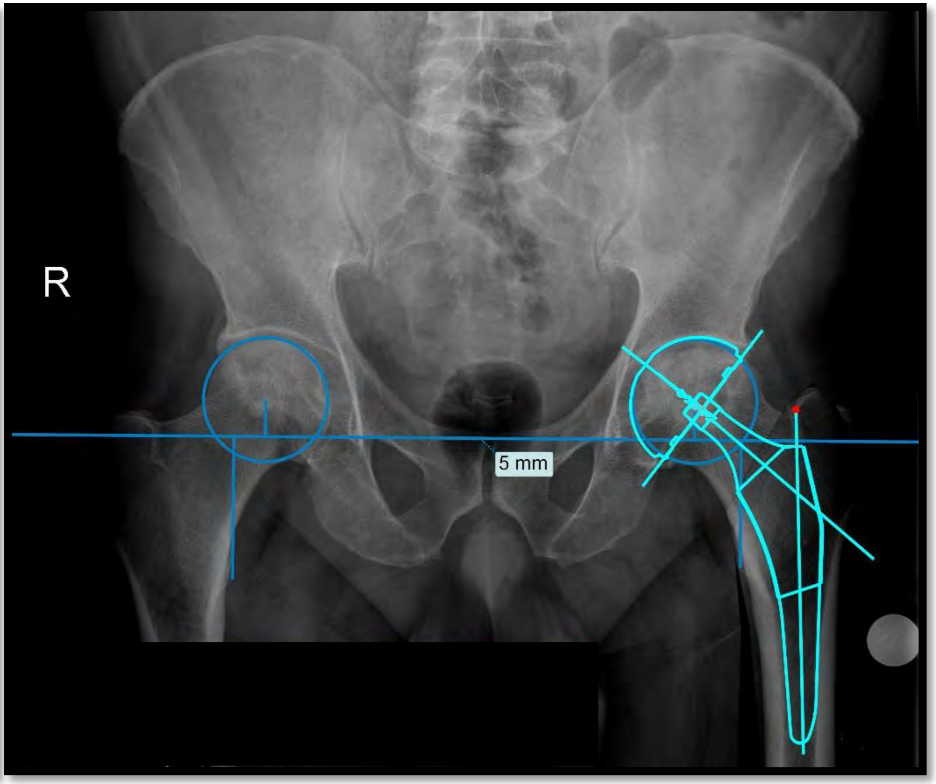
Prevention Of THA Dislocation

- Pre-operative
- Intra-operative
- Post-Operative

Pre-Operative

Identify patient's risk factors and select the best implant

Pre-Operative



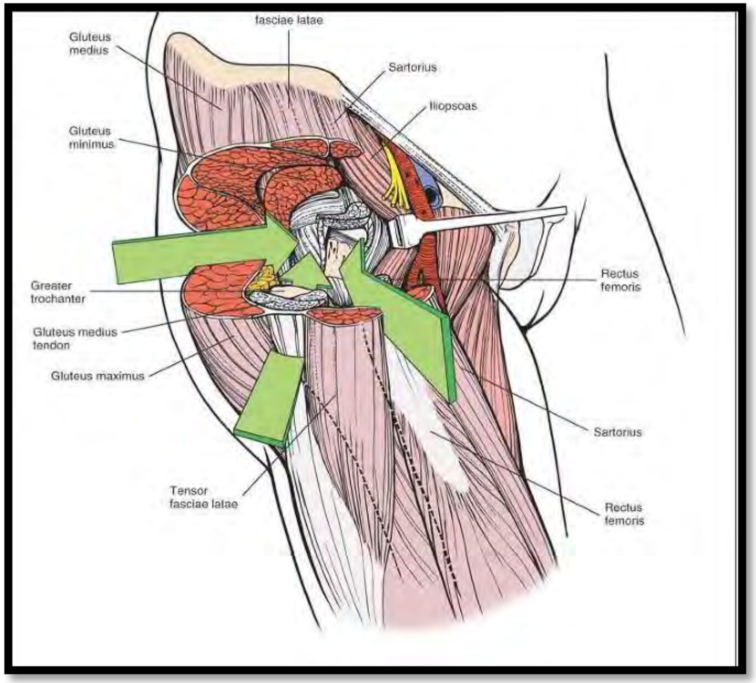
Pre-operative planning: restore centre of rotation and femoral offset:

- Minimize Bone impingment
- Restore correct soft tissue tension

Intra-Operative

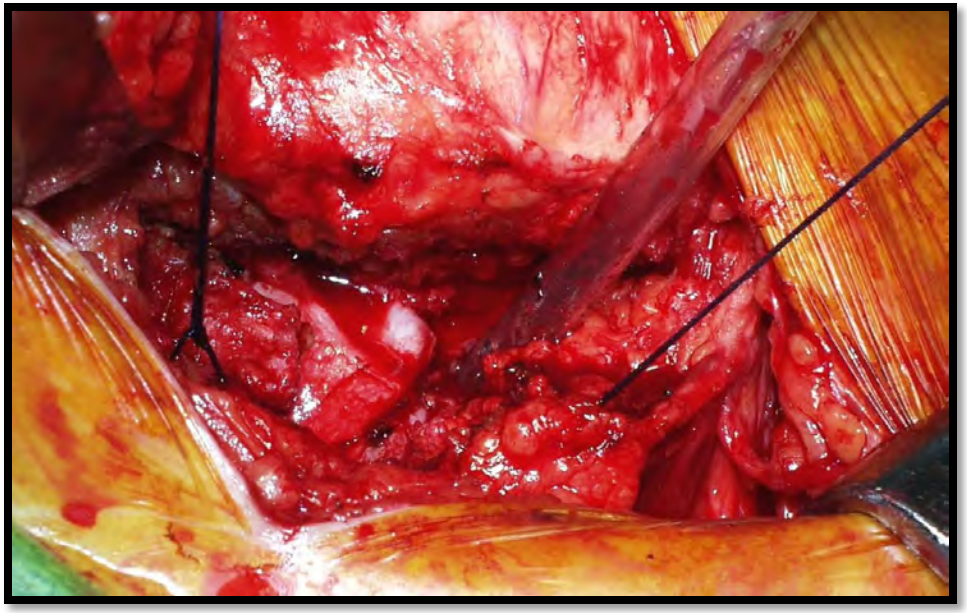
Surgical Approach

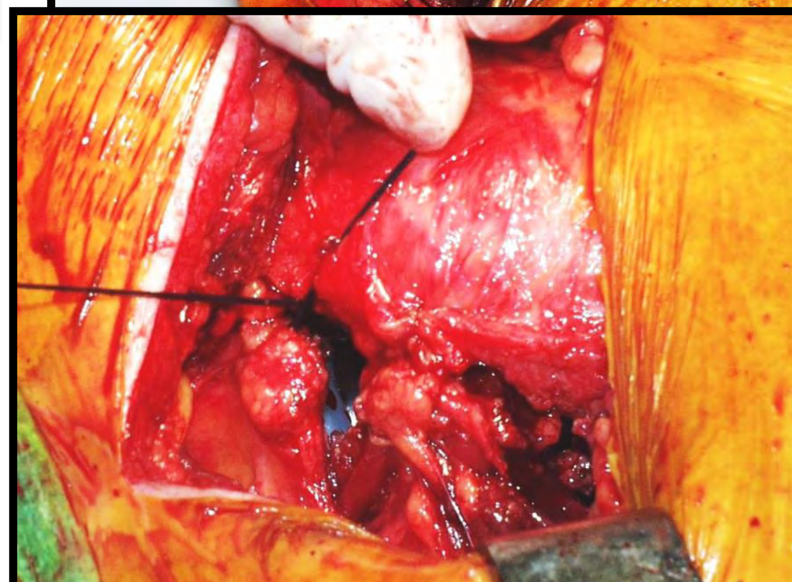
THE BEST APPROACH IS THE MOST FRIENDLY FOR SURGEON



Surgeon experience reduces risk of dislocation

Intra-Operative





Performing a <u>POSTERO-LATERAL APPROACH,</u> it is mandatory to repair the posterior capsule and the external rotator tendons

Intra-Operative

Implant Selection

- Head size
- Elevated rim liner
- Dual Mobility Cup

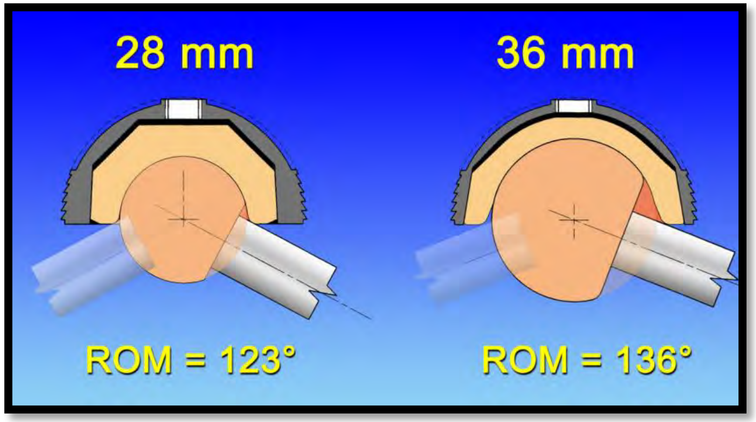
Intra-Operative

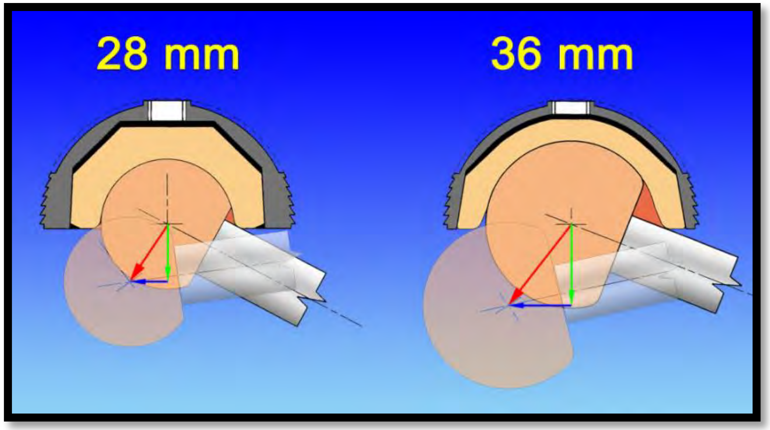
Femoral Head Size

The Biggest the best?

- Higher range of motion
- Higher Jumping distance

Better patient satisfaction





Intra-Operative

Elevated rim liner

- Improved stabilty in one direction
- Possibile correction of anteversion error
- Surgeon safety

- Risk of impingement
- Decrease arc of motion
- Increase polyethylene wear and debris

Intra-Operative

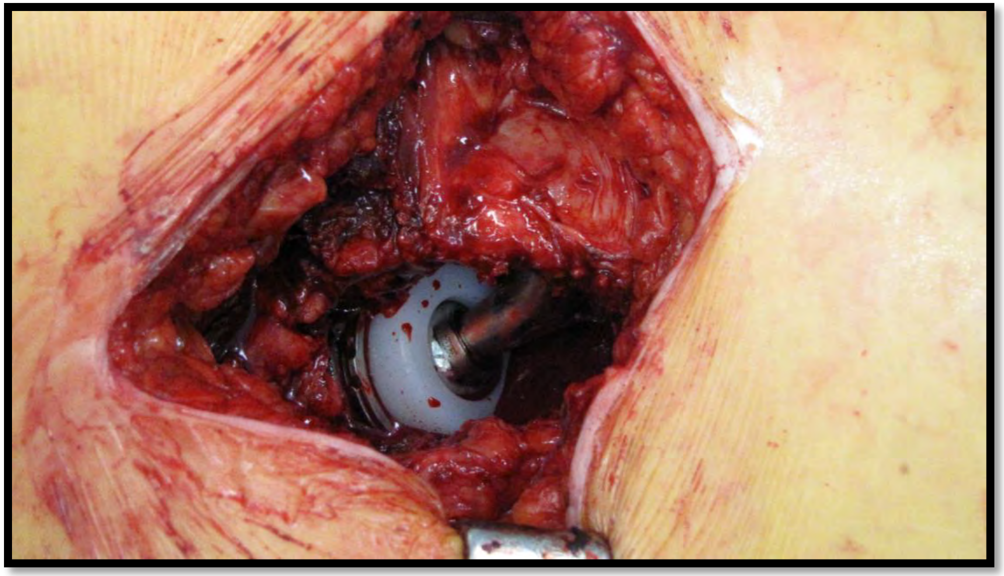
Dual Mobiliy Cups

Low Rate of Dislocation of Dual-mobility Cups in Primary Total Hip Arthroplasty

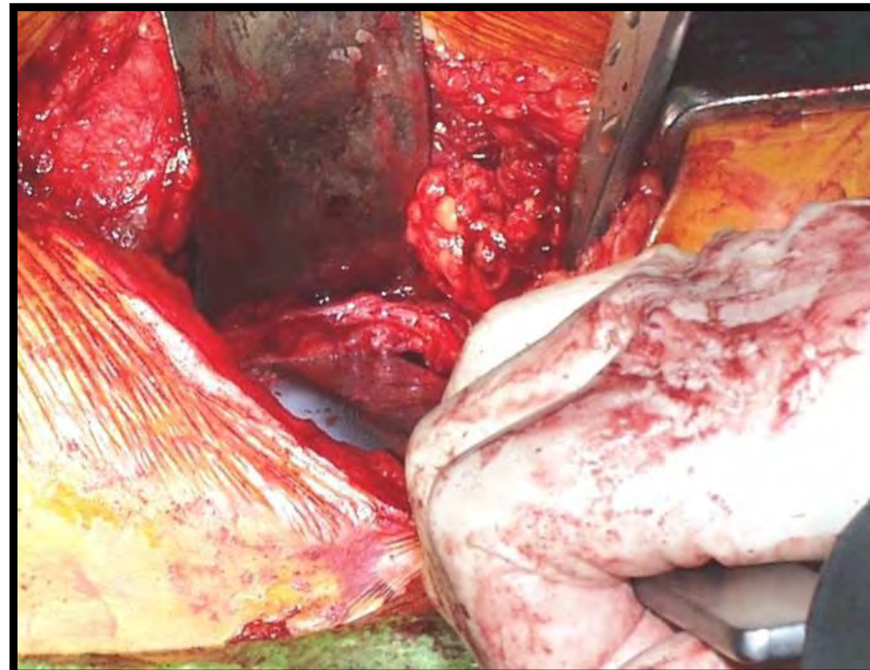
**Antoine Combes MD, Henri Migaud MD,
Julien Girard MD, PhD, Alain Duhamel PhD,
Michel Henri Fessy MD, PhD**

Clinical and orthopaedics related resource, 2013

0,88% of dislocation



Intra-Operative

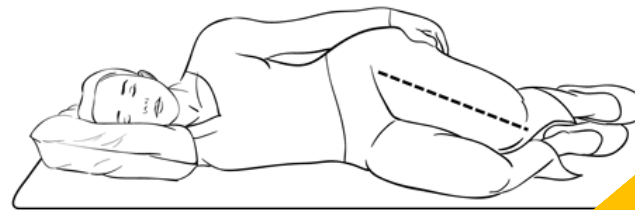


Remove all possibile source of impingement, bone or soft tissue

Post-Operative

Patient's education

- Pillows



- High Chairs and Toilet Seats

- Limited ROM

6 weeks limitations

Post-Operative

Are restrictions really necessary?

Hip Dislocation

Clin Orthop Relat Res (2011)

Are Hip Pr

Camilo Restre
Justin Brother
Richard H. Ro

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NO EVIDENCE WHEN PERFORMED ANTERIOR OR ANTERO-LATERAL APPROACH

BY E. LOUIS PEAK, MD, JAVAD PARVIZI, MD, FRCS, MICHAEL CIMINIELLO, MD, JAMES J. PURTILL, MD, PETER F. SHARKEY, MD, WILLIAM J. HOZACK, MD, AND RICHARD H. ROTHMAN, MD, PHD

Investigation performed at the Department of Orthopaedic Surgery, the Rothman Institute of Orthopaedics at Thomas Jefferson University Hospital, Philadelphia, Pennsylvania

Take Home Massage

- THA dislocation is the second cause of revision surgery
- Diagnosis is quite easy, but it's important to understand why an implant dislocated
- Best treatment is PREVENTION
- There's no one method better than the other, but there is the better method for the specific patient.
- Key points of prevention are the best implant selection and the correct positioning of the implant restoring the best anatomy for the patient


Thanks

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY

SOCIETÀ ITALIANA DELL'ANCA

Assessment of the relationship between pelvic tilt and functional acetabular position with EOS 2D/3D technology

Loppini M., Caldarella E., Della Rocca A., Astore F., Traverso F., Mazziotta G., Grappiolo G.

Department of Orthopaedic and Trauma Surgery, Hip Diseases and Lower Limb Replacement Unit, Humanitas Research Hospital, Milan, Italy

Introduction: epidemiology

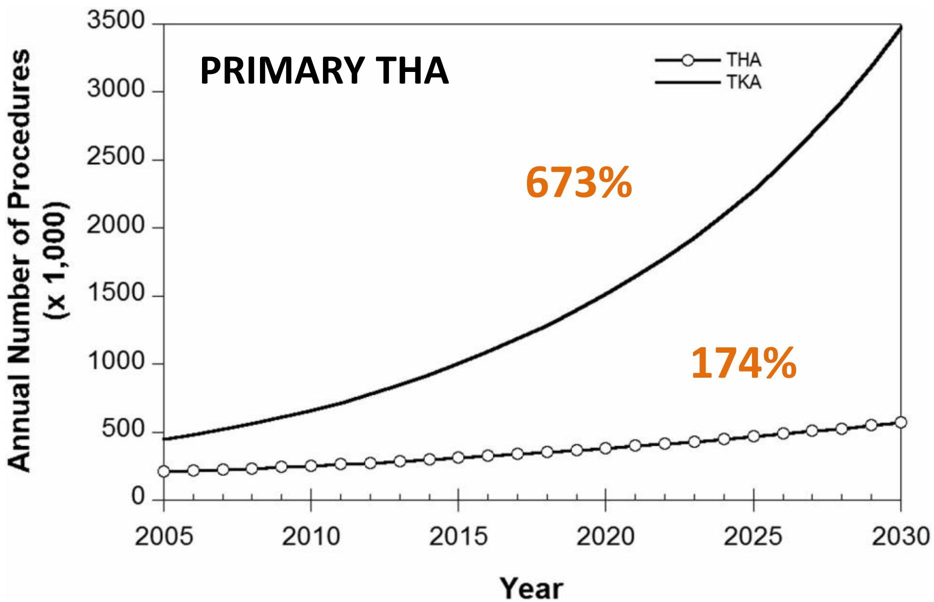
Registro Italiano ArtroProtesi (RIAP)

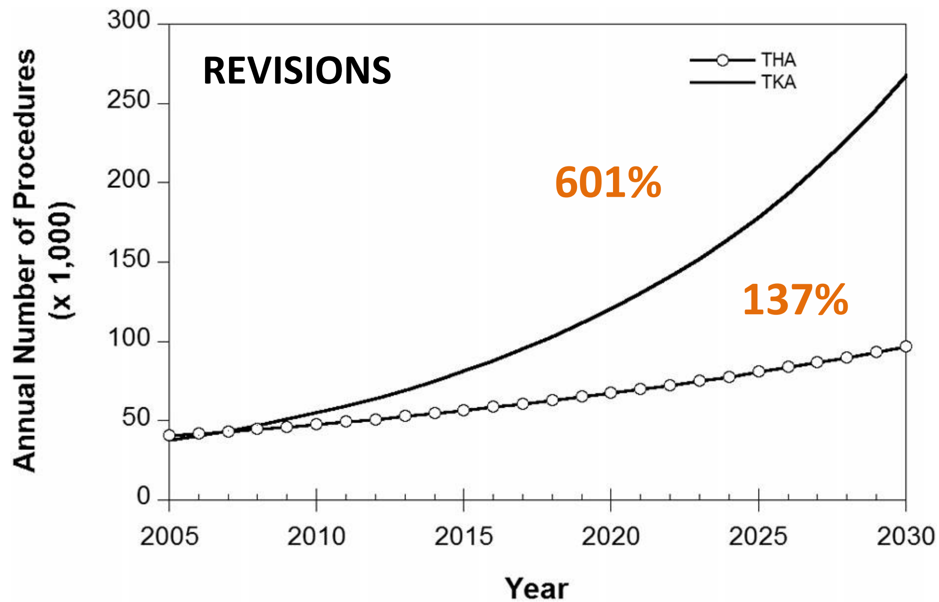
riap

registro italiano artroprotesi
italian arthroplasty registry

In 2013, the overall hip replacement surgeries were 97.399:

- 89.150 (91.5%) primary THA
- 8.249 (8.5%) revision surgery

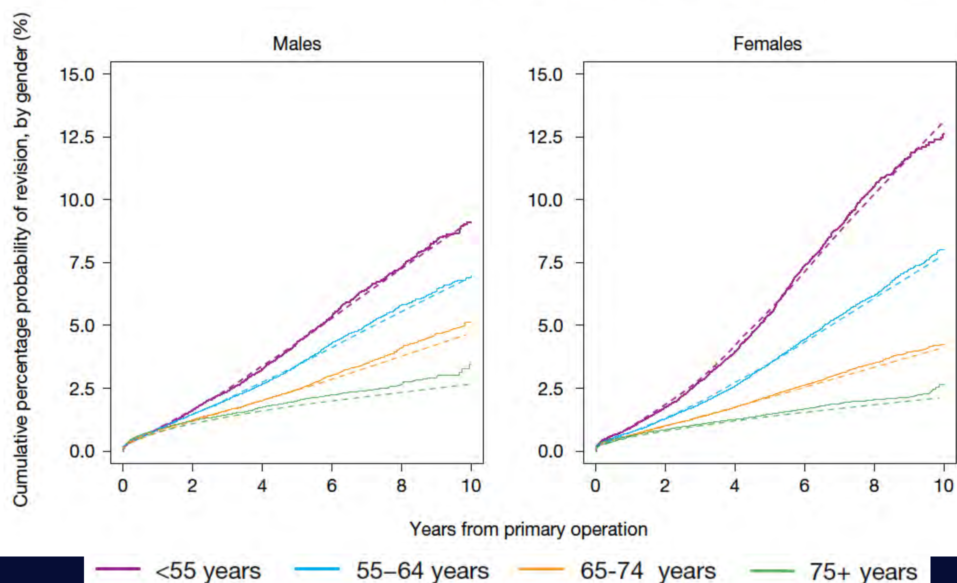




Kurtz S et al. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am. 2007;89(4):780-5.

Introduction: causes of revision

Time from primary operation	Patient-years at risk (x1,000)	Number of revisions per 1,000 patient-years for:						
		Pain	Dislocation/ subluxation	Infection	Aseptic loosening	Lysis	Periprosthetic fracture	Implant fracture
<1 year	497.6	0.85 (0.77-0.94)	2.32 (2.19-2.45)	1.28 (1.18-1.38)	1.28 (1.18-1.38)	0.10 (0.07-0.13)	1.49 (1.38-1.60)	0.27 (0.22-0.31)
1-3 years	756.8	1.25 (1.17-1.33)	0.66 (0.61-0.72)	0.87 (0.80-0.93)	1.38 (1.30-1.47)	0.21 (0.18-0.25)	0.29 (0.26-0.33)	0.14 (0.12-0.17)
3-5 years	469.0	1.77 (1.66-1.90)	0.55 (0.48-0.62)	0.58 (0.51-0.65)	1.48 (1.38-1.60)	0.40 (0.34-0.46)	0.39 (0.34-0.46)	0.12 (0.09-0.16)
5-7 years	227.8	1.96 (1.79-2.15)	0.58 (0.48-0.68)	0.44 (0.36-0.53)	1.75 (1.59-1.93)	0.56 (0.47-0.66)	0.54 (0.46-0.65)	0.17 (0.12-0.23)
>7 years***	75.1	1.72 (1.44-2.04)	0.75 (0.57-0.97)	0.39 (0.27-0.56)	1.88 (1.59-2.21)	0.84 (0.65-1.07)	0.48 (0.35-0.66)	0.15 (0.08-0.26)

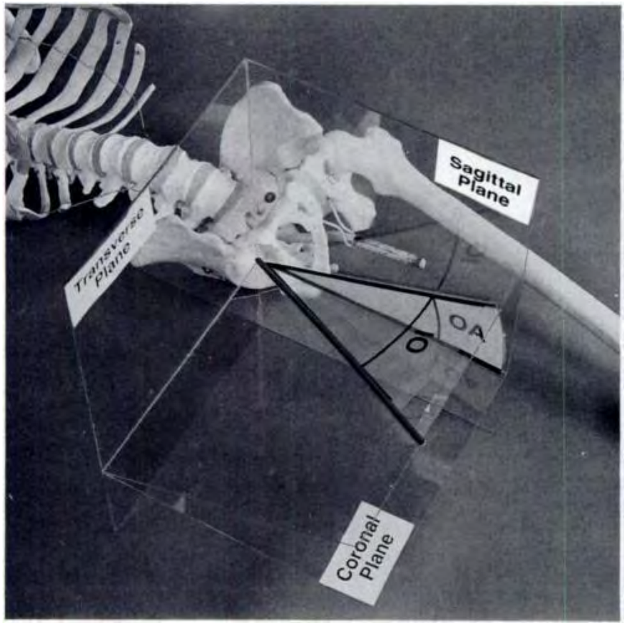


NJR National Joint Registry
www.njrcentre.org.uk
Working for patients, driving forward quality

Introduction: acetabular orientation

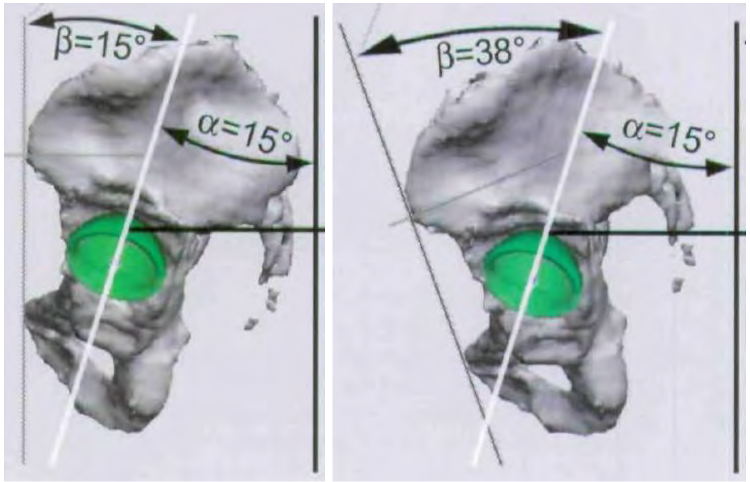
The “safe” range for cup orientation:

- **Inclination of 40° ± 10° (AI)**
- **Anteversion of 15° ± 10° (AA)**



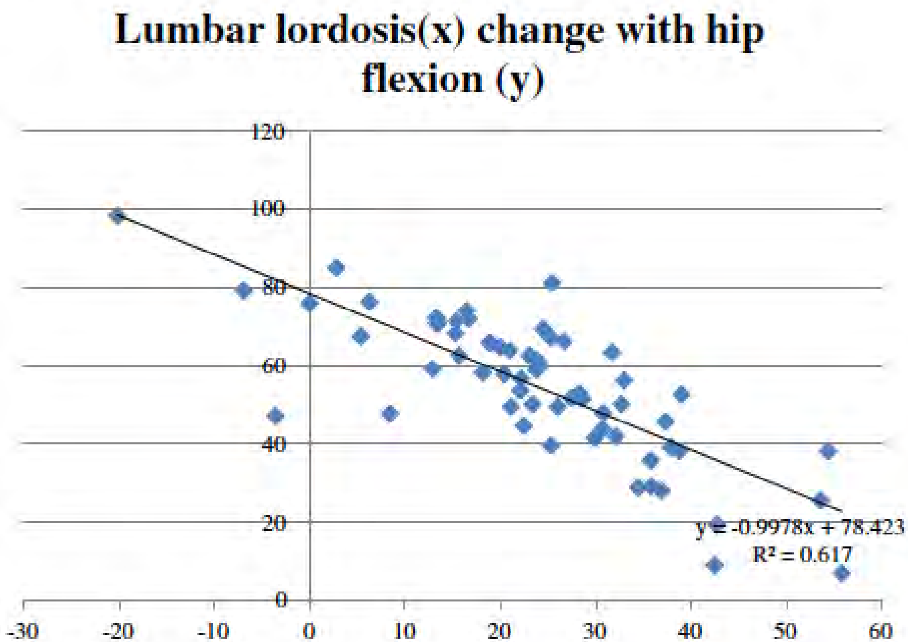
For every 5° of change in the pelvic tilt:

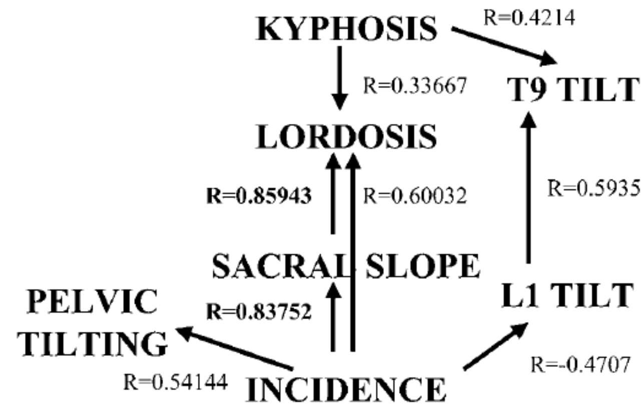
- anteversion changes 4°
- inclination changes 1.5°

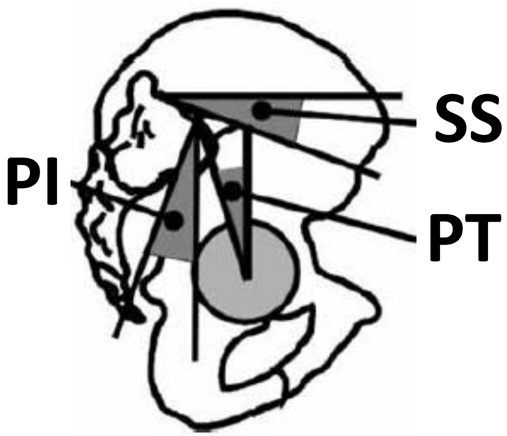


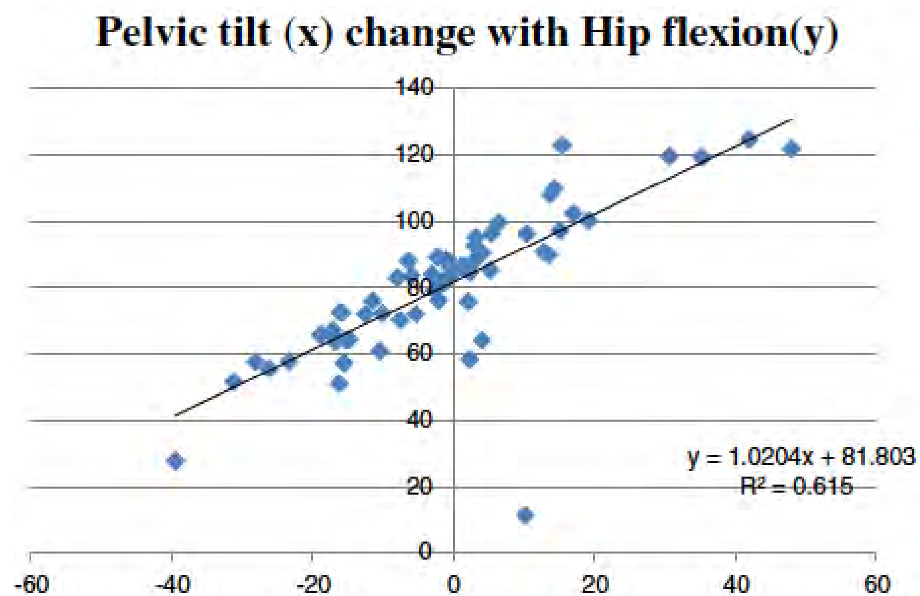
Lewinnek GE et al. Dislocations after total hip-replacement arthroplasties. J Bone Joint Surg Am. 1978;60(2):217-20.
Babisch JW et al. The rationale for tilt-adjusted acetabular cup navigation. J Bone Joint Surg Am. 2008;90(2):357-65.

Introduction: spino-pelvic biomechanics





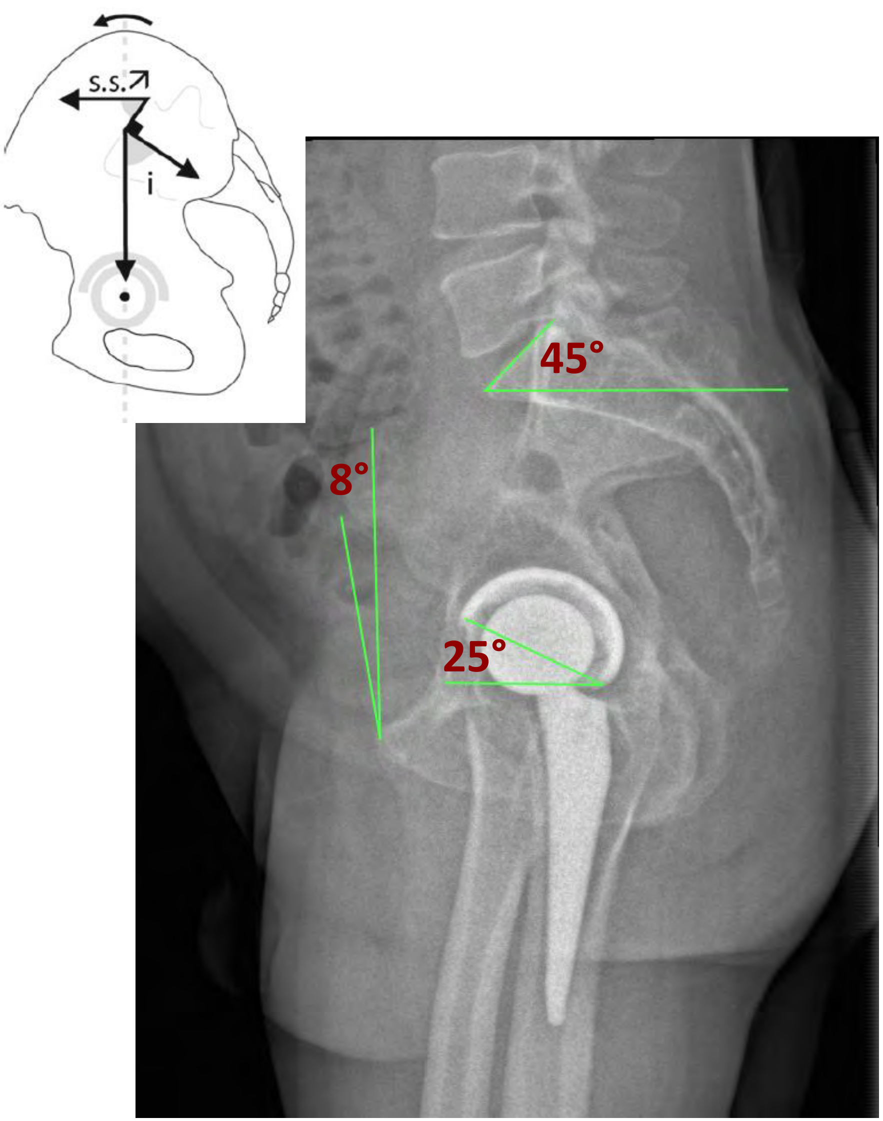


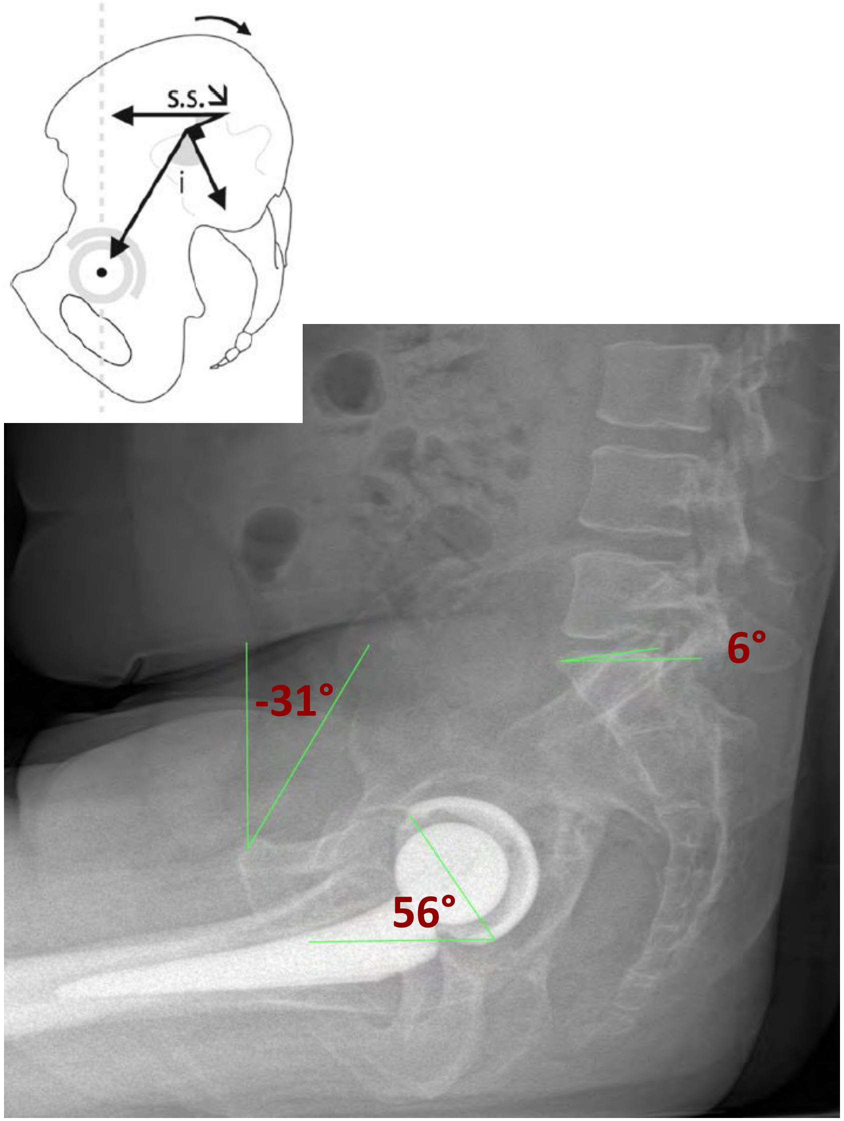


Legaye J, Duval-Beaupere G. Sagittal plane alignment of the spine and gravity: a radiological and clinical evaluation. Acta Orthop Belg. 2005;71(2):213-20.

Stephens A et al. The kinematic relationship between sitting and standing posture and pelvic inclination and its significance to cup positioning in total hip arthroplasty. Int Orthop. 2015;39:383–388.

Introduction: spino-pelvic biomechanics





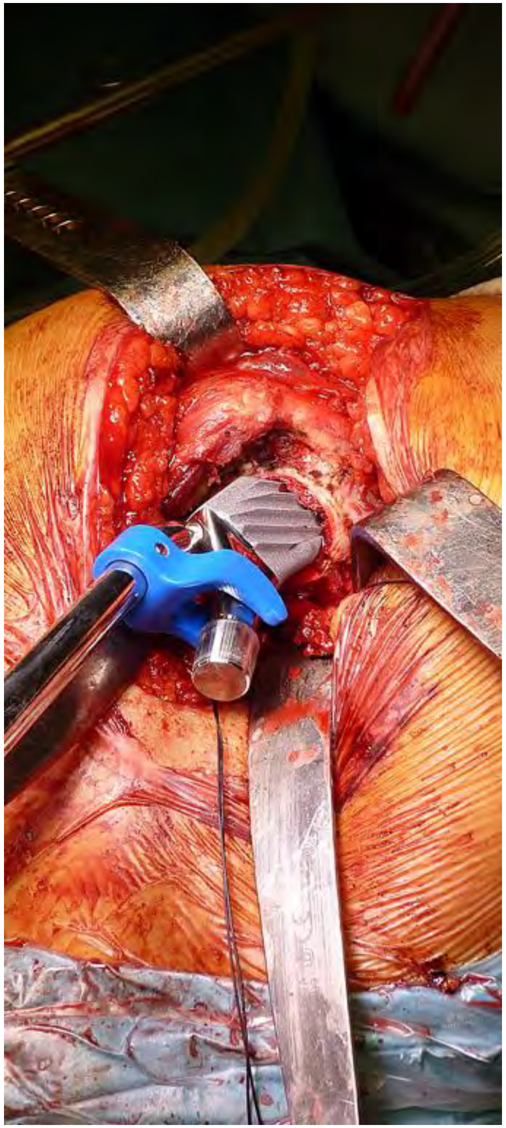
Objectives

- To investigate the variation of pelvic tilt after THA in standing and sitting position.
- To investigate the relationship between APP angle and SS in standing and sitting position.
- To investigate the relationships of APP angle and SS with postoperative AI and AA in standing and sitting position.

Patients

- 50 consecutive patients (M:F=28:22)
- Average age of 59 years (44 – 78)
- Primary THA between November 2014 and February 2015
- Posterior-lateral approach; femur first technique

PREOPERATIVE DIAGNOSIS	N° of HIPS (N=50)
Osteoarthritis	35 (73%)
Mild hip dysplasia	9 (16%)
Avascular necrosis	4 (7%)
Slipped Capital Femoral Epiphysis	2 (4%)



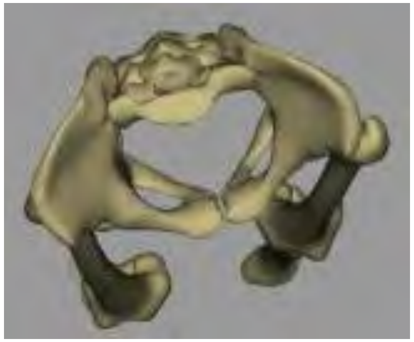
Exclusion criteria

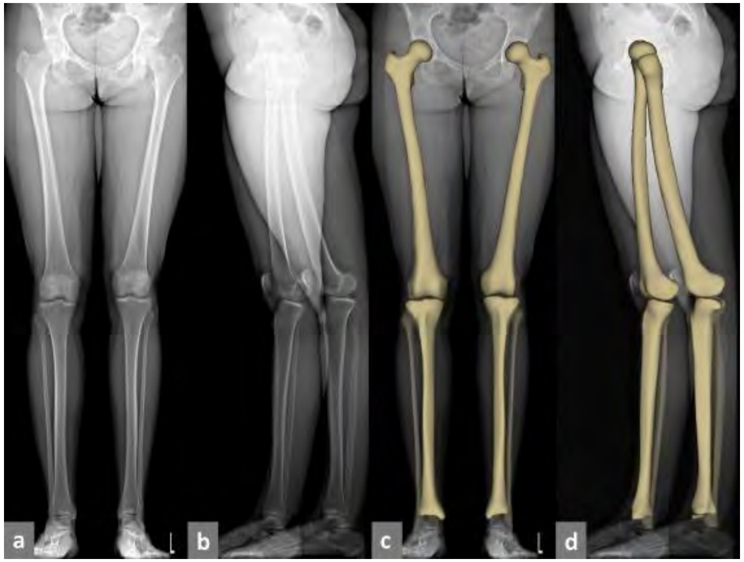
- Partial or total THA revision
- THA associated with other procedures (i.e. femoral osteotomy)
- Previous pelvic and/or femoral osteotomy
- Previous pelvic and/or femoral fractures
- Severe hip dysplasia (Crowe III or IV)
- Primitive or metastatic tumors of hip joint
- Previous spine and/or sacroiliac joint instrumentation
- Previous or current hip joint infection

Methods: radiographic assessment

EOS 2D/3D radiology system

- Scan of the whole body in the same image
- Patient is in an upright weight-bearing position
- AP and lateral pelvic acquisitions in the standing and sitting positions
- Pelvic parameter measurements are adjusted for rotations of the pelvis in the axial plane
- 3D reconstruction of bone segments
- Lower radioation doses





Faria R et al. The EOS 2D/3D X-ray imaging system: a cost-effectiveness analysis quantifying the health benefits from reduced radiation exposure. Eur J Radiol 2013;82(8):e342-9.
Than P et al. Geometrical values of the normal and arthritic hip and knee detected with the EOS imaging system. Int Orthop. 2012;36(6):1291-7.

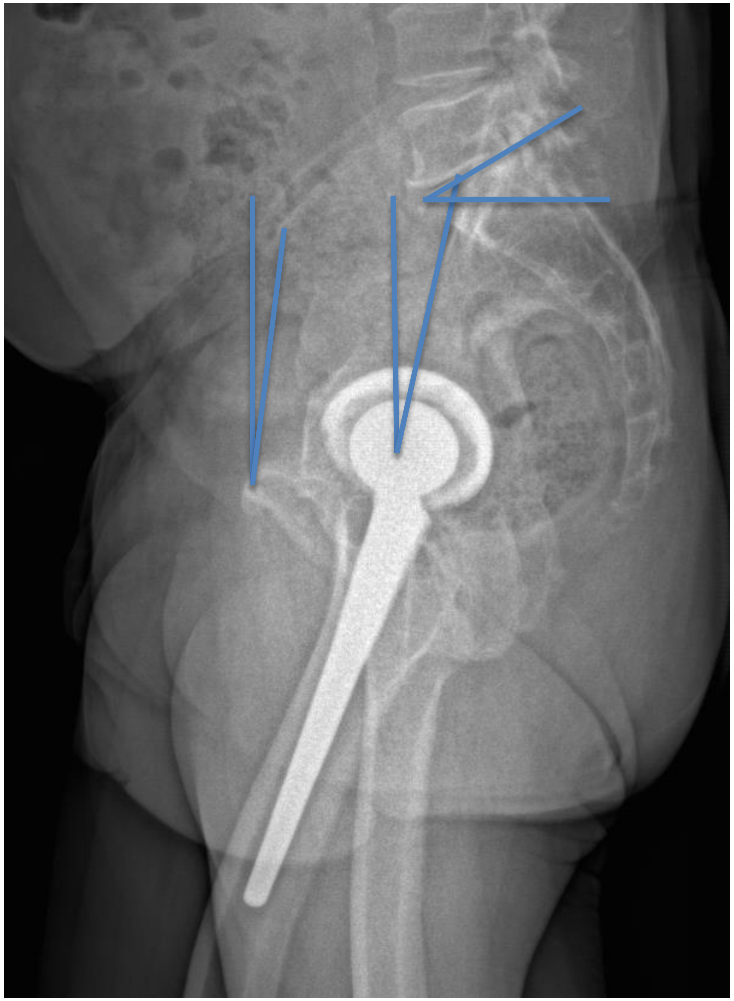
Methods: radiographic assessment

Pre-op and 3 months after surgery assessment:

- **Anterior pelvic plane angle (PPA)**
- **Pelvic tilt angle (PT)**
- **Sacral slope (SS)**

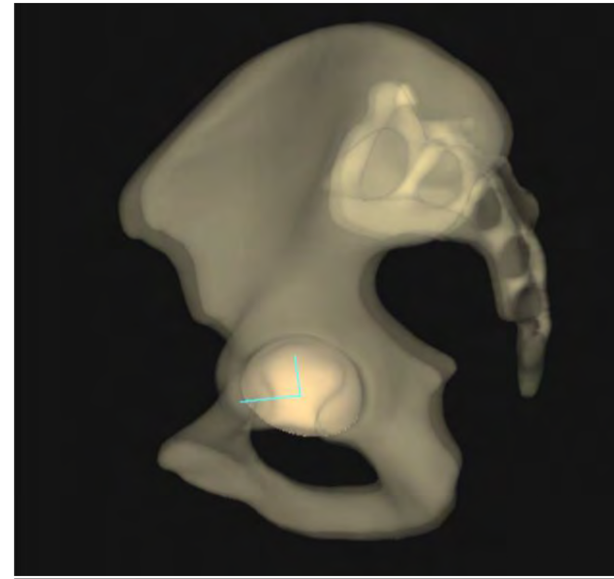
3 months after surgery:

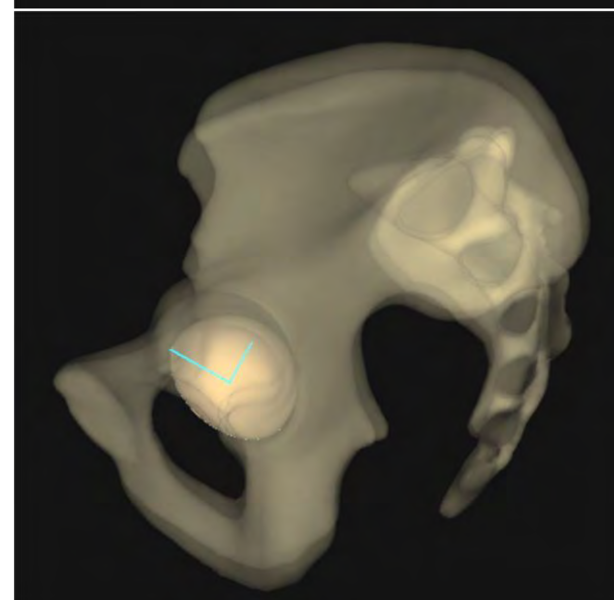
- Acetabular anteversion
- Acetabular inclination



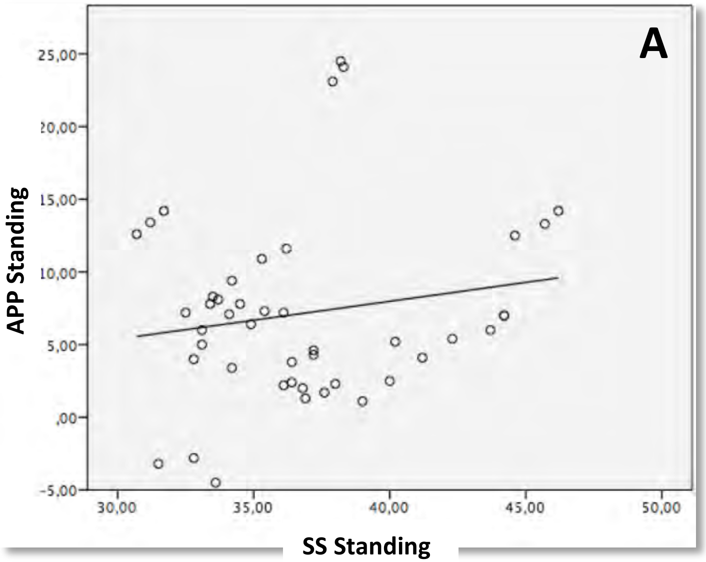
Results

	Pre-op	Post-op	P value
SS standing	37.9° (6.3)	36.6° (4.2)	0.25
SS sitting	10.2° (9.2)	10.4° (12.3)	0.38
Delta SS	27.7° (10)	27.3 (12.4)	0.42
PT standing	7.5° (7.2)	9.9° (5.5)	0.03 *
PT sitting	37.8° (8.2)	38.1° (9.9)	0.39

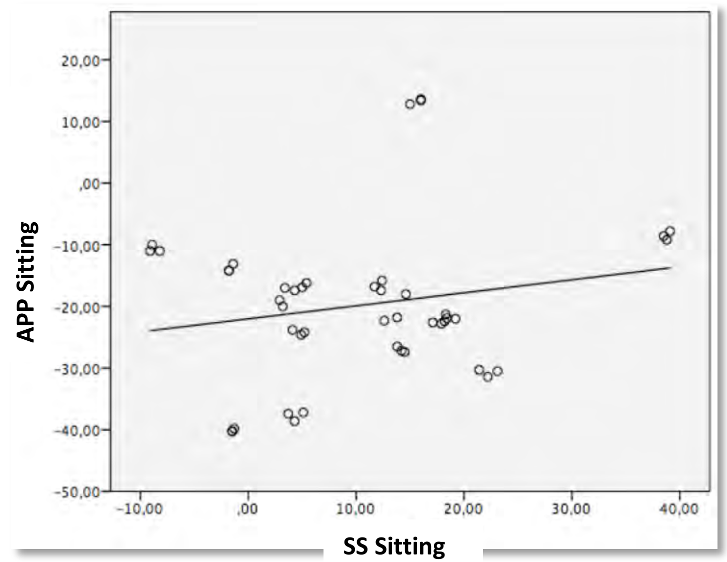




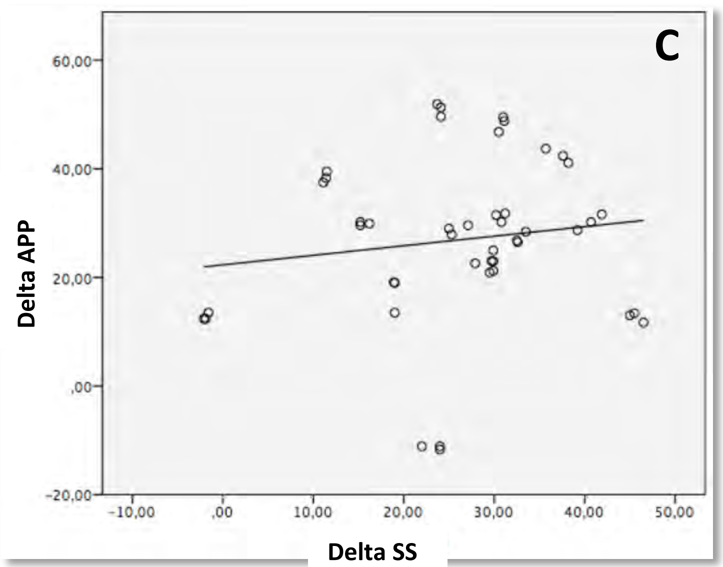
Results



r=0.36
P=0.82
R^2=0.29



r=0.29
P=0.85
R^2=0.037



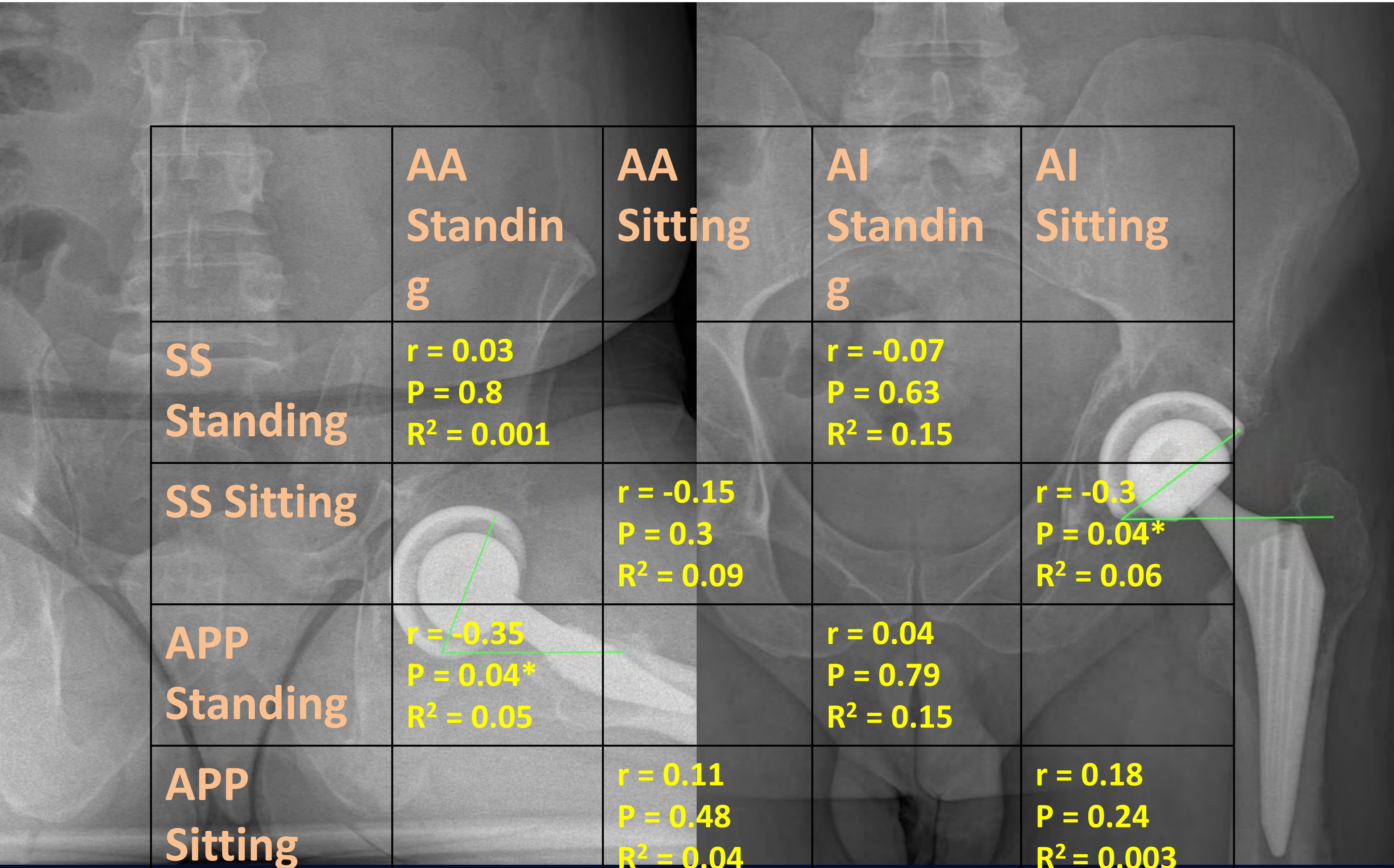
r=0.14
P=0.36
R^2=0.18

A: relationship APP/SS in standing

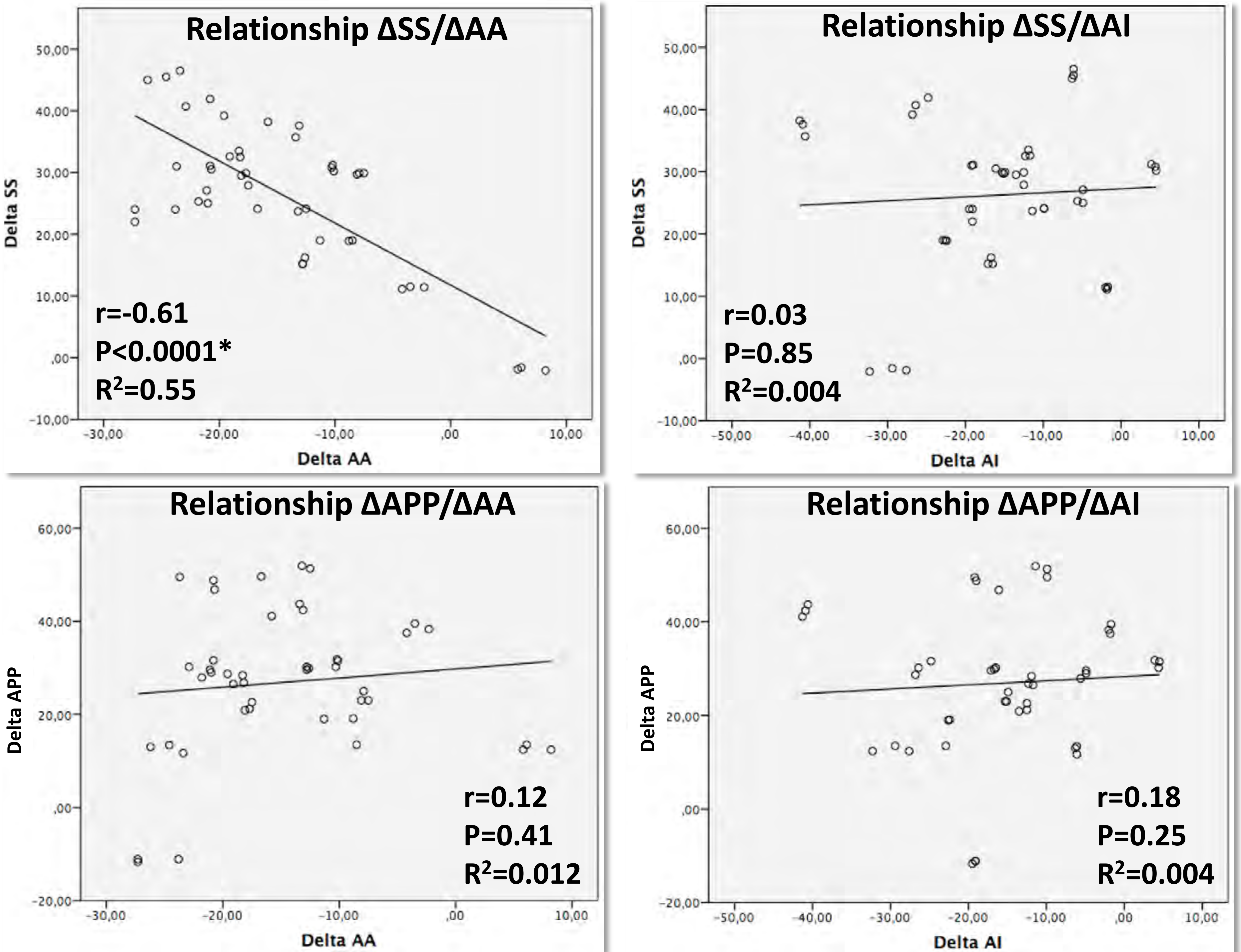
B: relationship APP/SS in sitting

C: relationship ΔAPP/ΔSS

Results



	AA Standing	AA Sitting	AI Standing	AI Sitting
SS Standing	r = 0.03 P = 0.8 R^2 = 0.001		r = -0.07 P = 0.63 R^2 = 0.15	
SS Sitting		r = -0.15 P = 0.3 R^2 = 0.09		r = -0.3 P = 0.04* R^2 = 0.06
APP Standing	r = -0.35 P = 0.04* R^2 = 0.05		r = 0.04 P = 0.79 R^2 = 0.15	
APP Sitting		r = 0.11 P = 0.48 R^2 = 0.04		r = 0.18 P = 0.24 R^2 = 0.003

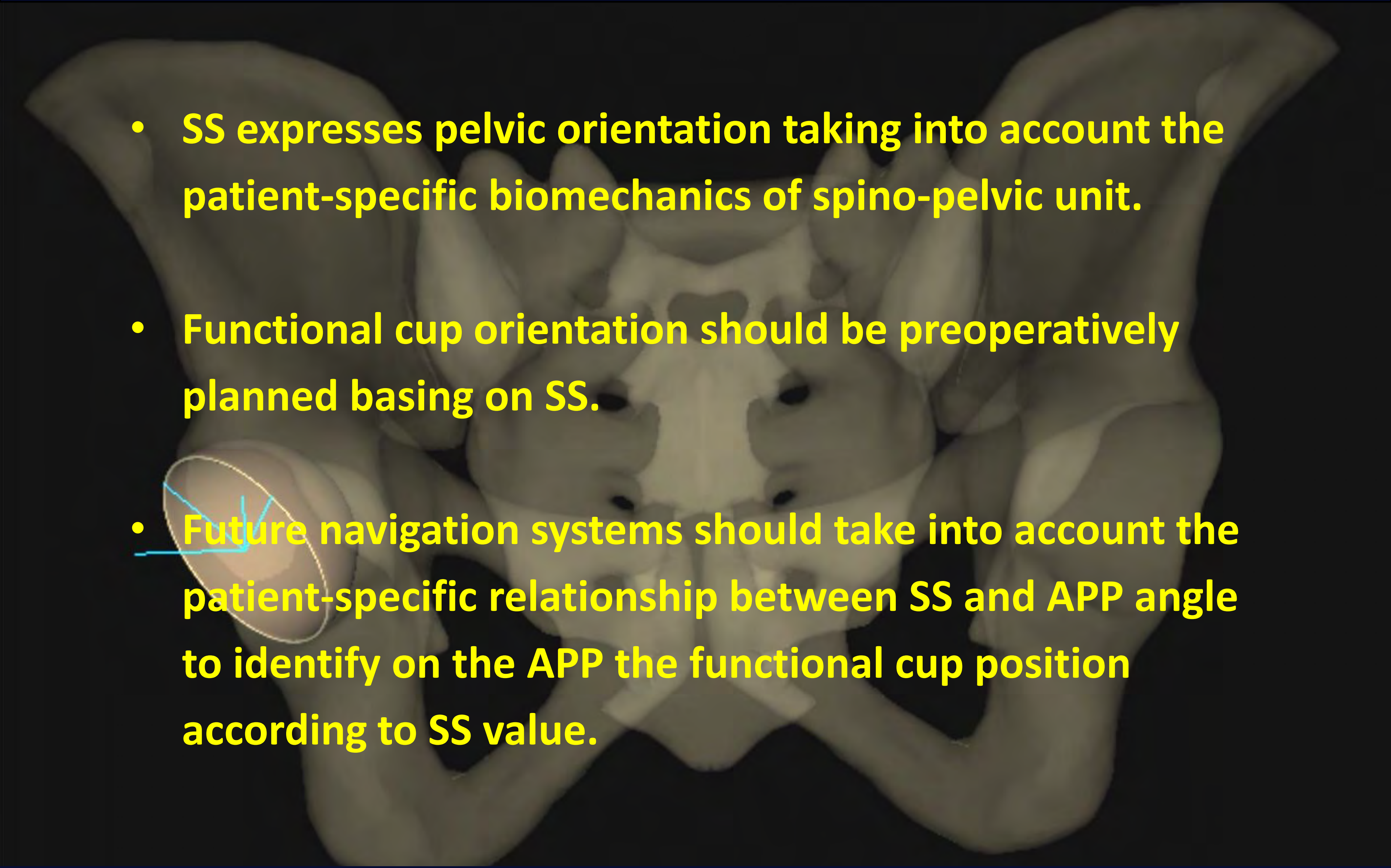


Relationship ΔSS/ΔAA
Delta SS
50,00
40,00
30,00
20,00
10,00
,00
-10,00
-30,00
-20,00
-10,00
,00
10,00
Delta AA
r=-0.61
P<0.0001*
R2=0.55
Relationship ΔSS/ΔAI
Delta SS
50,00
40,00
30,00
20,00
10,00
,00
-10,00
-50,00
-40,00
-30,00
-20,00
-10,00
,00
10,00
Delta AI
r=0.03
P=0.85
R2=0.004
Relationship ΔAPP/ΔAA
Delta APP
60,00
40,00
20,00
,00
-20,00
-30,00
-20,00
-10,00
,00
10,00
Delta AA
r=0.12
P=0.41
R2=0.012
Relationship ΔAPP/ΔAI
Delta APP
60,00
40,00
20,00
,00
-20,00
-50,00
-40,00
-30,00
-20,00
-10,00
,00
10,00
Delta AI
r=0.18
P=0.25
R2=0.004

Conclusions

- Pelvic parameters do not significantly change 3 months after THA in standing and sitting positions.
- There is no relationship between values of APP angle and SS before and after surgery in standing and sitting positions.
- Changes of SS between standing and sitting position significantly correlated with changes of AA.
- Preoperative EOS 2D/3D measures the functional pelvis orientation according to the spine sagittal balance for each patient in standing and sitting position.

Future perspectives



- SS expresses pelvic orientation taking into account the patient-specific biomechanics of spino-pelvic unit.

- Functional cup orientation should be preoperatively planned basing on SS.

- Future navigation systems should take into account the patient-specific relationship between SS and APP angle to identify on the APP the functional cup position according to SS value.

Società Italiana dell'Anca

BRITISH HIP SOCIETY

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@LoppiniMattia

HUMANITAS
RESEARCH HOSPITAL

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

UNIVERSITA’ DEGLI STUDI MILANO BICOCCA
ica Ortopedica e Scuola di Specialità in Ortopedia
Azienda Ospedaliera S. Gerardo - Monza
Dir.: Prof. Giovanni Zatti

Dual mobility sockets in patients with high risk of dislocation

G.Gallinari, R. Sotiri, A. Rossi, D. Munegato, G.Zatti

Milan – November 26th, 2015

THA instability

"Unpleasant" complication for the patient and the surgeon

Third cause of revision hip surgery (11.9%)

The Swedish Hip Arthroplasty Register, Annual Report 2012 J Kärrholm, G Garellick, C Rogmark, O Rolfson

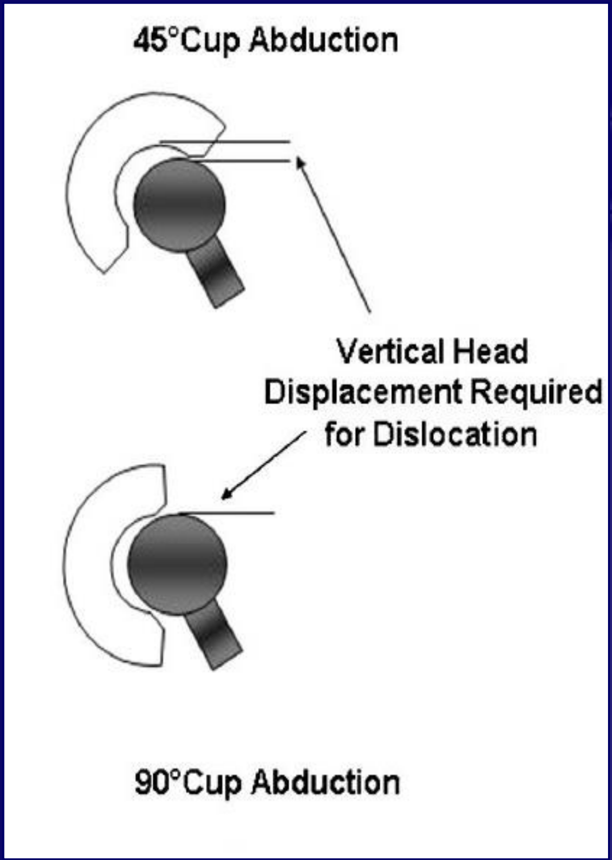
Number of reoperations per reason and year
primary THRs performed 1979–2012

Reason for reoperation	1979–2007	2008	2009	2010	2011	2012	Total	Proportion
Aseptic loosening	20,080	1,004	1,116	1,068	988	968	25,224	55.1%
Deep infection	3,649	405	431	420	468	522	5,895	12.9%
Dislocation	4,033	302	287	299	252	278	5,451	11.9%
Fracture	2,617	220	231	255	230	266	3,819	8.3%
2-stage procedure	1,476	73	97	103	97	83	1,929	4.2%
Technical error	955	43	58	61	69	64	1,250	2.7%
Miscellaneous	951	21	35	31	36	45	1,119	2.4%
Implant fracture	477	18	38	22	32	27	614	1.3%
Pain only	345	20	15	18	17	28	443	1.0%
Sekunday infection	5	0	0	0	1	0	6	0%
Missing	35	1	0	0	1	2	39	0.1%
Total	34,623	2,107	2,308	2,277	2,191	2,283	45,789	100%

THA dislocation
Risk factors

patient specific

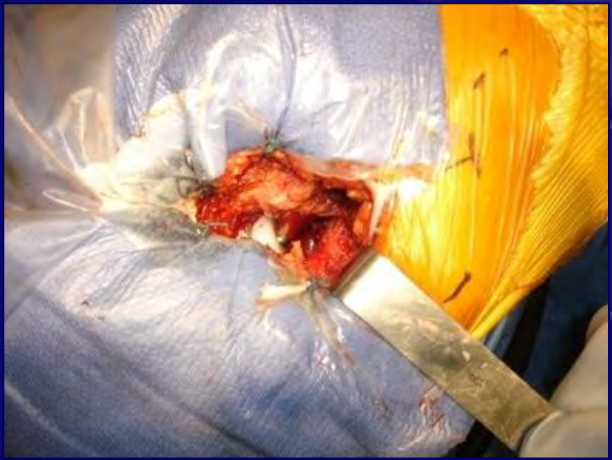
- Gender (F > M)
- Age (>75 ys)
- Muscolar deficiency (abductor muscles)
- Neuromuscular deseases
- Laxity
- Undisciplined patient (confused, alcoholic)
- Pre-op diagnosis of femural fracture
- ASA classification >3



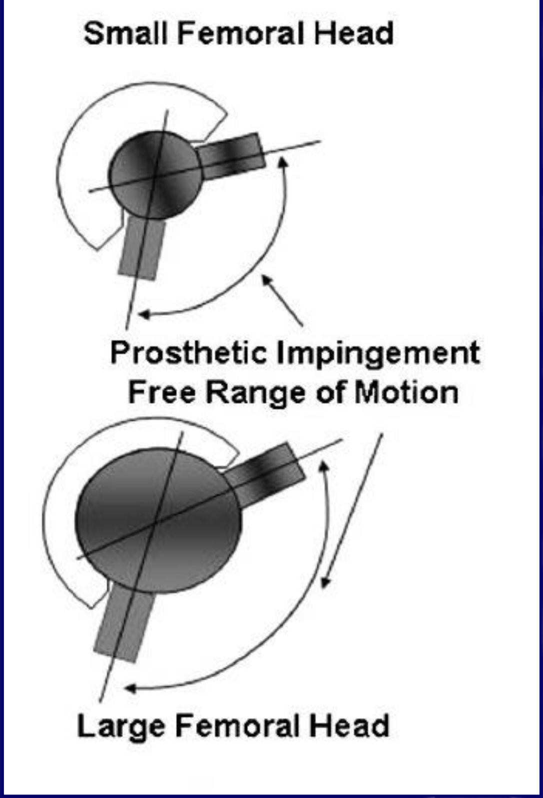
THA dislocation
Risk factors

Releted to operative variables

- Posterolateral approach
- Surgeon's experience
- Implant positioning
- Neck/Head diameter
- Offset restoration
- Revision surgery



THA dislocation
Risk factors

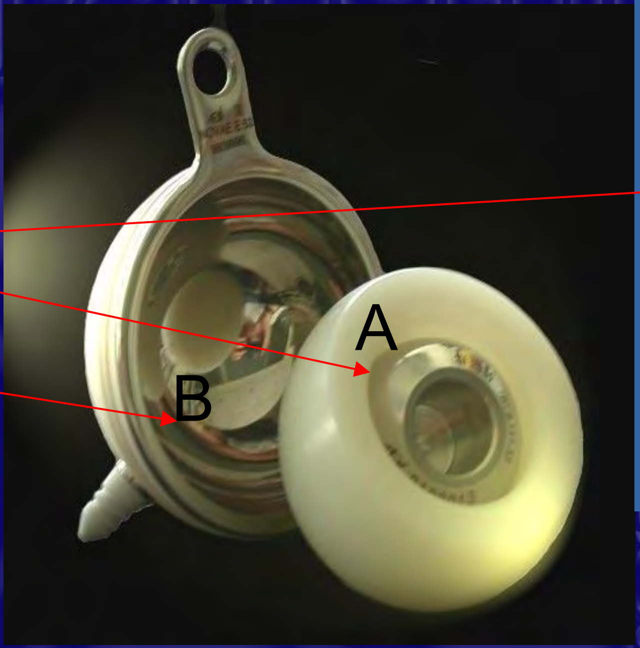


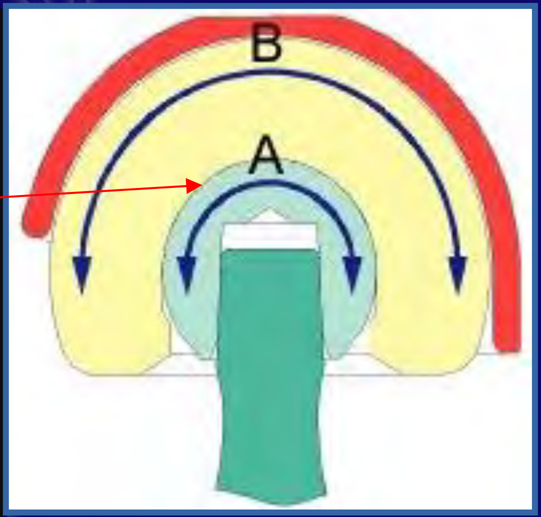
Implant characteristics

- Prosthetic head dimension
- Head / neck ratio
- Neck section
- Inlay’s characteristics
- Inlay consumption
- Impingement

Dual mobility

Dual Mobility
Mobility A
Mobility B
Socket

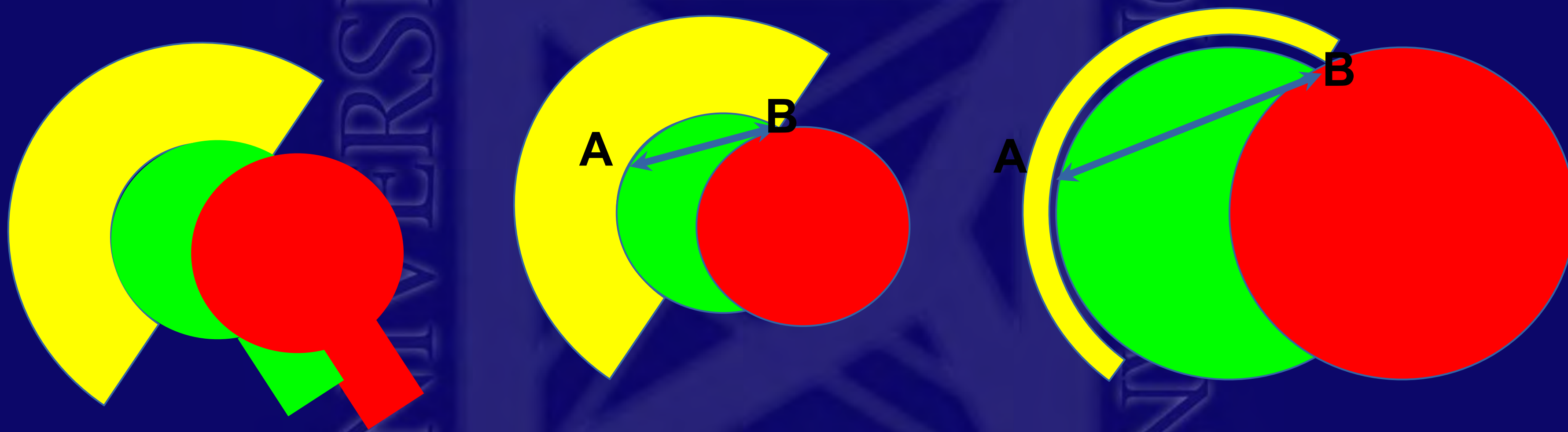


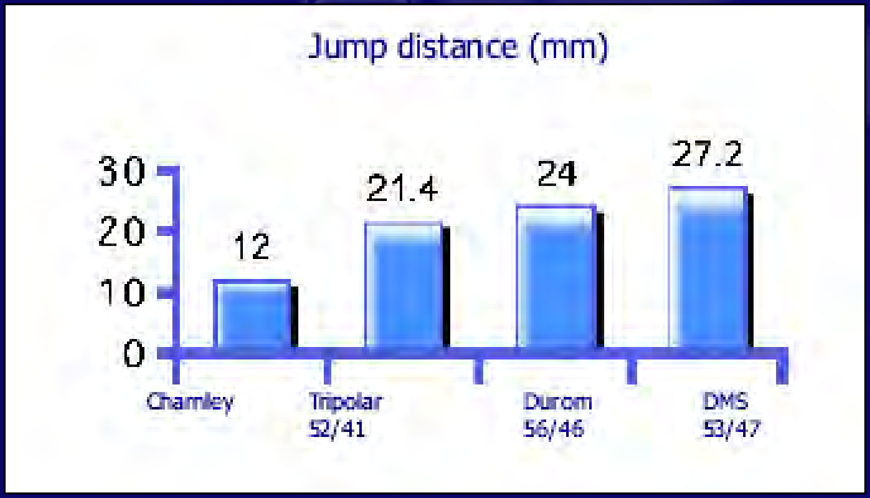


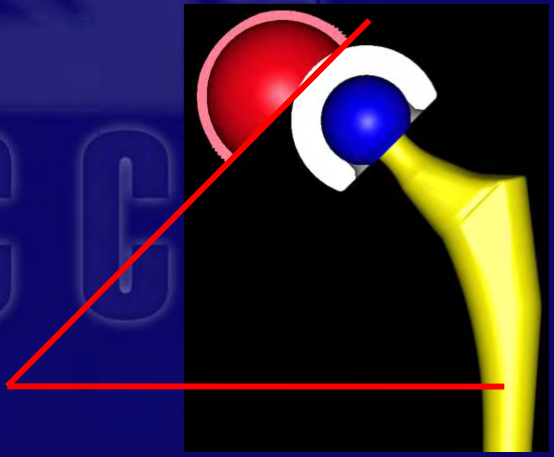
Increased stability plus greater range of movement by the application of two biomechanical principles

Biomechanical principles

Increased <u>jump distance</u> AB = less risk of dislocation (AB>27 mm)



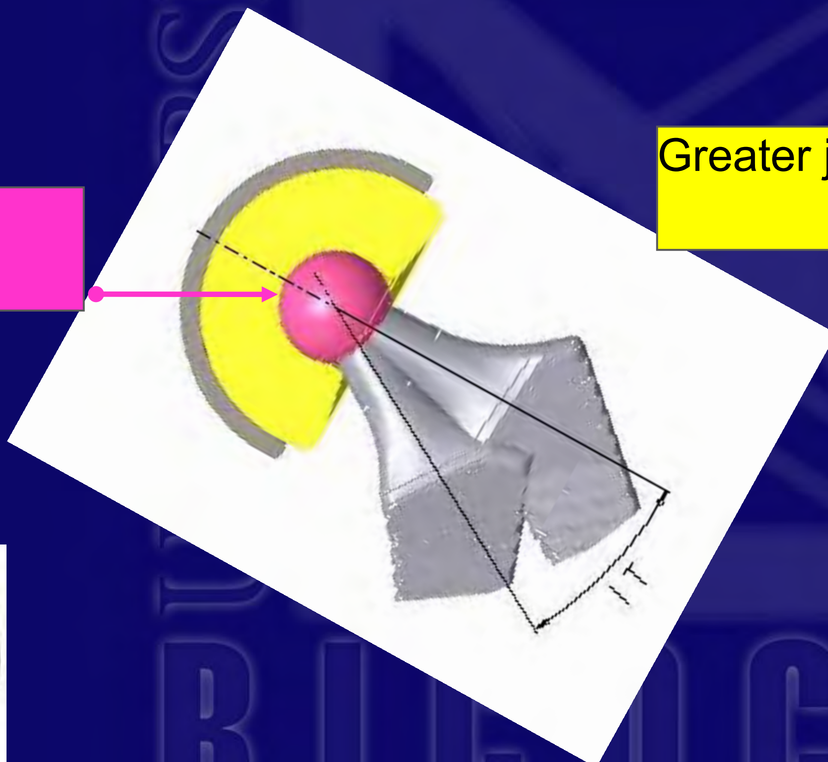




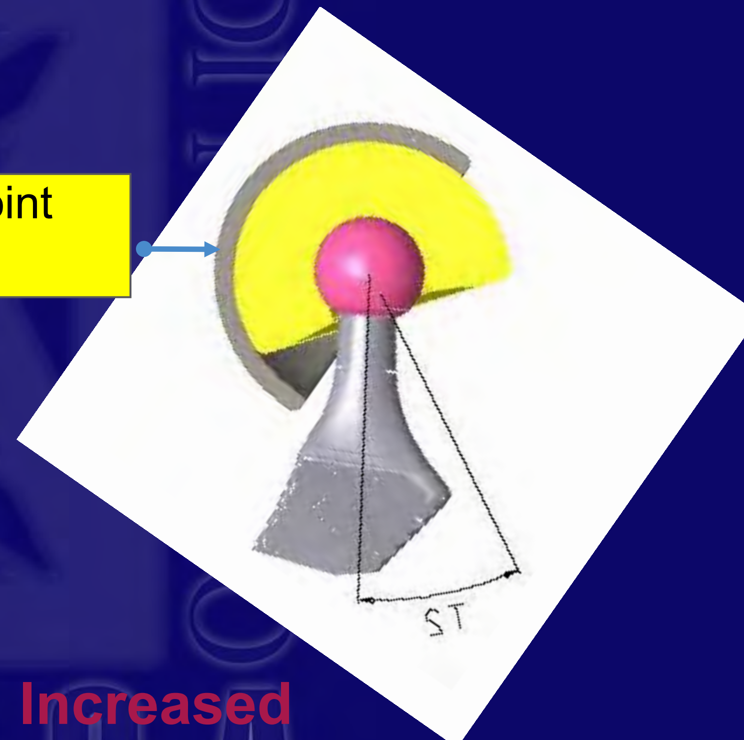
Biomechanical principles

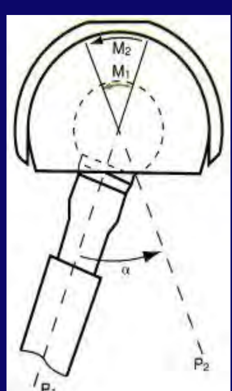
- Recruitment
- T1 plus T2
- Delayed contact between neck and inlay
- Big head advantages

Minor joint



Greater joint



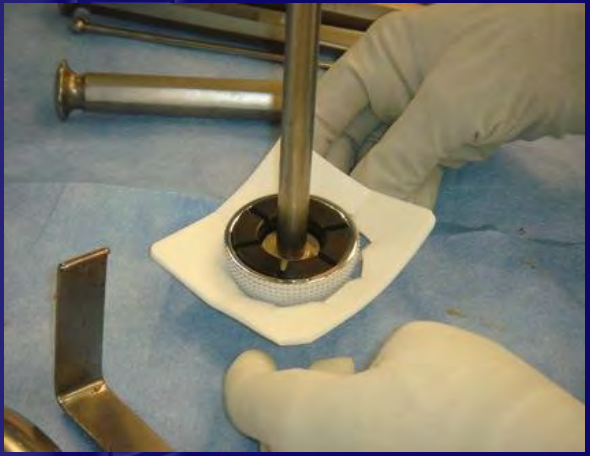


Crowninshield RD CORR 2004, 429

Increased ROM
Less risk of impingement

Our experience

86 dual mobility socket (unconstrained tripolar implants)



48 uncemented
38 cemented

37 M e 49 F

(48 femural neck fractures, 30 coxarthrosis,
8 revision hip surgery)

Cemented stem in 40 cases
Uncemented stem in 46 cases
Neck 12/14
Prosthetic metal head 22/28 mm

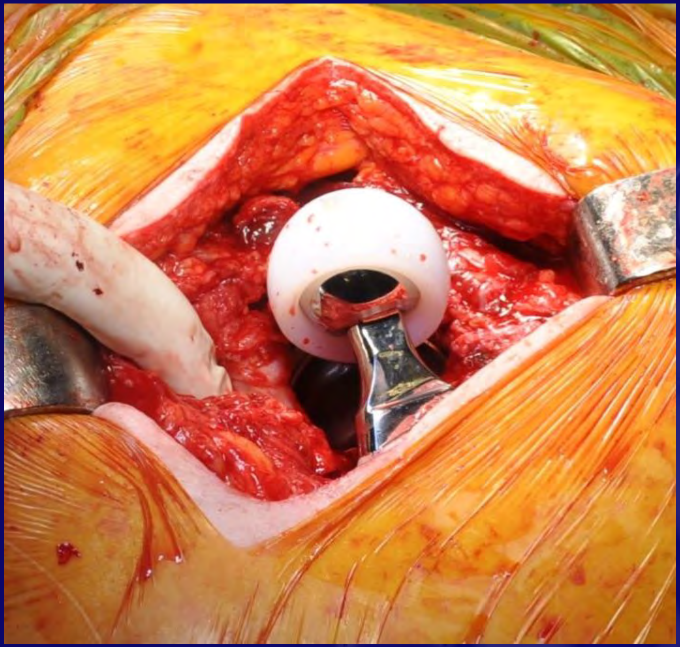
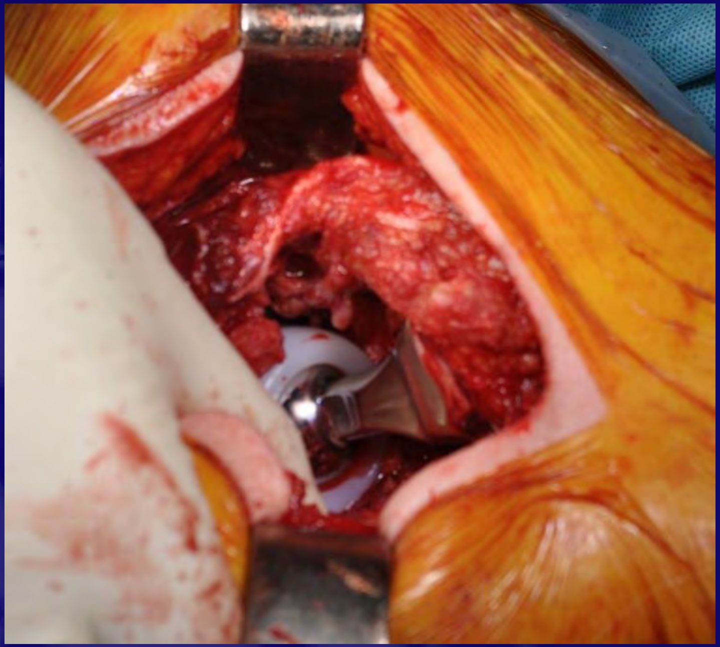
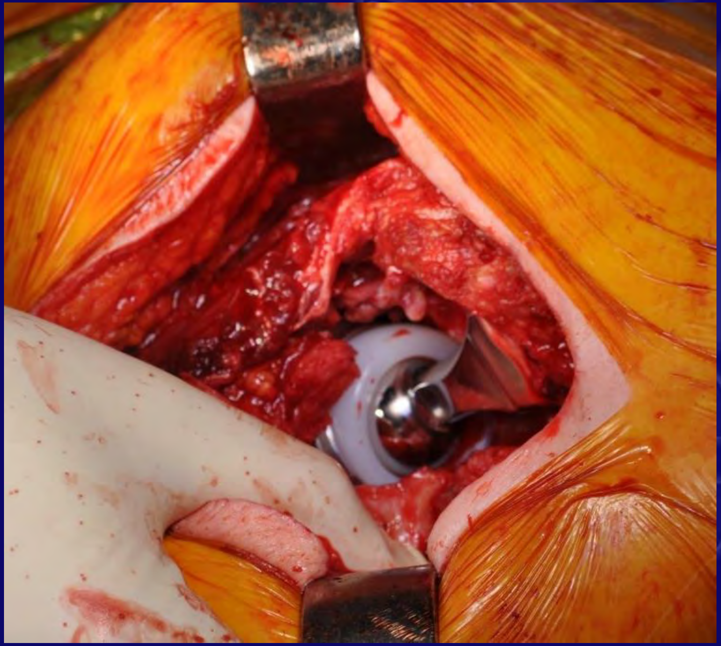
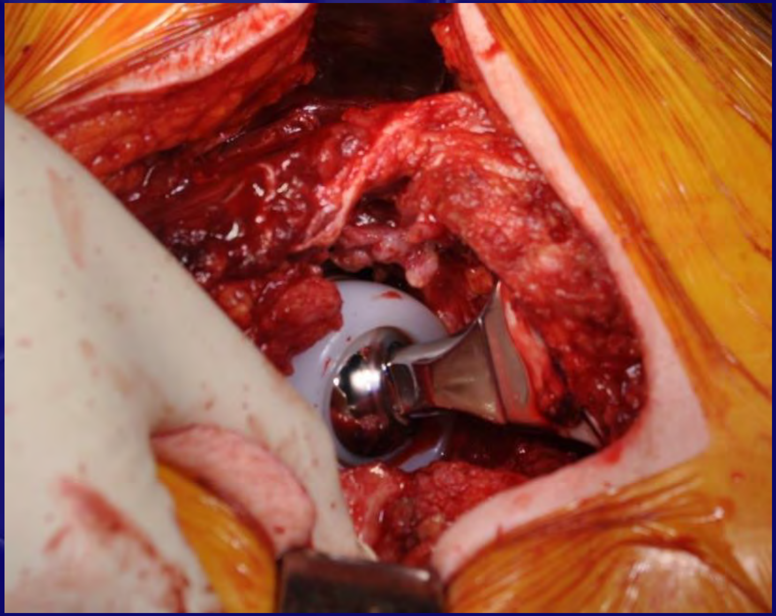
Postero-lateral approach

Our suggestions

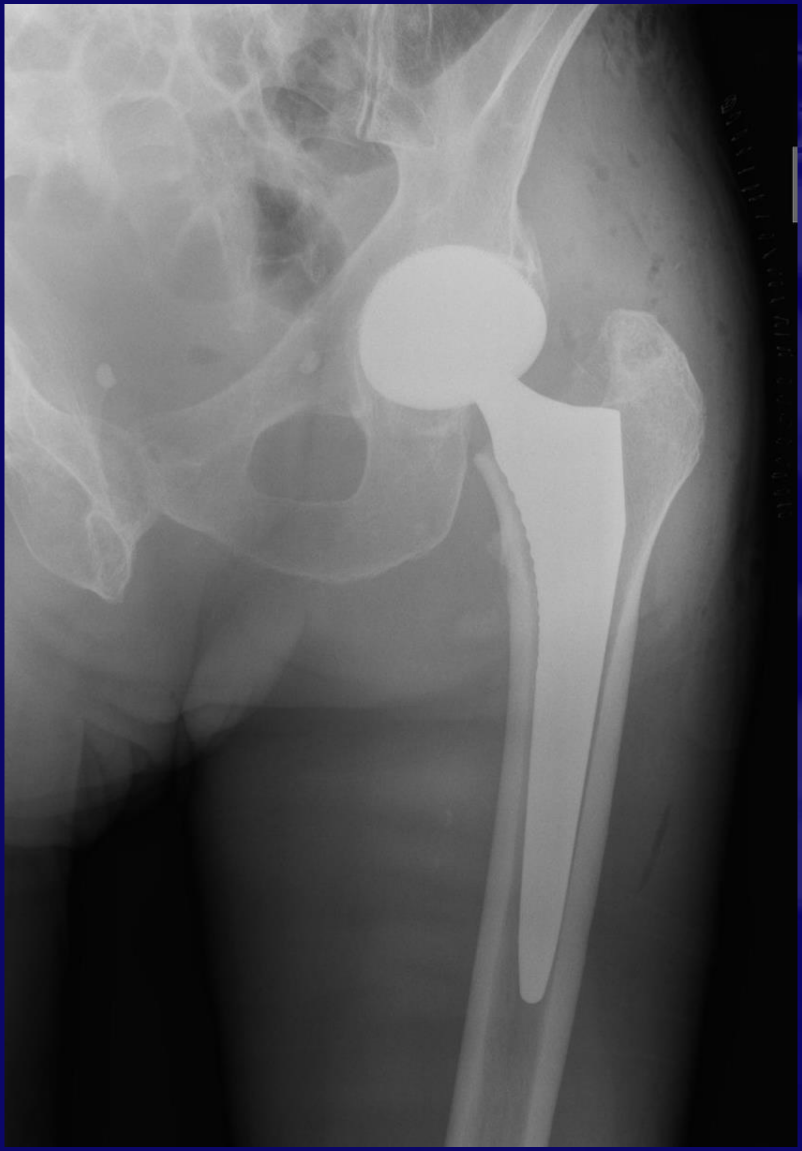
Primary indications:
muscular deficiency (especially abductor muscl
insufficiency secondary
to central or peripheral neurological
events

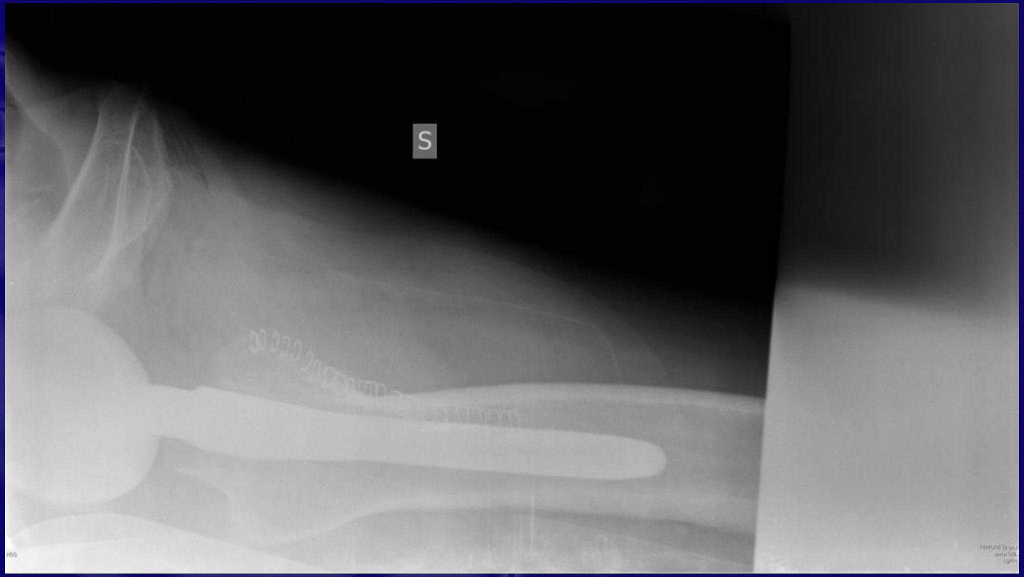
Relative indications:
Age > 75 ys
Femural neck fracture
Non compliance during physical therapy
As alternative to constrained implants
revision or first implant surgery

Patient with risk factors and age >75 y

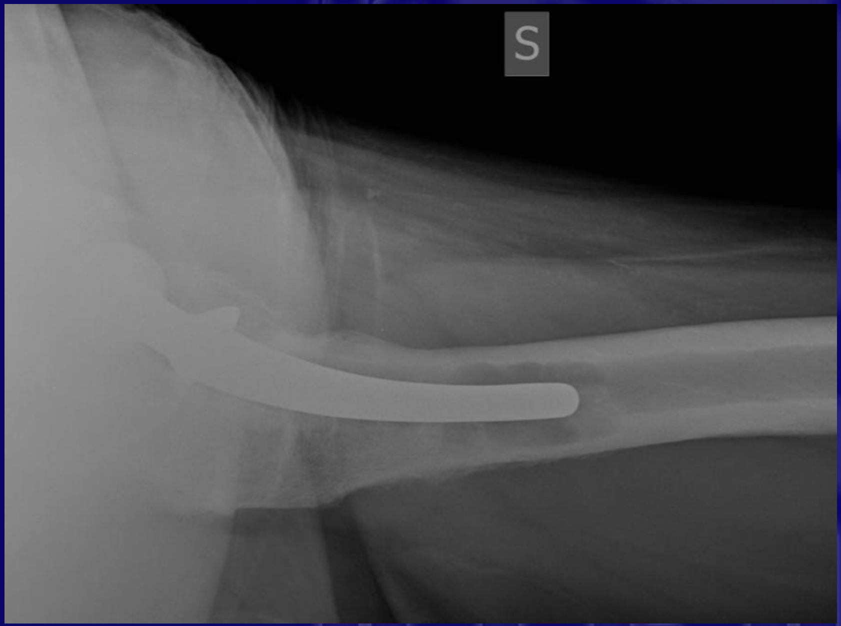
Male 58 years
Femural neck fractures
psychosis, alcoholic, non compliance
Increased risk of dislocation



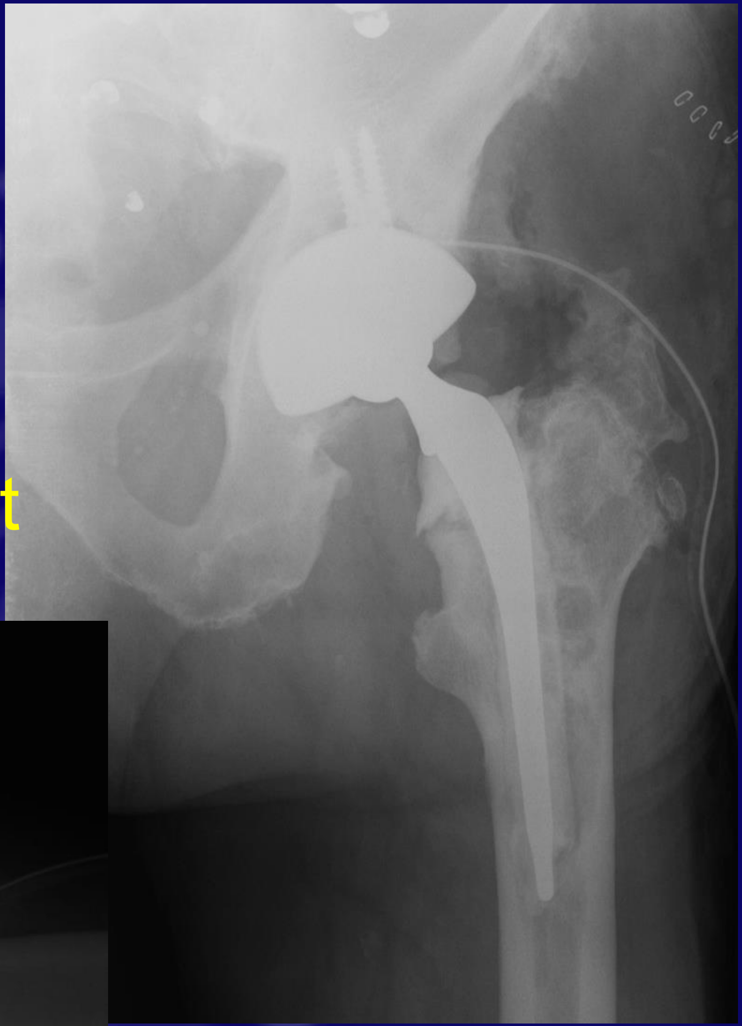


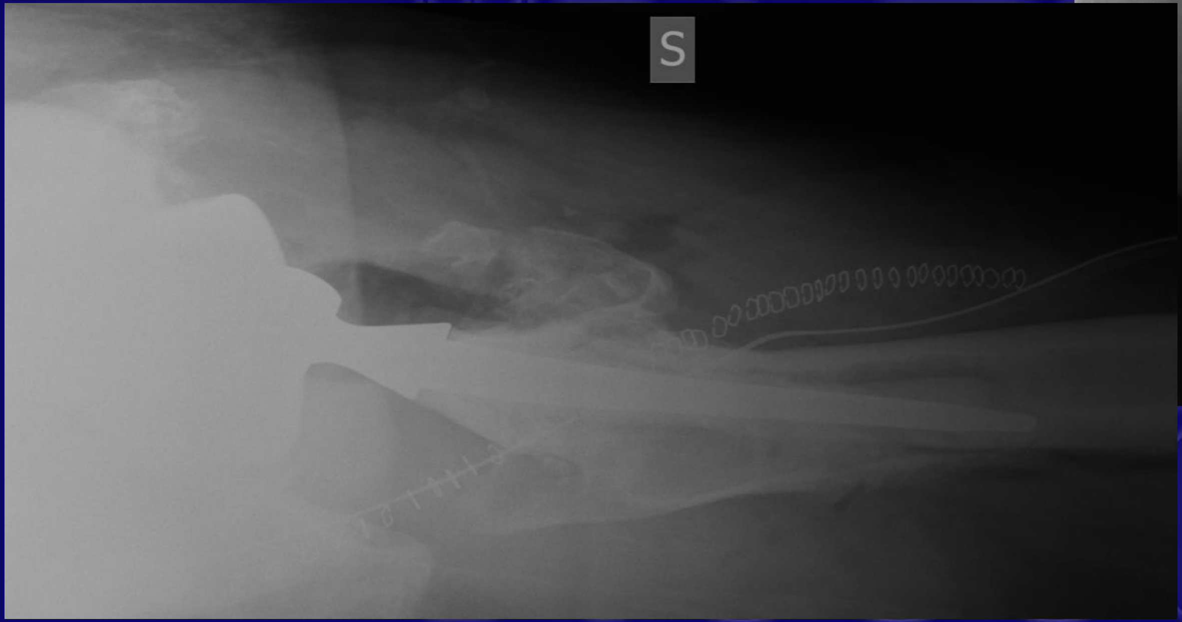
6 months follow up

Male 80 years
Aseptic loosening after 18 years
ASA 4, age, revision surgery,
muscular insufficiency



Post op
Revision surgery
Dual mobility socket with screws and graft
Stem revision cement on cement





Post op

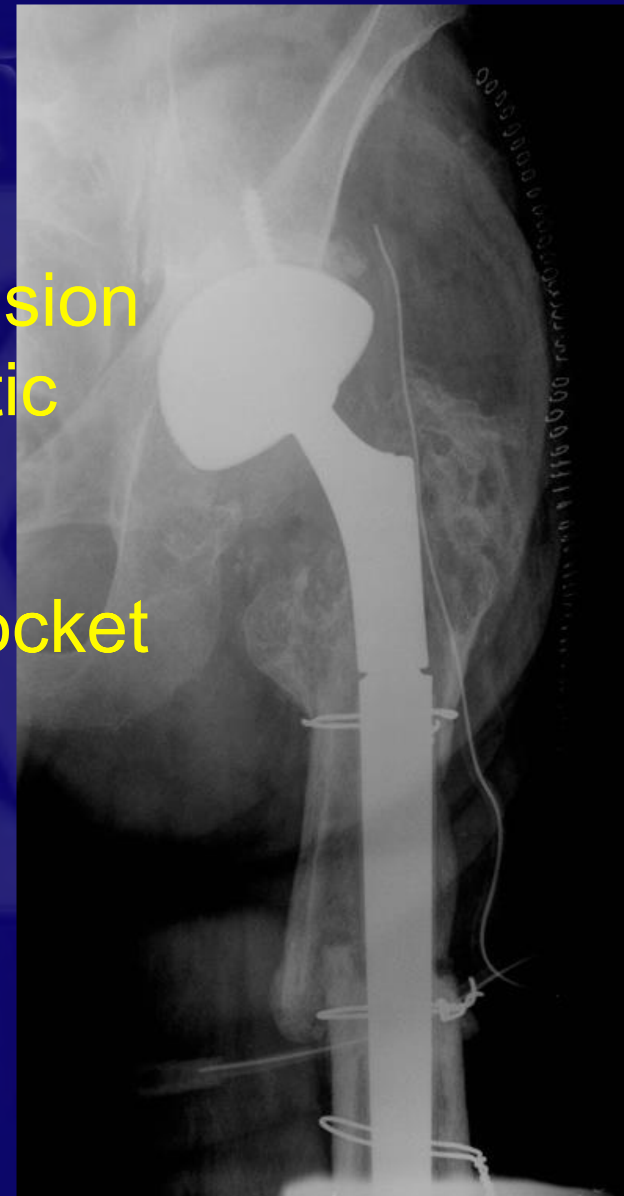
Revision surgery

Dual mobility socket with screws and graft

Stem revision cement on cement

Male 75 years
Two stages revision surgery for septic loosening

Dual mobility socket with screws
Long stem



No episode of dislocation

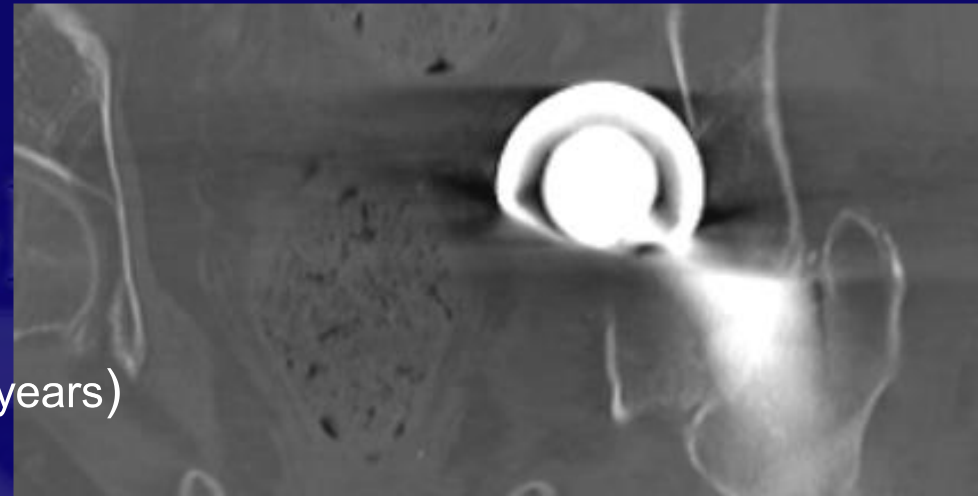
mean follow up 3 years (6 months - 5 years)

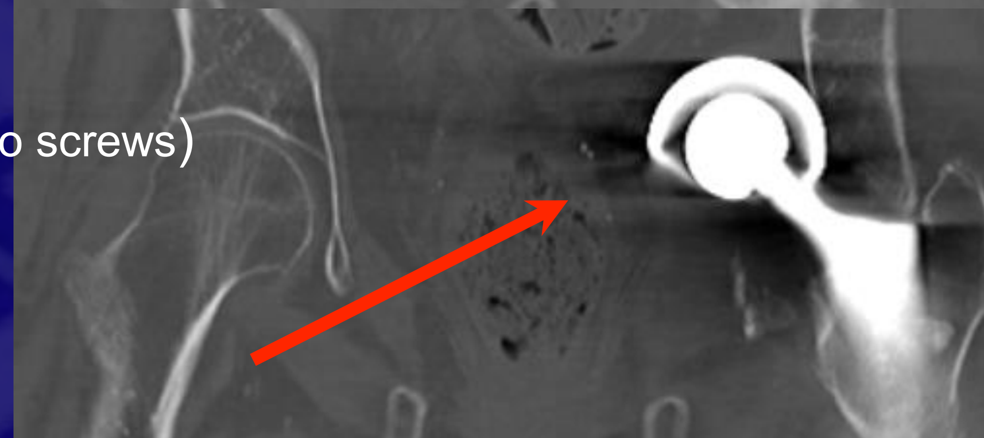
	Patients	Dislocation
Farizon, Leclercq SHFG 2006	875	2 **0,22%**
Leclercq RCO 2008	200	0
Guyen J Arthroplasty 2007	167	0
Ardouin SOFCOT 2008	231	0
Fiquet SOFCOT 2008	346	1 **0,28%**
Reynaud SOFCOT 2008	340	1 **0,29%**

Clinical results
and complications

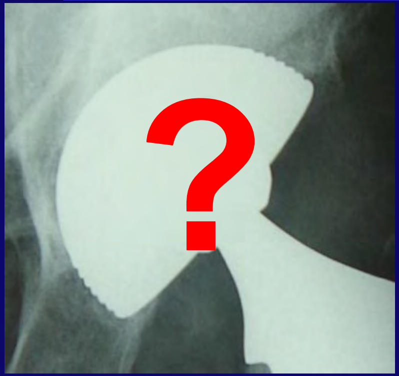
Dual mobility socket n=86
Mean follow up 4 years (6 months-6 years)
12 patients lost at follow up
No dislocation
No intraprosthetic dislocation
4 aseptic loosening after 3 years (no screws)
1 deep prosthetic infection
1 early infection

1 failure due to acetabular fracture
2 months after operation (no intraprosthetic dislocation despite the fracture)





Conclusions



Results are excellent in terms of preventing and treating instability in patients presenting risk factors for THA dislocation

Valid alternative to high constrained sockets in revision hip surgery or in younger patients with neurological or psychiatric deseases

Several European studies using dual mobility cups with mid- to long-term follow up support their effectiveness compared to fixed bearing cups (84 - 96% survival at 15 ys)

Concerns such as intra-prosthetic dislocation and accelerated wear have been emphasized, although they seem to be less significant in older and low-demand patients

Fig. 7. Wear of the collar: a) Homogenous wear; b) Asymmetrical wear

The use of dual mobility cups in younger patients should be viewed with caution based on a lack of current data concerning this high demand patient population

Thank You

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

University Hospital Southampton NHS
NHS Foundation Trust

British Hip Society

Società Italiana dell'Anca

The use of dual mobility bearings in total hip arthroplasty.

The UK experience

S. Abouel-Enin

M.P.Veettil, J.Griffiths, D.G.Dunlop, J.Latham

- 1976
- Prof Bousquet and Mr André Rambert


a big head
decreases dislocation risk
22.2 mm
Decrease wear

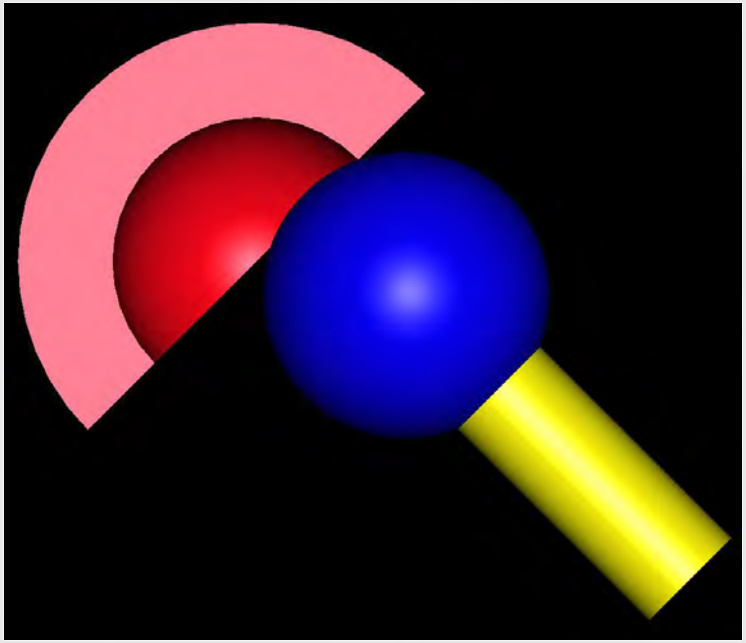
α: first mobility.

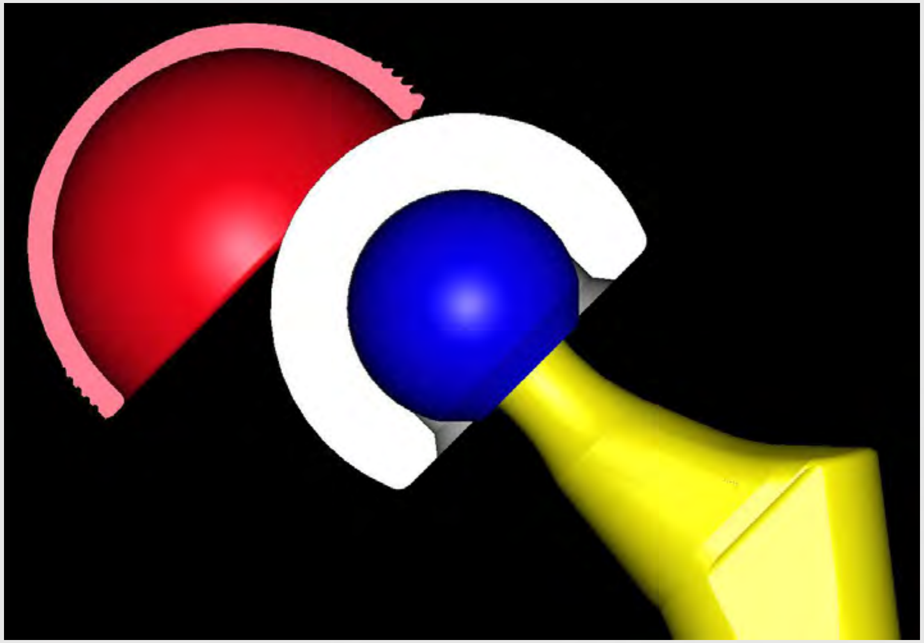
- 75% of movements
- 51°for 22.2mm head
- 76°for 28mm head

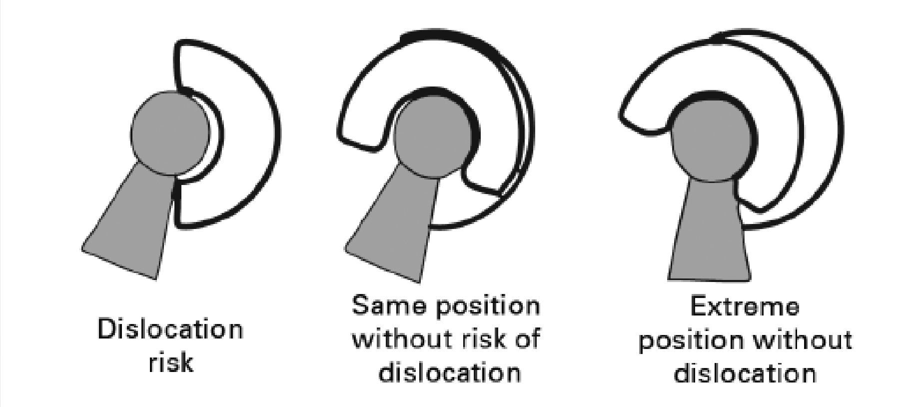
β: second mobility.

- over standard ROM
- 126°for a 43mm cup
- 140°for a 65mm cup

Jump distance







Ref	N. of hips	Indication	Mean FU	Implant design (cup)	Head size (mm)	Intraprosthetic dislocation (%)	Dislocation rate (%)
Boyer et al[25], 2012	240	Primary THA	22 yr	Novae®[1]	22.2	4.1	0
Farizon et al[23], 1998	135	Primary THA	12 yr	Novae®[1]	22.2	2	0
Lautridou et al[24], 2008	437	Primary THA	16.5 yr	Novae-1®[1]	22.2	0.7	1.1
Philippot et al[47], 2006	106	Primary THA	10 yr	Novae-1®[1]	22.2	1.9	0
Philippot et al[12], 2009	384	Primary THA	15.3 yr	Novae-1®[1]	22.2	3.6	0
Philippot et al[48], 2008	438	Primary THA	17 yr	Novae-1®[1]	22.2	5.2	0
Guyen et al[19], 2007	167	Primary THA	3 yr	Saturne®[2]	n/a	0	0
Leclercq et al[20], 2008	200	Primary THA	6 yr	Evora®[3]	22.2 (n = 175) 26 (n = 18) 28 (n = 7)	0	0
Hamadouche et al[56], 2012	168	Primary THA	6 yr	Tregor®[4]	22.2	2.4	0
Vielpeau et al[21], 2011	437 (Group A) 231 (Group B)	Primary THA	16.5 yr 5.2 yr	Original Bousquet Novae-E®[1]	22.2	0.7 0	0 0
Bouchet et al[54], 2011	105	Primary THA	2.3 yr	Novae®[1], Statfit®[5], Avantage®[6], Gyros®[7]	28	n/a	0
Bauchu et al[60], 2008	150	Primary THA	6.2 yr	Polarcup®[8] 3rd gen	n/a	0	0
Combes et al[22], 2013	2480	Primary THA	7 yr	Novae®[1], Avantage®[6], Collegia®[9], EOL®[10], Gyros®[7], Tregor®[4], Polarcup®[8], Saturne®[2], Evora®[3]	28 (n = 1484) 22 (n = 956)	0.1 0.6	0.7 0.5
Tarasevicius et al[36], 2010	42	Neck Fractures	1 yr	Avantage®[6]	28	n/a	0
Adam et al[35], 2012	214	Neck Fractures	3-9 mo	Saturne®[2]	28 (n = 182) 22.2 (n = 32)	0	1.4
Sanders et al[44], 2013	10	Spastic disorders	3.2 yr	Avantage®[6]	n/a	0	0
Philippeau et al[37], 2010	71	Tumor resection	3.3 yr	Avantage®[6], Saturn®[2], Novae®[1], other	n/a	n/a	9.8
Langlais et al[17], 2008	85	Revision THA	3.2 yr	Tregor®[4]	22	n/a	1.1
Leiber-Wackenheim et al[14], 2011	59	Revision THA	8 yr	Novae-1®[1] Novae-E®[1]	28	0	1.7
Hamadouche et al[31], 2010	51	Revision THA	4.3 yr	Tregor®[4]	22.2	2	2
Guyen et al[16], 2009	54	Revision THA	3.9 yr	Saturne®[2]	n/a	3.7	1.8
Hailer et al[61], 2012	228	Revision THA	2 yr	Avantage®[6]	n/a	n/a	2
Philippot et al[30], 2009	163	Revision THA	5 yr	Novae®[1]	22.2	0	3.7

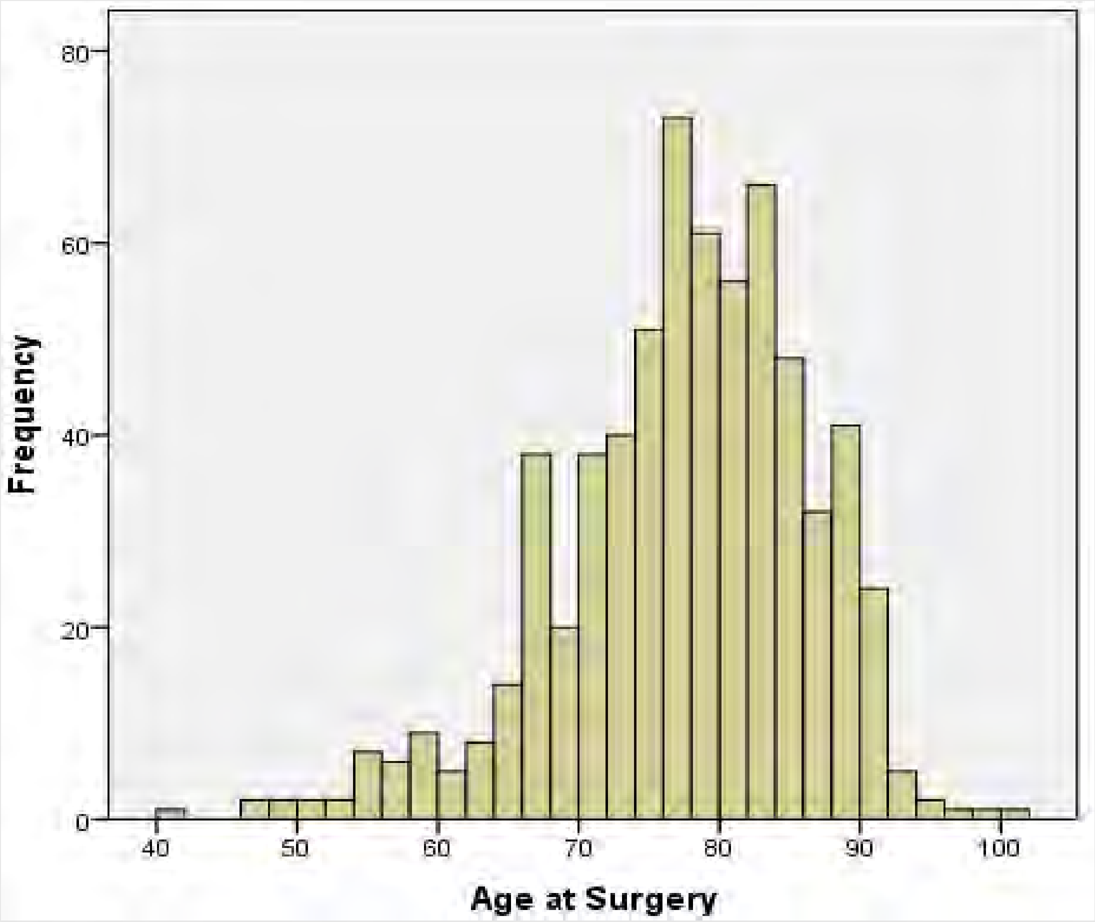
Our study

- Retrospective review
- 3 Hospitals
- Patients records cross-checked in surrounding 5 hospitals to cover a large catchment area
- First used for recurrent dislocation in 2006
- First used for primary THR in 2008
- Operating surgeon level: EVERYONE !

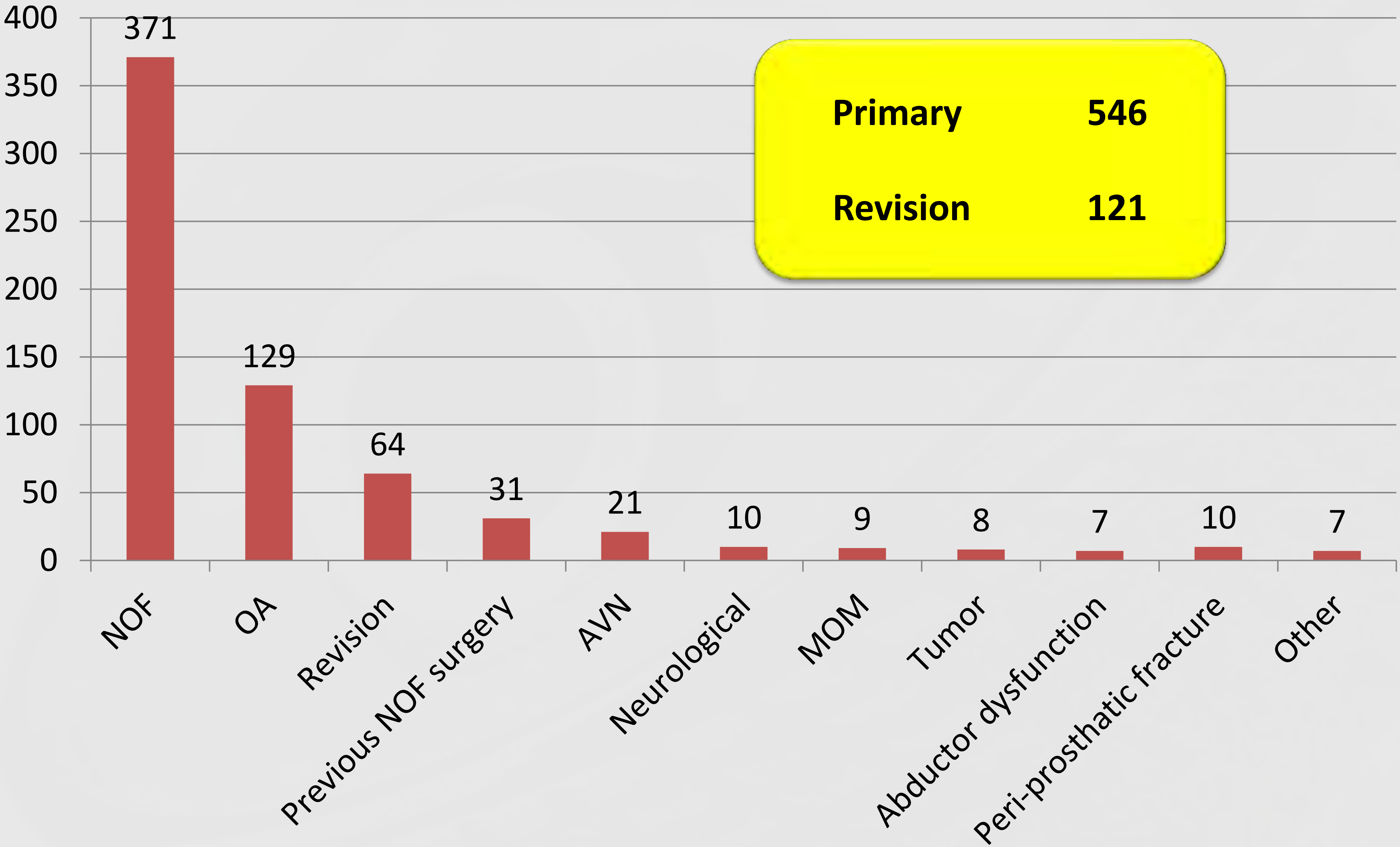
Patients

- 667 patients
- 2006 to 2014
- Minimum of 1 year follow up
- Mean follow up 3 years
- 32% males and 68% females
- 77 deaths (11.5 %)

- Mean age at time of surgery is 77 years
- Age range (41-100) years



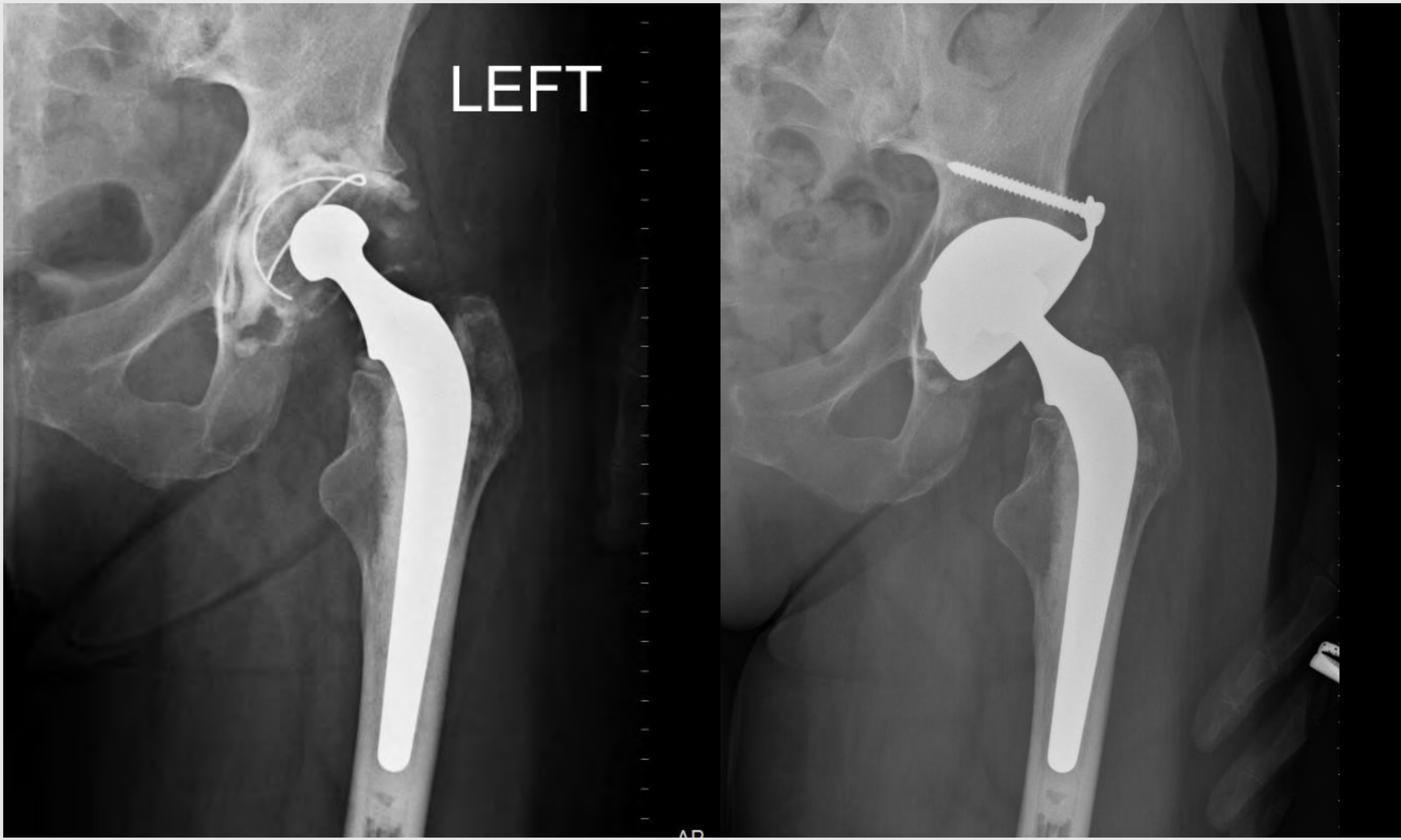
Indications



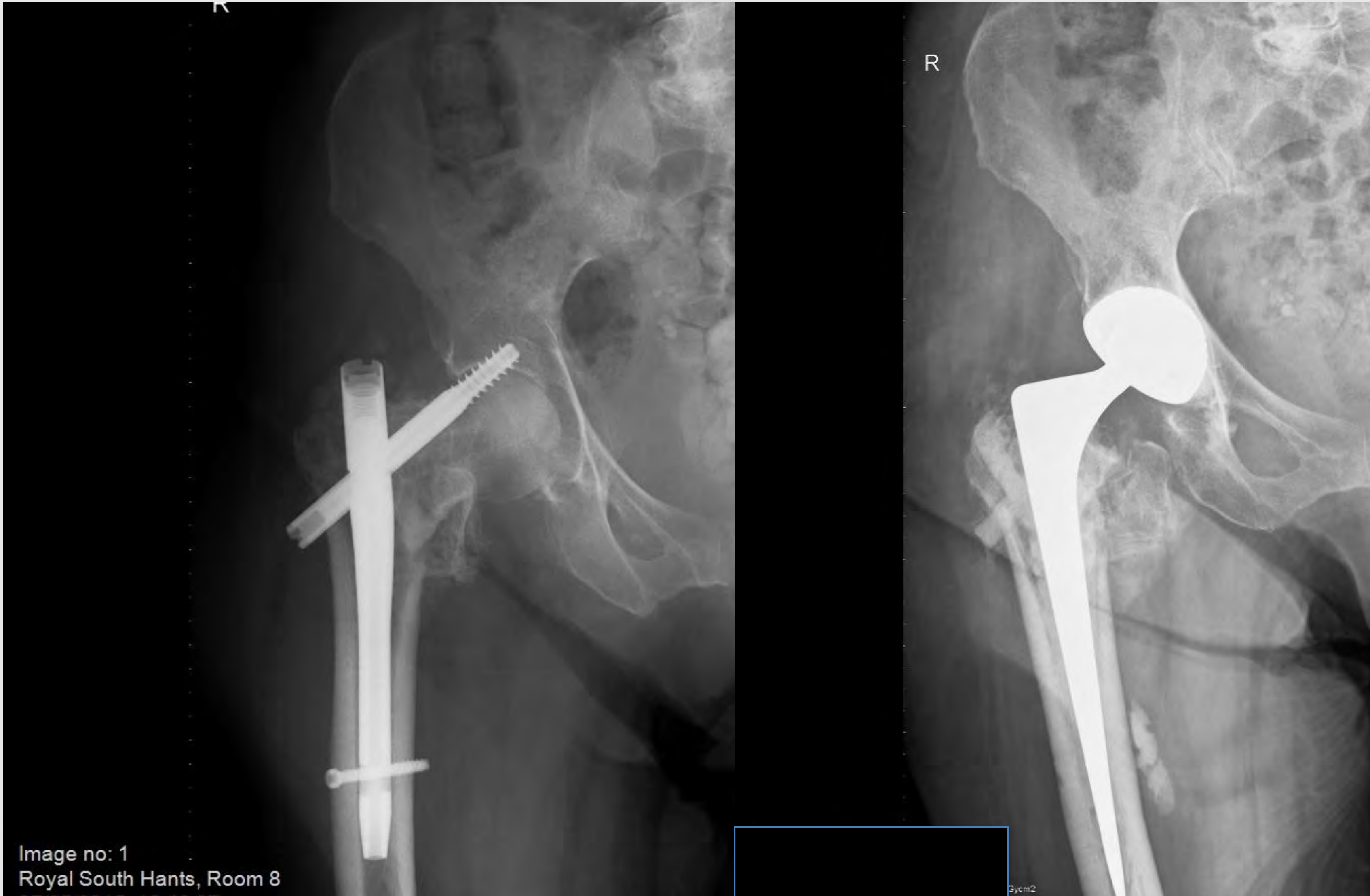
NICE National Institute for Health and Care Excellence

Recommendation	**Offer total hip replacement to patients with a displaced intracapsular fracture who:** • **were able to walk independently out of doors with no more than the use of a stick and** • **are not cognitively impaired and** • **are medically fit for anaesthesia and the procedure.**

Loose cup / fixed stem



Failed fixation

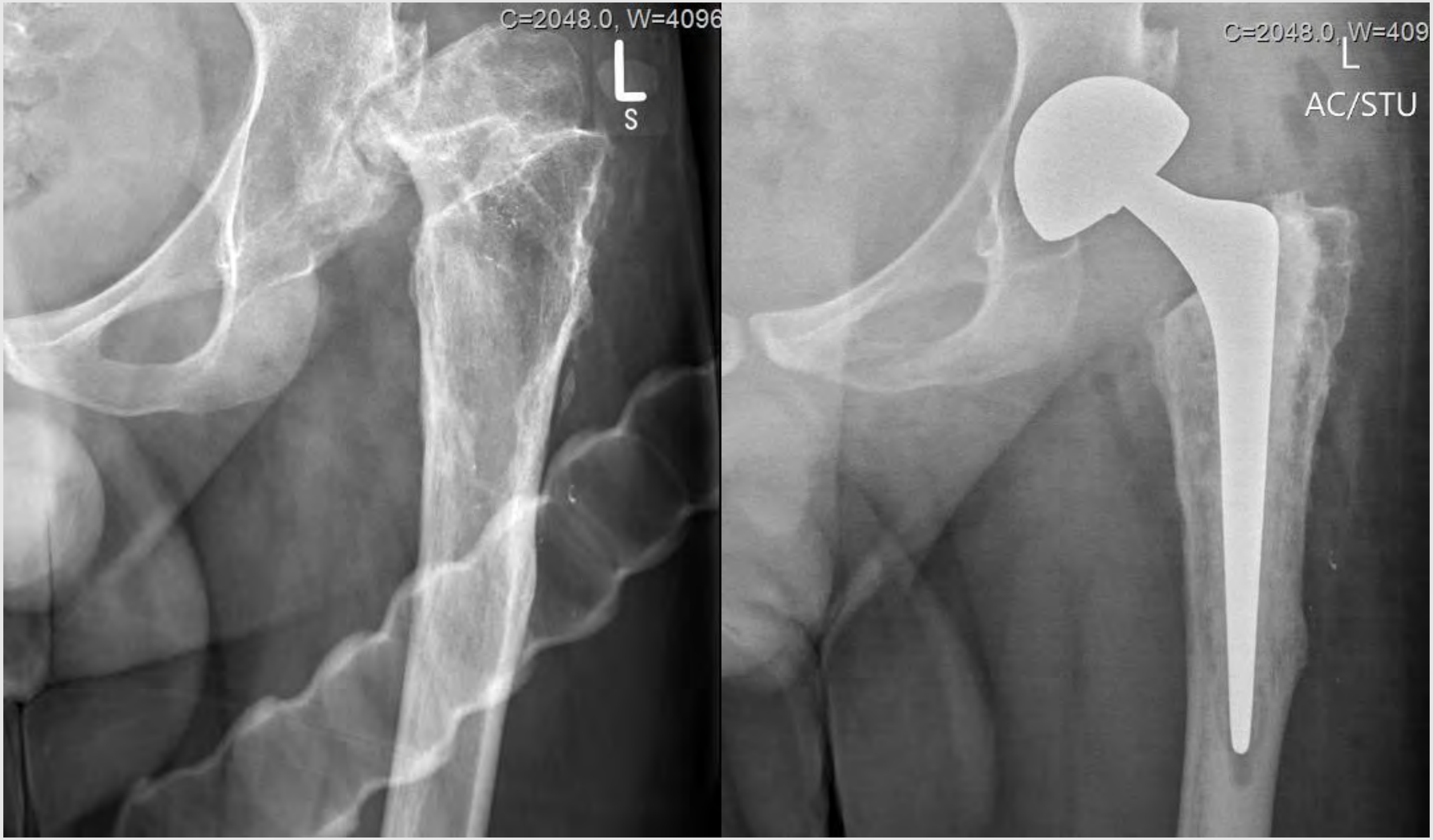


Revision

Revision custom-implant

Bone tumors

Hip dysplasia



Avascular necrosis

Osteoarthritis

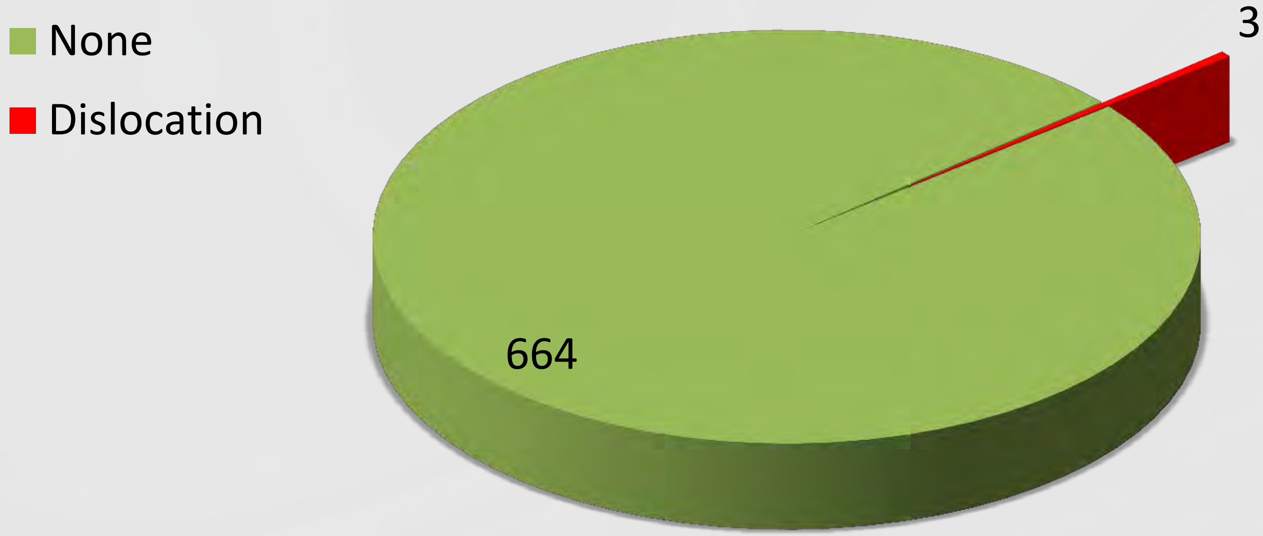
Criteria for failure

- Dislocation
- Revision for any reason

Results

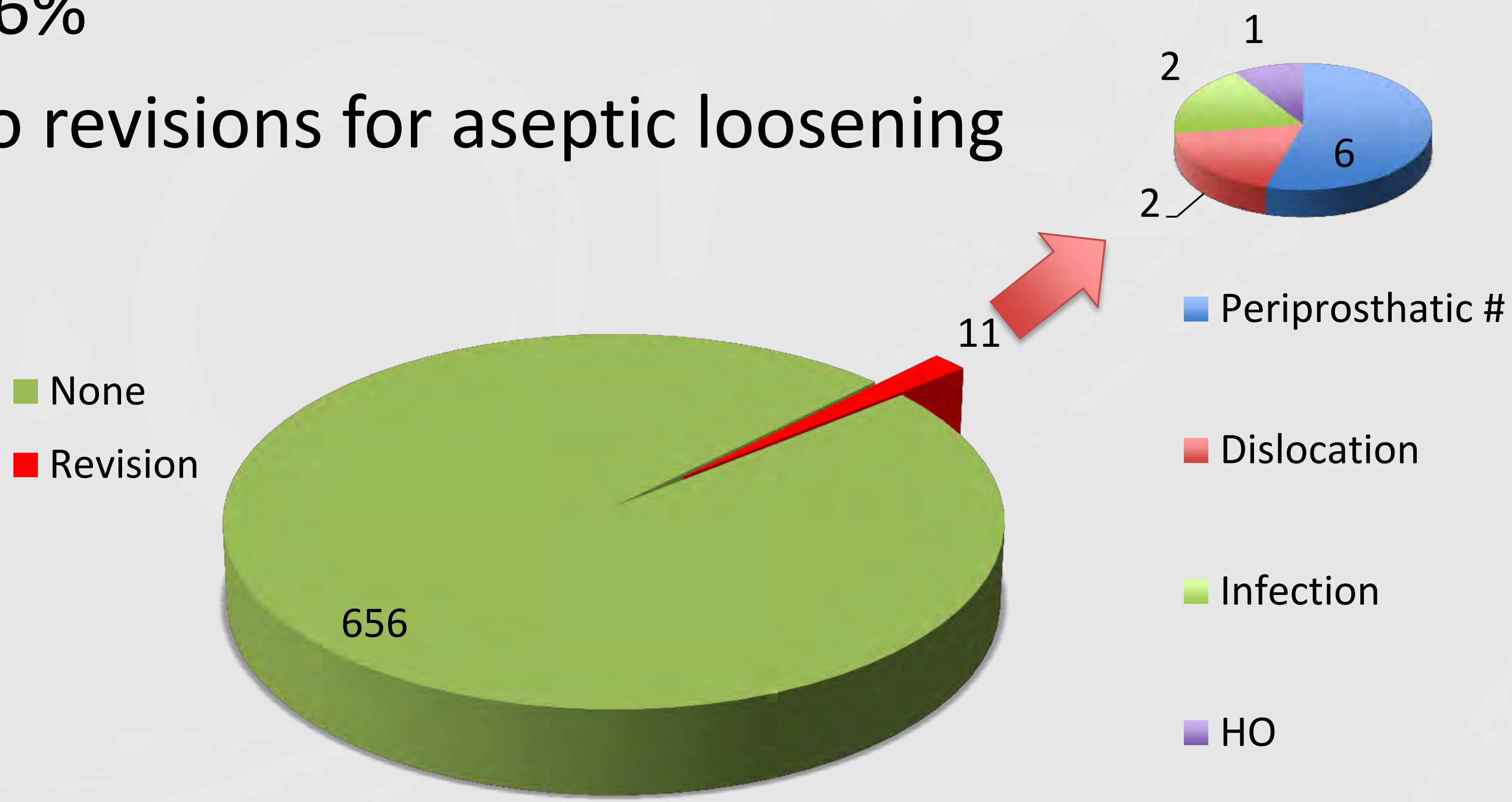
Dislocation

- 3 dislocations out of 667
- 0.4%
- Within first 6 months
- 2 required revision



Revision

- 11 Revisions
- 1.6%
- No revisions for aseptic loosening



Conclusion

- Dual mobility THR is an ideal choice in patients with high risk of dislocation both in primary and revision settings

- Our results show:

  0.4% dislocation rate

  0% revision rate for aseptic loosening

  1.6% revision rate for other causes


Thank you

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

IS THERE A DIFFERENCE IN ACETABULAR COMPONENT ORIENTATION AND POST-OP DISLOCATION BETWEEN ELECTIVE AND TRAUMA TOTAL HIP REPLACEMENTS?

Sarah Hirri, (FY2)
Timothy Kane FRCS (Trauma & Ortho)

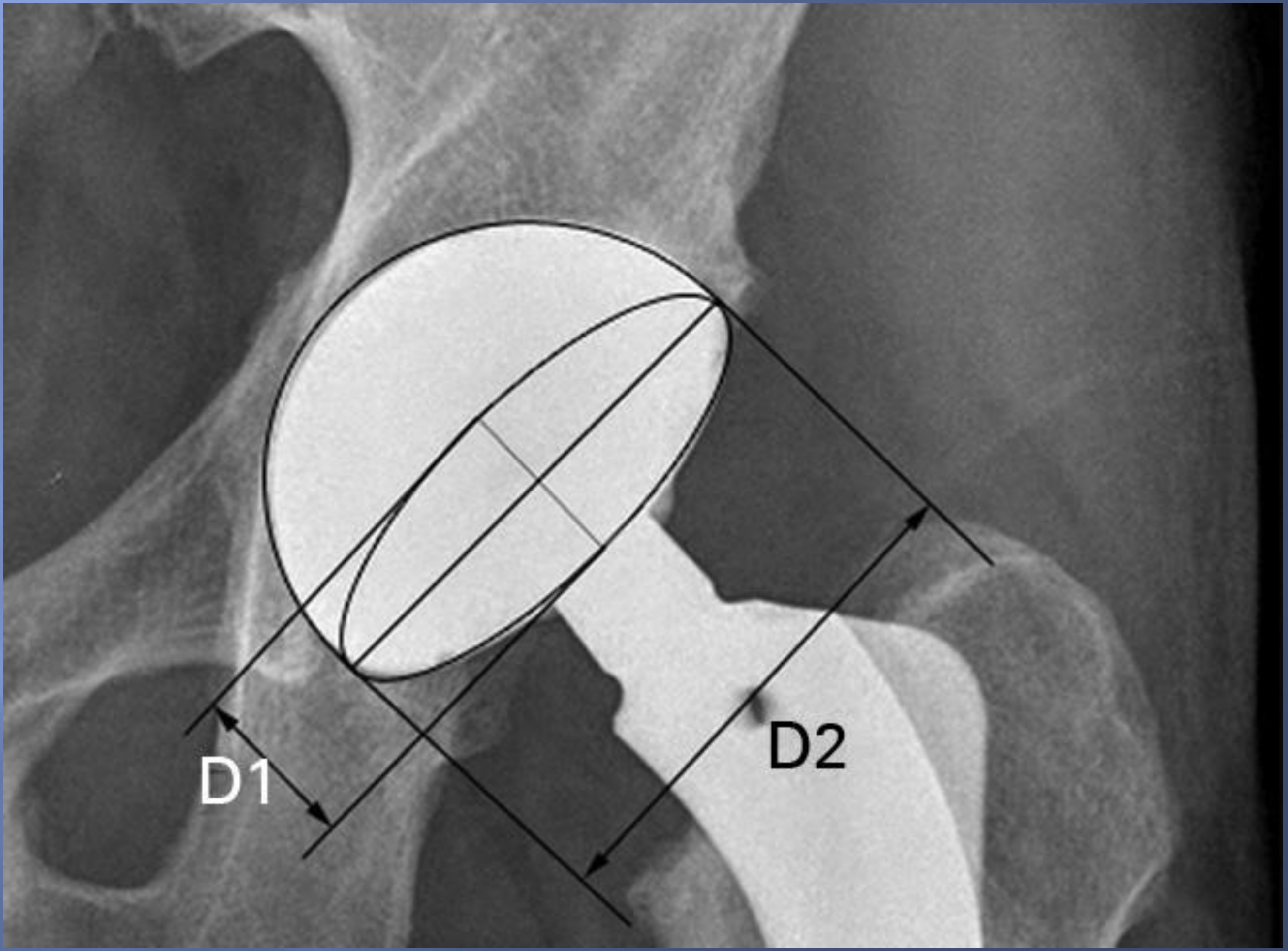
Queen Alexandra Hospital, Portsmouth,
PO6 3LY, United Kingdom

Introduction

- Acetabular component orientation in THRs is important in reducing dislocations
- Optimal acetabular component orientation remains controversial, has been defined by several 'safe zones'
- Correct identification the TAL aids cup positioning, which may be more difficult to identify in the arthritic acetabulum.
- There is limited data comparing acetabular component position between elective and trauma THRs

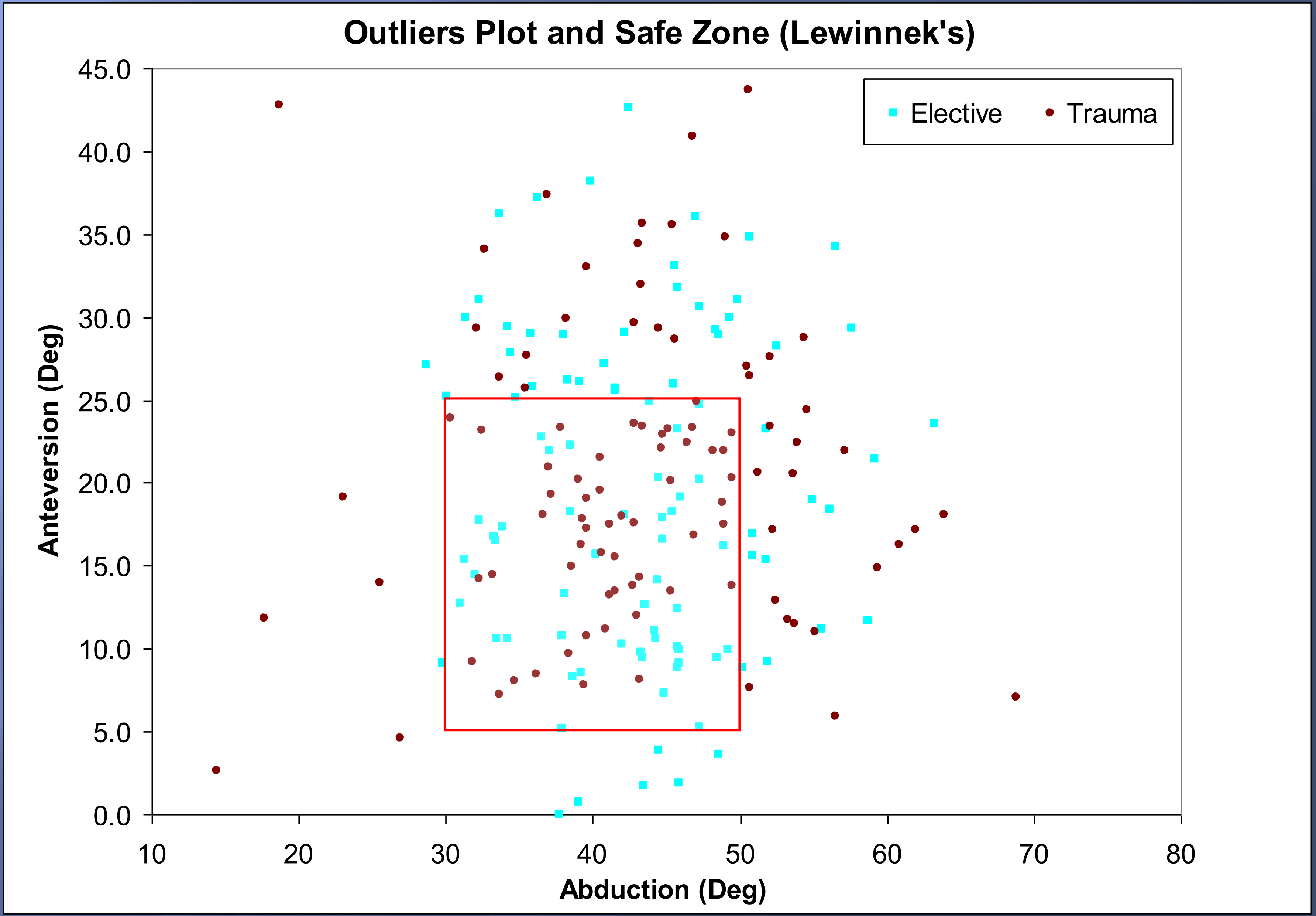
Method

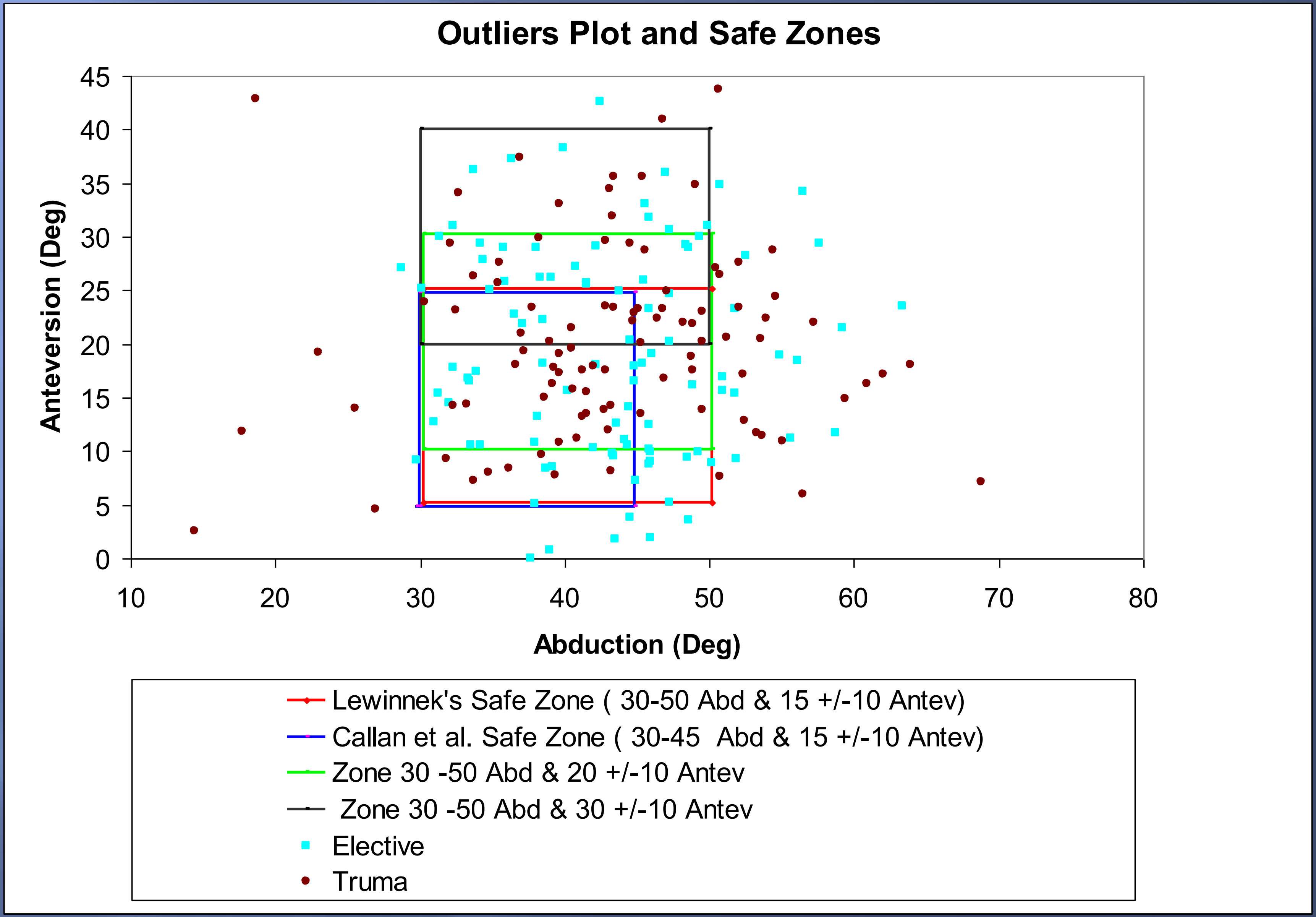
- Retrospective series of 99 consecutive trauma and 98 elective THRs identified using database.
- One observer measured post-operative antero-posterior (AP) pelvis radiographs for cup abduction and anteversion
- The cup orientation within different 'safe zones' was recorded.
- Dislocations at 6 months were identified radiographically.


D1
D2

Results

Operation	Elective	Trauma
Total No of Patients	98	99
Male	36	27
Female	62	72
Total Age (Average)	37.1-96.2 (68.9)	55.2-96.7 (72.0)
Male Age (Average)	37.1-94.9 (68.3)	56.7-96.7 (75.0)
Female Age (Average)	40.8-96.2 (69.2)	55.2-89.9 (71.0)


Outliers Plot and Safe Zone (Lewinnek's)
Elective
Trauma
Anteversion (Deg)
Abduction (Deg)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
10
20
30
40
50
60
70
80



Outliers Plot and Safe Zones
Anteversion (Deg)
Abduction (Deg)
0
5
10
15
20
25
30
35
40
45
10
20
30
40
50
60
70
80
Lewinnek's Safe Zone (30-50 Abd & 15 +/-10 Antev)
Callan et al. Safe Zone (30-45 Abd & 15 +/-10 Antev)
Zone 30 -50 Abd & 20 +/-10 Antev
Zone 30 -50 Abd & 30 +/-10 Antev
Elective
Truma

DETAILS		30^0 - 50^0 Abduction	30^0 - 45^0 Abduction	15^0 +/-10^0 Anteversion	Lewinnek's safe zone: 30^0 - 50^0 Abduction and 15 +/- 10 Anteversion
Elective	Total No	98	98	98	98
	Outlier No	16	41	37	48
	Outlier %	16.3	41.8	37.8	49.0
Emergency	Total No	99	99	99	99
	Outlier No	29	43	24	46
	Outlier %	29.3	43.4	24.2	46.5

DETAILS		Callan et al. safe zone: 30^0 - 45^0 Abduction and 15 +/-10 Anteversion	20^0 +/-10^0 Anteversion	30^0 - 50^0 Abduction and 20 +/-10 Anteversion	30^0 +/- 10^0 Anteversion	30^0 - 50^0 Abduction and 30 +/- 10 Anteversion
Elective	Total No	98	98	98	98	98
	Outlier No	75	30	43	55	63
	Outlier %	76.5	30.6	43.9	56.1	64.3
Emergency	Total No	99	99	99	99	99
	Outlier No	72	22	44	53	63
	Outlier %	72.7	22.2	44.4	53.5	63.6

Dislocations

- Elective group – 2 patients, one at 3 and one at 7 weeks

- Trauma group - 3 patients, including one that dislocated twice and another patient dislocating 4 times

- Time to first dislocation ranged from 26 to 39 days, latest dislocation at 5 months.

- No statistically significant difference in dislocation rate

Conclusion

- Cup positioning was consistent in elective versus trauma patients.
- There was no clinically significant difference in dislocation rate, however the sample size was small
- The trauma dislocations were more concerning as this group showed a tendancy towards becoming recurrent dislocators.

Thank you

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
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MILAN, ITALY

INTERNATIONAL COMBINED MEETING
BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

The influence of obesity in cup positioning during total hip replacement

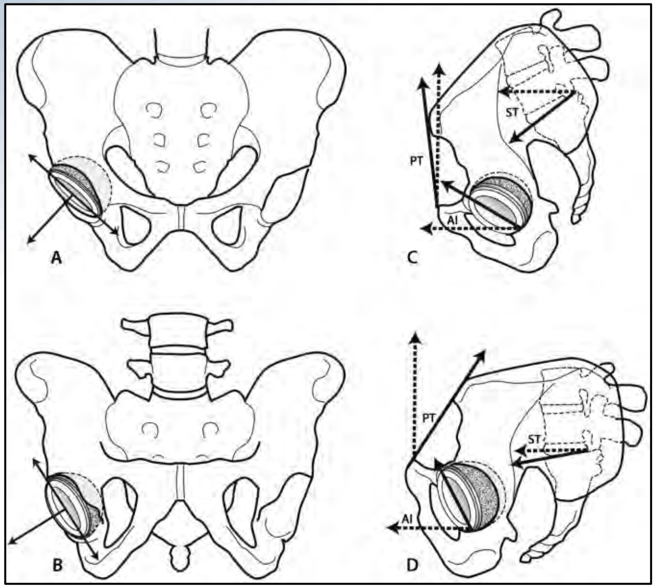
M. Franceschini – F. Calabrò – G.V. Mineo – M.M. Parrini
Clinica Ortopedica – IV Divisione
Istituto Ortopedico «G. Pini» - Milano

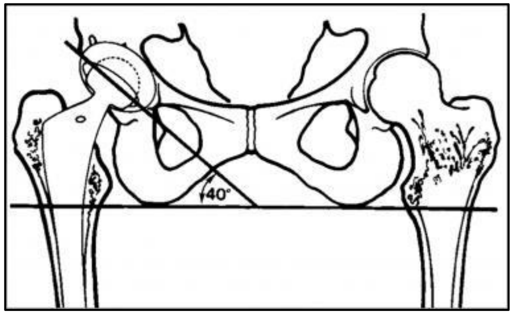
Correct position

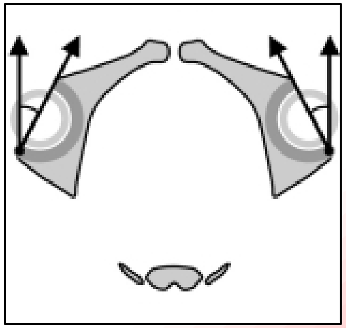
Normal biomechanics - good stability

Longterm survivorship – Good quality of life

Acetabular Cup Orientation







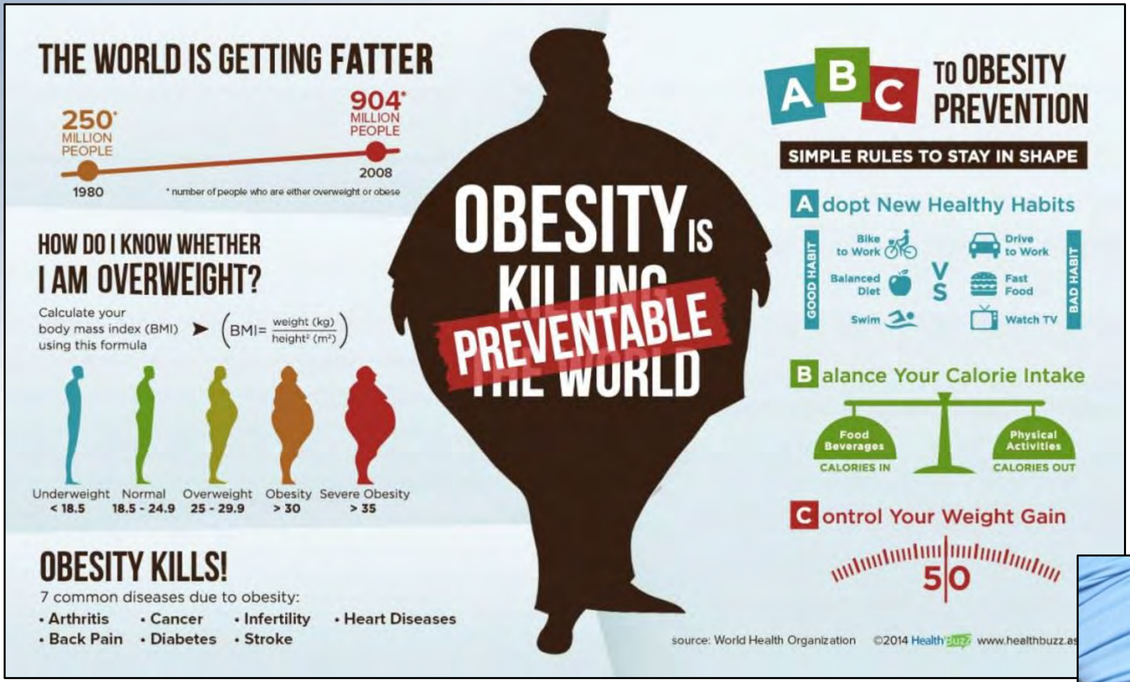
Lewinnek 'Safe Zone':

Inclination 30°-50° - Anteversion 5°-25°

Malpositioning?

- Dislocation
- Impingement
- Osteolysis
- Aseptic Loosening
- Increased Wear
- Fracturing of the polyethyilene liner
- Edge loading

Obesity



The incidence of obesity is constantly increasing

Literature

Clin Orthop Relat Res. 2011 Feb;469(2):319-29. doi: 10.1007/s11999-010-1487-1.

The John Charnley Award: risk factors for cup malpositioning: quality improvement through a joint registry at a tertiary hospital.

Callanan MC[1], Jarrett B, Bragdon CR, Zurakowski D, Rubash HE, Freiberg AA, Malchau H.

Orthop Traumatol Surg Res. 2015 May;101(3):289-96. doi: 10.1016/j.otsr.2015.01.011. Epub 2015 Mar 25.

The influence of obesity on primary total hip arthroplasty outcomes: A meta-analysis of prospective cohort studies.

Liu W[1], Wahafu T[1], Cheng M[1], Cheng T[1], Zhang Y[1], Zhang X[2].

Hip Int. 2014 May-Jun;24(3):263-9. doi: 10.5301/hipint.5000125. Epub 2014 Mar 17.

Acetabular component orientation in total hip arthroplasty: the impact of obesity.

McArthur BA[1], Vulcano E, Cross M, Nguyen J, Della Valle AG, Salvati E.

ANZ J Surg. 2013 Mar;83(3):171-4. doi: 10.1111/j.1445-2197.2012.06176.x. Epub 2012 Aug 21.

Body mass index and acetabular component position in total hip arthroplasty.

McBride A[1], Flynn J, Miller G, Barnes M, Mackie S.

Methods

- From January 2013 to October 2015

- 215 patients affected by Primary Hip Arthritis

- 3 surgical approaches:

  DAA

  Antero-Lateral

  Direct Lateral

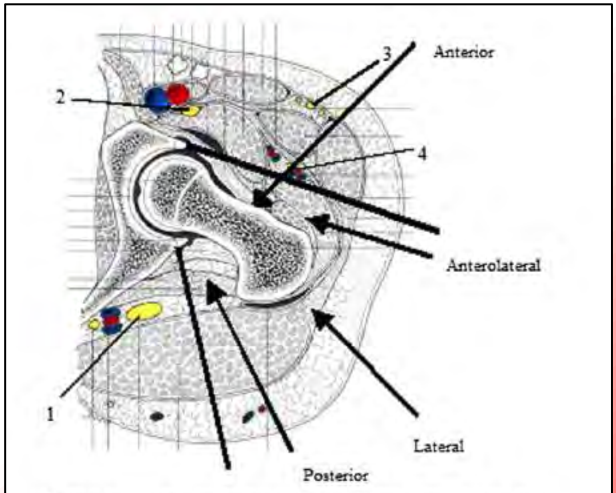


Figure 1 Approaches to the hip and surrounding nerves: Sciatic Nerve (1), Femoral Nerve (2), Lateral Femoral Cutaneous Nerve (3), and Obturator Nerve (4).

	Obese n=63	**Non Obese n=152**
Age	**65,3 ± 7,4**	**68,9 ± 9,5**
BMI	32,9 ± 3,7	24,4 ± 2,9
Gender F/M	39/24	67/85
Side L/R	34/29	74/78

Postop X Ray

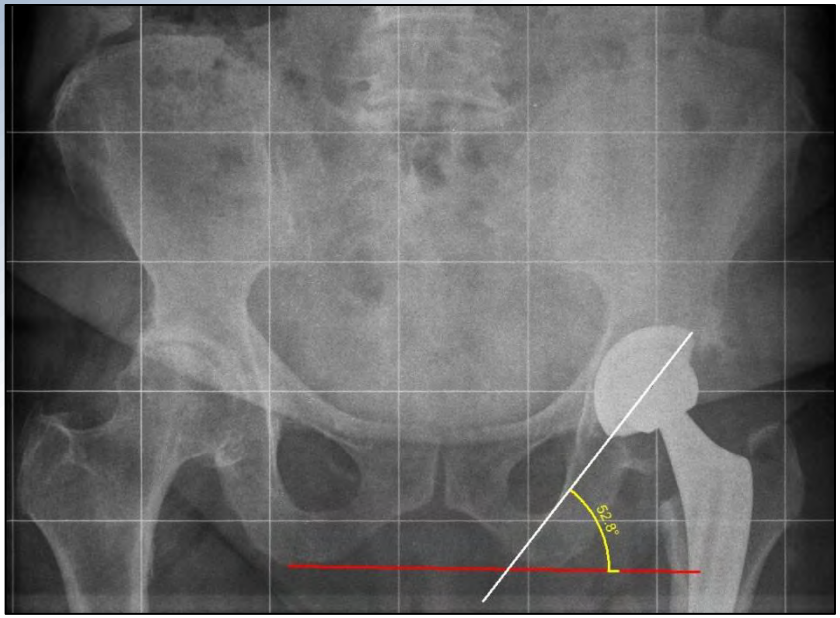
Why x Ray?

- Less irradiation than CT Scan
- Cheap
- Fast
- Enough accurate

Evaluation of radiological methods of assessing cup anteversion in total hip replacement

K. S. Manjunath[1] · Vijaya Soruban[2] · K. G. Gopalakrishna[2]

Inclination



Determined by an angle of a line between the inferior border of the ischial tuberosities and a line drawn transecting the widest point of the edge of the cup

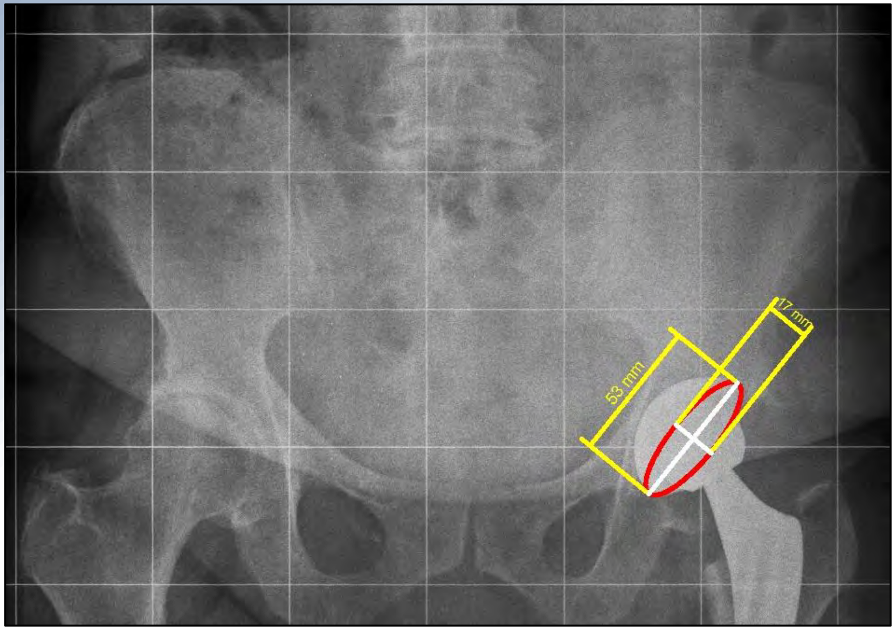
Safe zone: 30°-50°

Body mass index and acetabular component position in total hip arthroplasty

Andrew McBride, Jennifer Flynn, George Miller, Matthew Barnes and Scott Mackie

Department of Orthopaedics, Royal Hobart Hospital, Hobart, Tasmania, Australia

Antiversion



Comparison between methods:

- Lewinnek method

  ARCsin (short-axis/long-axis)

- Ruler

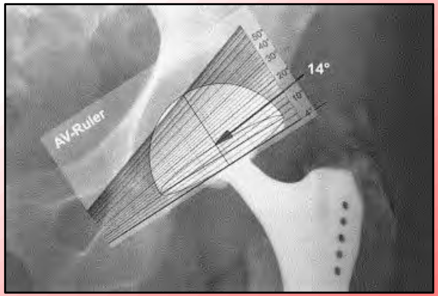
Safe zone: 5°-25°

Evaluation of radiological methods of assessing cup anteversion in total hip replacement

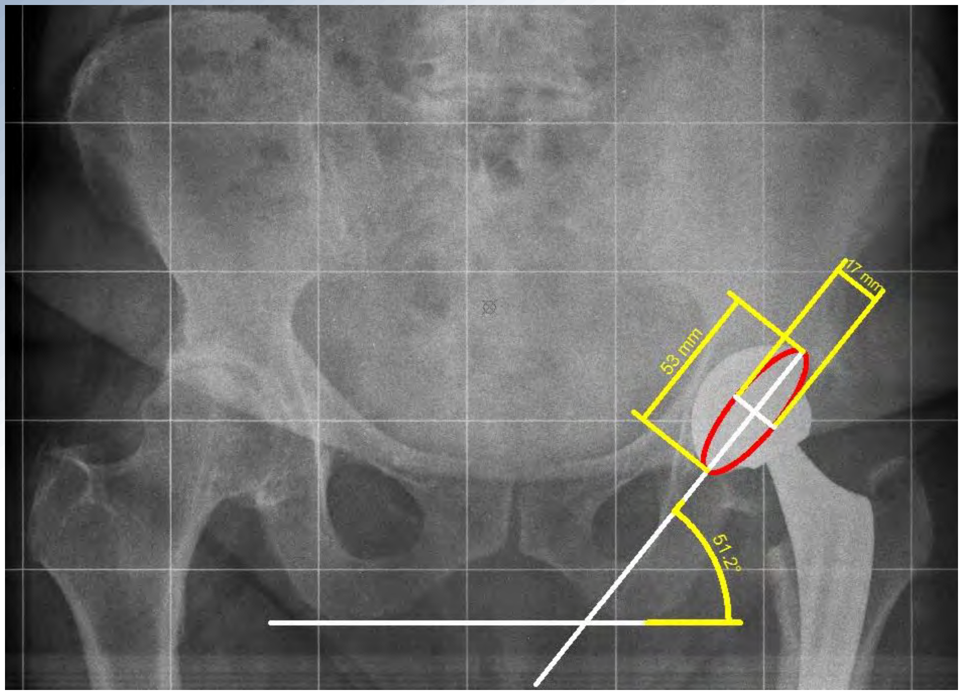
K. S. Manjunath[1] · Vijaya Soruban[2] · K. G. Gopalakrishna[2]

A new method of measuring acetabular cup anteversion on simulated radiographs

Vikas Bachhal,[1] Nipun Jindal,[2] Gaurav Saini,[1] Radheshyam Sament,[1] Vishal Kumar,[1] Devendra Chouhan,[1] and Mandeep Dhillon[1]



Measurements – Case 1



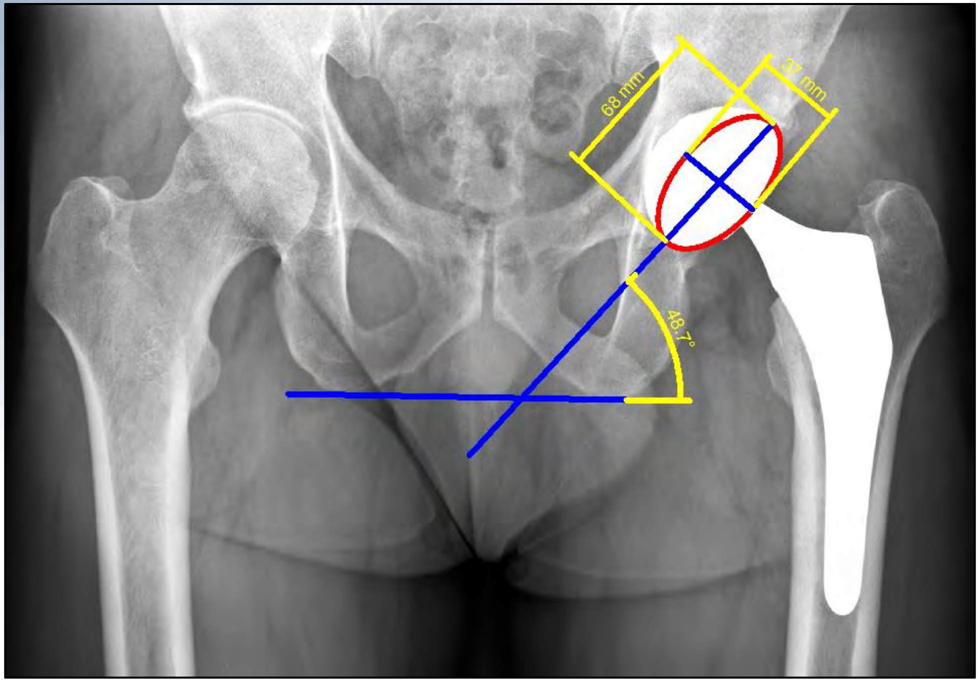
Inclination 51,2°

Antiversion 18,7°

BMI 31,3

Lewinnek 'Safe Zone':
Inclination 30°-50° - Anteversion 5°-25°

Measurements – Case 2



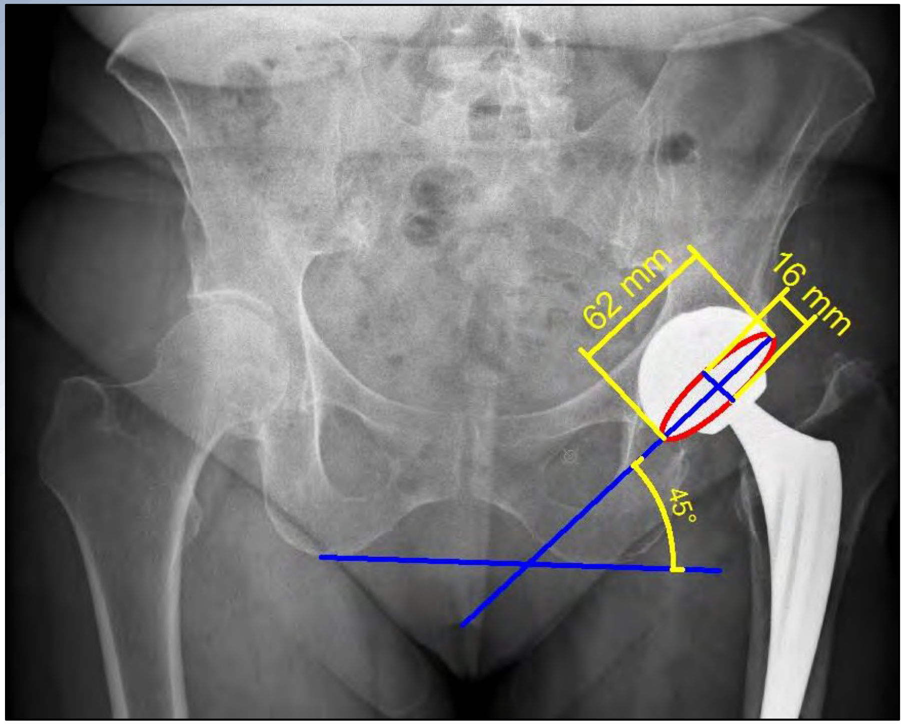
Inclination 48,7°

Antiversion 33,0°

BMI 27,2

Lewinnek 'Safe Zone':
Inclination 30°-50° - Anteversion 5°-25°

Measurements – Case 3



Inclination 45,0°

Antiversion 16,2°

BMI 27,7

Lewinnek 'Safe Zone':

Inclination 30°-50° - Anteversion 5°-25°

Results

	DAA n=71	Antero-Lateral n=47	Direct Lateral n=97
Inclination BMI < 30 Kg/m²	44,22° ± 8,21°	45,44° ± 5,13°	45,47° ± 8,29°
Inclination BMI > 30 Kg/m²	**49,50° ± 1,54°**	**50,36° ± 6,46°**	**47,95° ± 5,74°**
Anteversion BMI < 30 Kg/m²	17,53° ± 5,35°	20,24° ± 9,62°	16,24° ± 6,64°
Anteversion BMI > 30 Kg/m²	19,33° ± 2,44°	13,57° ± 2,31°	13,59° ± 2,44°

Conclusions

- In obese patients is more difficult to obtain the correct inclination for every surgical approach, in particular for the antero-lateral one.
- The anteversion is included into the safe zone for obese and non obese patients both.
- High BMI is a risk factor for Cup Malpositioning because of:
  - subcutaneous tissue thickness
  - bony landmarks identification is difficult
  - the patient positioning is problematic (TILT)
- The surgeon experience is important

Tip & Tricks

- Larger incision → Better exposure
- Dedicated instrumentation

  → Wider Homanns

  → Reamer with offset

  → Impactor with offset

- Fluoroscopy and/or navigation could be useful in Obese Patients

THANKS

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

ELEVATED LINER PLACEMENT AN ANATOMICAL STUDY.

Mr David Mitchell

Dr Leigh MacDonald

Associate Professor Norm Eizenberg

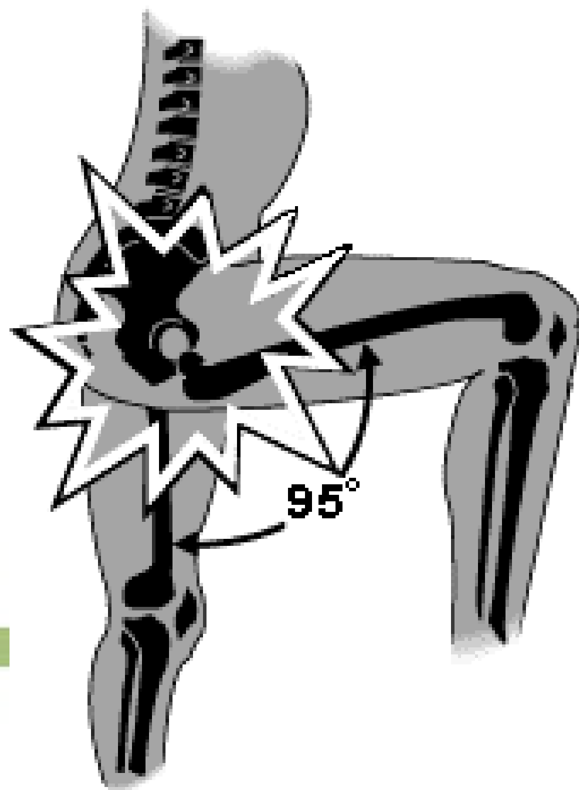
BALLARAT
ORTHOPAEDICS

Factors in Hip Instability

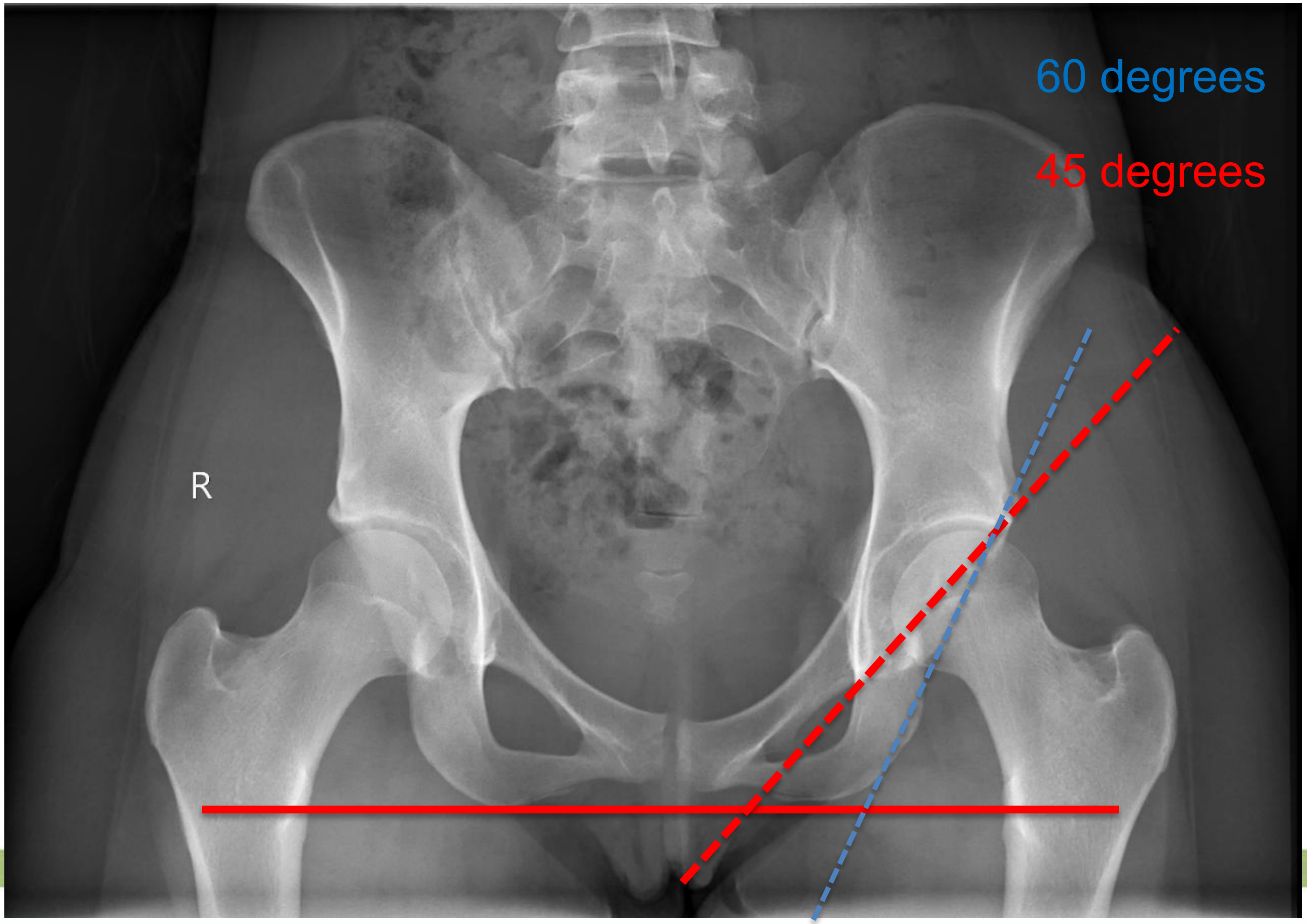
- Component positioning
    - Liner
- Head size
- Dual Mobility design

Issue

- A mechanism of hip dislocation occurs with internal rotation, flexion and adduction: initially posteroinferiorly
- Radiographic appearance is different:
  Muscle force pulls dislocated head posterosuperiorly



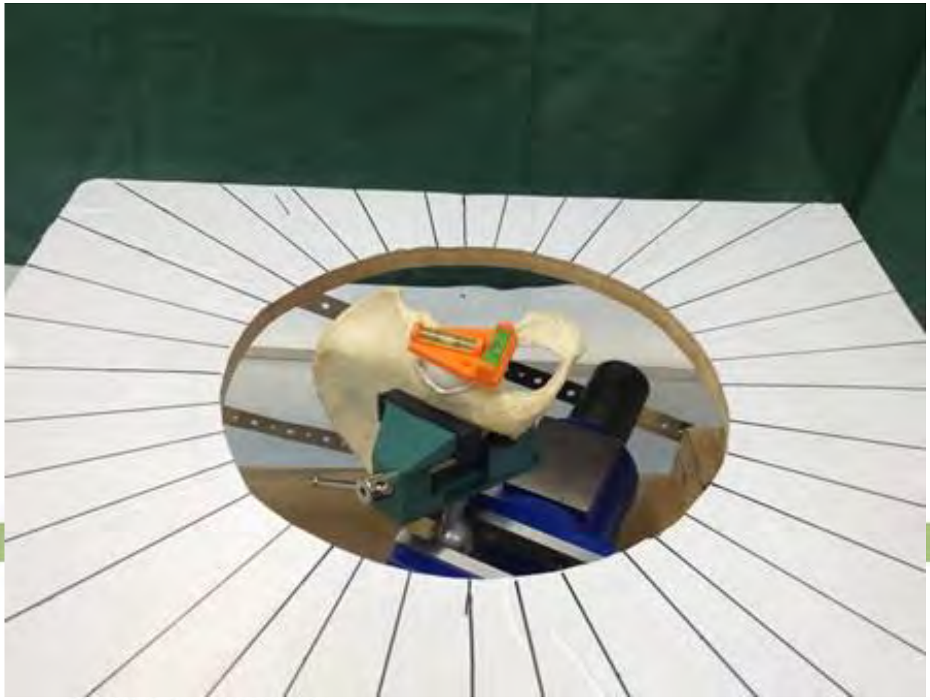
Anterior and posterior rim lines



BALLARAT
ORTHOPAEDICS

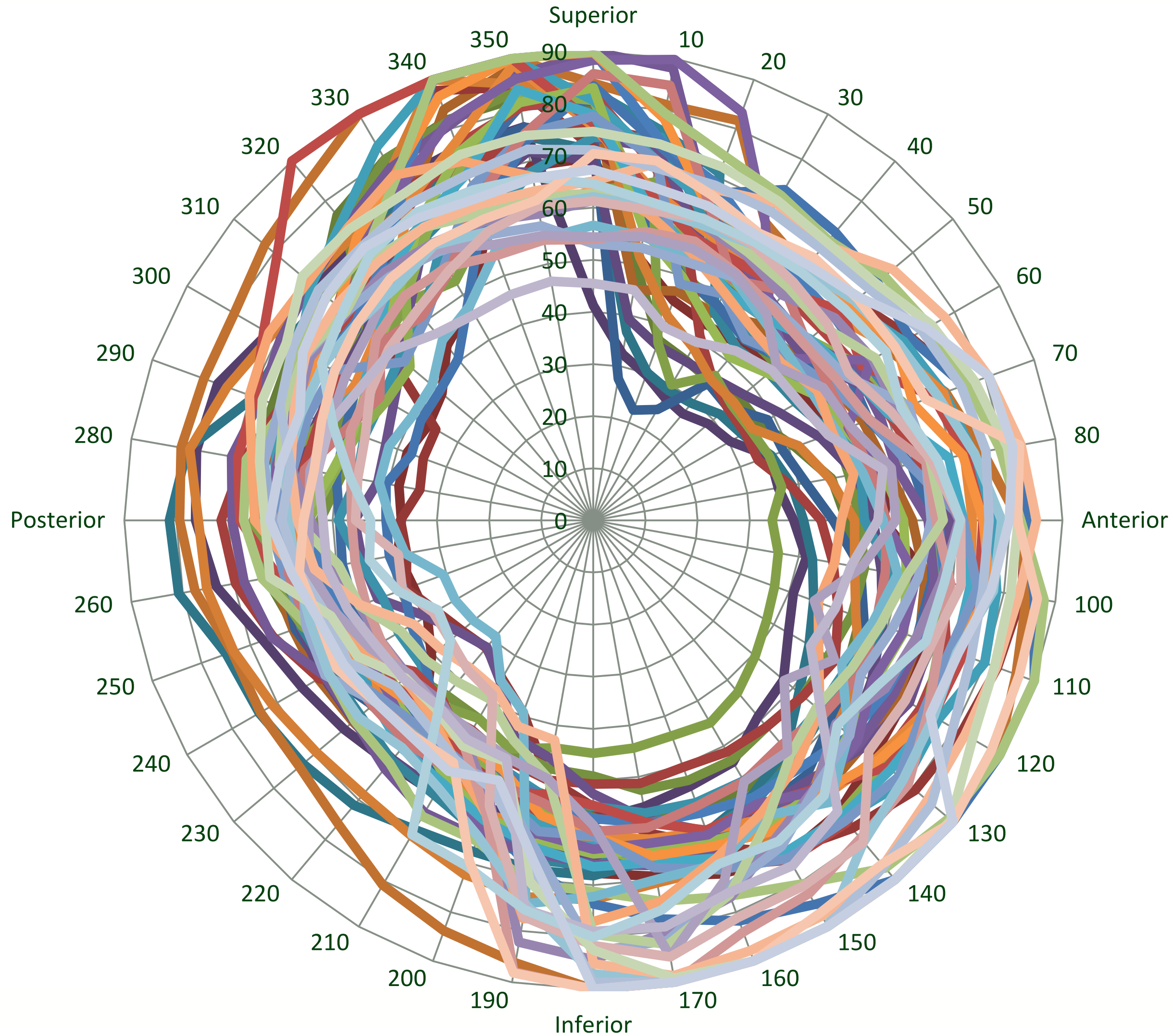
Method

- 48 dry bone specimens
- Hemipelvis fixed in vice
- Horizontal plane was equivalent to 45 degrees inclination and 20 degrees of anteversion



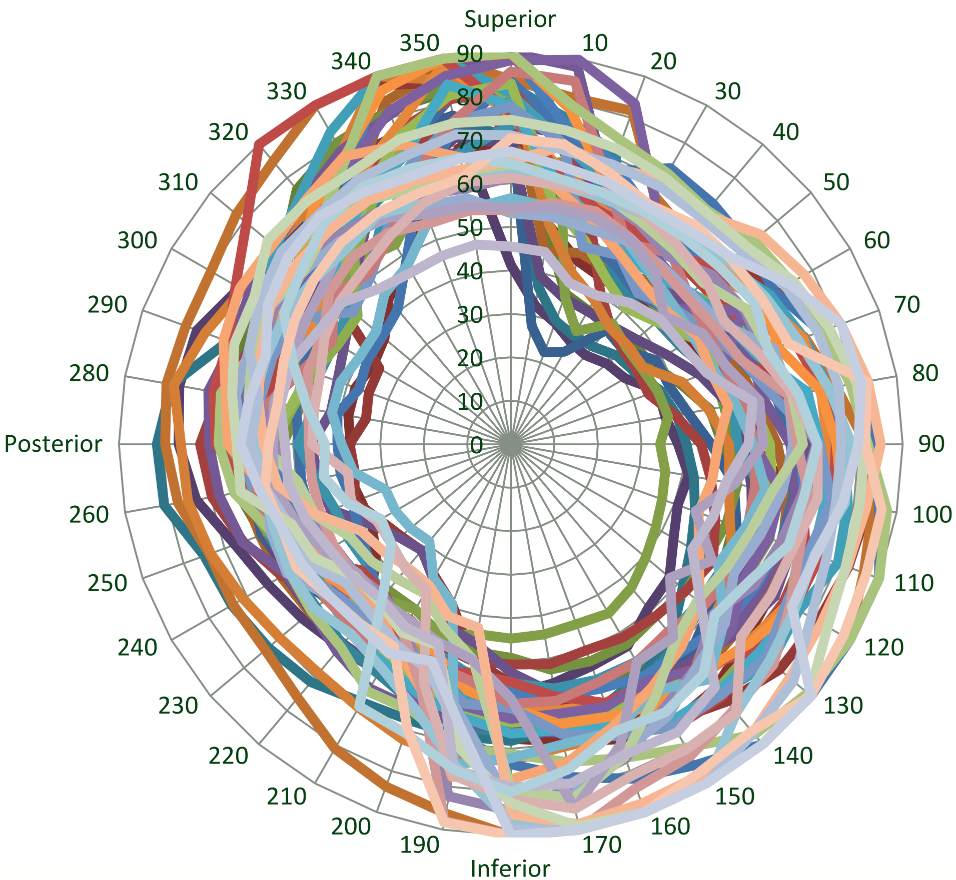
Method

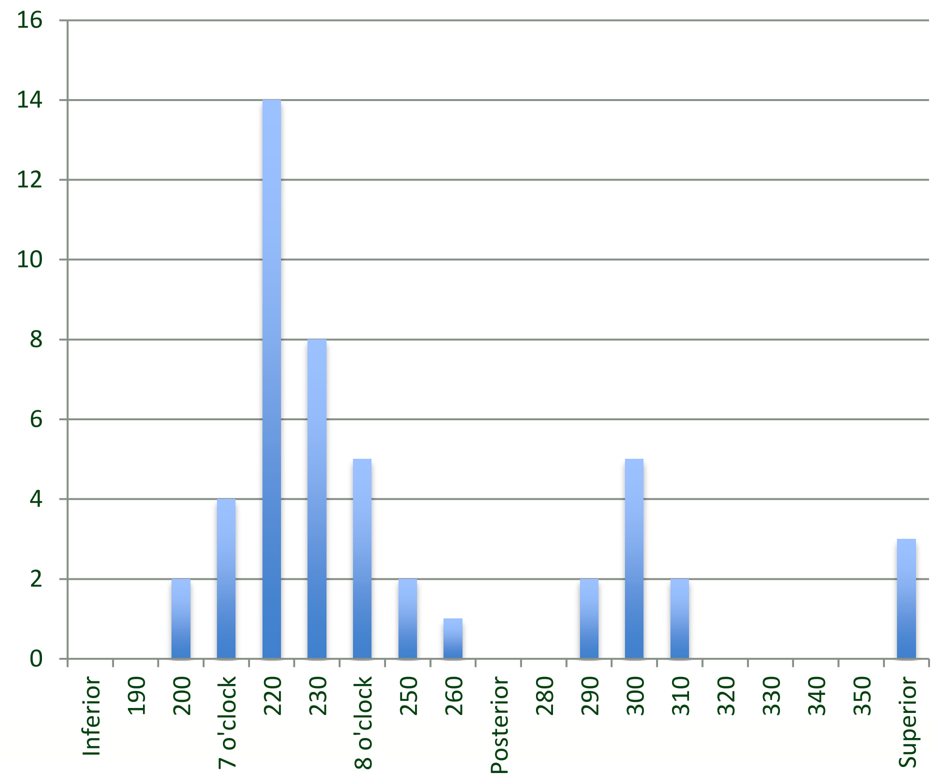
- Angle of inclination measured to the point touching the rim of the boney acetabulum
- Angle from vertical calculated
- Measurements mapped on a polar graph



BALLARAT ORTHOPAEDICS

Incidence of Posterior High Point

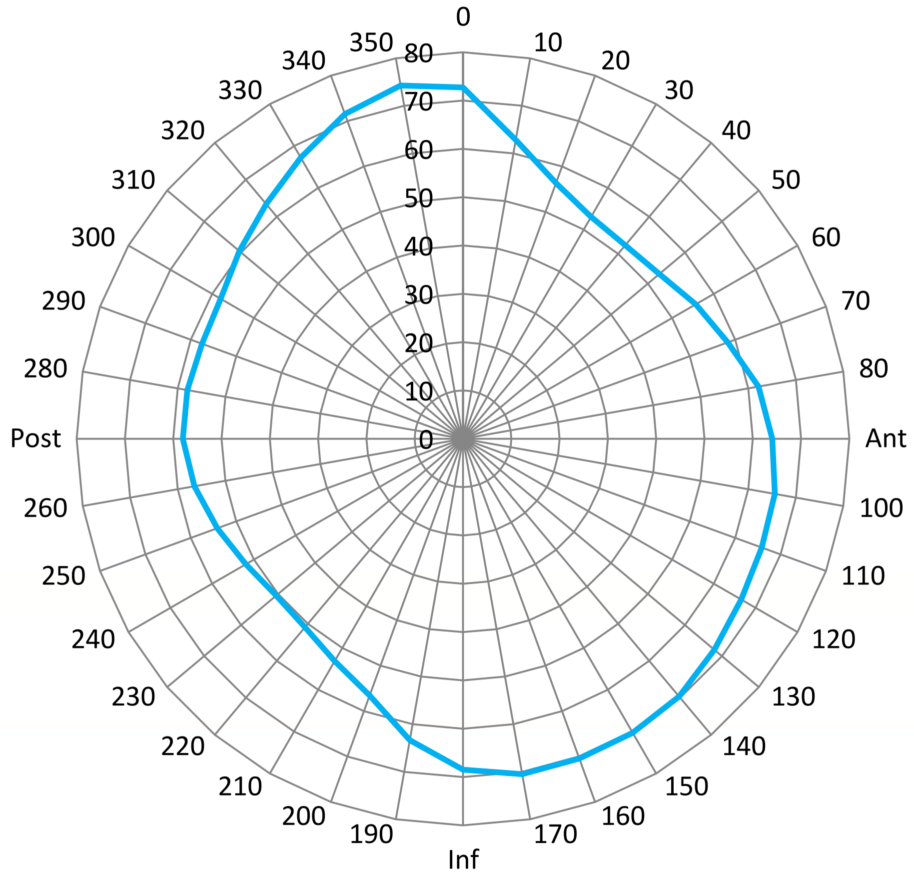




BALLARAT ORTHOPAEDICS

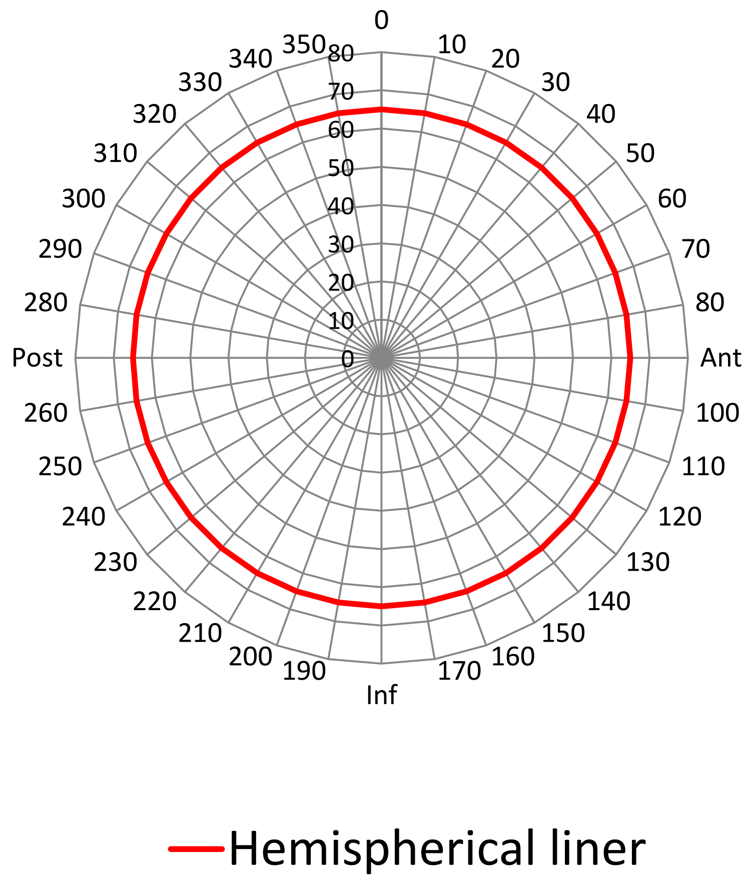
Results

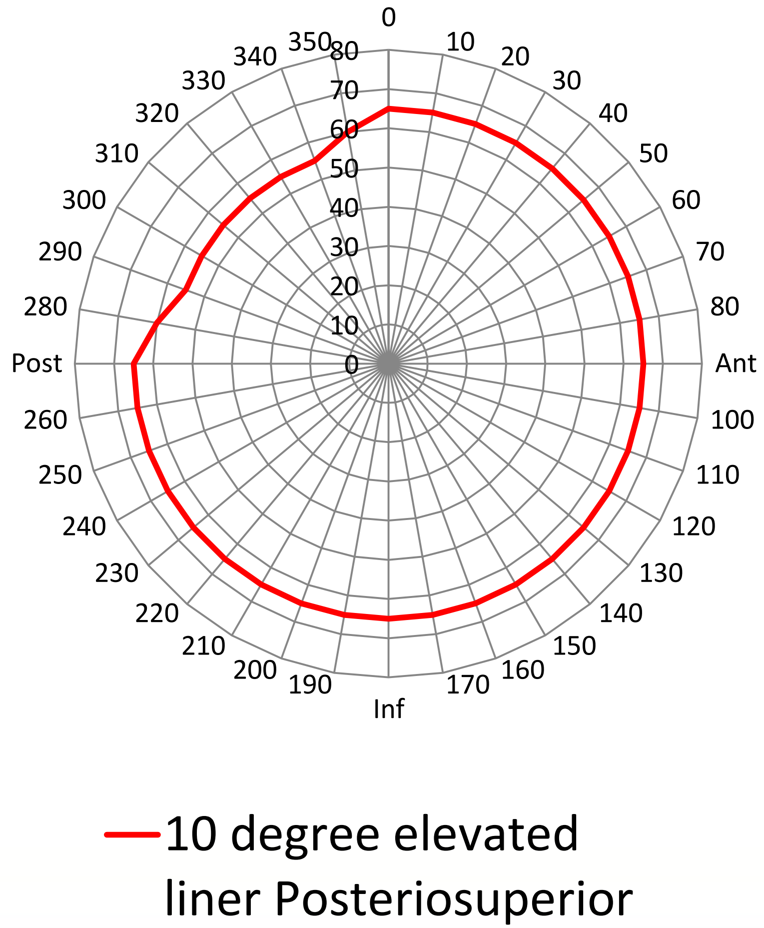
- Most common highpoint is at 7.30 position
- Average elevation 18.5 degrees



BALLARAT ORTHOPAEDICS

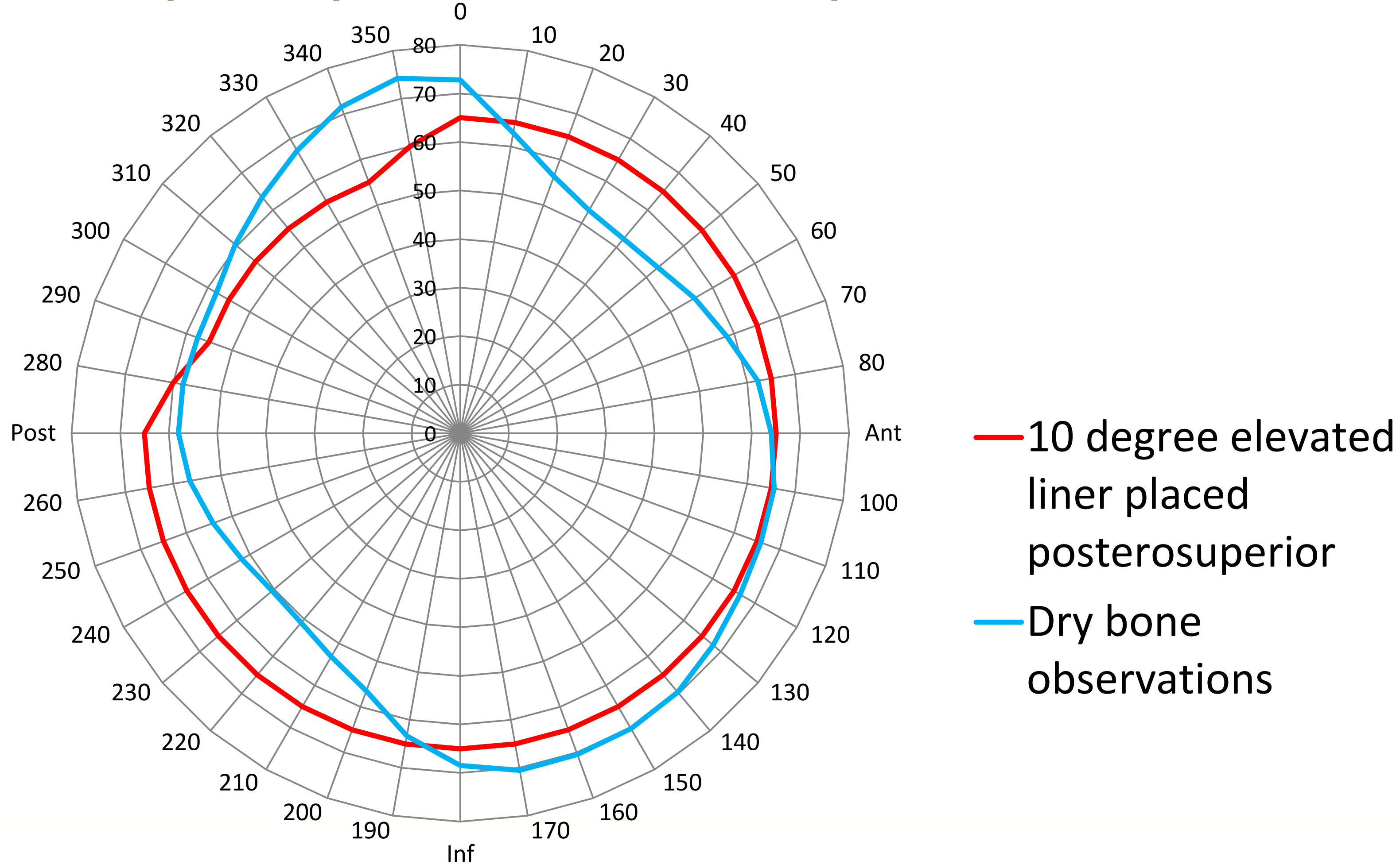
Flat v Elevated Lip Liner





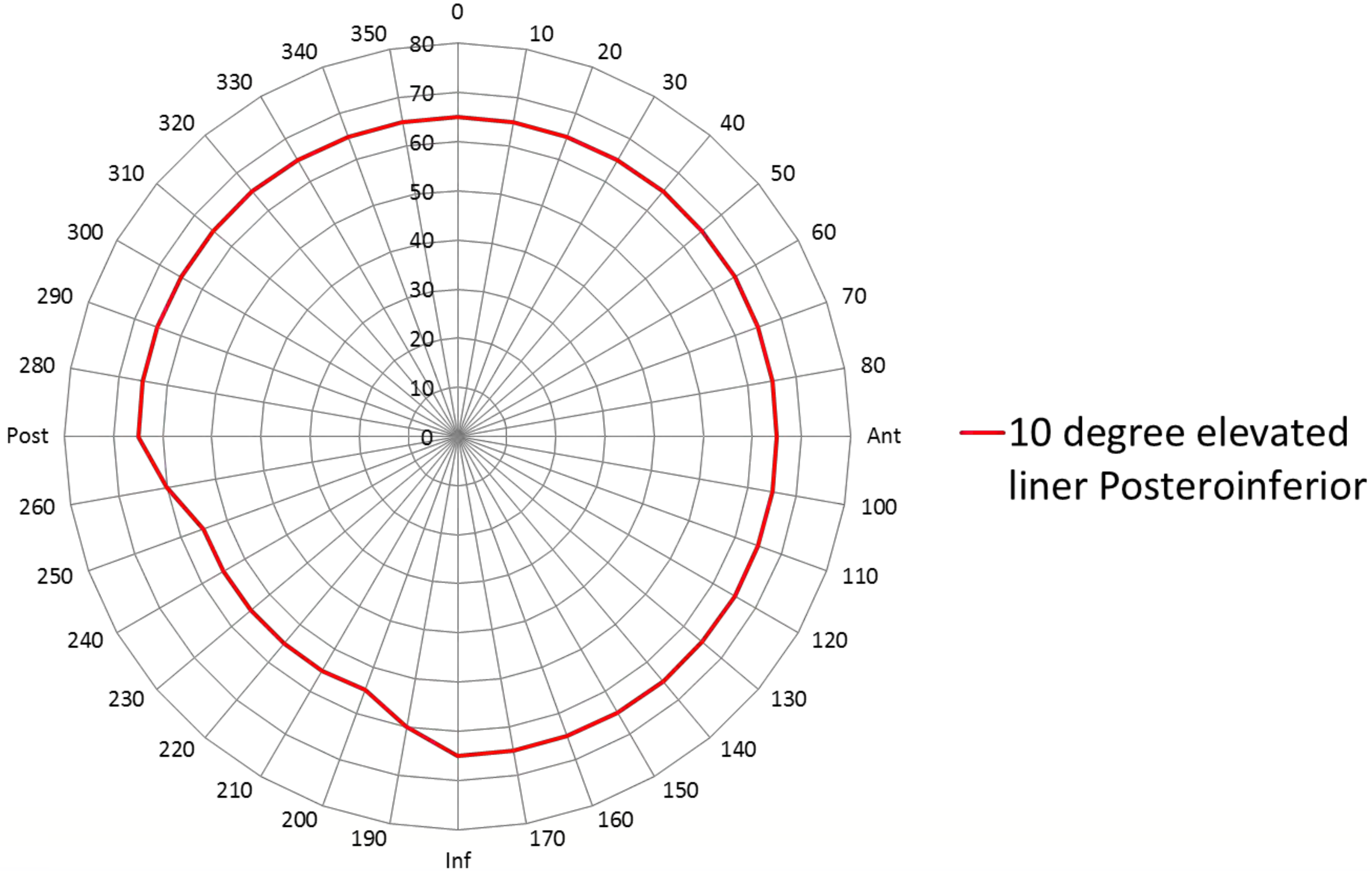
BALLARAT ORTHOPAEDICS

Superimposed Posterosuperior Liner



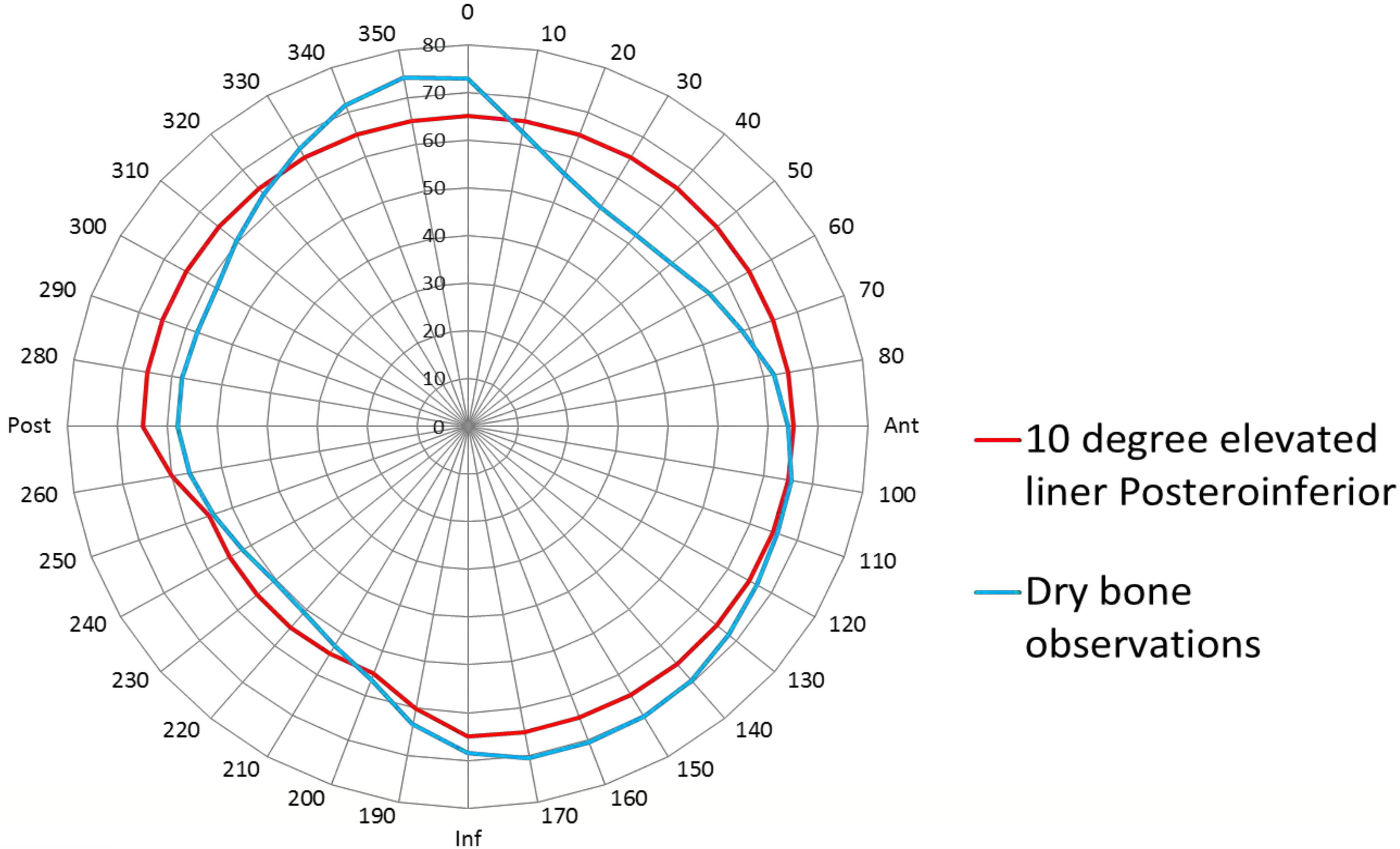
BALLARAT ORTHOPAEDICS

Posteroinferior Liner?



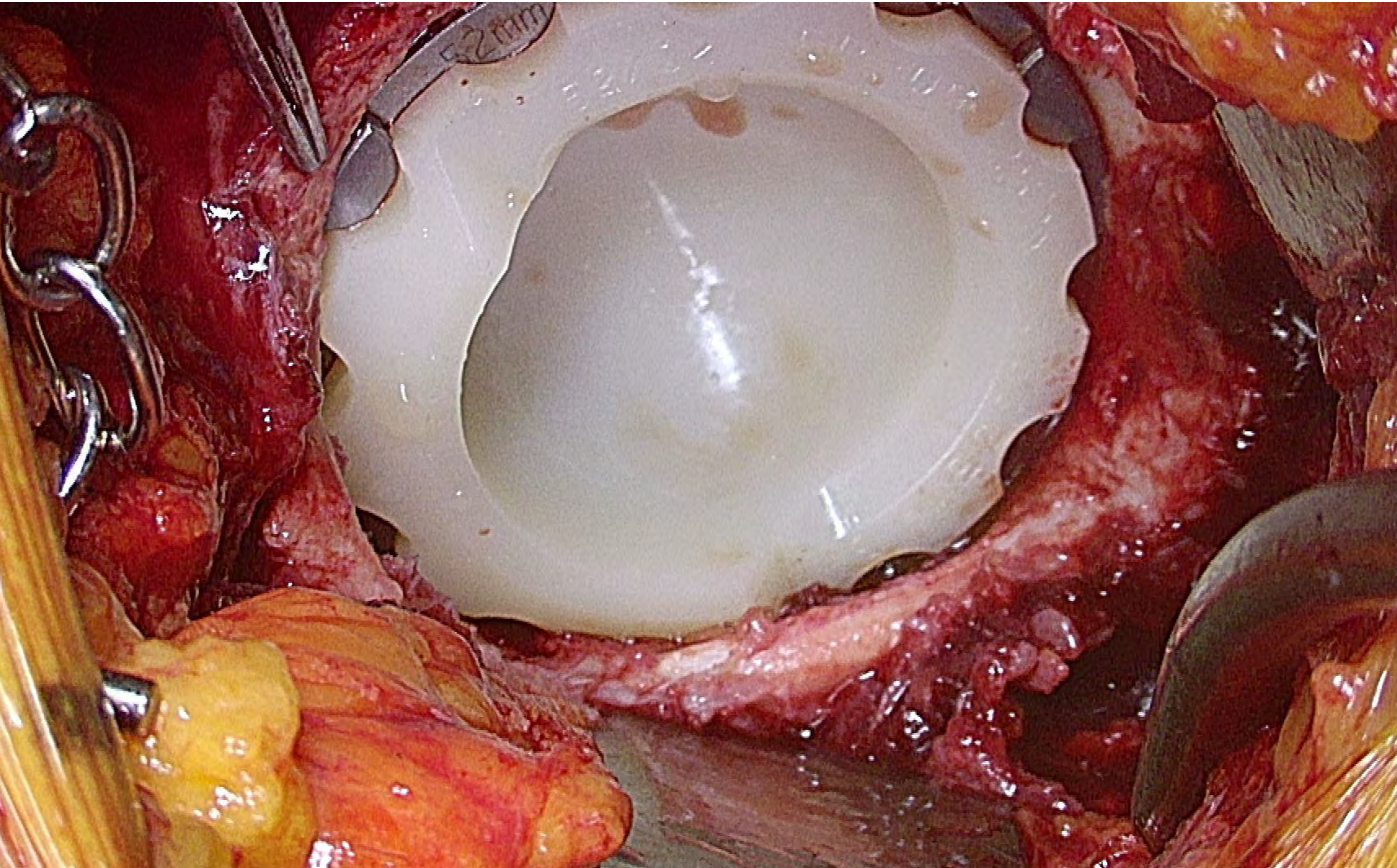
BALLARAT ORTHOPAEDICS

Superimposed Posteroinferior Liner

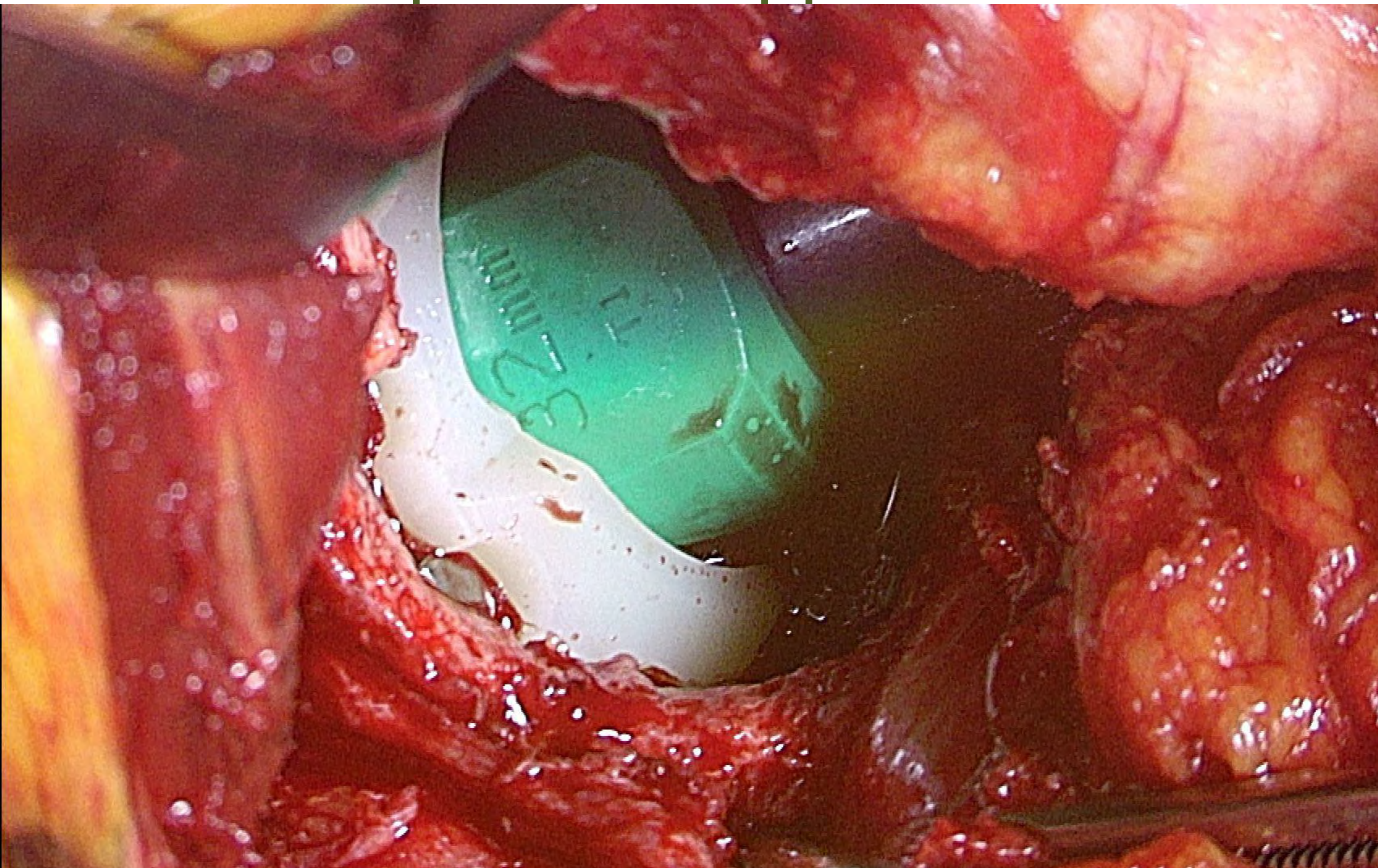


BALLARAT ORTHOPAEDICS

Intraoperative Appearance

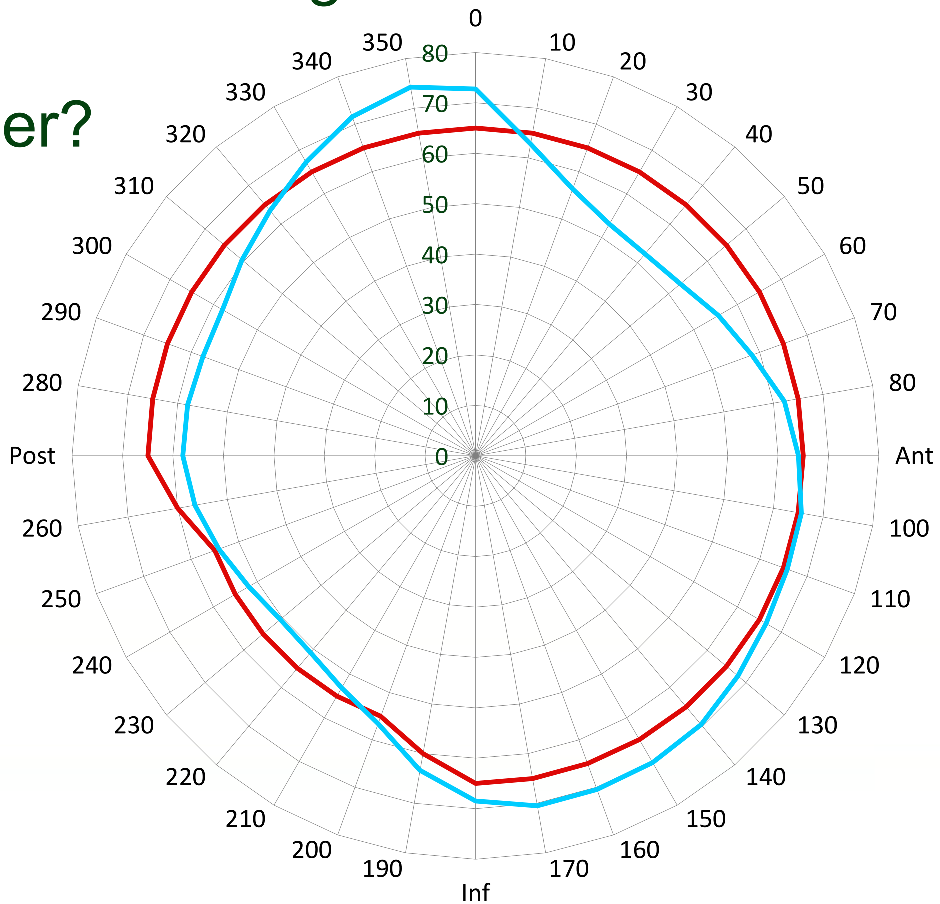


Intraoperative Appearance 2



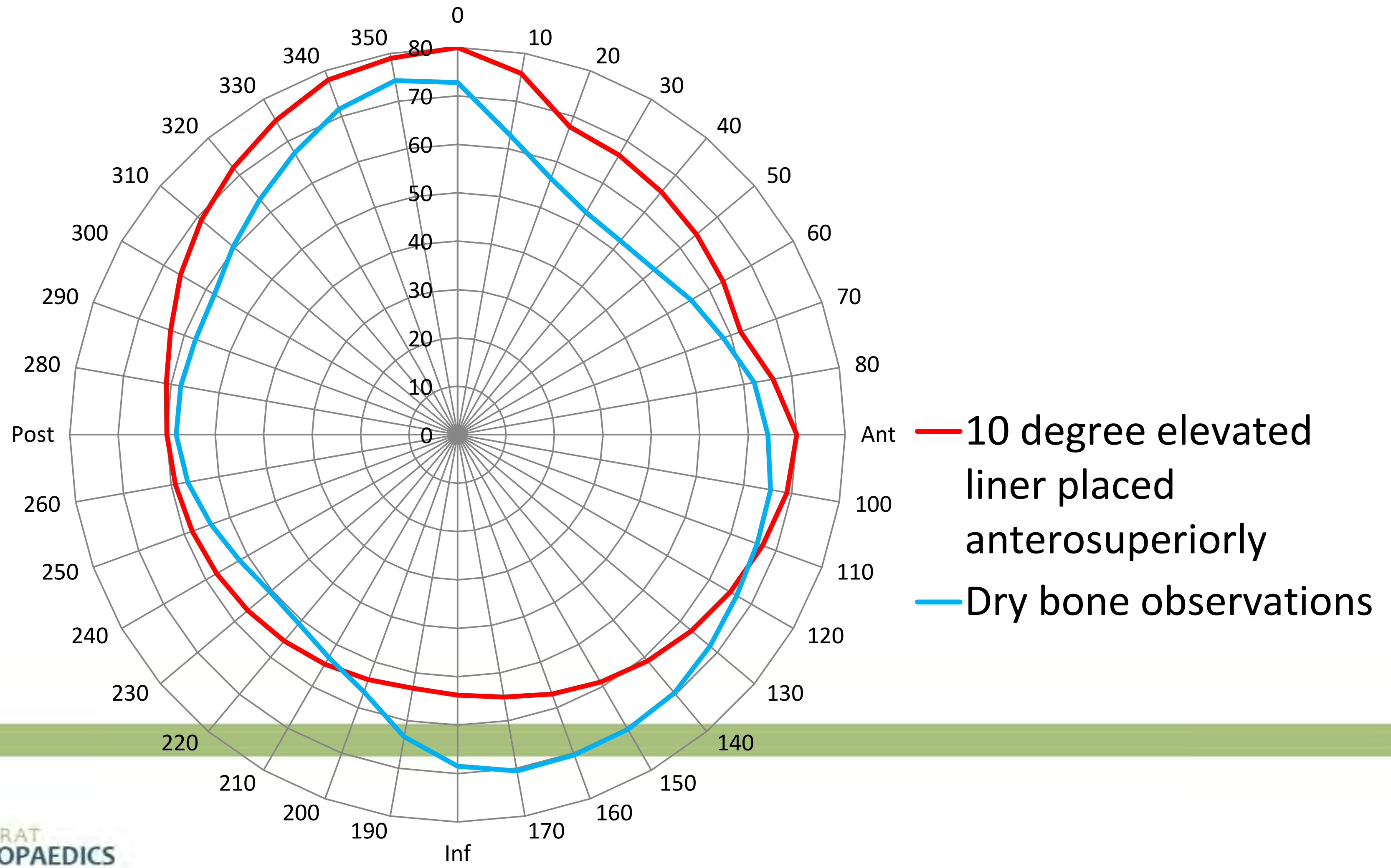
Conclusion

- Most common highpoint is at 7.30 position
- Average elevation 18.5 degrees
- Why not consider?



BALLARAT ORTHOPAEDICS

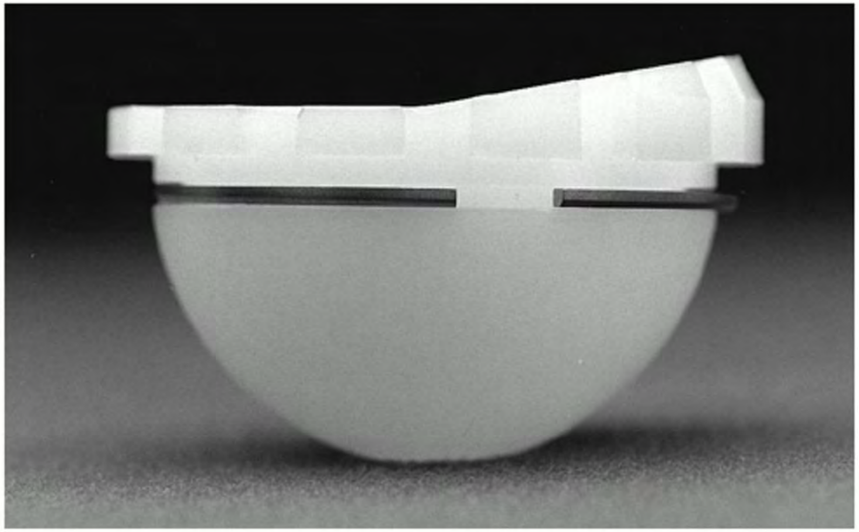
Imperfect Cup Positioning
60 degrees open & 10 degrees anteversion



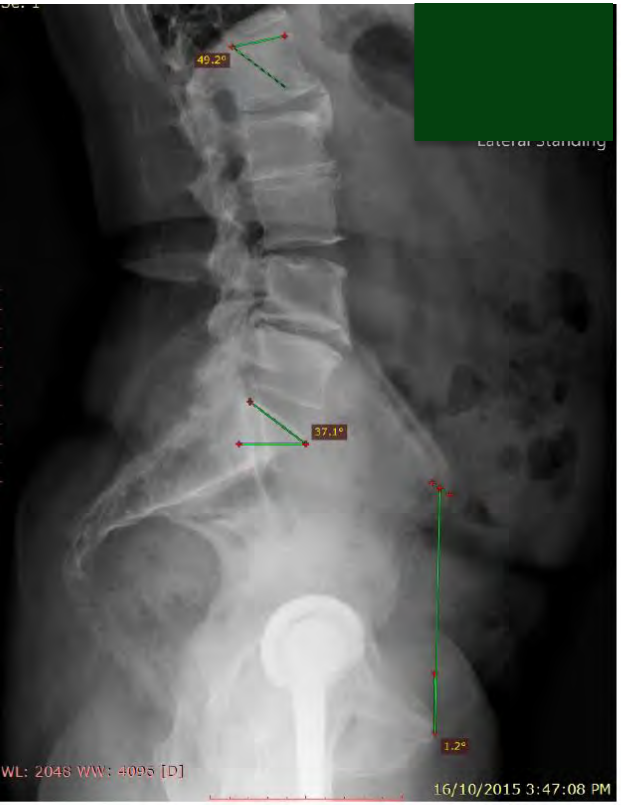
BALLARAT ORTHOPAEDICS

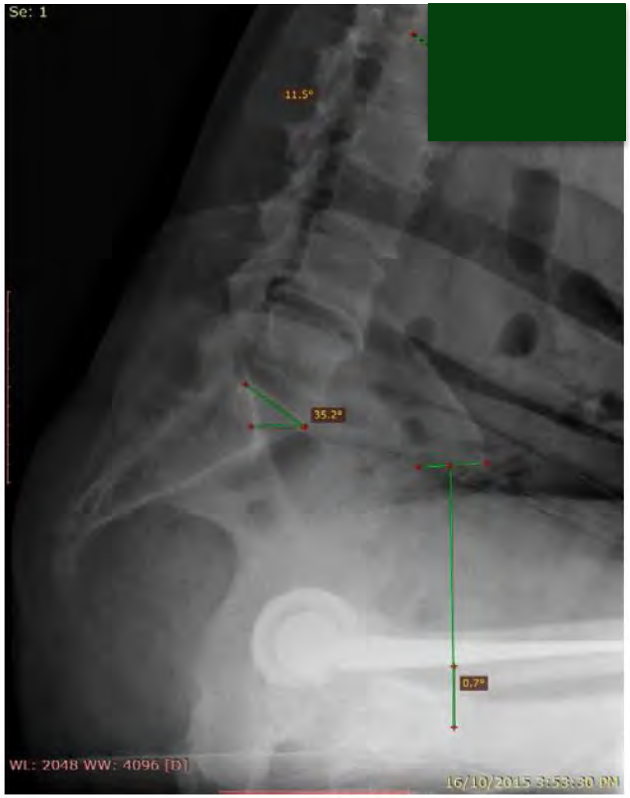
Conclusion

- Uncemented acetabular cups commonly have an elevated liner placed posterosuperiorly
- Cemented cups often have a long posterior wall
- Our paper explores this dichotomy



BALLARAT ORTHOPAEDICS





Standing parameters:

Pelvic Tilt:	**1.2°**
Sacral Slope:	**37.1°**
Lumbar Lordotic Angle:	**49.2°**

Flexed seated parameters:

Pelvic Tilt:	**-0.7°**
Sacral Slope:	**35.2°**
Lumbar Lordotic Angle:	**11.5°**

Step-up parameters:

Pelvic Tilt:	**0.0°**
Sacral Slope:	**35.9°**
Lumbar Lordotic Angle:	**41.6°**

BALLARAT ORTHOPAEDICS

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY

SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

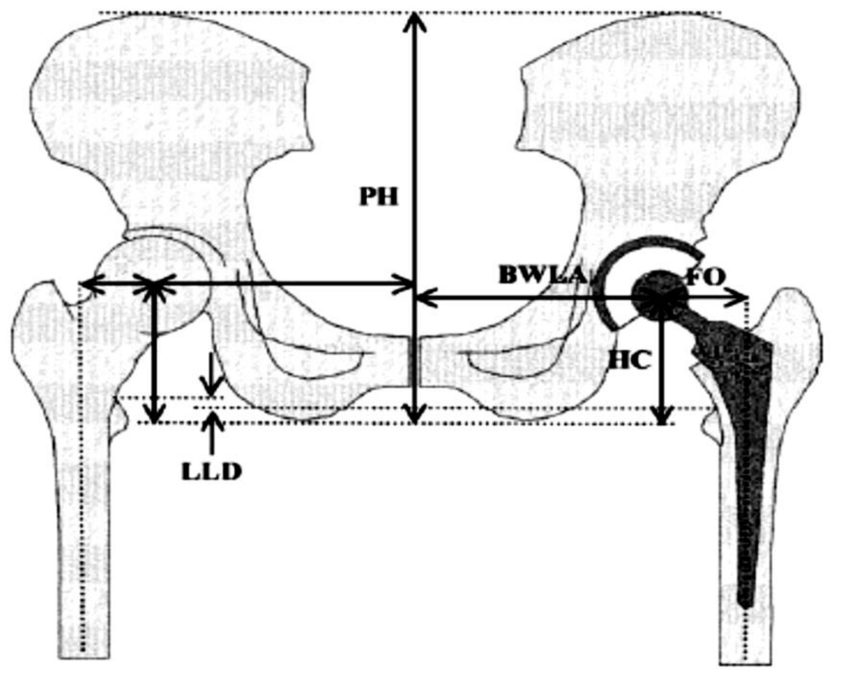
MILAN, ITALY

ACCURATE ANATOMIC RESTORATION IN PRIMARY TOTAL HIP REPLACEMENT WITH 3 D HIP PLANNING

U. REBERS, MALTA / GERMANY

INTERNATIONAL
KNEE & HIP
CENTER MALTA

THE SURGEONS´S OBJECTIVES IN THA



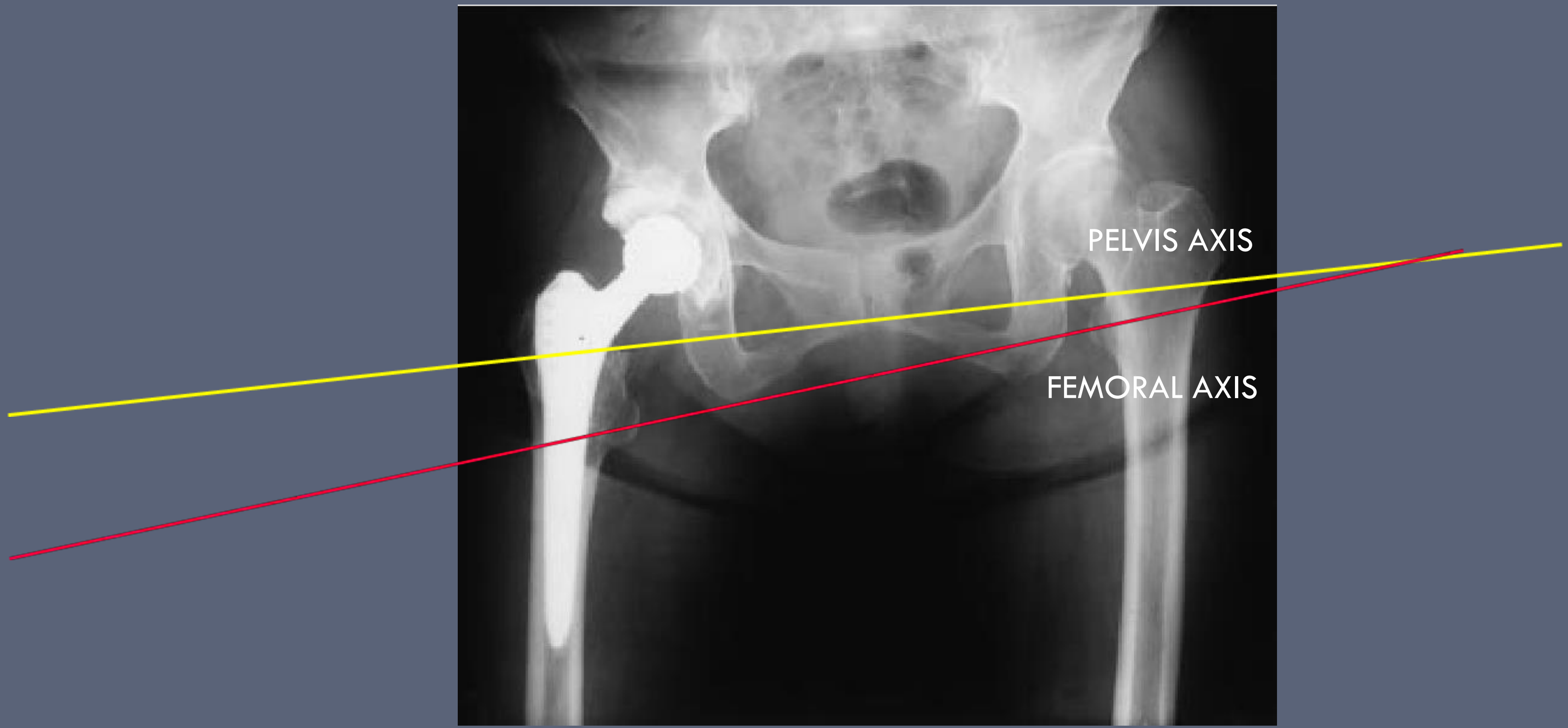
1. DETERMINE CENTRE OF ROTATION
2. REPRODUCE   FEMORAL OFF-SET
3. ESTABLISH LEG LENGTH EQUALITY

SIMULTANEOUS REPRODUCTION OF LEG LENGTH EQUALITY AND FEMORAL OFF-SET

IS NOT RESTORED IN 32% OF ALL CASES

REF: BOURNE et al , JOA 2002

COMMON PROBLEM IN THR

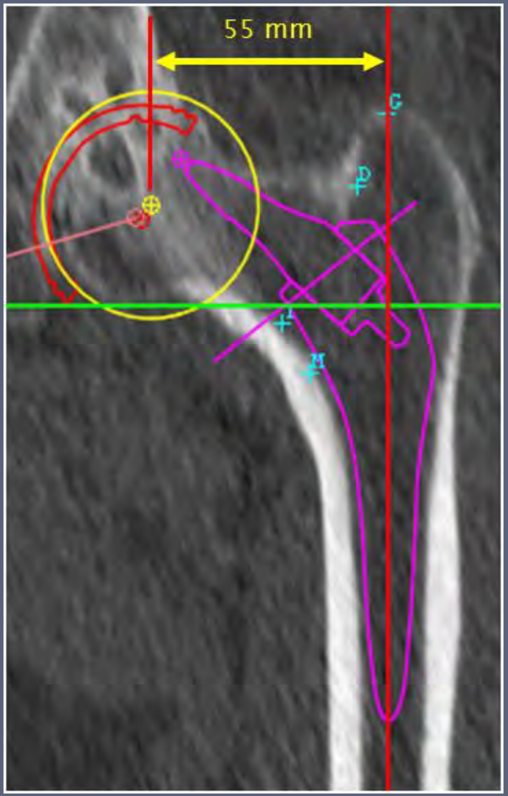


LEG LENGTH DISCREPANCY / LLD

POST OP OHS WAS REDUCED BETWEEN 18 % AND 27 % IN PATIENTS WITH LLD

KONYVES A. JBJS 2005

NEXT PROBLEM
THE RESTORATION OF THE FEMORAL OFF SET



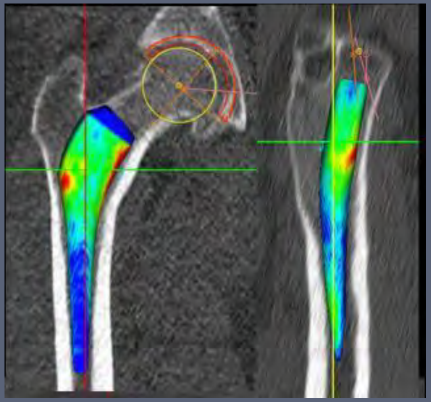
VOL. 91-B, No. 3, MARCH 2009

E. Sariali,
A. Mouttet,
G. Pasquier,
E. Durante,
Y. Catone

From Hôpital Pitié Salpêtrière, Paris, France

THE JOURNAL OF BONE & JOINT SURGERY (Br)

Accuracy of reconstruction of the hip using computerised three-dimensional pre-operative planning and a cementless modular neck



- **223 PATIENTS WITH PRIMARY THA**
- **CT SCANS PRE AND POSTOP**
- **3 D HIP PLANNING FOR ALL CASES**
- **CEMENTLESS IMPLANTS AND MODULAR NECK STEMS**

Accuracy of reconstruction of the hip using computerised three-dimensional pre-operative planning and a cementless modular neck

THE JOURNAL OF BONE & JOINT SURGERY (Br)

RESULTS OF THIS STUDY

ROTATIONAL CENTRE OF THE HIP WAS RESTORED WITH A MEAN ACCURACY OF 0.73 MM CRANIOCAUDALLY AND 1.2 MM LATERALLY

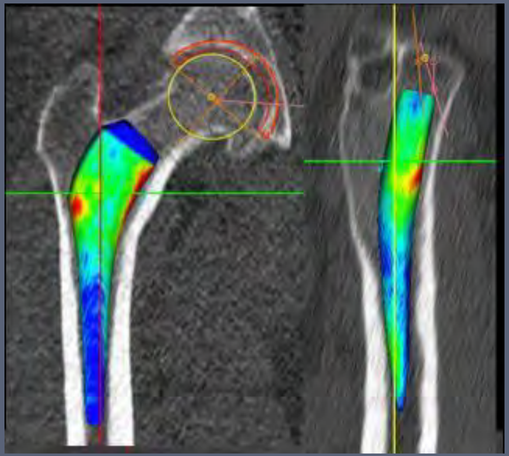
Accuracy of reconstruction of the hip using computerised three-dimensional pre-operative planning and a cementless modular neck

RESULTS OF THIS STUDY

FEMORAL OFFSET WAS RESTORED WITH A MEAN ACCURACY OF 0.8 MM

LEG LENGTH WAS RESTORED WITH A MEAN ACCURACY OF 1 MM

CT BASED COMPUTERIZED 3 D HIP PLANNING HAS SHOWN TO BE VERY ACCURATE AND HELPFUL TO RESTORE FEMORAL OFF SET, LEG LENGTH AND THE CENTRE OF HIP ROTATION SIMULTANEOUSLY

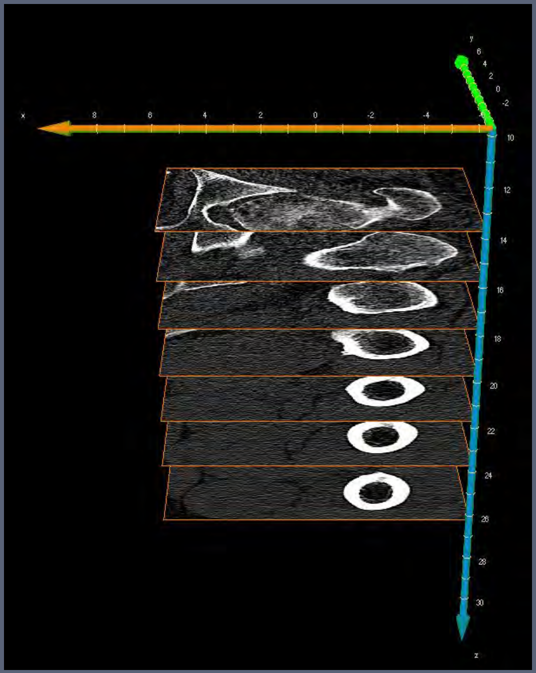


INTERNATIONAL KNEE & HIP CENTER MALTA

WHAT IS NECESSARY TO PERFORM 3 - D HIP PLANNING ?

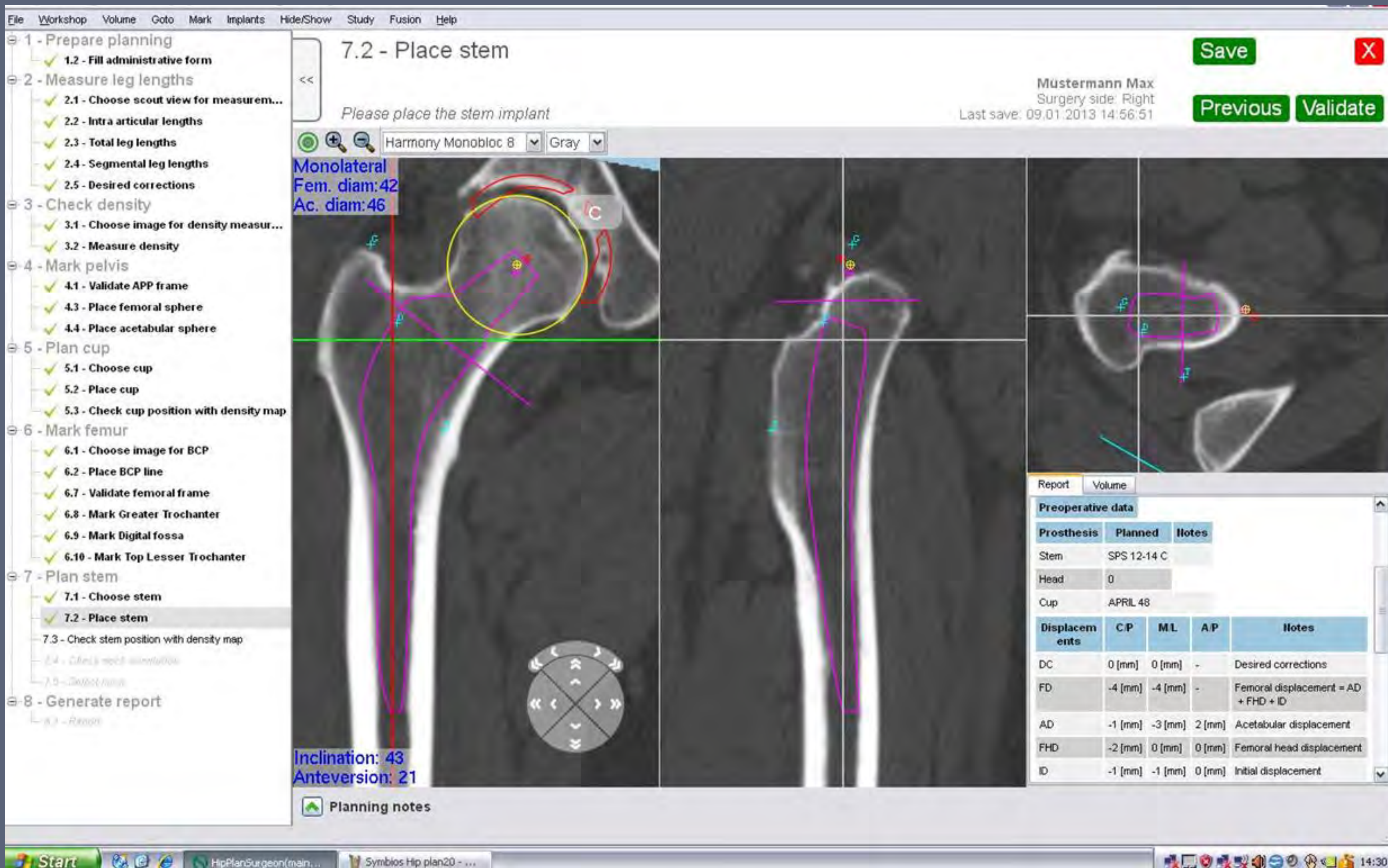
- CT SCAN
- PLANNING SOFTWARE
- CHOICE OF DIFFERENT STEMS
- MODULARITY

➢CT IMAGING FOLLOWING A SPECIAL PROTOCOL



PLANNING CUP POSITION AND ROTATIONAL CENTRE

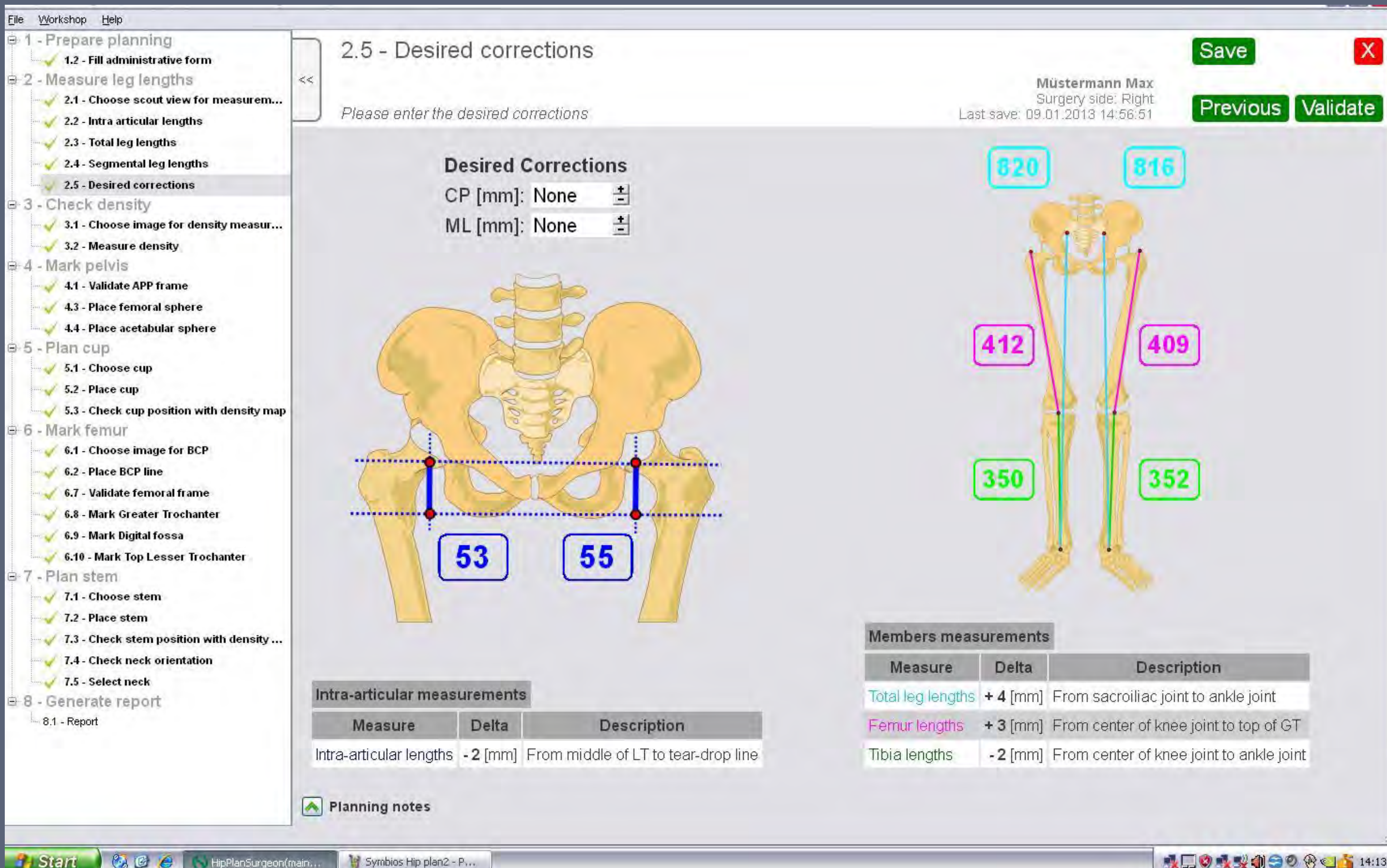
PLANNING THE STEM



INTERNATIONAL KNEE & HIP CENTER MALTA

U.REBERS , MALTA / GERMANY

DESIRED CORRECTIONS IN LEG LENGTH



ARE THERE ANY CONCERNS ABOUT IRRADIATION ?

USING A MODERN SPIRAL SCANNER THE IRRADIATION EXPOSURE
OF A PLANNING CT SCAN IS BETWEEN 3.5 AND 5 mSv WHICH IS EQUIVALENT TO FOUR PLAIN PELVIC X - RAYS

TECHNICAL IMPROVEMENTS IN CT SCANNING MIGHT BE ABLE TO REDUCE IRRADIATION EXPOSURE IN THE FUTURE

TAKE HOME MESSAGE

3 D HIP PLANNING IS A VERY RELIABLE TOOL TO

RESTORE ROTATIONAL CENTRE ,

FEMORAL OFF SET AND LEG LENGTH

SIMULTANEOUSLY

TAKE HOME MESSAGE

3-D HIP PLANNING OFFERS A PREOPERATIVE CHOICE OF IMPLANTS ADAPTED TO THE INDIVIDUAL ANATOMICAL NEEDS OF THE PATIENT.

MODULARITY IS ESSENTIAL

TAKE HOME MESSAGE

3-D HIP PLANNING HAS SHOWN TO BE AN EXCELLENT PLANNING TOOL GIVING MORE PRECISION AND ACCURACY THAN CONVENTIONAL TEMPLATING

THANK YOU VERY MUCH FOR YOUR ATTENTION

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

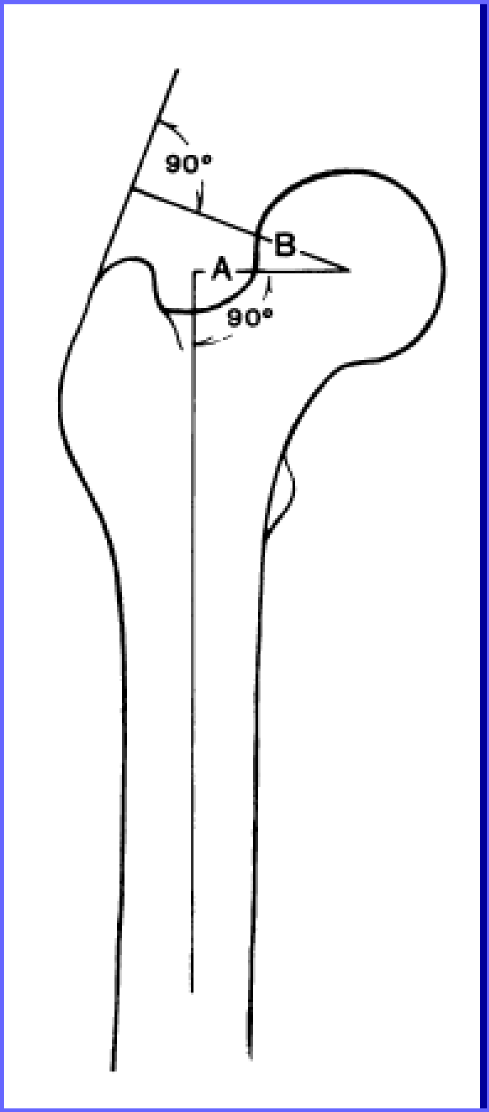
MILAN, ITALY

The correlation between femoral offset and clinical outcome

G. Toro C. Grinberg M. Gison G. Calabrò M. De Falco A. Toro

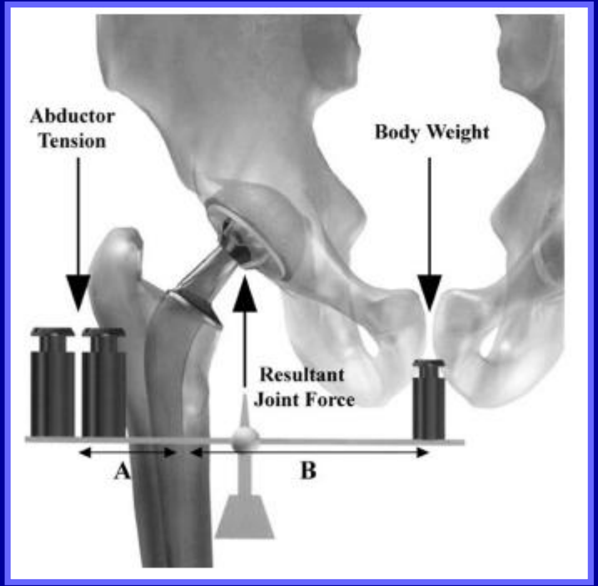
Femoral offset

- The perpendicular distance between the center of the femoral head and a line drawn down the center of the femoral shaft
- The perpendicular distance from the line of action of the abductor muscles to the center of the femoral head is the most effective variable for the numerical calculation.



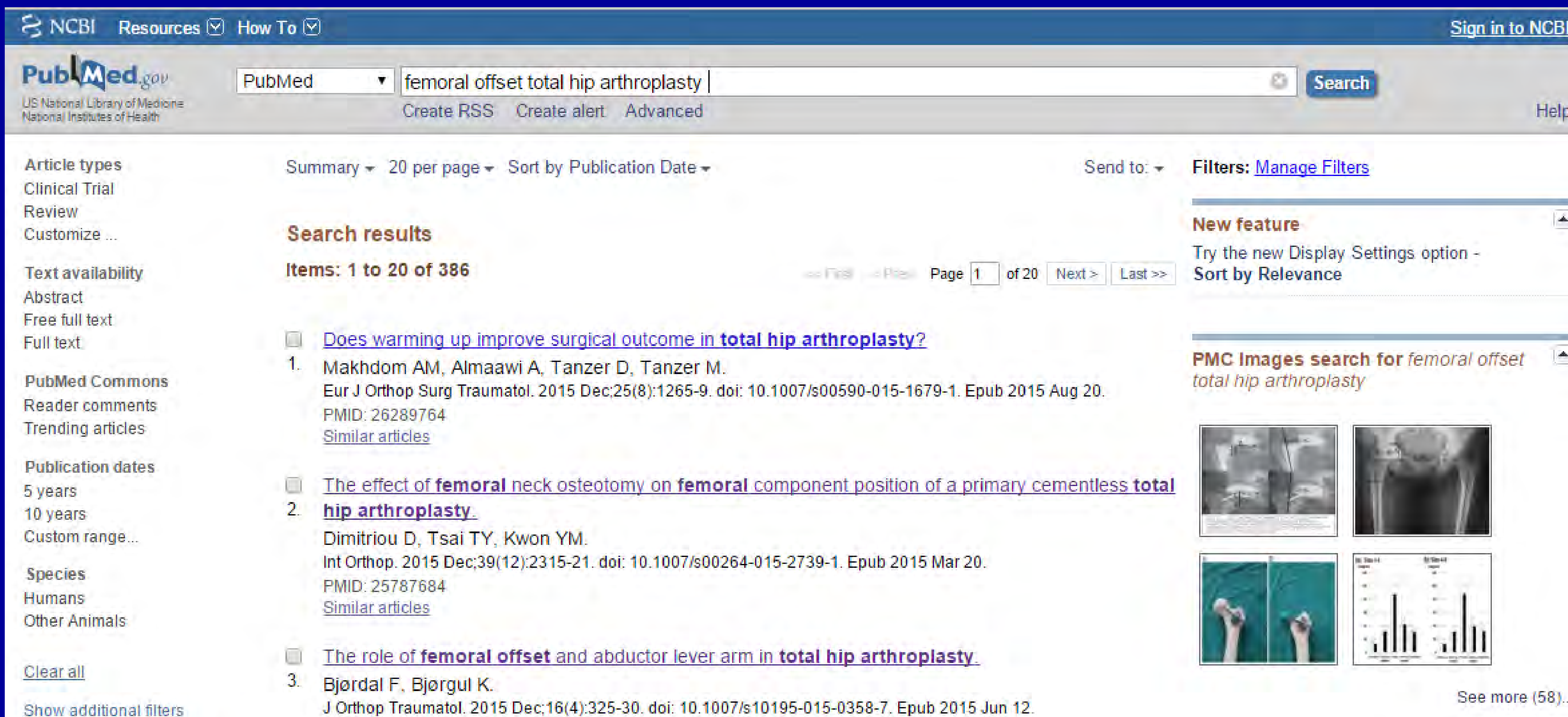
Introduction

- The lenght of abductors lever arm («A») is related to femoral offset
  - FO reproduction in THA assures an adequate abductor tension



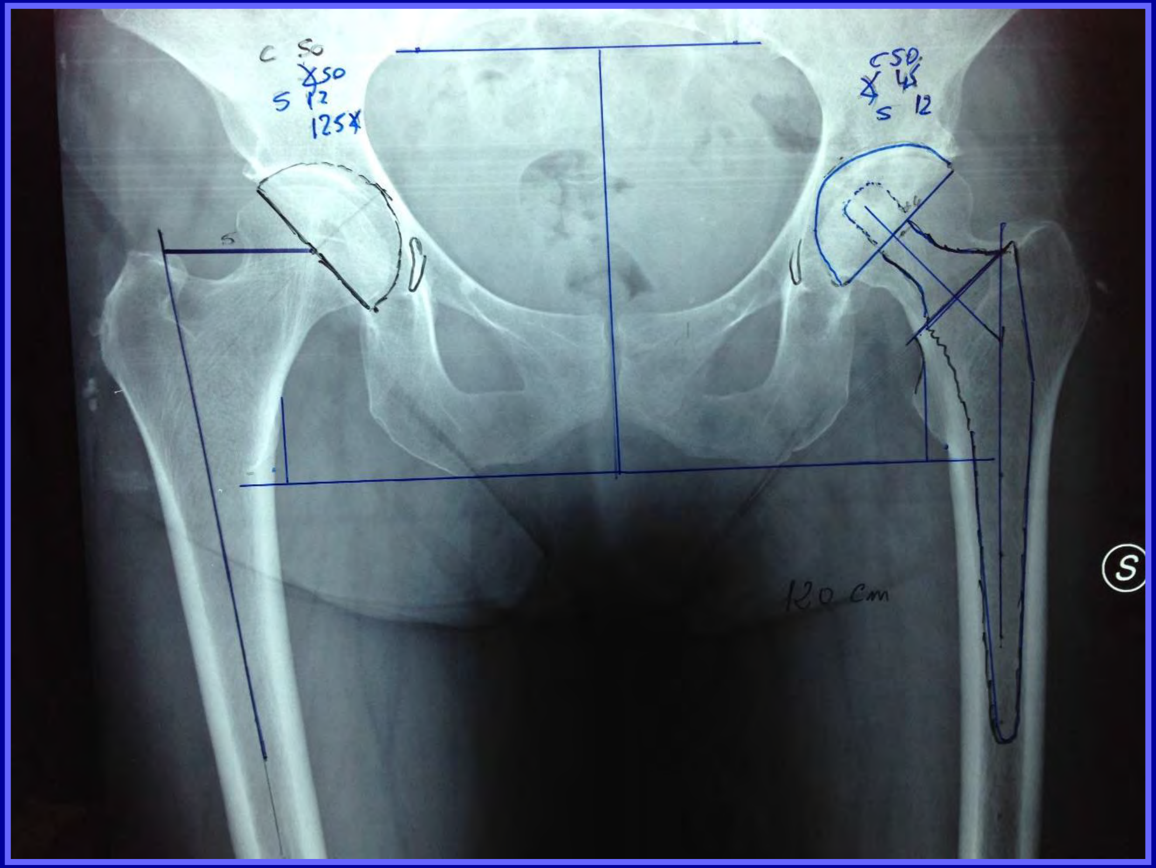
Introduction

- PubMed search using "femoral offset total hip arthroplasty" as keywords identifies 386 articles
- Over 365 published **after** year 2000



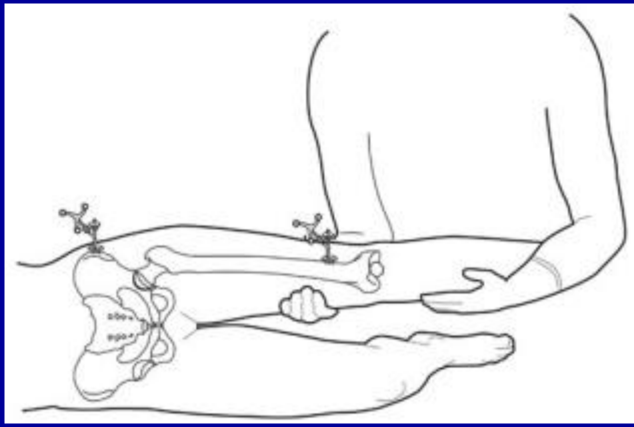
How to restore FO?

- Mandatory is the preoperative planning!

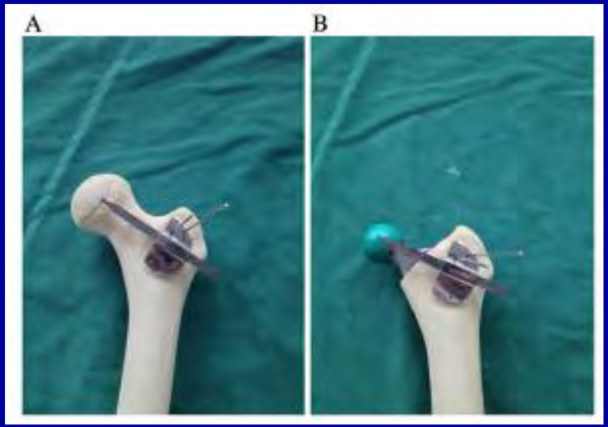


How to restore FO?

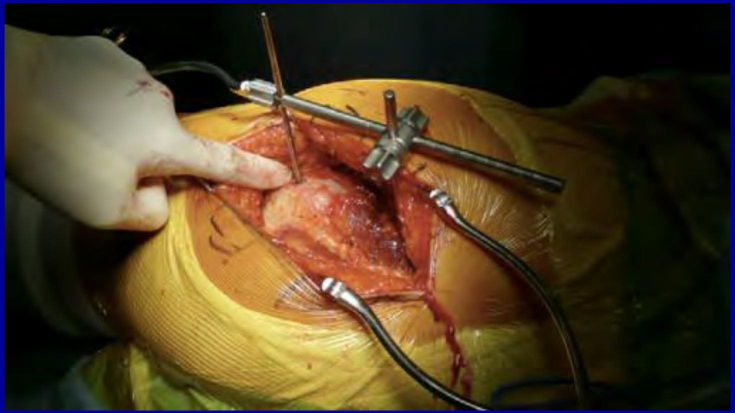
- Different intraoperative devices



Dastane et al., Clin Orthop Relat Res, 2011



Xue et al. Journal of Orthopaedic Surgery and Research, 2014



Barbier et al., Orthopaedics & Traumatology: Surgery & Research, 2012

How to restore FO?

- Intraoperative Tests

- Intraoperative X-Rays

How to restore FO?

- Intraoperative Tests

“There were considerable inter-examiner differences in the range of forces generated by the shuck test. The strength of traction forces and flexion angles influenced significantly the distance of displacement of prosthetic heads.”

Takao et al., *Reliability of Intra-Operative Assessment of Soft Tissue Tension in Total Hip Arthroplasty*. **Jbjs (Br) 2012**

Shuck Test. Performed by attempting to distract the total hip prosthesis in an inferior direction to assess the softtissue tension

flexing the knee to 90 degrees, and releasing the lower limb to assess the amount of recoil as the knee springs back toward extension.

How to restore FO?

- Intraoperative X-Rays reduce implant malposition to 1-8%

Kuroda et al., *Do we need intraoperative radiographs for positioning the femoral component in total hip arthroplasty?,* **Arch Orthop Trauma Surg, 2014**

Ezzet et al., *Use of intraoperative x-rays to optimize component position and leg length during total hip artrhroplasty*; **The Journal of Arthroplasty, 2014**

Tischler et al., *Does Intraoperative Fluoroscopy Improve Component Positioning in Total Hip Arthroplasty?,* **Healio Orthopaedics 2015**

Why it is important to restore the FO?

- FO is associated to ROM and abductor strength

Tezuka T et al.; Effects of hip joint center location and femoral offset on abductor muscle strength after total hip arthroplasty; Mod Rheumatol. 2015

Asayama I et al.; Reconstructed hip joint position and abductor muscle strength after total hip arthroplasty.; J Arthroplasty. 2005

McCrory et al.; Effect of femoral offset on rage of motion and abductor muscle strength after total hip arthroplasty, JBJS (Br),1995

Why it is important to restore the FO?

Acetabular Polyethylene Wear and Acetabular Inclination and Femoral Offset

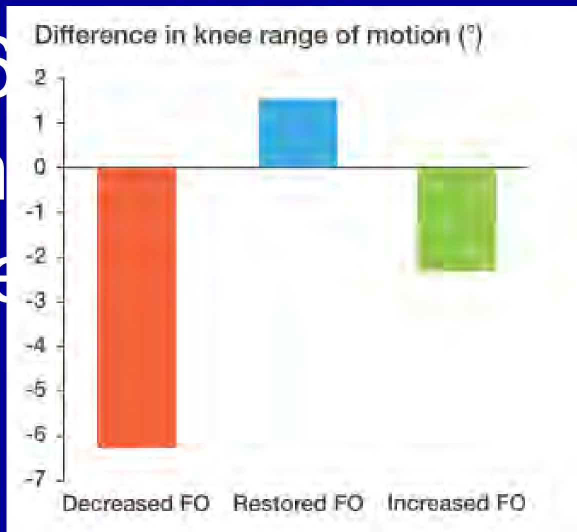
Clin Orthop Relat Res **2009**

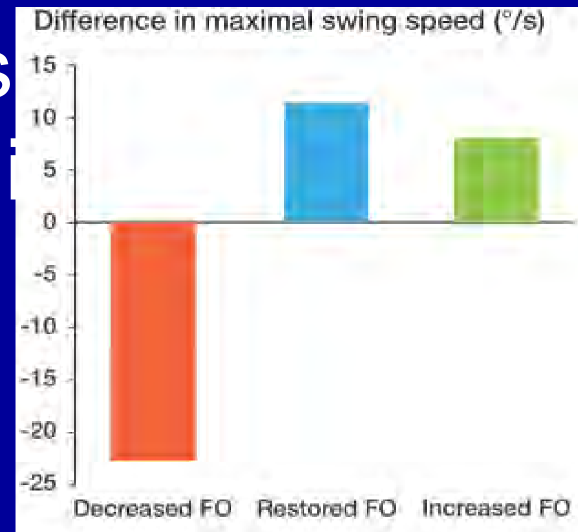
Nick J. Little MSc, MRCS, Constant A. Busch MD, FRCS,
John A. Gallagher MD, FRACS, Cecil H. Rorabeck MD, FRCSC,
Robert B. Bourne MD, FRCSC

"Reproduction of a reconstructed femoral offset to within 5 mm of the native femoral offset was associated with a reduction in conventional PE wear"

Why it is important to restore the FO?

"A 6 … creas … HA m … t, whi … de … usual …"





- Reduce knee ROM and maximal swing speed

The effect of femoral offset modification on gait after total hip arthroplasty

Elhadi Sariali[1], Shahnaz Klouche[1], Alexandre Mouttet[2], and Hugues Pascal-Moussellard[1]

Acta Orthopaedica, **2014**

Why it is important to restore the FO?

Difference in Hip Prosthesis Femoral Offset Affects Hip Abductor Strength and Gait Characteristics During Obstacle Crossing

Orthop clin N Am, **2012**

S. Chamnongkich, PhD, PT[a], I. Asayama, MD, PhD[b],

“High offset participants clear the THA limb with a higher foot-obstacle clearance (…) These observed deficits in the ability to clear obstacles underscore the importance of optimizing prosthetic placement”

Why it is important to restore the FO?

- Inadequate FO reproduction is considered one of the determining factors of Hip prosthesis dislocation

■ TOTAL HIP REPLACEMENT: AVOIDING & MANAGING PROBLEMS

Dislocation following total hip replacement

CAUSES AND CURES

PJ Brooks, JBJS (Br), 2013

Why it is important to restore the FO?

- Not completely understood its role in clinical outcomes

Liebs et al., 2014

Cassidy et al., 2012

Offset reproduction is related to pain, but not to functional scores

Xu B et al., 2013

Offset reproduction is related to functional scores, but not to pain

Our study

- Objective:
  - Investigate on the correlation between FO reproduction and Clinical Outcome

Our study

- January 2011 – September 2014
- 864 THA

• Did we restore patients' native FO?

• Did FO reproduction play a role in THA clinical outcome?

Materials & methods

- Inclusion criteria:
  - Follow-Up longer than 24 months
  - Primary THA
  - Unilateral prosthesis
- Exclusion criteria:
  - Incomplete Follow-Up
  - Revision THA
  - Presence of contralateral prosthesis

237

Materials & methods

- One experted surgeon reviewed preoperative and postoperative X-ray control
  - Reproduced offset if FO difference with contralateral side was in a range of +/- 5mm
  - Unreproduced offset if it was the difference with contralateral side was greater than 5 mm

Materials & methods

- Two independent surgeons collected data and performed a patient evaluation through
  - Clinical examination
  - X-ray (is neccessary)
  - VAS
  - Harris Hip Score

Results

- 23 patients in Unreproduced Offset group
  - Matched (according to sex and age) with 23 patients of the Reproduced offset group

	Cases	Age	Sex	Pre-operative VAS	Pre-operative HHS
Reproduced Offset	23	69 (+/-10)	F:M=2:1	8,7 (+/-1,3)	60,01 (+/-13,20)
Unreproduced Offset	23	69 (+/-10)	F:M=2:1	8,8 (+/-1,1)	59,87 (+/-14,01)

Results

- Complication
  - Reproduced Offset
    - 1 infection
  - Unreproduced Offset
    - 1 infection
    - 1 dislocation

Results

- F-U > 24 months (31-24)
  - VAS

Group	Respected Offset	Unrespected Offset
Mean	2,33	1,66
SD	3,61	2,46
SEM	5,23	3,56
N	23	23

P= 0,46

Results

- F-U > 24 mesi (31-24)
  - HSS

	Excelent (100 – 91)	Good (90 – 81)	Fair (80 – 71)	Poor (70 – 0)	
Reproduced	15	1	6	1	23
Unreproduced	8	3	10	2	23
	23	4	16	3	46

P= 0.23

Conclusions

- FO reproduction is not always achievable
  - It could determine limb lenghtening
  - The most important thing is implant stability!

Conclusions

- The surgeon has to try to reproduce FO
  - Improves abductor function
  - Reduces wear
  - Affects gait pattern
  - Effects on pain and clinical function are not completely understood

Conclusions

"A systematic hip templating approch is a first step in the right direction (…) Preorative planning must be considered of primary importance and as part of the operation «hip arthroplasty»"

G. Solarino et al., *Preoperative planning* in *Primary Total Hip Replacement,* Ed. Minerva medica, **2013**


Grazie

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Body Mass Index, Wound Fat Depth and Radiographic Acetabular Inclination in Total Hip Arthroplasty

Mr O. Diamond, Dr E McKeever, Mr D Beverland

Musgrave Park Hospital, Belfast,

Northern Ireland

Background

- The prevalence of obesity (BMI>30) is increasing in the general UK population.
- Success and outcome of THA is affected by component orientation.
- High acetabular inclination is known to be associated with an increased risk of several problems.

The Journal of Arthroplasty Vol. 27 No. 3 2012

The Influence of Obesity on Early Outcomes in Primary Hip Arthroplasty

Patrick K.R. Michalka, MBBS,* Riaz J.K. Khan, FRCS (Tr&Orth), FRACS (Orth),†
Matthew C. Scaddan, MBBS, FRACS (Orth),* Samantha Haebich, BSc, Hons,§
Nish Chirodian, FRCS (Tr&Orth),‖ and
James A. Wimhurst, MChir, FRCS (Tr&Orth)‖

Abstract: Obesity is considered an independent risk factor for adverse outcome after arthroplasty surgery. Data on 191 consecutive total hip arthroplasties were prospectively collected. Body mass index (BMI) was calculated for each patient and grouped into nonobese (BMI <30 kg/m^2), obese (BMI 30-34.9 kg/m^2), and morbidly obese (BMI ≥35 kg/m^2). Primary outcomes included functional improvement (Oxford hip score, 6-minute walk test and Short Form-12 Health Survey general health questionnaire) and postoperative complications. Subgroup analysis of surgeons' overall perception of operative technical difficulty was also performed. This study shows that total hip arthroplasties in obese patients were perceived, by the surgeon, to be significantly more difficult. However, this did not translate to an increased risk of complications, operation time, or blood loss, nor suboptimal implant placement. In addition, our results suggest that obese patients gain similar benefit from hip arthroplasty as do nonobese patients, but morbidly obese patients have significantly worse 6-minute walk test scores at 6 weeks. **Keywords:** total hip arthroplasty, obesity.

Acta Orthopaedica 2011; 82 (4): 417–422 417

Obesity in total hip arthroplasty—does it really matter?

A meta-analysis

Daniël Haverkamp, Mark N Klinkenbijl, Mathijs P Somford, G H Rob Albers, and Harm M van der Vis

Department of Orthopaedic Surgery, Tergooi Ziekenhuizen, Hilversum, the Netherlands
Correspondence: Daniel@drhaverkamp.com
Submitted 10-11-18. Accepted 11-03-11

Orthopaedics & Traumatology: Surgery & Research 101 (2015) 289–296

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Original article

The influence of obesity on primary total hip arthroplasty outcomes: A meta-analysis of prospective cohort studies

W. Liu, T. Wahafu, M. Cheng, T. Cheng, Y. Zhang, X. Zhang*

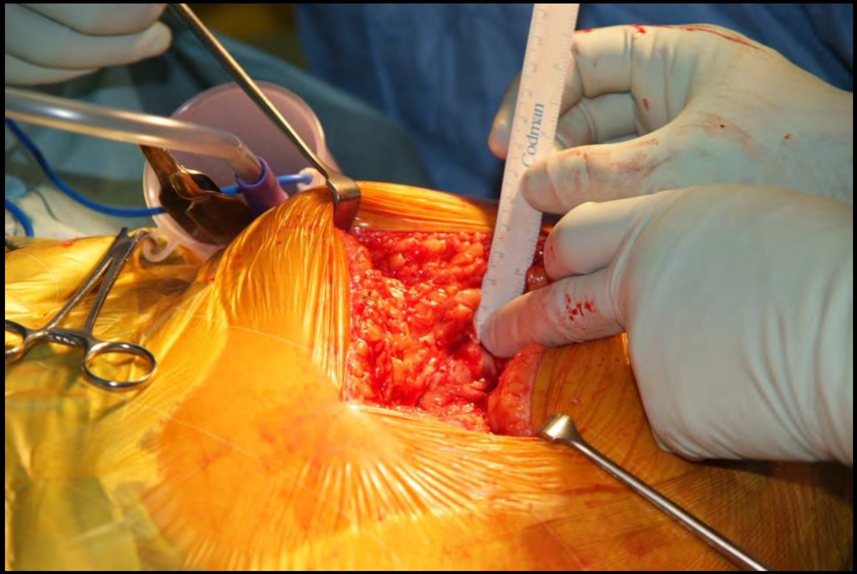
Department of Orthopedic Surgery, Shanghai Jiao Tong University Affiliated Sixth People's Hospital, Yishan Road 600, 200233 Shanghai, China

Background

- Procedure Difficulty
  - Exposing the acetabulum
  - Inserting the acetabular component

BMI v Fat Depth

- BMI (Kg/m^2)
- Fat Depth (cm)
  - Distance between the greater trochanter and the skin



Aims

- The aim of this study was to investigate if patient BMI or the fat depth of the hip wound were a risk factors for a high acetabular component inclination following THA.

Methods

1. Retrospective analysis of a consecutive series of 311 THA

2. Systematic Review

1. Consecutive Patient Analysis

- 1st December 2010 and 8th June 2011
- 311 consecutive Primary THA patients
- PACS digital x-ray
- Straight handle reamer and introducer
- 76 patients with either Fat Depth or BMI not recorded
- 235 patients available for analysis (75.6%)

Surgery

- Posterior approach
- Lateral decubitus position
- Uncemented acetabular component
- Target
  - Anteversion (TAL)
  - Operative acetabular inclination of 35°

Outcome

- Radiographic Acetabular Inclination
- Post-operative X-ray
- Supine

Analysis

1. Correlation coefficients

   - $0 < |r| < 0.3$ weak
   - $0.3 < |r| < 0.7$ moderate
   - $|r| > 0.7$ strong

2. Grouping analysis
   - BMI
     - <25
     - >25
   - Fat Depth
     - <5cm
     - >5cm

   Independent t-test

Statistical significance set at $p<0.05$
Excel 2007 (Microsoft, Redmond, WA)
SPSS Statistics 19.0 (SPSS Inc., Chicago, Illinois).

2. Systematic Review Methods

- Search ‘PICO’

  P: Total Hip arthroplasty patients

  I: BMI > 25 Kg/m2 (Or High Fat depth >5cm)

  C: BMI < 25 Kg/m2 (Low Fat depth <5cm)

  O: Radiographic acetabular inclination

2. Systematic Review Methods

MeSH Terms	Hits
((total hip arthroplasty) OR total hip replacement) AND obesity	304
((total hip arthroplasty) OR total hip replacement) AND fat	278
((total hip arthroplasty) OR total hip replacement) AND fat depth	2
((total hip arthroplasty) OR total hip replacement) AND wound depth	20
acetabular component positioning	167
acetabular component position	309
Total Abstracts reviewed	**1080**

2. Systematic Review Methods

1080
- 270 duplicates

810
- 173 not in English language

637
- 577 not using component orientation as an outcome

60
- 50 not measuring effect of BMI or Fat depth

10
- For critical appraisal

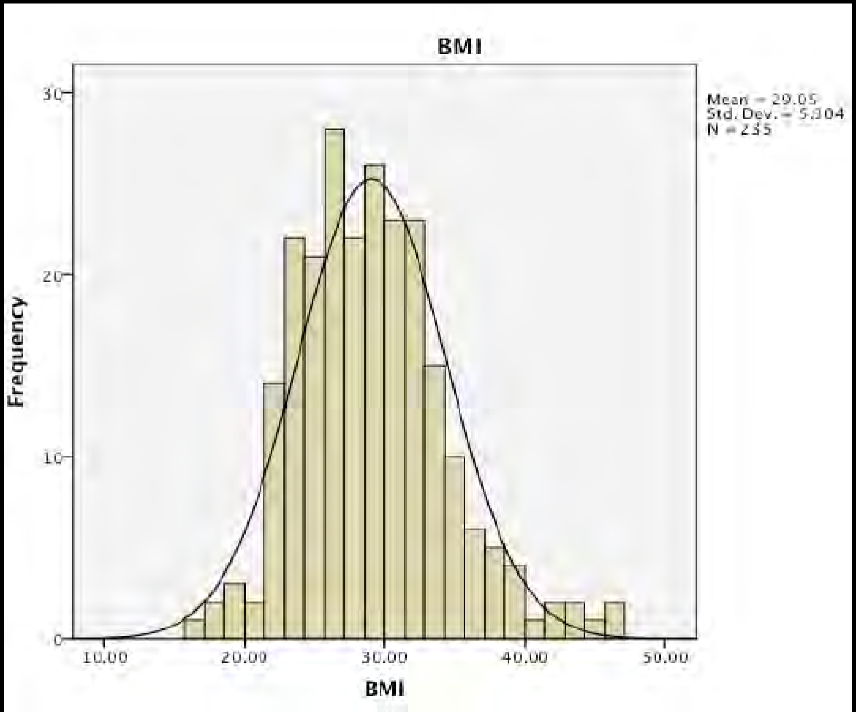
Consecutive Patients

RESULTS

Patient Demographics

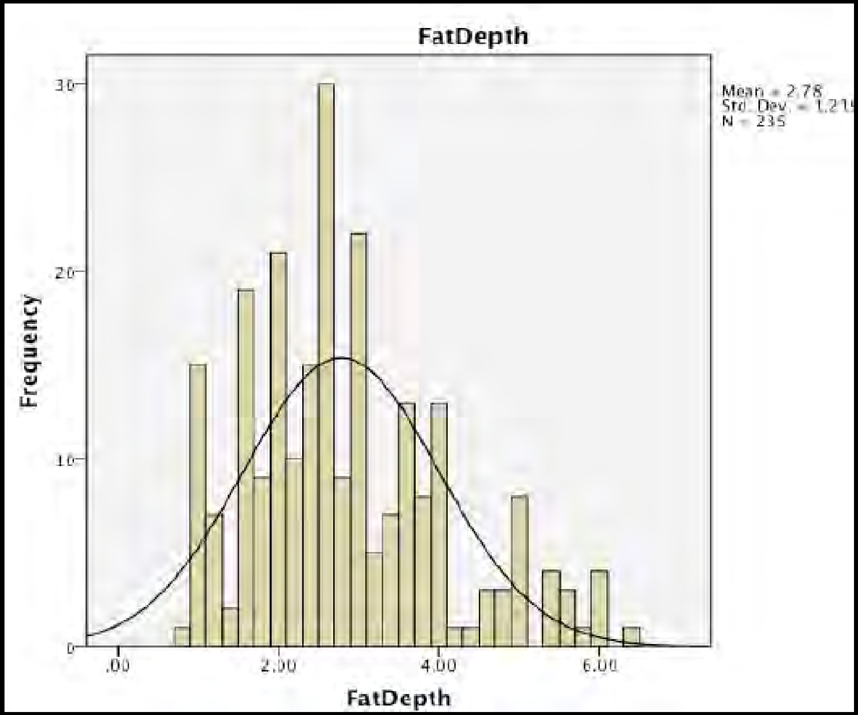
Number of THAs	311
Men / Women	142 / 169
Mean Age	69.5 (range 43 to 93) years
Mean duration of surgery	61.3 (range 38 to 115) minutes
Mean BMI of study population	29.1 (range 15.82- 46.44) kg/m^2
Mean hip wound fat depth	2.7 (range 0.8 to 6.3) cm
Mean radiographic acetabular inclination	41.87^0 (range 21 to 62.5^0).

BMI (Kg/m^2)



Mean	29.0
SD	5.3
Min	15.82
Max	46.4

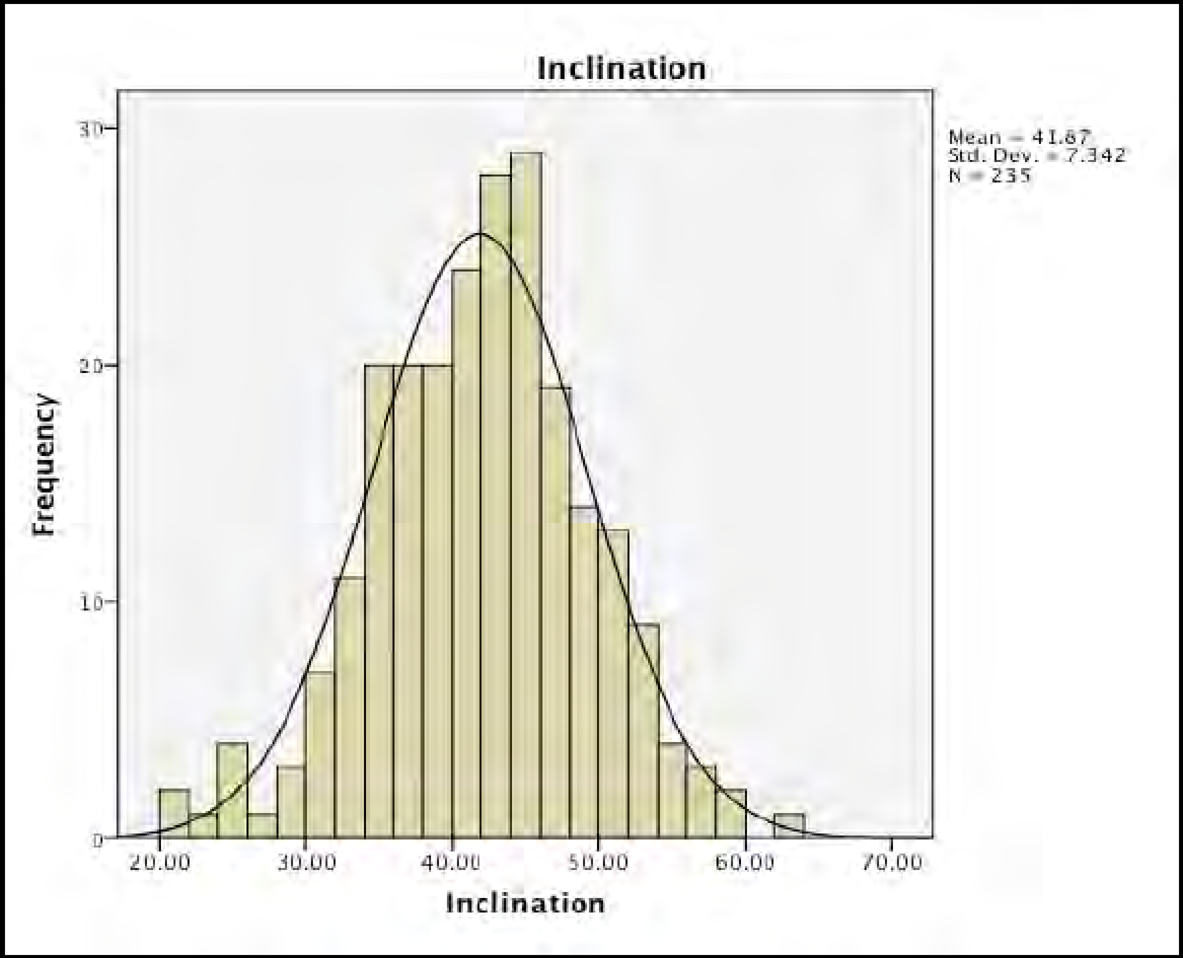
Fat Depth (cm)



Mean	2.8
SD	1.21
Min	0.8
Max	6.3

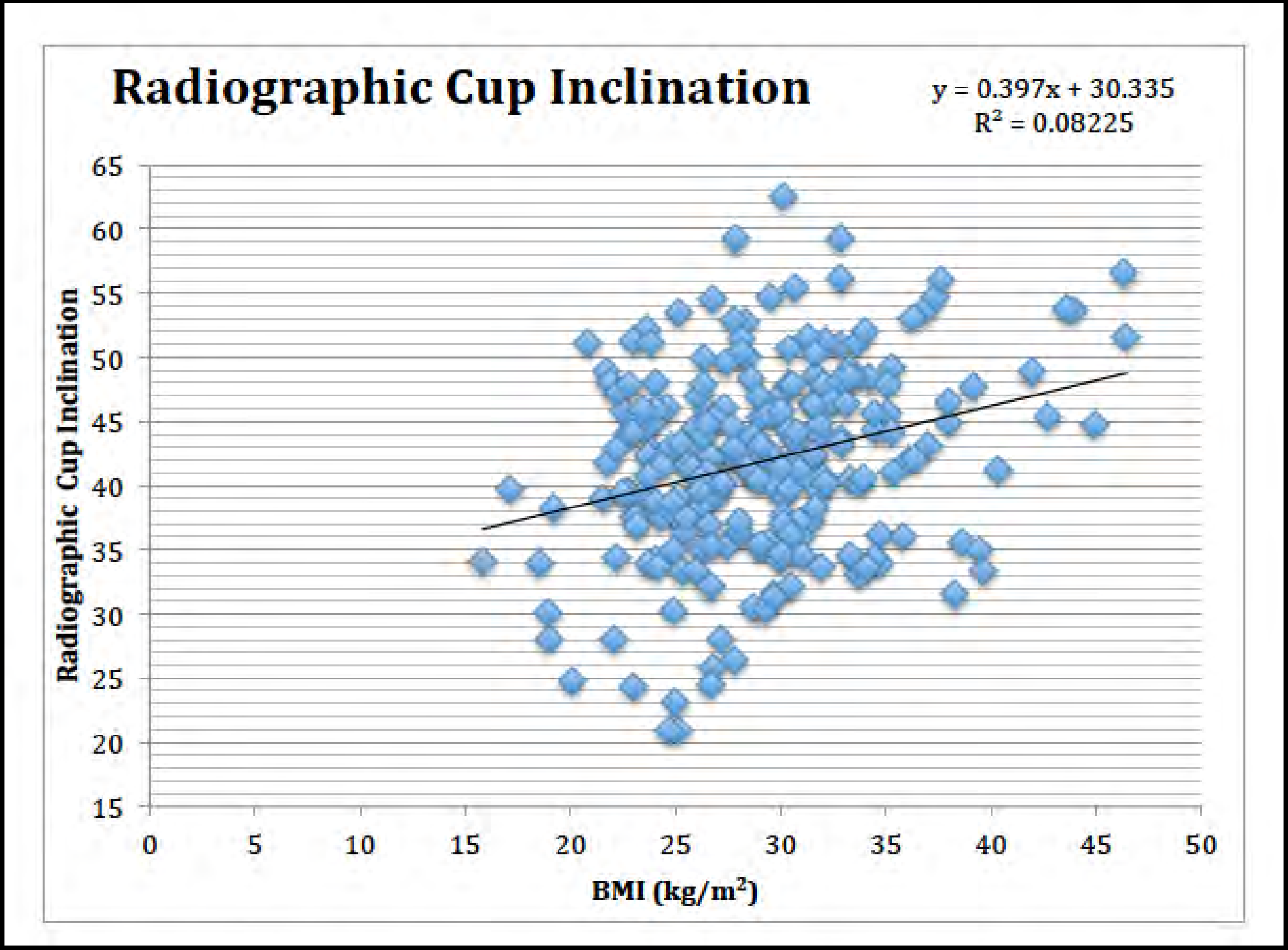
Inclination

(Degrees)



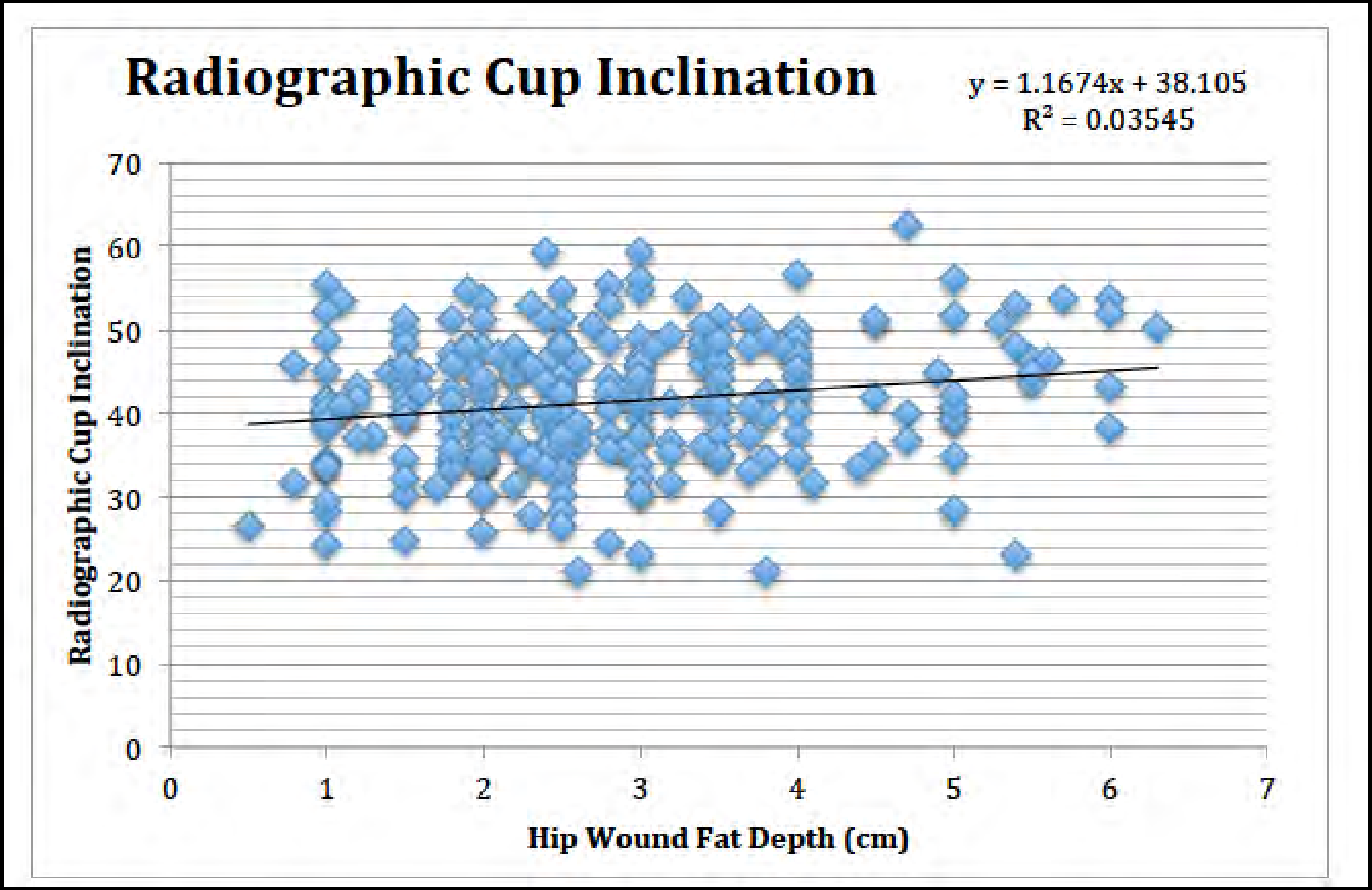
Mean	41.9
SD	7.3
Min	21.0
Max	62.5

BMI v Inclination



r = 0.29

Fat Depth v Inclination



R = 0.19

Group Analysis

	BMI <25	BMI >25	
Number	53	182	
Mean Age	70.9 (43-93)	69.1 (43-89)	P>0.05
Mean Op-Time (Min)	59 (38-100)	63 (40-115)	P>0.05

Group Analysis
BMI

Normal BMI (<25)

- n = 53
- Mean Inclination 39.1^{o}

Overweight/Obese (>25)

- n = 182
- Mean Inclincation 42.4^{o}

Independent t-test

P=0.026
Mean difference 2.54, 95%CI -4.78- -0.31^{o}

Group Analysis
Fat Depth

<5cm Fat Depth

- n = 215
- Mean Inclination 41.6^{o}

>5cm Fat Depth

- n = 20
- Mean Inclincation 45.3^{o}

Independent t-test

P= 0.03

Mean difference=3.70, 95%CI 0.34-7.06^{o}

SYSTEMATIC REVIEW

RESULTS

Paper	Study Type	Patients (n)	Grouping Variable (BMI)	Conclusion
Todkar, 2008, Acta Orth Belg	Case Series	72	<25/ >25>30 / >30	No Difference
McBride, 2012 ANZ J Surg	Case Series	102	<25 >25	Difference
Tsukada, 2010, J of Japan Orth Ass	Case Series (NAV)	69	<25 >25	No Difference
Pirard, 2007, Hip Int	Case Series	323	Correlation Analysis	No Difference
Callaman, 2011 CORR	Case Series	1603	<25/ >25>30 / >30	Obesity found as risk factor
Von Roth, 2011 Hip Int	Case Series	50	<25 >25	No Difference
McArthur, 2014 Hip Int	Matched Cohort Study	240	<30 >30	No Difference
Gupta, 2015 J Arthroplasty	Case Series	105	<30/ >30<35 / >35	No Difference
Barrack, 2013 JBJSAm	Case Series	1549	Odds ratio	Difference
Elson, 2013 J Arthroplasty	Matched Cohort Study	422	<35 >35	Difference
Current Study	**Case Series**	**235**	**Correlation Analysis + <25 / >25**	**Difference**

Discussion

- Weak correlations were found in the Pearson's Correlation analysis showing an r= 0.29 for BMI and 0.19 for fat depth

- Mean acetabular component inclination was higher for patients with a BMI of 25 or more (mean=42.44^0) compared to patients with a normal BMI (mean=39.09^0) (P=0.026).

Conclusions

- Obesity is an increasing problem
- Component orientation is vital
- BMI appears to be a greater risk factor than wound fat depth for a high acetabular inclination
- The problem may not be as simple as impingement of the introducer handle on the soft tissue
- Surgery is more difficult and time consuming
- Re-audit of current practice, assessing the introduction of angled reamers and offset introducer handle

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

OSPEDALE S.G. CALIBITA
FATEBENEFRATELLI
ISOLA TIBERINA

U.O.C. Ortopedia e Traumatologia
Direttore: Dott. V.Sessa

STUDIORUM UNIVERSITAS MESSANAE

GARIBALDI
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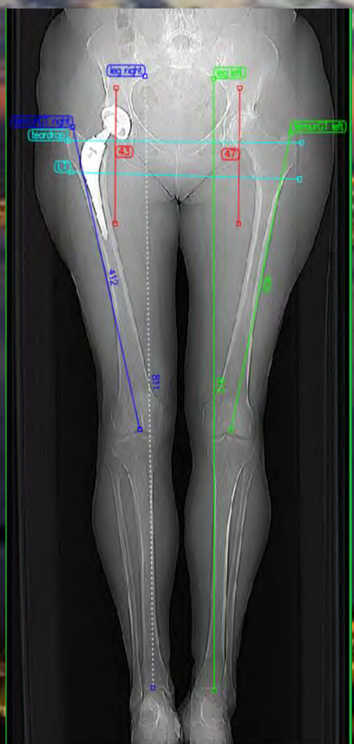
Azienda Ospedaliera di Rilievo Nazionale
e di Alta Specializzazione

U.O.C. Ortopedia e Traumatologia
Direttore G: Restuccia

Scuola di Specializzazione in
ORTOPEDIA e
TRAUMATOLOGIA
Università degli Studi di MESSINA
Direttore : M. A. ROSA

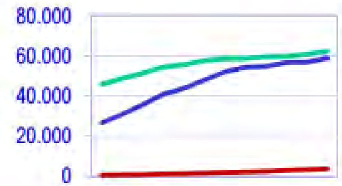


Dysmetry after Hip Arthroplasty

G. Miloro, **A. Merenda,** G. Restuccia,V. Sessa and M.A. Rosa

Interventi di sostituzione protesica in Italia

Fonte: Dati SDO(2001-2012)



Cod.	Denominazione	2001	2003	2005	2006	2007	2008	2009	2010	2011	2012	% (°)
		45.656	51.241	55.516	57.521	58.555	58.679	59.397	59.631	60.544	62.153	2,2
81.52	Sostituzione parziale	20.732	20.981	22.380	22.386	22.289	23.034	22.506	23.916	24.148	24.275	1,6
	Rivestimento	n.a	n.a	n.a	n.a	n.a	n.a	303	476	157	94	-32,3
(*)	Revisione	5.969	6.494	6.913	7.170	7.229	7.164	7.264	7.342	7.848	8.249	2,7
	Totale Anca	**72.357**	**78.716**	**84.809**	**87.077**	**88.073**	**88.877**	**89.167**	**90.889**	**92.707**	**94.771**	**2,1**

(°) Incremento medio annuo espresso in percentuale
(*) Anca: 81.53, 00.70, 00.71, 00.72, 00.73

Total hip arthroplasty | **2013** | **62.582**

Every year in Italy about 100,000 operations of hip prostheses are implanted and the number is increasing at a rate > 2%.

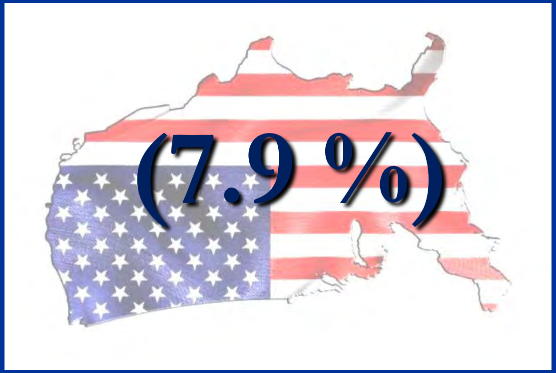
Successful total hip arthroplasty relieves pain and restores functions, restoring proper hip biomechanics and equalizing limb lengths.

Dysmetry

LIMB LENGTH DISCREPANCY IS A SIGNIFICANT SOURCE OF PATIENT DISSATISFACTION DUE TO ITS ASSOCIATION WITH COMPLICATIONS

HYPERMETRIA → nerve palsy, secondary contractures, abnormal gait, low back pain

IPOMETRIA → impingment with pain, secondary contractures ,abnormal gait



In USA is the second most frequent cause in claims for damages in prosthetic surgery.

(Sarin VK, Pratt VR, Bradley GW. Accurate femur repositioning is critical during intraoperative total hip arthroplasty lenght and offset assessment. J Arthroplasty 2005; 20:887-91).

MULTICENTRIC RETROSPECTIVE ANALYSIS OF DISMETRY AFTER HIP ARTHROPLASTY

- Inclusion criteria:

-COXARTHROSIS

- Exclusion criteria:

-CONTROLATERAL HIP ARTHROPLASTY
-DYSPLASTIC PATOLOGY
-RHEUMATOLOGIC PATOLOGY
-TRAUMATIC PATOLOGY

Materials and methods

- **77 pz : 65 - 80 y**
  - 32 M
  - 45 F

- **Dismetry >1cm :** **12 cases**

Materials and methods

77 PZ

(ANTERIOR / LATERAL APPROACHES)

12 pz DYSMETRIC

11 PZ
HYPERMETRIC

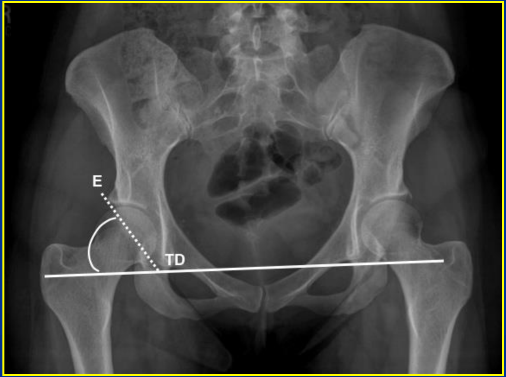
1 PZ
IPOMETRIC

Radiografic evaluation

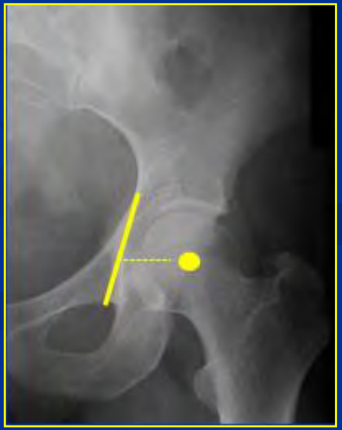
The parameters we examined were

ACETABULAR COMPONENT

- Inclination angle



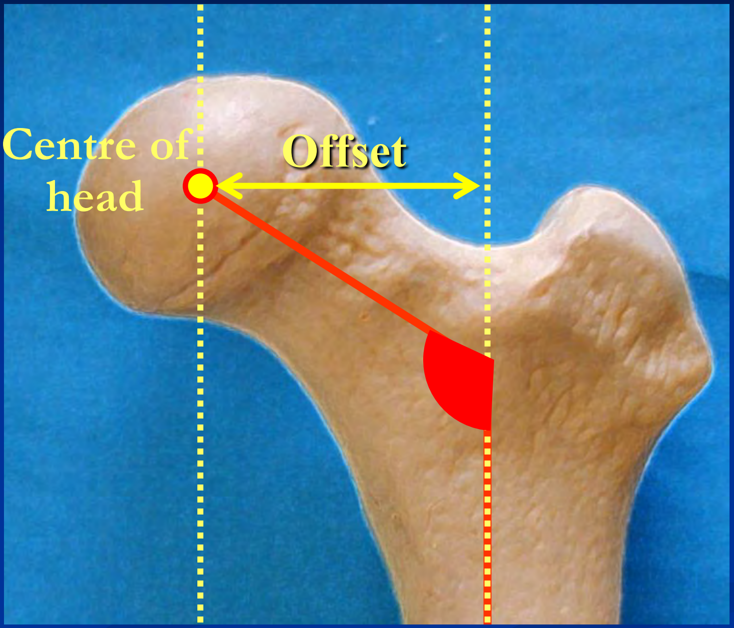
- Acetabular offset

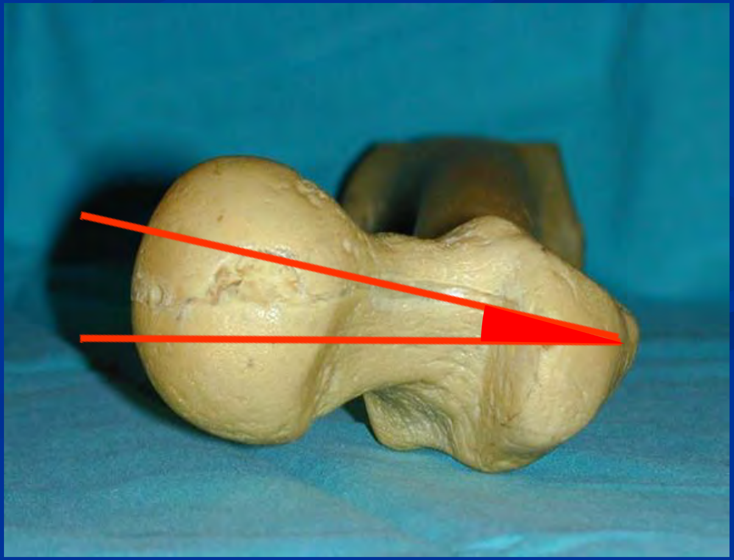


Radiografic evaluation

FEMORAL COMPONENT

- Cervical diaphyseal angle
- Femoral offset
- Anteversion





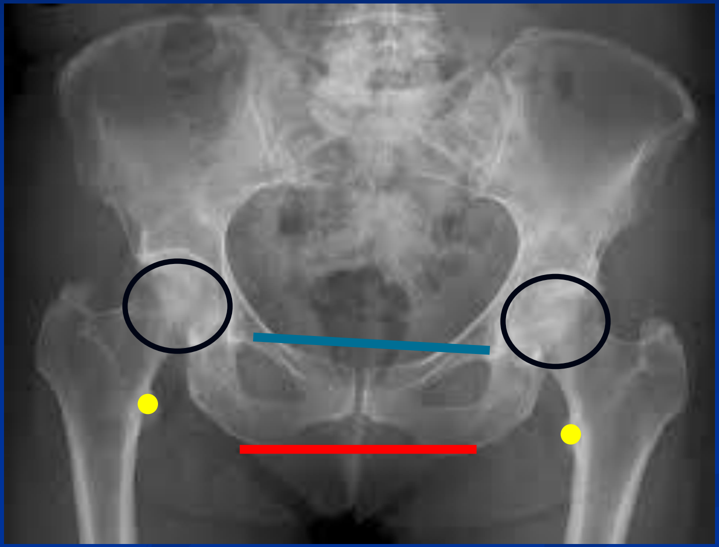
PRE - OPERATIVE PLANNING

On X-ray pelvic in anteroposterior projection we calculated the difference in lenght by joining a series of landmarks:

PELVIC REFERENCES:

bisischiatic line

interdrop line



FEMORAL REFERENCES:

Distance between femoral rotation centers

Distance between lesser trochanters

Preoperative Radiographic assessment of limb – lenght discrepancy in total hip arthroplasty

-Geert Meermans MD, Ahmad Malik MRCS, Johan Witt FRCS, Fares Haddad FRCS

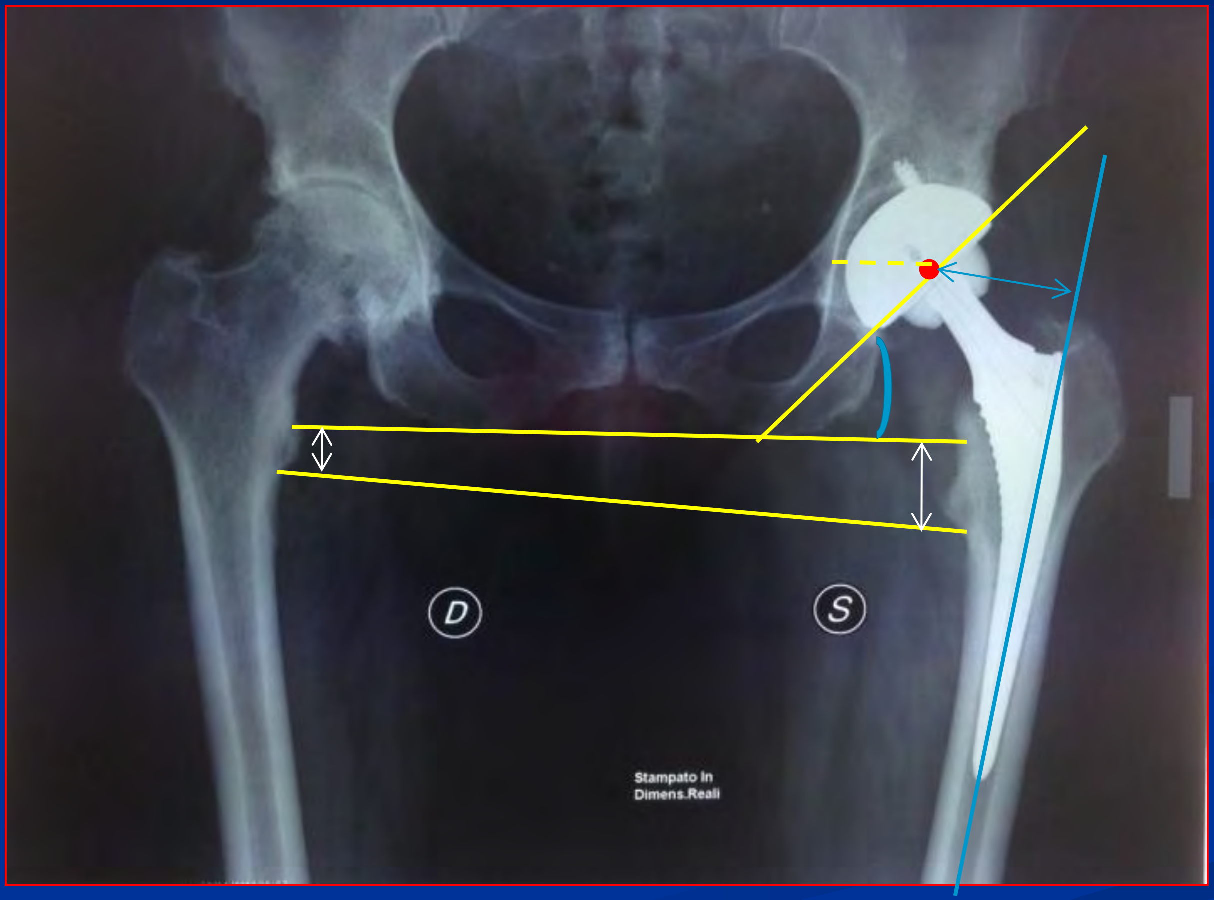
INTRAOPERATIVE MEASUREMENTS

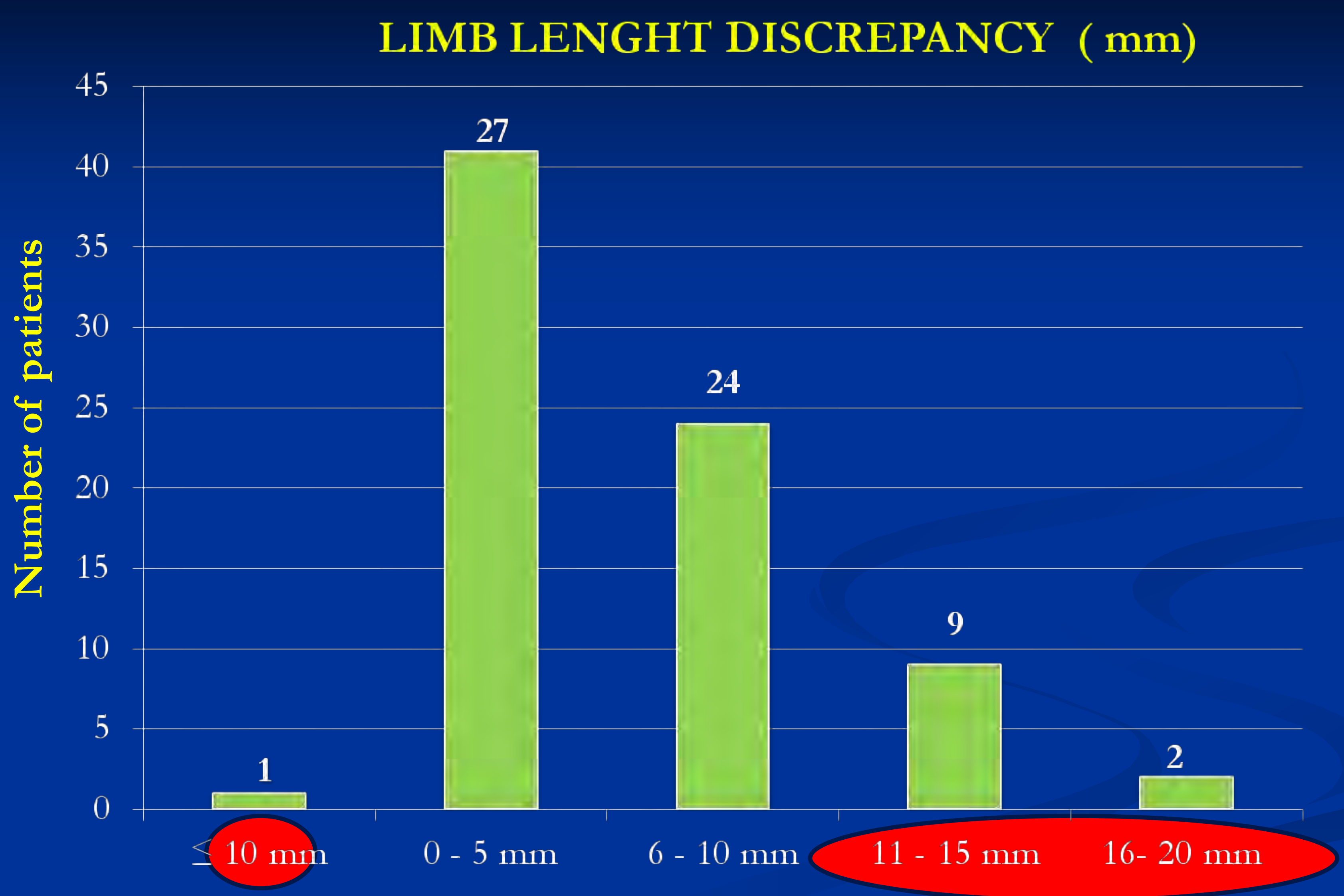
Distance between Steinman nail inserted into iliac wing and a landmark to the base of greater trochanter

Distance between lesser trochanter and morse taper

Comparison between osteotomized head and neck and morse taper

POST-OPERATIVE RADIOGRAPHIC EVALUATION

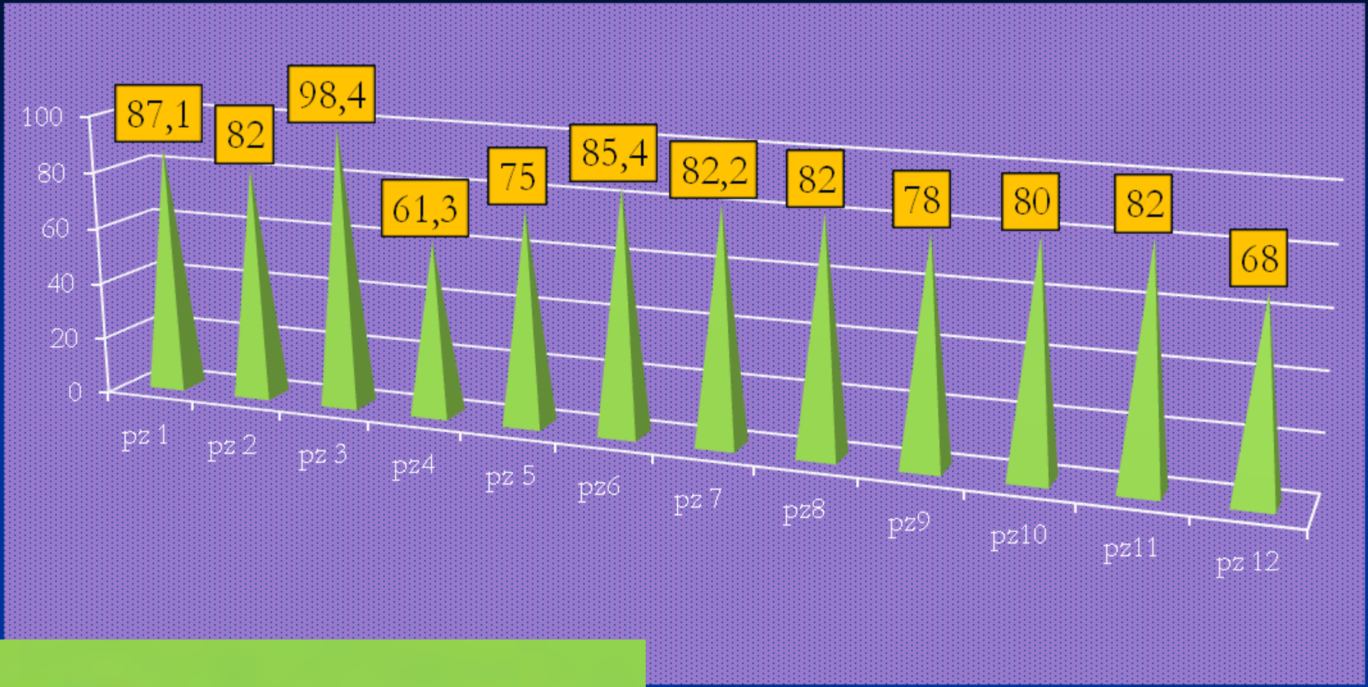


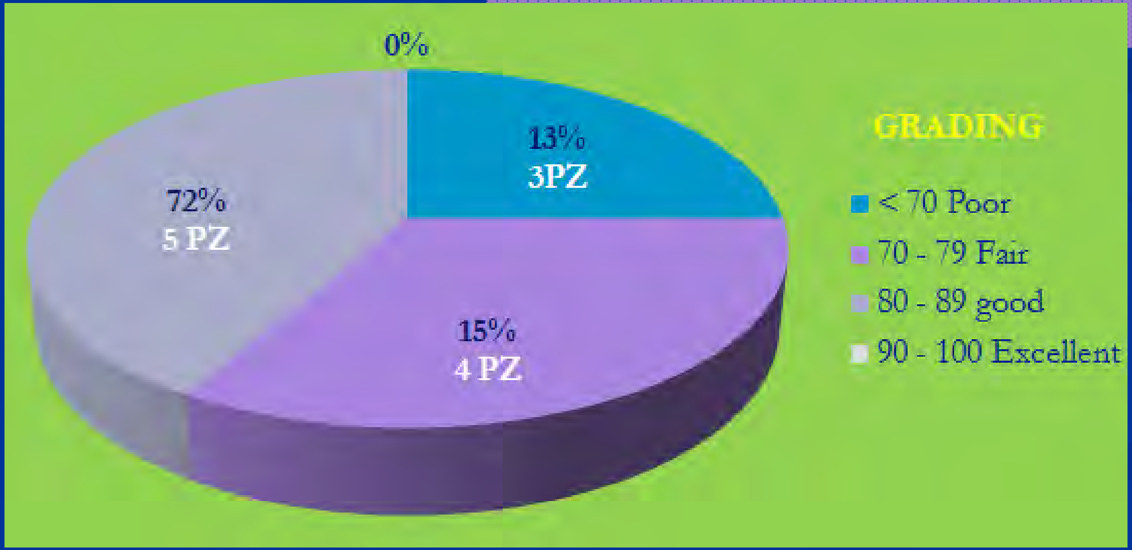


LIMB LENGHT DISCREPANCY (mm)
Number of patients
45
40
35
30
25
20
15
10
5
0
1
27
24
9
2
≤ 10 mm
0 - 5 mm
6 - 10 mm
11 - 15 mm
16- 20 mm

	Cervical diaphyseal angle (110° - 140°)		Inclination acetabular angle (35° -55°)		Lever arm (mm)		Femoral Offset (31 -44mm)		Acetabular offset (mm)		Dismetry (mm)
SIDE	Op	not op	op	not op	op	not op	op	not op	op	not op	
LEFT	135°	135°	50°	50°	61	57	38	39	32	39	**+12**
RIGHT	140°	120°	60°	53°	48	51	35	37	41	36	**+12**
RIGHT	130°	118°	42°	65°	55	65	46	55	45	41	**+10**
RIGHT	125°	130°	48°	58°	54	43	48	34	33	30	**+13**
RIGHT	135°	118°	48°	53°	66	69	54	54	40	37	**+11**
LEFT	130°	118°	50°	60°	58	64	41	48	41	40	**+12**
RIGHT	130°	130°	53°	54°	53	60	43	46	38	44	**+16**
RIGHT	130°	125°	50°	60°	50	50	33	40	35	30	**+12**
RIGHT	130	120°	60°	60°	40	30	30	30	30	25	**+11**
RIGHT	130°	130°	50°	50°	50	50	40	35	40	55	**-10**
LEFT	130°	120°	50°	50°	65	60	50	50	40	40	**+10**
LEFT	130°	120°	35°	50°	55	60	45	45	40	45	**+20**

WOMAC SCORE





HARRIS HIP SCORE

Evaluation : quality of life, symptoms, stiffness, pain, daily activities

CONCLUSIONS

Nowadays patients' demands are increasing and the Gold Standard is the return to a normal condition relating to age and life expectancy .

Preoperative and intraoperative planning are important to contain technical mistakes and limb length discrepancy.

Sometimes limb lengthening is wanted by surgeon with the aim to implant in the future a controlateral total hip arthroplasty.


THANK YOU

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Bilateral Total Hip Arthroplasty: One- Stage versus Two-Stage Procedure

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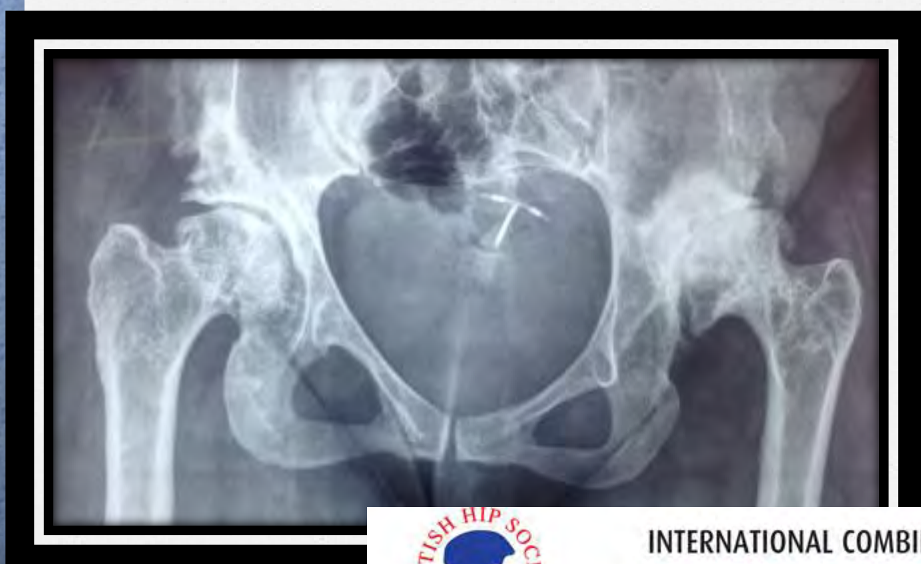
Afshin Taheriazam

Department of orthopedics,Tehran Medical Sciences Branch,Islamic Azad University,Tehran,Iran

International Combined Meeting BHS-SIdA, Milan - 26/27 November 2015

Introduction:

- *Disabling hip pain requiring THA can have variety of etiologies, many of which have an incidence of bilaterality.*



Introduction:

- Despite several studies, controversies prevailed about the rate of complications following one-stage and two-stage bilateral total hip arthroplasty (THA).

Introduction:

- Lindberg and Sjöstrand (1972) estimated that approximately one-third of patients with primary osteoarthritis of the hips would need bilateral surgery. [1]
- Since Ritter and Randolph (1976) performed the first detailed study of the functional outcome of simultaneous bilateral THA, there has been an ongoing discussion regarding benefits and disadvantages of one stage versus two-stage procedures. [2]

1.Lindberg L, Sjostrand LO: [The future needs of hip surgery. Prognosis for Lund 1972-1980]. Lakartidningen 1972,

69(37):4109-4112.

2 . Ritter MA, Randolph JC: Bilateral total hip arthroplasty: a simultaneous
procedure. Acta Orthop Scand 1976, 47(2):203-208.

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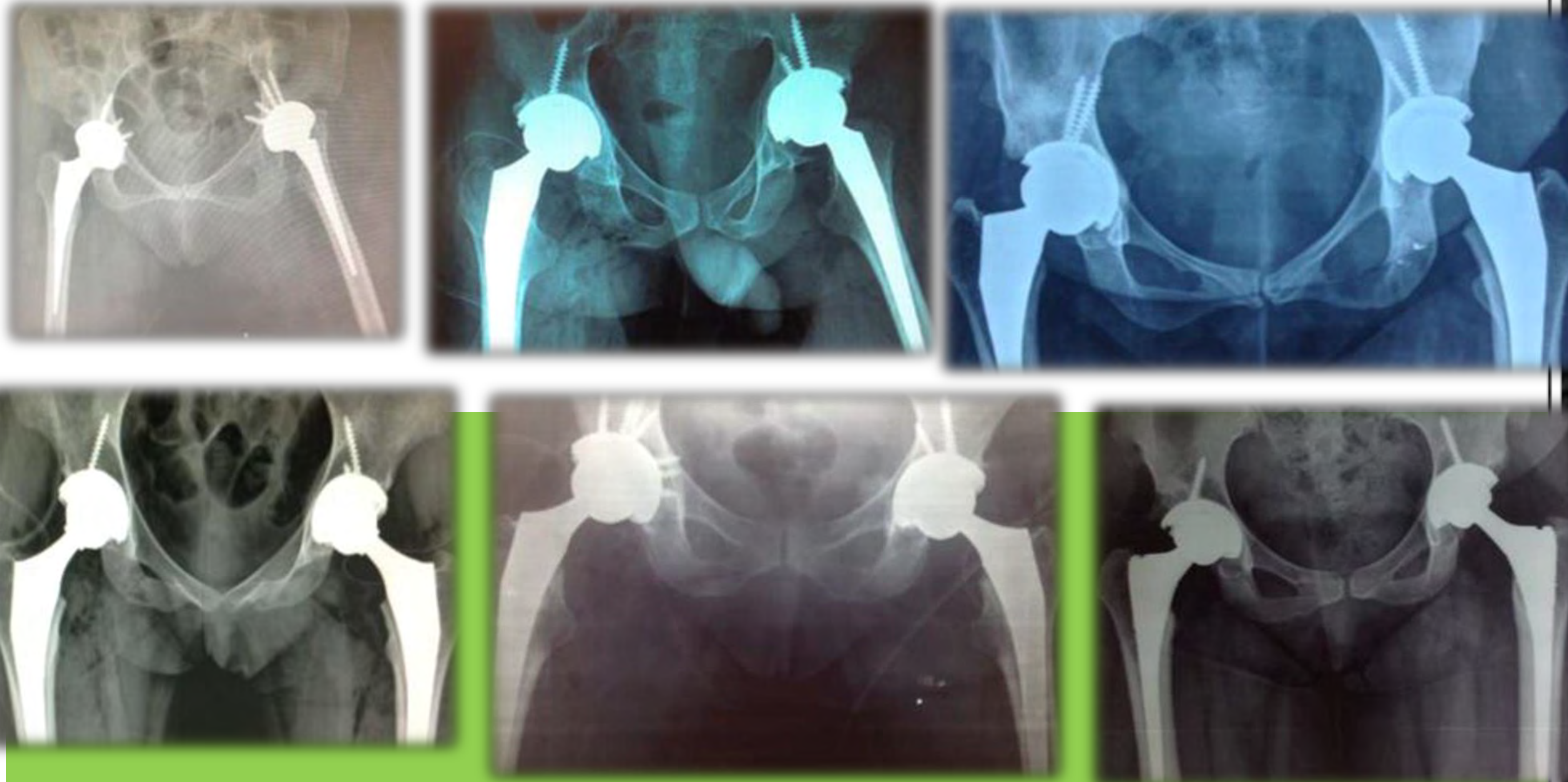

The number of single-stage bilateral total hip arthroplasties done each year is increasing.

Simultaneous bilateral hip replacement reveals superior outcome and fewer complications than two-stage procedures: a prospective study including 1819 patients and 5801 follow-ups from a total joint replacement registry

BMC Musculoskelet Disord, 11 (2010), p. 245

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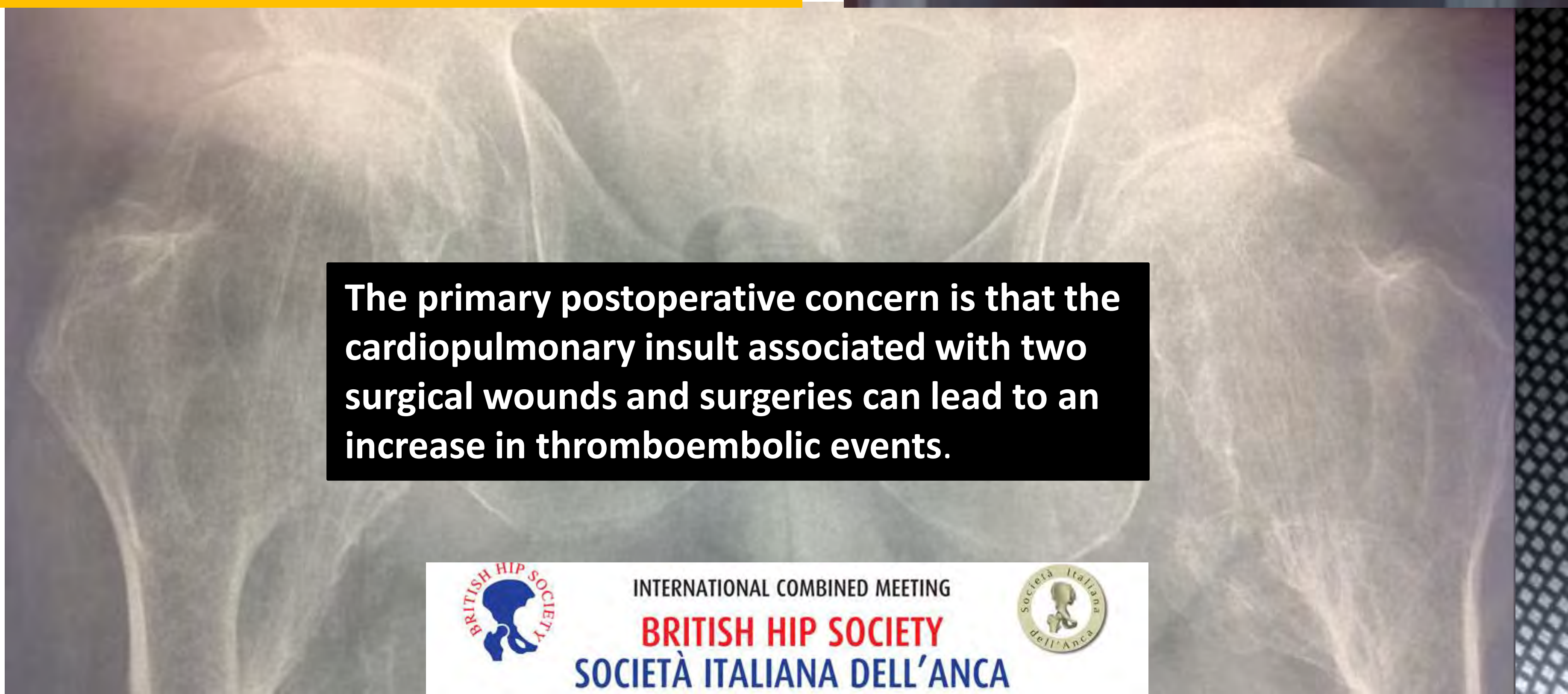
Is one-stage bilateral sequential total hip replacement as safe as unilateral total hip replacement?

Simultaneous bilateral versus unilateral total hip arthroplasty an outcomes analysis

J Arthroplasty, 20 (2005), pp. 421–426

whether the perioperative morbidity and mortality of patients having bilateral single-stage total hip arthroplasties would be increased.???

whether simultaneous bilateral sequential total hip replacement (THR) would increase the rate of mortality and complications compared with unilateral THR in both low and high-risk groups of patients. ???



The primary postoperative concern is that the cardiopulmonary insult associated with two surgical wounds and surgeries can lead to an increase in thromboembolic events.

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Hospital Stay and Cost:

The length of hospital stay in the single-stage group was significantly shorter than that in the two-stage patients.

this would certainly have an impact in reducing the economic burden.(Cost=25-30% reduction)

The economic
impact of lost employment
productivity with two recuperative
periods, although difficult to
measure
accurately, is likely reduced
with single-stage THA

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J Bone Joint Surg Br March 2006 vol. 88-B no. 3 298-303

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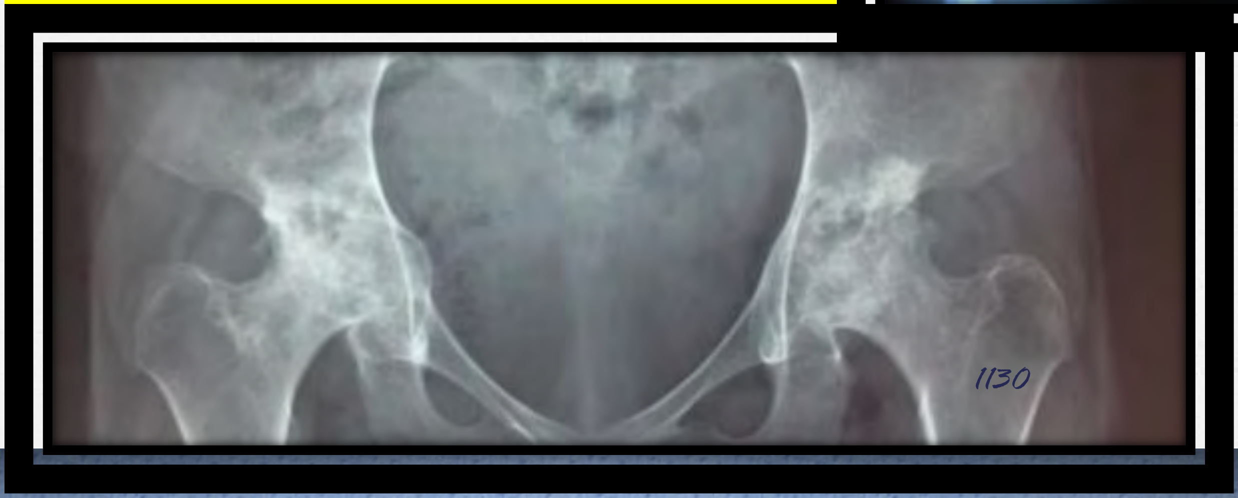
There are no absolute indications for a single-stage bilateral THA compared with staged procedures.

The strongest indication is severe disabling bilateral arthritis of the hip in a medically fit patient.



J Am Acad Orthop Surg. 2002 May-Jun;10(3):217-21

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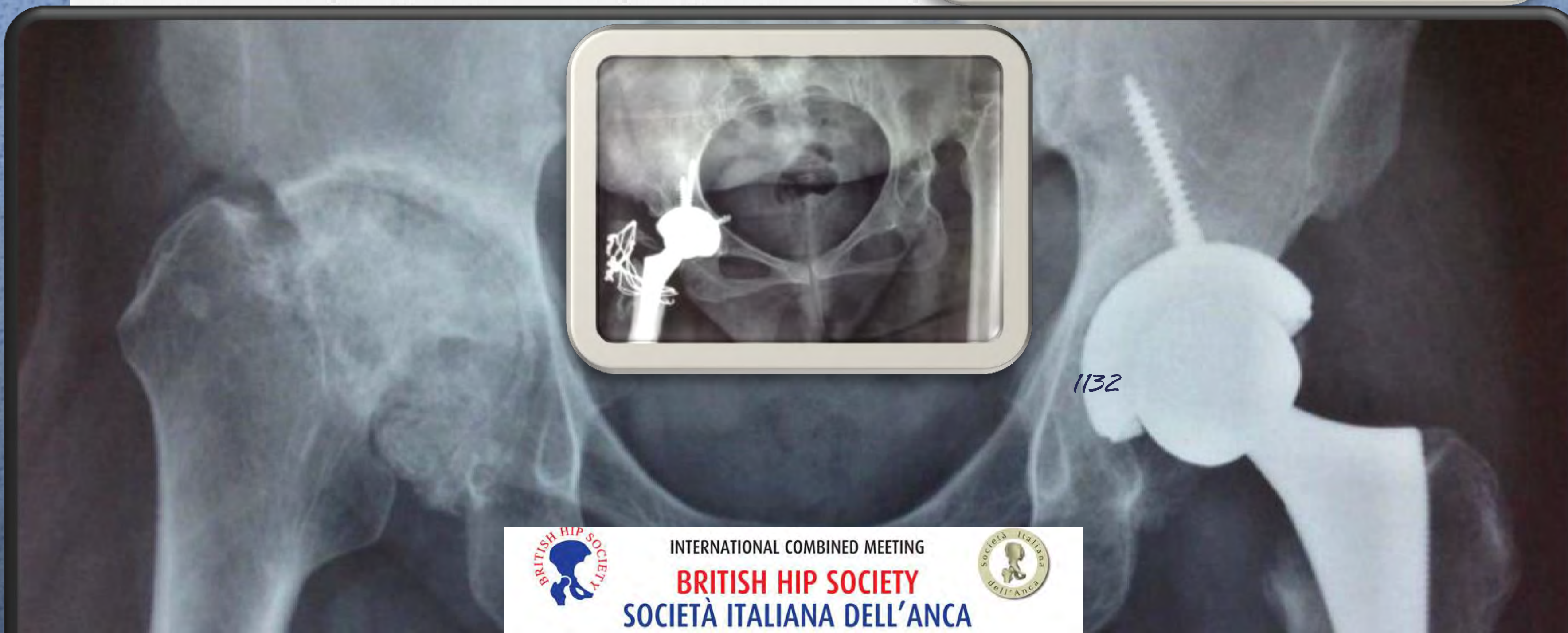
A relative indication is the existence of a condition that may impede the rehabilitation process.
(hip flexion contracture)

Another relative indication for single-stage bilateral THA is when lengthening during the hip reconstruction on the more symptomatic side would create an unacceptable limb-length inequality.



Patient preference is important

An elderly patient with significant comorbidities (eg, heart disease,pulmonary insufficiency, or diabetes)
usually **is not** a candidate for single-stage bilateral THA.

according to Schiessel patients prefer the simultaneous procedure because they undergo the process of operation, mobilization, and rehabilitation only once [11]. A better functional outcome after one-stage procedures is also reported for very stiff hips with a preoperative range of motion below 50°

- ***Bilateral THA*** is often performed on a hip table with the patient in the lateral decubitus position, with all bony prominences well padded and an axillary roll placed appropriately.

Surgical exposure :hardinge or posterolateral approach /in supine position by anterior approach

Review of articles:

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Review of articles:

RESEARCH ARTICLE — Open Access

Simultaneous bilateral hip replacement reveals superior outcome and fewer complications than two-stage procedures: a prospective study including 1819 patients and 5801 follow-ups from a total joint replacement registry

Abstract

Background

Atkinson et al. Journal of Orthopaedic Surgery and Research 2010, 5:84
http://www.josr-online.com/content/5/1/84

RESEARCH ARTICLE — Open Access

Bilateral hip arthroplasty: is 1-week staging the optimum strategy?

Henry D Atkinson[1,2*], Christopher A Bailey[2], Charles A Willis-Owen[2], Roger D Oakeshott[2]

Abstract

Seventy-nine patients underwent bilateral hip arthroplasty staged either at 1 week (Group 1) or after greater intervals (as suggested by the patients, mean 44 weeks, range 16-68 weeks) (Group 2), over a five year period at one institution. Sixty-eight patients (29 bilateral hip resurfacings and 39 total hip replacements) completed questionnaires regarding their post-operative recovery, complications and overall satisfaction with the staging of their surgery.

There was no significant age or ASA grade difference between the patient groups. Complication rates in the two groups were similar and overall satisfaction rates were 84% in Group 1 (n = 32) and 89% in Group 2 (n = 36). Cumulative hospital lengths of stay were significantly longer in Group 1 patients (11.9 days vs 9.1 days)(p < 0.01); this was true for both hip resurfacing and total hip arthroplasty patients, however resurfacing patients stays were significantly shorter in both groups (p < 0.01). Postoperative pain resolved earlier in Group 1 patients at a mean of 20.9 weeks compared with a cumulative 28.9 weeks (15.8 and 13.1 weeks) for Group 2 patients (p = 0.03).

The mean time to return to part-time work was 16.4 weeks for Group 1, and a cumulative 17.2 weeks (8.8 and 8.4 weeks) for Group 2. The time to return to full-time work was significantly shorter for Group 1 patients (21.0 weeks, compared with a cumulative 29.7 weeks for Group 2)(p < 0.05). The time to return to both full and part-time work was significantly shorter in total hip replacement patients with 1-week staging compared with delayed staging (21.0 vs 35.8 weeks (p = 0.02), and 13.8 vs 19.3 weeks (p = 0.03) respectively).

Hip resurfacing patients in Group 2 had significantly shorter durations of postoperative pain and were able to return to part time and full time work sooner than total hip arthroplasty patients. There was a general trend towards a faster recovery and resumption of normal activities following the second operation in Group 2 patients, compared with the first operation.

Bilateral hip arthroplasty staged at a 1-week interval resulted in an earlier resolution of hip pain, and an earlier return to full-time work (particularly following total hip replacement surgery), with high levels of patient satisfaction and no increased risk in complications; however the hospital length of stay was significantly longer. The decision for the timing of staged bilateral surgery should be made in conjunction with the patient, making adjustments to accommodate their occupational needs and functional demands.

Introduction

The optimum timing for bilateral hip arthroplasty is still under debate. Single-episode sequential bilateral hip arthroplasty though potentially financially advantageous and with shorter rehabilitation periods than staged arthroplasty [1-6], has been associated with a significantly increased risk of pulmonary complications, post-operative anaemia and heterotopic ossification [6-12].

Sequential bilateral total hip replacements during the same hospitalisation period have been advocated to avoid these potential complications whilst maintaining the functional benefits of near simultaneous surgery; and good clinical results and implant survivorship has been previously reported for these patients [6].

This study compared the post-operative recovery, complications and overall satisfaction rates of patients undergoing one-week staged bilateral hip arthroplasty

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Review of articles:

Single-Stage Bilateral Total Hip Arthroplasty

William Macaulay, MD, Eduardo A. Salvati, MD,
Thomas P. Sculco, MD, and Paul M. Pellicci, MD

J Am Acad Orthop Surg 2002;10:217-221

The Journal of Arthroplasty Vol. 27 No. 7 2012

Simultaneous Bilateral Total Hip Arthroplasty With Hydroxyapatite-Coated Implants: A 20-Year Follow-Up

Ran Schwarzkopf, MD, MSc,* Patrick Olivieri, BSc,* and William L. Jaffe, MD

Abstract: Bilateral hip arthroplasty has been reported to be a safe and effective way to treat bilateral hip arthritis in a selective group of patients. We report a follow-up of 30 patients who underwent simultaneous bilateral total hip arthroplasty with hydroxyapatite implants and were followed for an average of 19.4 years. Patients had an average Harris Hip Score of 90 at the latest follow-up (range, 78-99). The average Western Ontario and McMaster Universities Arthritis Index questionnaire index score was 12 (range, 0-41), with high functional results on the 12-Item Short Form Health Survey (SF-12) and Oxford 12 questioners. Using the Kaplan-Meier survivorship analysis, with revision for any reason as an end point, survivorship was 94% at 12 years, 88% at 15 years, 74% at 18 years, and 61% at 23 years. All revisions were for the acetabular component, and the survivorship for the femoral component was 100% throughout the 23-year period. We conclude that bilateral uncemented total hip arthroplasty can provide satisfactory long-term clinical, radiological, and functional outcomes in patients even with older generation polyethylene liners and stem designs.
Keywords: bilateral total hip arthroplasty, hydroxyapatite, functional score, longevity.

Total hip arthroplasty has been shown to be a successful procedure for patients with hip arthritis [1]. The benefits of total joint arthroplasty as a treatment of hip arthritis have been well characterized. Multiple studies have demonstrated that, following total joint arthroplasty, patients experience significant quantitative and qualitative improvement in both their physical function and quality of life [2-4].

To meet the increasing desire of patients to remain as active as possible, bilateral total hip arthroplasty has been the staple of treatment for a selective group of patients for some time [4-6]. Although there are increased risks such as blood loss, surgical site infection, thrombosis, and dislocation, these risks have been far outweighed by the function and quality of life gained by most patients following the surgery [7-9]. Bilateral total hip arthroplasty has been reported in the literature to be a safe an effective way to treat bilateral hip arthritis in a selective group of patients [3,5,10]. Bilateral hip arthroplasty is a major surgery and should be reserved for younger, healthier patients who can medically undergo such a demanding and prolonged surgery [3,5,11].

Long-term failure of cemented total hip arthroplasty is usually due to aseptic loosening caused by particle wear and osteolysis. Hydroxyapatite-coated hip implants were developed with the explicit goal of avoiding this problem and preserving bone in younger, more active patients [12]. These implants facilitate a biological bond between the implant and bone [11,13,14].

Long-term follow-up studies are essential to determine the effectiveness and durability of a procedure. Single-surgeon series have been noted to be the ideal, with an increased rate of failure noted in multisurgeon series [10,15-20]. The purpose of this study was to analyze the clinical, functional, and radiographic outcomes of a single-surgeon patient cohort of bilateral simultaneous total hip arthroplasty using hydroxyapatite-coated implants at NYU Hospital for Joint Diseases. In March 1998, we reported the results of 30 patients, 60 hips, who underwent simultaneous bilateral total hip arthroplasty with hydroxyapatite components and were followed for 24 to 76 months [11]. We have now reviewed the same cohort at a mean of 20 years (range, 18-23 years).

From the Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, New York, NY.
Submitted April 4, 2011; accepted October 24, 2011.
The Conflict of Interest statement associated with this article can be found at doi:10.1016/j.arth.2011.10.029.

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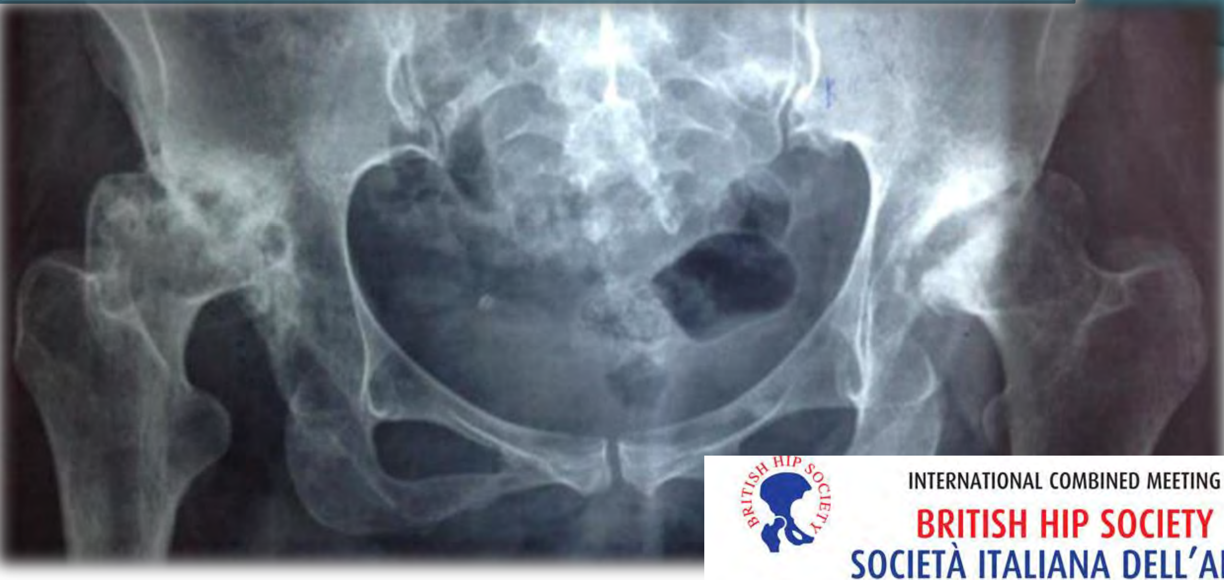
- **The fitness of the patients was categorised according to the ASA system**

. Patients of ASA grade 1 and grade 2 were categorised as 'low risk' and those of ASA grade 3 and grade 4 as 'high risk'

The most symptomatic hip is always treated first



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The decision as to whether cemented or cementless fixation to be used is made at the time of admission, depending upon the quality of the bone stock and the age of the patient. All patients with good bone stock and less than 65 years of age undergo cementless arthroplasty. The press-fit technique of insertion of the a
reaming of the a
impaction of the
supplementary f
in most cases.

- At the end of the procedure, a pelvic radiograph obtain in the operating room. patients may have a suction drain placed in each hip and receive prophylactic antibiotic therapy, as well as thromboembolism prevention with low-molecular-weight heparin for 30 days.

Three out of 10 articles noticed a higher need for blood transfusion in the simultaneous group, whereas the article by Parvizi described a lower need

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Complication rates in review of articles:

there was no significant difference in the incidence of major complications between high-risk (ASA 3 and 4) and low-risk (ASA 1 and 2) subgroups in both groups, no valid conclusions could be drawn since the number of patients in the high-risk subgroup was small compared with that in the low-risk subgroup.

Berend documented a significantly higher re-operation rate, more inpatient complications and adverse events in patients undergoing simultaneous bilateral THA in the lateral decubitus position although the author does not list them [5]. On the other hand, Parvizi reported fewer complications in the simultaneous group [8]. The remaining literature describes no significant differences in complication rates between simultaneous and two-stage bilateral THA.

In our prospective study:

we compared the complications and functional outcomes of one-stage and two-stage procedures.

One hundred and eighty patients (ASA class I or II) with bilateral hip osteoarthritis were assigned randomly to two equal groups. Two groups were matched in term of age and sex.

All of the surgeries were performed through the Harding approach using uncemented implants.
In two-stage procedures, surgeries were performed with 6 months to one year interval. All patients were evaluated one year postoperatively.

The Harris hip score averaged 84.1±12.6 and 82.6±15.3 in one-stage and two-stage groups, respectively (p=0.528). The hospital stay was significantly longer in two-stage group (9.8±1.1 versus 4.9±0.8 days). 1141

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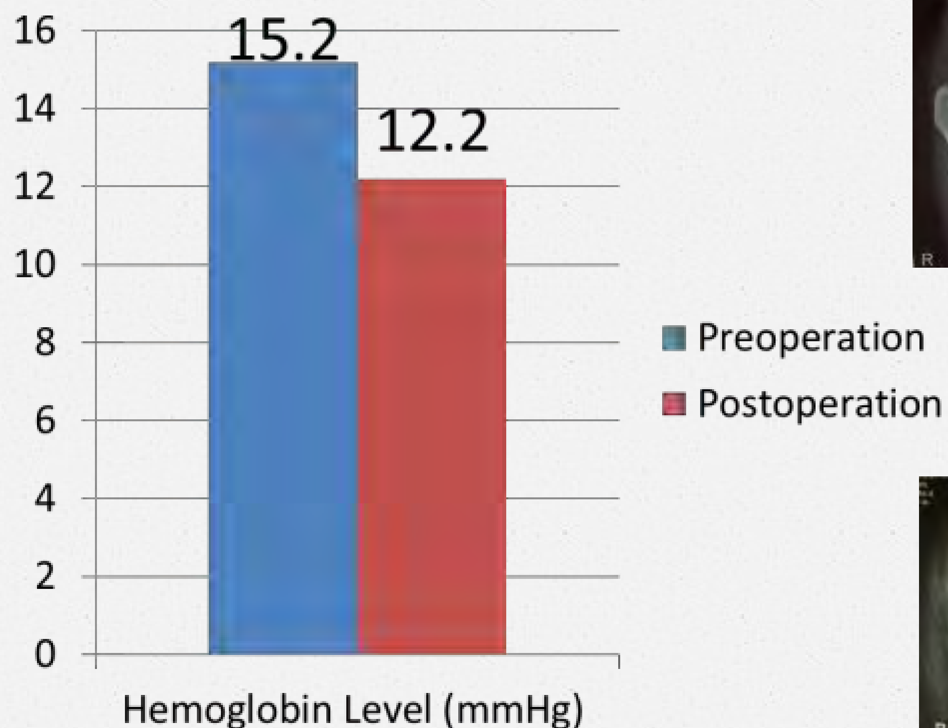
In our prospective study:

The cumulative hemoglobin drop and number of transfused blood units were the same.



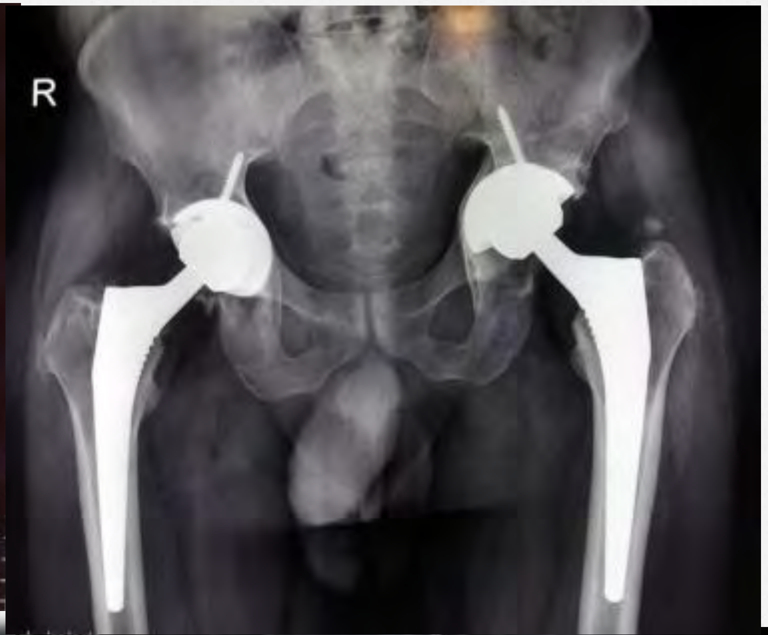
Complications:

One patient in each group developed symptomatic deep venous thrombosis and managed successfully.

There was no patient with perioperative death, pulmonary embolism, infection, dislocation, periprosthetic fracture or heterotrophic ossification.

No patient required reoperation.

Two patients in one-stage group developed unilateral temporary peroneal nerve palsy resolved after 3 and 4 months.



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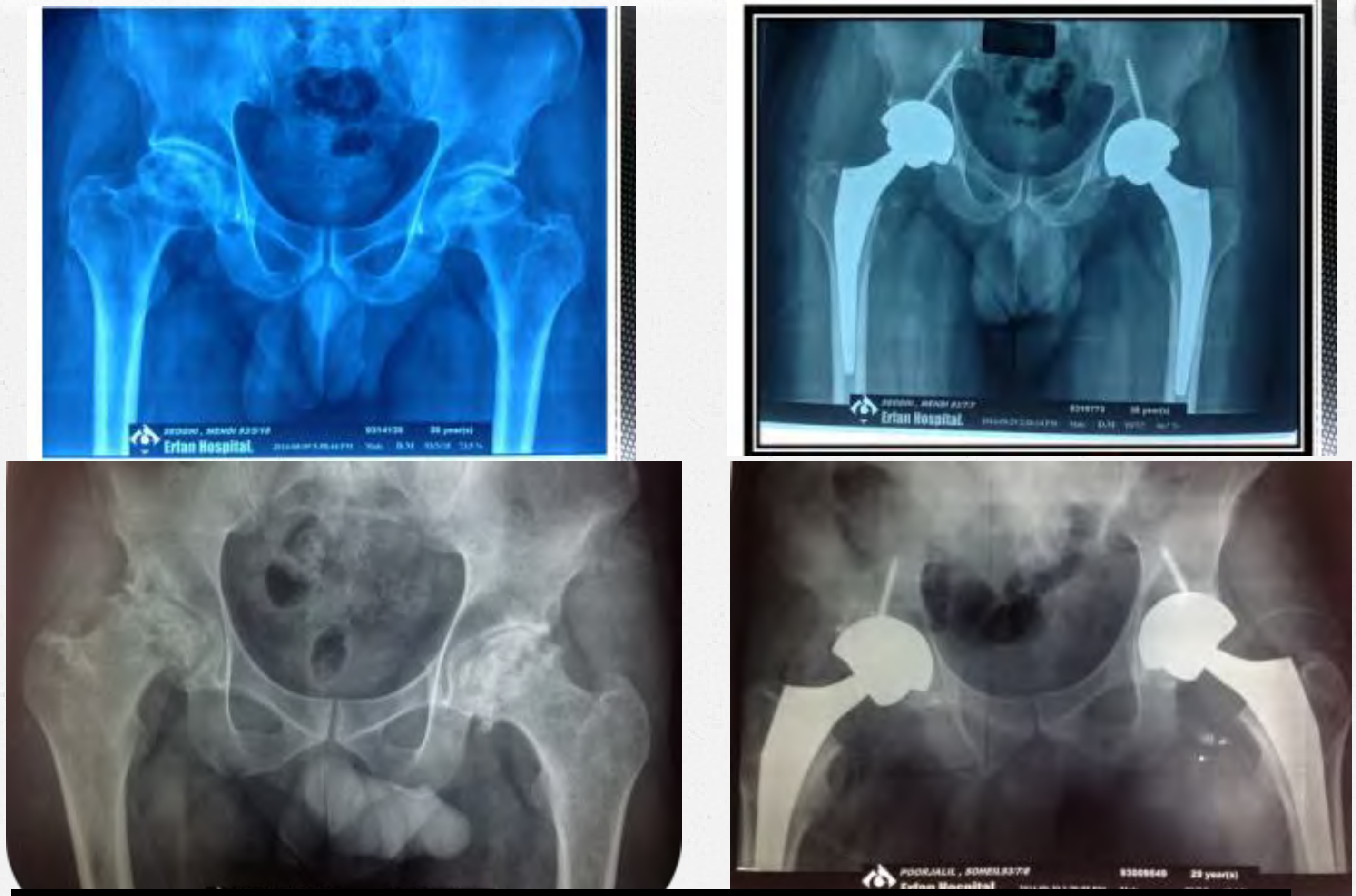

The current study showed that one-stage bilateral THA can be used successfully for patients who require bilateral hip arthroplasty without increased rate of complications

One-stage bilateral THA is an safe and efficient method for patients with ASA class I or II requiring bilateral THA.

- We recommend to perform one-stage bilateral THA for healthy patients with ASA class I or II.

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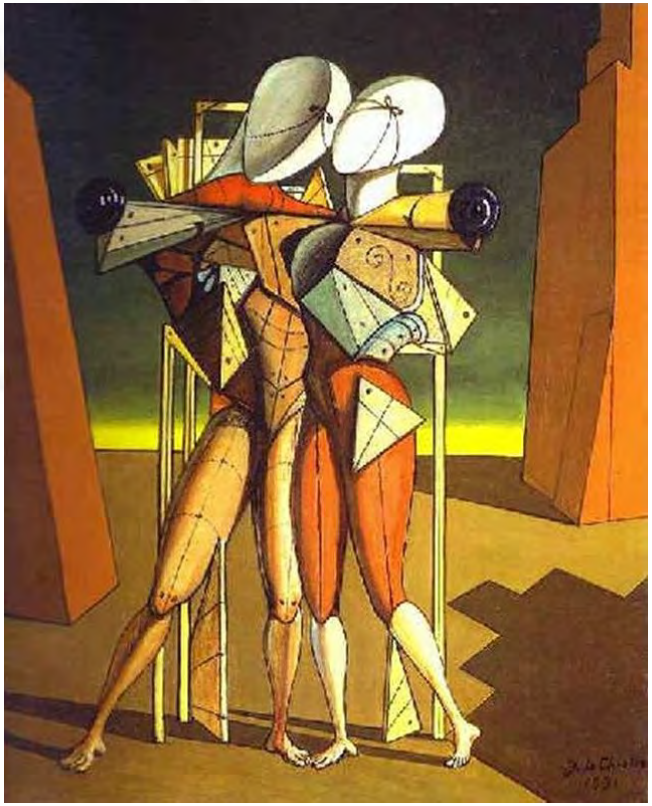
Robotic surgery applied to total hip arthroplasty: preliminary results and technical notes

P Caldora, L Ciampalini, P Guastafierro, D Lup, R Redi, P De Biase



C.O.R.A.
Chirurgia Ortopedica Robotica Assitita
Robotic Assisted Orthopaedic Surgery

Not orthopaedic robotic surgery purpose:

☑ *Teleoperative precision and modulation of the surgeon manuality*

Orthopaedic robotic surgery purpose:

☑ *Accuracy in the implant placement*

☑ *Mistakes limitation*

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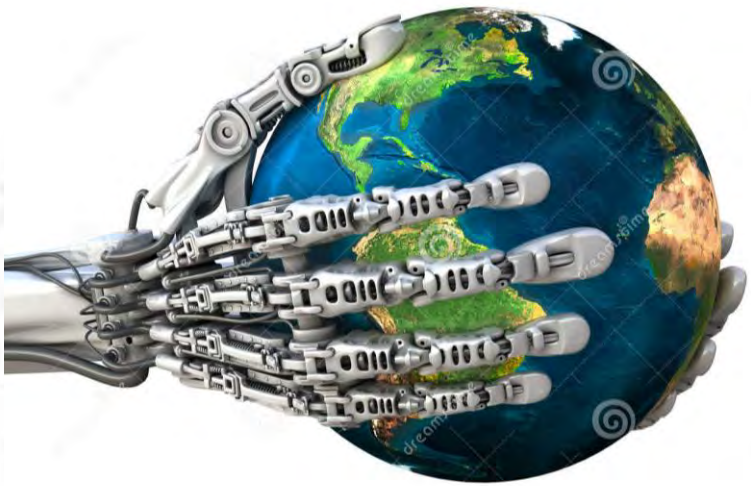
Robotic Assisted Orthopaedic Surgery

2006: first case USA
2008: 500 cases USA
2009: 1000 casesUSA
2013: 30.000 over the world
2014: > 40.000 over the world



Five centers in Italy

2011: first case
2015: 1.457 patients

1260 knees
197 hips

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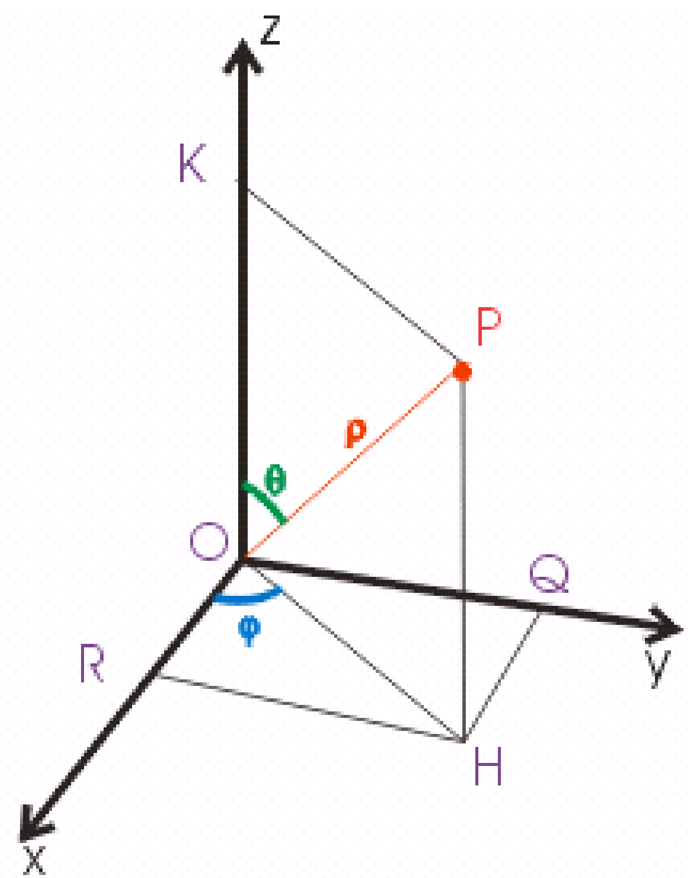
Robotic Assisted Orthopaedic Surgery

POTENTIAL LEVEL OF PRECISION

☑ Below one millimeter

☑ One degree



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- ☑ Accuracy
- ☑ Precision
- ☑ Mistakes limitation
- ☑ Safety

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Robotic Assisted Orthopaedic Surgery

Indications

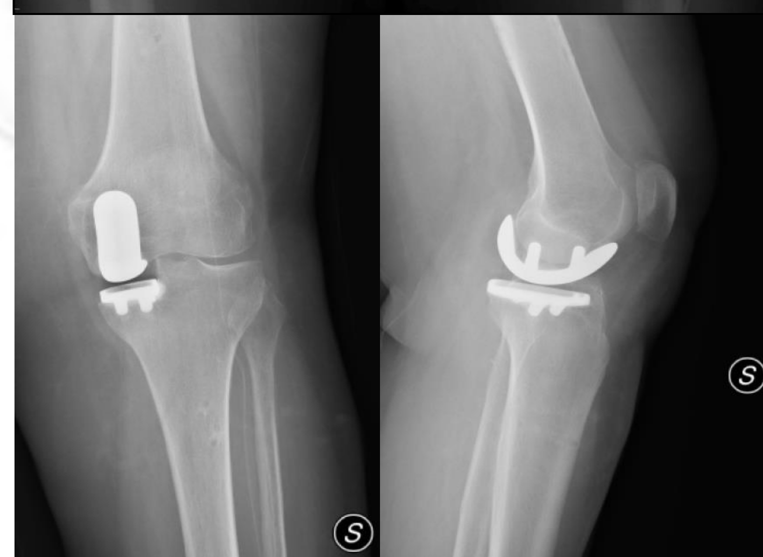
- ✓ **THA**
- ✓ **UKA**

partial knee replacement

-medial

-lateral

-patellofemoral



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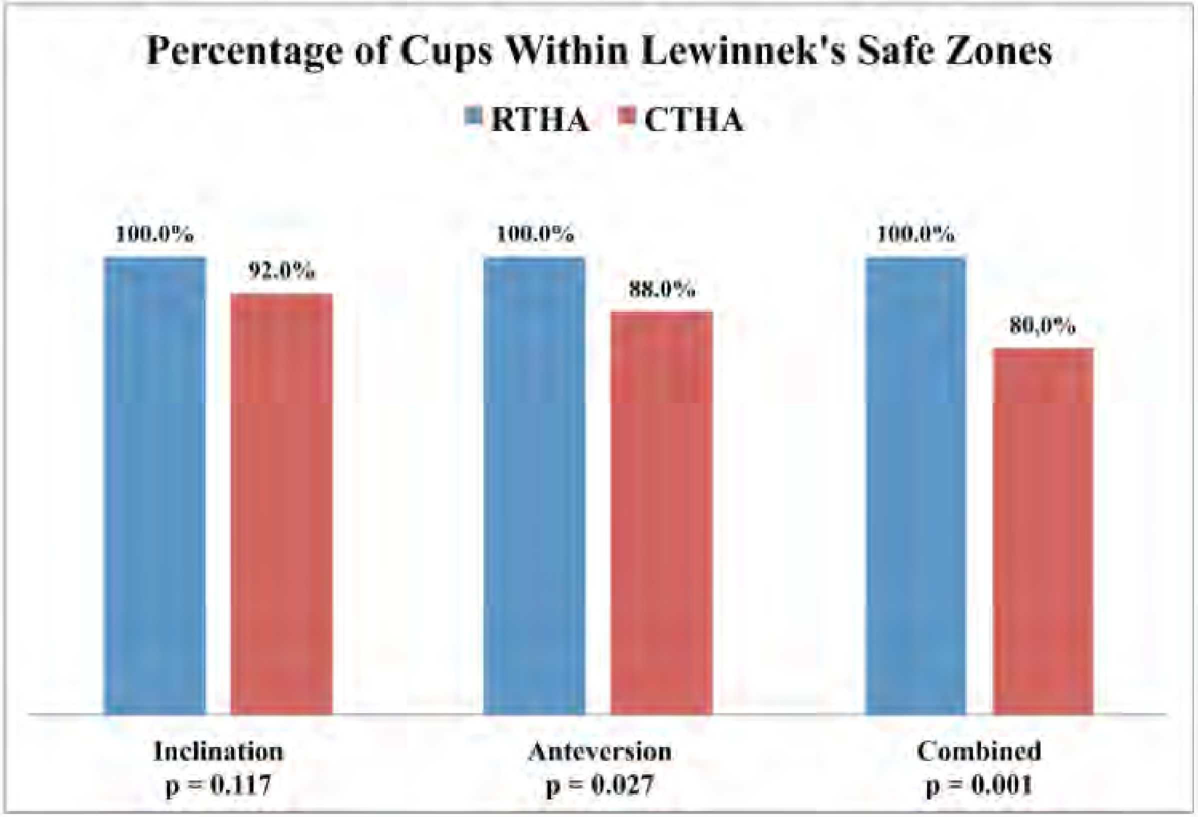
Clin Orthop Relat Res. 2014 Jan;472(1):329-36. doi: 10.1007/s11999-013-3253-7. Epub 2013 Aug 29.

Comparison of robotic-assisted and conventional acetabular cup placement in THA: a matched-pair controlled study.

Domb BG[1], El Bitar YF, Sadik AY, Stake CE, Botser IB.

160 THA
62 Conventional THA
69 Robotic THA
29 RX guided THA



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Technical Notes

- Preop CT
- Digital planning
- Digital simulation
- Surgery
- Implant placement check
- Xray controllo

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Robotic Assisted Orthopaedic Surgery

Technical Notes

Posterolateral Approach

Femoral preparation and stem implantation:

NAVIGATION

Socket preparation and cup placement :

ROBOTIC

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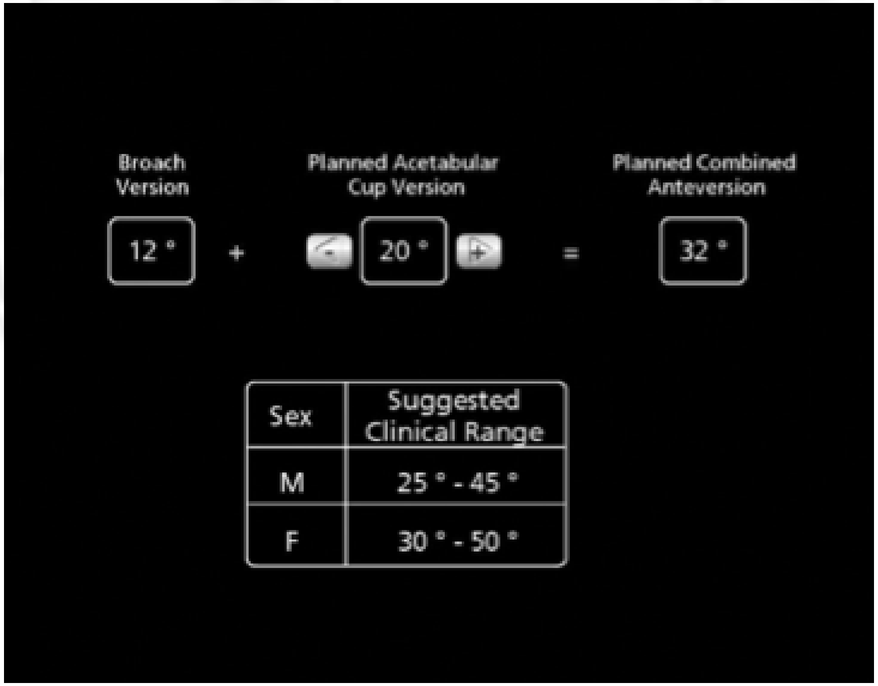
Robotic Assisted Orthopaedic Surgery

Technical Notes

A Combined Anteversion Technique for Robotic Arm Guided Total Hip Arthroplasty

Author: Lawrence D. Dorr, M.D., Medical Director, Total Joint Reconstruction, Dorr Arthritis Institute, Good Samaritan Hospital



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Robotic Assisted Orthopaedic Surgery

Patients:

July 2014 – October 2015

136 cases

77 Hips

59 Knees

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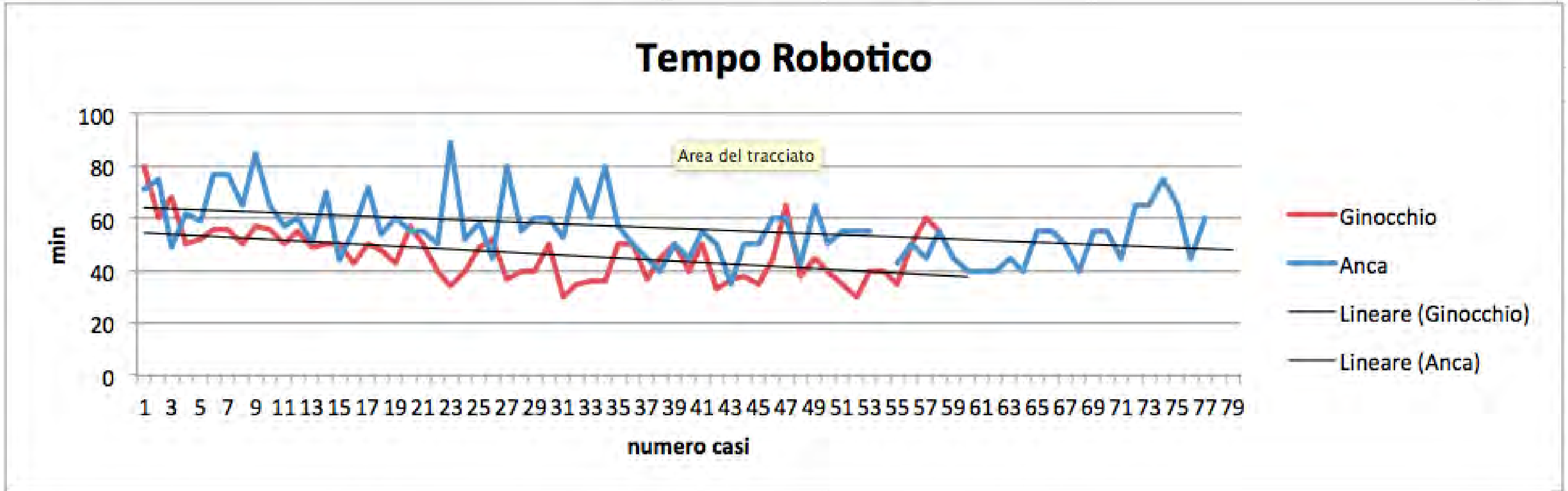
Robotic Assisted Orthopaedic Surgery

	RIEPILOGO ANCA MAKO
Protesi TOT	77
Media Tempo robotico (min):	56,8
Uomini	41
Donne	36
Sx	31
Dx	46



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Robotic Assisted Orthopaedic Surgery

Results

Valori Medi			
	Prima dell'operazione	Pianificata	
	Vs. Anca Opposta	Vs.Anca Opposta	Vs. Pre-op
Lunghezza anca [mm]	-1,7	0,6	3,5
Offset combinato [mm]	2,9	1,8	0,3
Versione Femorale [°]	5,9		
	Effettivo (°)	Pianificata (°)	Naturale (°)
Inclinazione Coppa	41,2	40,6	
Versione Coppa	21,2	21,3	
Antiversione Combinata	37,1	36,0	
Versione Stelo	15,8	14,8	5,9
	Vs. Anca Opposta	Vs. Pre-op	
Lunghezza Anca [mm]	2,1	3,8	
Offset Combinato [mm]	2,7	1,2	

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Robotic Assisted Orthopaedic Surgery

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Robotic Assisted Orthopaedic Surgery

ANCA RX Pianificazione Preoperatoria

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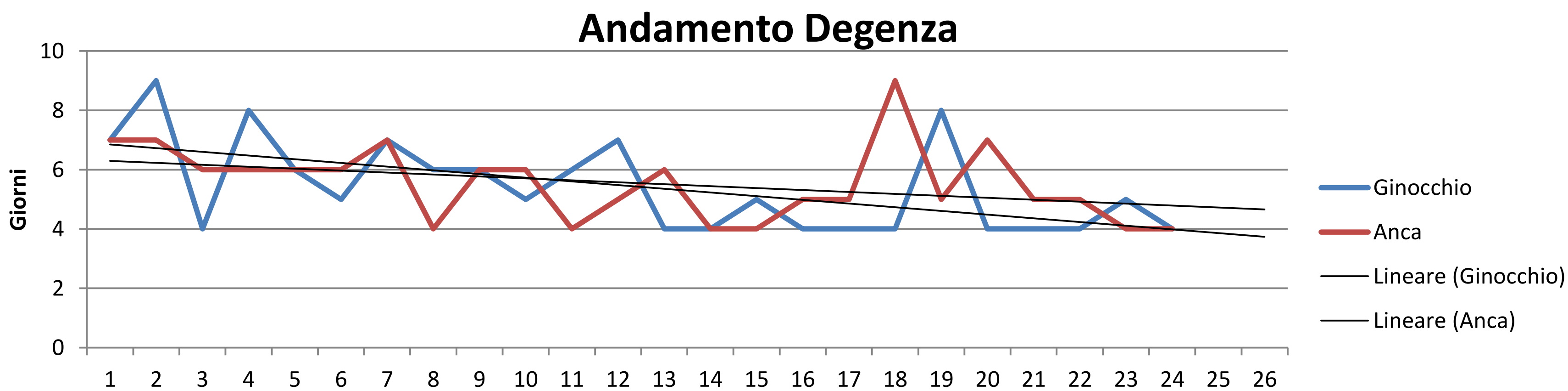
Robotic Assisted Orthopaedic Surgery

Degenza media ROBOTICHE	gg
GINOCCHIO	3
ANCA	3



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Robotic Assisted Orthopaedic Surgery

Conclusions

- ✓Complex technology
- ✓Safe procedure
- ✓Acceptable learning curve
- ✓Faster recovery?
- ✓Longer implants survivorship?
- ✓Costs?
- ✓Cost-effectiveness investigations

Roboti-cARe 2016

Robotic Cares in Arezzo - Multispeciality Live surgery event

April 12th-15th 2016 - **Arezzo-San Donato Hospital**

Chairmen:
P. Caldora, G. Ceccarelli, P. G. Ciabatti,
M. De Angelis, F. Lelli

Chairmen of scientific committee:
Filippo Annino – *filippo.annino@usl8.toscana.it*

Scientific committee:

General Surgery
Enrico Andolfi - *enri_72@yahoo.it*
Alessia Biancafarina

Gynecology
Ciro Sommella - *ciro.sommella@usl8.toscana.it*
Ario Joghtapour - Serena Tarani

Orthopedics
Pasquale Guastafierro - *pguastafierro@gmail.com*
Enrico Manzi

Otolaryngology
Giulia Burali - *giuliaburali@gmail.com*
Luca Ciampelli

Urology
Saba Khorrami - *Sabakhorrami@gmail.com*
Valentina Giommoni

Live surgery coordination:
Tiziano Verdacchi

thanks

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

Clinical and MRI results in 67 patients operated for gluteus medius and minimus tendon tears with a median follow-up of 4.6 years.

Konstantinos G Makridis, Michel Lequesne, Herve Bard, Patrick Djian

Institut Goethe-Clinique Nollet, Paris, France

Authors state no conflict of interest

Introduction

Although various techniques can be used to repair gluteal tendon tears, the long-term outcome is unclear and published studies typically involve only a small number of patients.

Objectives

To determine:

(1) if functional improvement can be obtained

(2) if the repairs are continuous based on MRI

(3) which factors determine success.

Patients and Methods

Period 2003-2010, 73 patients, one surgeon

Inclusion criteria:

- Patients with spontaneous ruptures of GMe and/or GMi
- Patients with ruptures resulting from acute or repetitive low-energy mechanisms

Exclusion criteria:

- Patients having ruptures resulting from high-energy mechanisms
- Patients with systemic inflammatory disease
- Patients with prior hip arthroplasty

Patients and Methods

Location, type of pain, Gait analysis

Resisted external derotation test in supine and prone positions

The 30 second single-leg stance test

The resisted abduction test

The Visual Analogue Scale (VAS) for pain

Verbal Scale for Self-assessment of Handicap

Lequesne Index of Severity for Osteoarthritis of the Hip

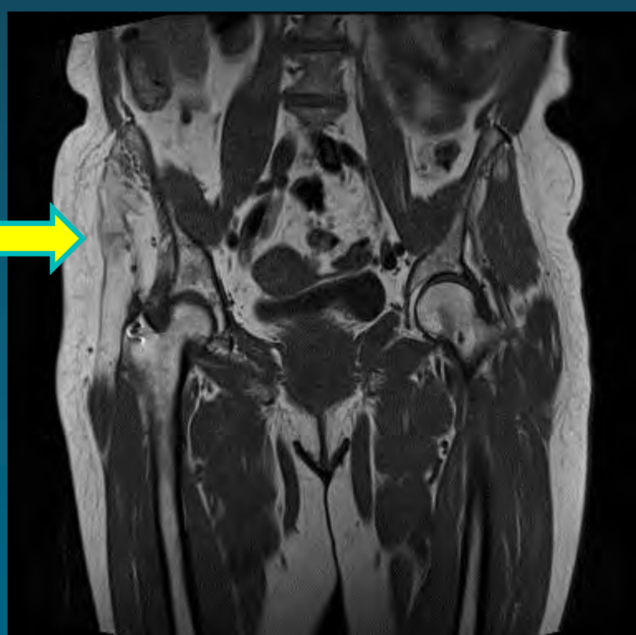
Harris Hip Score were completed before and after surgery

Patients and Methods

Radiographs with anteroposterior, and false profile views

MRI of the pelvis and the affected trochanteric region (with small fields)

Fatty degeneration of GMe



Rupture of GMe

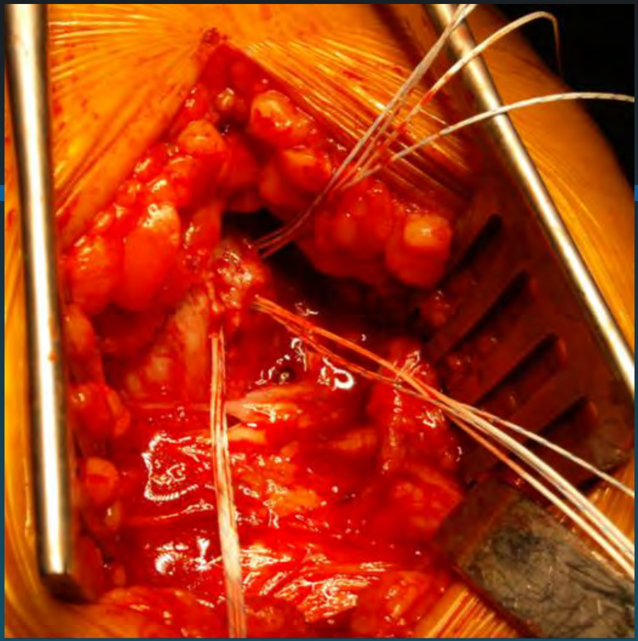
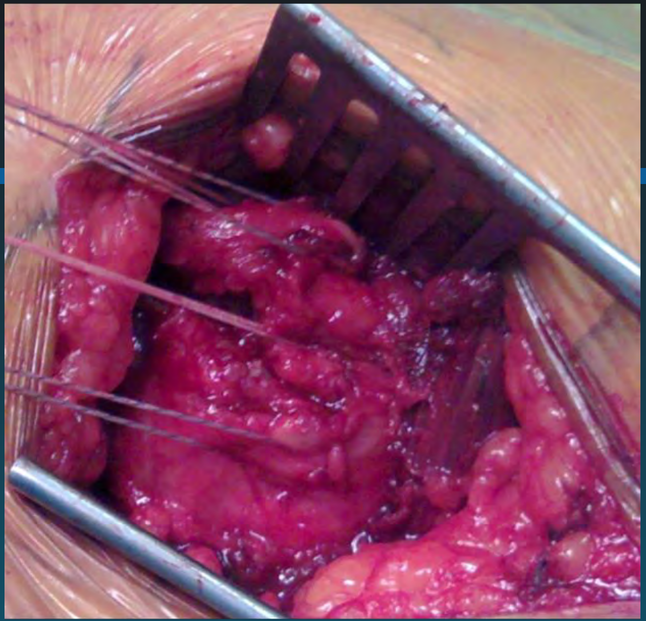
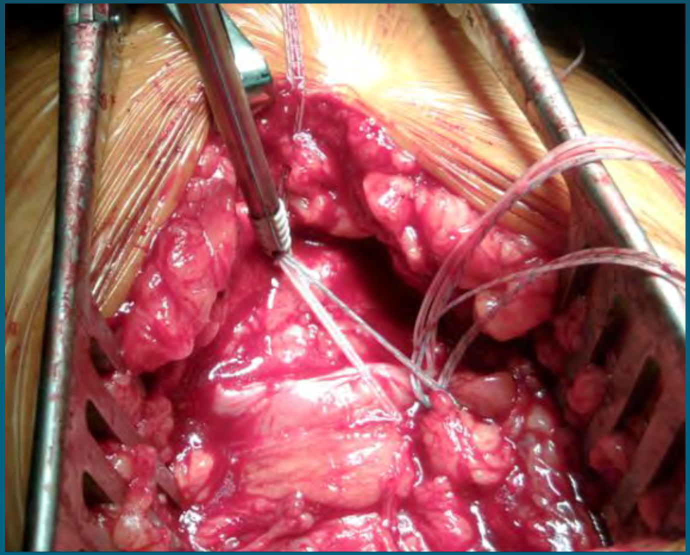
Surgical technique

Lateral decubitus, incision 8-10cm centered on the tip of greater trochanter

Bursectomy, inspection of the lesion: ANATOMICAL REPAIR

Two or three bone-anchors depending on the extension of the rupture

DOUBLE-ROW TECHNIQUE

Patients	67
Men	5
Women	62
Age	68 (25-87)
BMI	24,6 (20,4-32)
Duration of pain	2,8 years (6 months-10 years)
Follow-up	4,6 years (1-8 years)

Results

45 hips (64%) had a tear of the central lateral part of the GMe

21 hips (30%) had a rupture of anterior half of the GMe

4 hips (6%) had a rupture of posterior half of the GMe

GMi ruptures were found in 23 hips (33%)

Results: clinical evaluation

Resisted external derotation test in supine position:

positive in 97% of patients preoperatively

Resisted abduction test:

positive in 89% of patients preoperatively

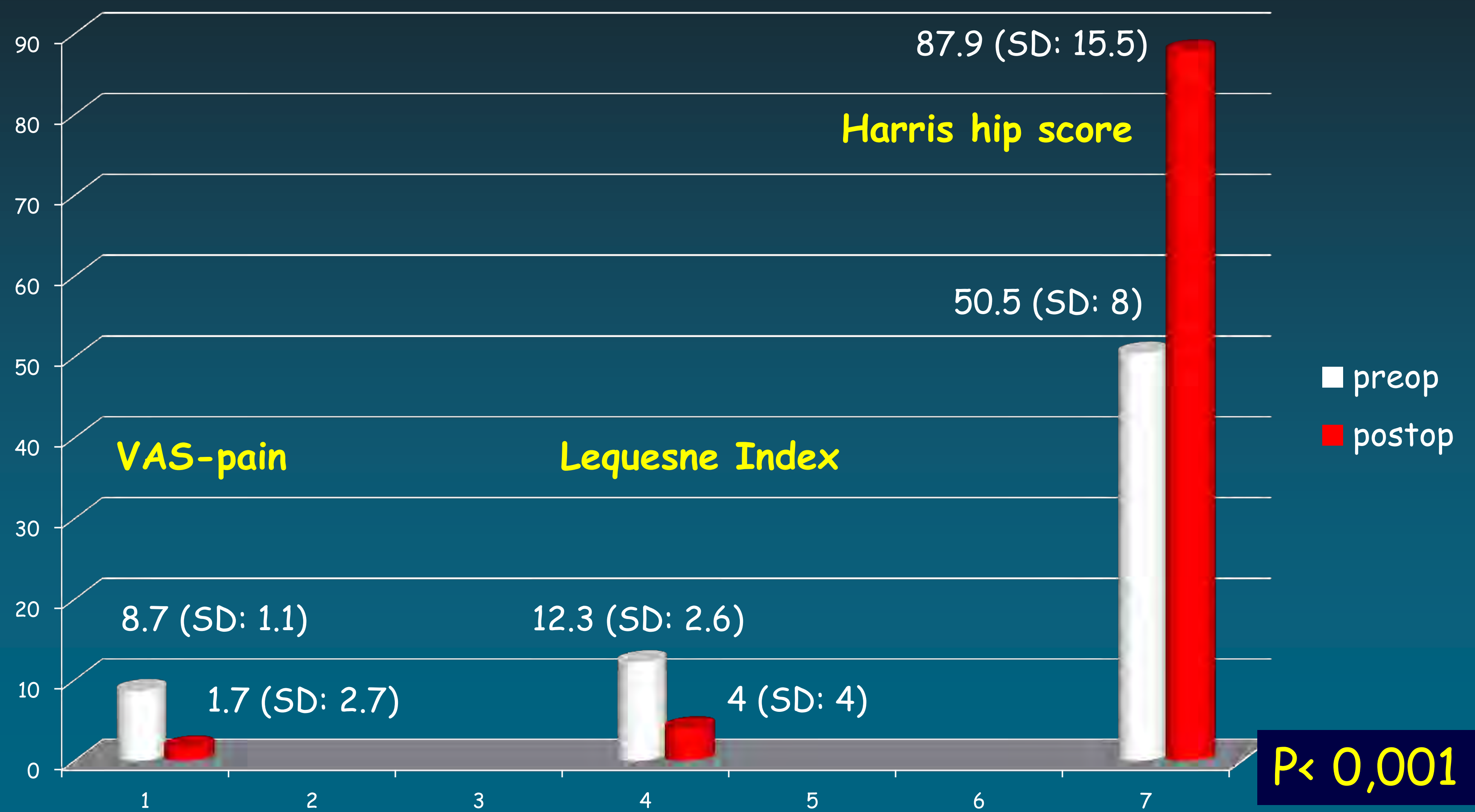
30 second single-leg stance test:

positive in 93% of patients preoperatively

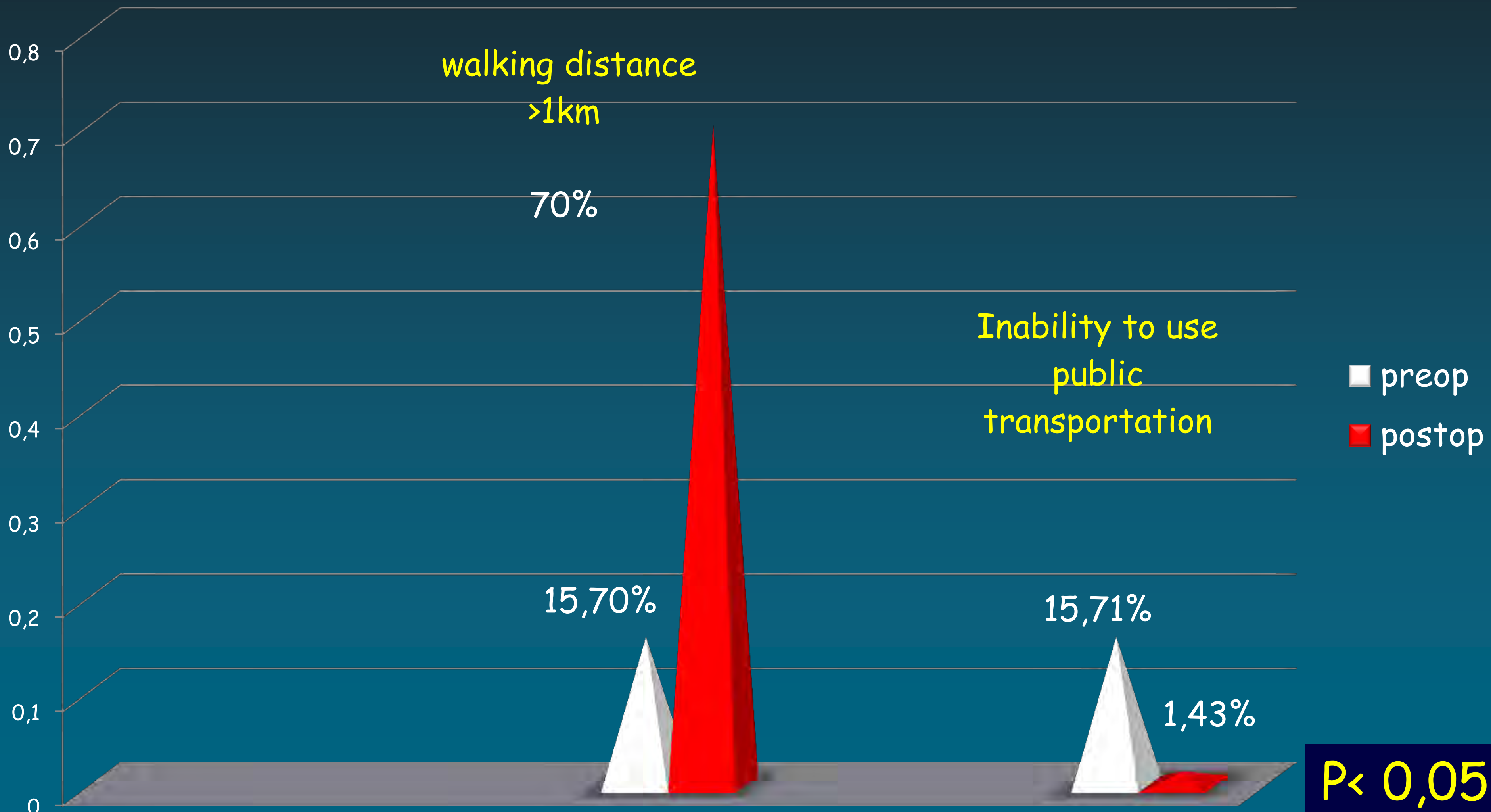
Trendelenburg gait:

positive in 66% of patients preoperatively

Results

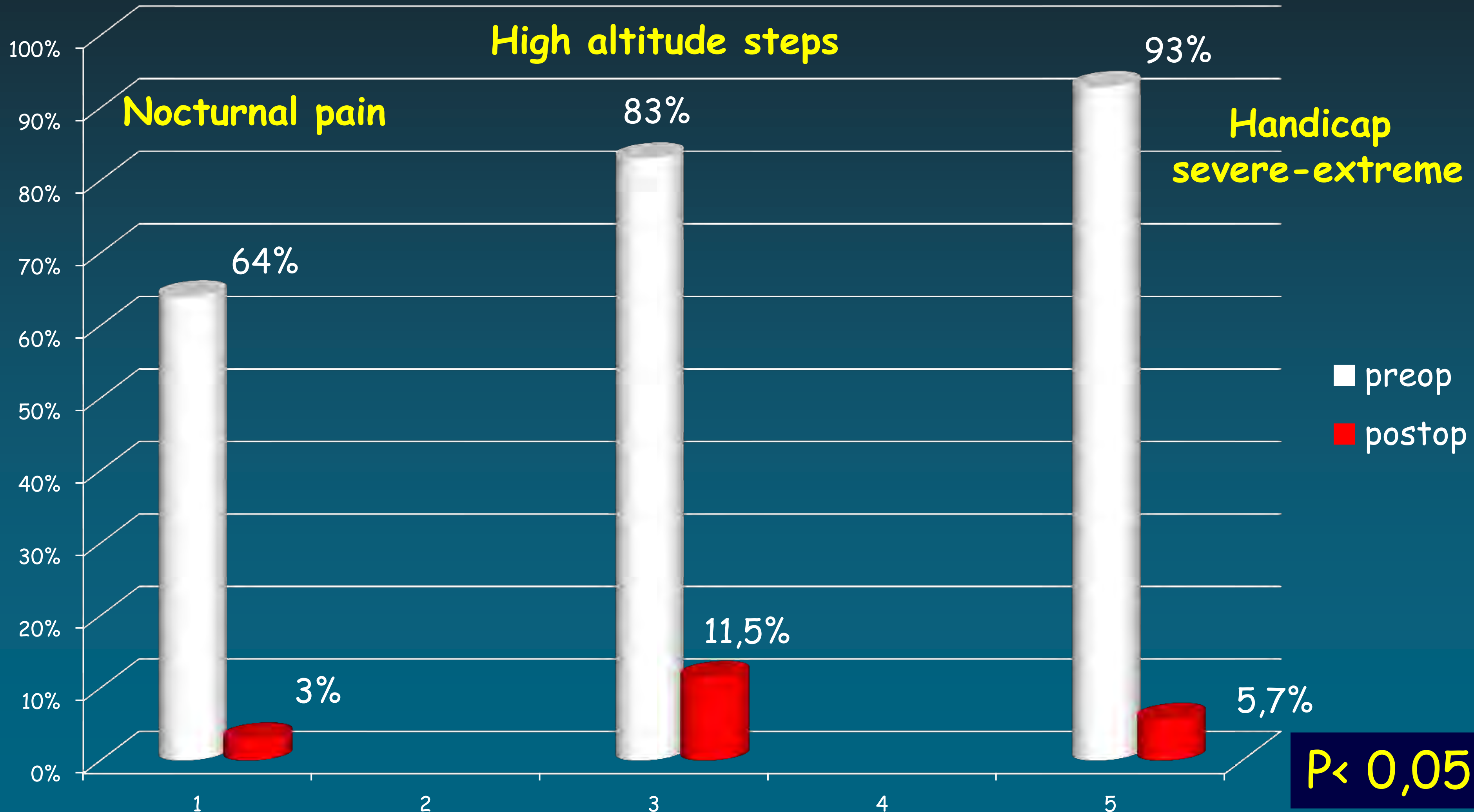

90
80
70
60
50
40
30
20
10
0
87.9 (SD: 15.5)
Harris hip score
50.5 (SD: 8)
VAS-pain
Lequesne Index
8.7 (SD: 1.1)
1.7 (SD: 2.7)
12.3 (SD: 2.6)
4 (SD: 4)
1
2
3
4
5
6
7
preop
postop
P< 0,001

Results



P< 0,05

Results



P< 0,05

Results

2 patients had a re-rupture (3 %)

(reoperation using the same technique; GMe healed uneventfully)

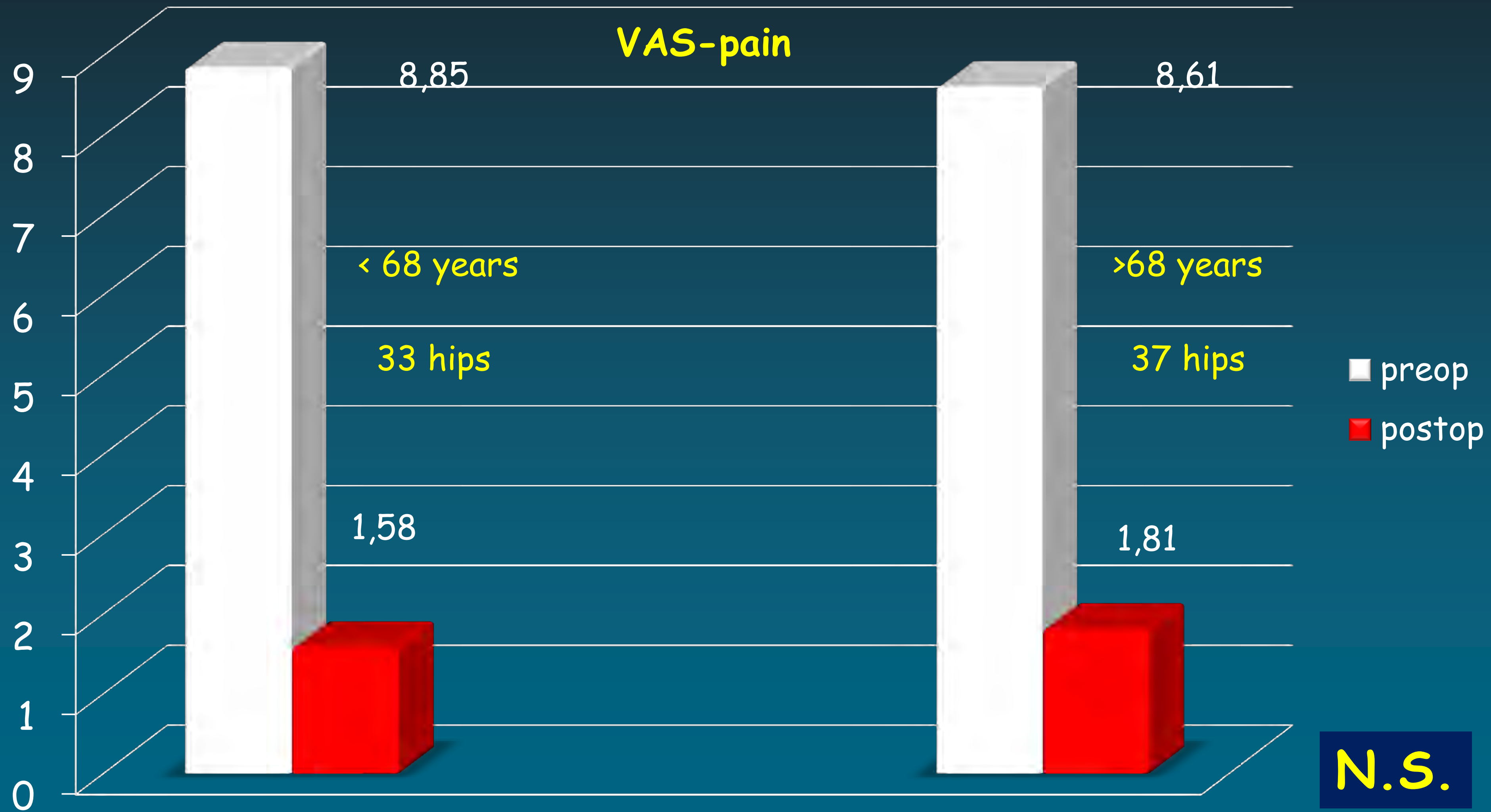
9 patients complained of persistent pain

(treatment with postoperative infiltrations and physiotherapy)

Analysis of the results

Possible risk factor

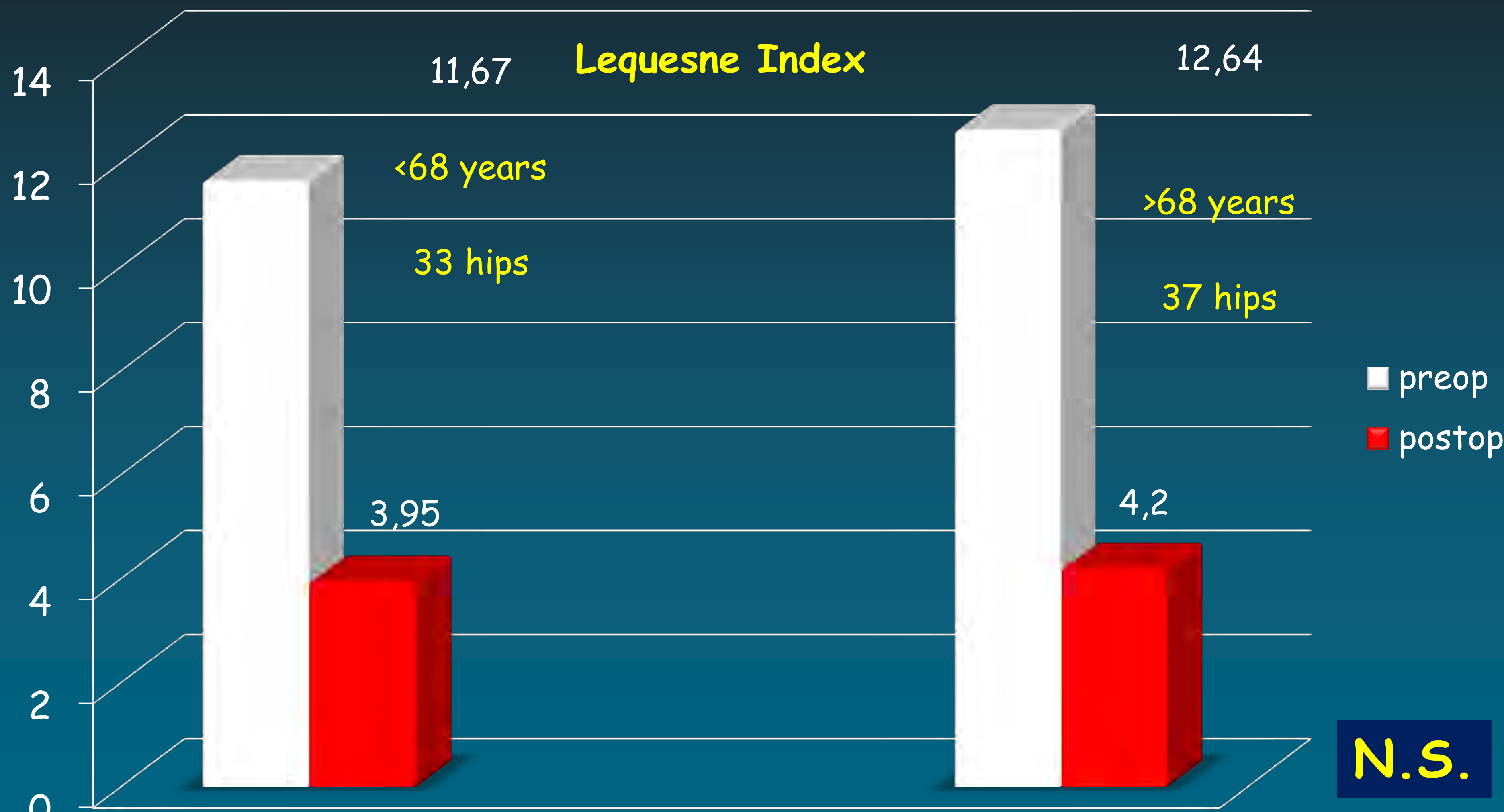
AGE



Analysis of the results

Possible risk factor

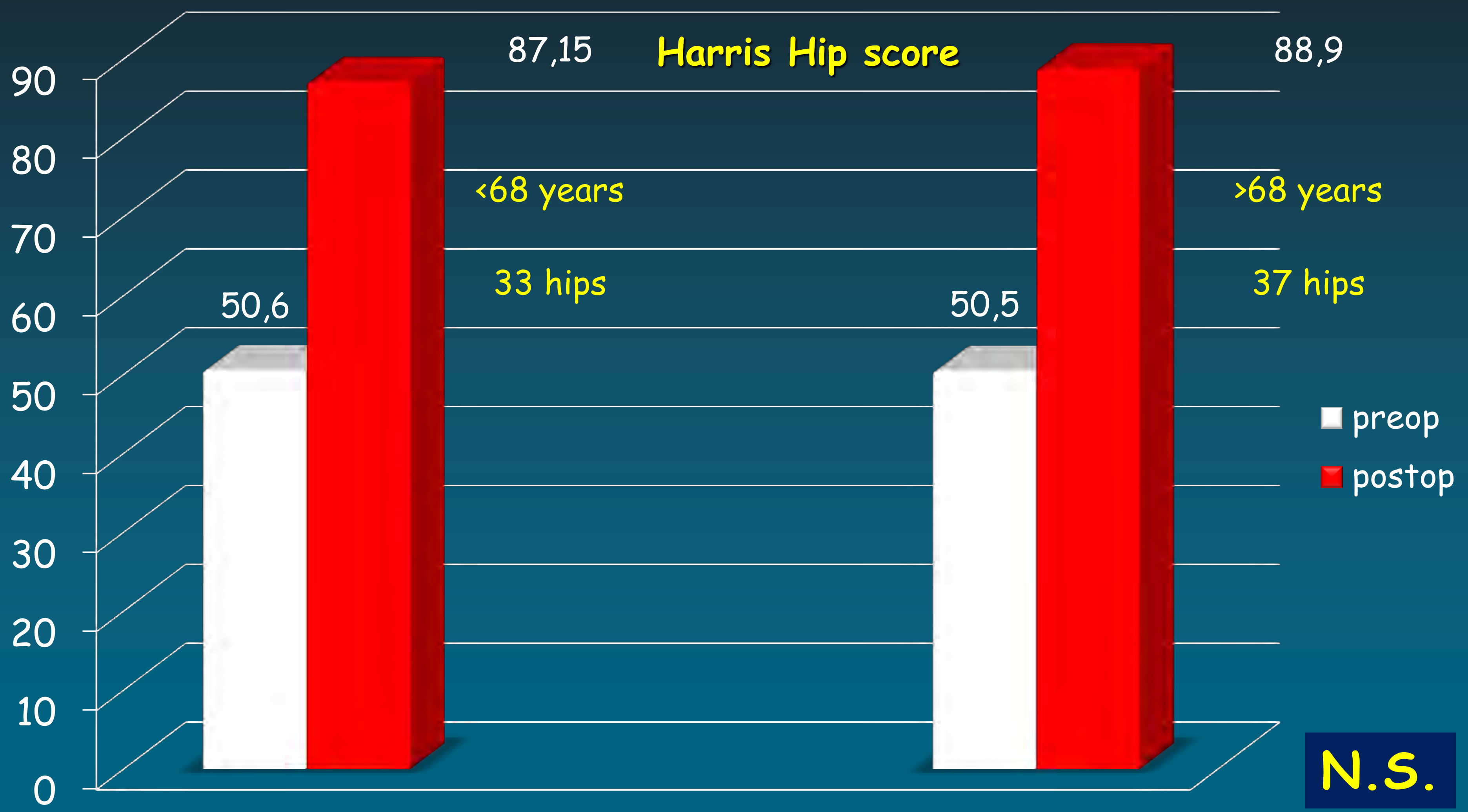
AGE



Analysis of the results

Possible risk factor

AGE



Analysis of the results

Possible risk factor

BMI

BMI	23,2 (20,8-24,9) 38 hips		27 (25-32) 32 hips	
	Preop	Postop	Preop	Postop
VAS-pain	8,81	1,58	8,59	1,81
LEQUESNE Index	12,26	3,88	12,25	4,28
HARRIS score	50,42	88,84	50,69	86,9
Pain at high altit. steps	84%	8%	81%	15%
HANDICAP	97%	5%	91%	6%

N.S.

Analysis of the results

Possible risk factor

MUSCLE ATROPHY

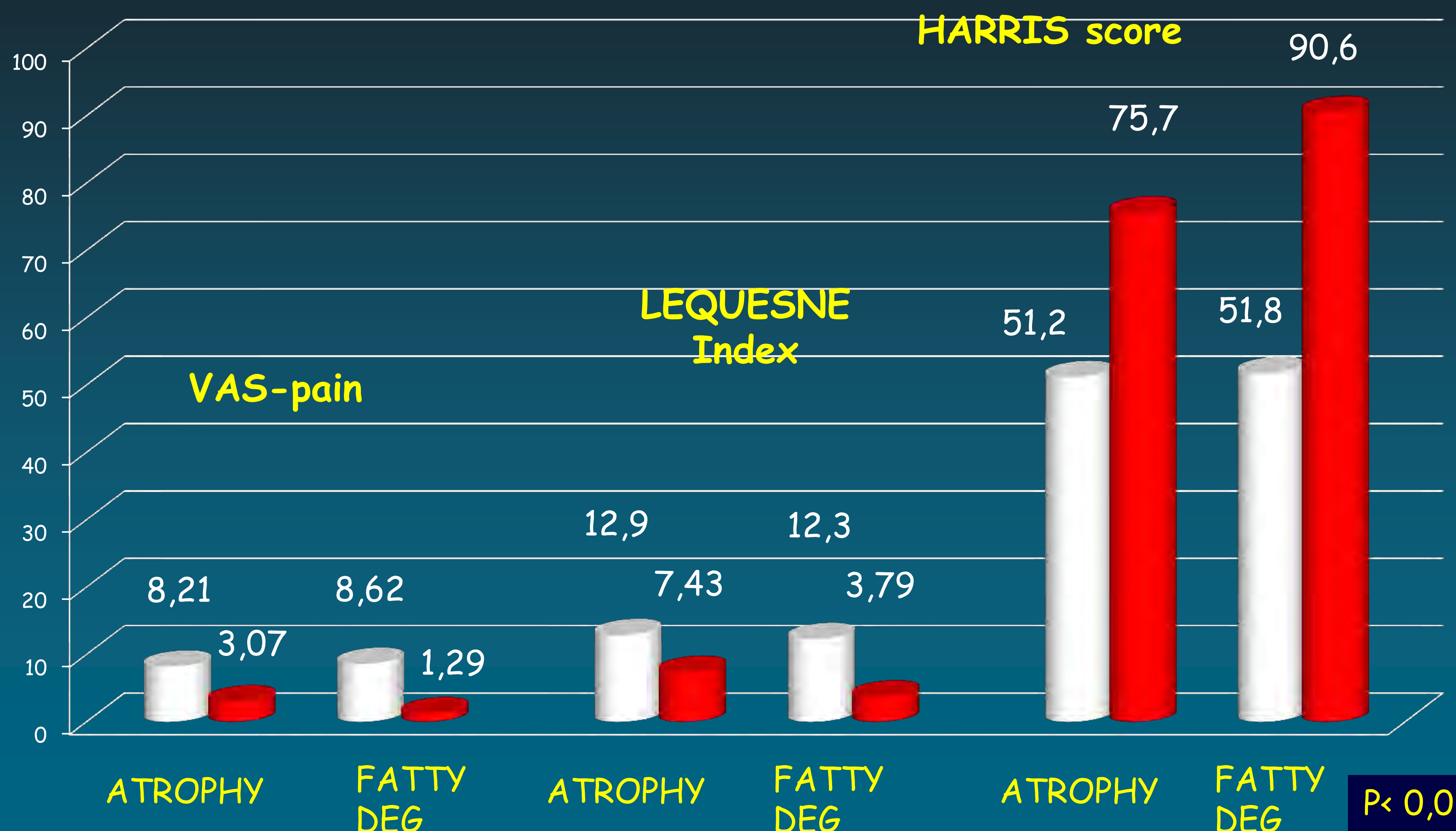
	ATROPHY 14 hips		NORMAL QUALITY 35 hips	
	Preop	Postop	Preop	Postop
VAS-pain	8,21	3,07	8,87	1,34
LEQUESNE Index	12,9	7,43	12,25	3,19
HARRIS score	51,2	75,7	49,3	90,7
Pain at high altit. steps	78,6%	21%	89,5%	8%
HANDICAP	90,5%	21%	95%	2,5%

P< 0,05

Analysis of the results

Possible risk factor

MUSCLE ATROPHY



P< 0,05

Analysis of the results

Possible risk factor

FATTY DEGENERATION

	Muscles with Fatty Deg. 21 hips		Normal muscles 35 hips	
	Preop	Postop	Preop	Postop
VAS-pain	8,62	1,29	8,87	1,34
LEQUESNE Index	12,3	3,79	12,25	3,19
HARRIS score	51,8	90,6	49,3	90,74
Pain at high altit. steps	76%	5%	89,5%	8%
HANDICAP	90%	0%	95%	2,5%

N.S.

Discussion

Diagnosis of exclusion

The application of specific diagnostic tests led to an accurate diagnosis

The Trendelenburg sign is not an accurate diagnostic test and this is probably due to the conservation of some fibers of GMe and/or GMi

Discussion

MRI $\rightarrow$ **diagnostic method of choice for the evaluation of the muscle atrophy and fatty degeneration**

Pan-pelvic T1-weighted and unilateral T2-fat saturated coronal, axial and sagittal small field views

Discussion

Age and BMI are probably not risk factors for the therapeutic prognosis of GMe/GMi ruptures

Fatty degeneration, especially stage I and II did not prove to be a risk factor

Muscular atrophy seems to negatively affect the treatment outcome and should be carefully evaluated before surgery

Conclusion

Using an open double-row technique to repair gluteal tendon tears led to 85% of patients having good clinical results with significant improvement in symptoms and disappearance of abnormal findings on MRI.

REFRACTORY CASES WITH PERSISTENT PAIN, POOR FUNCTIONAL STATUS AND NON-ATROPHIED GLUTEI MUSCLES ARE THE BEST INDICATION FOR THIS SURGICAL TREATMENT

References

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2. **Kong A, Van der Vliet A, Zadow S.** MRI and US of gluteal tendinopathy in greater trochanteric pain syndrome. *Eur Radiol 2007;17:1772-1783.*
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THANK YOU FOR YOUR PATIENCE

MERCI DE VOTRE PATIENCE

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY

The use of 3T MRI in diagnosing intra-articular hip pathology

Mr J. Lynch, Mr O. Diamond, Mr J O'Hara, Mr E Bache
Dr S. James, Mr C. McBryde

Royal Orthopaedic Hospital
Birmingham, UK

■ HIP

The prevalence of acetabular labral tears and associated pathology in a young asymptomatic population

A. J. J. Lee,
P. Armour,
D. Thind,
M. H. Coates,
A. C. L. Kang

From Christchurch Hospital, New Zealand

Acetabular labral tears and associated intra-articular pathology of the hip have been recognised as a source of symptoms. However, it is now appreciated that there is a relatively high prevalence of asymptomatic labral tears. In this study, 70 young asymptomatic adult volunteers with a mean age of 26 years (19 to 41) were recruited and underwent three tesla non-arthrographic MR scans. There were 47 women (67.1%) and 23 men (32.9%).

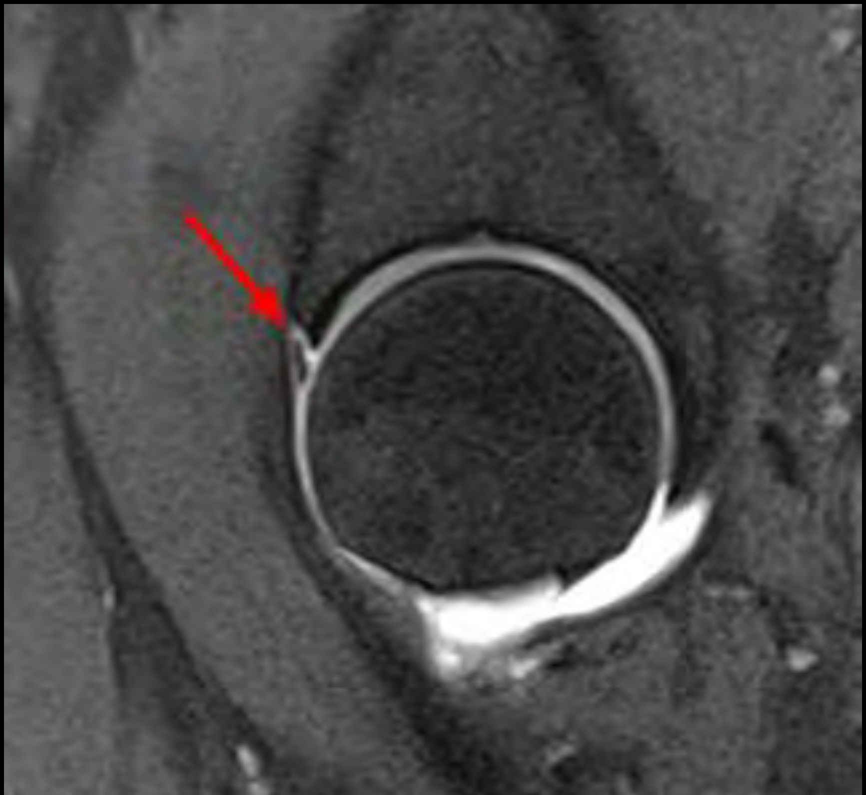
Labral tears were found in 27 volunteers (38.6%); these were an isolated finding in 16 (22.9%) and were associated with other intra-articular pathology in the remaining 11 (15.7%) volunteers. Furthermore, five (7.1%) had intra-articular pathology without an associated labral tear.

Given the high prevalence of labral pathology in the asymptomatic population, it is important to confirm that a patient's symptoms are due to the demonstrated abnormalities when considering surgery.

Cite this article: *Bone Joint J* 2015;97-B:623–7.

Background

- Magnetic Resonance Arthrogram (MRA) has been the gold standard imaging of the hip when investigating for acetabular labral tears



MRA Potential Disadvantages

- Intra-articular injection of contrast
  - Uncomfortable
  - Infection risk (1 in 40,000)
  - Allergic reaction (1 in 2000)
  - Contrast hinder

Case Report

Chondrolysis of the Hip following Septic Arthritis: A Rare Complication of Magnetic Resonance Arthrography

Barak Haviv,[1,2] Rafael Thein,[1,2] Alon Burg,[3] Snir Heller,[3] Shlomo Bronak,[1] and Steven Velkes[2,3]

Case Reports in Orthopedics
Volume 2013, Article ID 840681, 3 pages

MRI Potential Advantages

Eur J Orthop Surg Traumatol (2013) 23:335–344
DOI 10.1007/s00590-012-0972-5

ORIGINAL ARTICLE

The diagnostic test accuracy of magnetic resonance imaging, magnetic resonance arthrography and computer tomography in the detection of chondral lesions of the hip

Toby O. Smith · Michael Simpson · Vivian Ejindu · Caroline B. Hing

Meta-analysis 18 studies with 648 hips

MRI is superior to MRA in detection of chondral abnormalities of the hip

Eur Radiol (2011) 21:863–874
DOI 10.1007/s00330-010-1956-7

MUSCULOSKELETAL

The diagnostic accuracy of acetabular labral tears using magnetic resonance imaging and magnetic resonance arthrography: a meta-analysis

Toby O. Smith · Gemma Hilton · Andoni P. Toms · Simon T. Donell · Caroline B. Hing

- 19 papers with 881 hips
- MRI 13 studies
- MR arthrography 16 studies
- MRI (0.5-3T) MRA (0.5-3T)

- MRA appears to be superior to MRI for labral tears

Aim

- To assess the sensitivity and specificity of HRNC3T MRI in diagnosing labral tears in the ROH

Methods

Methods

- 100 consecutive hip arthroscopy patients
- Single surgeon
- All patients had HRNC3T MRI pre-op and no previous hip surgery
- Four Musculoskeletal Radiology Consultants
- Operation notes and MRI reports reviewed and analysed

HRNC3T MRI Protocol

- Initial PDFS axial of pelvis
- High resolution, small field of view PD fat suppressed axial oblique and coronal oblique of the hip (3mm)
- PD sagittal and T1 axial
- PDFS axial oblique and coronal oblique are the best sequences to assess the labrum, cartilage and CAM.

Results

Results

- 100 consecutive hip arthrocopy patients
- 1/12/14 to 31/8/15
- 68 female and 32 male patients
- Average time between scan and operation 8.4 months (<1 - 25 months)
- 4 Radiology Consultants involved in reporting
  - A - 24
  - B - 30
  - C - 30
  - D - 16

Results

- 84 acetabular labral tears were seen at hip arthroscopy
  - 60 of these were correctly identified on MRI

    (Sensitivity of 71.4%)

- 16 patients were found to have no labral tear at arthroscopy.
  - 14 MRI reports correctly reported this

    (Specificity 87.5%)

Results

- Great variation was seen between Radiologists.

	Sensitivity/Specificity:	Numbers
Radiologist A-	90.4% /100%	24
Radiologist B -	60.8%/71.4%	30
Radiologist C-	55.5%/100%	30
Radiologist D-	92.3%/100%	16

Results

- Great variation was seen between Radiologists.

	Sensitivity/Specificity:	Numbers
Radiologist A-	**90.4% /100%**	**24**
Radiologist B -	60.8%/71.4%	30
Radiologist C-	55.5%/100%	30
Radiologist D-	**92.3%/100%**	**16**

The Multidisciplinary Team Meeting

- Both Radiologist with higher accuracy participate in the YAH MDT
- Feedback loop
- High Volume does not equate to high standards without appropriate feedback

Cross-tabs

	TP +TN	FP + FN
MDT Radiologist	37	3
Non-MDT Radiologist	37	23

Radiologists who attended the YAH MDT reported labral pathology more accurately

The Fisher exact test statistic value is 0.000457.
The result is significant at $p < 0.01$.

Discussion

MR Arthrography of the Adult Acetabular Capsular–Labral Complex: Correlation with Surgery and Anatomy

Christian Czerny[1]
Siegfried Hofmann[2]
Michael Urban[3]
Christian Tschauner[4]
Andreas Neuhold[5]
Michael Pretterklieber[6]
Michael P. Recht[7]
Josef Kramer[1,8]

OBJECTIVE. Our purpose was to describe the appearance of the acetabular capsular–labral complex on MR arthrography and to correlate this appearance with surgical findings in adult patients and with gross anatomic findings in cadavers.

SUBJECTS AND METHODS. MR arthrography of the hip joint was performed in 40 patients and six cadavers. All patients underwent subsequent arthrotomy of the hip. MR arthrography consisted of a T1-weighted three-dimensional gradient-echo sequence in both the coronal oblique and sagittal oblique planes after intraarticular injection of a 2 mmol/l solution of gadopentetate dimeglumine. The normal and pathologic appearance of the capsular–labral complex was assessed, and the labra were evaluated on the basis of morphology, signal intensity, presence of a tear, and attachment to the acetabulum. MR arthrography findings were correlated with the surgical results in all patients and with the anatomic sections of the cadaveric hip joint specimens.

RESULTS. MR arthrography images of the T1-weighted three-dimensional gradient-echo sequences allowed visualization of the anatomic structures. The normal labrum was triangular, without any sublabral sulcus, and of homogeneous low signal intensity. A recess between the labrum and the joint capsule could be identified in instances in which no thickened labrum was present. Labral lesions included labral degeneration, a tear, or a detached labrum either with or without thickening of the labrum. The sensitivity for detection and correct staging of labral lesions with MR arthrography in the patient study was 91%; the specificity, 71%; and the accuracy, 88%.

CONCLUSION. MR arthrography with T1-weighted three-dimensional gradient-echo sequences allows excellent assessment of the normal and pathologic acetabular capsular–labral complex.

AJR:173, August 1999

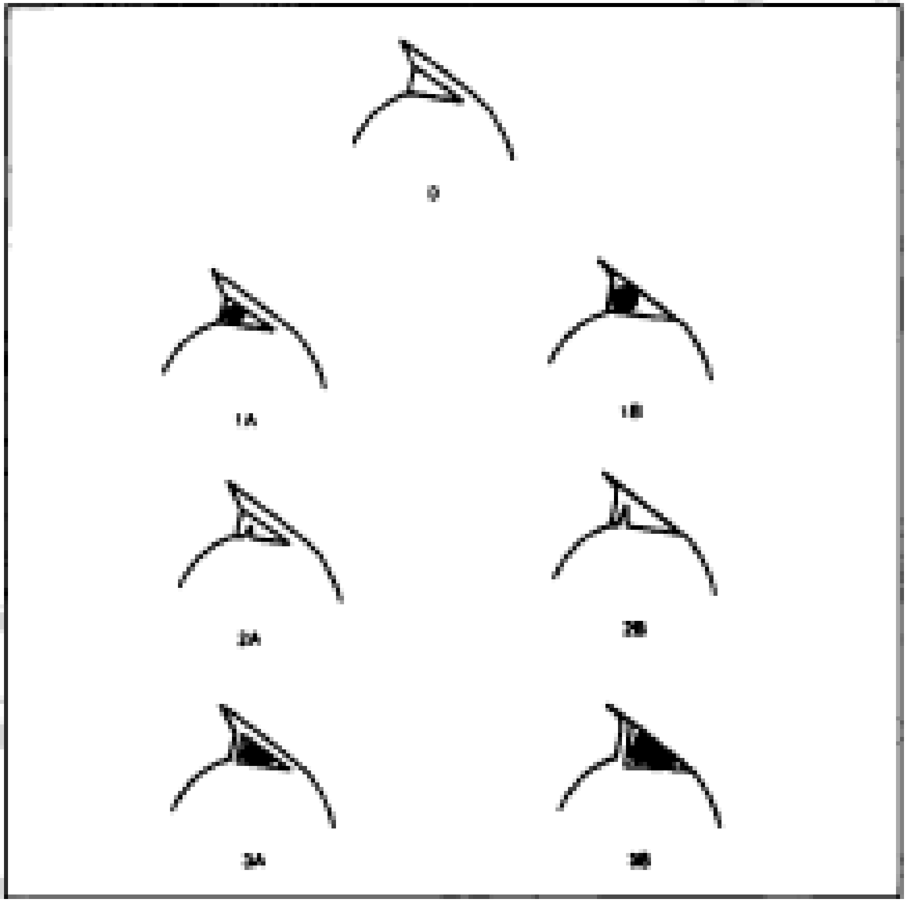


Fig. 1.—Drawing shows different types of acetabular labrum according to staging system described in Materials and Methods.

Magnetic Resonance Imaging of the Hip: Detection of Labral and Chondral Abnormalities Using Noncontrast Imaging

Douglas N. Mintz, M.D., Timothy Hooper, M.B.B.S., David Connell, M.B.B.S., Robert Buly, M.D., Douglas E. Padgett, M.D., and Hollis G. Potter, M.D.

Purpose: Traditional imaging techniques have limited ability to detect subtle chondral and labral injuries of the hip. We performed a retrospective review of patients who underwent magnetic resonance imaging (MRI) of the hip and subsequent hip arthroscopy in order to evaluate the ability of optimized, noncontrast MRI to identify tears of the acetabular labrum and defects in articular cartilage. **Type of Study:** Retrospective review of a consecutive sample. **Methods:** Between January 1997 and July 2000, 92 patients had MRI of the hip, followed by arthroscopic surgery of that hip by 1 of 2 surgeons (R.B., D.E.P.). Two musculoskeletal MR radiologists blinded to the initial MRI and surgical findings, independently interpreted the studies, looking for the location and degree of articular cartilage and acetabular labral pathology. **Results:** Of the 92 patients studied, each of 2 radiologists correctly identified 83 (94%) and 84 (95%) of the 88 labral tears present at surgery, respectively. There was 92% interobserver agreement on the MRI studies. For articular cartilage defects on the femoral head and acetabulum, there was good agreement (92% and 86% within 1 grade) between MRI and surgical grading and between the 2 MR readers (kappa of 0.8 for femoral head cartilage and 0.7 for acetabular cartilage). **Conclusions:** This study shows that noncontrast MRI of the hip, using an optimized protocol, can noninvasively identify labral and chondral pathology. Such information may facilitate deciding which patients warrant surgical intervention, thus preserving hip arthroscopy as a therapeutic tool. **Level of Evidence:** Level II, Development of Diagnostic Criteria Study. **Key Words:** Acetabular labrum—Articular cartilage—Cartilage—Hip—Labrum—Magnetic resonance imaging.

Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 21, No 4 (April), 2005: pp 385-393

Examination of acetabular labral tear: a continued diagnostic challenge

Michael P Reiman,[1] Richard C MatherIII,[2] Thomas W Hash II,[2] Chad E Cook[3]

Br J Sports Med 2014;48:311–319

- History
- Examination
- Appropriate and combined radiology
- Diagnostic injection

Conclusions

Conclusions

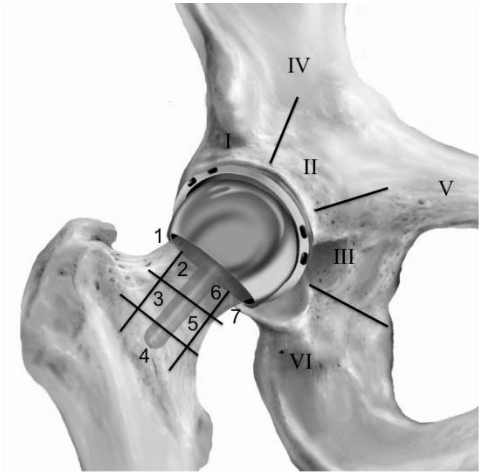
- HRNC3T MRI can be a reliable and accurate method of assessing the labrum
- Everybody has a different ‘Spin’ !
- Practice Audit is essential to ensure standards
- MDT benefits
- Future work needs to give description of normal and pathological labral morphology in hip HRNC3T MRI

INTERNATIONAL COMBINED MEETING

BRITISH HIP SOCIETY
SOCIETÀ ITALIANA DELL'ANCA

26-27 NOVEMBER 2015

MILAN, ITALY



RADIOGRAPHIC EVALUATION OF HIP RESURFACING: VALIDATION OF A NEW ZONAL SYSTEM

Sensitivity and specificity in detecting high wear

Catherine Van Der Straeten[1], Alessandro Calistri[2], George Grammatopoulos, Damien Van Quickenborne[2], Bart De Roest[2] Koen De Smet[2]

[1]MSK Lab, Department of Surgery and Cancer, Imperial College, London, UK

[2]ANCA Medical Centre, Ghent, Belgium

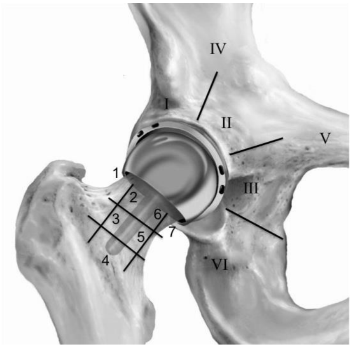
BHS-SIDA meeting Milan 2015

RADIOGRAPHIC EVALUATION OF HIP RESURFACING: VALIDATION OF A NEW ZONAL SYSTEM

Sensitivity and specificity in detecting high wear

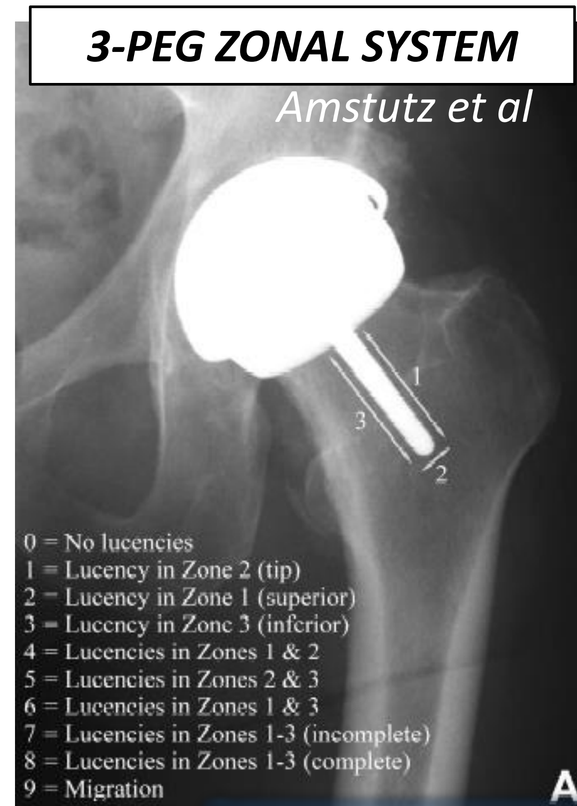
Presenter: Catherine Van Der Straeten, MD, PhD

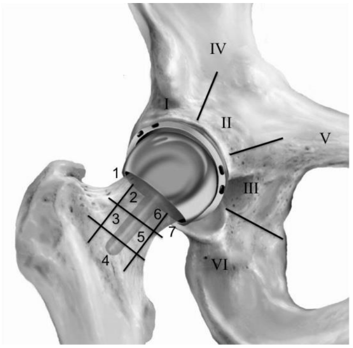
The authors declare that the research for and communication of this independent body of work does not constitute any financial or other conflict of interest.



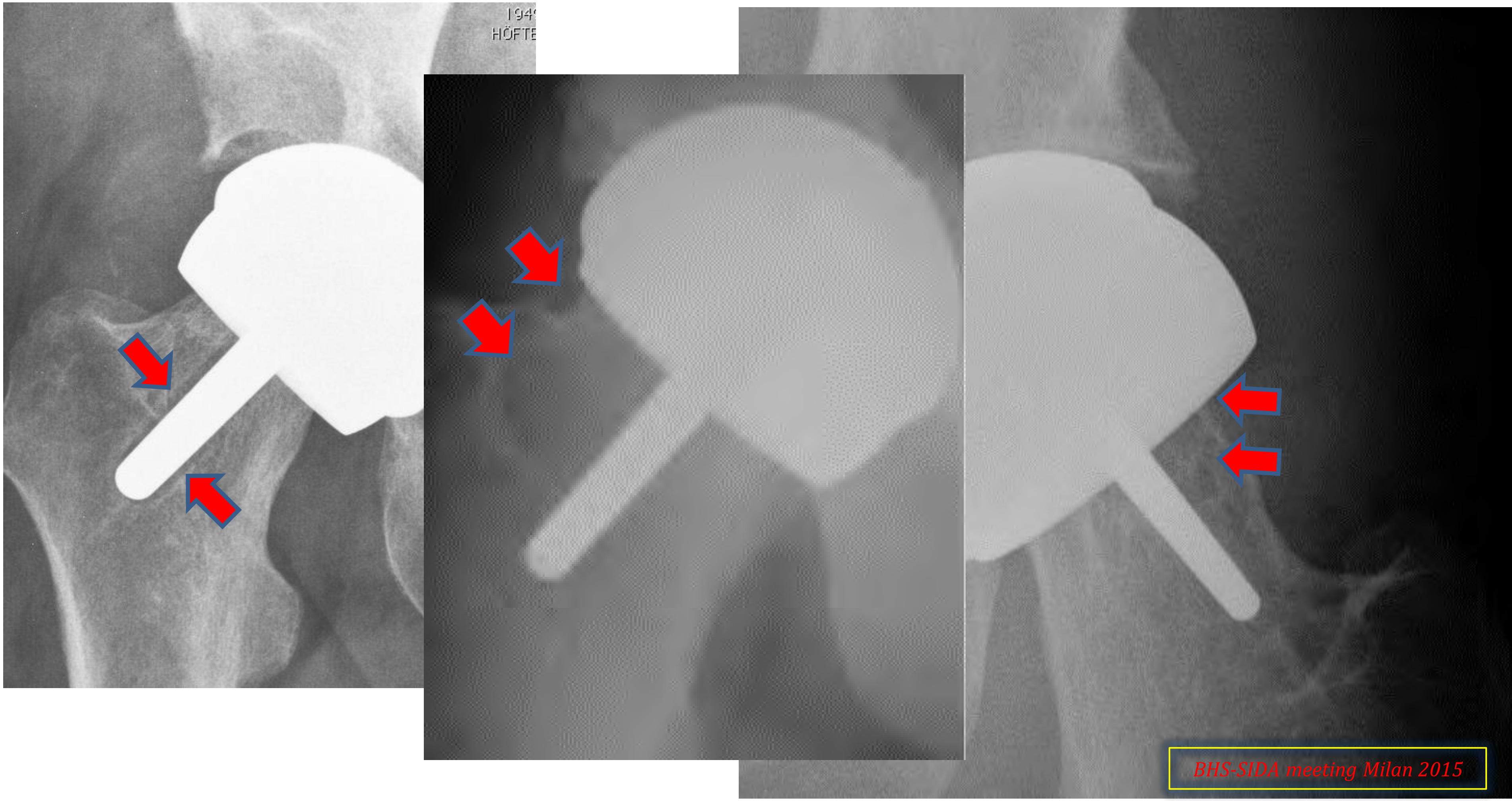
Introduction

- Hip Resurfacing requires new XRay evaluation protocol
- Acetabular component similar to THA
- Femoral component different:
  1. no implant in femoral canal
  2. metallic femoral head overlies and obscures junctions bone-cement and cement-prosthesis



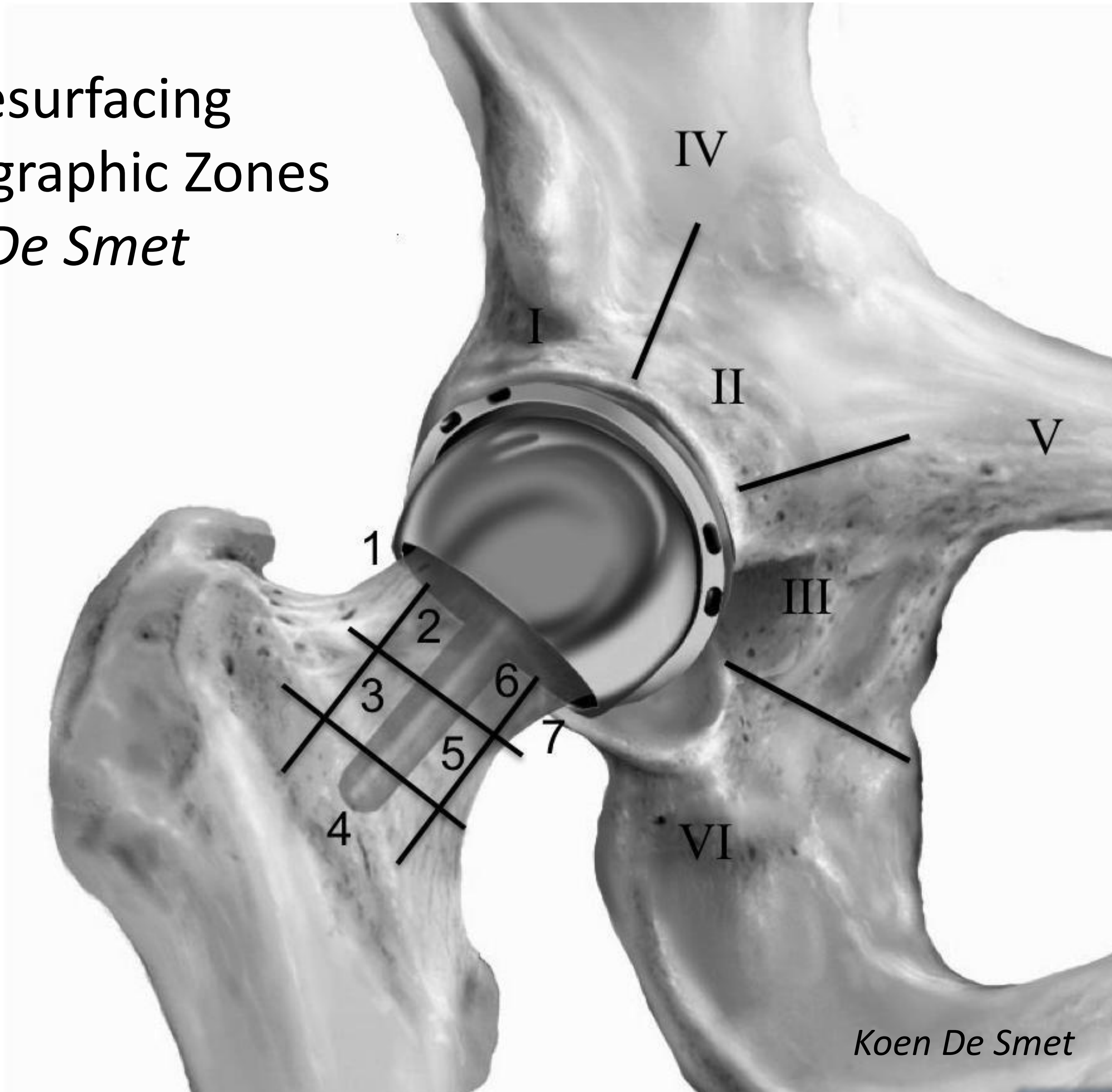


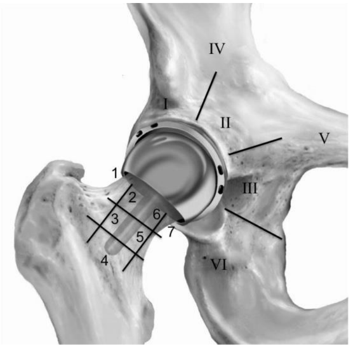
Femoral Component Evaluation



Hip Resurfacing Radiographic Zones

Koen De Smet





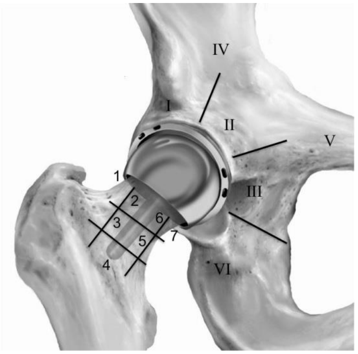
Study Objectives

Recommended screening tools for FU of MoM HA:

- Metal ions & cross-sectional imaging (US – MRI)

But: XRays = easy/cheap traditional FU method ⇒

- Test the efficacy of radiographs in identifying a problem with a resurfaced hip
- Correlate radiographic features with outcome



Patients and Methods

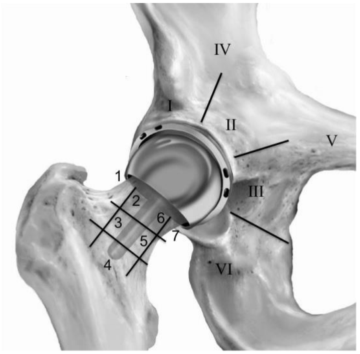
Retrospective study: Radiographic evaluation of

- 711 hip resurfacings (HRA) of 10 different designs
- 611 in situ (surgeon KDS) min 2 Xrays at >12mos
- 100 revised (45 primary KDS - 55 referrals)

Clinical evaluation: Harris Hip Score (HHS)

Metal ion measurements (Cr – Co serum - ICP-MS)

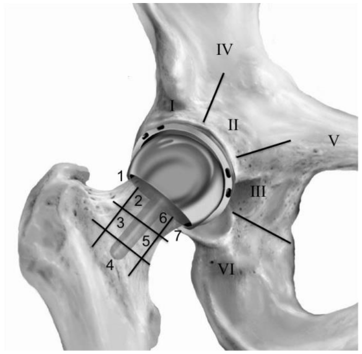
Adverse local tissue reactions (ALTR): intraop - MRI



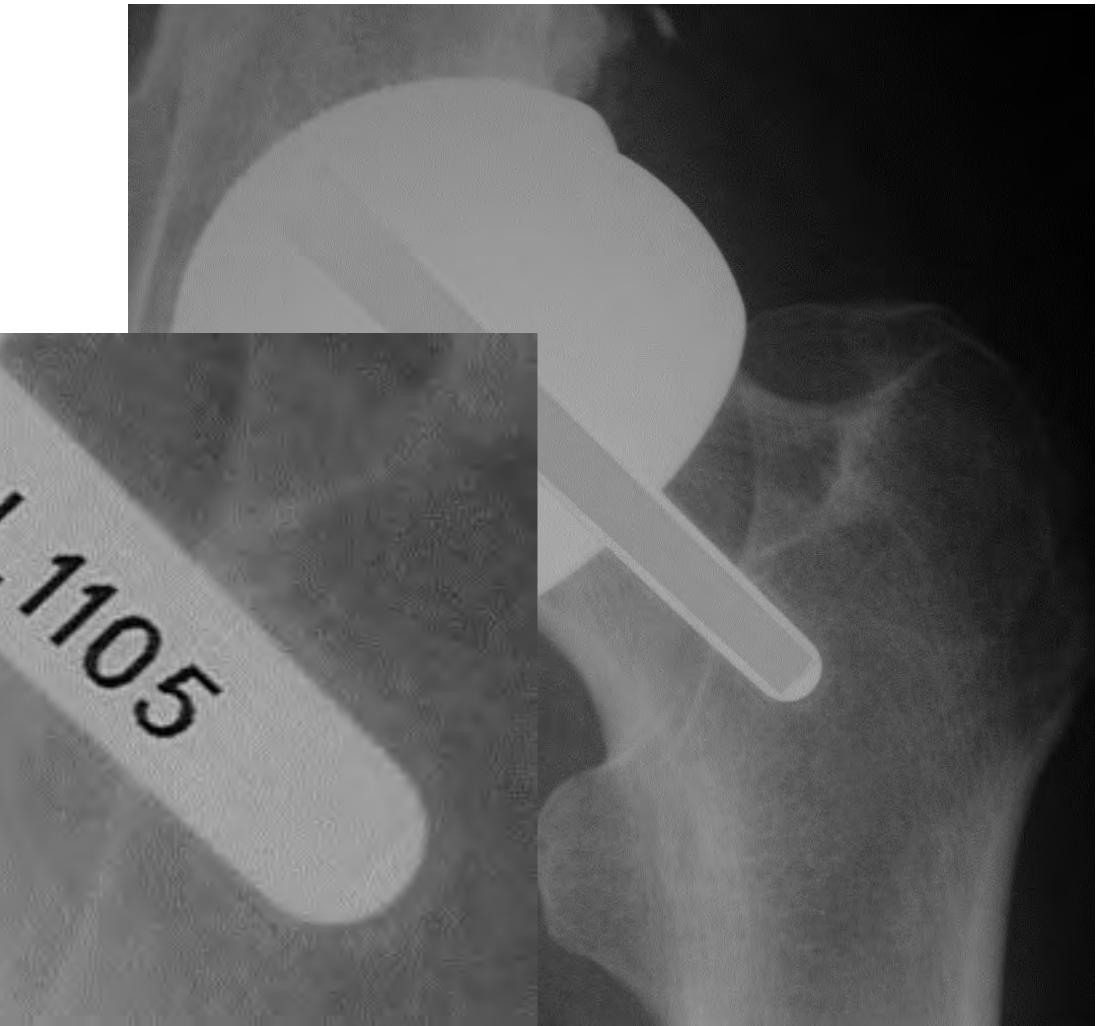
Classification of radiographic patterns

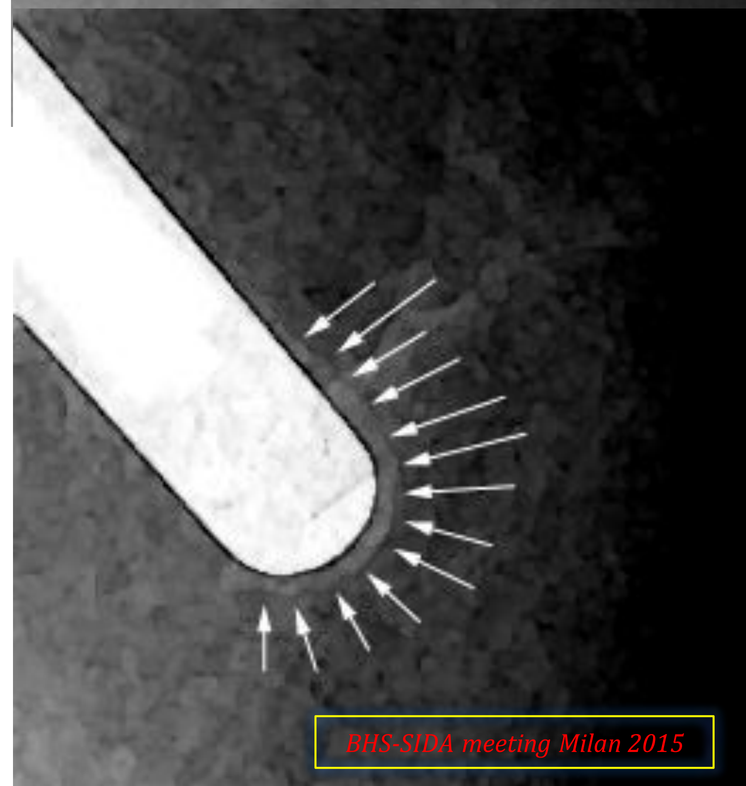
- **NORMAL** = no findings

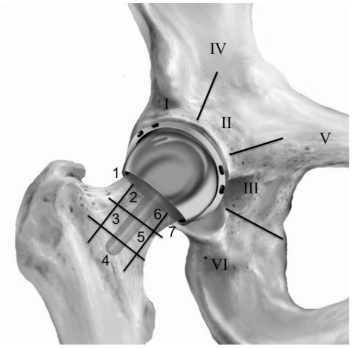
- **BORDERLINE**: findings *not considered* pathological when stable and not associated with migration
  > reactive lines (sclerotic lines – pedestal sign)
  > cortical thickening
  > cortical remodelling following impingement
  > cancellous condensation



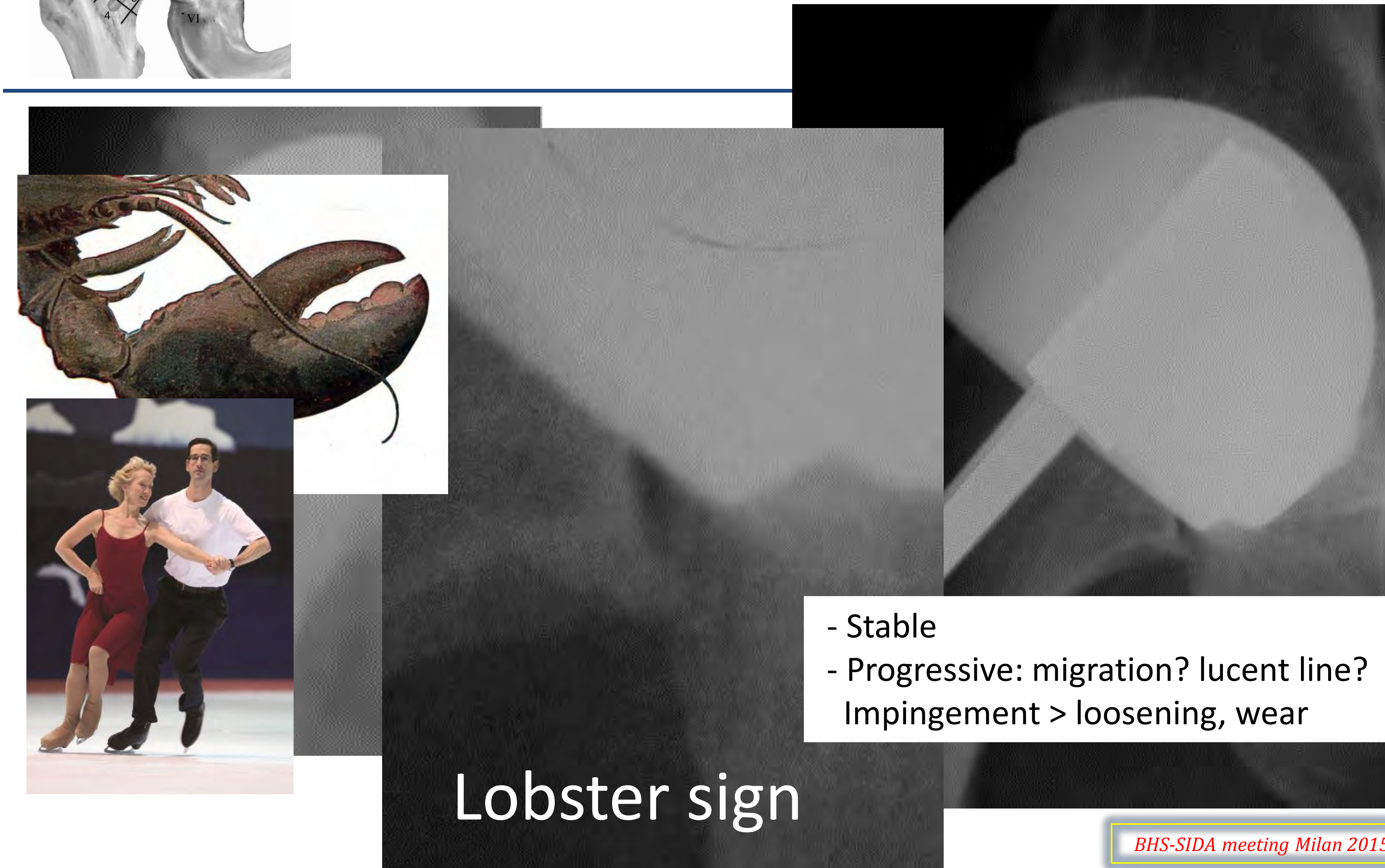
Reactive lines –



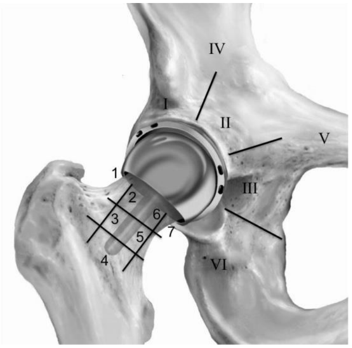




Borderline: Impingement signs

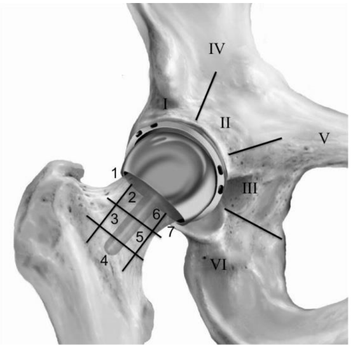


- Stable
- Progressive: migration? lucent line?
  Impingement > loosening, wear

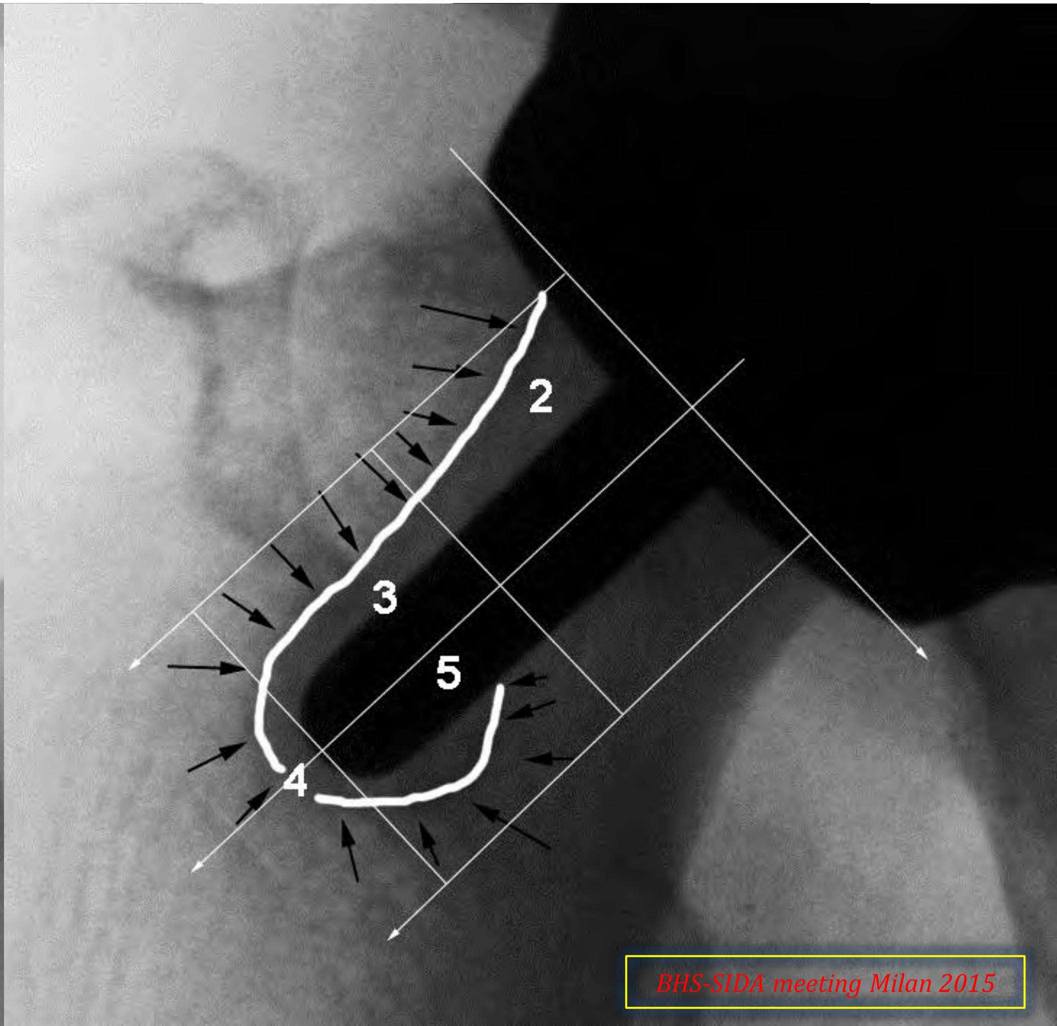


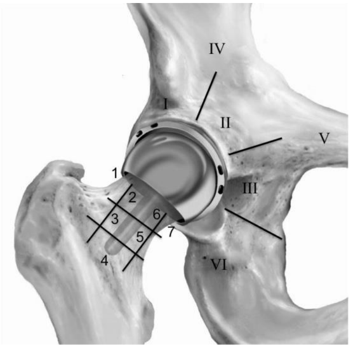
Classification of radiographic patterns

- **SINISTER:** findings considered pathological
  - > Lucent lines: 1mm, 2mm, 3mm
  - > Osteolytic areas
  - > Cancellous bone radiolucency
  - > Cortical resorption

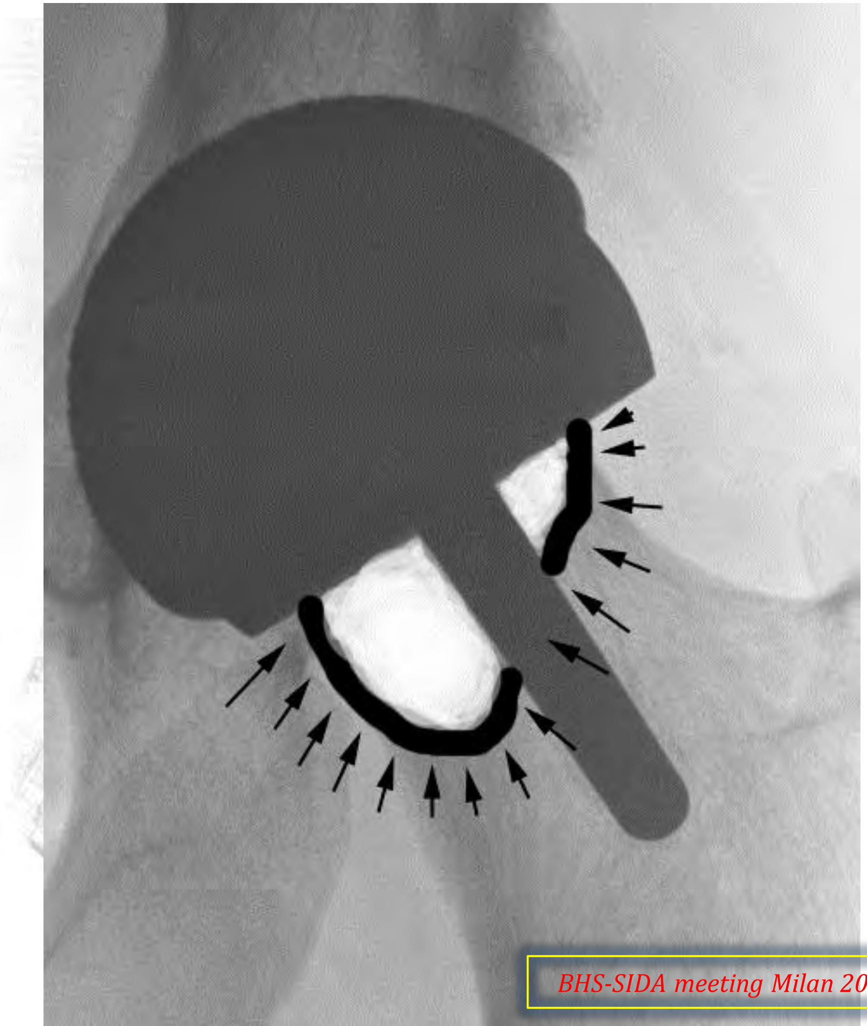


Lucent lines





Osteolysis



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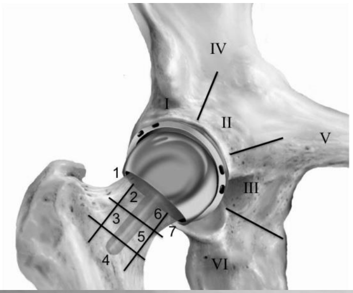
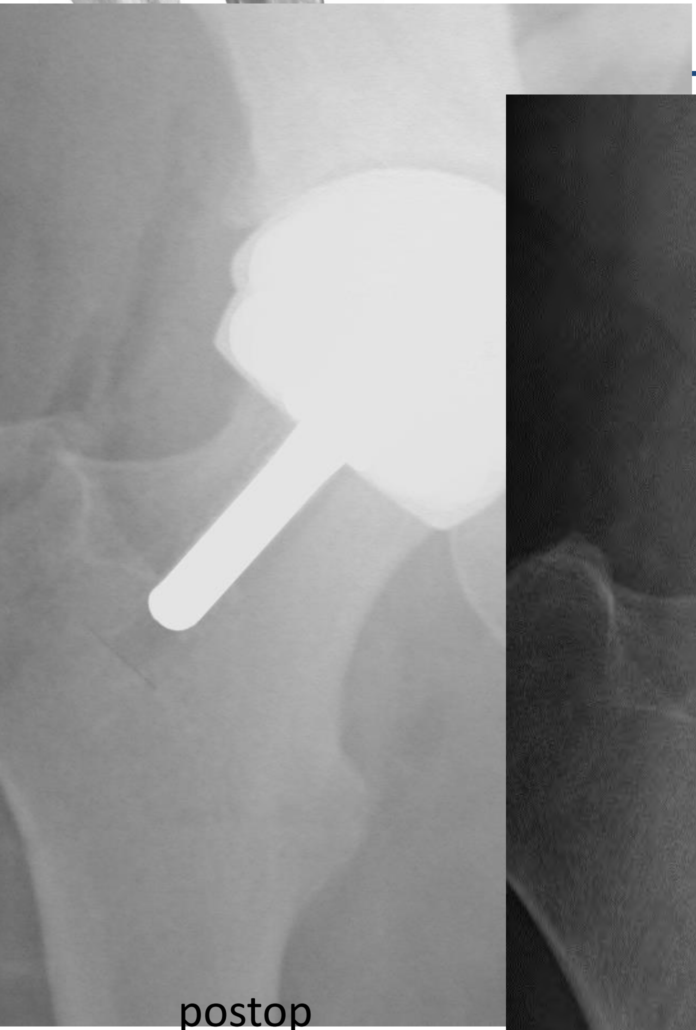
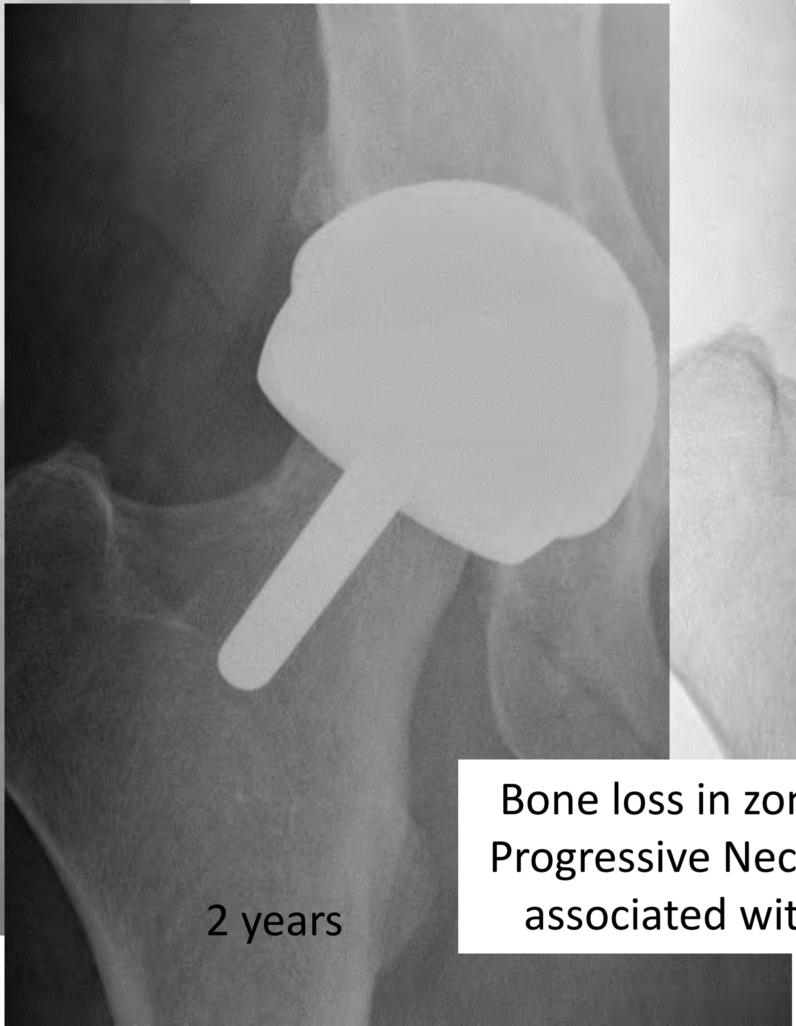
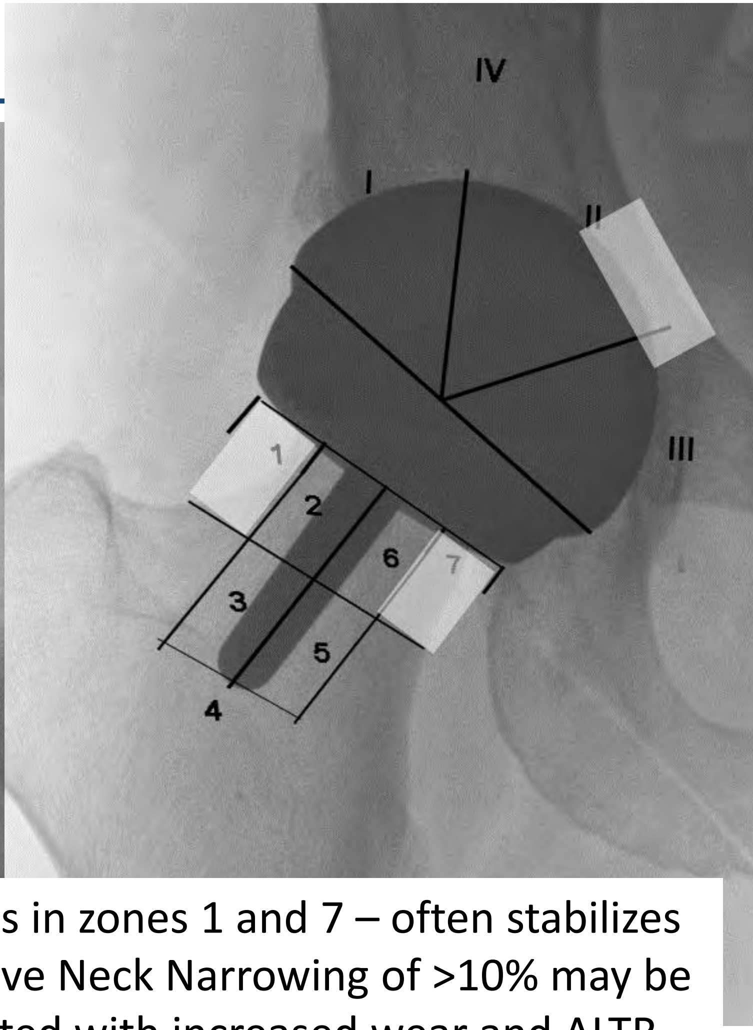


Neck narrowing







Bone loss in zones 1 and 7 – often stabilizes
Progressive Neck Narrowing of >10% may be associated with increased wear and ALTR

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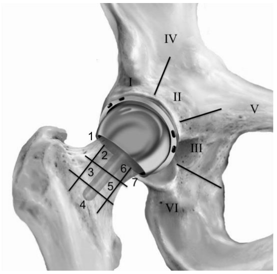
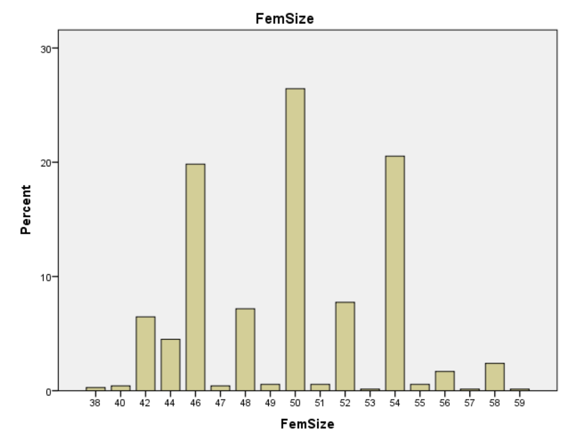


Results: Demographics

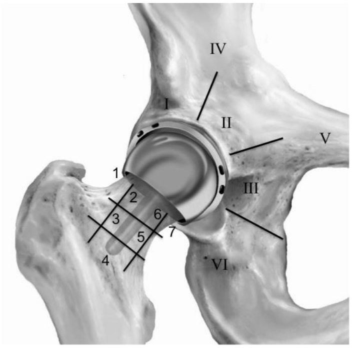
- 711 HRA in 703 patients (8 bilateral HRA)
- Mean age : **53 yrs** (29-70)
- 439 Males (**62.4%**) – 264 Females (**37.6%**)
- 10 HRA designs: BHR **62%**, Conserve plus **23%**, ASR **3.8%**
- Femoral comp. size: Mean **49.5mm**

  <50mm: 39% - ≥50mm: 61%



- Follow-up: mean **40 mos** (12-144)
- Harris Hip score last follow-up

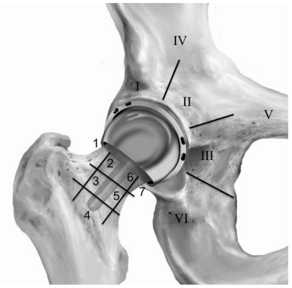
  mean **95.1** (median 100 – range 25-100)



Results: Revisions

- Total n = 100 HRA : 39 M – 57 F (4 bilat revisions)
- 45 primary KDS – 55 referrals (primary HRA elsewhere)
- Reasons for revision: (no fractures: early/1 Xray)
  - Component malpositioning: 50 (47 cups)
  - Component loosening: 22
  - Impingement: 4
  - Infection: 8
  - Metal sensitivity: 8
  - High ions ± pain: 7

Soft tissue reaction (ALTR): n = 52
Pronounced Metallosis: n = 38



Results

Radiological Patterns

Changes: n = 265 (**37.3%**)

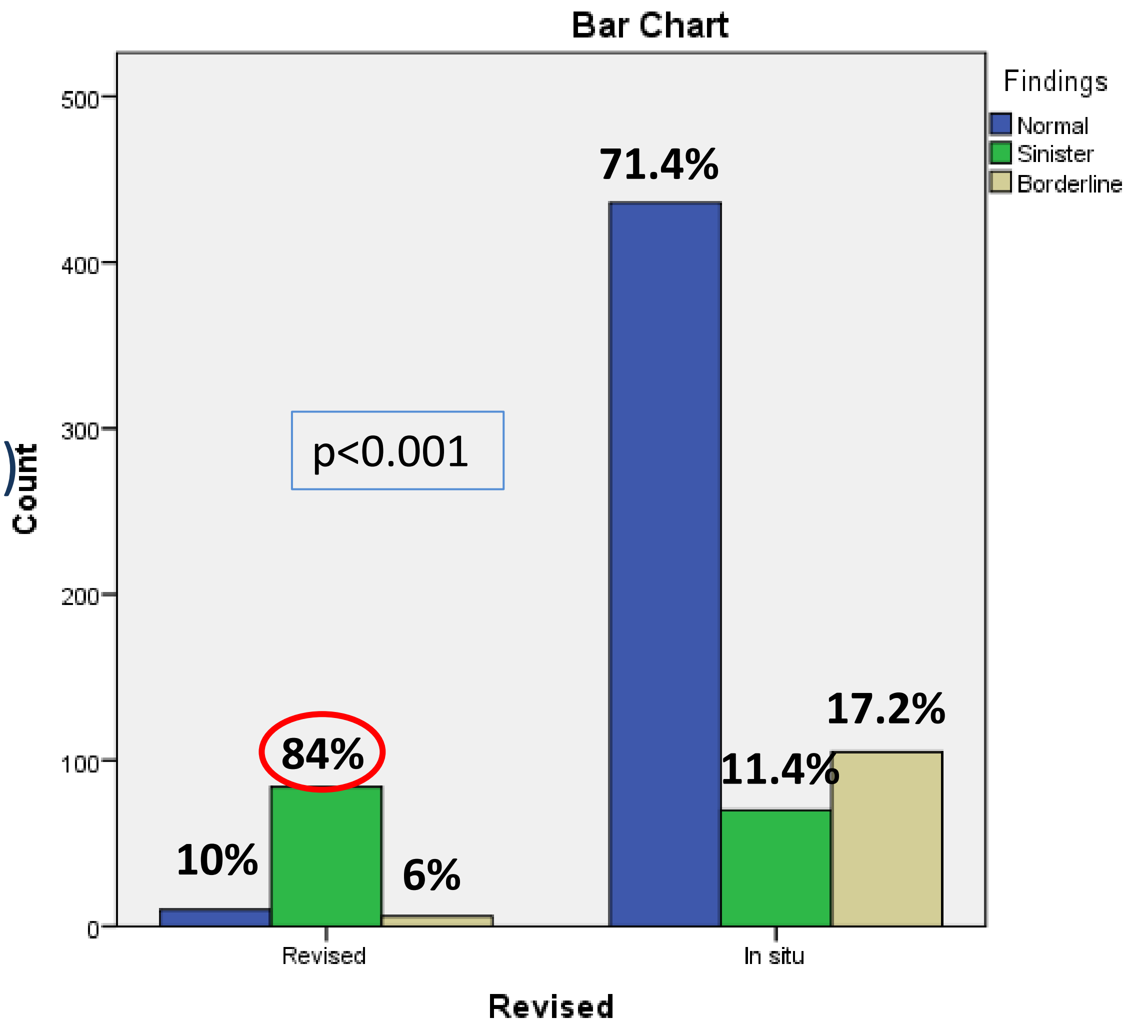
- Borderline: n = 111 (15.6%)
- Sinister: n = 154 (**21.7%**)

Mean follow-up: no difference

Revised: 36.4 months

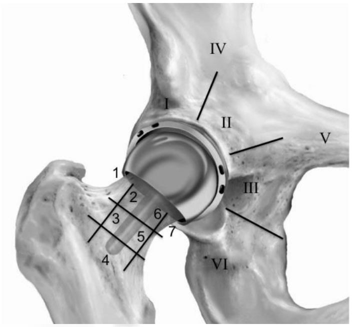
In situ: 40.7 months p=0.107

No difference in follow-up times between findings: p = 0.172

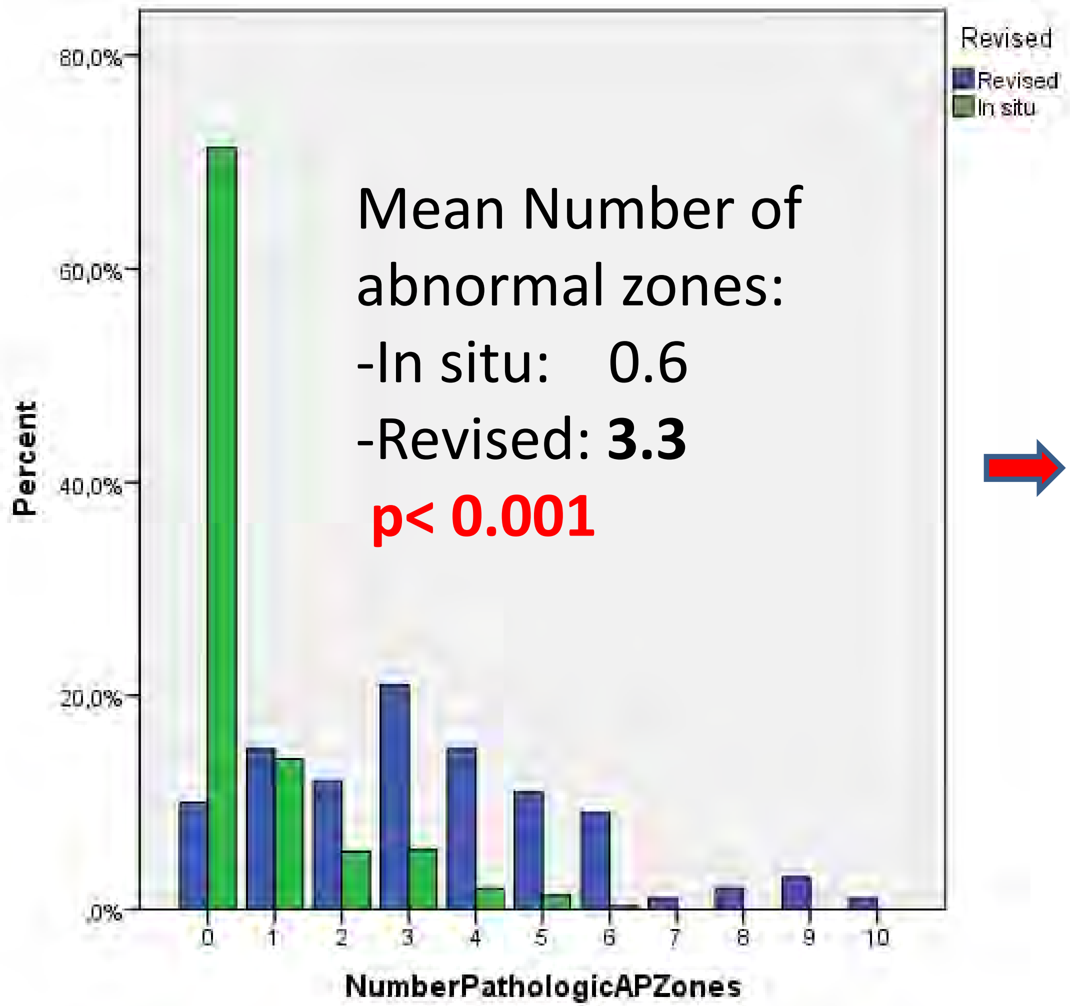


Count

		Findings			
		Normal	Sinister	Borderline	Total
Revised	Revised	10	84	6	100
	In situ	436	70	105	611
Total		446	154	111	711



Number of zones with abnormal findings



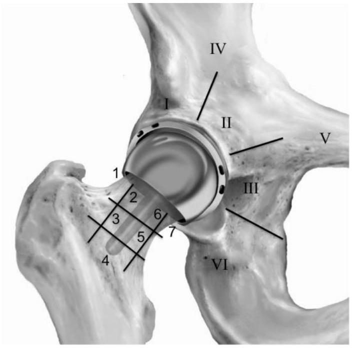
Mean Number of abnormal zones:

-In situ: 0.6

-Revised: **3.3**

p< 0.001

Nr Zones	In Situ	Revised
0	**71.4%**	**10%**
1	14.1%	15%
2	5.4%	12%
3	5.6%	21%
4	**7.3%** **2%**	**42%** **15%**
5	**1.3%**	**11%**
6	**3%**	**9%**
7	**0**	**1%**
8	**0**	**2%**
9	**0**	**3%**
10	**0**	**1%**



Radiological patterns vs Clinical Outcome (HHS) – Implant position

Mean Harris Hip Scores:

Overall p<0.001

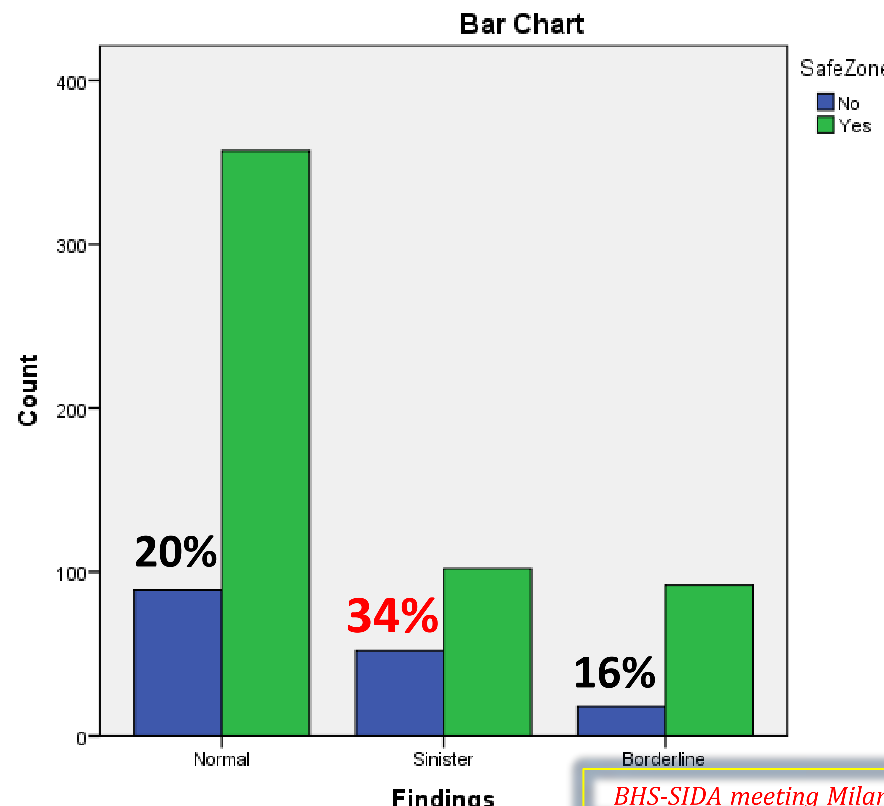
Normal: 98.11

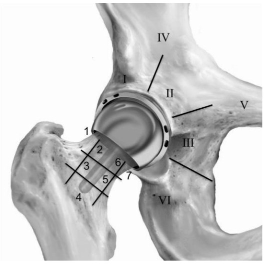
Borderline: 96.23

Sinister: 85.36

Acetabular position safe zone

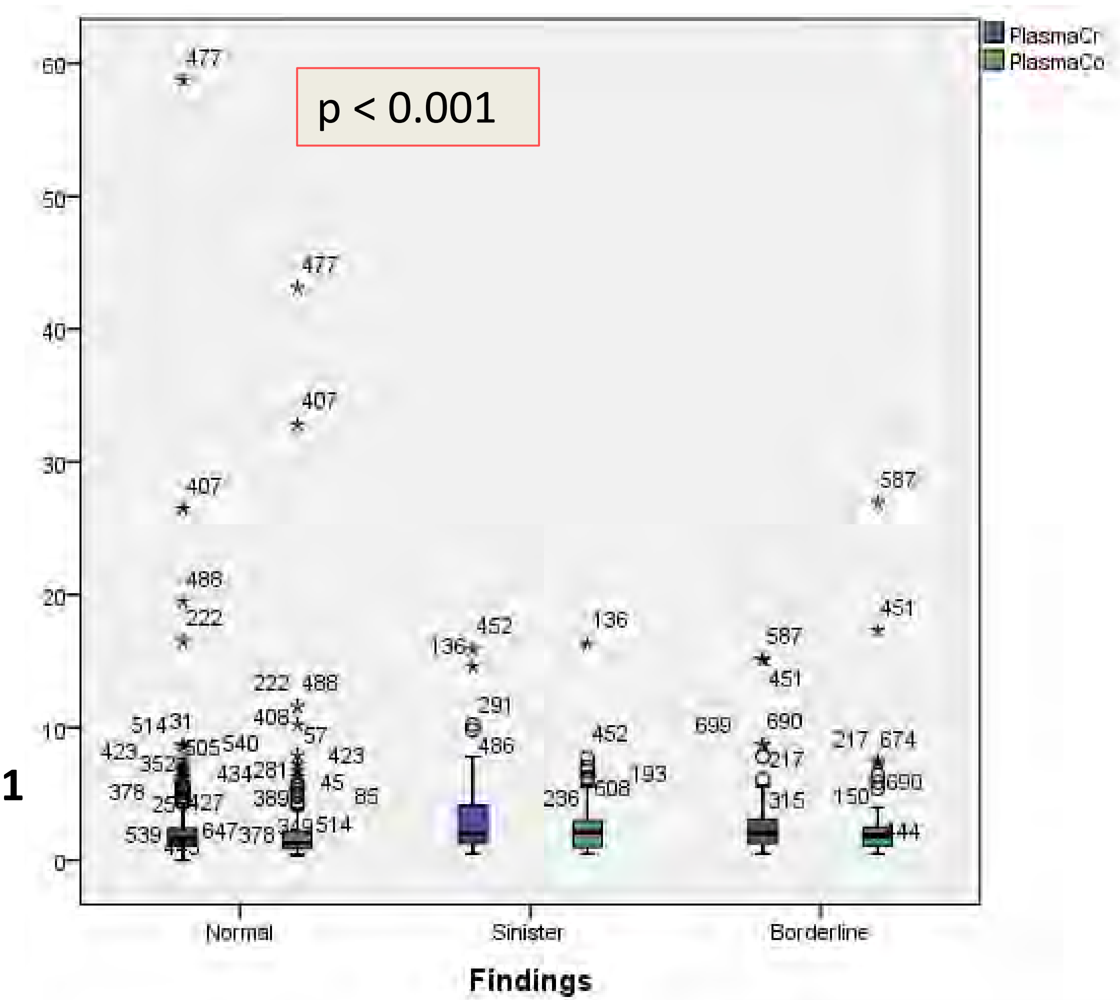
p<0.001





Radiological patterns vs Metal Ion Levels

	Cr µg/l	Co µg/l
Normal Mean	2.55	2.23
Median	1.60	1.40
Sinister Mean	17.43	17.50
Median	3.95	2.85
Borderline Mean	3.35	3.06
Median	2.00	1.90



Sinister vs normal/borderline: **p<0.001**
Borderline vs normal: p=0.01

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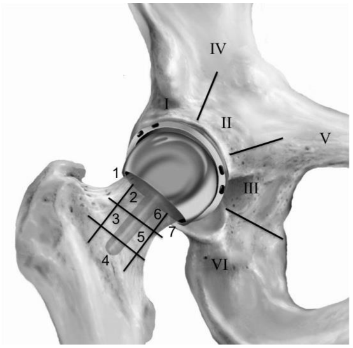
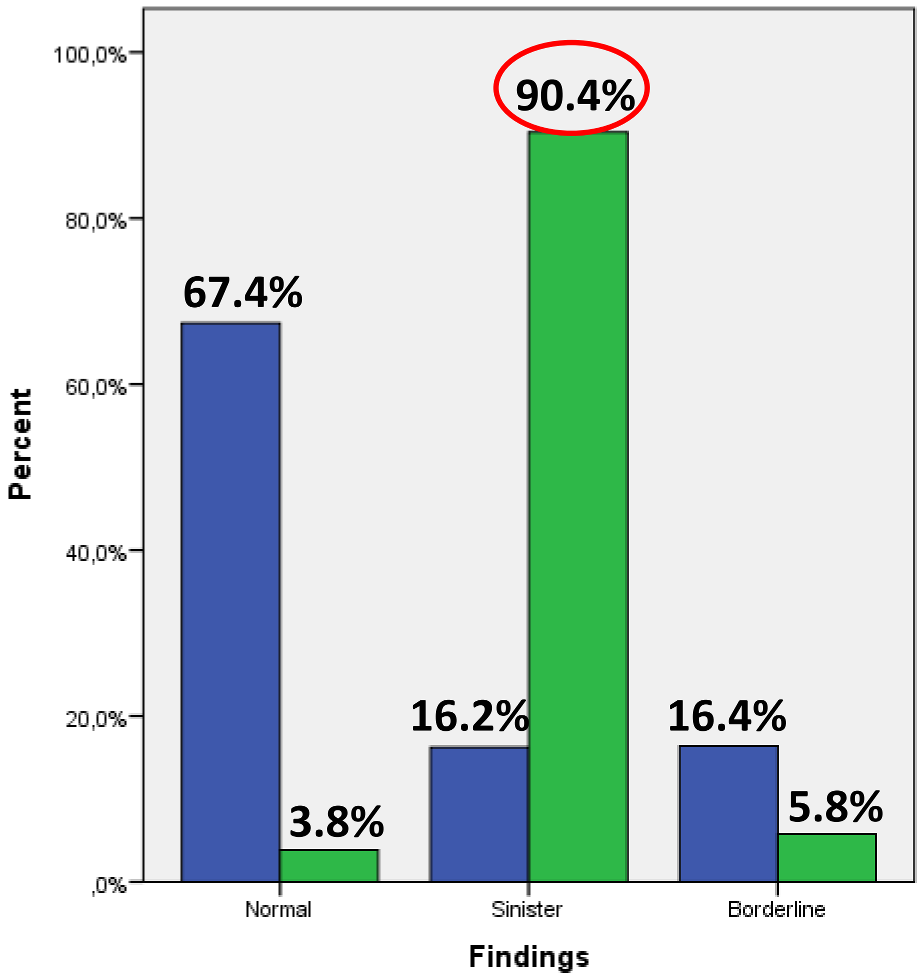


Radiological patterns vs Soft Tissue Reactions



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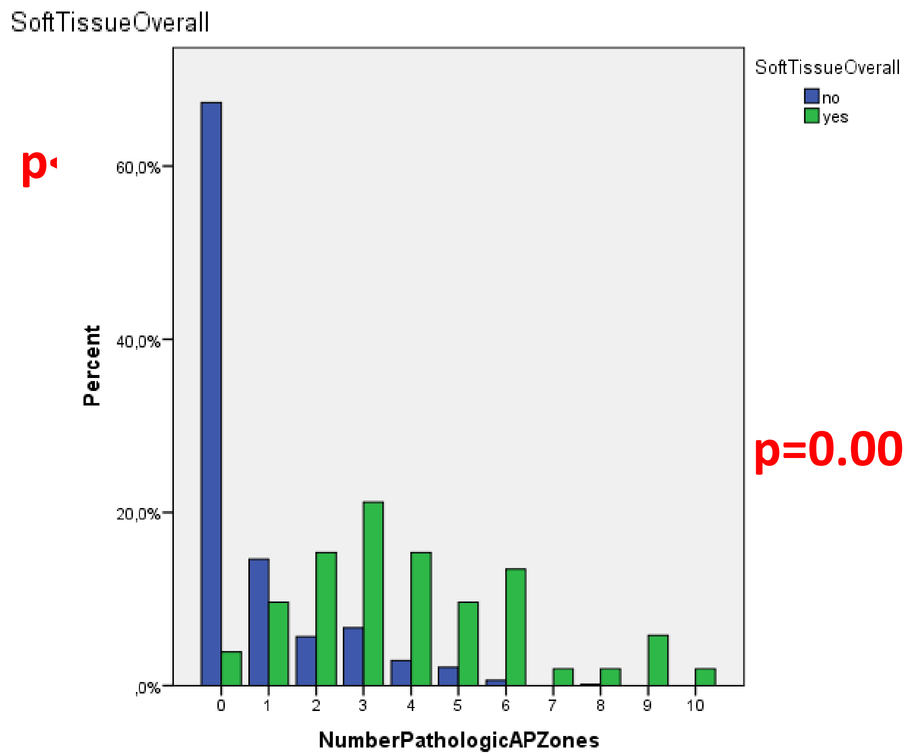
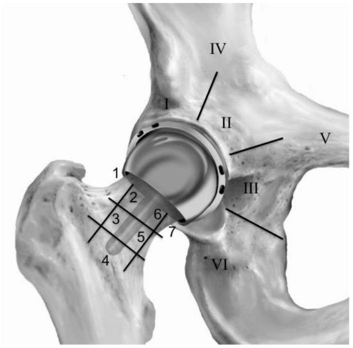
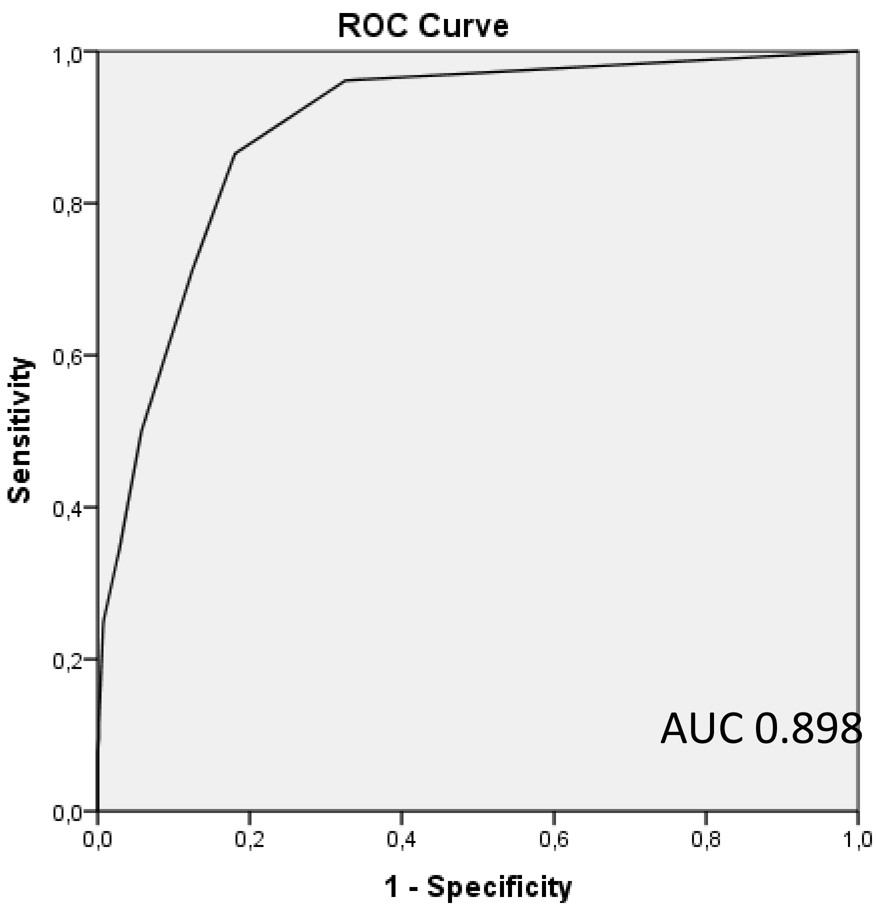


p=0.006



Predictive value of radiographs

ROC Analysis: Number abnormal zones ⟶ ALTR?

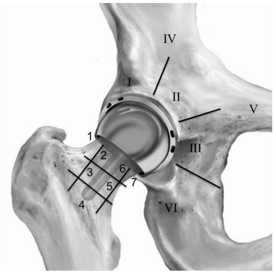


Diagonal segments are produced by ties.

Radiographic findings in **3.5 zones**:

Sensitivity 50% } in detecting hips
Specificity 94.2% } with ALTR

ODDS RATIO of a HRA
with sinister findings in ≥ 4 zones
having a soft tissue reaction
= 49



Conclusions

- Accurate evaluation of progressive changes: assessment in 3 (6) acetabular - 7 femoral AP zones
- Sinister changes in 84% of problematic hips

  90.4% of proven ALTR
- Abnormal in ≥4 zones (3.5) > 94% specificity ALTR
- High correlation of radiographic patterns with clinical outcome and metal ion levels
- Normal Xray does not mean ‘No problems’ → Clinical, metal ions, cross-sectional imaging

Thank You