

Metal on Metal Total Hip Replacements

Getting the Facts

Dr Anthony Leong

Question

Click on all true statements

1. Metal on metal hip replacement are only have only been used in the past decade
2. Most metal on metal hips need revision
3. Elevated serum cobalt levels regularly causes systemic side effects
4. Resurfacing hip replacements are not metal on metal hip replacments

Common Bearings in Hip Replacement



CoCr on Polyethylene



Ceramic on Polyethylene



Ceramic on Ceramic



Metal on Metal
(Cobalt Chrome Alloy)

History

- McKee – Farrar THR
 - First used in 1960
 - First widely used and successful THR
 - Cobalt chromium alloy
- Since then metal on metal articulations have been used continuously for THR





Resurfacing THR

1. Minimal bone resection
2. Minimal risk of dislocation
3. Restores normal anatomy
4. Lower wear rate
5. Lower osteolysis rate
6. Easy revision



1. Minimal bone resection



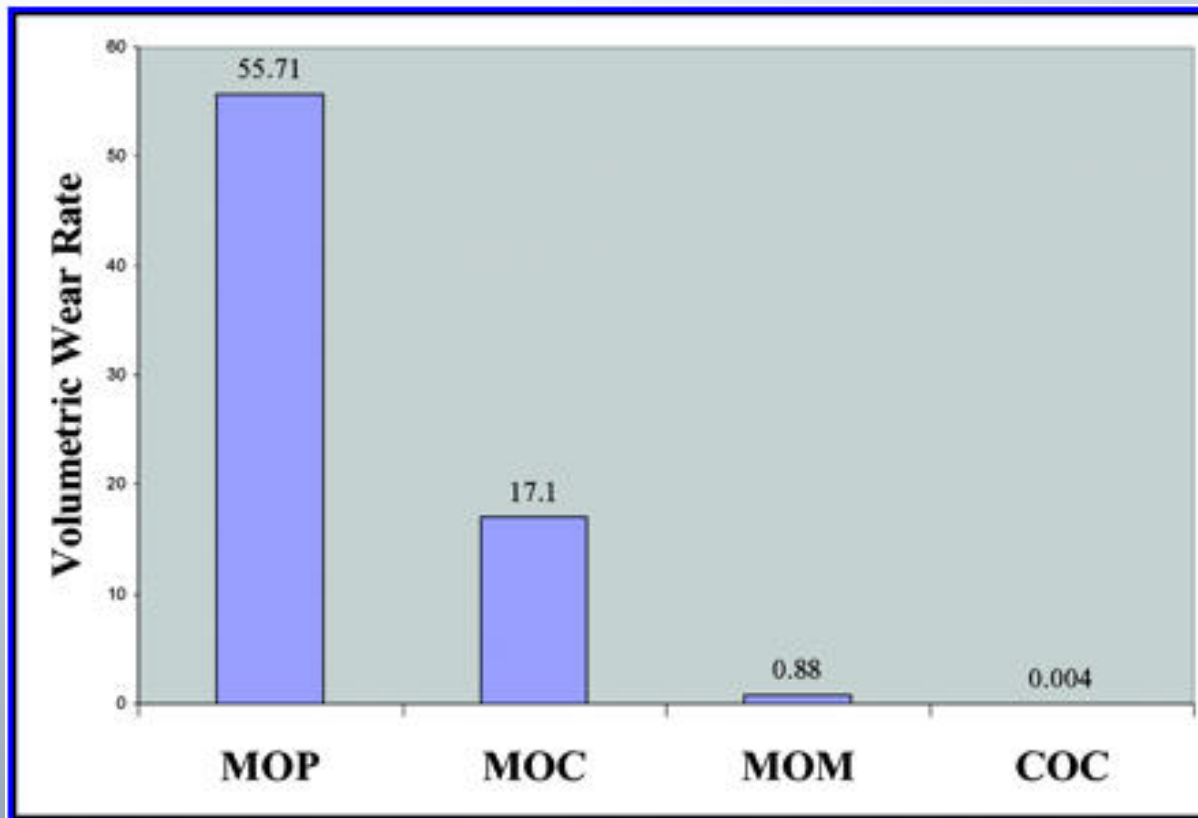
- THR
 - Femoral neck osteotomy
 - Ream femoral canal
 - Broach canal
- Resurfacing
 - Remove femoral articular surface

Why Consider MOM THR?

- To deal with the major problems with THR
 - Wear
 - Dislocation
 - Fracture

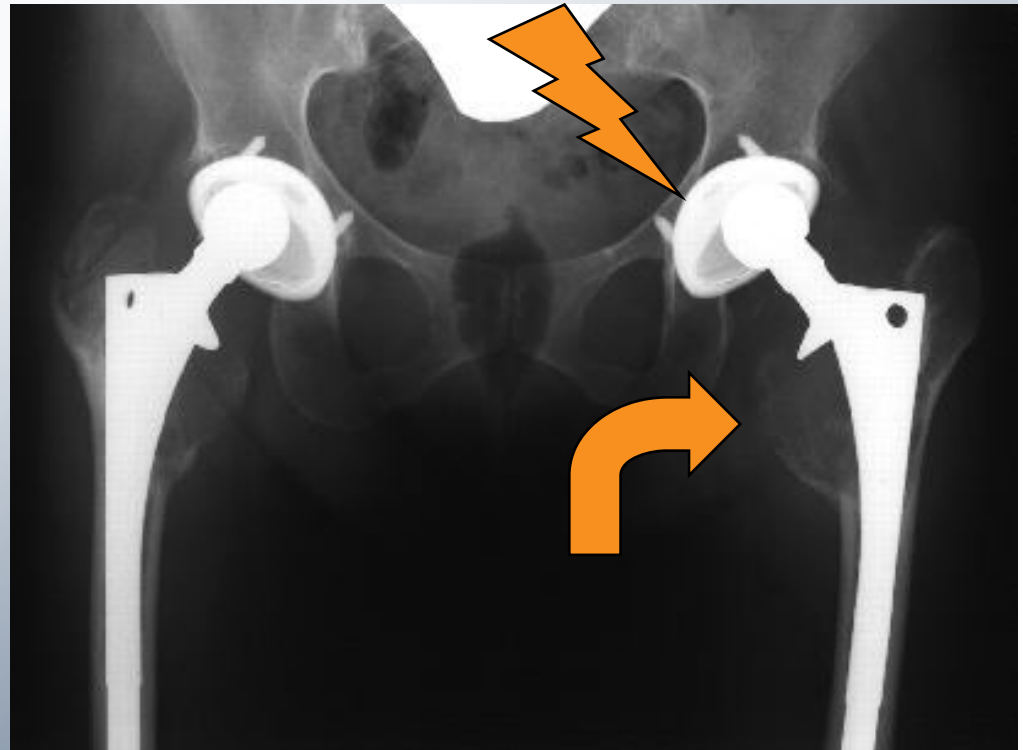
Minimal wear

- 0.8mm^3 volumetric wear/ year
- (60-200x ↓ volumetric wear)



Reduced Wear = Reduced osteolysis

- Wear debris
 - Osteolytic reaction
 - Lysis of bone
 - Loosening of prosthesis

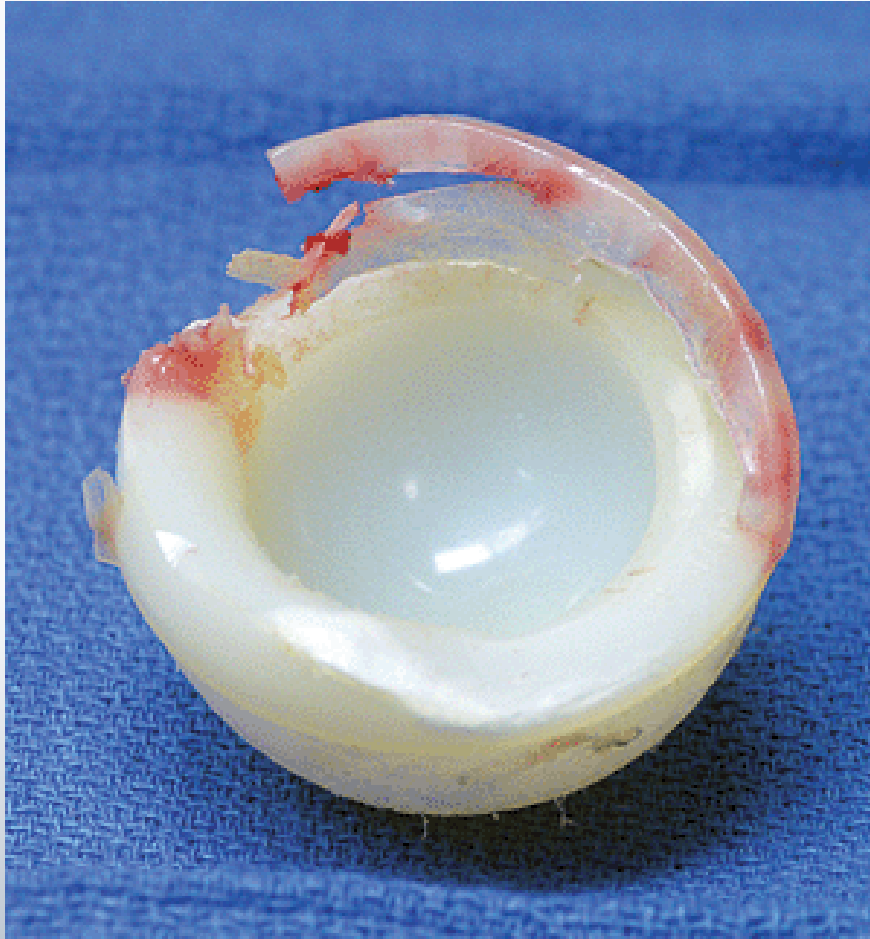


Minimal risk of dislocation

- Resurfacing THR (or large head metal on metal)
 - 0.2%
- THR
 - 3.9%
 - (1.5% if >50 THR / year)

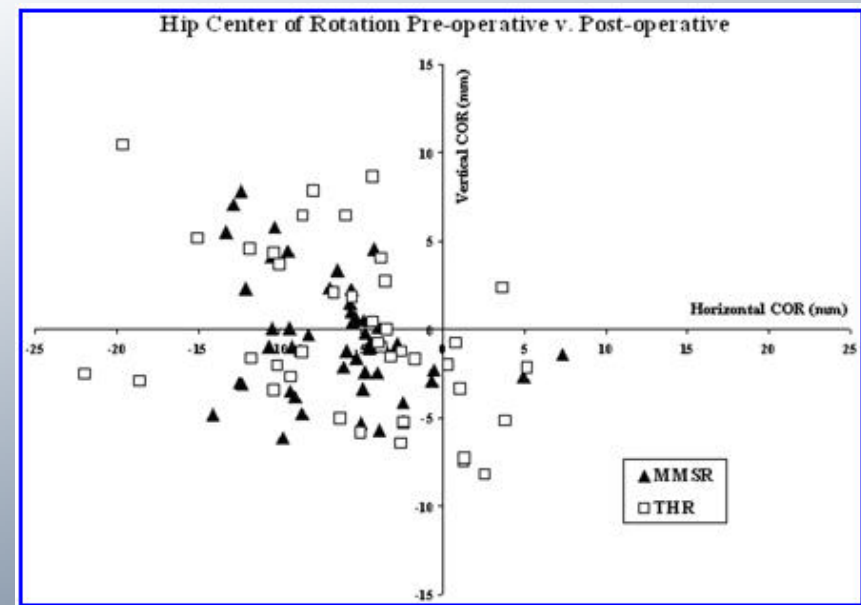
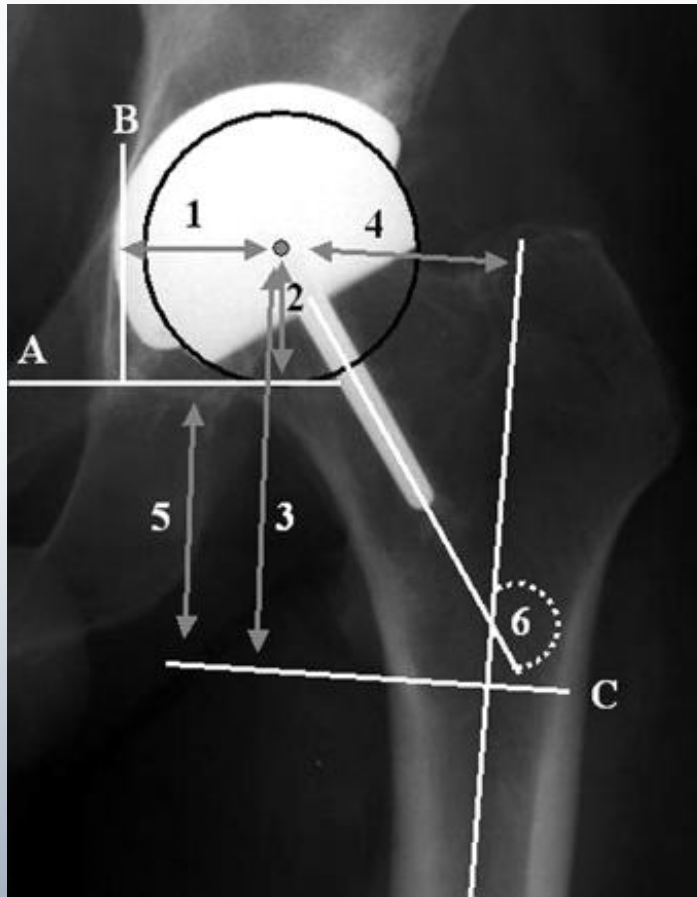


No Prosthetic Fracture Risk



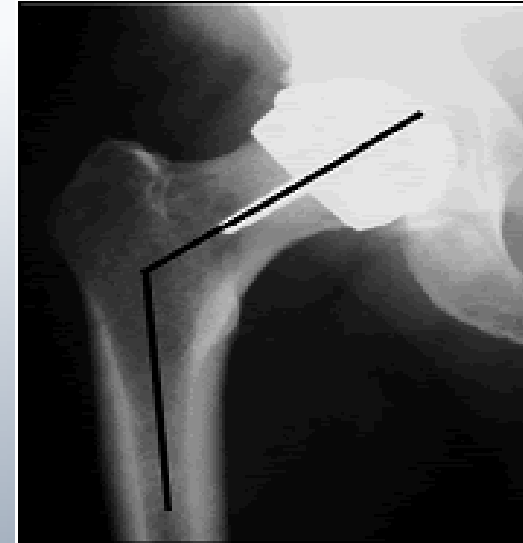
2A

3. Restores normal anatomy



Hip resurfacing Disadvantages

- Specific to resurfacing
 - Peri-prosthetic fracture
 - needs normal bone density,
 - suitable for healthy males <55 years and females <50 years
 - Steep learning curve
 - It is more sensitive to correct prosthesis placement to prevent complications

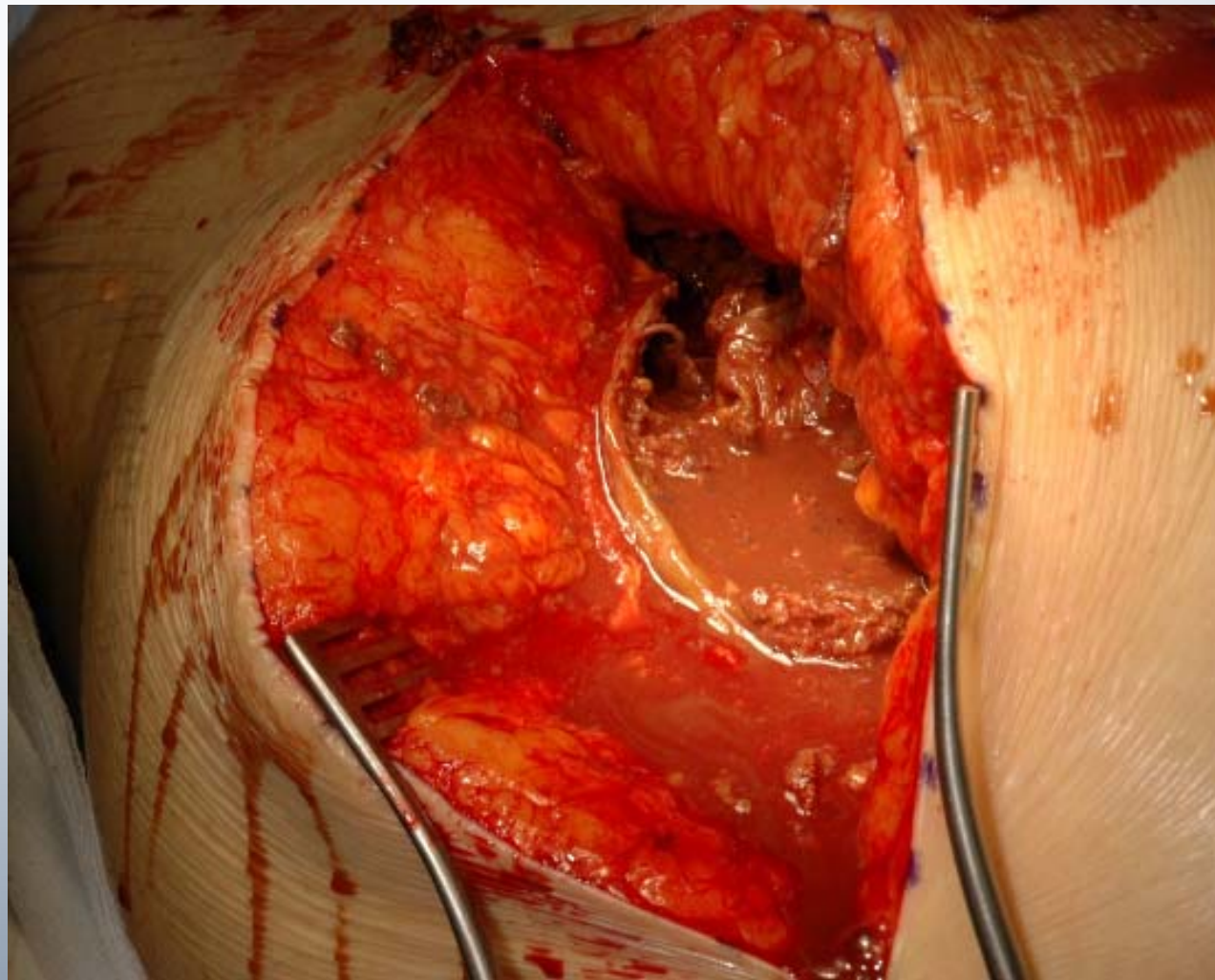


What's the Problem



- Production of cobalt and chromium wear debris
- Elevated levels of Co and Cr are measurable in the blood stream, kidney, liver and spleen
- Local (hip) adverse reaction to metal debris producing soft tissue and bone destruction

Pseudotumour and Osteolysis



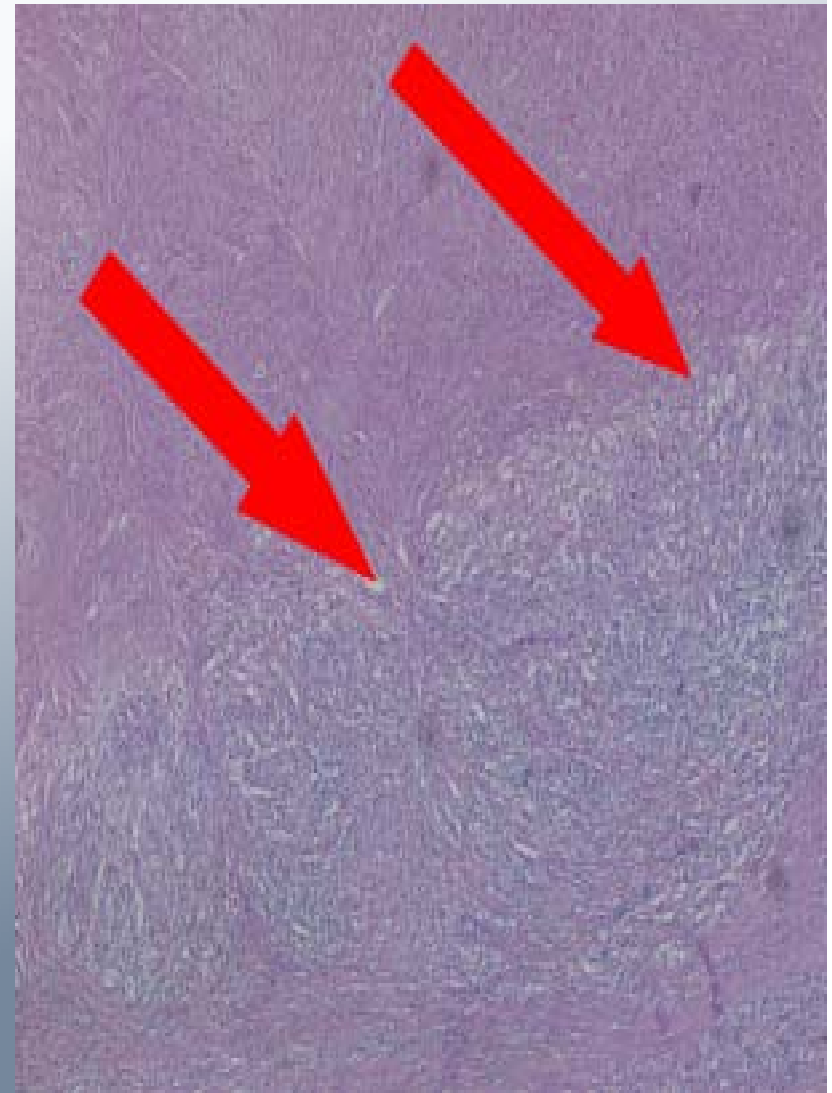
Pseudotumour



Pseudotumour

- Cobalt ions have dose dependent cytotoxic effects on macrophages in vitro
- In the presence of a high level of metal wear debris and prolonged exposure, cytotoxicity of macrophages lead to tissue necrosis in vivo
- Histo
 - Extensive soft tissue necrosis with collections of macrophages
 - Metal particle aggregates

Kwon et al Biomed Material 2009



Revision Rate

Type of Bearing	7years	12 years
Metal or Ceramic on Polyethylene	3.1%	5.5%
Metal on Metal (CoCr)	12%	18.6%
ASR (Recalled Depuy)	39%	
Resurfacing THR (CoCr)	7.5%	11.7%

AOA JRR 2013

Systemic Side Effects Elevated Serum Co and Cr in THR

- Proposed/reported systemic side effects of elevated cobalt and chromium levels

Generalised Symptoms

- Lethargy
- Tinnitus
- Memory loss
- Metallic taste in mouth
- Skin rashes

Specific Symptoms/Pathology

- Neuropathy
- Visual disturbance
- Endocrine dysfunction (hypothyroidism)
- Haematological (polycythemia)
- Cardiomyopathy
- Cancer

REVIEW ARTICLE

Interpreting cobalt blood concentrations in hip implant patients

DENNIS J. PAUSTENBACH, DAVID A. GALBRAITH, and BRENT L. FINLEY

Cardno ChemRisk, LLC, San Francisco, CA, USA

- **Conclusions.** Based on currently available data, only under very unusual circumstances should a clinician expect biologically important systemic adverse effects might occur in implant patients with blood cobalt concentrations less than **5000 nmol/L.**

Cobalt Level Reference

- Normal 0-20 nmol/L
- Normal functioning MOM THR 0-120nmol/L
- Close monitoring required >120nmol/L
- Prosthesis likely to fail >180 nmol/L
- Systemic toxicity unlikely until >5000 nmol/L

RESEARCH ARTICLE

Open Access

A retrospective comparative study of mortality and causes of death among patients with metal-on-metal and metal-on-polyethylene total hip prostheses in primary osteoarthritis after a long-term follow-up

Tuomo Visuri*¹, Håkan Borg², Pekka Pulkkinen³, Pekka Paavolainen⁴ and Eero Pukkala⁵

- All patients over 17yrs post-operatively
- MOM 579 patient 1585 MOP patients
- Decreased mortality in first 10 yrs for both groups compared to general population (no change for 2nd decade)
- No increased risk of any cancer in either group

Cobalt Toxicity

- Beer foam stabiliser
 - Cardiomyopathy developed in heavy drinkers (15-30 beers/day) who were malnourished
- Cobalt therapy (older treatment for anaemia and HRT)
 - Hearing and vision changes in patients with anaemia and reduced GFR
 - Resolved after stopping therapy

Cobalt Ingestion

- Mineralife vitamin supplement study 90 days
 - 1000µg/day
 - Maximum serum cobalt levels exceeded 1600 nmol/L
 - Testing remained normal for:
 - FBC/TSH/T₄ remained normal
 - Metal allergy testing
 - Hearing, visual and peripheral nerve testing
 - Cardiac function

Cobalt Level Reference

- Normal 0-20 nmol/L
- Normal functioning MOM THR 0-120nmol/L
- Close monitoring required >120nmol/L
- Prosthesis likely to fail >180 nmol/L
- Systemic toxicity unlikely until >5000 nmol/L

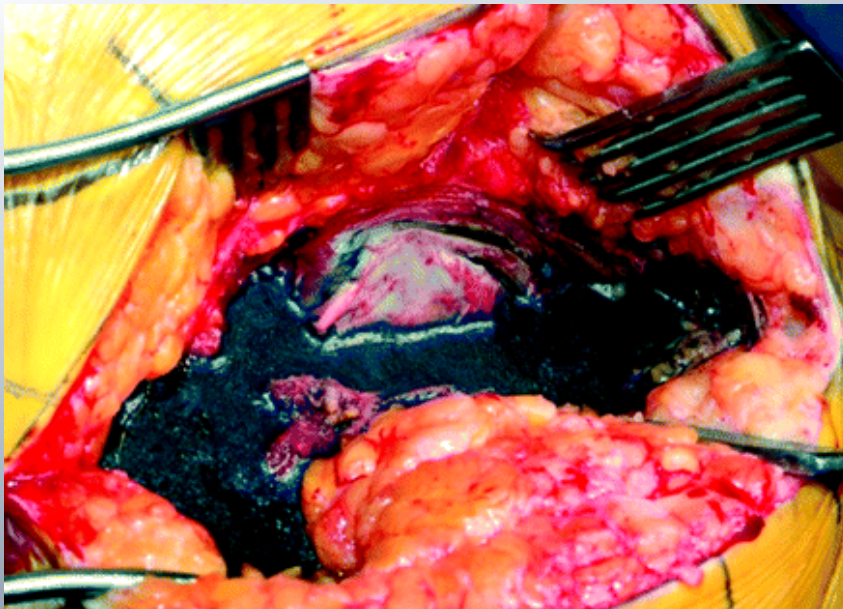
Cobalt Toxicity Death

- Case
 - 52year old
 - Fracture of ceramic prosthesis
 - Revised to metal (CoCr) femoral head on polyethylene liner



Cobalt Toxicity Death

- Due 3rd body wear, lost 28g of metal
- Peak cobalt concentration
110,525 nmol/L
- Died of hypothyroidism and cardiomyopathy

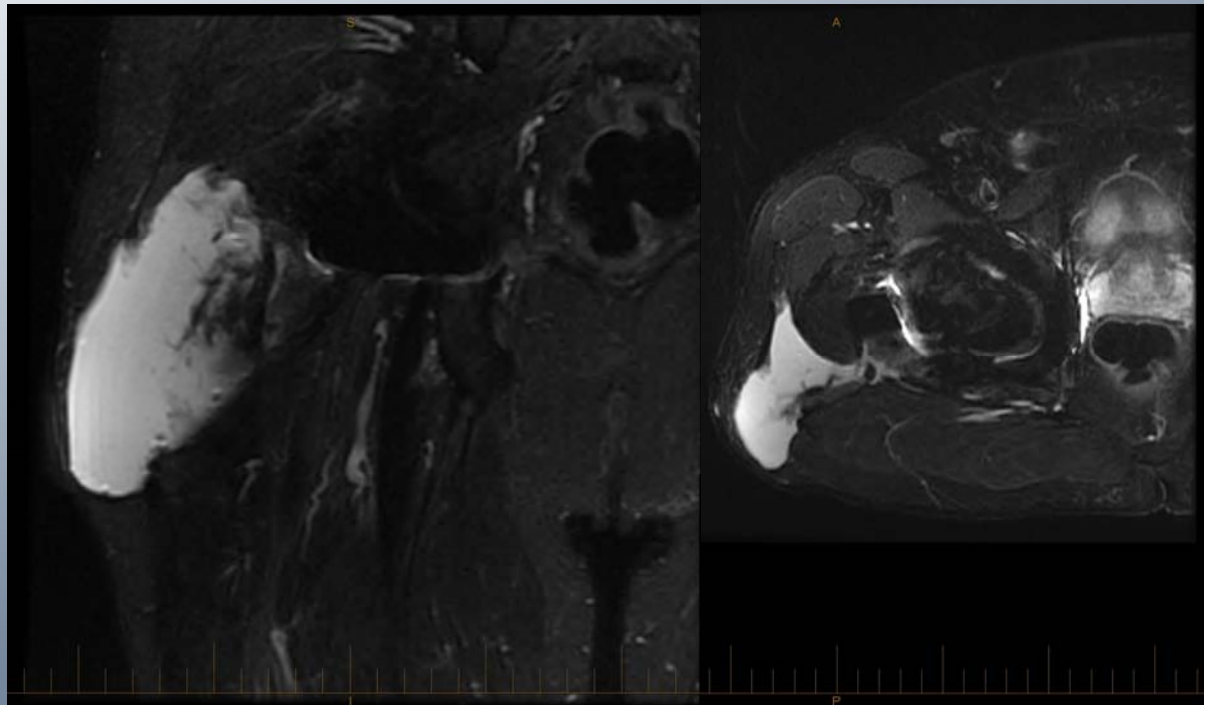


How to Investigate

- Screening
 - Asymptomatic patients
 - Yearly
 - Xray – pelvis and hips (osteolysis/loosening)
 - Ultrasound – fluid collection or soft tissue mass (pseudotumour)
 - Cobalt and Chromium serum levels

How to Investigate

- Symptomatic patients or abnormal screening tests
 - Xray
 - MRI with MARS (assess for pseudotumours)
 - CT (assess for osteolysis)
 - Bone scan
 - Cobalt and Chromium levels
 - ESR/CRP



When to Revise

- Decision multi- factorial
 - Pain
 - Loosening prosthesis
 - Pseudotumour/soft tissue erosion or loss
 - Osteolysis (bone loss)
- Cobalt and chromium levels

Case Presentation

- 56 year old female
- Nurse (wife of oncologist)
- 2008 THR Modular Large head MOM
- Never happy – persistent disabling groin pain since op



Question

- In regards to this patient
(click on all correct answers)
 1. She needs immediate removal of prosthesis
 2. She needs investigation for possible infection
 3. She is likely to have systemic side effects of cobalt and chromium
 4. The metal on metal hip may be causing her pain
 5. Appropriate investigations would include Xray, MRI, CT and cobalt and chromium levels

2010



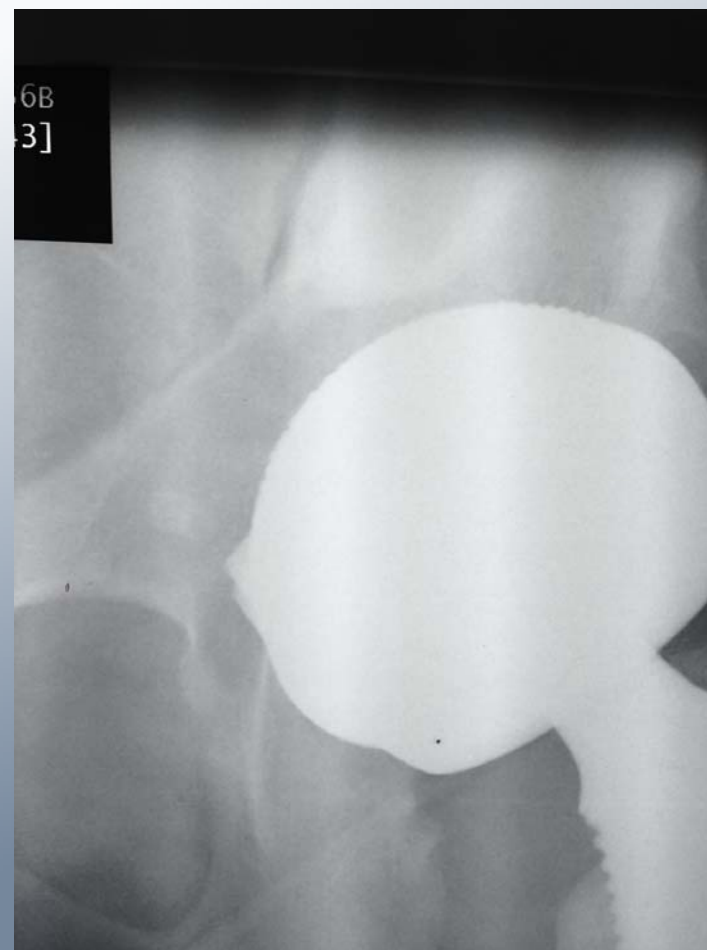
2013

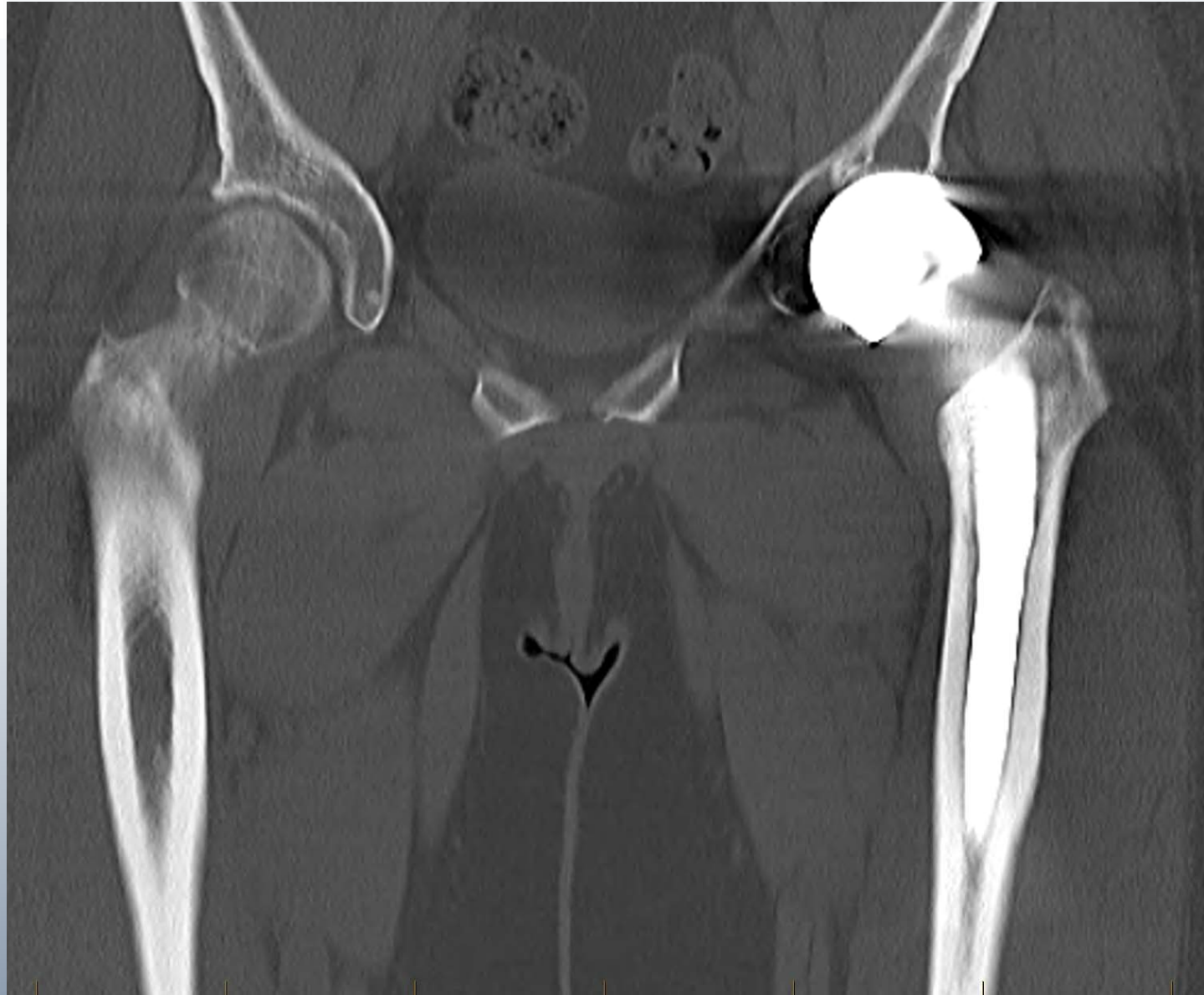


2010



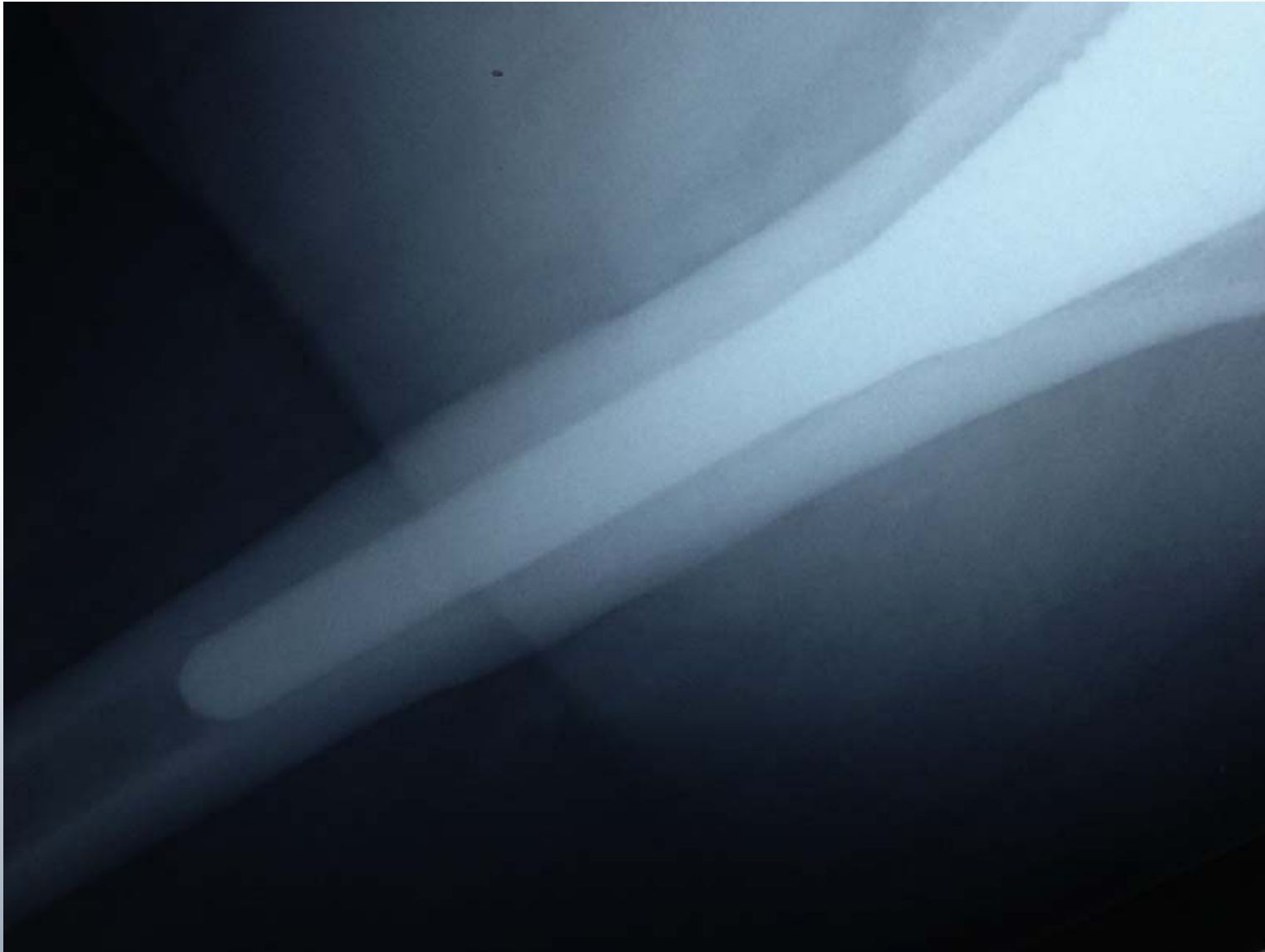
2013

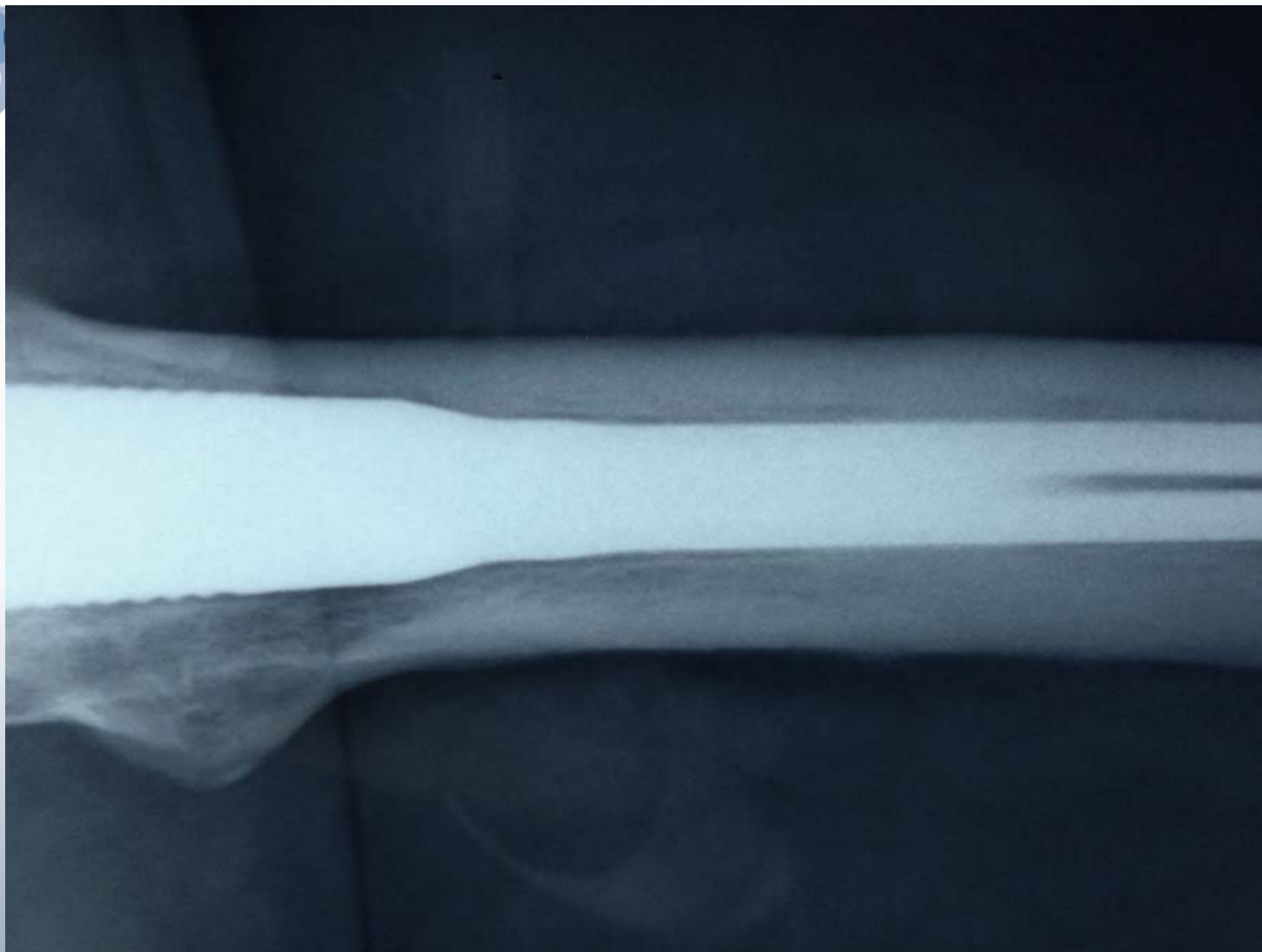


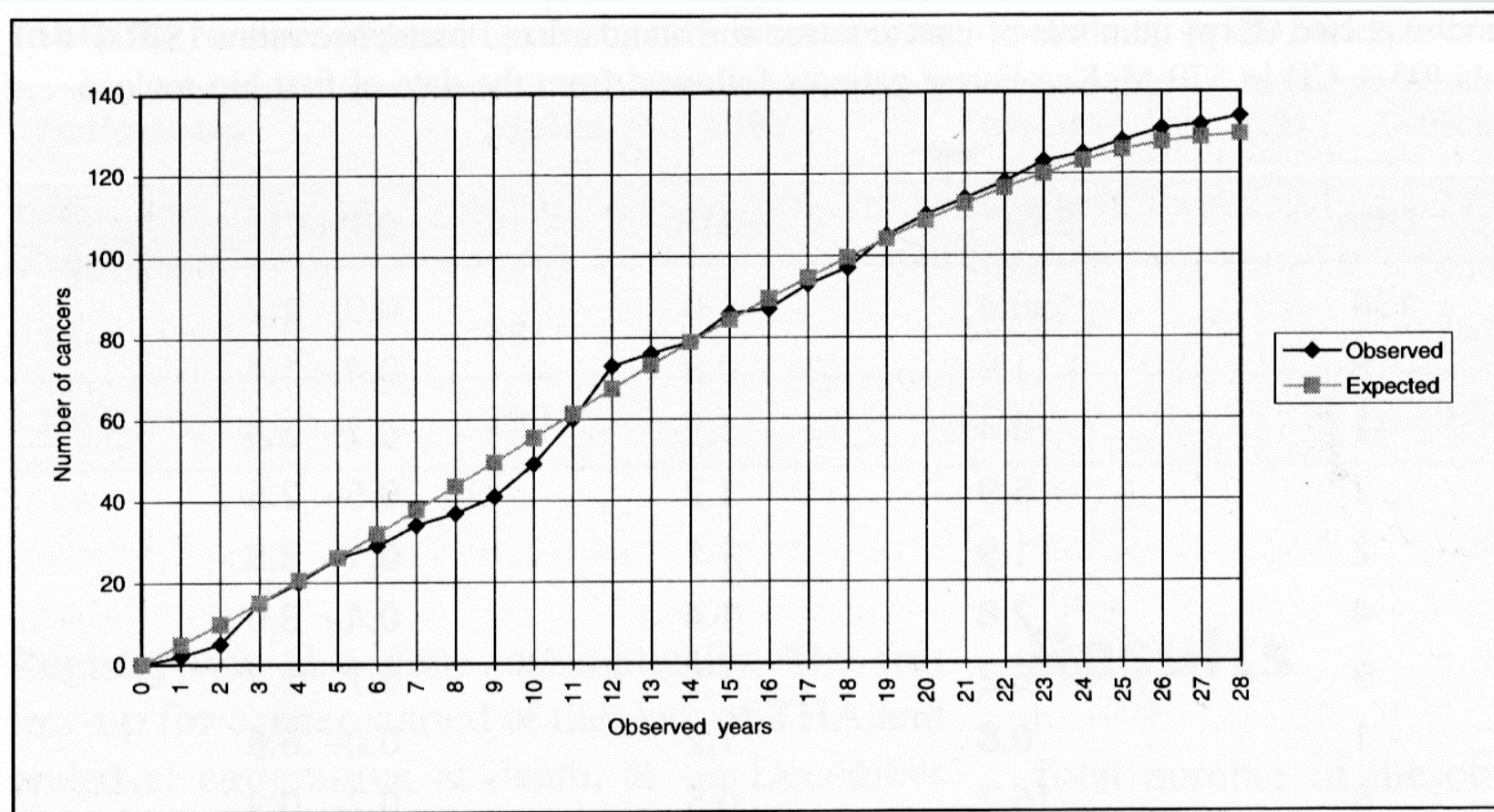


Blood Results

- Co 104nmol/L, Cr 64 nmol/L
- ESR₃₇ CRP 17 (persistently mildly raised)

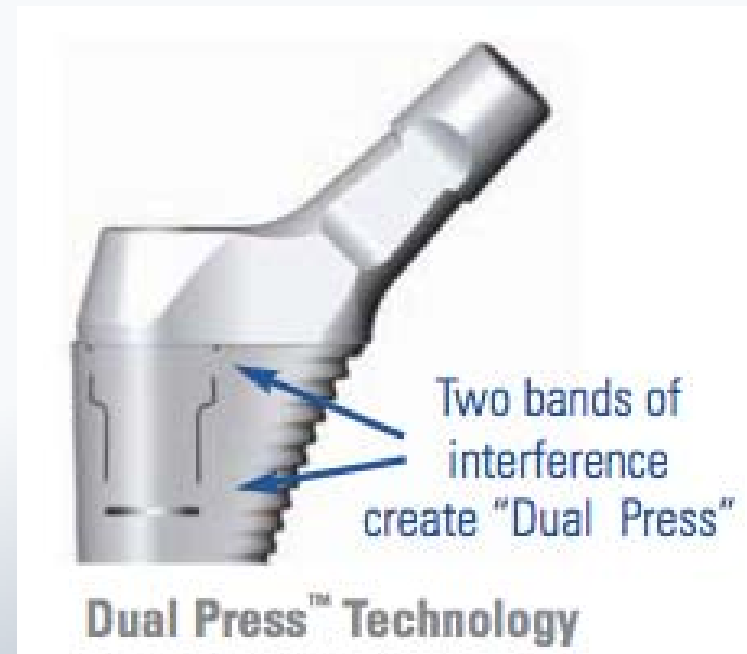






*First Generation Metal on Metal Bearings
28 year follow-up of over 600 patients*





Titanium particle debris generation was less than .004mg after 48.5 million loading cycles. (As a point of comparison, this is approximately 1000x below the reported yearly volumetric wear of metal-on-metal articulations).³

Aspiration In Theatre

- 10mls of clear fluid
- 20 white cells/cmm
- No growth
- Excellent short term relief of pain

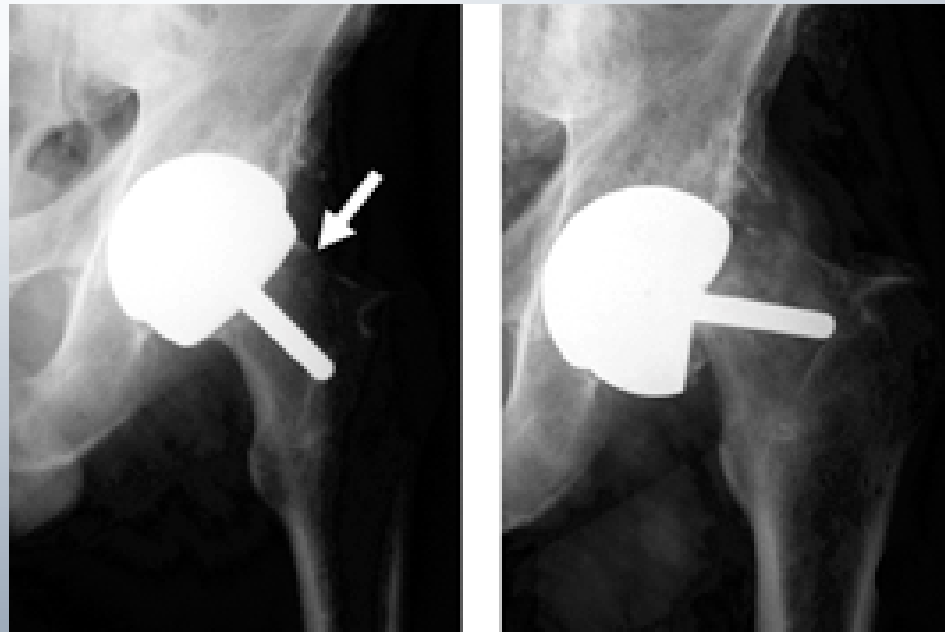


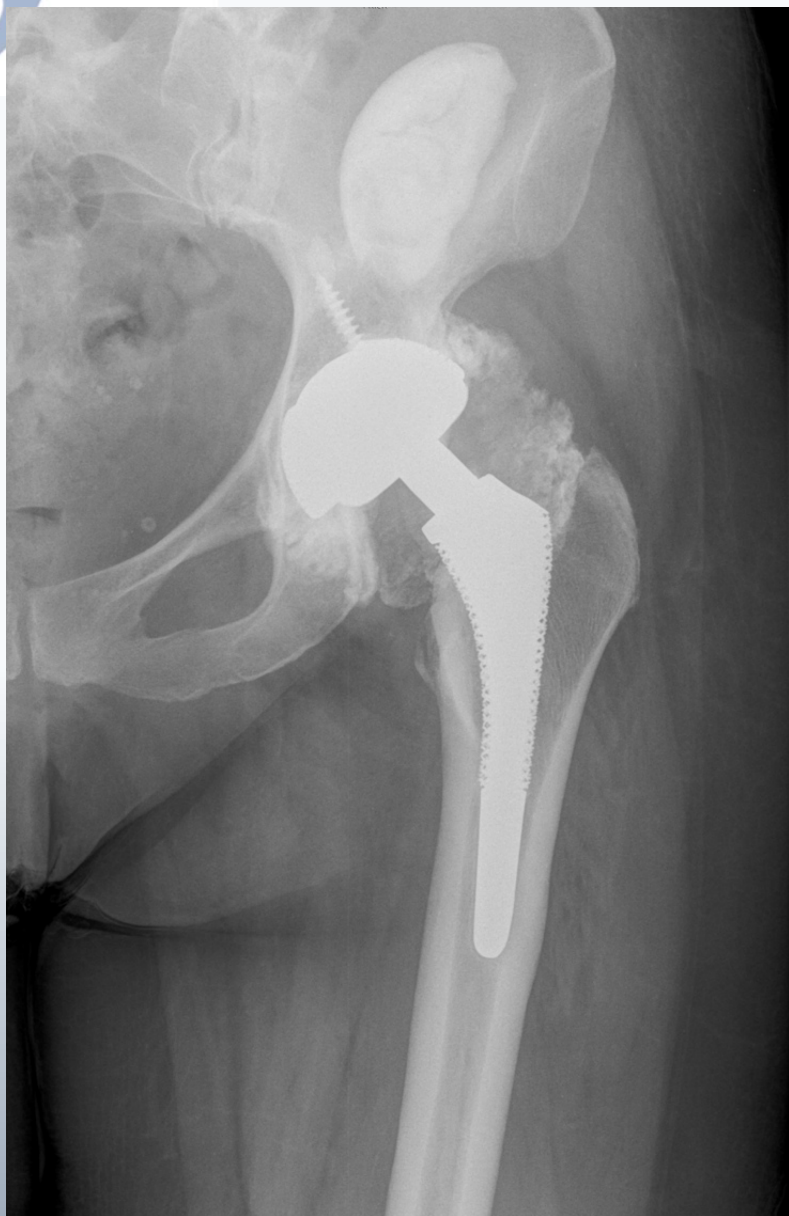
Post Revision 2013



Case

- 58 year old female
- Social worker
- 2009 Resurfacing THR
- Fracture 6/52 post op
- Converted to modified ceramic total hip replacement
- 2011 increasing pain





Revision of Acetabulum Jan 2012



- April 2012
 - Dislocating
 - Unstable acetabulum
 - Severe pain
 - Cobalt 7600 nmol/L
 - Cr 460 nmol/L
-
- Infected -Growing
 - Enterococcus faecalis
 - Pseudomonas aer.
 - Staph epi



Intra-pelvic Metallosis Collections



Systemic Effects

- Fatigue and generally unwell
- Investigation with specialists were normal for
 - Haematology
 - Endocrine
 - Cardiology
 - Neurology
 - Auditory
 - Ophthalmic

Excision Arthroplasty combined
laparotomy
April 2012

Repeat laparotomy and washout
8 weeks later after persistent
draining sinus



P1
12/12/2012 09:34



P1
12/12/2012 09:34





Dec 2013

- CRP/ESR normal
- Reducing doses of antibiotics
- No pain
- Co 98 nmol/L
- Cr 114 nmol/L
- Returned to work



Summary

- All metal on metal total hip replacements need regular surveillance and must not be lost to follow-up
- Elevated metal ion levels are much more likely to indicate failure of the hip replacement, at much lower levels than would induce systemic side effects
- Patients can be reassured that significant systemic side effects are unlikely with a well functioning MOM THR
- Current evidence shows no increased risk of cancers
- Early revision of THR if pseudotumour, osteolysis or pain is present is indicated, independent of Co or Cr levels



Case 3

64year old female

Severe RA

Previous

Bilateral TKR

Bilateral Total elbow replacements

C-spine fusion

Sept 2012 non-traumatic, bone scan diagnosed, left inter-trochanteric proximal femoral fracture
- DHS insitu

February 2013 Lumbar spine fusion with commencement of Forteo (recombinant parathyroid hormone)





While inpatient rehab diagnosed with AVN right femoral head
Booked for THR right hip April 2013
2 days prior to operation readmitted with increasing left hip pain



Repeat bone scan no AVN to left femoral head

At time treatment options considered

- primary THR
- osteotomy with IMN or DHS

Valgising Osteotomy with bone grafting left hip 150degree DHS

R9
R3







Resurfacing Results

5 year 98% survival of implant (Treacy et al.
JBJS - B, Vol 87-B, Issue 2, 167-170, 2005)

- Australian Joint Replacement Registry 2008
Results Revision Rates
 - Primary THR 4.2% at 7 years
 - Resurfacing 5.4% at 7 years