# Retrieval findings of MoM hip prostheses

## Dr Tom Joyce Reader in Biotribology Newcastle University 24<sup>th</sup> October 2011

# Overview of lecture





- Why look at retrievals?
- Tribology measuring roughness and wear
- DePuy ASR resurfacings
- DePuy ASR XL (THR)
- Other large head metal-onmetal (LHMoM)
- Damage to taper junctions
- Context THR history

# Why look at retrievals?

- Implantation of prostheses in people provides the truest test of any device
- Examples of learning from *ex vivo* prostheses
   Wear volumes from total
- Wear volumes from total hip replacements
- Failure of DLC coating on toe prosthesis
- Newcastle/North Tees is the only independent explant centre in world





### Measurement of surface roughness

- ZYGO NewView non-contacting profilometer
- Typical changes 0.015µm to 0.100µm Ra
- Results in change from fluid film to boundary lubrication. Wear occurs over large sliding distance



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J Engineering Tribology, 2009, 317-323



Early failure of metal-on-metal bearings in hip resurfacing and large-diameter total hip replacement

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### Measurement of wear

- Wear is a volume
- Co-ordinate Measuring Machine (CMM) recommended by international standards for measurement of wear in hip prostheses (ISO14242-2)
- State-of-the-art LEGEX 322 has an accuracy of 0.8µm







Cup inclination 38°, anteversion 17°, AVN failure at 3 years, total wear from head 1.3mm<sup>3</sup>

# ARMD ASR™ head late fracture





- 64 yr old male, femoral fracture at 4 years
- 50.5mm dia, inclination 59°, anteversion 31°
- Red area shows at least 20µm of wear, wear volume from head 134mm<sup>3</sup>



# Failed ASR<sup>™</sup> head and cup pairs



Common factor – 'rim wear' at edge of cup. Associated with smaller cups and those fitted at high inclination and/or anteversion angles





## Summary – why these ASR<sup>™</sup> failed

- Rim wear occurs on acetabular component
- High surface roughness values lead to shift from fluid film to boundary lubrication
- Wear volumes are high due to greater sliding distance in large diameter resurfacing designs
- Wear volumes correlate with high Co and Cr ion concentrations in blood of patients
- Tissue destruction and pain linked with metal wear debris

# But the BHR is fine?

- Not always
- Case study
- 42 months
- Size 42 in a male
  89mm<sup>3</sup> head
- 93mm<sup>3</sup> cup



# What about the ASR<sup>™</sup> XL?





- Female patient, ASR<sup>™</sup> XL, failure at 35 months
- 45.5mm diameter, inclination 60°, anteversion 31°: Co 32.2µg/L, Cr 22.0µg/L
- Red area shows at least 20µm of wear depth, wear volume from head 20.2mm<sup>3</sup>



# Look elsewhere on the ASR™ XL

- Wear at the taper junction
- We use our CMM to measure taper wear
- Example 0.7mm<sup>3</sup> taper volume loss; maximum wear depth 39 microns
- Enough to cause failure and tissue destruction in this patient

















Maximum wear depth 22 microns



# So why are tapers releasing wear debris?



- These materials (CoCr and Ti) have been used together for many years in this application
- Why would corrosion suddenly be a problem?
- Stems have become smaller as heads have become bigger
- Localised damage consistent with increased lever arm

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Device	Number implanted	Impact	
Capital 3M hip (1998)	5,000	Introduction of National Joint Registry	

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De Puy ASR™ (2010)	93,000	?????	

# If you like that .....

- NJR 2010 for resurfacing prostheses the five year revision rate was 6.3% (5.7% to 7.0%)
- For large head metal-onmetal (LHMoM) five year revision rate was 7.8% (6.6% to 9.3%)
- NJR 2011 resurfacing at 11.8% at seven years
- LHMoM 13.6% at seven years







