

Wear Rates of XLPE are Nearly 50% Lower than First Thought Once the Initial Creep has been Eliminated: an RCT to Compare 4 Bearing Combinations

James Wu, MD

Amir Khoshbin MD, MSc, FRCSC, Amit Atrey MD, MSc, FRCSC, James Waddell MD, FRCSC

St Michael's Hospital, University of Toronto

Toronto, Canada



Toronto Orthopaedics
Leadership. Innovation. Impact.

Context of study

- Polyethylene wear remains a primary concern in THA
 - Osteolysis caused by microscopic PE debris has been a major cause of THA failures and revision
- Much research and innovation has been produced to minimize wear
 - Numerous long term studies of different bearing surfaces
- Younger and more active patients are getting THA
 - Need to maximize longevity of implants
 - Patients want to know how long their hip will last

4 bearings study

- 100 hips assessed and randomized to one of 4 bearing surfaces
 - Ultra-high molecular weight polyethylene (UHMWPE) and Cobalt-Chrome (CoCr)
 - UHMWPE and Oxidized Zirconium (OxZir)
 - Highly crosslinked polyethylene (XLPE) and CoCr
 - XLPE and OxZir
- Age : 22.5 -65.4y (mean 52.2y)
- M:F 52:48

Protocol

- All patients received a porous-coated cementless acetabular shell and a cylindrical proximally coated femoral stem with a 28mm head
- Standardized AP and lateral post-op XRs
- Patients reviewed clinically and radiographically at 6 weeks, 3 months, 1,2,5 and 10 years
- XRs analyzed with Polyware (computer software package) by blinded independent third party
- We defined creep period as first 3 months post-op



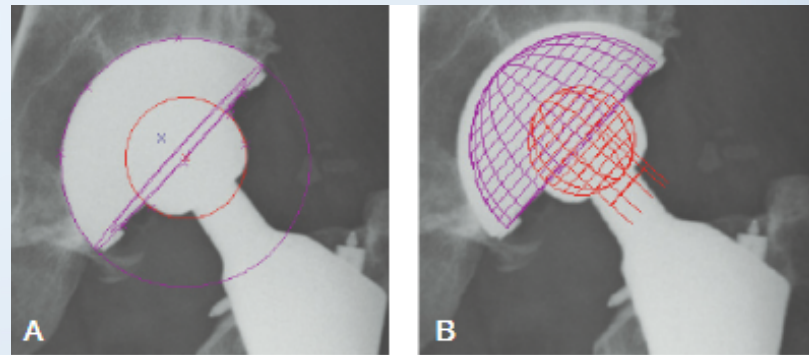
What about creep?

- Creep is the time dependent plastic deformation of a material undergoing stress
- There is an initial embedding period of the femoral head into the PE liner. This increases the conformity of the bearing surfaces
- Creep does not generate PE particles thus does not contribute to osteolysis
- Previous reported PE wear rates do not necessarily account for creep
- Approximately 80% of creep occurs in the first 3 months postoperatively, and 95% occurs by 6 months postoperatively. This suggests that 99% of creep occurs by 9 months, and virtually all of it occurs by 1 year.

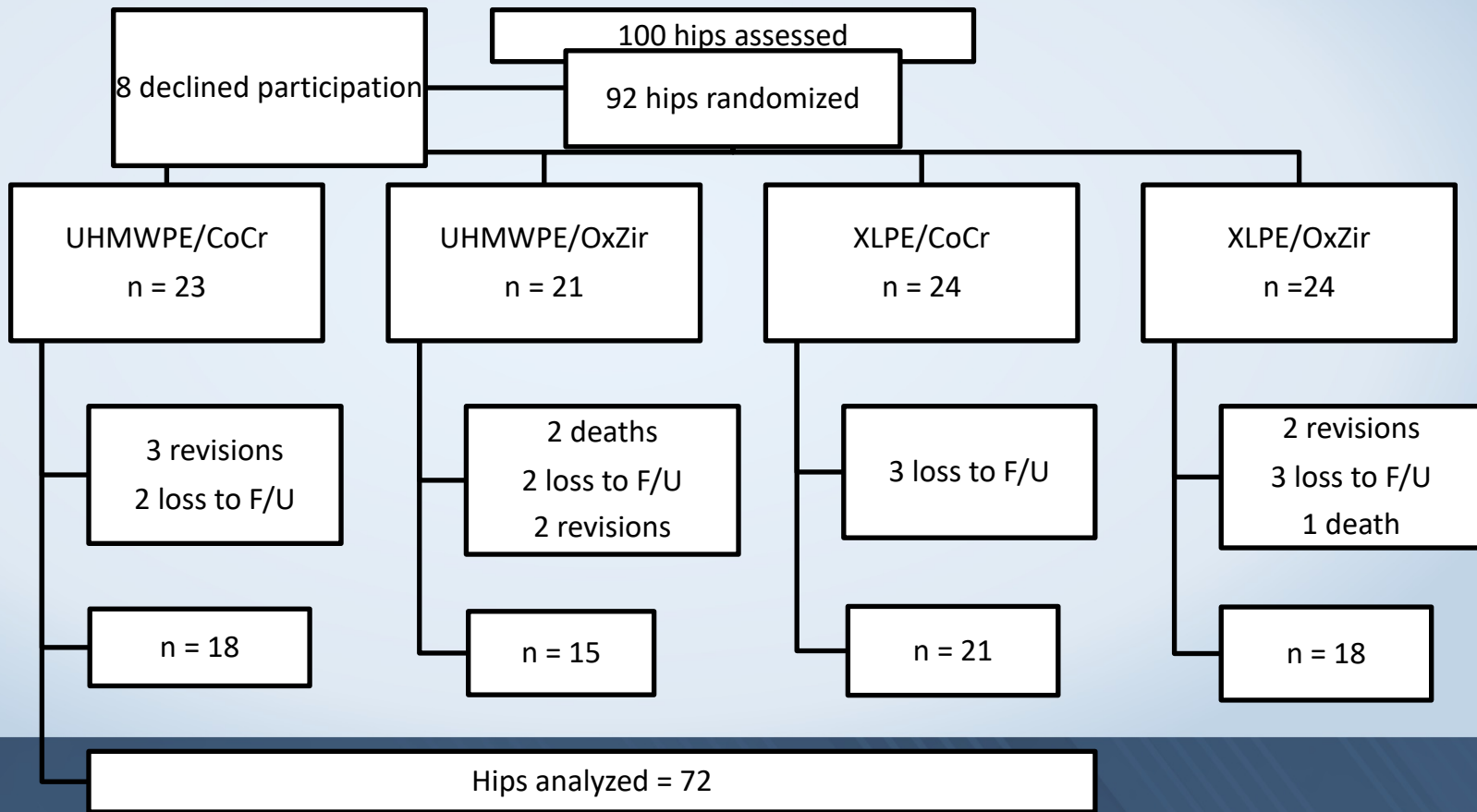


PolyWare

- 3D analysis automated software developed by Devane and al.
- Image processing automatically selects points on computed radiographs AP and Lateral
- Accuracy 0.022 – 0.058 mm
- Precision 0.001 - 0.0042 mm
- One of the most accurate radiographic calculation of wear available

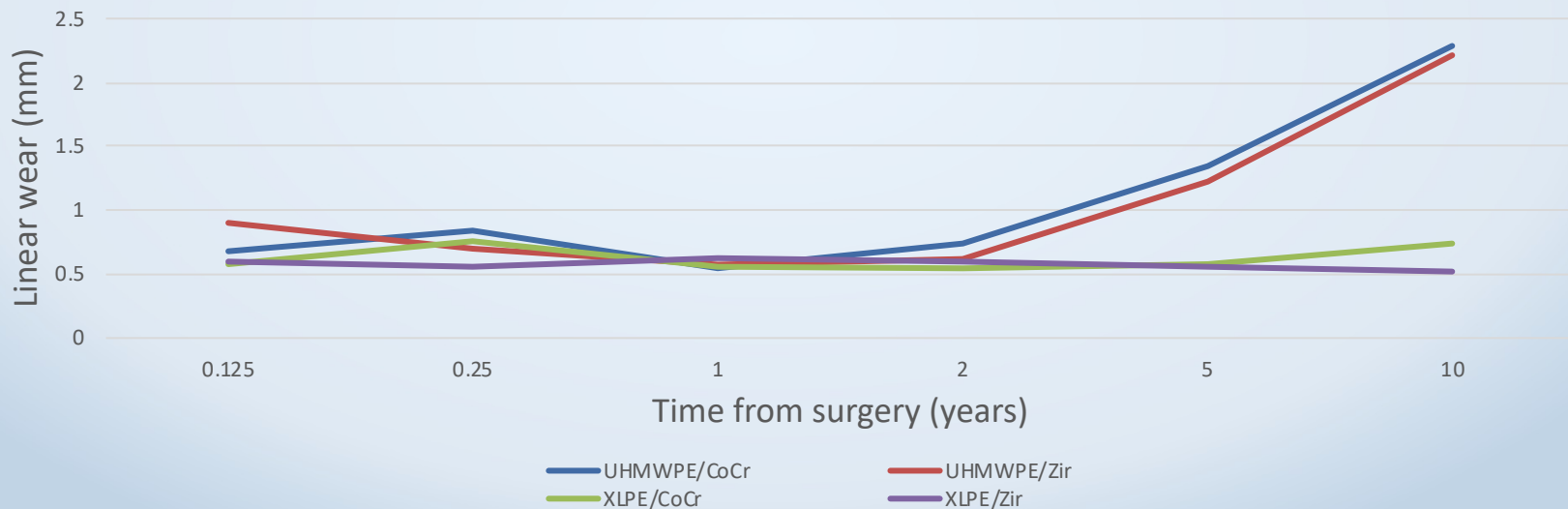


Randomization



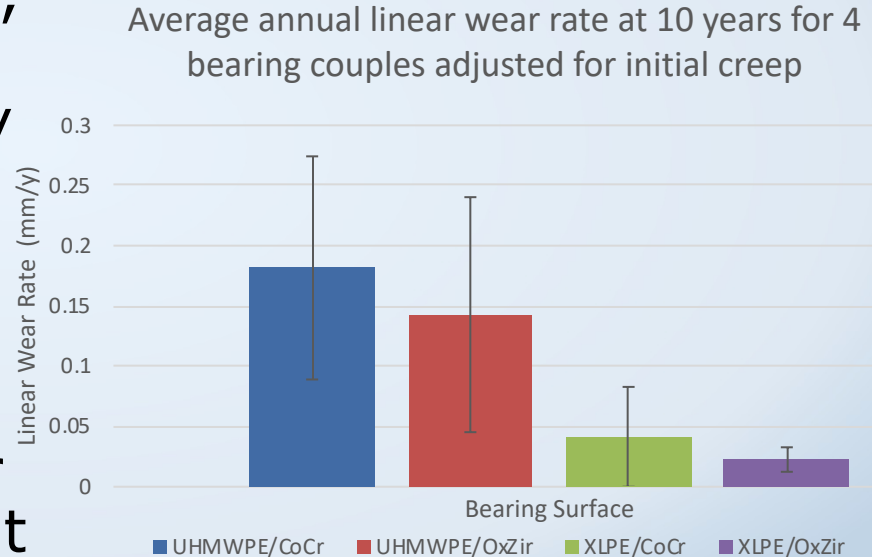
Results

4 bearings' polyethylene liner linear wear during 10 years



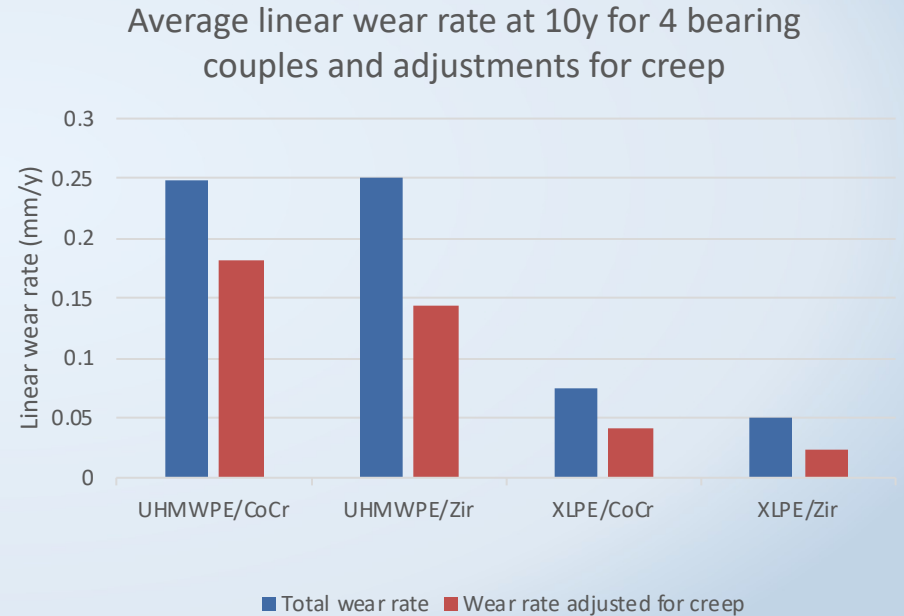
Results of 4 bearings analysis

- After adjusting for creep, the annual linear wear rate is again significantly less for XLPE than UHMWPE
- There is no statistically significant difference between CoCr and OxZir in terms of linear wear at 10y



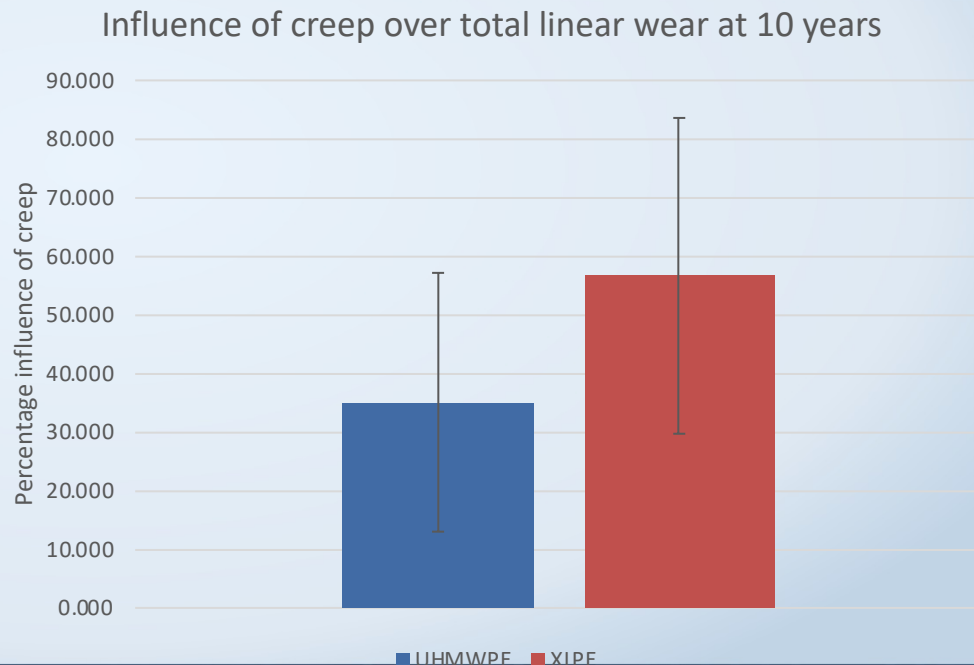
Creep plays significant role in overall calculation of wear

- After subtracting “wear” from first 3 months from total at 10y, there is a statistically significant difference in the average annual linear wear at 10y.
- The true wear of both UHMPE and XLPE is thus even much lower than previously calculated



Creep is more significant in XLPE

- XLPE exhibits proportionally more creep than UHMWPE, ie the first 3 months account for more of the calculated radiographic wear at 10y.
- On average, over half of the wear at 10y is actually creep in bearings with XLPE and creep accounts for over 1/3 of wear in UHMWPE couples



Clinical significance

- Wear rates are even lower than previously described
- Osteolysis will likely become obsolete
- We can likely tell patients that their implant bearings will outlive them

Future

- Is XLPE the pinnacle for THA liners?
 - Promising innovations at this conference!
- Catastrophic failure at a given time point?
 - Excellent track record since use in last 15-20y