AHN
ORTHOPAEDIC
UPDATE 2025

BEDFORD
SPRINGS, PA

STEPHEN (DREW)
BURGESS, MD

# Bearing Surfaces in Total Hip Arthroplasty

# Total Hip Arthroplasty

"The operation of the century"

First total hip arthroplasty performed in 1953 by George McGee utilized a modified Thompson cemented hemiarthroplsty femoral stem along with a one piece cobalt chrome socket

First successful "modern" total hip arthroplasty performed by Sir John Charnely on April 8, 1962

- Utilized a cemented ultra high molecular weight polyethlene acetabular component with a non-modular cemented femoral stem with small diameter (22 mm) CoCr head

Advancements in biomaterials as well as surgical technique and perioperative management have driven a massive rise in the utilization of the procedure for treatment of arthritis, fracture, osteonecrosis, congenital deformity and other conditions over the last 60 years

REVIEW · Volume 370, Issue 9597, P1508-1519, October 27, 2007 Download Full Issue

The operation of the century: total hip replacement

Prof Ian D Learmonth, FRCS [a] · Claire Young, FRCS [b] · Prof Cecil Rorabeck, FRCS [c]

Affiliations & Notes Article Info

# Highly Crosslinked Polyethylene

Introduced in total hip arthroplasty in 1998

PE irradiation breaks macromollecular chains which are in turn available to recombine with neighboring chains

- Irradiation dose at least 50 kGy, no benefit over 100 kGy and resistance to crack propagation can decrease at higher doses

Linear wear rate of 0.0185 mm/year compared to 0.23 mm/year with conventional polyetyhlene

Very low to no osteolysis seen

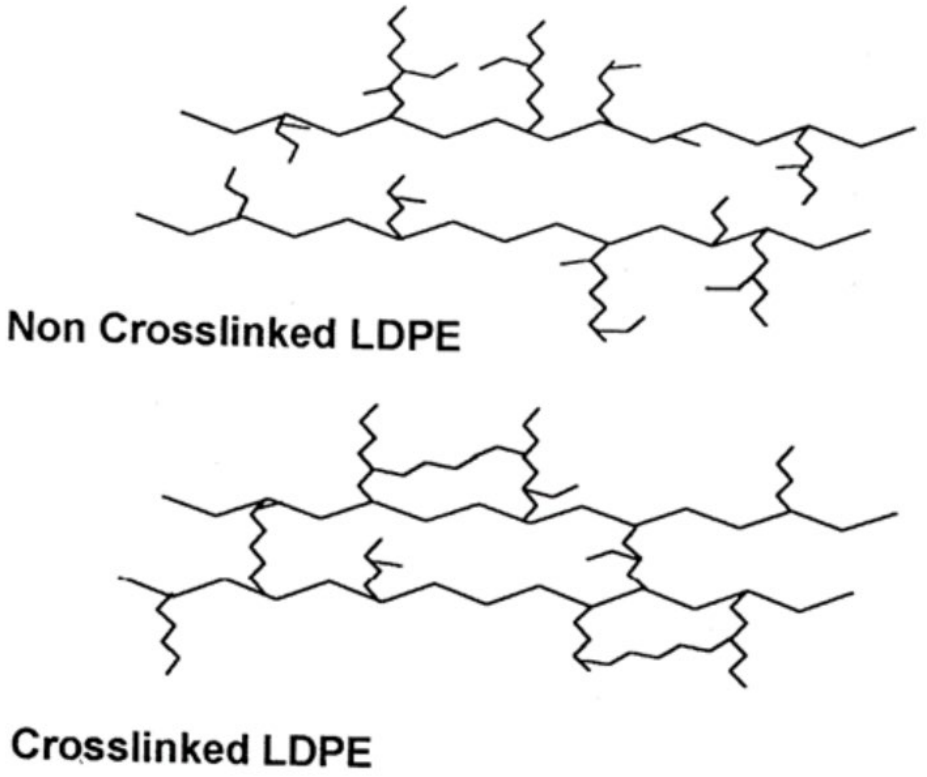


Photo: https://behinpolymerco.com/en/cross-linked-polyethylene/

# Ceramics

Hard, biomechanical non-metal materials such as alumina ($Al_2O_3$) and zirconia ($ZrO_2$)

First used in THA in Europe in 1980s, in the USA in 1990s

Great durability, low wear, low debris production, high biocompatibility

Photo: https://hometriangle.com/blogs/the-timeless-allure-of-ceramics-a-guide-to-ceramic-art-materials-and-uses/

# Cobalt Chromium

Metal Alloy primarily composed of Co and Cr

- Also can contain very small amounts of Mo, Ni and several other metals

High Strength, hardness and ductility

Excellent resistance to fatigue and wear

Quite biocompatible, but can produce metal ion debris in some scenarios which have been problematic

Photo: https://www.beautyzir.com/blogs/news/advantages-of-cobalt-chromium-alloy-in-dental-applications?srsltid=AfmBOopNwGMOFnIiuDjaeZGZYq2afn_KPZuFkIL8jl4Ldn_am4hlYDFS

# Single Mobility Options

# Dual Mobility Options


# Ceramic on Highly Cross-Linked Polyethylene

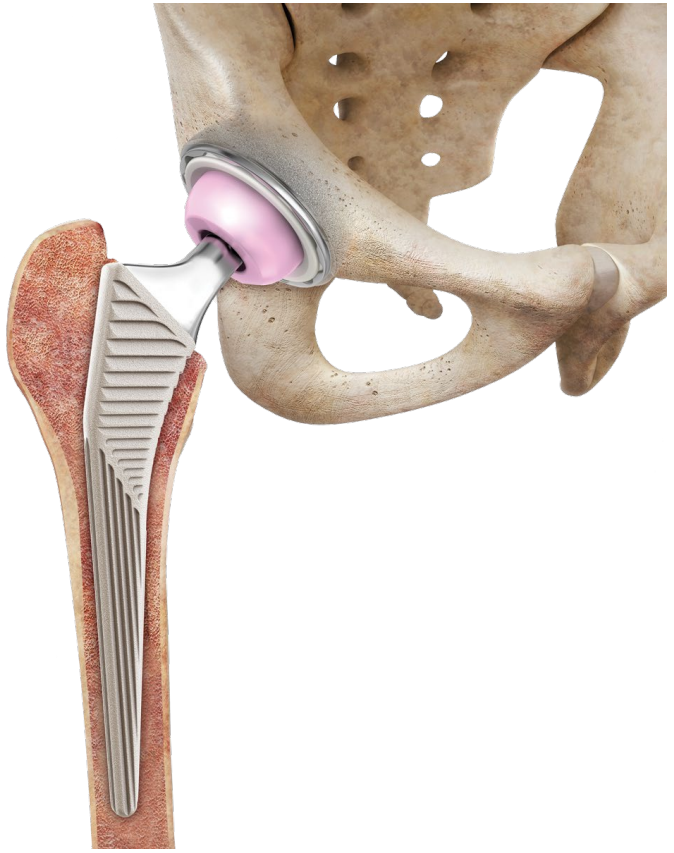

Photo:https://www.jnjmedtech.com/sites/default/files/images/Hip_Anatomy_Cementless_Hip.png

# Ceramic on Highly Cross-Linked Polyethylene

## PROS

Very low wear rates and osteolysis with modern HXLPE

Familiarity

Most modular options for intra-operative adjustments (lipped, face changing, offset, etc)

No metal ion production

## CONS

Can still see polyethylene wear

Ceramic can fracture

Poly can fracture

# Ceramic on Ceramic

Photo: https://biomed.drexel.edu/orthoceramics/Encyclopedia/chapter2.html

# Ceramic on Ceramic

## PROS

Hard bearing surface

Exceptional wear resistance

No osteolytic generating particle production

## CONS

Potential for fracture, although much less with current generation ceramics than early generation

Squeaking

Can be more difficult to remove modular ceramic liner than polyethylene liner

# Metal (Cobalt Chromium) on Polyethylene

Photo: https://bonesmart.org/hip/hip-replacement-implant-materials/

# Metal on Polyethylene

## PROS

Most modular options for intra-operative adjustments (lipped, face changing, offset, etc)

Relatively inexpensive

Familiarity

No wear or fracture risk on the femoral side

## CONS

Trunnionosis (metal ion generation and local/systemic reaction) which occurs at the femoral head/neck junction

Poly can wear or fracture

# Metal on Metal

Photo: https://bonesmart.org/hip/hip-replacement-implant-materials/

# Metal on Metal

## PROS

Larger head can decrease dislocation risk and increase ROM before impingement

Exceptional wear resistance

## CONS

Metalosis (metal ion production from metal/metal articulation)

Trunnionosis (metal ion production from head neck junction)

# Dual Mobility

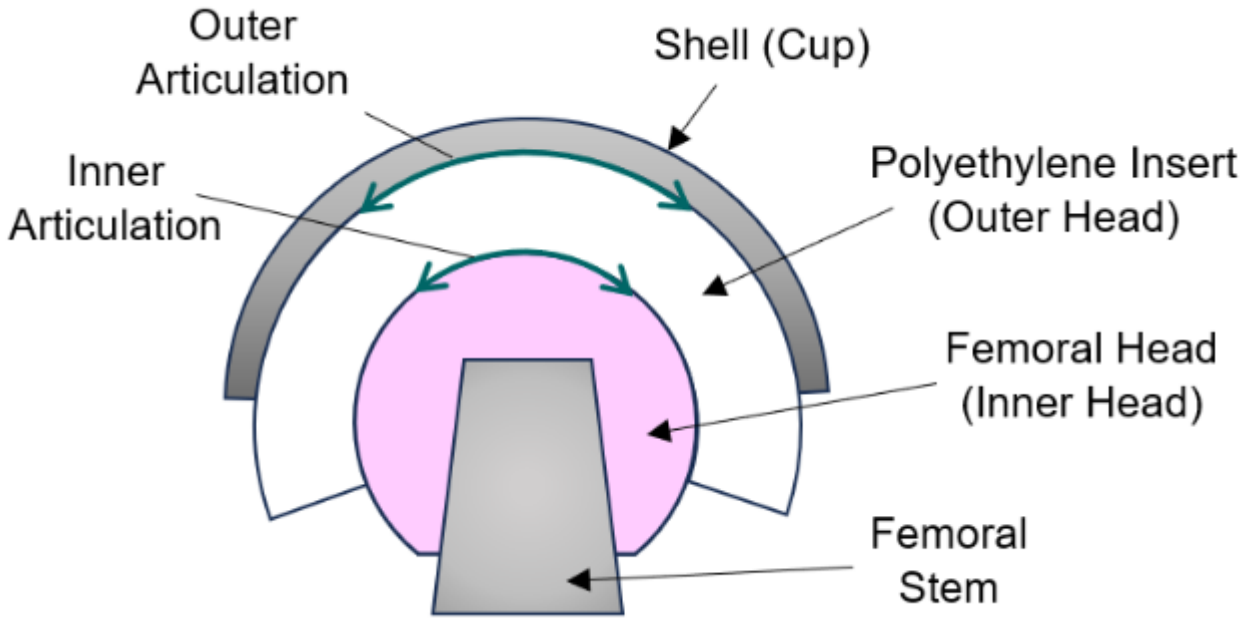


Photo: https://www.orthoinno.com/innovations/dual-mobility-hip-testing/

# Dual Mobility

## PROS

Can be either modular or non-modular on the acetabular side

Can increase arc of motion prior to impingement theoretically lowering dislocation risk and increasing range of motion and hip mobility

Potentially even lower rate of polyethylene wear than single mobility bearing surfaces (Gigante et al)

## CONS

Can have intra-prosthetic dissociation

Can be more difficult to reduce via closed means (34.6% vs 90%) when compared to standard articulations

Modular acetabular options raise some concerns for metal ion generation

More expensive

# Dual Mobility

FDA Approved for utilization in US in 2009

Measurable levels of Co and Cr seen in MDM hips at mean 30.4 months, although at low levels. Ceramic (0.4 mcg/L) heads had lower levels than CoCr (1.2 mcg/L) heads, but no effect of ion levels on outcome scores (Kamath et al)

Lower dislocation rates compared to non-dm bearings at 90 days and 1 year in patients with history of lumbar spine fusion or diagnosis of lumbar degenerative disc disease (Nessler et al)

Mixed data on dislocation rates in revision THA (Dubin et al-improved,  Sonn et al-no difference when compared to >/= 40 mm head)

# Current Trends in Bearing Surfaces

Most common bearing surface in 2025 is Ceramic on Highly Cross Linked Polyethylene (HXLPE)

- Increasing utilization of larger heads with thinner polyethylene liners
- Single institution study from AAHKS 2025 showed 0/92 thin (3.9 mm) polyethylene liners required revision for polyethylene wear or for instability (Fillingham et. Al)

Rare utilization of metal on metal bearing surfaces (Dr. Slipak will discuss resurfacing which still commonly utilizes MoM)

Decreasing and now rare utilization of metal on polyethylene bearing surface in primary THA

Increasing utilization of DM bearing surfaces in primary and revision THA

- Single institution study of 4548 primary THA from 2013 to 2020 showed increased use of DM from 3.4% in 2013 to 47.1% in 2020 with no decrease in early survivorship

# From AAHKS 2025 Meeting

For posterior approach DM constructs significantly reduced risks of dislocation, for AL approach standard PE liners had lowest absolute dislocation risk, and DA had lower dislocation risk regardless of bearing selection (Cochrane et. Al)

- 30,000 THA between 1998 and 2022 at single center

Multicenter RCT showed DM did not statistically significantly reduce dislocations in high risk primary THA versus standard bearing (2.1% vs 0.7%) (Potluri et. Al)

Single institution study from AAHKS 2025 showed 0/92 thin (3.9 mm) polyethylene liners required revision for polyethylene wear or for instability (Fillingham et. Al)

# Summary

Total hip arthroplasty is a wonderful option for treating numerous debilitating conditions affecting the hip with excellent long-term results

Surgical technique and biomaterials have evolved over the 60+ years in which THA has been performed, and we have seen improved clinical outcomes as well as increased longevity of implants throughout that period

Mid-term data showing excellent results with even very thin (3.9 mm) modern HXLPE

Dual mobility constructs offer theoretical advantage of improved stability and increased impingement free ROM, but clinical literature is mixed on these results

Utilization of DM implants may be more beneficial in posterior approach cases compared to anterior based cases

Adopt all new technology with caution, and use best available data to guide treatment for each patient

# Thank You

# References


Knight SR, Aujla R, Biswas SP. Total Hip Arthroplasty - over 100 years of operative history. Orthop Rev (Pavia). 2011 Sep 6;3(2):e16. doi: 10.4081/or.2011.e16. Epub 2011 Nov 7. PMID: 22355482; PMCID: PMC3257425.

Langlois, Jean, and Moussa Hamadouche. "What have we learned from 20 years of using highly crosslinked PE in total hip arthroplasty?Orthopaedics & Traumatology: Surgery & Research. Vol 109 Iss 1. Feb 2023

Puccio FD, Mattei L. Biotribology of artificial hip joints. *World J Orthop* 2015; 6(1): 77-94 [PMID: 25621213 DOI: 10.5312/wjo.v6.i1.77]

Dual Mobility Articulation in Total Hip Arthroplasty: Mixed Femoral and Acetabular Components are a Feasible Option Holland, Christopher et al. The Journal of Arthroplasty, Volume 39, Issue 9, S178 - S182

Guyen, Olivier MD, PhD*†,‡; Chen, Qing Shan MS*; Bejui-Hugues, Jacques MD†; Berry, Daniel J MD*; An, Kai-Nan PhD*. Clinical Orthopaedics and Related Research (1976-2007): February 2007 - Volume 455 - Issue - pp 202-208doi: 10.1097/01.blo.0000238796.59596.1f

Dislocated Dual-Mobility Hip Implants Are Unlikely to Be Successfully Closed Reduced and Are More Likely to Require Revision Than Standard Articulation ImplantsMallender, Janyne et al.Arthroplasty Today, Volume 35, 101860

Nessler JM, Malkani AL, Yep PJ, Mullen KJ, Illgen RL 2nd. Dislocation Rates of Primary Total Hip Arthroplasty in Patients With Prior Lumbar Spine Fusion and Lumbar Degenerative Disk Disease With and Without Utilization of Dual Mobility Cups: An American Joint Replacement Registry Study. J Am Acad Orthop Surg. 2023 Mar 1;31(5):e271-e277. doi: 10.5435/JAAOS-D-22-00767. Epub 2022 Dec 29. PMID: 36728665.

# References Cont.


Dubin JA, Bains SS, Chen Z, Hameed D, Moore MC, Mont MA, Nace J, Delanois RE. Single center evaluation of outcomes of modular dual mobility liners during revision total hip arthroplasty: A five-year follow-up. J Orthop. 2023 Jul 25;43:75-78. doi: 10.1016/j.jor.2023.07.016. PMID: 37559883; PMCID: PMC10407033.

Lee A, Arthur J, Najdawi J, Durst CR, Rajaee SS, Spitzer AI. No Decrease in Early Survivorship of Dual Mobility Implants in Primary Total Hip Arthroplasty. Arthroplast Today. 2024 Jul 3;28:101452. doi: 10.1016/j.artd.2024.101452. PMID: 39071094; PMCID: PMC11282969.

Leipman J, Salehi N, Restrepo C, SmithE, Purtill J, Fillingham Y. (2025, Oct 25). Long-Term Follow up of thin polyethylene liners in total hip arthroplasty. American Association of Hip and Knee Surgeons 2025 Annual Meeting, Dallas, TX, United States

Potluri A, Yadav A, Weintraub M, DeBenedetti A, Della Valle C, Schwarzkopf R, Courtney P, Heckmann N, Nam D. (2025, Oct 25). Dual-mobility femoral heads in patients at high risk for dislocation: A randomized control trial. American Association of Hip and Knee Surgeons 2025 Annual Meeting, Dallas, TX, United States

Cochrane N, Panos J, Pagnano M, Taunton M, Wyles C, Abdel M. (2025, Oct 25). No one-size-fits-all: Surgical approach dictates optimal bearing choice in 30,000 THAs over 25 years. American Association of Hip and Knee Surgeons 2025 Annual Meeting, Dallas, TX, United States

Gigante AP, Senarighi M, Ciccullo C, De Berardinis L, Farinelli L. Reduced polyethylene wear in dual mobility versus single mobility hip implants: Results from quantitative and qualitative scanning electron microscopy analysis. J Exp Orthop. 2025 Feb 26;12(1):e70177. doi: 10.1002/jeo2.70177. PMID: 40017700; PMCID: PMC11865326.

Kamath AF, Courtney PM, Lee GC. Metal ion levels with use of modular dual mobility constructs: Can the evidence guide us on clinical use? J Orthop. 2021 Feb 20;24:91-95. doi: 10.1016/j.jor.2021.02.018. PMID: 33679034; PMCID: PMC7910403.