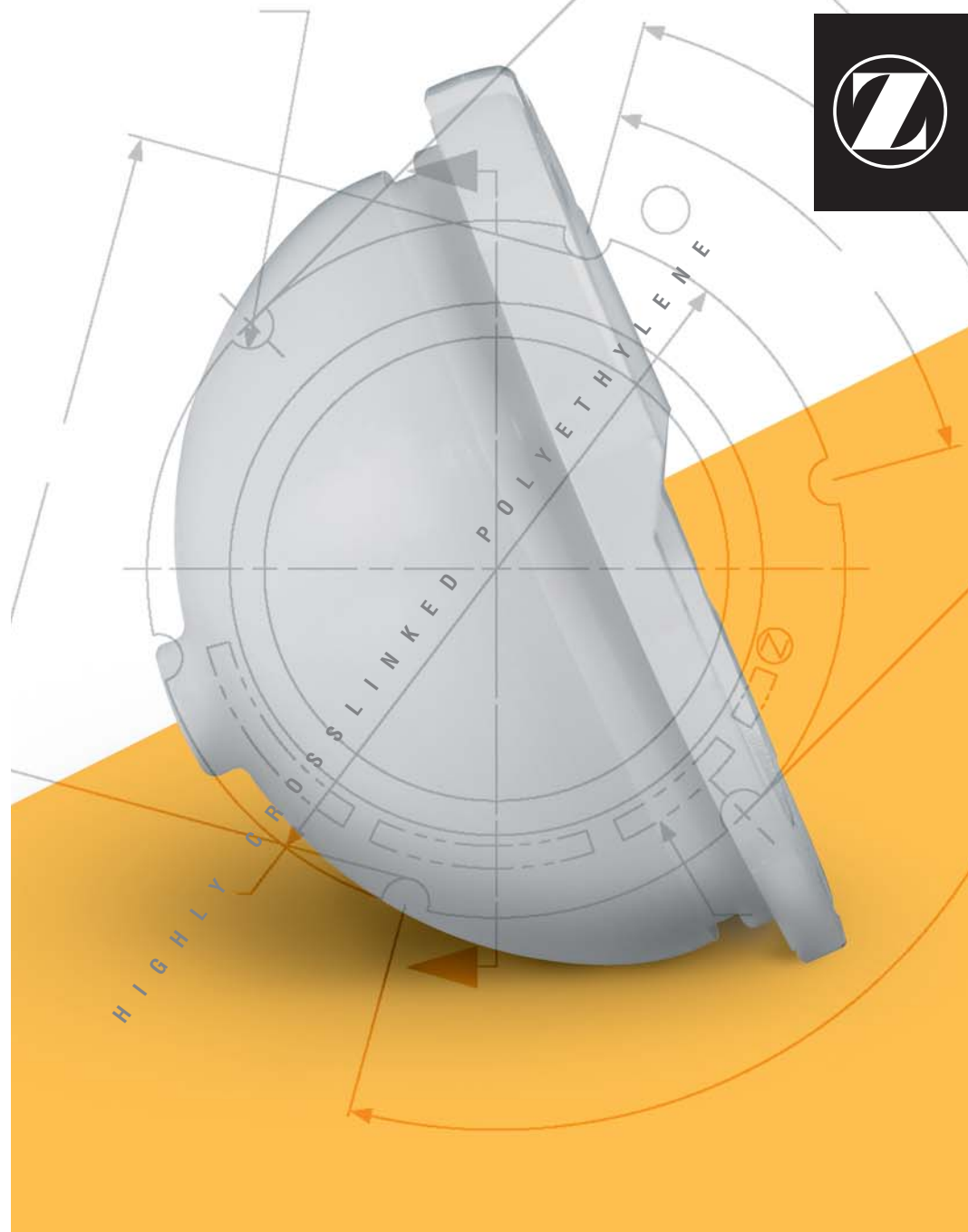


Limit Wear-
Not Options

Alternative Bearing Surfaces

For more information, contact your Zimmer representative or visit us at www.zimmer.com.

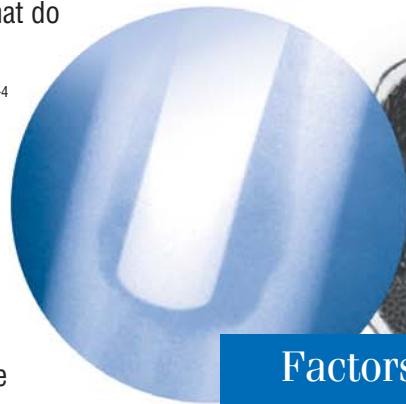


Issue: **Wear** in Total Hip Arthroplasty

Patient longevity and active lifestyle have led to an increase in the physical demands placed upon THA bearing surfaces. As a result, implant manufacturers are continuing to search for ways to improve performance of these bearing surfaces and have introduced several products to help address the issue.

As with any bearing surface, the primary concern for orthopaedic surgeons is wear and the impact that wear debris has on THA. Although the vast majority of total hip arthroplasties are successful, in the small amount that do fail, literature reports osteolysis as a primary limiter of implant service life.¹⁻⁴

The results of osteolysis due to wear debris can be seen in this radiograph at the distal tip of a stem.

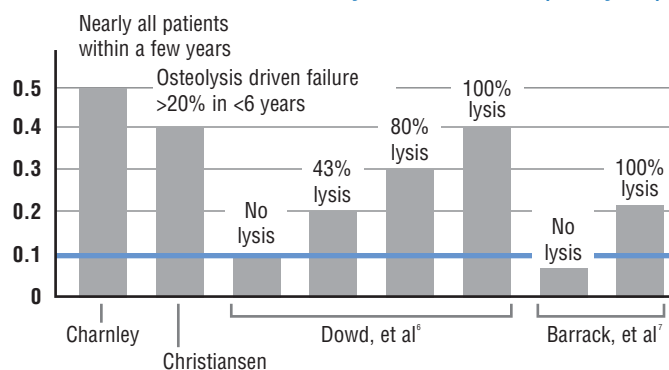


The true measure of wear

The question regarding wear has to be clarified in relation to clinically relevant wear.

The answer can be found in several important studies⁵⁻⁷ that suggested a threshold level for the body's reaction to particulate debris.⁵ The threshold level was measured as a function of linear wear per year, measured in millimeters. The Dumbleton, et al study⁵ concluded that osteolysis was more common when linear wear exceeded 0.1mm/year and rare when it was below that threshold.

Linear wear relative to osteolysis occurrence (mm/year)



Factors affecting wear *in vivo*

The ultimate test of any bearing surface remains its performance *in vivo*.⁸ This is influenced by a complex interplay of numerous factors. While implant material, design, and processing can be controlled, the patient's general health or individual response to wear cannot.

Implants

- Material
 - Roughness
 - Contact area
- Design
 - Modular
 - One-piece
 - Conformity
- Processing
- Sterilization
- Packaging

Fixation

- Cemented
- Cementless
- Augmented (Cables, screws, locking pins)

Patient

- Age
- Weight
- Activity level
- General health
- Individual response to wear debris
- Expectations
- Bone equality

Surgical Technique

- Experience
- Component positioning

Factors affecting bearing wear *in vivo*



Solutions: Alternative Bearing Surfaces

A key goal for the orthopaedic surgeon is to reduce wear; thereby reducing a potential source of osteolysis. As a result, a great deal of activity and interest is centered on alternative bearing surfaces as contemporary solutions for addressing wear.⁹⁻¹¹ Alternative bearing materials are defined as such by their potentially lower wear rates. The “alternative” in “alternative bearing” refers to an alternative to conventional polyethylene (UHMWPE).

Alternative bearing surface options

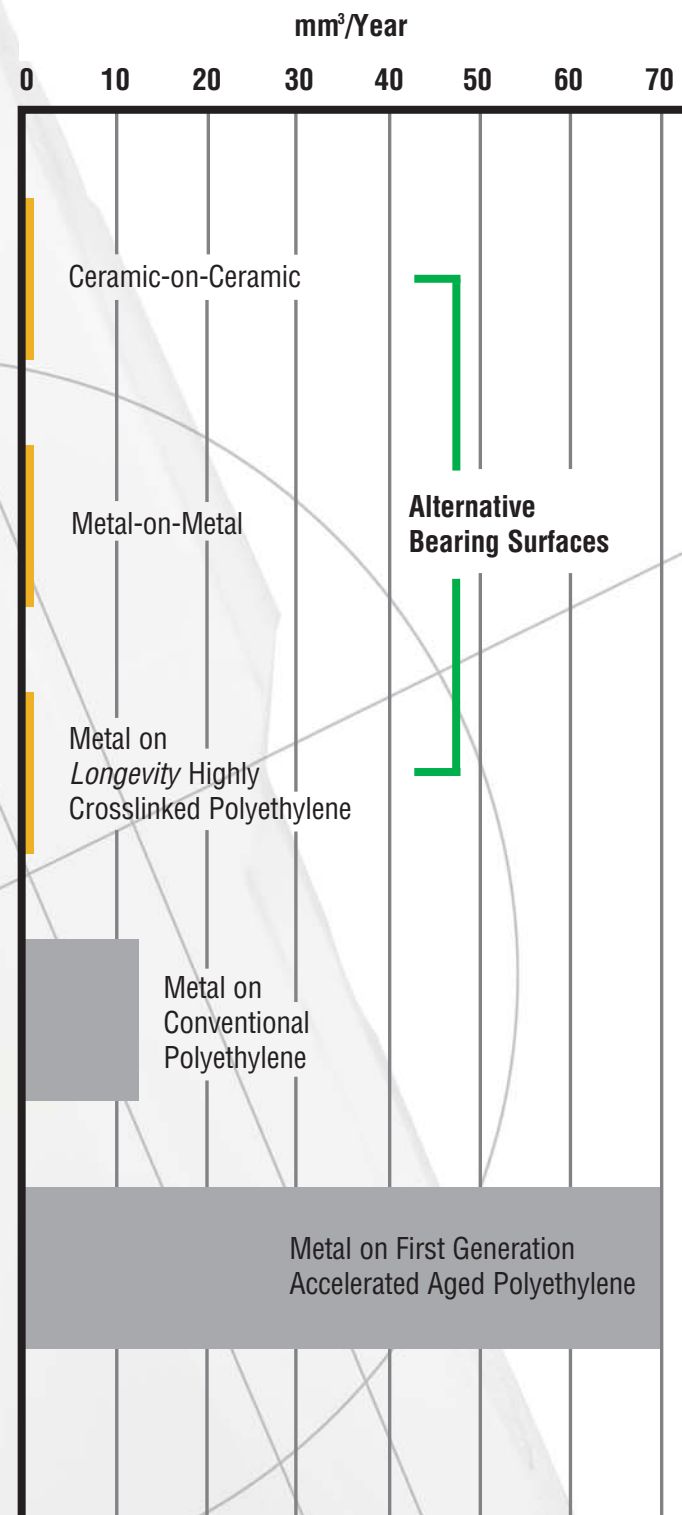
Femoral head	Acetabular articulating surface
Metal	Metal
Ceramic	Ceramic
Metal or Ceramic	Highly Crosslinked Polyethylene

There are no new bearing materials

Implant manufacturers have created excitement for and introduced their individual brand of alternative bearing surface materials. In reality, there are no brand new bearing materials. However, significant gains have been made over 20 years in the evolution of metal, ceramic, and polyethylene materials and their respective manufacturing processes. In addition to conventional polyethylene, the surgeon now has several alternative bearing surfaces to choose from.

Comparison of wear rate

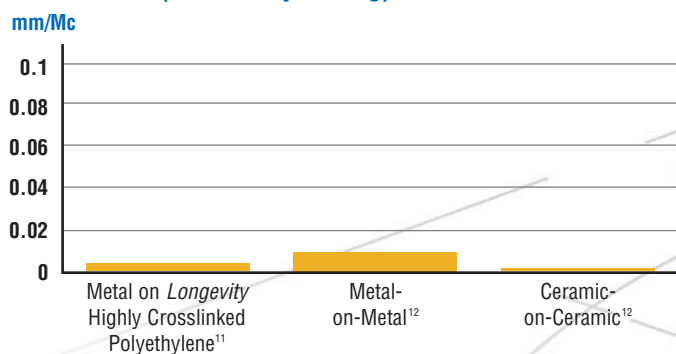
Due to improved materials and processes, wear rates were reduced by 50-60 times in laboratory testing,⁹⁻¹¹ when alternative bearings were compared to first generation polyethylene.



Preeminent Alternative Bearing: Longevity

Highly Crosslinked Polyethylene

Linear wear (Laboratory testing)



Yes, highly crosslinked polyethylene is an alternative bearing surface

If alternative bearing surfaces provide an alternative to conventional polyethylene and deliver a less than 0.1mm/Mc wear debris rate, *Longevity*® Highly Crosslinked Polyethylene certainly meets the criteria. Zimmer's *Longevity* Highly Crosslinked Polyethylene showed a wear rate of 0.001mm/Mc *in vitro*,¹¹ a rate that is 1/100th of the level shown to be associated with osteolysis.

Leadership and innovation in addressing wear

Zimmer introduced *Longevity* Highly Crosslinked Polyethylene in 1999, well before alternative bearings became a focus of discussion.

- Zimmer's crosslinking process produces an 89%* reduction of wear debris *in vitro*, compared to conventional polyethylene.¹¹
- *Longevity* Polyethylene is made from a proprietary process that interlinks molecular chains, leaving virtually no free radicals to promote oxidation.¹¹
- *Longevity* Polyethylene meets or exceeds ASTM and ISO standards.¹³

Neutral Standard ID

7mm Offset

10° Elevated Rim

20° Elevated Rim



* Wear reduction of 90 and 88 percent for 22mm and 32mm femoral heads, respectively, when compared to standard Zimmer polyethylene. The results of *in vitro* tests have not been shown to correlate with clinical wear mechanisms.

Limit Wear- Not Options: Longevity

Highly Crosslinked Polyethylene

Joint stability matters

Joint stability plays a key role in addressing wear and in the overall success of THA. According to Dr. Bill Maloney, a recognized expert in hip replacement surgery, "limiting intraoperative options of liner configuration, head size, or neck length may have negative consequences in relation to overall joint stability." For alternative bearing surfaces, *Longevity* Polyethylene offers a diverse portfolio that does not limit intraoperative options.

The Zimmer *Trabecular Metal*™ Modular Acetabular System, the preeminent porous surface for optimum bone ingrowth. Tests have shown that it's "The Best Thing Next To Bone."[™]



Zimmer acetabular components

Proper acetabular cup placement and fixation are critical when alternative bearing surfaces are used.¹⁴ Micromotion, lack of liner congruency, and failure of the locking mechanism can contribute to the generation of wear debris. *Longevity* Highly Crosslinked Polyethylene, with the *Trilogy*® Acetabular System and the Zimmer *Trabecular Metal* Modular Acetabular System, can provide a combination that is an optimal fit.



The *Trilogy* Acetabular System features liner to shell congruency, an innovative liner locking mechanism, and an excellent history of clinical success with fiber metal fixation beginning with the Harris/Galante and HGP II porous cups.^{11,13-16}



Liner choices in alternative bearing couplings



<i>Longevity</i> Polyethylene	Ceramic on Ceramic	Metal on Metal
Neutral Standard ID	Neutral Standard ID	Neutral Standard ID
10° Elevated Rim	–	–
20° Elevated Rim	–	–
7mm Offset	–	–
Neutral Large ID	Neutral Large ID	Neutral Large ID
10° Elevated Rim Large ID	–	–
Oblique*	–	–
Eccentric*	–	–
Constrained*	–	–

* Not currently available in *Longevity* Highly Crosslinked Polyethylene.

Leadership: Zimmer Innovation

Limiting wear, not options

Limiting choices in the OR is not an option. While metal-on-metal, ceramic-on-ceramic, and metal or ceramic on *Longevity* Highly Crosslinked Polyethylene alternative bearing surfaces offer parity in wear rates, Zimmer provides component systems and solutions designed to limit wear, not the surgeon's intraoperative options.



The comprehensive solution

Zimmer relentlessly pursues the best resources to enhance the five key factors important to implant performance: Material, Processing, Design, Sterilization, and Packaging.

References

- 1 Charnley J. Rate of wear in total hip replacements. *Clin Orthop*. 1975;112-171.
- 2 Wroblewski BM, Siney PD. Charnley low-friction arthroplasty of the hip. *Clin Orthop*. 1993;291:191-201.
- 3 Goldring SR, Clark CR, Wright TM. The problem in total joint arthroplasty: Aseptic loosening. *J Bone Joint Surg*. 1993;(75)A:799-801.
- 4 Harris WH. The problem is osteolysis. *Clin Orthop Rel Res*. 1995;311:46-53
- 5 Dumbleton JH, Manley MT, Edidin AA. A literature review of the association between wear rate and osteolysis in total hip arthroplasty. *J Arthroplasty*. 2002;17-5:649-661.
- 6 Dowd JE, Sychterz W, Engh CA. Characterization of long-term femoral head penetration rates: Association with and prediction of osteolysis. *J Bone Joint Surg*. 2000;(82)A:1102-1107.
- 7 Barrack RL, Folgueras A, Munn B. Pelvic lysis and polyethylene wear at 5-8 years in an uncemented total hip. *Clin Orthop Rel Res*. 1997;335:211.
- 8 Schmalzried TP, Clarke LC, Mckellop HA. Bearing surfaces. *The Adult Hip*. 1998;17:247.
- 9 Mahoney OM, Dimon JH. Unsatisfactory results with a ceramic total hip prosthesis. *J Bone Joint Surg*. 1990;(72)A:663-671.
- 10 Charnley J. Low friction principles: Low friction arthroplasty of the hip. 1979;(1):6.
- 11 Data on file at Zimmer, Inc.
- 12 Fisher J, Besong AA, Firkins PJ, et al. Comparative wear and debris generation in UHMWPE on ceramic-on-ceramic, metal-on-metal, and ceramic-on-metal hip prosthesis. 46th Annual Meeting, Orthopaedic Research Society, March 12-15, 2000.
- 13 Doehring TC, Saigal S, Shanbag AS, et al. Micromotion of acetabular liners; Measurements comparing the effectiveness of locking mechanisms. Orthopaedic Research Society, 42nd Annual Meeting, 1996.
- 14 DePuy Pinnacle Acetabular Cup surgical technique. Pg. 36.
- 15 Sporer SM, Callaghan JJ, Olejniczak JP, et al. Hybrid total hip arthroplasty in patients under the age of fifty: A five-to-ten year follow-up. *J Arthroplasty*. 1998;13(5):485-491.
- 16 Berger RA, Jacobs JJ, Quigley LR, et al. Primary cementless acetabular reconstruction in patients younger than 50 years old: 7-11 year results. *Clin Orthop Rel Res*. 1997;344:216-226.