

Longevity[®] Highly Cross-linked Polyethylene

Clinical Value Dossier—Hip

Introduction

Beginning in the late 1990s, the first versions of highly cross-linked polyethylene (HXLPE) bearings became available as manufacturers looked to reduce the prevalence of wear. At that time, *in vitro* studies were demonstrating improved wear rates in HXLPE versus conventional polyethylene (PE).¹ Zimmer introduced Longevity HXLPE in 1999, using electron beam radiation in the manufacturing process to achieve high levels of cross-linking² as well as a remelting process to reduce free radicals that can cause oxidation. Since its introduction, there have been numerous short-term, mid-term, and long-term clinical studies summarizing the success of Longevity HXLPE bearings in THA. In addition, differences in revision surgeries and polyethylene durability in young patients have been evaluated.^{8,9}

Published Clinical Articles

Short-term Results

Does Highly Cross-Linked Polyethylene Wear Less Than Conventional Polyethylene in Total Hip Arthroplasty?³

Sion Glyn-Jones, MRCS; Sherif Isaac, FRCS; Jennifer Hauptfleisch, MD; Peter McLardy-Smith, FRCS(Orth); David W. Murray, FRCS; and Harinderjit Singh Gill, DPhil

- 54 hips
- 2-year follow-up
- 100% survivorship

The purpose of this prospective, double-blind, randomized study was to compare the 3D liner penetration of HXLPE liners to conventional PE liners. A total of 27 hips were implanted with the Longevity liner and 27 hips were implanted with the Trilogy[®] conventional PE liner. Penetration rates were evaluated at 3 months and 2 years, as well as Oxford Hip Scores at 1 year post-op. At 3 months, there was no significant difference in penetration rates for the 2 groups. However, at 2 years, the penetration rate for the Longevity HXLPE group (0.06mm/yr) was significantly lower than the conventional PE group (0.10mm/yr). Oxford Hip Scores improved for both groups (48 to 13.3 for Longevity HXLPE and 50 to 12.9 for conventional PE) and no significant differences were observed. No implants were revised for either group. The authors concluded that cross-linking decreases the polyethylene wear rate.

Mid-Term Results

Wear Comparison Between a Highly Cross-Linked Polyethylene and Conventional Polyethylene Against a Zirconia Femoral Head⁴

Kiyokazu Fukui, MD, PhD; Ayumi Kaneuji, MD, PhD; Tanzo Sugimori, MD, PhD; Toru Ichiseki, MD, PhD; Kenji Kitamura, MD, PhD; and Tadami Matsumoto, MD, PhD

- 65 hips
- Mean 5.4-year follow-up
- 86% wear rate reduction
- No radiographic osteolysis

The purpose of this study was to compare the 5-year wear of HXLPE liners to conventional PE liners using a zirconia femoral head. A total of 45 hips were implanted with the Longevity HXLPE liner and 20 hips were implanted with the Trilogy conventional PE liner. At an average follow-up of 5.4 years, the mean penetration rate for the Longevity HXLPE group was 0.01 ± 0.006 mm/yr and 0.068 ± 0.025 mm/yr for the conventional PE group; an 86% reduction. In addition, no osteolysis was observed in the Longevity HXLPE group vs. 15% had osteolysis in the conventional PE group. The authors observed a reduction in wear with a zirconia-HXLPE bearing combination.

Minimum Five-Year Follow-Up Wear Measurement of Longevity Highly Cross-Linked Polyethylene Cup Against Cobalt-Chromium or Zirconia Heads⁵

Ichiro Nakahara, MD; Nobuo Nakamura, MD, PhD; Takashi Nishii, MD, PhD; Hidenobu Miki, MD, PhD; Takashi Sakai, MD, PhD; and Nobuhiko Sugano, MD, PhD

- 102 hips
- Mean 6.7-year follow-up
- No osteolysis or loosening
- 100% survivorship

The purpose of this study was to compare the efficacy of HXLPE liners with ceramic vs. cobalt-chromium heads. A total of 51 hips were implanted with the Longevity HXLPE liner and zirconia head and 51 hips were implanted with the Longevity HXLPE liner and cobalt-chromium head. At an average follow-up of 6.7 years, there were no significant differences in total penetration rate or steady-state wear rate between the two groups. In addition, there was no osteolysis or loosening in either group. There were no differences in Merle d'Augigne and UCLA scores at final follow-up. Survivorship was 100% in both groups. The authors concluded that there was a steady-state wear rate of almost zero with Longevity HXLPE liners and there was no advantage seen for the zirconia heads compared to cobalt-chromium heads.

The Seven-Year Wear of Highly Cross-Linked Polyethylene in Total Hip Arthroplasty⁶

Geraint E.R. Thomas, MA, MRCS; David J. Simpson, PhD; Shahid Mehmood, MRCS; Adrian Taylor, FRCS(Orth); Peter McLardy-Smith, FRCS, MA; Harinderjit Singh Gill, DPhil; David W. Murray, MA, MD, FRCS(Orth); and Siôn Glyn-Jones, MA, DPhil, FRCS(Orth)

- 54 hips
- Minimum 7-year follow-up
- 8x lower wear rate than conventional
- 100% survivorship

The purpose of this prospective, double-blind, randomized study was to compare the 7-year wear of HXLPE liners to conventional PE liners. A total of 27 hips were implanted with the Longevity liner and 27 hips were implanted with the conventional PE liner. All patients received an uncemented acetabular shell and a cemented polished tapered stem construct. At a minimum follow-up of 7 years, the steady-state wear rate was found to be 8 times lower in the HXLPE group vs. the conventional PE group. Two patients in the conventional PE group experienced wear rate threshold of 0.17mm/yr, which is greater than the osteolysis wear rate at 0.1mm/yr. Alternatively, the maximum wear rate in the highly cross-linked polyethylene group was 0.07mm/yr. The authors concluded that there was a significant difference in terms of the wear rate between the two types of polyethylene ($p = 0.007$); the highly cross-linked polyethylene had a steady-state wear rate that was eight times lower than that of the UHMWPE.

Long-Term Results

Wear Comparison Between Conventional and Highly Cross-Linked Polyethylene Against a Zirconia Head A Concise Follow-Up, at an Average 10 Years, of a Previous Report⁷

Kiyokazu Fukui, MD, PhD; Ayumi Kaneuji, MD, PhD; Tanzo Sugimori, MD, PhD; Toru Ichiseki, MD, PhD; Tadami Matsumoto, MD, PhD

- 56 hips
- Mean 10.5-year follow-up
- No radiographic osteolysis
- 100% survivorship

The purpose of this follow-up study was to compare the 10-year wear of HXLPE liners to conventional PE liners using a zirconia femoral head. A total of 45 hips were implanted with an HXLPE Longevity liner and 20 hips were implanted with a Trilogy conventional PE liner. Since the 2011 Fukui study, 9 patients were lost to follow-up, leaving 36 hips in the Longevity HXLPE liner group. At an average follow-up of 10.5 years, the mean wear rate for the Longevity group was 0.045 ± 0.028 mm/yr and 0.080 ± 0.039 mm/yr for the conventional PE group. In addition, no osteolysis was observed in the Longevity HXLPE liner group vs. 25% had osteolysis in the conventional PE liner group— an increase of 10% from the original study. Survivorship in both groups was 100%. The authors concluded HXLPE maintains a significantly lower wear rate than conventional PE with a zirconia femoral head for at least 10 years where the incidence of osteolysis was 25% in the conventional PE group compared to 0% in the HXLPE group.

Revision THA

Use of Porous Tantalum Components in Paprosky Two and Three Acetabular Revision. A Minimum Five-Year Follow-Up of Fifty One Hips⁸

Xavier Flecher; Benjamin Appy; Sébastien Parratte; Matthieu Ollivier; and Jean-Noel Argenson

- 51 hips
- Mean 6.8-year follow-up
- Mean HHS 84
- 100% survivorship with aseptic loosening as endpoint

The purpose of this study was to evaluate the 5–10-year outcome and survivorship of acetabular revision total hip arthroplasty using tantalum components. Longevity HXLPE liners were used for all surgeries. A total of 51 patients were retrospectively reviewed at an average follow-up of 6.8 years. Twenty-five patients included a femoral revision and 16 patients required the use of tantalum augments stabilized by screws and cement. At follow-up the HHS score had improved from 44 pre-op to 84 post-op. The mean post-op hip center position was 29mm and the mean acetabular inclination was 42°. Six patients underwent re-operations without component revision. One patient required a cup re-revision for septic loosening (not component related). With aseptic loosening as an endpoint, the global survivorship was 100%. The authors concluded that in a revision scenario that includes TM, Longevity HXLPE liners had a 100% survivorship at 5-10 yrs, with aseptic loosening as the endpoint.

Young Patients

Total Hip Arthroplasty Using Highly Cross-Linked Polyethylene in Patients Younger Than 50 Years With Minimum 10-Year Follow-Up⁹

Nikola Babovic, BA; Robert T. Trousdale, MD

- 54 hips
- Mean 10.44-year follow-up
- Mean HHS 91.2
- No osteolysis or loosening
- 100% survivorship

The purpose of this study was to investigate the long-term outcomes in patients younger than 50 years of age who underwent THA using HXLPE liners. All liners used in surgery were Longevity liners. Fifty patients (54 hips) were evaluated for an average follow-up length of 10.44 years. The average age of the population was 38.9 years (15–50 years). Survivorship was 100% with no evidence of osteolysis or implant loosening. Clinical outcomes were excellent, with an average HHS of 91.2 at final follow-up. Wear rates were low at 0.020±0.0047 mm/yr. The authors have concluded that HXLPE liners have excellent long-term potential, even in a younger, more active population.

References

1. McCalden, R. W., et al. Wear Rate of Highly Cross-Linked Polyethylene in Total Hip Arthroplasty: A Randomized Controlled Trial. *Journal of Bone and Joint Surgery*. 91(4), 773-782, 2009.
2. Greer, K. W., et al. The Effects of Raw Material, Irradiation Dose, and Irradiation Source on Crosslinking of UHMWPE. *Journal of ASTM International*. 1(1), 1-11, 2004.
3. Glyn-Jones, S., et al. Does Highly Cross-Linked Polyethylene Wear Less than Conventional Polyethylene in Total Hip Arthroplasty?: A Double-Blind, Randomized, and Controlled Trial Using Roentgen Stereophotogrammetric Analysis. *The Journal of Arthroplasty*. 23(3), 337-343, 2008.
4. Fukui, K., et al. Wear Comparison Between a Highly Cross-Linked Polyethylene and Conventional Polyethylene Against a Zirconia Femoral Head: Minimum 5-year Follow-up. *The Journal of Arthroplasty*. 26(1), 45-49, 2011.
5. Nakahara, I., et al. Minimum Five-year Follow-up Wear Measurement of Longevity Highly Cross-linked Polyethylene Cup Against Cobalt-Chromium or Zirconia Heads. *The Journal of Arthroplasty*. 25(8), 1182-1187, 2010.
6. Thomas, G. E., et al. The Seven-year Wear of Highly Cross-linked Polyethylene in Total Hip Arthroplasty: A Double-blind, Randomized Controlled Trial Using Radiostereometric Analysis. *Journal of Bone and Joint Surgery*. 93(8), 716-722, 2011.
7. Fukui, K., et al. Wear Comparison Between Conventional and Highly Cross-linked Polyethylene Against A Zirconia Head: A Concise Follow-up, at an Average 10 Years, of a Previous Report. *The Journal of Arthroplasty*. 28(9), 1654-1658, 2013.
8. Flecher, X., et al. Use of Porous Tantalum Components in Paprosky Two and Three Acetabular Revision. A minimum five-year follow-up of fifty one hips. *International Orthopaedics*. 41(5), 911-916, 2017.
9. Babovic, N., et al. Total Hip Arthroplasty Using Highly Cross-linked Polyethylene in Patients Younger than 50 years with Minimum 10-year Follow-up. *The Journal of Arthroplasty*. 28(5), 815-817, 2013.

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