

Comparison between Delta-on-Delta and Delta-on-Highly Cross-Linked Polyethylene Total Hip Arthroplasty in South Korea; National Claim Database Analysis

Jung-Wee Park, Young-Kyun Lee

INTRODUCTION:

Despite the effectiveness of this procedure, some patients often require revision surgery after total hip arthroplasty (THA). Aseptic loosening remains the leading cause of revision following THA, primarily driven by osteolysis from polyethylene (PE) wear debris. To address this, alternative bearing surfaces such as ceramic and highly cross-linked polyethylene (HXLPE) have been developed to reduce wear-related complications. Ceramic bearings offer favorable tribological properties, including high hardness, wettability, and low friction, resulting in reduced wear and osteolysis. Although ceramic fracture has been a concern, the introduction of fourth-generation ceramics (BioloX Delta) has significantly improved material strength and reduced fracture rates, with liner malseating still posing a risk. HXLPE, produced by irradiating and thermally treating ultra-high molecular weight polyethylene (UHMWPE), also demonstrates reduced wear and debris generation. While several Western registry studies have compared ceramic-on-ceramic (CoC) and ceramic-on-HXLPE (CoHXLPE) THA, there remains a paucity of large-scale studies evaluating the safety and effectiveness of Delta ceramic versus HXLPE liners in THA using Delta ceramic heads, particularly in East Asian populations.

The purpose of this study was (1) to evaluate the national trends of Delta ceramic and HXLPE liner in THA, and (2) to compare survivorship of Delta ceramic versus HXLPE liner when used with a Delta ceramic head.

METHODS: Using the K-NHIS database, we identified all patients who underwent primary THA using Delta ceramic head in the South Korea between 2003 and 2013 ($n = 16,250$). Cumulative incidences of dislocation, periprosthetic joint infection (PJI), periprosthetic fracture were evaluated according to bearing type: Delta ceramic-on-Delta ceramic (DoD), and Delta ceramic-on-HXLPE (DoHXLPE). Survivorship for revisions was calculated to determine differences. Multivariable Cox proportional hazard regression ratios (HRs) were used for comparisons.

RESULTS:

A total of 15,299 patients underwent THA with Delta ceramic head between 2003 and 2013. Delta liner was used in 14,255 patients (93.2%) and HXLPE in 1,044 patients (6.8%). Utilization of Delta liner have noticeably increased since 2007. DoHXLPE group had a higher risk of PJI (aHR = 2.10, 95% CI = 1.29-3.43) compared to the DoD group within 1 year. There were no significant differences in risk of dislocation (aHR = 1.41, 95% CI = 0.97-2.05) and periprosthetic fracture (HR = 0.90; 95% CI = 0.39, 2.06) within 1 year.

After 10 years, DoHXLPE group had a higher risk of any revision (aHR = 1.38; 95% CI = 1.03, 1.32) compared to the DoD group, despite the similar risk of cup revision and stem revision. The 10-year survival rate for any revision in DoD group (96.5%, 95% CI= 96.2, 96.9) was higher (96.2% (95.1, 97.2)) than those in DoHXLPE group (95.3% 95% CI=93.9, 96.7).

DISCUSSION AND CONCLUSION: This nationwide registry-based cohort study is the first in East Asia to directly compare DoD and DoHXLPE bearings in THA. The utilization of DoD has markedly increased since 2007, particularly among younger, healthier male patients. DoD demonstrated superior implant survivorship and a significantly lower risk of PJI compared to DoHXLPE, aligning with previous findings from Australian and Dutch registries. Unlike earlier studies, our analysis stratified by ceramic generation and revealed that DoD had a lower adjusted hazard ratio for revision than DoHXLPE, especially after 10 years.

While this retrospective study is subject to potential selection bias and limitations inherent to claims data—including lack of information on femoral head size—it offers clinically meaningful evidence supporting the use of Delta ceramic liners with Delta heads. Given the observed benefits in implant longevity and infection risk, Delta ceramic liners may be a favorable option in THA, although further prospective studies are needed to validate these findings and guide optimal bearing surface selection.