

# Oxidized Zirconium Femoral Components in Total Knee Arthroplasty: A Retrieval Study of the Tibial Bearing

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**Disclosures:** Afton K. Limberg (N), Zachary M. Currier (N), Kori C. Jevsevar (N), Matthew P. Abdel (AAHKS, IOEN, MAOA, OsteoRemedies, Springer, Stryker), Andrew J. Holte (N), Alexander R. Orem (Medacta), Douglas W. Van Citters (DePuy, Medacta, RevBio, TJO)

**INTRODUCTION:** Advanced materials for total knee arthroplasty (TKA) including crosslinked bearings and cobalt-free components show promise for reducing revision rate and improving outcomes. Longer duration studies attributing mechanical success to material choices are challenging to design owing to the complexity of in vivo radiological wear analysis. Recent large-scale retrieval studies with cobalt femurs have illuminated wear rates in knees and identified key factors contributing to wear reduction, including sex, age, crosslinked polyethylene, polished trays, and implant conformity. The objective of the current study is to test whether an alternative metal in the femur changes these factors.

**METHODS:** An IRB approved retrieval database was searched to identify 137 oxidized zirconium femoral TKA components over a period from 2004-2023; 75 had a bearing surface of never-irradiated polyethylene (PE) and 62 had a bearing surface of cross-linked polyethylene (XL). All had a polished tibial tray. The mean duration of implantation was 58 months (2-178 months) for the PE group and 34 months (5-84 months) for the XL group. The most common reasons for retrieval were instability in the PE group, and instability was tied with infection in the XL group. The patients were 50% females for the PE group and 47% females for the XL group, with a mean age of 64 years and 62 years, respectively. Mean BMI was 32.3 kg/m<sup>2</sup> for the PE group and 33.5 kg/m<sup>2</sup> for the XL group. Dimensional change (creep plus wear) was measured from the thickness of the polyethylene insert using short duration (<16 months) and never implanted devices as a reference. Oxidation (maximum ketone oxidation index) was measured via FTIR using a cross-section of the medial condyle of the polyethylene at <3 months post-explant. Statistical analyses were conducted using groups matched for in vivo duration. A p-value<0.05 was considered significant.

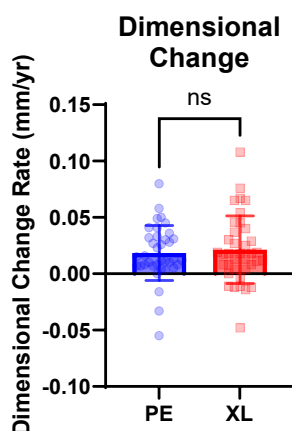
**RESULTS SECTION:** Dimensional change rate and in vivo oxidation rate were statistically indistinguishable between the two bearing types (Figures 1 & 2). Mean dimensional change rate for the PE group was 0.018±0.024 mm/year and 0.021±0.030 mm/year for the XL group. These values were not statistically different (p=0.64). Mean oxidation rates were also not statistically different, with the mean rate for the PE group being 0.051±0.052 a.u./year and the mean value for the XL group being 0.064±0.055 a.u./year (p=0.248). Only one device (PE) exceeded the critical oxidation threshold. While attempts were made to match patient populations in the two groups, small differences still exist. Previous work showed that younger age and male sex lead to higher dimensional change rates, suggesting that patient factors combined with the polished tibial tray may account for the lack of statistical difference between these two groups.

**DISCUSSION:** Overall, no significant differences were identified for dimensional change rate or oxidation rate for tibial inserts against an oxidized zirconium femoral component. The dimensional change results are very low and consistent with other reported values in the literature<sup>1</sup>, and similarly the oxidation rates were low and comparable to what has previously been reported for never irradiated or remelted TKAs<sup>2,3</sup>. Future studies should compare these values to those from cobalt-chromium based implants. The present results suggest that surgeons may have increased confidence in the use of these cobalt-alternative bearing couples.

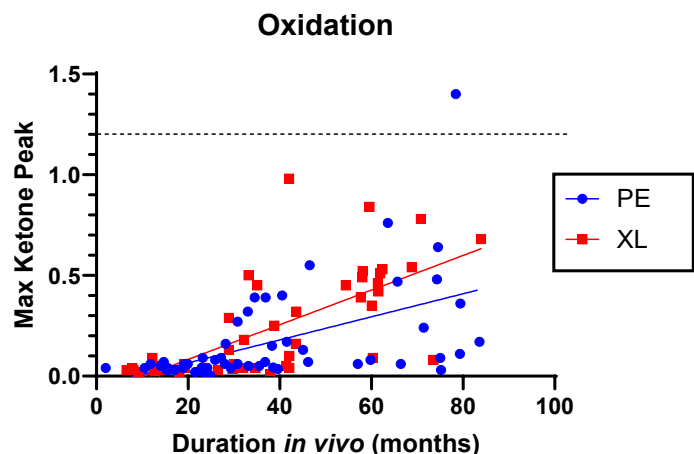
**SIGNIFICANCE/CLINICAL RELEVANCE:** (1-2 sentences): Dimensional change rate and oxidation rate for tibial inserts against oxidized zirconium femoral components were low and consistent with previously reported literature values.

**REFERENCES:** 1. Currier et al. BJJ 2021; 2. Currier et al. JBJS 2023; 3. Currier et al. JOA 2015

**IMAGES AND TABLES:**



**Figure 1:** Plot depicting dimensional change rate versus the duration in vivo. Dimensional change was measured via the thickness of the polyethylene component, taking implants in vivo for <16 months as the zero point. The presented data represents a matched data set including only in vivo durations out to 85 months for both groups.



**Figure 2:** Scatter plot showing the max ketone peak detected via FTIR versus duration in vivo. The dashed line at a max ketone peak of 1.2 represents the critical oxidation threshold. The presented data represents a matched data set including only in vivo durations out to 85 months for both groups.