Comparative Measurements of Oxidation in Highly Crosslinked and Conventional Acetabular Liners

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Components used in a total hip arthroplasty: femoral head, metal back cap, and polyethylene acetabular liner

Recently, crosslinked Ultra-high molecular weight polyethylene (PE) was introduced as an alternative to conventional PE as the bearing material in total joint replacements. Particulate PE debris generated by wear of the PE component triggers osteoclast-mediated resorption of bone resulting in implant loosening. Oxidation may lead to increased wear of the PE implant. In this investigation, the amount of oxidation was measured using shelf-aged acetabular liners of both conventional and crosslinked PE.

The objective of this study was to quantitatively measure and compare the oxidative resistance of crosslinked and conventional unused acetabular liners, in order to gain a better understanding of the wear resistance of these materials. Three conventional and three highly crosslinked PE acetabular liners from five different companies as well as three additional conventional liners were analyzed to determine the relative amounts of oxidation. One company uses gamma radiation for its final sterilization while others use non-radiation sterilization techniques. Oxidation was determined after 18-22 months of shelf aging using Fourier Transform Infrared (FTIR) spectroscopy techniques. Conventional PE did not have significantly higher oxidation than crosslinked PE (density: p=0.064, oxidation index: p=0.594). However, data suggest that radiation sterilized PE have increased oxidation compared to non-radiated PE (density: p<0.0002, oxidation index: p<0.001).