SURFACE DAMAGE OF POLYETHYLENE TIBIAL COMPONENTS OF THE AGILITY TOTAL ANKLE ARTHROPLASTY SYSTEM: A RETRIEVAL STUDY

*+Baker, K.C.; *Israel, R.; *Greene, P.W.; *Herkowitz, H.N.
* William Beaumont Hospital, Royal Oak, MI.
Kevin.Baker@beaumont.edu

INTRODUCTION:

Chronic loosening of the metallic talar component has been reported as the main reason for revision of total ankle prostheses.\(^1\) Looseing of the talar component is diagnosed radiographically as a subsidence, or migration and is often accompanied by lytic changes to the talus. While wear-debris induced osteolysis is often implicated as the cause of talar loosening, no work has been done to date to examine the damage modes of the polyethylene tibial components of total ankle arthroplasty (TAA) systems.\(^2,3\) This retrieval study forensically evaluates the polyethylene tibial components of three Agility TAA systems revised due to pain stemming from component loosening.

METHODS:

Three TAA systems (AGILITY™, DePuy) were retrieved via revision surgeries performed at William Beaumont Hospital. The polyethylene tibial components were rinsed with deionized water, ultrasonically cleaned with a diluted surfactant solution and desiccated with 70% ethanol. The polyethylene tibial components were sputtered with a 2.5nm thick Au-Pd film to enhance contrast during optical microscopy (Leica MZ-16, Leica Inc.) and to facilitate further characterization by scanning electron microscopy (SEM, JEOL JSM 6400, JEOL LTD.).

RESULTS:

Figure 1 shows the plastic deformation of the polyethylene articular surface, manifested by depressions mirroring the shape of the metallic talar component (talar footprint), as observed by optical microscopy. The rims of the polyethylene, proximal to the articulating surface, had also undergone deformation as shown in Figure 1.

A well-defined boundary between the talar footprint and the rest of the polyethylene articulating surface was observed and shown in Figure 2. Outside of the talar footprint, machining grooves were still visible with some disperse grooving and pitting. Within the talar footprints of all examined tibial components, the surface morphology was relatively smooth. Increases in surface roughness was noted when moving towards the anterior and posterior rims from the center of the talar footprint.

Figure 2. SEM image showing the boundary between the talar footprint and the rest of the articulating surface, with abrasive wear at the rim.

Figure 3. SEM images showing damage near the posterior rim (top left and right) and near the anterior rim (bottom left and right).

DISCUSSION:

In this retrieval study of Agility total ankles, three dominant modes of damage to the polyethylene tibial components were observed with optical and scanning electron microscopy. The first damage mode documented was the presence of a depression in the articulating surface of the polyethylene conforming to the shape of the talar component (talar footprint). The second mode of damage was plastic deformation of the rim-articulating surface interface. The final damage mode observed was an increasing amount of abrasive wear damage proximal to the anterior and posterior rim, within the talar footprint.

Nicholson et al demonstrated that the peak pressures in the Agility total ankles could exceed the yield limit of polyethylene in a cadaveric study due to edge loading.\(^3\) While edge loading may explain the plastic deformation of the rim-articulating surface interface, it cannot account for the presence of the talar footprint. This phenomenon is similar to the linear penetration of the femoral head into the acetabular liner, often seen in total hip arthroplasty.

Increased amounts of abrasive wear damage in the anterior and posterior regions of the talar footprint may be due to implant design, or altered biomechanics. The surface morphology in these regions seems to indicate the production of wear debris with fibrillar and globular shapes, which could lead to osteolysis and subsequent loosening of the talar component.

REFERENCES:


ACKNOWLEDGEMENTS:

The Implant Retrieval Program at William Beaumont Hospital is partially funded by the Stryker Corporation.

53rd Annual Meeting of the Orthopaedic Research Society
Poster No: 1211