Radiographic and Damage Mode Analysis of Retrieved DePuy Agility Ankle Arthroplasty Systems

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Severe arthritis and other diseases frequently resulted in complete arthrodesis of the ankle before the 1970s. First generation ankle implants allowed total ankle arthroplasty as an alternate treatment option. After poor outcomes, second generation designs were introduced, including the Agility (DePuy, Warsaw, IN) total ankle system. These designs had better outcomes; however, high failure rates were reported, especially implant failure due to chronic loosening of metallic components. The purposes of this study were to analyze the damage modes observed in retrieved Agility (DePuy, Warsaw, IN) total ankle systems and investigate the radiographic mode(s) of failure.

Ten systems (each system contains a metallic talar component, metallic tibial component, and polyethylene liner) were collected and each component was analyzed for common damage modes using microscopy. Analyses revealed damage to each component producing third-body particles, a precursor to wear debris-induced osteolysis as sources for component loosening. Abrasion, dishing, and pitting were the most commonly observed damage modes. Contact stress calculations demonstrated the expected stresses to the polyethylene liner at several regions on the liner. Clinical damage modes were also analyzed with postoperative implant procedure and preoperative revision procedure radiographs. Radiographic analyses and medical record review determined the locations of ballooning and line osteolysis, congruency, component migration and component loosening, which linked the laboratory findings.

The clinical relevance of this study is to correlate poor clinical outcome with component instability and osteolysis. Analyzing retrieved component wear and damage may be an important step toward improving implant design thereby decreasing wear debris induced osteolysis and improving clinical outcomes. Component wear and damage may ultimately lead to chronic loosening of components. Further research is needed with longterm clinical studies to determine the efficacy of these implants. Current research to analyze wear debris is ongoing.

![Fig. 5. Scanning electron micrographs of damage observed in two retrieved Agility (DePuy, Warsaw, IN) polyethylene liners, showing abrasion of polyethylene from Explant 1 (A) and embedded titanium in polyethylene tibial liner from Explant 5(B).](image-url)
Fig. 2. Description of methods for determining osteolysis and congruence, as applied to ankle prostheses, showing a mortise view radiograph from Explant 8 with methodology described by Pyevich et al. for determining the location and presence of ballooning osteolysis and lucency (A) and a mortise view radiograph from Explant 8 outlining the Haskell and Mann method, as adapted to the Agility (DePuy, Warsaw, IN) implant, for measuring congruence (B).