ANALYSIS OF RETRIEVED UHMWPE TIBIAL COMPONENTS FROM NEXGEN TKRs

Garcia RM; Messerschmitt PJ; Thomas RD; Kraay MJ; Goldberg VM; Rimnac CM
University Hospitals Case Medical Center, Case Western Reserve University, Cleveland, OH

Introduction: The NexGen TKR (Zimmer, Warsaw, IN) was developed with the goal of improving implant longevity, patellofemoral biomechanics and function, and load transmission [1-3]. The NexGen TKR has demonstrated good to excellent clinical results [2, 3]. However, less information is available concerning the extent of wear damage of UHMWPE components associated with this modular type prosthesis [4]. The objective of this study was to evaluate the performance of the NexGen TKRs retrieved at our institution with respect to damage analysis of the UHMWPE tibial components.

Methods: Between 1996 and 2006, 54 NexGen TKRs were retrieved at our institution. 34 were included in this study (24 Posterior Stabilized, 6 Cruciate Retaining, 4 Legacy Constrained Condylar Knee) from 33 patients (24 female, 9 male). The remaining 20 TKRs underwent destructive analyses for another study. Indications for primary TKR included OA in 32 and RA in 2 patients. 29 TKRs were cemented and 5 were uncemented. The mean patient age was 66.6 ± 12.0 years (40.8-94.9 years) and the mean weight was 88.3 ± 18.0 kg (61-129 kg).

Implant retrieval was conducted under an IRB-approved protocol. The mean implantation time was 27.2 ± 26.8 mos (1.0-96.2 mos). Indications for revision surgery included: infection (15/34); aseptic loosening (9/34); instability (5/34); restricted range of motion (2/34); malalignment (2/34); and synovitis (1/34).

Wear damage analysis [5] was conducted on all 34 retrieved UHMWPE tibial components. The articulating surface, the backside surface, and the vertical post surfaces of the tibial components were examined visually and at 10x magnification using a stereomicroscope. The components were scored for pitting, scratching, burnishing, embedded particulate debris, abrasion, permanent deformation, and delamination. The articulating surface was divided into 10 sections while the backside surface and the post surface were each divided into 4 sections. A scale of 0-3 was used for each damage mode in each section. Thus, the maximum total damage score was 210 for the articulating surface, 84 for the backside surface, and 84 for the post surface. Two independent observers assessed the components and total damage scores were obtained.

AP and lateral radiographs taken prior to revision surgery were available for 24/34 TKRs. Radiolucencies were evaluated in the tibia on the AP film and in the femur on the lateral film. Zones were derived similar to the Knee Society evaluation system [6], however, each zone was graded from 0-2. A maximum score of 14 was possible each for the tibia and the femur. Intraoperative evaluation of component fixation at the tibia and femur was also recorded.

Results/Discussion: Resin composition and sterilization technique was known for 11/34 components. Three were GUR 1050, 7 were 1900 H, and 1 were GUR 4150. All

11 components were sterilized by gamma radiation, 9 in a N_2 environment. None of the 34 retrieved tibial components were fractured or showed delamination on any of the three surface. The primary damage modes were pitting and scratching accounting for 51-76% of the mean damage score. Overall, damage was low with 15-20% of the maximum total damage score for each surface observed. The mean total damage score at the articulating surface was 39.4 ± 12.7 (16-70), at the backside surface was 16.7 ± 4.7 (9-28), and at the post surface was 12.5 ± 4.9 (9-28). The mean summated damage score for the articulating and backside surfaces was 56.1 ± 14.4 (30-89). Of interest, 23/33 UHMWPE components were noted to have mild permanent deformation at the inferior surface locking mechanism (the inferior surface of one component was not evaluated as it consisted of trabecular metal).

There was a significant positive correlation between the summated total damage score and implantation time ($r^2=0.13$, p=0.04) and mean total backside damage score and implantation time ($r^2=0.16$, p=0.02). There was no association between damage scores for each of the 3 surfaces when compared to patient weight.

The mean radiolucent scores were low compared with the total possible: 3.7 ± 2.4 for the tibia and 2.2 ± 2.6 for the femur; the summated total mean radiolucent score was 6.0 ± 3.7 (2-13). There was no statistically significant correlation between radiolucent scores and wear damage scores. 26 TKR components were recorded to be well fixed at intraoperative evaluation while 8 components were deemed grossly loose. Although higher in the loose subset, damage scores did not reach significance when compared to the entire cohort.

In this study of a contemporary TKR, all retrieved components had a low level of damage. This finding is consistent with a recent study of 43 retrieved NexGen UHMWPE tibial components at another institution [4]. As opposed to the findings by [4], however, damage was found to increase with implantation time. The absence of a statistically significant correlation between patient weight and surface damage may have been confounded by a lower activity level [7, 8], which was not evaluated in this study. The absence of severe damage, including delamination and fracture is consistent with the reported good to excellent clinical and other retrieval results of this contemporary TKR design [2-4].

References: 1) Clarke, et al. JOA, 2006, 21:167; 2) Bertin, KC. CORR, 2005, 436:177; 3) Ip, et al. J Orth Surg (HK), 2003, 11:38; 4) Crowninshield, et al. JOA, 2006, 21:754; 5) Hood, et al. JBMR, 1983, 17:829; 6) Ewald, FC. CORR, 1989, 248:9; 7) Foran, et al. JOA, 2004, 19:817; 8) Stukenborg, et al. Orthop, 2005, 34:664.