**EVALUATION OF ANTERIOR TIBIAL POST IMPINGEMENT DURING GAIT IN POSTERIOR-STABILIZED TOTAL KNEE ARTHROPLASTY**

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**Introduction:** Posterior-stabilized total knee arthroplasty (TKA) has been widely used since its introduction nearly three decades ago, and long-term follow-up studies have reported satisfactory results. However, mechanical failure due to fracture of the tibial post recently has been described in several reports (1). The possible fracture mechanism was the repeated impingement between the intercondylar notch of the metal femoral component and the anterior aspect of the polyethylene tibial post (1, 2, 3). The main purpose of this study was to determine if anterior tibial post impingement occurs during gait activity after posterior-stabilized TKA using high resolution dynamic flat-panel detector images.

**Materials and Methods:** The subjects who had undergone clinically successful arthroplasty gave informed consent to participate in this study as approved by the institutional review board. The study group consisted of 12 knees with a posterior-stabilized TKA (Nexgen LPS, Zimmer, Inc., Warsaw, IN). The average age at the time of knee arthroplasty was 71 ± 6 years, and the average follow-up after surgery was 19 ± 12 months. The average postoperative knee extension/flexion angle was 13.1 ± 6.0° (Fig. 1A). The average implant flexion angle at the stance/swing phase was 5.9 ± 8.6°/45.6 ± 13.1° (Fig. 1A). The average implant flexion angle at stance/swing phase was -6.1 ± 8.0°/33.6 ± 14.4° (Fig. 1A). At the stance phase, 12 of 36 x-ray images represented flexed position, and 7 images represented hyperextension more than 15° (Fig. 1B). Anterior post impingement was determined by the intersection of the 3-D model surfaces of the femoral component and tibial polyethylene insert (SolidWorks® 2001Plus SP3.0, SolidWorks Corporation). The skeletal knee flexion angle between the femoral shaft axis and the tibia shaft axis was measured at sagittal x-ray images using an angle scale. A radiological assessment of the femoral component flexion angle and the posterior tibial tilting angle at the lateral view was performed according to the Knee Society roentgenographic evaluation.

**Results:** The average skeletal flexion angle at the stance/swing phase was 5.9 ± 8.6°/45.6 ± 13.1° (Fig. 1A). The average implant flexion angle at stance/swing phase was -6.1 ± 8.0°/33.6 ± 14.4° (Fig. 1A). At the stance phase, 12 of 36 x-ray images represented flexed position, and 7 images represented hyperextension more than 15° (Fig. 1B). Anterior post impingement was observed for all X-ray images in all knees when at the stance phase (Fig. 2). At the swing phase, all X-ray images displayed noncontact in the anterior or posterior aspects of the tibial post. The average postoperative alignment of femoral prosthesis on the lateral radiograph was 5.6 ± 2.7° of flexion relative to the distal half of the femoral shaft axis. The average postoperative alignment of the tibial prosthesis on the lateral radiograph was 5.9 ± 2.9° of posterior tilt relative to the proximal half of the tibial shaft axis.

**Discussion:** Patients with NexGen posterior-stabilized TKA had a high incidence of anterior tibial post impingement during the stance phase of gait. There was no hyperextension and/or instability on clinical examination in any of the knees. There was also no evidence of component malpositioning observed by radiographic examinations in any of the knees. At the stance phase, the average skeletal alignment of the femoral component impinged on the anterior aspect of the tibial post.

![Fig. 1: The average skeletal and implant flexion angles at the swing (solid column) and stance (mesh column) phases of gait (A). Distribution of implant flexion angle at the stance phase of gait activity (B).](image1.png)

Previous studies have indicated that a flexed femoral component and an inclined tibial component can lead to anterior post impingement (1, 3). However, NexGen LPS was designed to allow 14° hyperextension in implant alignment without impingement. Furthermore, even without femoral component flexion and posterior tibial slope, anterior post impingement occurred in this study. The posterior translation of the femur can lead to anterior post impingement without hyperextension. During gait, the anteriorly directed shear force on the tibia normally is resisted by the ACL. In the posterior-stabilized TKA, engagement of the anterior portion of the femoral component onto the tibial post provides a functional substitute for the ACL, thereby resulting in limitation of posterior displacement of the femur relative to the tibia. In NexGen LPS, the relatively flat shape in the anterior aspect of the post caused the impingement area to be located on the bilateral anterior corners of the tibial post (Fig. 3). The antero-posterior force does not significantly increase during the gait cycle, but repetitive anterior impingement can lead to the wear or fracture of the polyethylene post. Therefore, further attention must be given to the configuration of the anterior portion of the femoral component and the polyethylene post when designing posterior-stabilized total knee prostheses.

![Fig. 2: Examples of top (left) and rear (right) views are shown for a patient with a posterior-stabilized prosthesis, experiencing anterior post impingement during stance phase of gait activity. White arrows represent the intersections of the 3-D model surfaces of the femoral component and the polyethylene insert, which were located on the bilateral anterior corners of the tibial post.](image2.png)