KNEELING AFTER TOTAL KNEE ARTHROPLASTY

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INTRODUCTION:
While kinematic information is now available concerning deep flexion after total knee arthroplasty (TKA), little information exists concerning kneeling. It is not clear whether kneeling is considered safe after TKA. In this study we examine whether femoral and tibial components articulate within the intended design parameters during kneeling. We hypothesized that the tibiofemoral contact position would differ as a function of flexion angle and implant design.

METHODS:
An in vivo kinematic analysis of kneeling after TKA was performed on 20 total knee arthroplasties in 18 consenting patients. A commercially available prosthesis (Scorpio, Stryker Howmedica Osteonics, Allendale, NJ) was used in all cases. Ten posterior stabilized (PS) prostheses and ten posterior cruciate ligament retaining (CR) prostheses were used. The subjects were 52 to 80 years old, and underwent testing an average of 21.3±12.7 months from time of surgery. The study was approved by the Human Research Review Committee at our institution.

A radiographic technique was used to provide three-dimensional measurements of the position of the tibia relative to the femur during standing and kneeling. True lateral radiographs were taken with the subject standing with the leg fully extended, kneeling on the anterior aspect of the proximal tibia with the knee at 90° of flexion, and then kneeling with the knee in maximal flexion.

An image matching technique provided three-dimensional measurements of the femoral component position relative to the anterior-posterior (AP) midpoint of the tibial baseplate. Contact between the components was determined by evaluating the minimum distance between the femoral and tibial surfaces.
Two-way ANOVAs were conducted to determine if there were effects of TKA design (PS or CR) on flexion angle on AP tibiofemoral contact position. Data from the medial and lateral compartments of the knee were analyzed separately. If an interaction was present, relationships were assessed with linear regressions. To compare the AP contact location from different size knees, the data were normalized such that -100% represented the posterior edge of the tibial baseplate, and 100% represented the anterior edge of the baseplate. The origin of the coordinate system was located at the AP center of the baseplate.

RESULTS:
The average Knee Society Score for both groups was 91.9, and all subjects stood and knelt with ease.

When standing, the tibiofemoral contact position (medial position: -7mm±3; lateral position: -4mm±3) of the CR design was located more posterior than the PS design (medial position: -5mm±2; lateral position: -5mm±2).

Movement from standing to kneeling at 90° produced significantly different responses between the designs (p<0.05). For the CR knees, the femur translated anteriorly (average medial and lateral translations were 4mm±4 and 2mm±6, respectively), while there was little change in the position of the tibia relative to the femur for the PS design (average medial and lateral translations were 0.2mm±3 and 1mm±4, respectively).

During kneeling, movement from 90° to maximum flexion produced a posterior translation of the femur for both designs (CR average medial and lateral translations were -5mm±4 and -5mm±4, respectively; PS average medial and lateral translations were -6mm±4 and -6mm±3, respectively) (p<0.05). The relationship between the tibiofemoral contact position and flexion angle during kneeling was more variable for CR knees (r=0.38) than PS knees (r=0.64), indicating that the PS design provides a more consistent AP position than the CR design.

For the CR cases, the average AP contact positions of the femur, relative to the AP center of the tibial baseplate, for standing, kneeling at 90° flexion, and maximum kneeling, were -26%±11, -18%±18, and -36%±13, respectively (Fig. 1). Similarly, for the PS design, the AP contact positions of the femur, relative to the AP center of the baseplate, were -21%±9, -24%±10, and -47%±13 (Fig. 1). The contact position was never located near the posterior edge (–50% to -100%) of the baseplate (Fig. 1).

PS knees dislocate when the arch of the femoral cam slides over the tibial post; the distance between the bottom of the femoral cam and the tip of the tibial post averaged 13mm±2, and was always at least 10mm during maximum kneeling, indicating dislocation was unlikely (Fig. 2).

DISCUSSION:
Many patients wish to resume normal activities after TKA, including kneeling, and yet little information exists regarding kneeling after TKA. The data presented here indicate that both CR and PS prosthetic designs functioned as they were designed during kneeling. Kneeling with the knee at 90° flexion resulted in tibiofemoral contact positions similar to those previously reported during weight bearing flexion activities, such as squatting into deep flexion and stair climbing. Furthermore, kneeling at greater than 90° flexion produced posterior translation (rollback) with both designs. There was less variability in the contact position of the PS design compared to the CR design. Importantly, neither subluxation of the CR design nor dislocation of the PS design appeared likely to occur.

All patients were deemed to have an excellent clinical result at a minimum of 10 months post-operatively and these results may not be applicable to all patients after TKA.

Our study demonstrates that subjects with TKA can kneel with articulation of the tibia relative to the femur within the intended design constraints of both the CR and PS designs. These findings establish the basis for subsequent clinical studies that are designed to evaluate safety. Whether kneeling will lead to premature polyethylene wear, PCL attrition, or patellar problems is questions that can not be addressed without a longer-term clinical study. At this time we are cautiously optimistic that careful and occasional kneeling may not be detrimental to the longevity of TKA, and will add to the functional result that the patient may enjoy.

REFERENCES:
(1) Banks, J Arthroplasty, 12:297; (2) Dennis, CORR, 356:47; (3) Komistek et al., J Arthroplasty, 17:209; (4) Stiehl et al., CORR, 365:139.
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