A loose extension gap during TKA leads to increased mid-flexion laxity

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Introduction: The aim of this study was to quantitatively analyze the amount coronal plane laxity in mid-flexion that occurs with a loose extension gap in TKA. In the setting of a loose extension gap, we hypothesized that although full extension is achieved, a loose extension gap will ultimately lead to increased varus and/or valgus laxity throughout mid flexion.

Methods: After obtaining IRB approval, six fresh-frozen cadaver legs from hip-to-toe underwent TKA with a posterior stabilized implant (APEX PS OMNIlife Science, Inc.) using a computer navigation system equipped with a robotic cutting-guide, in this controlled laboratory cadaveric study. After the initial tibial and femoral resections were performed, and the flexion and extension gaps were balanced using navigation, a 4mm distal recut was made in the distal femur to create a loose extension gap (using the same thickness of polyethylene as the well-balanced case). Real implants were used in the study to eliminate error in any laxity inherent to the trials. The navigation system was used to measure overall coronal plane laxity by measuring the mechanical alignment angle at maximum extension, 30, 45, 60 and 90 degrees of flexion, when applying a standardized varus/valgus load of 9.8 [Nm] across the knee using a 4kg spring-load located at 25cm distal to the knee joint line. (Figure 1). Coronal plane laxity was defined as the absolute difference (in degrees) between the mean mechanical alignment angle obtained from applying a standardized varus and valgus stress at 0, 30, 45, 60 and 90 degrees. Each measurement was performed three separate times.

Separate generalized estimating equations were calculated for each flexion angle to compare opening angle differences

Figure 1: Overall laxity in the coronal plane was significantly greater at 30°, 45°, and 60° of flexion for in the case of a loose extension gap (4mm distal femur recut) and the standard TKA.
between conditions using proc genmod in the SAS System 9.2 (Cary, NC). Each of the 3 measurements were used as repeated measures for each specimen. An independent covariance structure was specified, which has been demonstrated to be robust in a wide variety of dependent covariance matrices. Due to the large number of comparisons, we calculated a false discovery rate (FDR) adjusted p-value using the non-adaptive Benjamini and Hochberg procedure. This evaluation determined that a p-value of <0.03 was considered statistically significant.

**Results:** In the setting of a loose extension gap (4mm distal recut), overall coronal-plane laxity was increased by a mean of 3.6° at 30° of flexion, 3.4° at 45° of flexion, and 2.8° at 60° of flexion (p < 0.0001 for each flexion angle). (Figure 2) However, there was no difference in coronal plane laxity between the well-balanced TKA and the TKA with a loose extension gap at full extension and 90° of flexion, when applying a standardized varus and valgus load.

**Discussion and Conclusions:** Using a reliable, accurate, and reproducible method of measuring coronal plane laxity, we have shown that in the setting of a loose extension gap during total knee arthroplasty, coronal plane laxity will be significantly higher in mid-flexion compared to the well balanced state.

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