The Extension Planning Angle in Gap-Balancing Total Knee Arthroplasty Influences Mid-Flexion Laxity

Jeffrey H. DeClaire, MD, UNITED STATES, **Presenter**
Sami Shalhoub, MS, UNITED STATES
Christopher Plaskos, PhD., UNITED STATES
Jeffrey M. Lawrence, MD, UNITED STATES
Amber L. Randall, MD, UNITED STATES
John M. Keggi, MD, UNITED STATES
Disclosures

- Consultant: Zimmer Biomet
- Royalties: Zimmer Biomet
- Consultant: Smith Nephew
- Research support: Omni LifeScience
Gap – Balancing in TKA

- The aim of gap-balancing in total knee arthroplasty (TKA) is to produce equal and symmetric gaps throughout the range of motion (ROM).

- The technique references the native flexion and extension gaps to plan the femoral bone resections to achieve a balanced knee.

However, the native tibiofemoral gaps are significantly different between $0^\circ$ and $10^\circ$ of flexion.
Therefore, planning for equal and symmetric gaps at $0^\circ$ and $90^\circ$ of flexion could result in a different femoral plan, and thus a different knee laxity profile throughout flexion, including in mid-flexion, than when planning at $10^\circ$ and $90^\circ$ of flexion.
This study therefore aims to quantify the change in the post-operative tibiofemoral gap throughout the ROM when varying the planning extension angle between 0 and 10 degrees flexion.
Study Methods

- 40 patients (mean age: 71±10, BMI: 28.6±7.7) undergoing robotic-assisted TKA were included.

- After resecting the tibia, the knee joint was tensioned using a computer-controlled ligament tensioning tool.

- The system applied a load ranging between 80-100N of tension equally to the medial and lateral compartments as the limb was manually taken through a ROM.
Study Methods

The femoral implant position and size was then planned to have equal and symmetric knee gaps in extension and flexion.

Patients were divided into two sequential groups:

Group-A: The knee was planned to have equal and symmetric gaps at $0^0 \text{ and } 90^0$ (18 knees),

Group-B: The knee was planned to have equal and symmetric gaps at $10^0 \text{ and } 90^0$ (14 knees).
Study Methods

- The femur was resected, and a femoral trial was inserted and the postoperative gaps were measured throughout the ROM while the tensioning tool applied equal tension to the ligaments.

- Mean and standard deviation of the post-operative gaps were calculated for each group.

- T-tests were used to identify significant differences between the two groups.
Results

- In both group-A and group-B, the post-operative extension and flexion gaps were balanced to within 1mm of each other on average.

Significantly larger gaps were seen in mid-flexion for group-A than for group-B, with a maximum laxity increase of 3-4mm occurring around 25-30° in group A.
Results

The gap profiles between 20-60\(^\circ\) were significantly different from the gaps at the extension and flexion planning angles in group-A, but not in group-B.

Post-operative gap profiles measured in knees that were planned to have equal gaps at 0\(^\circ\) and 90\(^\circ\) (left, Group A) and at 10\(^\circ\) and 90\(^\circ\) (right, Group B)
Discussion

- Gap planning at 10° of flexion produced equal and symmetric gaps from 10-90° that were similar in patterns to those reported in the native knee.

- Gap planning at 10° resulted in smaller gaps and increased tension at full extension, however, which may result in a flexion contracture requiring a posterior capsule release or distal femoral recut to achieve full extension.
Discussion

- **Gap planning at 0°** resulted in larger gaps and lower joint forces at full extension, **but increased knee laxity in mid-flexion** which may contribute to mid-flexion instability.

- Depending on the clinical circumstances of the case, the implications of planning at both 0° and 10° in gap balancing TKA should be taken into consideration.
Thank You