Soft Tissue Balance in Total Knee Arthroplasty for Patients with Rheumatoid Arthritis

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Disclosures:

Introduction: Balancing of joint gap is a prerequisite in total knee arthroplasty (TKA). Recently, the tensor has been developed which can measure the joint gap with the patellofemoral joint reduced for more physiological assessment, and the results for osteoarthritis (OA) patients indicated that the flexion gap is larger than the extension gap during posterior-stabilized (PS) TKA. However with respect to the rheumatoid arthritis (RA) patients, the soft tissue balance in TKA is still unknown. Therefore, the purpose of this study was to investigate the characteristics of the joint gap during TKA surgery for patients with RA.

Methods: We measured the joint gap during PS TKA and compared the results between the OA and RA patients.

Subjects: We implanted 90 consecutive knees with a PS TKA using a NexGen LPS-flex (Zimmer, Warsaw, IN). OA was the underlying disease in 60 knees and RA was the disease in 30 knees. In OA group, there were 10 men and 50 women with a mean age of 77.1 years (range, 64-88 years). The average preoperative maximum extension angle of the knee was -11.0° (range, -30°-0°) and flexion angle was 120.3° (range, 70°-145°). While in RA group, there were 6 men and 24 women with a mean age of 70.7 years (range, 53-80 years). The average preoperative maximum extension angle of the knee was -9.0° (range, -40°-0°) and flexion angle was 124.4° (range, 95°-145°). The average preoperative femorotibial angle (FTA) was 183.6° (range, 173°-193°) and 177.8° (range, 170°-188°) in OA and RA, respectively.

Surgical procedure: We performed all operations with a measured resection technique. The knee was exposed through a medial parapatellar approach. We performed distal femoral osteotomy perpendicular to the mechanical axis of the femur. The rotational position of the femoral component was determined based on the epicondylar axis of the femur with anterior reference for anteroposterior sizing. We made the proximal tibial cut perpendicular to the mechanical axis of the tibia in the frontal plane with a posterior tilt of 7° in the sagittal plane. The rotational position of the tibial component was aligned with medial 1/3 of the tibial tubercle. After the bone cuts had been completed, we performed standard soft tissue balancing using a spacer block.

Joint gap measurements: We used the tensor device consisted of two plates that were connected to the main body by the offset arm (Figure 1a). The upper plate was free to seesaw under the relative balance between medial and lateral soft tissues and had a post at its center to fit the intercondylar space of the femoral component. The lower plate was fixed with pins to the center of the proximal tibia. The width of the joint gap was defined as the center distance between the upper side of the seesaw plate and the underside of the lower plate. After bone cuts and soft tissue balancing, we measured the joint gap with the femoral component in position using this tenser device with the patella reduced position after repair of the medial arthrotomy with a few stitches (Figure 1b). The center width and asymmetry (tilting) of joint gaps under 40-lb distracting force (Figure 2) were measured at 0° extension and 90° of knee flexion.

We compared the results of the center width and tilting of joint gap, between the OA group and the RA group. Also, correlations were assessed between the center width and tilting of joint gap. Two trials of each measurement were performed and averaged for analysis. Data are expressed as average ± standard error. Statistical analysis was performed using unpaired t-test with a significance level of 0.05.

Results: The center widths of the joint gap were 11.1 ± 0.2 mm in OA group and 10.3 ± 0.3 mm in RA group at 0° extension, and 14.3 ± 0.4 mm in OA group and 14.6 ± 0.5 mm in RA group at 90° of knee flexion, respectively. There were no significant differences between two groups (Figure 3). The changes in the joint gap from 0° to 90° (the mean value at 90° minus the mean value at 0°) were 3.2 ± 0.3 mm in OA group and 4.3 ± 0.4 mm in RA group. The increase of joint gap from 0° to 90° in RA was significantly larger than that in OA group (p<0.05) (Figure 4). The tilting angle of the joint gaps (varus gap expressed as positive values) at 0° extension were 1.4 ± 0.2° in OA group and 1.5 ± 0.4° in RA group, and there were no significant differences between two groups. While at 90° of knee flexion, the tilting angle of the joint gap in RA group (5.3 ± 0.5°) was significantly larger than that in OA group (2.6 ± 0.4°) (p<0.001) (Figure 5).

In RA group, there was a positive correlation (r= 0.34, p <0.05) between the increase of joint gap from 0° to 90° and the tilting...
angle of the joint gap at 90° of knee flexion (Figure 6).

**Discussion:** In this study, the increase of joint gap from 0° to 90° in RA group was significantly larger than that in OA group. In addition, the lateral gap in knee flexion, calculated from the tilting angle of the joint gap, was significantly larger in RA group and was correlated with the increase of joint gap from 0° to 90° of knee flexion. These differences could be attributed to reduced stiffness of the lateral structure, such as lateral collateral ligament and popliteofibular ligament, as well as the extensor mechanism in patients with RA. Therefore, it is necessary to consider the individual stiffness of soft tissues, together with the applied tension, to decide the rotation of femoral component by reference to the flexion gap during TKA for RA patients.

**Significance:** In RA patients, the lateral gap in knee flexion is significantly larger than that in OA patients.

**Acknowledgments:**

**References:**
Lateral

Figure 2
Figure 3: Center width of the joint gap

Figure 4: Change in the joint gap from 0° to 90°
Figure 5: Tilting angle of the joint gap
Figure 6: Relationship between the center width and tilting angle of joint gap.