INTRODUCTION: At the time of total knee arthroplasty (TKA), it is recommended that the medial and lateral soft tissue tension of the gaps be balanced at both extension and flexion after performing bone resection. However, there is some disagreement regarding the importance of pursuing the perfect rectangular gaps during TKA. Some authors have noted that a slight lateral laxity is acceptable.

In vivo fluoroscopic analyses have recently revealed the kinematics after TKA thus clarifying such aspects as condylar lift-off. The postoperative soft tissue balance may also play a role in the incidence of lift-off. The purpose of this study was to determine the varus-valgus balance at both extension and flexion as well as the location and the amount of lift-off during stair climbing, in order to elucidate any correlations between the varus-valgus balance and lift-off.

METHODS: The study group consisted of 14 knees with an average follow-up of 27.3 months after TKA. 11 knees received cruciate-retaining TKA (Foundation knee, Encore medical) and 3 knees received posterior-stabilized TKA ( Nexgen LPS, Zimmer). The average age at the time of surgery was 74.0 years. The average postoperative knee extension / flexion angle was 1.9° / 120.1°. The knee society score (knee score / function score) was 92.4 / 74.9. All subjects gave their informed consent and an institutional review board approved of the study.

Radiographs were obtained in the anteroposterior view of the knee with varus and valgus stress in extension and flexion. In extension, 150 N of varus and valgus stress was applied to the knee flexed at 10° with a Telos device (Telos, Weiterstadt, Germany). In flexion, 50 N was applied to the knee flexed at 80° with the patient in the sitting position. The angle by the templates on the femoral condyles and tibial plateau was then measured on the film.

In addition, continuous X-ray images of stair climbing were taken using a flat panel detector (Clavis, Hitachi, Tokyo, Japan) (Fig 1a). The flat panel detector provided dynamic images with a higher resolution over a wider area (Distortion-free image, 0.20 × 0.20 mm/pixel resolution, 3 frames/sec, and Image area size 397(H)×298(V) mm) (Fig 1b). The stair climbing proceeded from knee flexion to extension. The radiographic images at 10°, 45° and 80° of knee flexion were selected and analyzed using an image-matching technique. Condylar lift-off was evaluated at each point of knee flexion, while considering the configuration of the polyethylene insert. The distances from the femoral condyles to the articular surfaces of the polyethylene insert were measured in the medial and lateral compartment separately (c).

Furthermore, the coronal alignment after the operation was determined using postoperative full-length standing radiographs. The rotational position of the femoral component relative to the epicondylar axis was also determined using a kneeling view as reported by Takai. A statistical analysis was performed by the paired t-test, Mann-Whitney’s U test, and Pearson’s correlation coefficient, and probability values of less than 0.05 were considered to be statistically significant.

RESULTS: At extension, the mean angle was 6.7±2.3° (average±SD) in varus stress and 5.9±1.8° in valgus stress. There were no statistically significant differences between the lateral and medial laxities at extension. At flexion, the mean angle was 9.2±3.9° in varus stress and 4.1±2.4° in valgus stress. The lateral laxity was significantly greater than the medial laxity at flexion (p < 0.05).

The average amount of lift-off at 10°, 45° and 80° of knee flexion were 0.5±0.55mm, 0.47±0.27mm, and 0.61±0.52mm respectively. There were no statistical differences between the average amount of lift-off at 10°, 45° and 80° of knee flexion. At 10° of knee flexion, five of 14 knees had a lift-off of more than 0.5mm, with 3 knees (60%) on the lateral side and 2 knees (40%) on the medial side. At 80° of knee flexion, five of 14 knees had a lift-off of more than 0.5mm, with 4 knees (20%) on the lateral side and 1 knee (80%) on the medial side.

The laxity of the lift-off side at knee extension significantly increased the amount of lift-off at 10° of knee flexion (p < 0.05) (Fig 2a). However, no statistically significant correlation between the lateral laxity of lift-off side at knee flexion and the amount of lift-off at 80° of knee flexion was demonstrated (Fig 2b).

CONCLUSION: No major malalignment was observed in any of the subjects, and %MA was 49.3±9.3%. No statistically significant correlation between the coronal alignment after operation and the amount of lift-off at 10° of knee flexion was demonstrated (Fig 3a). The rotational alignment of femoral component was 0.8±1.7° external position relative to the epicondylar axis. The external rotation of femoral component tended to increase the amount of medial lift-off at 80° of knee flexion (p = 0.08) (Fig 3b).

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