**Preoperative Knee Kinematics Impacts Upon Postoperative Knee Kinematics In Total Knee Arthroplasty**

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**Introduction:** Total knee arthroplasty (TKA) is a well-established procedure that generally results in excellent clinical results, particularly pain relief and functional recovery. The recently reported 20-year survival rate after TKA with revision for any reason is 70.9%-91.0%. However, patient-reported outcomes after TKA did not indicate satisfaction levels comparable to those reported after total hip arthroplasty (THA). The dissatisfaction after TKA is considered to be partly attributed to abnormal knee kinematics. Dynamic kinematics in normal knee shows medial pivot pattern. In addition, the patients who demonstrate medial pivot kinematics pattern after TKA is known to have better clinical results than that of non-medial pivot pattern. However, it is unclear how preoperative factors affect postoperative knee kinematics. We hypothesized that preoperative factors effect on postoperative kinematic patterns in conventional TKA. The aim of this study was to evaluate the relationship between preoperative factors of the knee and postoperative knee kinematics pattern in TKA.

**Methods:** Patients. The present study consists of 38 patients with medial osteoarthritis who underwent a primary TKA using a CT-based navigation system from July 2010 to September 2012. Procedure. All the operations were performed by a single surgeon using a subvastus approach and the same posterior cruciate ligament substituting type (PS type) of prosthesis (Genesis II™ total knee system, Smith & Nephew, Memphis, TN). The proximal tibia osteotomy and the distal femur osteotomy were set on the navigation system perpendicular to the mechanical axis in the coronal plane with 3° tibial posterior inclination in the sagittal plane. The coronal plane ligament imbalance was corrected until the gap imbalance was fewer than 2 mm. This gap balance was checked using a ligament balancer (Smith & Nephew) at 80 N in medial and lateral compartment of the knee. The navigation system was used to measure the flexion gap with the CAS ligament balancer (Depuy, Warsaw, IN, USA) at 90° knee flexion. The amount of external rotation on femoral osteotomy was adjusted by the navigation system with a balanced gap technique. The patella was resurfaced and a lateral release was not performed. Tibial A-P axis of the tibial tray was placed parallel to Akagi’s line, connecting the middle of the posterior cruciate ligament to the medial border of the patellar tendon attachment. Kinematics measurement. We measured each kinematics pattern immediately after capsule incision (preoperative knee kinematics) and after implantation (postoperative knee kinematics) in TKA. Subjects were divided into two groups based on kinematics patterns: a medial pivot group (group M) and a non-medial pivot group (group N). A chi-square test was used for statistical analysis. P values less than 0.05 were considered significant. Radiographic analysis. Femoro-tibial angle (FTA), mechanical femoro-tibial angle (mFTA), and mechanical axis (%MA) were also measured both preoperatively and postoperatively.
**Results:** There were 19 knees in group M and 19 knees in group N at preoperative knee kinematics measurement. Nineteen knees in group M at preoperation resulted in 14 knees in group M and five knees in group N at postoperative knee kinematics measurement. On the other hand, in group N at preoperation resulted in 2 knees in group M and 17 knees in group N at postoperative kinematics (Fig. 1). Preoperative knee kinematics significantly correlated with postoperative knee kinematics (P < 0.01). Although the most cases demonstrated medial pivot kinematics preoperatively resulted in medial pivot pattern postoperatively, a few patients changed kinematics pattern from medial pivot to non-medial pivot. In group M (pre-op), the cases that each component was located appropriately tended to keep the medial pivot pattern after operation (Fig. 2), on the other hand, the cases that have rotational deviation of each component tended to change to non-medial pivot pattern after operation (Fig. 3). These results suggest that it is important to locate each component appropriately with more attention paid to rotation of the femoral component. In group N (pre-op), however, an appropriate procedure could not improve the knee kinematics pattern in most cases. Regarding the preoperative factors (ROM, FTA, mFTA, %MA, and posterior condylar angle), there were no significant differences between the two groups. Although varus deformity in group N (mFTA 191.2° ± 6.8°) tended to be greater than group M (188.4° ± 5.5°), there was no significant difference between the two groups (P = 0.16). In postoperative factors, rotational alignment of the femoral component from surgical epicondylar axis (SEA) was 2.4° ± 0.7° internal rotation in group M and 6.4° ± 0.5° internal rotation in group N (P < 0.01). Group N showed significant internal rotation of the femoral component compared with group M. In other postoperative factors (ROM, FTA, mFTA, %MA), there were no significant differences between the two groups.

**Discussion:** Preoperative knee kinematics robustly impacted upon postoperative knee kinematics. When we measure the preoperative kinematics, we can expect the postoperative kinematics to some extent. To maintain the medial pivot pattern, it is important to locate each component appropriately with more attention paid to rotation of the femoral component. However, in conclusion, a precise bone cut assisted by a navigation system and our modified gap technique could not improve the abnormal knee kinematics pattern in most cases. Further technical improvement or a new implant design are required to correct preoperative abnormal knee kinematics in conventional TKA.

**Significance:** This is the first study to show the relationship between preoperative factors of the knee and postoperative knee kinematics pattern in TKA. Although further technical improvements are required to correct preoperative abnormal knee kinematics, these findings will be valuable in strategy to reproduce the medial pivot pattern after TKA.