In Vivo Kinematic Comparison Of Medial Pivot Total Knee Arthroplasty In Weight-bearing And Non-weight-bearing Deep Knee Bending

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INTRODUCTION: Total knee arthroplasty (TKA) is an established treatment for osteoarthritis of the knee, yet approximately 20% of patients are not satisfied with the outcome. One reason for this dissatisfaction is considered to be physiological post-operative knee kinematics. To address this dissatisfaction and achieve physiological kinematics, medial pivot (MP) TKA was introduced. The purpose of this study was to identify the in vivo knee kinematics of an MP TKA design during deep flexion under weight-bearing (WB) and non-weight-bearing conditions, and to evaluate the influence of WB on kinematics.

METHODS: This study was approved by the institutional review board.
Eleven knees in nine patients who underwent MP TKA between 2022 and 2024 were analyzed. Patient demographics were expressed as mean ± standard deviation (SD). There were 6 female knees and 1 male knee, with a mean age of 81.0 ± 5.5 years, mean height of 151.6 ± 10.1 cm, mean weight of 56.8 ± 7.0 kg, and mean Body Mass Index (BMI) of 24.8 ± 2.2 kg/m². All implants used were the Evolution MP CS System with patella resurfacing. And all implants were cemented. Kinematic analysis was performed at a mean of 12.6 ± 6.8 months postoperatively. The kinematics of the eleven knees were investigated using a 2D/3D registration technique during squatting (weight-bearing) and passive-assisted knee flexion (non-weight-bearing). The evaluated parameters were the anteroposterior translation of the closest point of the femoral component relative to the axial plane of the tibial component in medial (MAP) and lateral (LAP) side, the axial rotation of the femoral component relative to the tibial component (ER), and the kinematic pathway. Statistical analysis was performed using JMP 18 (SAS Institute Inc.). All data were expressed as mean ± standard deviation.

RESULTS SECTION: Femoral ER was observed under both weight-bearing and non-weight-bearing conditions. Regarding medial anteroposterior translation, no anterior translation was observed between 0° and 90° of flexion under both weight-bearing and non-weight-bearing conditions; however, anterior translation was observed beyond 90° of flexion. Regarding lateral anteroposterior translation, posterior translation was observed under both weight-bearing and non-weight-bearing conditions. The kinematic pathway showed a medial pivot motion from 0° to 90° of flexion under both weight-bearing and non-weight-bearing conditions, and central pivot motion was observed beyond 90° of flexion.

DISCUSSION: In this study, The Evolution showed no medial AP translation of the femur during mid flexion angle. Lateral AP position of the femur translated posteriorly across all flexion angles. The femoral component externally rotated and amount of the ER angle were approximately ten degrees under both weight-bearing and non-weight-bearing conditions.

SIGNIFICANCE/CLINICAL RELEVANCE: The medial AP translation of the femur showed no anterior motion under both WB and NWB condition during mid flexion angles and the effect of WB condition is small.

IMAGES AND TABLES:
Figure 1. femoral external rotation

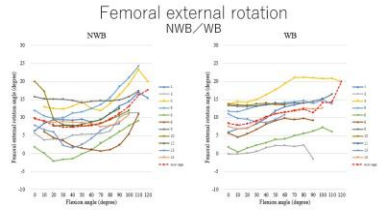

Figure 2. medial anteroposterior translation

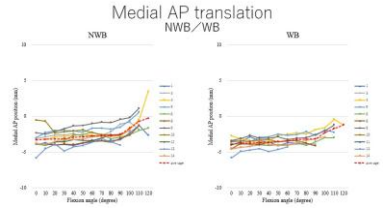

Figure 3. lateral anteroposterior translation