In Vivo Kinematics of Rotating Platform Mobile-Bearing Total Knee Arthroplasty

ABSTRACT INTRODUCTION:
Mobile-bearing (MB) total knee prostheses have been developed to achieve lower contact stress and higher conformity compared to fixed-bearing total knee prostheses. However, little is known about the in vivo kinematics of MB prostheses especially about the kinematics of polyethylene insert (PE). In vivo motion of PE during squatting still remains unclear. The objective of this study is to investigate the in vivo motion of MB total knee arthroplasty including PE during squatting.

PATIENTS AND METHODS:
We investigated the in vivo knee kinematics of 11 knees (10 patients) implanted with Vanguard Rotationg Platform High Flex (Biomet®). Under fluoroscopic surveillance, each patient did a weight-bearing deep knee bending motion. Motion between each component was analyzed using two- to three-dimensional (2D/3D) registration technique, which uses computer-assisted design (CAD) models to reproduce the spatial position of the femoral, tibial components, and PE (implanted with five tantalum beads intra-operatively) from single-view fluoroscopic images (Fig.1,2). We evaluated the range of motion between the femoral and tibial components, axial rotation between the femoral component and PE, the femoral and tibial component, and the PE and tibial component, and AP translation of the nearest point between the femoral and tibial component and between the femoral component and PE.

RESULT:
The mean full extension angle was 0.5 ± 3.2° (range: -4.0 to 4.7°) and the mean maximum flexion angle was 9.0 ± 11.3° (range: 98 to 137°). The external rotation of the femoral component relative to the tibial component demonstrated 7.6 ± 3.6° (range: 2.3 to 13.6°). From 0° to 120° flexion (fig.3), the PE rotated 8.0 ± 5.2° (range: 2.5 to 18.0°) externally relative to the tibial component (fig.4), the femoral component rotated little relative to the PE. At standing position, the femoral component already rotated 1.2 ± 9.8° (range: -16.5 to 15.9°) externally relative to the tibial component and the PE also rotated 0.8 ± 9.8° (range: -16.1 to 16.0°) externally on the tibial tray. From 0° to 120° flexion, there was almost little A-P translation of the medial femoral condyle within 2 mm. The lateral condyle translated posteriorly with knee flexion. The average amount of posterior translation was 5.7 ± 1.6 mm (range: 2.5 to 7.5 mm). The femoral component relative to the tibial component exhibited a medial pivot pattern external rotation from 0° to 120° flexion (fig.5).

DISCUSSION AND CONCLUSION:
In this study, we evaluated the in vivo motion of MB total knee arthroplasty including PE during squatting. About this total knee prosthesis, the mobile-bearing mechanism which advantages over fixed-bearing prosthesis to keep high conformity might work well, and arc of range of motion was maintained. And subject having this prosthesis experienced normal pivot pattern where the lateral condyle rotated around the medial condyle.

REFERENCES