Asymmetric Femoral Component Design is Preferable for the Patellofemoral Contact Configuration in Total Knee Arthroplasty

INTRODUCTION:
Patellofemoral joint complication is one of the most frequent causes of revision total knee arthroplasty (TKA). The patellar component generally contacts with the femoral component on its distal surface in knee flexion, therefore, the configuration of the distal surface of the femoral component is more important than the patellofemoral trochlear design. The shape and size of the distal condyle of the femoral component can affect the contact configuration between the patellar component and the distal surface of the femoral component. Almost all of the commercially available femoral components have symmetric condyles, but recently, the guided motion TKA designs with asymmetric femoral condyles have been introduced. In the coronal view, the medial condyle is more distally prominent than the lateral condyle in normal knees and the guided motion TKA designs take this anatomic feature into the design. There are several clinical studies about the guided motion TKA, however, it is unclear whether the asymmetric femoral condyle design has an advantage over the symmetric design in patellofemoral contact.

The objective of the current study was to measure the angle between the patellar tendon at the tibial attachment and the tangent of the most distal part of femoral condyles and to determine which design is theoretically preferable for the patellofemoral contact.

METHODS:
We scanned 45 normal knees at a flexion angle of 90º using an open magnetic resonance imaging (MRI) (Fig. 1-A). An axial plane was defined perpendicular to the tibial mechanical axis (Fig. 1-B), then the MRI data were modified to achieve using a computer program.

RESULTS:
The tangent of the most distal part of femoral condyles was internally-rotated relative to the patellar tendon at the tibial attachment in all the knees, averagely in 8.4° ± 3.6° (range, 1.8° to 16.6°) (Fig. 3-A). The horizontal axis of the patella was internally-rotated in 3.5° ± 4.5° (range, -4.9° to 10.0°) relative to the patellar tendon at the tibial attachment.

DISCUSSION:
Smooth patellar tracking is essential for successful TKA. For the femoral component design, the configuration of the distal surface of the femoral component is important in terms of the patellofemoral joint contact forces because the patellar component generally contacts with the femoral component on its distal surface in knee flexion.

In the present study, the tangent of the most distal part of femoral condyles was internally-rotated relative to the patellar tendon at the tibial attachment in all the knees (Fig. 3-A). The femoral component is generally set perpendicular to the femoral mechanical axis in the coronal plane, and in varus knees, the size of the femoral component is usually adjusted to be as close as possible to the lateral posterior condyle in the sagittal plane. Therefore, the medial femoral condyle would be implanted slightly under-sized when the symmetric femoral component is used. Consequently, the tangent of the most distal part of the symmetric femoral component would be more internally-rotated relative to the patellar tendon if relative rotational position between the distal femur and the proximal tibia is same before and after TKA (Fig. 3-B). Briefly, the patellar tendon would be more twisted than the preoperative condition when the symmetric femoral component is used. This would deviate the patellofemoral contact force on the lateral part of the patellar component. On the other hand, the tangent of the most distal part of the asymmetric femoral component would be less internally-rotated than the symmetric femoral component. It remains unclear about the difference of the clinical outcome between the symmetric and asymmetric femoral component on the patellofemoral joint, however, in this respect, the asymmetric femoral component would be preferable to the symmetric femoral component for the postoperative congruity of the patellofemoral joint.

It needs further investigations for the clinical significance of the asymmetric femoral component design.

SIGNIFICANCE
The asymmetric femoral component design would be preferable to the symmetric femoral component for the postoperative congruity of the patellofemoral joint.