CORONAL AND AXIAL ALIGNMENT OF THE FEMORAL COMPONENT IN TOTAL KNEE ARTHROPLASTY FOR MEDIAL OSTEOARTHRITIC KNEES WITH VARUS DEFORMITY.

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Introduction

Current operative techniques during total knee arthroplasty (TKA) have been established mainly based on anatomic configurations of normal lower extremities in the United States and Europe. Therefore, these techniques may not be suitable for Japanese osteoartritic knees with varus deformity because of anatomic variations. In this study, characteristics of anatomic variations of Japanese knees with varus osteoarthritis (OA) were clarified, and modification of operative techniques for the anatomic variations was discussed.

Methods

This study was comprised of 133 Japanese female patients with varus OA. Their mean age was 69.9 years (range, 50 - 89). All patients received standardized radiographs of their lower extremities, known as orthoradiography, which used three successive exposures centred over the hip, knee and ankle, with a tube-to-film distance of 2 m. Care was paid to place the lower extremities in a neutral position so that the patella faced anteriorly. Radiographs were taken in the supine position. On orthoradiography, five parameters were measured (Fig 1), these being the femoral angle, the angle between the mechanical and anatomic axes (angle M-A), the bowing angle of the femoral shaft (BFS), the tibia resection angle (TRA) and the femur resection angle (FRA). The femoral angle is the lateral angle between the central line of the distal diaphysis of the femur and the tangent of the distal femoral condyles. The angle M-A is the angle between the central line of the distal diaphysis of the femur (the anatomical axis) and the line from the center of the femoral head to the central point of the intercondylar notch (the mechanical axis). BFS is the angle between the central line of the distal diaphysis and the central line of the proximal diaphysis of the femur. TRA was the angle between perpendicular line to the mechanical axis (cut surface) and the tangent to the lateral and medial femoral condyles. When the distal femur is cut perpendicular to the mechanical axis, TRA is to be the degree of external rotation of the femoral component relative to the anatomical axis.

In normal knees in the United States and Europe, the femoral angle is 81°, BFS is 0°, the angle M-A is 6°, TRA is 3° and FRA is 3°.

Results

The femoral angle was 81.9° ± 2.0° (mean±standard deviation). BFS was 2.0° ± 3.3° (range, -5° - 16°). The angle M-A was 7.7° ± 1.9° (range, 4° - 13°). TRA was 7.2° ± 3.8° (range, 86° - 106°). FRA was 0.9° ± 2.5° (range, -4° - 6°).

The characteristics of Japanese knees with medial OA were bowing of the femoral shaft and proximal tibia vara (Fig 1). The femoral angle in Japanese knees with medial OA was same with normal knees in the United States and Europe.

Discussion

The characteristics of medial OA knees influence coronal and axial alignment of the femoral component. Distal femur should be cut perpendicular to the mechanical axis. Because of large angle M-A, the distal femur should be cut in more valgus angle than that in normal knees in the United States and Europe. Although it has been recommended that the distal femur be cut 7° relative to perpendicular line to the anatomical axis in female patients, the femoral component in 7° valgus position will induce varus deformity. Such knees with lateral bowing of the femoral shaft.

If the distal femur is cut perpendicular to the mechanical axis, the femoral component should be externally rotated in the value of FRA relative to the posterior condylar line. The mean FRA, however, was 1°. FRA was minus in some knees, which demonstrated that the femoral component should be internally rotated in order to resect the same amount of bone from medial and lateral condyles both distally and posteriorly in some knees with medial OA. These results demonstrated that external rotation of the femoral component in order to obtain better patellar tracking may induce varus/valgus instability at 90° of flexion. The femoral component inserted using the epicondylar axis may be too much externally rotated because the epicondylar axis has been reported to be rotated 6° externally relative to the posterior condylar line in both normal knees and Japanese OA knees.

If the distal femur is cut in 7° valgus position in knees with larger Angle M-A, the external rotation angle of the femoral component is to be the angle between the resected line of the distal femur and the tangent to the lateral and medial femoral condyles. The results showed that the angle of external rotation of the femoral component is larger than 3° in 20% patients in this study.

Regardless of the angle of the femoral component in the coronal and axial planes, if TRA is larger than FRA, medial ligament release is necessary in order to obtain ligament balance in full extension. In almost all knees in this study, TRA is larger than FRA. Furthermore, the femorotibial joint space becomes wider after medial release, and the posterior cruciate ligament will become tight. Posterior cruciate ligament substituting system may be reliable in medial OA knees with lateral bowing of the femoral shaft.

In medial OA knees with lateral bowing of the femoral shaft, the authors cut the distal femur and the proximal tibia first, and ligament balance at full extension is obtained. Next, at 90° of flexion, the external rotation angle of the femoral component is set parallel to the cut surface of the tibia keeping the ligament balance. With these operative procedures, ligament balance both in full extension and at 90° of flexion can be obtained in any knee with medial OA. However, external rotation of the femoral component relative to the posterior condylar line should be more than 3° in order to obtain normal patellar tracking.

Difference of anatomic variations of patients among countries should be recognized, and modification of operative technique is necessary according to the anatomic variations.

Fig 1: Five parameters are present. The scheme also shows characteristic configurations of the femur and the tibia in Japanese knees with medial OA. Coronal and axial alignment of the femoral component should be decided according to these anatomic configurations.

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