Introduction. Several studies have documented internal tibial rotation with increasing flexion of the normal knee. As an effect of this rotation the tibial condylar flexion facet centre displaces anteriorly and the lateral one posteriorly on the tibia with increasing flexion (1, 2, 3). In cases with rupture of the anterior cruciate ligament (ACL) and after total knee replacement this internal tibial rotation is decreased or might even turn into external rotation. Brandsson et al (1) noted that this loss of internal rotation after ACL rupture mainly was an effect of changed direction of the AP translations of the lateral femoral condyle increased external tibial rotation and increased anterior displacement of the lateral femoral condyle. Nagao et al (4) showed that the internal tibial rotation also was reduced at 20° flexion in cases with early grade I osteoarthritists of the knee. These authors used ultrasound and CT. We used dynamic radiostereometric analysis (RSA) to record the detailed kinematics of knee with non-inflammatory medial arthritis during active extension and weight bearing.

Methods. Fifteen patients (median age 65 years) with non-inflammatory knee arthritis (OA) were included in the study. Four to eight spherical tantalum markers (size 0.8 mm) were inserted in the distal femur and the proximal tibia. Ten patients (median age 24 years) with normal knees were used as controls. The patients ascended a platform (height: 8 cm) and the knee motions were recorded using simultaneous and sequential exposures (2-4/s) from two ceiling mounted tubes. In total, each series constituted 10 exposures (range 5-15) corresponding to a time period of about 3-5 seconds. The relative tibial rotations (internal-external rotation, adduction-abduction) were computed. We also studied the relative anterior-posterior translations of the circular centre of the medial (MFFC) and lateral (LFFC) femoral condyles (flexion facet centres) and the middle of tibial plateau. The motions were interpolated at 5 degrees interval of extension. The analysis was done in the interval between 50° and 20°. Repeated measures analysis of variance (MANOVA) was used to compare the three groups. All the patients and the controls gave their informed consent before they were included in the study. The local ethics committee approved the study.

Results. At 50 degrees of flexion the tibia has rotated 2.1° internally in OA knees (fig 1). At 20 degrees the median internal rotation was almost the same (2.6°). In the normal knees the internal rotation reached 6.7° at 50 degrees and 4.7° at 20 degrees of flexion (p=0.035). The corresponding rotations in the frontal plane were 0.9° and 1.8° varus angulation in the OA and 1.4° and 0.3° valgus angulation in the normal knees (p=0.3). During extension from 50° to 20° the medial condyle (MFFC) displaced 0.8 mm posteriorly in the OA knees and 2.7 mm posteriorly in normal knees (p=0.06). The corresponding translations of the lateral condyle (LFFC) were 0.8 mm anteriorly in the OA knees and 1.5 mm posteriorly in normal knees (p=0.046) (fig 2). MFFC displaced 1.6 mm proximally during increasing extension in the normal knees but maintained a rather constant position in the OA knees (p=0.000). The LFFC translated 0.6 mm distally in the OA knees and 0.5 mm proximally in the normal knees (p=0.007). When the relative AP translations of the middle of the tibial plateau were analyzed using the femur as fixed reference the difference between the 2 groups became more obvious. This point shifted 6.1 mm anteriorly in the OA knees and 9.6 mm anteriorly in the normal knees (p=0.000). The midpoint on the tibia displaced 2.7 mm distally during extension in the OA knees and 5.1 mm distally in the normal knees (p=0.000).

Discussion. We could confirm decreased internal tibial rotation found in earlier CT study (1). The changed motion of the lateral femoral condyle showed similarities to those observed in cases with rupture of the ACL. In a previous study our group has shown that normal tibial rotation can be actively avoided (3). Previous observational studies on resected part of the tibia during total knee replacements (5) have shown increased central and anterior cartilage damage in cases with medial osteoarthritis. Thus, one explanation to our findings could be that the OA patients actively avoided internal rotation to decrease pain. Another hypothesis is that the ACL has lost its function in these cases due to degenerative changes in the intercondylar space. Combined RSA and MRI studies of these knees might enable detailed animation and definition of contact areas, which will facilitate our understanding of the development and progression of the osteoarthritists of the knee (6).

References.

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DYNAMIC RADIOSTEREOMETRIC STUDIES OF KNEES WITH NON-INFLAMMATORY MEDIAL ARTHRITIS

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