THE INFLUENCE OF EXTENSOR MECHANISM ON FLEXION-EXTENSION GAP IN TKA
- CHANGES OF PATELLAR TENDON STRAIN -
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INTRODUCTION:
Equally balanced gaps in extension and flexion are prerequisite for satisfactory soft tissue balancing during Total Knee Arthroplasty (TKA) 1. However, the flexion-extension joint gap is known to be influenced by patellar position (eversion or reduction) 2. The present study was performed to clarify the effect of the tension of the knee extensor mechanism (patellar tendon - patella - quadriceps complex) on the joint gaps in TKA.

MATERIALS AND METHODS:
Subjects: The subjects were 20 knees (17 patients) undergoing posterior stabilized type TKA using a NexGen LPS-flex (Zimmer, Warsaw, IN). There were 2 men and 15 women, with a mean age of 68.0 years (44-84 years). Osteoarthritis (OA) was the diagnosis in 11 knees of 11 patients and rheumatoid arthritis (RA) was the diagnosis in 8 knees of 6 patients. Average preoperative extension and flexion angle of the knee was -20.5 degrees (-60 to 0 degrees) and 92.5 degrees (20 to 120 degrees), respectively. Average preoperative Femoro-Tibial angle was 180.1 degrees (165 to 192 degrees).

The joint gap measurement: After osteotomy by tension independent cut method and adjustment of the soft tissue balance using spacer-block technique, the joint gaps with femoral component in position were measured under 40-lb distracting force using a tensor device at 0, 10, 45, 60, 90, and 135 degrees of flexion (Figure 1). At first, the joint gaps were measured with patellar eversion, and next the joint gaps were measured while the patella was maintained in the reduced position with medial capsular repair by a few stitches.

The patellar tendon strain: We also determined the longitudinal strain on the patellar tendon at each joint gap measurement while the patella was maintained in the reduced position using a 5mm long-minute uniaxial foil strain gauge (KFG-1-120-C1-11L5M3R, Kyowa electronic instruments Co., Ltd., Tokyo). The strain gauge was attached to the central patellar tendon surface using e-cyanoacrylate monomer at a knee flexion angle of 45°. The longitudinal strain on the patellar tendon measured by the strain gauge was analyzed using sensor interface (PCD-300A, Kyowa electronic instruments Co., Ltd., Tokyo). At 0, 10, 45, 60, 90, and 135 degrees of knee flexion, we recorded the average of the strain among 5 seconds after five times of tensioning by the ratchet type torque wrench. Strain values at each flexion angle were calculated to the central patellar tendon surface using

RESULTS:
The joint gap: With patellar eversion, the mean width of the joint gap at each angle of flexion gradually increased (8.4, 11.5, 13.2, 13.5, 14.4, and 15.7 mm, respectively). In contrast, with the patella in reduced position, the joint gaps at 90 and 135 degrees of flexion decreased significantly (13.9mm, 11.0mm, respectively) compared with the joint gaps with patellar eversion (Figure 2)
The patellar tendon strain: The mean strain on the patellar tendon at each angle of flexion gradually increased with an increasing angle of knee flexion. The strain value at 90 degrees and 135 degrees of flexion were significantly greater than those at other angles (Figure 3).

Relation between the values of strain and the decrease in joint gaps: At 90 degrees of flexion, there was a significant positive correlation between the patellar tendon strain and decrease in joint gaps (with patellar eversion minus with patellar reduction)

DISCUSSION:
When the patella was in the reduced position, the joint gap at 90 degrees of flexion decreased with increasing patellar tendon strain. The magnitude of the strain on the patellar tendon is considered to be proportional to the stress acting on the patellar tendon. Thus, in addition to static ligamentous stabilizers, dynamic stabilizers including extensor mechanism are the important determinants of joint gaps, especially in flexion. We, therefore, have to re-evaluate the significance of equally balanced gaps during TKA.

REFERENCES:
1) Insall JN, et al., Clin Orthop 192:13, 1985

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