INTRODUCTION:
The patellofemoral joint accounts for the majority of complications after total knee arthroplasty (TKA). Imbalance of the tension of the patellar retinaculum and quadriceps may result in maltracking of the patella. To avoid this maltracking, some surgeons use a subvastus approach or a midvastus approach instead of a standard medial parapatellar approach. Maltracking is also at times addressed intraoperatively by lateral retinacular release (LRR). Recently, Marson and Tokish reported that tourniquet application altered intraoperative patellofemoral tracking and deflation of the tourniquet decreased necessity for LRR [2]. The purposes of this study were: (1) to assess differences of tensile stress of the lateral patellar retinaculum (lateral patellofemoral ligament: LPFL) after the parapatellar and midvastus approaches; and (2) to assess tensile stress changes of LPFL before and after tourniquet deflation.

MATERIALS AND METHODS:
Single-setting bilateral TKAs were performed in 12 patients. All patients were female with an average age of 67.9 years (range, 51-80 years). Preoperative diagnosis were osteoarthritis in 11 patients and rheumatoid arthritis in 1. In each patient, the medial parapatellar approach was randomly performed on one knee and the midvastus approach on the other knee.

Before incision, soft tissue was preconditioned by knee flexion and extension several times and then a tourniquet was inflated to 350mmHg. A standard midline skin incision was made and the LPFL was exposed. A 20mm horizontal incision along the thickest portion of the LPFL was made, and the buckle transducer was clamped onto the LPFL. The LPFL tension was calibrated to zero in the knee extension position, and then the knee was flexed manually to 30°, 60°, 90° and 120°, and LPFL stress changes were measured by the transducer. After medial parapatellar or midvastus approaches, LPFL stresses were measured in the same manner. Next, the tourniquet was deflated and the measurement was repeated. Paired t-tests were used to compare the two sets of measurements, with significance set at P<0.05.

Biomechanically, LPFL is so inhomogeneous and anisotropic that it is extremely difficult to determine the complete material properties. In this study, a transducer was used to measure pressure along the LPFL. The buckle transducer consisted of a custom-made buckle frame and pressure strain gauge (9E02-P16, NEC Sanei). The pressure was recorded to a digital oscilloscope (Omniace RT3424, NEC Sanei). In our pilot study, the pressure measured by this buckle transducer was proportionate to the LPFL tensile stress changes [1]. Therefore, these measurements were used as representatives of tensile stress changes.

RESULTS:
Before each approach, LPFL strain increased with knee flexion. After the parapatellar approach, LPFL strain decreased at each knee flexion, and the decreases were statistically significant at all knee flexion angles [Fig.1]. On the other hand, no significant changes occurred after the midvastus approach [Fig.2]. After tourniquet deflation, LPFL strain was slightly recovered at 0° and 30° knee flexion angle in the parapatellar approach [Fig.1]. In the midvastus approach, LPFL strain was significantly decreased at 90° and 120° knee flexion angle after tourniquet deflation [Fig.2].

DISCUSSION:
The midvastus approach has several potential benefits, including improved blood supply to the patella, earlier return to function of extensor mechanism, and fewer patellofemoral tracking problems. In this study, LPFL tensile stress was not statistically changed after the midvastus approach, proving that this approach may avoid maltracking of the patella after arthroplasty.

Deflation of the tourniquet significantly changed tension of LPFL in both approaches. However, the patterns of these changes were different between the two approaches. LPFL strain in the parapatellar approach improved after tourniquet deflation. This means that the rate of LRR could be decreased, if the patellar tracking is assessed after tourniquet release. Interestingly, the LPFL strain in the midvastus approach was significantly decreased after tourniquet deflation. This result suggests that the midvastus approach also influences patellar tracking like the parapatellar approach, and reevaluation of patellar tracking after deflation of the tourniquet is necessary.

Fig. 1  Tensile Stress Changes of LPFL in Parapatellar Approach

Fig. 2  Tensile Stress Changes of LPFL in Midvastus Approach