ISAKOS

International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine

9th Biennial ISAKOS Congress • May 12-16, 2013 • Toronto, Canada

Paper #134

Length Change Behavior of Native Medial Patellofemoral Ligament Fiber During Knee Flexion: An In Vivo Study

Si Young Song, MD, KOREA
Young-Jin Seo, MD, PhD, KOREA
Kyu-Cheol Noh, MD, KOREA
Yon-Sik Yoo, MD, PhD, KOREA

Dongtan Sacred Heart Hospital
Hwaseong , Gyeonggi-do , KOREA

Summary:
The contribution of superior fibers to resist lateral dislocation of the patella is maximal at low flexion angles, and that of inferior fibers is maximal at mid-flexion angles. Thus, superior and inferior fibers of the MPFL act functionally synergistic throughout the range of motion, which may provide the theoretical foundation for anatomical double-bundle MPFL reconstruction.

Abstract:
Introduction:
The MPFL is fan-shaped, broad condensation of capsular fibers, being wider at its patellar attachment than its femoral attachment. To date, in vivo length change behavior of native MPFL fibers throughout the range of knee motion still remains to be clarified. We hypothesized that the native MPFL does not behave as a simple bundle of fibers with constant length but as a continuum of ligament fibers with differential length change during knee flexion. The purposes of this study were to (1) measure the length changes of the native MPFL fibers, and (2) determine the length change behavior for the MPFL fibers during knee flexion in vivo.

Methods:
The subject compromised eleven male volunteers with no history of knee pathology. The mean age was 32.0 ± 3.9 years. The right knee of each subject was scanned with a CT scanner at five different knee flexion angles (0°, 30°, 60°, 90° and 120°). Customized software was used to created, manipulate, and analyze the 3D model. The 3D knee model at 0° of flexion was chosen as a reference. On the femoral side, femoral insertion point (point F) described by Schoettle et al was marked at translucent 3D image model of a true lateral view of the knee. On the patellar side, five points were determined: 20% (point 20), 30% (point 30), 40% (point 40), 50% (point 50) and 60% (point 60) from the superior pole of the patella. To minimize technical error of measurement, the femoral model at 0° of flexion was superimposed on each discrete femoral model at 30°, 60°, 90°, and 120° of flexion, and the superimposed models obtained were again divided into 5 models at different flexion angles. This procedure was performed using the surface-to-surface matching method. Using this process, identical femoral points were automatically established on the 3D models at 30°, 60°, 90°, and 120° of flexion. Patellar points in the 3D models at 30°, 60°, 90°, and 120° of flexion were established using the same method. The shortest line which connects these attachment sites was designated as the MPFL fiber. The virtual linear fibers in 3D space along the 3D surface of the bone models were detoured by bony protrusions to avoid bone penetration. We thus created 5 virtual fibers on the 3D knee models, and digitally measured the length of the different fibers was at 5 different knee flexion angles. This provided 25 measurements per knee.

Results:
All five fibers showed anisometric behavior during the entire range of motion. Throughout the knee flexion-extension arc, the average length changes were 6.9 ± 1.7 mm in F60, 6.9 ± 2.4 mm in F50, 8.1 ± 2.6 mm in F40, 9.1 ± 2.5 mm in F30, and 9.1 ± 2.5 mm in F20. However, length changes in these five fibers were not significantly different. (P = 0.08) Regarding the length change pattern, the lengths of two superior fibers (F20 and F30) increased as the knee flexed

Paper #134

from 0° to 30°, and decreased as the flexion angle increased over 30°. The length of a middle fiber (F40) increased during flexion from 0° to 30° and decreased during flexion from 30° to 120°. In contrast, in two inferior fibers (F50 and F60), F50 showed a gradual increase in length as the knee flexed from 0° to 30°, and then plateau pattern from 30° to 60°, and a decrease as the knee was flexed over 60°. The length of F60 increased as the knee flexed from 0° to 60°, and decreased as the flexion angle increased over 60°.

Conclusion:
This finding shows that the contribution of the superior and middle fibers to resist lateral dislocation of the patella is maximal in early flexion, whereas that of the inferior fibers is maximal in mid-flexion. The superior and inferior fibers of the MPFL act functionally synergistic to restrain lateral force throughout the range of knee flexion.