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Medial Patellofemoral Ligament Influence on Patellofemoral Joint Kinematics: An In-Vitro Analysis

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Summary:
Patellar stability is an important component for a correct kinematic behavior of the knee. Patellofemoral (PF) maltracking can lead to joint disorders associated with pain and mobility alterations. The goal of this work was to study the morphology of the Medial Patellofemoral Ligament (MPFL) and its effect on knee kinematics.

Abstract:
Introduction:
Evaluation of patello-femoral joint pathology and efficacy of treatment is challenged by lack of consensus on its kinematics [1]. Specifically damages to the Medial Patello-femoral Ligament (MPFL) has been suggested to be the essential lesion in lateral patellar dislocation [2,3]. While MPFL reconstruction has better results compared to previous procedures, a recent systematic review advocated a greater knowledge of MPFL behavior to prevent alteration of patello-femoral kinematics, joint compression and long term chondral degeneration after reconstruction [4]. The objective of this study was to analyse the morphology of the MPFL and its influence on patello-femoral kinematics with reference to the trochlea.

Methods:
A kinematic study on six cadaveric knees, using a non-image based navigation system, under an axial quadriceps load of 60 N, in MPFL-intact and MPFL-deficient state, with and without a laterally directed load of 25 N at 0°, 30°, 60° and 90°, was performed. The MPFL was isolated from the Medial Menisco-Tibial Ligament, the navigation system was used to define its insertions, four representative fibers and trochlear surface.

Results:
The MPFL femoral insertion exhibited a high intra-group variability with a mean surface area of 36.5 ± 11.74 mm2. During flexion, the superior decussation were almost isometric, while the inferior two bundles moved closer significantly. The medial shift between 20°-25° of tibial flexion in the MPFL intact, was absent in the MPFL-deficient state and the patella lateralized even without a laterally directed load. The patella did not exhibit any medial tilt between 20°-25° in the current study. A laterally directed load significantly increased the lateral patellar shift after MPFL dissection, peaking at 30° and 60°.

Discussion:
The variable femoral insertion of the MPFL is in agreement with previous literature. The isometric insertion points of the superior fiber pair can be compared to Victor et. al's isometric central bundle. No fibers exhibited kinematic behavior comparable to Victor et. al's cranial bundle, which probably represents an aponeurosis for the insertion of the VMO. The current study shows a statistically significant lateral shift and tilt in this state. The peak patellar shift under load between 30° and 50° in MPFL deficient state probably reflects the peak strain on the MFPL in this range of

knee flexion

Conclusion:
These comparisons clarify that the MFPL has an aponeurotic nature that works as a restraint during motion, with an active role under stress, but low role during neutral knee flexion.

References:
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