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The Effect of Anterolateral Complex Sectioning and a Macintosh Tenodesis on Patellofemoral Joint Contact Pressures and Kinematics

Eivind Inderhaug, MD, MPH, PhD, NORWAY
Joanna M. Stephen, PhD, UNITED KINGDOM
Andy Williams, MBBS, FRCS, FRCS (Orth), FFSEM(UK), UNITED KINGDOM
Andrew A. Amis, FREng, PhD, DSc, UNITED KINGDOM

Imperial College
London, UNITED KINGDOM

Summary:
In knees with injury to the anterolateral complex a MacIntosh tenodesis did not affect patellofemoral contact pressures or patellar kinematics as compared to the intact knees as long as 20 N graft tension was used - but with 80 N graft tension, and the tibia free to rotate into external rotation, increased lateral contact pressures and increased patellar tilt was seen.

Abstract:
Background: Anterolateral complex (ALC) injuries may occur alongside anterior cruciate ligament (ACL) injuries in up to 50% of cases. Whilst these are recognised to affect tibiofemoral mechanics if left untreated, it is not known whether they impact patellofemoral joint (PFJ) contact pressures and kinematics. Furthermore, anterolateral tenodesis traditionally involve the use of the iliotibial band (ITB), which has direct patellar attachments, and thus these procedures could subsequently impact PFJ mechanics and kinematics. The aims of this study were to determine the effects of PFJ kinematics and mechanics from: (1) Sectioning the ALC and (2) A MacIntosh tenodesis.

Methods: Eight fresh frozen cadaveric knees were placed in a customised testing rig, where the femur was fixed but the tibia could be moved freely from 0-90° flexion. Individual quadriceps heads and the ITB were separated and physiologically loaded with 205 N using a weighted pulley system. PFJ contact pressures were measured using a calibrated flexible Tekscan sensor inserted through an incision proximal to the patella and deep to the quadriceps, which did not alter PFJ kinematics. The sensor was guided into the PFJ and once its position was confirmed, sutured in place. Measurements were taken at 0°, 30°, 60° and 90°, and patellar kinematics were measured simultaneously using an Optical Tracking System.

The ACL was left intact throughout testing to represent a 'perfect' ACL reconstruction. The intact knee was tested followed by the knee with ALC sectioned. Four tenodesis protocols were then tested in a randomised order: 20N and 80N graft tension each with the tibia held in its neutral intact alignment using a clamp and also with the tibia free to rotate. During graft fixation 10N and 2N loads were applied to the central quadriceps and ITB respectively to simulate the tension in an anesthetised leg. Full loading was then applied throughout testing. Statistical analysis was undertaken using a repeated-measures ANOVA, Bonferroni post hoc analysis and paired t-tests.

Results: Patellar lateral translation and tilt, and medial and lateral PFJ contact pressures were not significantly altered as a result of sectioning the ALC ($P>0.05$). Similarly, they were not significantly different to the intact knee when the tenodesis procedure was performed with fixed tibial rotation combined with a 20N or 80N graft tension or by a free hanging tibia tensioned with 20N (All: $P>0.5$). However, grafts tensioned with 80N whilst the tibia was free hanging resulted in significant increases in lateral patellar tilt, and significantly elevated lateral PFJ pressures ($P<0.05$).

Conclusions: Injuries to the ALC are becoming increasingly recognised. This is the first study to focus on the impact of ALC injury and subsequent tenodesis on PFJ mechanics and kinematics. The findings demonstrate that although injury to the ALC itself does not alter PFJ mechanics or kinematics, the addition of an anterolateral tenodesis can

cause elevated lateral contact pressures and induce lateral patellar tilting if overtensioned, although this is not the case when lesser tension of 20N is applied. The importance of correct graft tension during anterolateral tenodeses is therefore evident.