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Paper #189

Biomechanical Consequence of a Posterior Root Tear of the Lateral Meniscus in the Human Knee. Stabilizing Effect of the Meniscofemoral Ligament.

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Summary:
The integrity of the meniscofemoral ligament holds the meniscus in place and guarantees an equal distribution of the intraarticular pressure.

Abstract:
Purpose:
In case of an ACL injury a root tear of the lateral meniscus is a common concomitant injury. The aim of this study was to examine the biomechanical effectiveness of a root tear classification. The classification respects different localizations of a tear and their influence on the intraarticular pressure in the lateral compartment. Does the intact meniscofemoral ligament restore the meniscus function, stabilizing the intrarticular pressure in case of a posterior root tear?

Methods:
According to their localization posterior root tears are classified depending on their relationship to the posterior meniscofemoral ligament. 3 different types can be distinguished. The type I root tear is an isolated avulsion of the root. The type II is a complete radial tear of the posterior horn of the lateral meniscus and localized between the root and the meniscal attachment of the meniscofemoral ligament (MFL). The type III tear complies with a complete rupture of the posterior meniscus attachments (root tear and rupture of MFL). After preparation 10 human cadaveric knees were tested in a material testing machine (Zwick/Roell Z005-TN2A). The intraarticular pressure was measured using a digital sensor (Novel type S2042) when an axial load of 100 N was applied. The intraarticular pressure was recorded 1.)for the intact state of the lateral meniscus, 2.) for a type I root tear and 3.) for a type III tear after transection of the root and the meniscofemoral ligament. To calculate the mean intraarticular pressure a region of interest (ROI) was used. The ROI was defined as the 1.0 × 1.0 cm2 area around the peak contact pressure. Statistical analysis was performed by the use of SPSS Software for Windows, release 15.0.1 (SPSS, Chicago, IL). Before statistical testing, each continuous variable was analyzed in an explorative manner for its normal distribution (Kolmogorov-Smirnov test). The Mann-Whitney U test was used for comparison of nonparametric variables (peak contact pressure, difference in pressure) between each study group. The significance level was $P < .05$.

Results:
In case of an intact posterior attachment of the lateral meniscus the axial load of 100 N creates an intraarticular pressure of 120 kPa. After creation of a posterior type I root tear (transection of the root) no significant increase of intraarticular pressure was measured (141 kPa; $p<0,6$). The type III root tear (transection of the root and the MFL) leads to a significant increase of the intraarticular pressure up to 946 kPa ($p<0,004$).

Discussion:

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The isolated root tear (type I) has no significant influence on the intraarticular pressure. The MFL holds the meniscus in place and restores the lateral meniscus function guaranteeing an equal distribution of the intraarticular joint pressure. The type III tear leads to an extrusion of the lateral meniscus and a decrease of the contact area with a significant increase of the intraarticular pressure. These results support the usefulness of a root tear classification of the posterior lateral meniscus. The classification of lateral meniscus root tears allows to estimate the impact of different tear localizations. In clinical practice we recommend a fixation of a root tear in case of an MFL injury or absence of the MFL.