THE ROLE OF PERIPATELLAR RETINACULUM IN THE TRANSMISSION OF FORCES WITHIN THE EXTENSOR MECHANISM

INTRODUCTION: The specific role of the peripatellar retinaculum as a frontal plane stabilizer of the patellofemoral joint has been well established. However, due to its unique orientation, the peripatellar retinaculum also may play a complimentary load sharing role with respect to the patellar ligament. Similar to the patellar ligament, patellar retinaculum provides distal inferior support for the patella through the medial and lateral menisco-patellar ligaments which connect the patella to the tibia. Due to the transverse and oblique orientation of the retinaculum fibers however, it is conceivable that this structure may functionally unload the patellar ligament by resisting tensile forces created by the extensor mechanism. The purpose of this study was to determine the extent to which the peripatellar retinaculum affects the magnitude of forces experienced by the patellar ligament. It was hypothesized that the patellar retinaculum acts as a load sharing structure to decrease the forces experienced by this structure. Information obtained from this study will be useful in further defining the role of the peripatellar retinaculum as an integral component of the extensor mechanism.

METHODS: Ten fresh-frozen, unmatched cadaver knees were used in this study. Each was macroscopically intact and radiographically normal. The individual components of the extensor mechanism, vastus medialis (VM), vastus lateralis (VL), vastus intermedius (VI) and rectus femoris (RF) were separated from each other with the fascial planes. Both the tibia and femur were secured within PVC tubing using diaphyseal bolts and locking pins. The cylinders were then mounted on a custom knee jig that provided six degrees of freedom at the femur, and five degrees of freedom at the tibia. This apparatus was fixed to a materials testing machine frame (Model #1122, Instron Corp, Canton, MA, USA), which was used to flex and extend the knee. Anatomically positioned pulleys guided cables from the muscle clamps to the applied load. To quantify the force in the patellar ligament during testing, a buckle transducer (NK Biotechnical Corp, Minneapolis, MN) was placed near the tibial attachment. Extensor mechanism loading was achieved by applying forces through the individual heads of the quadriceps along their principle muscle fiber orientation. The total extensor muscle force used in this study was 276 N. The distribution of extensor force across the various muscles was based on cross sectional area data as reported by Wickiewicz et al. Each pulley was adjusted so that the force application of the respective musculature represented the primary fiber direction and orientation (Figure 1.). Following the initial set-up, muscle loading commenced and the buckle transducer force was recorded. After testing at 0 degrees of knee flexion, the knee was flexed to 20, 40, and 60 degrees by lowering the Instron crosshead. Patellar ligament force data were obtained at these knee flexion angles. Once the patellar ligament tension for the retinaculum intact condition was collected, both the lateral and medial retinaculum was removed. Following the removal of the retinaculum, the procedures as described above were repeated.

A two-way, repeated measures ANOVA was used to compare patellar ligament tension between the retinaculum intact and retinaculum cut conditions across knee flexion angles. Statistical analysis was performed using SPSS statistical software (SPSS, Chicago, IL) with a significance level of p<0.05.

RESULTS: At each knee flexion angle, the patellar ligament forces observed at 60 degrees may be more a function of increasing patellar retinaculum tension due to the lengthening of the extensor mechanism. The observed increases in patellar ligament forces after cutting of the patellar retinaculum is an indication of the load sharing function of the retinaculum as a part of the extensor mechanism. This load sharing effect was most pronounced at 0 and 60 degrees. It is possible that with the knee in full extension, external rotation of the tibia increases the load placed on the patellar retinaculum as a result of the ‘screw home mechanism’ of the knee. Alternatively the load sharing observed at 60 degrees may be more a function of increasing patellar retinaculum tension due to the lengthening of the extensor mechanism. Since the knowledge of the forces transmitted from the quadriceps to the patellar ligament is important for accurate biomechanical analysis of the patellofemoral joint, failure to account for the influence of the patellar retinaculum could result in an overestimation of the forces experienced by the patella.

DISCUSSION: The observed increases in patellar ligament forces after cutting of the patellar retinaculum is an indication of the load sharing function of the retinaculum as a part of the extensor mechanism. This load sharing effect was most pronounced at 0 and 60 degrees. It is possible that with the knee in full extension, external rotation of the tibia increases the load placed on the patellar retinaculum as a result of the ‘screw home mechanism’ of the knee. Alternatively the load sharing observed at 60 degrees may be more a function of increasing patellar retinaculum tension due to the lengthening of the extensor mechanism. Since the knowledge of the forces transmitted from the quadriceps to the patellar ligament is important for accurate biomechanical analysis of the patellofemoral joint, failure to account for the influence of the patellar retinaculum could result in an overestimation of the forces experienced by the patella.


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