

Strains in the Knee Retinaculum with Anterior and Valgus Knee Loads

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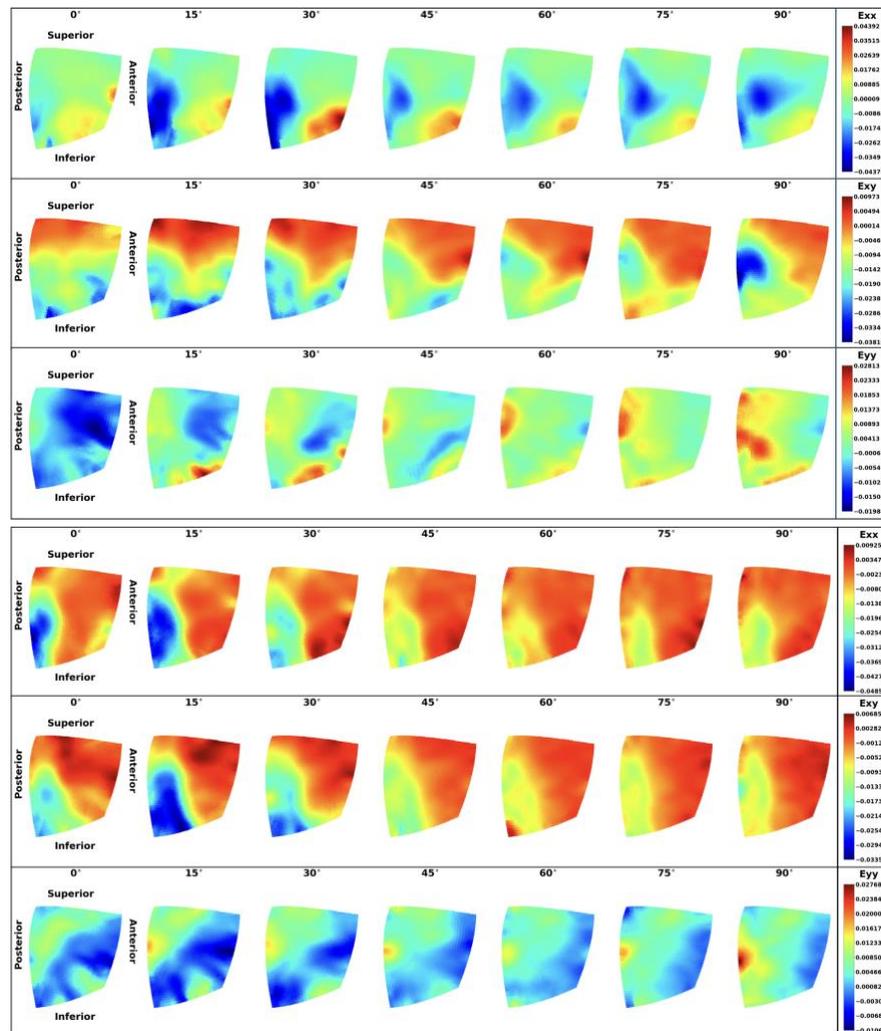
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INTRODUCTION: Strains in the tissue, a measure of tissue loading, under different knee kinematics can be studied to determine joint function. Identifying the functional loading of soft tissue structures is helpful for understanding basic knee function, which can improve the identification of injury mechanisms and surgical treatment techniques. There remains a paucity of literature on strain distributions in the medial retinaculum under relevant and controlled knee loads. This study aims to use digital image correlation (DIC) to measure the strain distributions in the medial retinaculum for specific loadings over different flexion angles.

METHODS: Institutional approval was received for this study (Corid 1186). Eight (n=8) left, fresh frozen cadaveric knees were checked for abnormalities, and kinematics were recorded using a robotic testing system. The kinematics of the intact knees were measured under an 89 N anterior tibial (AT) load and a 7 N-m valgus (Val) tibial load at 0, 15, 30, 45, 60, 75, and 90 degrees of flexion. The knees were then dissected to expose the retinaculum, and the tissue was marked with ink. The border of the tissue was defined on the posterior side by the posterior edge of superficial medial collateral ligament. The inferior edge was defined as parallel line 1 cm distal of joint line. The anterior edge is the medial border of patella. The superior edge was defined as the vastus medialis of quadriceps muscle at 90 degrees flexion. The kinematics of the intact knee under loading were imposed on the dissected knee while recording a video of the tissue. From the video, DIC was then used to calculate the strains in the tissue. Strains from the specimens were converted to a standard file format, missing data were interpolated, and the values averaged.

RESULTS: Figure 1 shows the distributions of mean normal and shear strains as a function of flexion angle under AT load. Figure 2 shows the mean normal and shear strain distributions as a function of flexion angle for a valgus moment.



DISCUSSION: For anterior knee load, the major finding was that there are large anterior-posterior normal strain and shear strain near the inferior border of the medial retinaculum. For valgus knee load, the major finding was that there are large inferior-superior normal strain and shear strain near the mid-substance of the medial retinaculum.

SIGNIFICANCE/CLINICAL RELEVANCE: This data indicates that different excessive knee loads can be expected to cause injuries to different parts of the medial retinaculum. If the injury mechanism is known, this can give insight into the expected location of damage, which may affect the surgical repair.

Figure 1: Mean strains, normal anterior-posterior (top), shear (middle), and normal inferior-superior (bottom) under an anterior tibial load

Figure 2: Mean strains normal anterior-posterior (top), shear (middle), and normal inferior-superior (bottom) under a valgus load