Failure properties and strain distribution analysis of meniscal attachments.

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Abstract

The menisci are frequently injured due to both degeneration and traumatic tearing. It has been suggested that the success of a meniscal replacement is dependent on several factors, one of which is the secure fixation and firm attachment of the replacement to the tibial plateau. Therefore, the objectives of the current study were to (1) determine the failure properties of the meniscal horn attachments, and (2) determine the strain distribution over their surfaces. Eight bovine knee joints were used to study the mechanical response of the meniscal attachments. Three meniscal attachments from one knee of each animal were tested in uniaxial tension at 2%/s to determine the load deformation response. During the tests, the samples were marked and local strain distributions were determined with a video extensometer. The linear modulus of the medial anterior attachment (154±134MPa) was significantly less than both the medial posterior (248±179MPa, p=0.0111) and the lateral anterior attachment (281±214MPa, p=0.0007). Likewise, the ultimate strain for the medial anterior attachments (13.5±8.8%) was significantly less than the medial posterior (23±13%, p<0.0001) and the lateral anterior attachment (20.3±11.1%, p=0.0033). There were no significant differences in the structural properties or ultimate stress between the meniscal attachments (p>0.05). No significant differences in ultimate strain or moduli across the surface of the attachments were noted. Based on the data obtained, a meniscal replacement would need different moduli for each of the different attachments. However, the attachments appear to be homogeneous.