

Horizontal and Vertical Suturing of Human Meniscus Lesions Display Different Shear Load Fixation Characteristics: An In Vitro Biomechanical Study

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Summary:

Although a common failure mechanism, few studies have evaluated in vitro biomechanical meniscus repair characteristics under shear loads. Under shear loads similar to those experienced during early rehabilitation and activities of daily living, horizontal sutures were found to be more resistant to construct displacement, while vertical sutures were found to be more resistant to failure.

Abstract:

Vertical and horizontal sutures are both commonly used for meniscus lesion repair. Recent reports suggest that horizontal suture techniques may be more effective for resisting shear loads.

This in vitro biomechanical study used 10 pair of male cadaver knees (33.4 ± 5.5 years of age) obtained between 24-48 hours following death to evaluate vertical and horizontal suture repair of peripheral meniscus lesions using 2-0 braided polyester suture material. Twenty medial menisci with intact capsules were carefully harvested. A standardized peripheral longitudinal lesion was created by the primary investigator in each meniscus. Ten menisci harvested from the right knee were repaired using a single horizontal suture loop (Group 1). Ten menisci harvested from the left knee were repaired using a single vertical suture loop (Group 2). Standardized suture placements were performed by the primary investigator. Following repair, no tissue was left intact across the lesion so only the suture provided fixation. Specimens were placed in specially designed tissue clamps and loaded into a servohydraulic device so that tensile loads were applied parallel to the lesion, creating a shear effect. Specimens underwent 100 submaximal loading cycles (5-50 N) prior to load to failure testing (5 mm/min). Non-parametric statistical analysis was performed ($P < 0.05$). The number of specimens/group that survived submaximal cyclic loading did not display statistically significant group differences (Group 1 = 5, Group 2 = 7). Of specimens that survived submaximal cyclic loading, Group 1 displayed less displacement than Group 2 (1.6 ± 0.5 mm vs. 2.3 ± 0.8 mm, $P = 0.04$). However, for all specimens, Group 2 withstood more submaximal loading cycles than Group 1 prior to repair failure (98.2 ± 4.5 cycles vs. 64.0 ± 33.4 cycles, $P = 0.03$).

Groups did not display statistically significant differences for load at failure, displacement at failure, construct stiffness, or failure mode. Most specimens in each group failed by suture pulling through the meniscus tissue. Under submaximal cyclic, shear loads similar to those experienced during early rehabilitation and activities of daily living, horizontal sutures were found to be more resistant to construct displacement, while vertical sutures were found to be more resistant to failure.