

Paper #193

Lateral Meniscal Allograft Transplantation with Bone-Block and Suture-Only Techniques Partially Restores Knee Kinematics and Forces

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Summary:

Lateral meniscal transplantation partially restored medial-lateral translation of the tibia in response to anterior loads and resultant forces in the meniscal allograft were 50-60% of the intact lateral meniscus forces. Both lateral MAT fixation techniques functioned similarly in response to our loading conditions.

Abstract:

Background

The effects of meniscus deficiency on knee kinematics and contact pressures are well described. The ability of lateral meniscal allograft transplantation (MAT) to improve knee stability and the load-bearing function of the meniscus in a meniscectomized condition is critical for surgical success.

Purpose

The purpose of this study was to compare the effects of two lateral MAT fixation techniques -bone block and suture-only- on translational and rotatory knee stability, resultant forces in the meniscal allograft, and in situ force in the anterior cruciate ligament (ACL).

Methods

Using a robotic testing system, loads (134-N anterior tibial load + 200-N axial compression, 5-N m internal tibial torque + 5-N m valgus torque, and 5-N m external tibial torque + 5-N m valgus torque) were independently and continuously applied during flexion of 10 fresh-frozen cadaveric knees (mean age: 75 years). Kinematics data was recorded for four knee states: intact, total lateral meniscectomy, lateral MAT bone-block and lateral MAT suture-only fixation techniques. The resultant forces in the lateral meniscus and in the meniscal allograft were quantified using the principle of superposition by reproducing recorded paths after removal of the lateral meniscus and the meniscal allograft, respectively. In situ force in the ACL was quantified using the principle of superposition. A repeated measures analysis of variance (ANOVA) with a post-hoc Bonferroni correction was used to analyze the variations in kinematics and forces at 0°, 30°, 60° and 90° of knee flexion. Significance was set at $P < 0.05$.

Results

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When anterior loads were applied, both lateral MAT bone-block and suture-only fixation techniques decreased medial translation of the tibia that was increased after total lateral meniscectomy at 30°, 60° and 90° of knee flexion by 54.2%, 48.0%, and 50.0%, and 50.0%, 40.0% and 34.6%, respectively ($P < .05$). However, no significant difference in medial-lateral translation or internal-external rotation of the tibia was observed with either lateral MAT technique in response to rotatory loads ($P > .05$). Resultant forces in the meniscal allograft were 50-60% of the forces in the intact lateral meniscus in response to all loading conditions at all knee flexion angles. In situ force in the ACL decreased after total lateral meniscectomy, but no increase was observed after either lateral MAT technique. Overall, no significant differences between lateral MAT techniques were observed regarding kinematics and meniscal allograft and ACL forces ($P > .05$).

Discussion And Conclusion

The data from this study demonstrates that lateral MAT partially restored medial-lateral translation of the tibia in response to anterior loads and resultant forces in the meniscal allograft were 50-60% of the intact lateral meniscus forces. Considering the effects of lateral meniscectomy on knee kinematics, the stabilizing effects of lateral MAT may be beneficial in improving the short and long-term disability associated with lateral meniscal deficiency. Furthermore, significant load-bearing of the meniscal allograft may improve tibiofemoral contact pressures and may slow the development of the degenerative changes commonly observed in meniscectomized knees. Both lateral MAT fixation techniques functioned similarly in response to our loading conditions.