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What is This?
Comparison of In Situ Forces and Knee Kinematics in Anteromedial and High Anteromedial Bundle Augmentation for Partially Ruptured Anterior Cruciate Ligament

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Investigation performed at the University of Pittsburgh, Pittsburgh, Pennsylvania

Background: High tunnel placement is common in single- and double-bundle anterior cruciate ligament (ACL) reconstructions. Similar nonanatomic tunnel placement may also occur in ACL augmentation surgery.

Purpose: In this study, in situ forces and knee kinematics were compared between nonanatomic high anteromedial (AM) and anatomic AM augmentation in a knee with isolated AM bundle injury.

Study Design: Controlled laboratory study.

Methods: Seven fresh-frozen cadaver knees were used (age, 48 ± 12.5 years). First, intact knee kinematics was tested with a robotic–universal force sensor testing system under 2 loading conditions. An 89-N anterior load was applied, and an anterior tibial translation was measured at knee flexion angles of 0°, 30°, 60°, and 90°. Then, combined rotatory loads of 7-N·m valgus and 5-N·m internal tibial rotation were applied at 15° and 30° of knee flexion angles, which mimic the pivot shift. Afterward, only the AM bundle of the ACL was cut arthroscopically, keeping the posterolateral bundle intact. The knee was again tested using intact knee kinematics to measure the in situ force of the AM bundle. Then, arthroscopic anatomic AM bundle reconstruction was performed with an allograft, and the knee was tested to give the in situ force of the reconstructed AM bundle. Knee kinematics under the 3 conditions (intact, anatomic AM augmentation, and nonanatomic high AM augmentation) and the in situ force were compared and analyzed.

Result: The high AM graft had significantly lower in situ force than the intact and anatomic reconstructed AM bundle at 0° of knee flexion (P < .05) and the intact AM bundle at 30° of knee flexion under anterior tibial loading. There were no differences between anatomic graft and intact AM bundle. The high AM graft also had a significantly lower in situ force than the intact and anatomic reconstructed AM with simulated pivot-shift loading at 15° and 30° of flexion (P < .05). Under anterior tibial and rotatory loading, there was a difference in tibial displacement between anatomic and high AM reconstructions and between the high AM graft and intact ACL under rotational loading with the knee at 15° of flexion.

Clinical Relevance: Anatomic AM augmentation can lead to biomechanical advantages at time zero when compared with the nonanatomic (high AM) augmentation. Anatomic AM augmentation better restores the knee kinematics to the intact ACL state.

Keywords: anterior cruciate ligament; augmentation; partial rupture; in situ force; biomechanics