In-Vitro Anatomic Double-Bundle and Single-Bundle Anterior Cruciate Ligament Reconstructions Demonstrate Equivalent Laxity after Time Zero Cyclic Loading

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Disclosures:

Introduction: Previous studies support the hypothesis that “anatomic” graft placement within the anterior cruciate ligament (ACL) footprint, whether done with a double-bundle (ADB) or single-bundle (ASB) technique, provides similar biomechanical stability and clinical outcomes. However, the trend for accelerated activity has raised concern for increased rates of early laxity development. A previous non-arthroscopic biomechanical study found increased laxity with ASB versus ADB reconstruction after cyclic loading. We hypothesized that there would be no difference with regard to laxity development when comparing ADB versus ASB techniques in a controlled biomechanical study.

Methods: Twenty-two cadaveric knees (11 matched pairs), mean age 51.7 (range, 36-60), were randomized to either ADB or ASB ACL reconstruction. Fresh bovine knee flexor tendon graft diameters were matched for all reconstructions. For ADB reconstruction, a single 6.5mm looped graft and a single 7.5mm looped graft formed the anteromedial and posterolateral bundles, respectively. Similar 6.5 and 7.5mm grafts were quadrupled (combined diameter 10mm) for the ASB construct. RigidLoops and IntraFix screws/sheaths (DePuy/Mitek) provided femoral and tibial graft fixation, respectively. During arthroscopy, low tolerance tunnels were drilled using anatomic landmarks. Anatomic placement within the femoral/tibial footprints was confirmed using high-resolution computerized tomography imaging. Anterior tibial translation laxity using a 134N anterior force at 30 degrees of knee flexion was measured in the ACL intact, post-reconstruction and post-cyclic loading (500 cycles of an anterior load, 0 to ±134 N, at 15 degrees of knee flexion) conditions. Increased laxity from the post-reconstructed to post-fatigue state was compared using a two-way ANOVA and a Tukey post-hoc test. For the purposes of the study, the threshold for relevant laxity increase was determined to be 3mm a priori.

Results: Mean ACL intact laxity at 30 degrees knee flexion was 9.64mm (± 2.83) for ADB and 8.92mm (± 1.47) for ASB knees. After reconstruction, mean laxity increased to 11.71mm (± 2.62) for the ADB versus 10.14mm (± 2.31) for the ASB group (See Figure 1). After cyclic loading, average laxity in the ADB group was 13.96mm (± 2.83), with an increase of 2.25mm. In the ASB group, mean laxity was 12.64mm (± 3.90), representing 2.24mm of increased laxity (p=0.130). In both groups, 81.8% of knees (9/11) exhibited less than 3mm of increased anterior laxity. Post cycling, laxity was statistically increased in both groups versus the post-repair state (p<0.05).

Discussion: Standard arthroscopic ADB and ASB ACL reconstructions were similar after cyclic loading. When undergoing the equivalent to a Lachman test post-cycling, average laxity in the majority (81.8%) of specimens remained less than 3mm. These results differ markedly from the previous non-arthroscopic study that utilized different fixation devices and other methods, including older, non-matched pair specimens.

Significance: In a limited biomechanical model, arthroscopic ABD and ASB ACL reconstruction are equivalent after a cyclic loading protocol meant to simulate the fatigue of activities in the early post-operative recovery phase.

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References: 1. Nohmi S, Ishibashi Y, Tsuda E, Yamamoto Y, Tsukada H, Toh S. Biomechanical comparison between single-bundle