Comparison of Single-and Double-Bundle ACL Reconstructions in Restoration of 6DOF Knee Joint Kinematics

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Background

The ACL deficiency alters 6DOF knee kinematics, yet only anterior translation and internal rotation have been the primary measures in previous studies. The purpose of this study was to compare the 6DOF knee kinematics after single-bundle and double-bundle ACL reconstructions under various external loading conditions.

Materials and Methods

Eight human cadaveric knees were tested using a robotic testing system under four different knee conditions: ACL intact, ACL deficient, single-bundle reconstructed using a quadruple hamstring tendon, and double-bundle reconstructed using two double-looped hamstring tendons. Kinematics of each knee were measured under an anterior tibial load of 134 N, a quadriceps muscle load of 400 N, and combined tibial torques (10 N · m valgus and 5 N · m internal tibial torques) at 0°, 15°, 30°, 60°, and 90° of knee flexion.Specifically, we reported anterior-posterior, medial-lateral, internal-external, and varus-valgus kinematics of the knee at different flexion angles.

Results

Both single-bundle and double-bundle reconstructions were shown to reduce the increasedanterior and medial tibial translation caused by ACL deficiency. The double-bundle reconstruction could restore the anterior and medial stabilities closer to the intact knee than the single-bundle reconstruction ($P>.05$). The internal rotation under the muscle load was significantly decreased compared to the intact knee after both reconstructions, more so after double-bundle reconstruction ($P<.05$). No significant differences were observed in varus-valgus rotation between the two reconstructions.

Conclusion

The double-bundle ACL reconstruction was more efficient in restoration of anterior and medial tibial translations than the single-bundle ACL reconstruction, but it overcorrected the internal tibial rotation under the muscle load.