Double-bundle ACL reconstruction: novice surgeons utilizing computer-assisted navigation versus experienced surgeons

ANTHONY CA¹, DUCHMAN K², MCCUNNIF P¹, MCDERMOTT S¹, BOLLIER M², WOLF BR², THEDENS DR³, ALBRIGHT JP²

¹University of Iowa Carver College of Medicine, Iowa City, IA, USA
²Department of Orthopaedics and Rehabilitation, University of Iowa Hospitals and Clinics, Iowa City, IA, USA
³Department of Engineering, University of Iowa Hospitals and Clinics, Iowa City, IA, USA

chris-anthony@uiowa.edu

Background: While the anterior cruciate ligament is often referenced as a single entity, previous literature describes in detail the positioning and location of the native AM and PL bundles of the ACL on the tibial plateau and lateral femoral condyle [1,5]. Previous work has also shown that tunnel malpositioning may cause grafts that fail to reproduce the native biomechanics of the ACL, increase graft tension in deep knee flexion, increase anterior tibial translation, and lower IKDC (International Knee Documentation Committee) scores [3,4,5]. While double-bundle reconstruction attempts to recreate the two-bundle anatomy of the native ACL, recent research also indicates that double-bundle reconstruction more closely reproduces the biomechanical properties of the ACL and restores the rotatory and sagittal stability to the level of the intact knee that was not attainable with anatomic single-bundle reconstruction [2]. While double-bundle reconstruction provides these biomechanical benefits, it poses a significant challenge to the surgeon who must attempt to accurately place twice as many tunnels while avoiding tunnel convergence compared to single-bundle reconstruction.

Hypothesis: We hypothesize that experienced surgeons without the use of computer assisted navigation will place tunnels on the tibial plateau and femoral condyle that more closely emulate the locations of the native AM and PL bundles than inexperienced surgeons with the use of computer-assisted navigation.

Materials: Twenty fresh-frozen human cadaver knees underwent arthroscopic anatomic double-bundle ACL reconstruction. Three medical students without prior surgical experience performed the double-bundle ACL reconstruction using a passive computer-assisted surgery system (OrthoPilot®, Aesculap Implant Systems, Tuttingen, Germany) in eleven knees. Three experienced orthopaedic surgeons performed the
double-bundle reconstruction without the use of computer-assisted surgery in nine knees. Each knee had pre- and postoperative imaging in order to determine the location of bony landmarks, soft tissue anatomy, and accuracy of anteromedial (AM) and posterolateral (PL) tunnel placement on the tibial plateau and lateral condyle of the femur.

**Results:** There were no significant differences in AM or PL tunnel position evaluated in both the sagittal and coronal planes when comparing the novice and experienced surgeon groups on the tibial plateau. On the femoral condyle, the novice surgeon group placed the AM tunnel significantly anterior to the experienced surgeon group (p = 0.0073) along Blumensaat’s line. The PL tunnel was also placed significantly more anterior on the femoral condyle by the novice surgeon group compared to the experienced surgeon group (p = 0.0098). There was no significant difference between novice and experienced surgeons in tunnel placement with respect to the notch height for both the AM and PL tunnels on the femoral condyle. The novice surgeon group placed the tibial AM tunnel at an average of 32.1±7.1% and the tibial PL tunnel at an average of 54±5.8% of the sagittal distance of the tibial plateau measured from the anterior cortex. The experienced surgeon group placed the tibial AM tunnel at an average of 37.7±7.4% and the tibial PL tunnel at an average of 53±8.7%. In the coronal plane, the novice surgeon group placed the tibial AM tunnel at an average of 43±3.3% and the PL tunnel at an average of 47±3.0% of the maximum coronal width measured from the medial cortex. The experienced surgeon group placed the AM tunnel at an average of 43±1.8% and the PL tunnel at 49±2.2%. On the lateral femoral condyle, the novice surgeon group placed the femoral AM tunnel at an average of 43±10% along the distance of Blumensaat’s line and 11±11% of the notch height while the experienced surgeon group placed the femoral AM tunnel at an average of 30±7.2% along Blumensaat’s line and 5.9% ±6.5% of the notch height. The novice surgeon group placed the femoral PL tunnel at an average of 46±7.3% along Blumensaat’s line and 49±12% of the notch height while the experienced surgeon group placed the femoral PL tunnel at an average of 37±7.2% along Blumensaat’s line and 42±14% of the notch height.

**Conclusions:** Novice surgeons utilizing computer-assisted surgery place the AM and PL tunnels on the tibial side with a similar degree of accuracy and precision compared to experienced surgeons. On the lateral femoral condyle, novice surgeons using a computer-assisted surgery system are less accurate placing both the AM and PL tunnels significantly more anterior along Blumensaat’s line compared to experienced surgeons. There was no significant difference between the two groups in accuracy of tunnel positioning with respect to notch height. In general, the radiographically defined tunnels placed by both the novice and experienced surgeon groups were slightly anterior along Blumensaat’s line compared to previous anatomic data in the literature, reaffirming the difficulty in tunnel placement along the lateral femoral condyle.

**References**