Navigated anatomic femoral tunnel placement using a transtibial technique for hamstring anterior cruciate ligament reconstruction

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Background: Recent publications have supported the anatomic placement of anterior cruciate grafts to optimise knee function.¹²,³ The transtibial technique has been shown to be less accurate than the anteromedial portal for anatomic femoral tunnel placement using traditional methods.⁴ However, recently, anatomic placement using the anteromedial portal has been shown to have a higher failure rate than graft placement using the transtibial method. This is considered to possibly be due to it being more technically difficult and to the femoral tunnel length being relatively short leading to compromise of fixation methods.⁵ It also requires the knee to be in hyper flexion. This position is not feasible during with a tourniquet in situ on the heavily muscled thighs of some athletes. In previous non navigated work, the knee was kept at 90⁰ flexion and it was suggested that using a more medial tibial tunnel would allow access to the anatomical femoral footprint.

Hypothesis: That navigation can be used to place the femoral tunnel in the anatomic position via a more medial transtibial tunnel.

Methods: In 25 patients underwent Navigated Anterior Cruciate reconstruction with quadruple hamstring grafts. The Orthopilot™ 3.0 ACL (BBraun Aesculap, Tuttingen) software was used. The registration included outlining the tibial and femoral footprints of the ACL. The centres of the femoral and tibial footprints were marked on the bones with a radio frequency probe. A pivot shift test and measurements of the anterior drawer and internal and external rotation were performed and recorded using the software. A navigated guide wire was inserted at 25⁰ to the sagittal plane and 45⁰ to the transverse plane exiting through the centre of the tibial footprint. The position of the guide wire in the xyz planes was noted and it was registered on the navigation system. The guide wire was advanced into the joint to just clear of the surface of the...
femoral footprint. The knee was then placed in 90° flexion and the relationship between the tip of the guide wire and the marked centre of the femoral footprint was noted. Flexion/extension of the knee was done to determine the closest position of the guide wire tip to the centre of the anatomical femoral footprint. If the tip was within 2mm of the centre of footprint, the position was accepted. The guide wire was then advanced into the femur and the tunnels drilled. If not the tibial guide was repositioned and the process repeated. When the final position of the femoral tunnel was made, a screen shot was done. The screen shot was measured to determine the shape and area of the femoral footprint and the tunnel aperture and the percentage overlap. These were analysed subsequently using ImageJ software (National Institute of Health). The graft was fixed proximally with a cortical plate and suspension method and distally with an interference screw. A pivot shift test and measurements of the anterior drawer and internal and external rotation were repeated and recorded using the software.

**Results:** In 22 out of 25 patients the centre of the drill hole was within 2mm of the centre of the anatomic femoral footprint. In 3 patients it was between 2 and 4 mm off centre. The femoral tunnel diameter ranged from 7.5mm to 9.5mm. The aperture of the tunnel was of necessity an ellipse due to the obliquity of the angle between the drill and the medial wall of the lateral femoral condyle. In 23 knees there was more than 80 % overlap between the tunnel aperture and the anatomical footprint. In the other 2 knees there was 65% and 75% overlap respectively. The direction of the final tibial tunnel ranged from 22° to 28° from the sagittal plane and 42° to 49° from the transverse plane. The optimum knee flexion was between 76° and 94°. In all cases, the pivot shift recorded by the software was shown to be absent after graft fixation. There was a statistically significant difference between the anterior drawer, internal and external rotation as measured by the software before and after graft fixation (p<0.05)

**Conclusions:** Based on our data, navigation allows reproducible transtibial anatomic placement of the quadruple hamstring ACL graft. This is possible when the position of the tibial tunnel is customised to the anatomy of the individual patient's knee.

**References**