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Does Femoral Morphology and Tunnel Position Affect Single Bundle Anatomical ACL Reconstruction Isometry?

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Summary:
Anatomic Single Bundle ACL reconstruction results in an anisometric graft that lengthens(tightens) in extension; we discuss the relevance of the femoral tunnel position and femoral morphology as assessed using 3-D reconstructed CT Scan relative to the amount of lengthening(tightening) recorded intraoperatively.

Abstract:
Anatomical single bundle ACL reconstruction is currently a commonly performed technique. In order to optimise our femoral tunnel position we utilise the following landmarks - arthroscopic visualisation of the femoral footprint, the residence ridges, the superior edge of the condyle and the bone-articular cartilage interface. Drilling through the AM portal usually results in a slightly oblique hole towards the posterolateral (PL) bundle position. We therefore start our guidewire slightly towards the anteromedial (AM) bundle footprint and around 60% of the distance from the articular cartilage margin to the roof of the notch. Once the graft is fixed to the femur we assess the isometry, through a range of motion, relative to the anterior tibial cortex. We have noted that the graft is anisometric and usually retracts when going into terminal extension. The purpose of this study was to assess whether the morphology of the femoral condyle and or the tunnel position has an effect on the isometry.

Methods:
Ethical clearance was obtained from our university ethics committee. All patients over the age of 18 who had an ACL reconstruction by 2 of the authors were included in a prospective data collection cohort. A single bundle anatomic trans AM portal femoral tunnel drilling was performed. The isometry was measured intraoperatively by the surgeon and recorded. Immediately post operatively a spiral CT scan was performed with 3-d reconstruction. The tunnel positions were measured using a Hertel grid as described and further measurements relative to the tunnel and articular surface were made simulating the position of the femoral tunnel relative to the tibia in 0°, 30° and 90° flexion. All radiographic measurements were performed by an independent radiologist blinded to the intraoperative findings.

Results:
Seventeen knees were assessed. The were 10 male and 7 female. The average isometry was 2.6mm (range 0-4mm) tightening in full extension. The centre of the femoral tunnel was measured on average 3.7 mm (range 1-6mm) from Blumensaat's line and 10.7mm (range 3-17mm)from the superior edge of the lateral femoral condyle. The distance from the centre of the tunnel to the bone articular cartilage interface at 0° flexion was on average 20.7mm (range 17-32mm), at 30° flexion 13.2mm (range 9-17mm) and at 90° flexion 8.1mm (range 6-11mm). The difference between the distances was calculated. The change in length between the centre of the tunnel and the edge at different angles did not correlate with the amount of shortening. Femoral tunnel position compared well with published studies as plotted on the Hertel grid, but as a single factor did not correlate with the amount of shortening.

Discussion:
Anatomical single bundle ACL reconstruction produces an anisometric graft that lenghtens in the last 30° of extension. The amount of lenghtening is not related to tunnel position and morphology of the femoral condyle

independently. Fixation of the graft at 30° may capture the knee and prevent full extension while fixation in full extension may result in a graft that is a few mm loose at 30° and still pivoting. Care should be taken to place the femoral tunnel in the native footprint and assess the amount of retraction of the graft on an individual basis. This may result in fixation of the tibial end of the graft in more extension than the traditional 30degrees flexion. Further investigation is being done to assess the clinical effects.