Sports Medicine
**Literature Matters**

# Optimization of Anteromedial Portal Femoral Tunnel Drilling with Flexible and Straight Reamers in Anterior Cruciate Ligament Reconstruction (ACLR): A Cadaveric 3-Dimensional Computed Tomography Analysis

Forsythe B, Collins MJ, Arns TA, Zuke WA, Khair M, Verma NN, Cole BJ, Bach BR, and Inoue N.
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## Top Level Summary:

Stryker's VersiTomic flexible reamers are designed to limit the need of hyperflexion during tunnel placement, and allow a more anatomic tunnel placement compared with rigid reamers when femoral tunnels are drilled through an anteromedial portal (AMP) during ACLR. **When using the AMP during a 3D CAD modeling study, VersiTomic curved guides and flexible reamers result in a greater distance of the tunnel to the femoral cortex while preserving adequate tunnel length at lower knee flexion angles.** This study suggests the knee should be flexed to at least 110° for VersiTomic flexible reamers and 125° for straight reamers to create long femoral tunnels without breaching the posterior cortex.

## Methods:

Six cadaveric knees (4 male, 2 female) were placed in an external fixator at various degrees of flexion (90°, 110°, 125°, and maximum 135° to 140°). Computed tomography (CT) scans were obtained at all flexion points for 3D point-cloud models. VersiTomic straight guides and reamers were used as comparison. Using custom CAD software, surgical instrumentation was modeled identically to that of the VersiTomic system. Guides were modeled such that the guide tip touched the insertion point identified by the surgeon, with the curved portion as close to the medial condyle as possible. A guidewire was simulated to travel through the guide and out of the lateral femoral condyle (exit point). Virtual tunnels of 8mm and 10mm diameter were created to simulate tunnels created during routine ACLR using soft tissue and bone-tendon-bone grafts. The smallest distance from the posterior wall of the lateral condyle to the guide wire (termed "least distance") was measured to determine posterior wall blow out frequency (Fig. 1).[1] Tunnel length was also measured, defined as the distance between the insertion point and the exit point; with adequate tunnel length described as > 25mm.

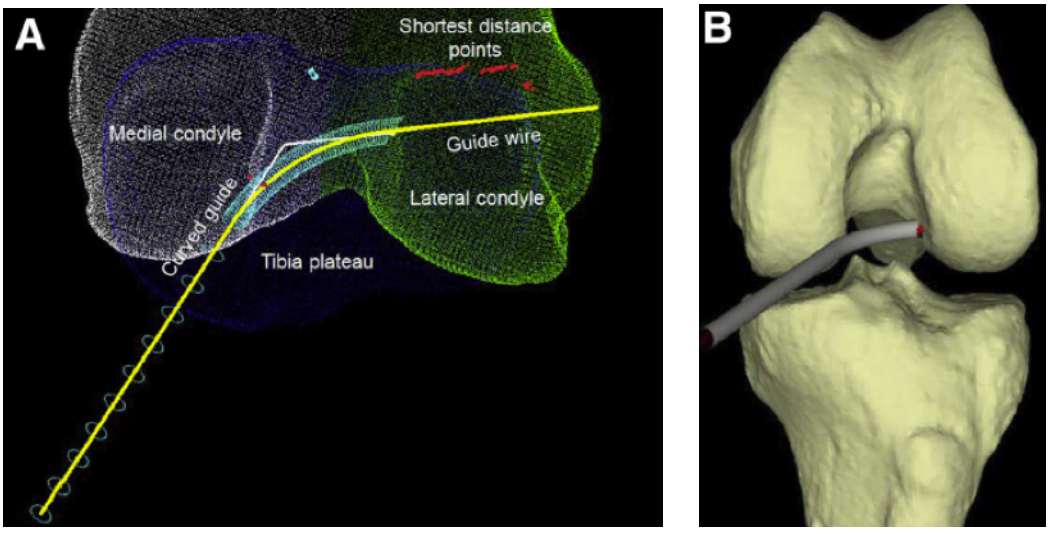


**Figure 1.** (A) Analysis of tunnel length and shortest distances from the guidewire using a 3D point-cloud model. The curved guide is automatically rotated around the entry point until the guide contacts the medial condyle and medial tibia plateau. (B) 3D representation of the virtual placement of the curved guide; red point is the entry point of the guidewire.

## Results:

### Average least distance

As the degree of knee flexion increases, the average least distance from the posterior wall of the lateral femoral condyle increases for both VersiTomic flexible and straight reamers (Fig. 2; $p < 0.001$). At knee flexion angles of more than 110° for curved guides and more than 125° for straight guides, the adequate distance to the posterior wall was achieved without breaching the femoral cortex.

### Femoral tunnel length

Femoral tunnel length was consistently more than 25mm when drilling with VersiTomic flexible reamers. With straight reamers, a 25mm tunnel length was reach at 110° of flexion and greater. Despite no current consensus on adequate tunnel length, this study shows the achievable tunnel lengths at multiple flexion angles for VersiTomic flexible and straight reamers. Moreover, with both curved and straight guides, increasing knee flexion produced significantly longer tunnel lengths ($p < 0.001$).

### Posterior wall blowout

Drilling the femoral tunnel through the AMP at 90° of knee flexion, with either curved or straight guides, greatly put the posterior cortex at risk. However, at flexion angles of 125° or greater, the posterior cortex was not breached by either guide (Fig. 2).

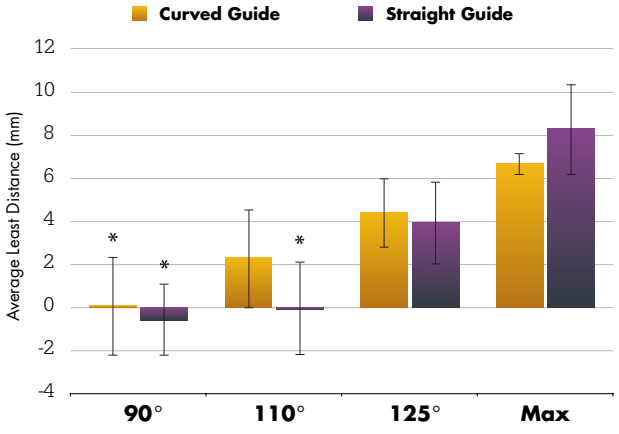


**Figure 2.** The average least distance along the middle third of a 10mm tunnel created with curved and straight guides. VersiTomic flexible reamers resulted in significantly greater least distances from the posterior wall compared with straight reamers with the knee at 90° and 110° of flexion ($p = 0.014$; $p = 0.001$). Error bars represent the standard deviation of the mean (95% confidence). *Indicates posterior wall blowout in specimens (2 at 90° with curved and straight guides, 3 at 110° with straight guides).

## Clinical Relevance:

The goal of ACLR via the AMP is to create anatomic reconstruction of the ACL, including the size of the insertion site. The VersiTomic Flexible Reaming System is designed to optimize anatomic placement of femoral socket(s) for ACLR, by increasing the potential for longer tunnels farther from the posterior cortex without hyperflexion. To create longer femoral tunnels without breaching the posterior cortex while drilling through the AMP, it is important to note that VersiTomic flexible and straight reamers require different degrees of knee flexion to achieve optimal tunnel dimensions with respect to tunnel length and footprint coverage.

## References


1. The minimum recommended distance of 1.5 to 2mm of posterior back wall should be calculated into the femoral offset guide and added to the tunnel radius to avoid posterior wall blowout.

Bach, B. Curbside Consultation of the ACL: 49 Clinical Questions. Slack Incorporated; 1st edition (Feb 15, 2008).



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