

# Characterizing the Rotational Profile of the Distal Femur: A Roadmap for Distal Femoral Replacement Surgery

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## INTRODUCTION:

Restoration of native distal femoral rotational alignment is crucial during distal femoral replacement to prevent mechanical complications and optimize patellar tracking. However, in the setting of extensive femoral bone loss or resection, traditional references like the transepicondylar axis (TEA) and Whiteside's line are not available. Therefore, this study aimed to describe the rotational profile of the femoral osseous anatomy relative to the TEA at various distances proximal to the native joint line.

## METHODS:

Adult patients with computerized tomography (CT) scans of the bilateral lower extremities were screened for inclusion. Exclusion criteria included acute fracture or evidence of prior fracture, congenital deformity, or incomplete imaging. Using the TEA as a reference, 4 angles were measured in the axial plane using the following lines: 1) a line parallel to the anterior cortex (ACA), 2) a line parallel to the posterior cortex (PCA), 3) a line through the linea aspera bisecting the femoral canal (LAA), and 4) a line from the midpoint of the trochlear groove the anterior-most aspect of the intercondylar notch (WL). These angles were assessed at 3, 5, 7, and 9 centimeters (cm) proximal to the joint line, which was defined as the distal-most point of the medial femoral condyle. The average of both legs was reported. External and internal rotation relative to the TEA were denoted as positive and negative, respectively.

## RESULTS:

In total, 45 patients (90 femora) were included with an average age of  $62.1 \pm 14.3$  years and BMI of  $25.2 \pm 5.7$  kg/m<sup>2</sup>. Near the joint line, WL was nearly perpendicular to the TEA ( $89.8 \pm 2.7^\circ$ ). At more proximal levels, the anterior cortex became increasingly internally rotated (3 cm ACA:  $-12.9 \pm 3.5^\circ$ , 9 cm ACA:  $-20.8 \pm 6.4^\circ$ ), while the posterior cortex became increasing externally rotated (3 cm PCA:  $-6.7 \pm 2.5^\circ$ , 9 cm PCA:  $9.4 \pm 6.2^\circ$ ). WL remained nearly perpendicular to the TEA (3 cm WA:  $88.9 \pm 2.3^\circ$ , 5 cm WA:  $90.2 \pm 3.8^\circ$ , 7 cm WA:  $91.6 \pm 4.5^\circ$ ) but could not be measured reliably at 7 cm proximal to the joint line and was not identifiable at 9 cm proximal to the joint line. The LAA was measurable beyond 5 cm proximal to the joint line and became increasingly internally rotated (5 cm LAA:  $-31.5 \pm 14.3^\circ$ , 9 cm LAA:  $-44.0 \pm 14.2^\circ$ ).

**DISCUSSION AND CONCLUSION:** At distal resection lengths, Whiteside's line is an accurate anatomic landmark for femoral component rotation. However, at more proximal resection lengths, orthopaedic surgeons should avoid using the linea aspera as this may lead to gross internal rotation of the femoral component. The posterior cortex may be a valuable rotational landmark at more proximal resection levels.

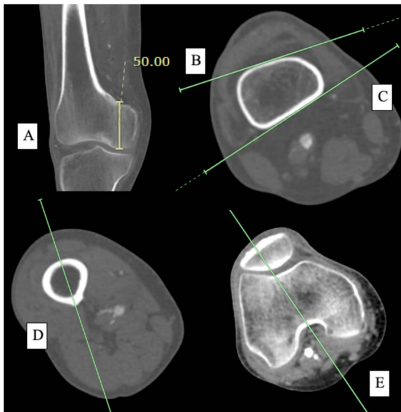


Figure 1. Distances of 3, 5, 7, and 9 centimeters were measured from the distal-most point of the medial femoral condyle on a coronal view of the knee (Figure 1A). Lines were drawn parallel to the anterior femoral cortex (B) and posterior femoral cortex (C). Where possible, lines were drawn intersecting the linea aspera while bisecting the femoral canal (D) and connecting the midpoints of the trochlear sulcus and intercondylar fossa.