A Novel Fluoroscopic Method for Assessing Rotational Malalignment of the Tibia

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Purpose: Tibial malrotation following intramedullary nail fixation is a preventable and potentially disabling iatrogenic complication. To date, there are no standardized or widely accepted fluoroscopic methods to assess tibial torsion. In this study, we propose a novel fluoroscopic technique that has clearly defined structures as reference lines and is easily performed intraoperatively. The purpose of this study is to evaluate the accuracy and reproducibility by comparing this and a previously described radiographic method to the gold standard, CT.

Methods: Circular ring external fixators were secured to the tibial midshaft of 5 cadaveric lower extremity specimens. A transverse tibial osteotomy and partial fibular shaft excision were then performed. Tibial torsion was initially measured on CT and then by 2 fluoroscopic methods at differing degrees of tibial rotation. Using deformity correction software, the frame and tibia were programmed to rotate 5, 10, 15, 20, 25, and 30° of internal and external rotation. The previously described “mortise" method measures the angle between a line tangential to the posterior femoral condyles and the inner surface of the medial malleolus. Introduced in this study, the “intermalleolar” method applies the same femoral reference, but uses the intermalleolar line where the distal fibula perfectly bisects the tibia at the physeal scar. Measurements were performed by both a fellowship-trained orthopaedic trauma surgeon and an orthopaedic surgery resident, who were blinded to the degree of rotational change and to the other observer’s measurements. Accuracy and interobserver reliability were then assessed.

Results: Both resident and attending measurements of tibial torsion using the intermalleolar method did not differ significantly from the gold standard, CT. Mean rotational differences were 2.80 and 2.95°, respectively (range, 0-10°; $P = 0.422$, $P = 0.215$). This method was highly reliable between observers (intraclass correlation coefficient [ICC] 0.992). Only one of the observational groups using the mortise method did not differ significantly from CT. Mean rotational differences were 4.06 and 2.42° (range, 0-18°; $P = 0.011$, $P = 0.611$). This method was also highly reliable (ICC 0.958).

Conclusion: Measuring tibial torsion fluoroscopically using the intermalleolar method is both accurate and reproducible, even when performed by surgeons with varying degrees of experience. It may be more accurate than the previously described mortise method, and also provides an absolute value that represents the true tibial rotation. This novel technique may be employed reliably and effectively in the operating room to identify tibial malrotation and assist in intraoperative rotational corrections.