**TITLE:** Quantitative lesser trochanter profile versus cortical step sign in assessing femoral malrotation after femoral nailing

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**INTRODUCTION:** Various methods have been described for qualitatively assessing the presence of malrotation intraoperatively after femoral nailing, however, no simple methods have been described to quantitatively measure the direction and magnitude of malrotation. The ‘Cortical Step Sign’ (CSS) is a technique using the thicknesses of the cortices on each side of a fracture to assess qualitatively for malrotation. A modification of a different technique that uses the relative sizes of the lesser trochanters to calculate the direction and magnitude of malrotation has been recently described [‘Quantitative Lesser Trochanter Profile’ (QLTP)], and we hypothesized that surgeons would be able to use the QLTP to better estimate the magnitude and direction of malrotation than by using the CSS technique.

**METHODS:** Eleven cadaveric femora were harvested and stripped of soft tissue. A transverse osteotomy was performed at the midpoint of the diaphysis, a reamed intramedullary nail placed, and the femur mounted on a jig to allow for free rotation of the proximal femur with the distal femur fixed. Matched pairs of left and right AP fluoroscopic images were then obtained of the proximal femur and the osteotomy site at rotations of 0° and at randomly assigned numbers of both internal and external rotation between 11-20°, 21-30°, and 31-40°. A computer based quiz was then made from a random order of the 66 images of the proximal femur and 66 images of the osteotomy site. A quiz was then constructed of these 132 images in random order. Nine Orthopaedic Traumatology attendings or fellows who were blinded as to the magnitude of malrotations completed the quiz. Responders were asked to estimate the amount and direction of malrotation based on images of either the osteotomy sites using the Cortical Step Sign technique or based on images of the proximal femur using the QTLP. The QTLP used 3 measurements of the lesser trochanter size (maximal lesser trochanter size, non-rotated contralateral image, and a potentially malrotated image ). Malrotation for these QTLP cases was then calculated based on a simple novel formula [malrotation = (70\*(LTPcontralateral-LTP¬injured)/LTPmax)] using the three measurements. The frequency with which observers correctly determined the direction of malrotation was compared between techniques using Fischers Exact test. Adjusted intraclass correlation coefficients (ICC) were calculated to determine the reliability of each technique. Matched paired t-tests were used to determine the mean measurement error.

**RESULTS:** Observers correctly determined the direction of malrotation in 93.4% of cases using QLTP and 9.4% of cases using CSS (p<0.0001). The ICC was 0.54 for CSS and 0.87 for QLTP (p<0.0001), showing a statistically significant difference in reliability. Overall, the QLTP substantially outperforms the CSS in all assessed metrics. The mean error for malrotation was 10.3 degrees for QLTP and 14.0 degrees for CSS, for a difference of 3.7 degrees (95% CI = 2.9-4.8 p<0.0001).

**DISCUSSION/CONCLUSION:** The Quantitative Lesser Trochanter Profile technique provides a significant improvement in measurement reliability (ICC: 0.87 vs. 0.54) and determination of direction of malrotation compared to the Cortical Step Sign technique. Furthermore, QLTP technique provides an additional advantage of superior measurement accuracy (p<0.0001).