

The Reliability of Contralateral Templating for Femoral Shaft Fractures: A CT Study of Side-to-side Differences of Femoral Neck Version in 328 Femurs

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Background/Purpose: Malrotation is the most common deformity following intramedullary fixation of diaphyseal femur fractures (OTA/AO type 32). To prevent malrotation, many surgeons use fluoroscopic imaging of the contralateral extremity to provide a template for reduction; however, this practice does not account for side-to-side variations in native femoral version. The objective of this study was to determine the side-to-side differences in femoral neck version in a diverse population and to explore patient factors that are predictive of side-to-side variation.

Methods: Our institution's radiology database was screened for patients with bilateral lower extremity CT scans. Patients with complete CT imaging of bilateral femora were included in our study. Patients were excluded if they had an acute fracture of the femur, evidence of a prior femoral fracture, evidence of congenital hip dysplasia, or inadequate imaging. Femoral neck version was computed for each femur by measuring the angle between the posterior condylar axis and a line drawn down the center of the femoral neck and head. Demographic information was also recorded for each subject, including age, sex and ethnicity. Side-to-side differences in femoral neck version were correlated with demographic variables in a multiple linear regression model. All statistical analysis was performed using Stata 13 (StataCorp LP).

Results: After exclusion criteria were applied, 164 subjects (328 femora) with a mean age of 48.3 years (SD 14.0 years) were included in our study. Of these, 96 (58.9%) were male and 67 (41.4%) were female. The average femoral neck version was 8.9° in males and 10.0° in females. When compared in a pairwise fashion, there was a significant side-to-side difference in femoral version ($5.4 \pm 4.4^\circ$, $P < 0.01$). There was no systematic difference in version between the right ($9.7 \pm 9.4^\circ$; range, -19° to 38°) and left ($9.1 \pm 9.4^\circ$; range, -24° to 33°) femora ($P = 0.31$). Average side-to-side difference was not significantly different between males ($6.1 \pm 5.1^\circ$) and females ($4.8 \pm 3.7^\circ$) ($P = 0.70$) or between white ($5.0 \pm 3.1^\circ$), black ($5.4 \pm 5.1^\circ$), Hispanic ($5.1 \pm 4.1^\circ$), or Asian ($8.2 \pm 6.1^\circ$) ethnicities ($P = 0.11$). There was a trend toward greater side-to-side difference in Asians compared to whites ($P = 0.06$) and Hispanics ($P = 0.06$). Asian ethnicity predicted a greater side-to-side difference in version in univariate regression ($\beta = 3.10$, $P = 0.02$) and in a multivariate model controlling for age, sex, and ethnicity ($\beta = 3.17$, $P = 0.04$). Of the patients examined, 53.6% had a side-to-side difference in version $< 5^\circ$, 17.7% had a difference in version $\geq 10^\circ$, and 4.3% had a difference in version $> 15^\circ$.

Conclusion: Side-to-side differences in femoral neck version are common and may affect femoral rotation during intramedullary fixation of diaphyseal femur fractures. An asymme-

try of $>10^\circ$ was observed in almost 20% of the study subjects. In these cases, relying on the contralateral limb for rotational alignment could result in a difference from native anatomy that is clinically significant. Asian race was found to be a significant predictor of increased side-to-side differences in femoral version, while sex and age were not.

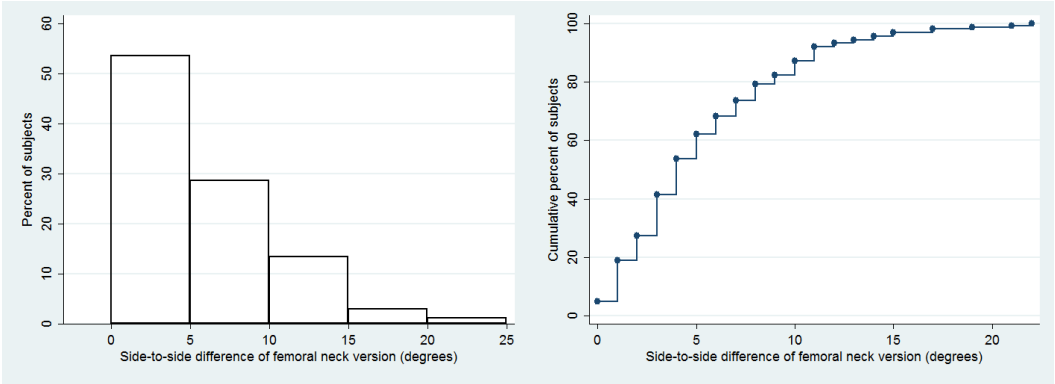


Figure 1: (a) histogram and (b) cumulative frequency plot demonstrating the absolute right-left (side-to-side) difference in femoral version.