Evaluation of Intraoperative Fluoroscopic Techniques to Estimate Femoral Rotation: A Cadaveric Study

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Purpose: The intraoperative evaluation of femoral torsion utilizing fluoroscopy is an inexact science. Several methods have been described in order to prevent postoperative malrotation of femur fractures treated with an intramedullary nail. However, minimal data exist comparing these different techniques with regard to accuracy. We sought to compare different fluoroscopic techniques both for estimating rotation of the uninjured femur, as well as establishing rotation of the injured side utilizing a cadaveric model.

Methods: Measurement of native femoral version via CT was performed in 10 cadavers to yield 20 intact femurs. A transverse osteotomy was created in the diaphysis of each right femur. Four surgeons utilized 3 fluoroscopic techniques to match the rotation of the fractured side to uninjured side. These included matching the lesser trochanter profile (LTP), the true lateral (TL), and neck-horizontal (NH) angle techniques, as previously described. The accuracy of each method was assessed via measurement of the angle subtended by 2 Steinmann pins placed into the femur above and below the osteotomy. By comparing this angle to the angle subtended by the same pins prior to the osteotomy, the accuracy of each observation could be assessed. For the TL and NH techniques, each surgeon also estimated the femoral version of the intact femur.

Results: The absolute mean error in estimating the femoral version of the intact femur using the TL and NH method compared to CT was 8.2° (95% confidence interval [CI] 6.5, 10.0), and 4.4° (CI 3.3, 5.4), respectively. The interobserver agreement between surgeons was 0.69° (CI 0.27, 0.91) and 0.72° (CI 0.39, 0.91) for the TL and NH estimations, respectively. The concordance with CT for the TL estimation ranged from 0.37 to 0.83 and the concordance for the NH estimation ranged from 0.65 to 0.80. The absolute mean rotational error in the fractured femur was 6.0° (CI 4.6, 7.6) for the TL method, 6.6° (CI 5.03, 8.15) for the NH method, and 8.5°(CI 6.5, 10.6) for the LTP method.

Conclusion: The NH method was more accurate in estimating the version of the intact femur compared to the TL technique. In the fractured femur, the mean rotational error observed was similar between the TL, NH, and LTP methods and ranged between a mean of 6° and 8.5°. All techniques were within the acceptable clinical margin of error of rotation after femoral fracture, and we recommend that surgeons utilize the technique with which they are most familiar.