

An Anatomical Study of the Greater Trochanter Starting Point for Intramedullary Nailing

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Purpose: Intramedullary nail insertion through a greater trochanter starting point has been increasing in popularity. Although the optimal position for insertion in the coronal plane has been well characterized, sagittal plane insertion position is poorly defined.

Methods: 744 paired femora from well-preserved cadavers were placed both in a neutral apparent neck-shaft angle (ANSA) position, and with internal rotation to neutralize femoral anteversion in a true neck-shaft angle (TNSA) position. A marker was placed at the apex of the greater trochanter from the anterior viewpoint to simulate placement of a guidewire at the tip of the trochanter. The perpendicular distance between the marker and the center of the intramedullary canal was measured on AP and lateral images. The angle of anteversion was measured between the bicondylar plane and femoral neck. In a subset of 276 femora, the greater trochanter morphology was graded into 4 groups: anterior lean, posterior lean, centered, and flat. Multivariate Pearson product-moment correlation analysis was performed to determine the influence of morphological variance and anteversion on the accuracy of using the greater trochanteric apex as a starting point for intramedullary nail insertion.

Results: Mean age was 56 ± 11 years. In the sagittal plane, mean anterior displacement of the trochanteric apex was 5.0 ± 4.1 mm and 4.6 ± 4.2 mm relative to the intramedullary canal for the ANSA and TNSA positions, respectively ($P < 0.0005$). In the coronal plane, mean lateral displacement of the apex was 7.1 ± 4.6 mm for the ANSA view and 6.4 ± 4.6 mm for the TNSA view ($P < 0.0005$). In both the ANSA and TNSA views, there was a weakly positive association between anterior lean morphology and anterior displacement ($r = 0.156$, $P < 0.05$; $r = 0.173$, $P < 0.01$) and between flat morphology and lateral displacement ($r = 0.172$, $P < 0.01$; $r = 0.141$, $P < 0.05$). Anteversion negatively correlated with anterior displacement weakly in both ANSA and TNSA views ($r = -0.084$, $P < 0.05$; $r = -0.150$, $P < 0.01$).

Conclusion: The apex of the greater trochanter is lateral and anterior relative to the intramedullary canal, and the magnitude of lateral and anterior displacement is minimally changed when the femur is internally rotated. Trochanteric intramedullary nails are designed to compensate for lateral displacement of the greater trochanteric apex, but not for anterior displacement. Based on these data, intramedullary nail insertion sites should be about 5 mm posterior to the trochanteric apex to account for its anterior positioning.