

Short Cephalomedullary Nails in Wide Femoral Canals: The Toggle Phenomenon

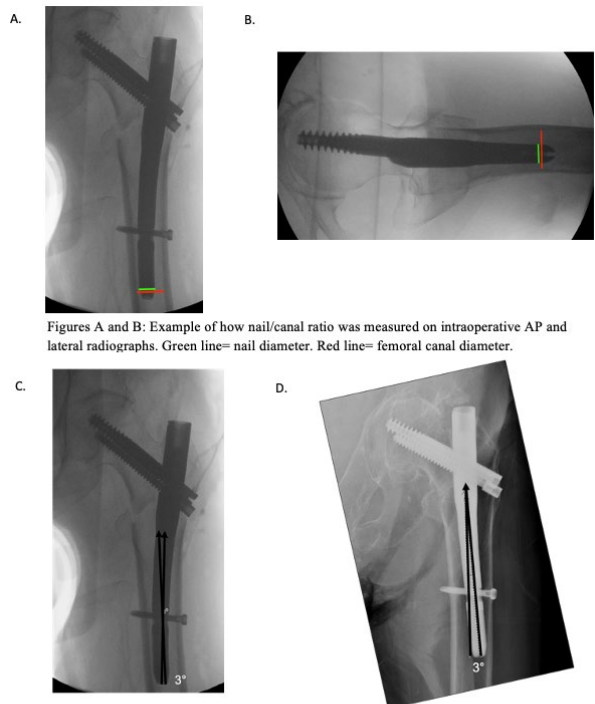
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Purpose: In patients with wide femoral canals, a short cephalomedullary nail (CMN) may not provide adequate stability, leading to toggling of the nail around the distal interlocking screw and loss of reduction. The purpose of this study was to define a method for measuring nail toggle and to identify risk factors for nail toggle. A secondary aim was to examine whether increased nail toggle is associated with increased varus collapse and reoperation rate.

Methods: 71 patients with intertrochanteric femur fractures treated with a short CMN from October 2013 to December 2017 were retrospectively evaluated. The nail/canal ratio was measured on AP and lateral radiographs. Nail toggle and varus collapse were measured on intraoperative and final follow-up radiographs. Risk factors for nail toggle including demographics, fracture classification, quality of reduction, Dorr type, nail/canal ratio, lag screw engaging the lateral cortex, and tip-apex distance (TAD) were recorded.

Results: On univariate regression analysis, Dorr type C ($P = 0.006$), lag screw not engaging the lateral cortex ($P = 0.033$), shorter TAD ($P = 0.049$), and smaller nail/canal ratio ($P < 0.001$) were found to be associated with increased nail toggle. On multivariate regression analysis, shorter TAD ($P = 0.005$) and smaller nail/canal ratio ($P < 0.001$) remained associated with increased nail toggle. Seven patients (10%) sustained nail toggle $> 4^\circ$. They had a smaller nail/canal ratio (0.54 vs 0.74, $P < 0.001$), more commonly Dorr C (57% vs 14%, $P = 0.025$), lower incidence of lag screw engaging the lateral cortex (29% vs 73%, $P = 0.026$), shorter TAD (13.4 mm vs 18.5 mm, $P = 0.042$), and greater varus collapse (6.2° vs 1.3° , $P < 0.001$) compared to patients with nail toggle $< 4^\circ$. There were two reoperations in the nail toggle $> 4^\circ$ group (29% vs 8%, $P = 0.138$).

Conclusion: Lower percentage nail fill of the canal and shorter TAD are risk factors for increased nail toggle. Increased nail toggle was found to be associated with increased varus collapse.



Figures A and B: Example of how nail/canal ratio was measured on intraoperative AP and lateral radiographs. Green line= nail diameter. Red line= femoral canal diameter.

Figures C and D: Example of how nail toggle was measured. (a) Intraoperative AP shows nail in 3 degrees of valgus relative to the femoral axis (b) Final AP radiograph, over 4 years post-op, shows nail in 3 degrees of varus relative to the femoral axis. Nail toggle is 6 degrees of varus.