**Do Small Femoral Nails Create Nonunions? A Case-Control Series**

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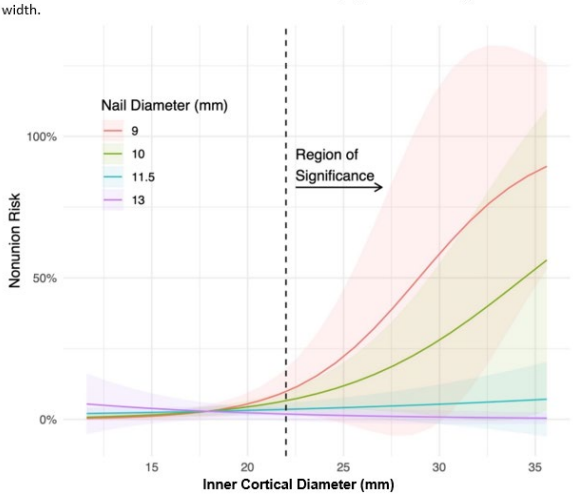
**Purpose**: Previous literature has argued that femoral shaft fracture nonunions are unrelated to geometric mismatch between the femoral nail diameter and bone size. Based on our clinical experience, our hypothesis was that mismatch between femoral nail size and femoral shaft size increases the chance of nonunion.

**Methods**: This retrospective case-control study included patients with a femoral shaft fracture treated with an intramedullary nail at a single Level I trauma center from 2016 through 2022. Case patients had an operatively treated nonunion. We randomly sampled control patients from 1105 event-free patients using a 3:1 case-control ratio. Our variable of interest was the nail diameter and, specifically, if the cortical bone diameter modified its association with nonunion. We considered 9 measures of cortical diameter and selected AP-measured inner cortical diameter at the bottom of the lesser trochanter based on model fit. We fit a logistic regression model interacting nail diameter with inner cortical diameter, adjusting for confounders such as body mass index, open fractures, and smoking status, as well as weighting for the case-control sampling. We used the Johnson-Neyman interval to identify an inner cortical diameter range where nail diameter was associated with nonunions at the alpha = 0.05 level.

**Results**: Our final sample included 203 patients. Of these, 50 patients had nonunion surgery. The nail diameter ranged from 9 mm to 13 mm, with 10 mm being the most common (53%). The median AP-measured inner cortical diameter was 18 mm (range, 12 mm to 36 mm). A smaller nail diameter significantly increased the risk of nonunion if the inner cortical diameter exceeded 22 mm (P<0.05). For example, if the patient's inner cortical diameter was 23 mm, the risk of nonunion was 3-fold higher with a 9-mm nail compared to an 11.5-mm nail (relative risk [RR], 3.5; 95% confidence interval [CI], 1.6–7.6, P<0.01). Conversely, nail diameter was not associated with an increased nonunion risk when the inner cortical diameter was 22 mm or less.

**Conclusion**: A mismatch between femoral canal diameter and intramedullary nail diameter appears to only be associated with a greater risk of nonunion in patients with larger canal diameters. Clinicians should be cautious with using smaller femoral nails when treating femoral shaft fractures in patients with wider femoral canals as this appears to be associated with a relatively large risk of nonunion.

**Figure:** Association of nail diameter with nonunion surgery after accounting for inner cortical width.




The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device they wish to use in clinical practice.