

Comparison of Flexible Intramedullary Nailing and Plating Techniques for Treatment of Pediatric Midshaft Femur Fractures in Children Ages 5-11 Years

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Background/Purpose: Current AAOS clinical practice guidelines for pediatric femoral shaft fractures indicate flexible intramedullary nails for children 5-11 years old; however, growing evidence suggests these fractures may be treated with open or submuscular plating techniques as well. The purpose of this study was to directly compare estimated blood loss, operative time, and fluoroscopy time between flexible intramedullary nailing and plating techniques used in 5-11-year-old children with middle-third femur fractures based on length stability. We hypothesized that estimated blood loss, operative time, and fluoroscopy time would be greater with plate fixation.

Methods: We retrospectively identified all pediatric middle-third femur fractures treated with flexible nails, submuscular plating, or open plating between 2004 and 2014. Clinical data analyzed included patient age, body mass index (BMI), ISS, side of injury, presence of open fracture, length stability (stable or unstable), estimated blood loss, operative time, fluoroscopy time, major complications, and length of stay. Major complications were defined as: unplanned reoperation, malunion requiring operative treatment, leg-length discrepancy >2 cm, or nonunion. The estimated blood loss, operative time, fluoroscopy time, open fracture prevalence, and length stability were compared between the three fixation methods using paired *t* tests or Fisher's exact test as appropriate.

Results: There were 65 middle-third femur fractures in 63 patients included in this study (age = 8.7 ± 2.0 years; 43 male, 20 female; 27 left-sided injuries, 38-right sided; BMI = 18.2 ± 3.54 kg/m²). Flexible nail fixation was the most common technique utilized (50/65 [77%]) followed by open and submuscular plating (15/65 [23%]). The two plating methods were grouped together for analysis as differences in estimated blood loss, operative time, and fluoroscopy time were not significant ($P = 0.1$, $P = 0.51$, and $P = 0.17$, respectively). There was no statistical difference in ISS ($P = 0.92$) or length of stay ($P = 0.79$) between fixation techniques. Individual fracture characteristics, being open or length unstable, were not found to be significant between the two fixation groups ($P = 0.566$ and $P = 0.214$, respectively). Comparing operative variables, there was a significantly increased operative time (2.5 vs 1.6 hours, $P = 0.007$) and a notably greater estimated blood loss (79.0 vs 40.1 mL, $P = 0.057$) for the plating technique compared to flexible nails. Fluoroscopy time was not statistically significant between the two fixation methods (flexible nailing 2.5 vs plating 3.3 minutes, $P = 0.21$). One complication occurred in the flexible nail group (1/50 [2%]) consisting of an unplanned reoperation to revise a nail tenting the skin and one complication occurred in the plating group (1/15 [8%]) consisting of a leg-length discrepancy of 2.1 cm.

Conclusion: Midshaft femur fractures in children 5-11 years old may be successfully treated with flexible intramedullary nailing or open/submuscular plating, regardless of length stability. However, a greater estimated blood loss and operative time were seen in plating

techniques. Increased radiation exposure, measured in fluoroscopy time, was equal between the groups despite our original hypothesis. To our knowledge, this study represents the first direct comparison of the common fixation methods specifically for midshaft femur fractures and favors the use of flexible intramedullary nailing based on decreased blood loss and operative time.