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### **“Analysis of Maximal Intramedullary Nail Separation in Pediatric Femur Fractures”**

**Background:** Pediatric femur fractures are the most common orthopedic surgery requiring hospitalizations along with monitoring for 12-24 months after discharge. Flexible intramedullary (IM) nailing is a common technique for the treatment of pediatric femur fractures and has yielded shorter time to weight-bearing and return to activity when compared to spica casting and external fixation. The nails pass through the medulla in either a 'C-' or 'S-' shaped configuration and, as a byproduct, produce three points of fixation: the proximal nail crossing, the maximal point of separation, and the distal nail crossing. Recent literature suggests that the point of maximal nail separation should be at the site of fracture to provide the best fixation.

**Hypothesis:** We hypothesize that the patients with maximum nail separation at the site of the fracture will show callus formation earlier, have a lower rate of malunion/nonunion/refracture, have a lower frequency of post-op casting and have quicker time to weight-bearing and return to activities.

**Methods:** A retrospective chart review was conducted of 101 pediatric patients who underwent IM nailing for femur fractures. Patient outcomes were separated based on distance of maximal nail separation in regard to fracture site. A univariate analysis was performed by dividing the cohort into three separate groups based on maximal nail separation relative to the fracture site (distal to site, at fracture site, and proximal to site). Outcomes such as surgery length, length of hospitalization, time to callus formation, time to weight bearing, malunion rate, nonunion rate, refracture, and unplanned return to OR were compared.

**Results:** Maximal nail separation at the fracture site yielded insignificant results when compared to maximal nail separation distal or proximal to the fracture site in regards to length of hospitalization (1.8 days vs. 2.3 and 1.7,  $p = 0.098$ ), time to callus formation (27 days vs 34 and 29,  $p = 0.140$ ), time to weight bearing (30 days vs 35 and 33,  $p = 0.609$ ), malunion rate (3.1% vs 1.9% and 0%,  $p = 1.000$ ), nonunion rate (3.1% vs 0% and 0%,  $p = 0.466$ ), refracture rate (6.3% vs 0% and 0%,  $p = 0.209$ ), and unplanned return to the OR rate (3.0% vs 1.8% and 0%,  $p = 1.000$ ). There was a statistically significant difference in regards to length of surgery (83 minutes vs 103 and 114,  $p = 0.034$ ) and post-operative casting rates (15.6% vs 16.4% and 57.1%,  $p = 0.003$ ).

**Conclusions:** IM nailing with maximal nail separation at the fracture site in pediatric femur fractures is associated with shorter times in the operating room along with lower postoperative casting rates. However, it is not related to avoidance of postoperative complications such as malunion, nonunion, or refracture rates. Nor is it related to postoperative goals such as quicker callus formation or time to weight-bearing. These findings suggest that IM nailing with maximal nail separation may be preferable in regards to shorter operations and avoidance of casting.