Nailed it! Can Rigid Intramedullary Femoral Nailing be Safely Used for Pediatric Femoral Shaft Fractures in Patients Between Ages 8-10 Years?

Stefano Cardin[1], Kwang Won Park, Bensen Benjamin Fan, Mark A Birnbaum, James E Toledano, Jose A Herrera Soto[1]
[1]Orlando Health

INTRODUCTION: The treatment modalities for pediatric femoral shaft fractures are historically determined by the patient's age and weight. Rigid intramedullary nailing (RIN) is usually recommended for patients over 11 years of age, and flexible intramedullary nailing (FIN) for patients under 10 years old. However, little is known about the use of the RIN in patients between ages 8 to10 years. In this study, we examined the differences in patients with femoral shaft fractures who were treated with FIN versus RIN in terms of (1) fracture healing; (2) changes of anatomic parameters; and (3) related complications.

METHODS: We retrospectively reviewed 54 patients, ages between 8-10 years, with femoral shaft fractures, who underwent either FIN or RIN between 2011 and 2020 at a single institution (Table 1). Lateral trochanteric entry point was used during RIN. The minimum follow-up period was 6 months. Paired *t*-test, independent *t*-test, and Chi-square test were used to compare the clinical outcomes (Table 2) and radiographic parameters (Table 3) between the groups.

RESULTS: There were 17 patients in the FIN group and 37 patients in the RIN group. The FIN group had a mean age of 8.3 years, which was 1 year younger than the RIN group ($p < 0.01$). The mean patient weight was significantly heavier in the RIN group (37.9 Kg) when compared to the FIN group (27.4 Kg) ($p < 0.01$). Complete union of the fracture was achieved slightly faster in the RIN group ($p = 0.04$). There were no significant differences in postoperative complications between the groups. There were also no clinical or radiographical significant changes of the anatomic parameters in either group, including neck shaft angle and articulotrochanteric distance. No evidence of femoral head avascular necrosis (AVN) was encountered at the time of final follow-up for either group.

DISCUSSION AND CONCLUSION:

Lateral trochanteric entry RIN is a feasible surgical option for femoral shaft fractures in patients between ages 8 to 10 years. This is true especially for heavy patients or those with unstable fracture patterns. RIN did not present a risk for femoral head AVN or changes to the proximal femur anatomical parameters in the stated age group during our follow-up. Further investigation with long-term follow-up is warranted to evaluate any late postoperative sequelae.

Table 1. Demographic factors, fracture locations, and fracture patterns of the patients.

Variable	Group I. Flexible Nailing (n = 17)	Group II. Rigid Nailing (n = 37)	*p* value
Age (years)	8.3 ± 0.6	9.3 ± 0.7	< 0.01
Mean ± SD			
Sex			0.36
Male	13	32	
Female	4	5	
Weight (Kg)	27.4 ± 5.9	37.9 ± 9.4	< 0.01
Mean ± SD			
Body mass index (Kg/m²)	16.4 ± 2.5	19.3 ± 3.1	< 0.01
Mean ± SD			
Fracture Stability			0.94
Length stable	9	20	
Length unstable	8	17	

SD: Standard deviation

Table 2. Clinical outcomes including fracture healing and related complications.

Variable	Group I. Flexible Nailing (n = 17)	Group II. Rigid Nailing (n = 37)	*p* value
Time to union (months)	3.7 ± 0.9	3.4 ± 1.7	0.04
Mean ± SD			
Time to removal (months)	8.7 ± 3.9	11.8 ± 5.9	0.02
Mean ± SD			
Complications			
Overgrowth (≥ 1 cm)	4	5	0.36
Delayed healing	1	2	0.94
Surgery/Implant related	1	1	0.57

SD: Standard deviation

Table 3. Radiographic changes of neck shaft angle and articulotrochanteric distance. (Mean ± Standard deviation)

Variable	Group I. Flexible Nailing (n = 17)		Group II. Rigid Nailing (n = 37)	
	Involved	Uninvolved	Involved	Uninvolved
NSA (°)				
Initial	139.4 ± 6.0	139.1 ± 6.5	139.1 ± 6.0	140.2 ± 4.2
Final	135.5 ± 5.6	135.0 ± 5.6	136.3 ± 5.3	137.4 ± 4.4
ATD (mm)				
Initial	23.7 ± 5.3	23.8 ± 5.0	26.0 ± 3.6	25.9 ± 3.4
Final	25.1 ± 7.4	24.7 ± 5.6	27.1 ± 3.9	26.3 ± 4.1

NSA: Neck shaft angle

ATD: Articulotrochanteric distance