

Impact of Surrounding Canal Size on Union Following Limited Reamed Intramedullary Nailing of Femur Fractures

Mark Gage, MD; Richard Yoon, MD¹; Daniel Seigerman, MD²; Derek Donegan, MD³; Philip Lim, BS, MD⁴; John Koerner, MD⁵; Frank Liporace, MD¹;

¹New York University Hospital for Joint Diseases, New York, New York, USA;

²Rothman Institute, Hackensack, New Jersey, USA;

³University of Pennsylvania Hospital, Philadelphia, Pennsylvania, USA;

⁴Northridge, California, USA;

⁵Rothman Institute, Philadelphia, Pennsylvania, USA

Background/Purpose: Diaphyseal femur fractures (AO/OTA 32A-C) are most often treated with reamed intramedullary nailing. High union and relatively low complication rates exist for such a treatment method. When choosing an intramedullary implant for a femoral shaft fracture, size of the implant selected is typically based on canal diameter, amount of reaming performed, age and sex of the patient, or surgeon preference. Our group hypothesized that the use of 10-mm intramedullary nail independent of patient demographics, fracture characteristics, intramedullary canal size at the isthmus, and amount of reaming does not alter the union rate and time to union.

Methods: 67 patients with an average of 12 months follow-up who were treated with size 10-mm intramedullary nail for a femoral shaft fracture were assessed for fracture characteristics, time to union, and union rate. Three distinct groups were compared based on difference between the intramedullary nail diameter and the size of the canal at the isthmus: <1 mm, 1 to 2 mm, and >2 mm.

Results: Baseline and demographic comparisons yielded no significant differences between the three groups in regards to mean age, gender, body mass index (BMI), mechanism of injury, or percent open injury (Table 1). There were no significant differences between the three groups in regards to AO/OTA classification (Table 2). No significant difference was found between groups when comparing mean canal diameter, mean difference between canal diameter and canal fill, and time (measured in days) to union (Table 3). We had an overall union rate of 98.5% with no mechanical implant failures.

Conclusion: Our group maintains that limited reaming technique and insertion of a 10-mm nail, independent of canal size, does not impact overall union or time to union for femoral shaft fractures. Due to the results of our study, we have implemented routine use of a 10-mm nail inserted via limited reaming technique no matter how large the canal diameter.

Table 1. Baseline and demographic information for all three comparative cohorts (total n= 67)

	Group 1 (≤1mm, >90% Fill) n=17	Group 2 (>1 to <2mm, 90-83% Fill) n=32	Group 3 (≥2mm, <83% Fill) n=18	P Value
Age (SD), yrs	30.8 (11.6)	30.9 (16.1)	30.1 (11.5)	0.98
Gender (%M)	71%	69%	83%	0.52
BMI	26.5 (4.2)	25.9 (3.6)	27.2 (4.7)	0.55
Ethnicity (n)				0.60
White	5	10	3	
African American	8	13	10	
Hispanic/Latino	4	8	3	
Asian	0	0	0	
Other	0	1	2	
Mechanism of Injury (n)				0.67
MVA	7	12	7	
Fall	2	2	3	
Pedestrian Struck	3	6	2	
Crush	1	0	1	
GSW	2	3	4	
Motorcycle	2	7	2	
Sports related	0	2	0	
Open Injury (n)	3	3	4	0.44

Table 2. AO/OTA 32A-C and Winquist classifications for all three cohorts (n= 67)

	Group 1 (≤1mm) n=17	Group 2 (>1 to <2mm) n=32	Group 3 (≥2mm) n=18	P value*
<u>AO/OTA 32</u>				
A1	0	3 (9%)	1 (6%)	0.30
A2	5 (29%)	8 (25%)	1 (6%)	
A3	6 (35%)	10 (31%)	3 (17%)	
B1	2 (12%)	3 (9%)	2 (11%)	
B2	1 (6%)	3 (9%)	5 (28%)	
B3	0 (0%)	1 (3%)	0	
C1	2 (12%)	0	4 (22%)	
C2	1 (6%)	2 (6%)	1 (6%)	
C3	0	2 (6%)	1 (6%)	
<u>Winstquist</u>				
1	10 (58%)	21 (66%)	3 (17%)	0.12
2	3 (18%)	4 (13%)	5 (28%)	
3	3 (18%)	4 (13%)	5 (28%)	
4	1 (6%)	3 (9%)	5 (28%)	

*Categorical comparisons via chi-squared analysis, significance p<0.05

Table 3. Mean canal diameter, differences between the 10-mm nail and canal, and mean time to union in each study cohort (n=67).

	Group 1 (≤1mm, >90% Fill) n=17	Group 2 (>1 to <2mm, 90-83% Fill) n=32	Group 3 (≥2mm, <83% Fill) n=18	P Value
Mean canal diameter, (SD), mm	10.8 (0.20)	11.4 (0.26)	12.80 (0.95)	0.0001*
Mean difference (SD), mm	0.78 (0.19)	1.39 (0.26)	2.75 (0.95)	0.0001*
Mean time to union (SD), days	142.4 (54)	129.9 (48)	137.6 (89)	0.79

*Significance set at p<0.05, via one-way ANOVA