



## Intramedullary Implant is Associated with Early Weight Bearing in Trochanteric Fractures: An ACS-NSQIP Analysis

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### Abstract

**Background:** Trochanteric fractures are common among geriatric population. Patient outcomes (i.e. early weight bearing, and length of hospital stay) depend on treatment modalities. While there's a growing preference to treat these types of fractures with intramedullary implant, less evidence is available on its immediate outcomes. The present study compared the short-term outcomes of the intramedullary implant and extramedullary implant in the treatment of trochanteric fractures. The primary outcome of this study was weight-bearing on day one. The secondary outcomes were duration of post-operative Deep Vein Thrombosis (DVT) prophylaxis and Length of Stay (LOS).

**Method:** The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database was queried for patients with isolated trochanteric fractures admitted between 2016 to 2017. Patients with preoperative use of mobility aid were excluded from the study. Patients presented with sepsis were also excluded.

**Results:** 3322 patients met the inclusion criteria. Treatment with the intramedullary implant was associated with a slightly higher rate of weight-bearing on day one [ARR: 1.051 (95% CI: 1.007-1.02); p=0.021], low incidence of post-operative DVT prophylaxis up to 28 days [ARR: 0.896 (0.85-0.94); p=0.0001] and shorter mean LOS [0.83 days (1.480-0.183); p=0.012] compared with extramedullary implant.

**Conclusion:** This study supports the use of intramedullary implant in the treatment of trochanteric fractures as it is associated with early weight-bearing, less need for post-operative DVT prophylaxis and shorter length of stay.

**Keywords:** Hip fracture; Intramedullary implant; Extramedullary implant; Early weight-bearing

### Introduction

Hip fractures are common in older age population and are associated with higher morbidity and mortality rate [1]. In the United States, treatment of hip fractures causes a considerable financial burden to the healthcare system with estimated costs of care between \$10.3 billion and \$15.2 billion [2,3]. 44% of hip fracture cost is associated with intertrochanteric fracture care [4]. As the older age population is projected to grow dramatically [5], treatment modalities to provide better patient outcomes have become a major interest.

Trochanteric fractures can be treated using both intramedullary and extramedullary implants. However, intramedullary implant has been shown to be favorite among orthopedic surgeons in the United States [6]. Several studies [7-9] have evaluated complication rate associated with intramedullary and extramedullary implants in trochanteric fractures, but short term outcomes (i.e. weight-bearing on day one, post-operative DVT prophylaxis and LOS) have not been well studied between the two types of surgical treatment. We hypothesized that intertrochanteric fractures treated with intramedullary implant are associated with better early outcomes.

### Method

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database was queried for patients admitted during 2016 and 2017. Cases with

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intertrochanteric fractures were identified from corresponding years' procedure targeted files. The surgical procedure was identified using Current Procedural Terminology (CPT) codes when patients treated with an extramedullary implant [CPT code 27244] or with an intramedullary implant [CPT code 27245].

Patients with other concomitant fractures and sepsis were excluded. Patients with preoperative use of mobility aid were also excluded from the study.

Results of categorical variables are presented with frequencies and percentages. Age was taken as a non-parametric variable and reported by a median, and Interquartile Range (IQR). Pearson chi-square test was used to compare two groups in terms of sex, BMI and comorbidities (diabetes, history of COPD, use of steroids and disseminated cancer). Age between two groups was compared using the Mann-Whitney U-test.

We counted the postoperative events/outcome of interest and compared rates of events (relative risk) between cohorts of patients treated with an extramedullary or intramedullary implant. Bivariate and multivariate models using Poisson regression with robust variance, adjusting for age, sex, BMI, diabetes, history of dialysis, history of disseminated cancer, and the use of steroids, were used to investigate the association between the use of extramedullary or intramedullary implants and pertinent post-operative outcomes. Only cases in which complete information was available (n=2204) considered for regression analyses and those which had missing values have been omitted. Post-operative outcome 'place of residence at post-operative day 30', was dichotomized as "still residing in hospital" OR "not". The total length of hospital stay was compared using linear regression. The results of the regression analyses are presented as crude and adjusted Relative Risk (RR) with their 95% Confidence Intervals (CI). A significance level of  $p < 0.05$  was used for all analyses. Statistical analysis was performed using STATA/MP version 15 (STATA Corp., Texas, USA) [10].

## Results

After excluding 527 cases with missing variable, 3,322 cases were included in the univariate and bivariate analysis. Patients' median age was 78 (IQR 48–68) and most of the patients were female (67%). 38.9% of patients had normal weight (BMI=18.5-24.9), and 15.6% patients were obese (BMI  $\geq$  30). 98.7% patients received pre-operative dialysis and 19.3% had diabetes (Table 1). On Bivariate analysis only age (77 vs. 78,  $p=0.03$ ) and use of steroid (9.48% vs. 9.44,  $p=0.017$ ) was statistically significant between the two treatment groups. Other variables were unremarkable (Table 2).

On multivariate analysis (Table 3), 2,204 cases with complete information on study variables were included. Intramedullary group was associated with higher rate of weight bearing on day one (81.6% vs. 76.9%) with ARR=1.051 (95% CI: 1.007–1.098,  $p=0.021$ ), however post-operative use of mobility aid was not significant between the two groups. Rate of post-operative medical DVT prophylaxis was higher in extramedullary (69.2% vs. 59%) with ARR=0.8967 (95% CI: 0.854909405,  $p=0.194$ ). Patients also had longer mean length of stay in the extramedullary group ( $6.322 \pm 0.324$  vs.  $5.535 \pm 0.107$ , ARR=-0.831, 95% CI: -1.48– -0.18,  $p=0.012$ ).

## Discussion

Trochanteric fractures account for 42% of all hip fracture [4]. Preference of treatment methods plays an important role to ensure

good outcomes in these fractures, especially among older patients. In this study, we found that treatment of trochanteric fractures with intramedullary implant allows patients for early weight-bearing which also reduces the need for 28-day post-operative DVT prophylaxis and hospital length of stay. We believe that this is the largest study to investigate the association between extramedullary and intramedullary implant in trochanteric fracture treatment and early weight-bearing on day one.

A previous study using ACS-NSQIP by Bohl et al. [8] showed that intramedullary implants are associated with decreased length of stay in patients with trochanteric fractures. This finding was contrary to the Cochrane review of forty-three randomized trials which found no difference between the implant in terms of length of stay [11]. Our study approves Bohl's finding as patients treated with extramedullary implant had longer length of stay than the opposite category ( $p < 0.05$ ).

Functional outcomes after trochanteric fractures treatment can be accessed through several methods. Conflicting findings can be found in the literature favoring one treatment method in some aspect of functionally over another since there's no universal functional scoring system exist. Zhang et al. [12] found that patients in five RCT treated with intramedullary implant achieved better functional outcomes compared to extramedullary implant group, however, the

**Table 1:** Demographics and clinical characteristics.

Variables	Total (N=3322)
Age, median (IQR)	78.00 (68-48)
Gender	
Male	1096 (33)
Female	2226(67)
<b>Preoperative risk factor/co-morbidity</b>	
<b>BMI, n (%)</b>	
≤ 18.50	252 (7.6)
18.51 - 24.90	1292 (38.9)
24.91 - 29.90	848 (25.5)
29.91 - 34.90	355 (10.7)
34.91 - 39.90	102 (3.1)
39.91+	61 (1.8)
Unknown	412 (12.4)
<b>DM, n (%)</b>	
Yes	642 (19.3)
No	2680 (80.7)
<b>Hx of COPD, n (%)</b>	
Yes	314 (9.5)
No	3008 (90.5)
<b>Use of steroids, n (%)</b>	
Yes	174 (5.2)
No	3148 (94.8)
<b>Pre-op dialysis, n (%)</b>	
Yes	3280 (98.7)
No	42 (1.3)
<b>Disseminated cancer, n (%)</b>	
Yes	69 (2.1)
No	3253 (97.9)

Table 2: Bivariate analysis.

Variables	Treatment with extramedullary implant (n=696)	Treatment with intramedullary implant (n=2626)	P value
	n (%)	n (%)	
Age, median (IQR)	77.00 (67-84)	78.00 (69-84)	0.0393*
Gender			
Male	235 (21.4)	861 (78.5)	0.650#
Female	461 (20.7)	1765 (79.29)	
<b>Preoperative risk factor/co-morbidity</b>			
<b>BMI</b>			
≤ 18.50	54 (21.4)	198 (78.6)	
18.51 - 24.90	258 (20)	1034 (80)	
24.91 - 29.90	177 (20.9)	671 (79.1)	0.745#
29.91 - 34.90	68 (19.2)	287 (80.8)	
34.91 - 39.90	15 (14.7)	87 (85.3)	
39.91+	13 (21.3)	48 (78.7)	
Unknown	111 (26.9)	301 (73.0)	
<b>DM</b>			
Yes	129 (20.1)	513 (79.9)	0.552#
No	567 (21.2)	2113 (78.8)	
<b>DM type</b>			
Type-1 (insulin)	47 (18.4)	208 (81.6)	0.728#
Type-2 (non-insulin)	82 (21.2)	305 (78.8)	
<b>Hx of COPD</b>			
Yes	66 (21)	248 (79)	0.975#
No	630 (20.9)	2378 (79.1)	
<b>Use of steroids</b>			
Yes	24(3.45)	150 (5.71)	0.017#
No	672 (96.55)	2476 (94.29)	
<b>Pre-op dialysis</b>			
Yes	7 (16.7)	35 (83.3)	0.492#
No	689 (21)	2591 (79)	
<b>Disseminated cancer</b>			
Yes	15 (21.7)	54 (78.3)	0.871#
No	681 (20.9)	2572 (79.1)	

# Chi-square test

\* Mann Whitney u test

results remain questionable as the other four Randomized Control Trial (RCT) did not find any significance. While intramedullary implant provides better recovery to perform daily living activities, extramedullary implant is associated with better range of motion of hip flexion [13]. Early functional abilities are important to lower risk of thromboembolism. Patients who remain in bed after surgery for longer period of time are prone to venous stasis and thromboembolism. Evidence from a literature review showed that immobility in post-operative patients is associated with lower functional outcomes, slower recovery and longer length of stay [14]. This risk can be decreased by early weight-bearing and ambulation after surgery [15,16]. Weight bearing after fractures is important as it activates osteoblasts and other cells responsible for bone healing. In our study patients who were treated with intramedullary implant had higher rate of weight-bearing on day one which was associated with shorter length of stay, depicting that early mobility enhances early

recovery [17].

A recent meta-analysis of 17 randomized control trials showed no significant difference in DVT as a complication between the two treatment groups. Our study found similar finding, however, fewer patients treated with intramedullary implant required prophylaxis of 28-Day DVT prophylaxis up to 28 days. This was statistically significant even after controlling for patients' age, sex, BMI and comorbidities (ARR=0.89, 95% CI: 0.85-0.94, p=0.0001).

The limitation of this study can be inherent to ACS NSQIP. The procedure targeted file of the database does not differentiate between pertrochanteric, subtrochanteric and intertrochanteric fractures. Additionally, stable fractures from unstable fractures in the mentioned groups were not reported as well. The database also lacks indicators of functional outcomes such as lower extremity measure, Salvati and Wilson scoring system, Harris Hip Score and

Table 3: Multivariate analysis.

Post-op Outcomes	Extramedullary implant (n=459)	Intramedullary implant (n=1745)	Crude RR (95% CI)	*Adjusted RR (95% CI)
	n (%)	n (%)		
<b>Weight bearing on day one</b>				
Yes	353 (76.90)	1425 (81.66)	1.048 (1.0049-1.094); p=0.029	1.051 (1.007-1.098); p=0.021
No	106 (23.10)	320 (75.1)		
<b>Postoperative use of mobility aid</b>				
Yes	434 (94.55)	1678 (96.16)	1.016 (.9934 1.039); p=0.164	1.015 (1.015-1.038) p=0.194
No	25 (5.45)	67 (3.84)		
<b>Post-op medical DVT prophylaxis up to 28 days</b>				
Yes	318 (69.28)	1031 (59.08)	0.903 (0.860-0.947); p=0.0001	0.8967 (0.8549- 0.9405); p=0.0001
No	141 (30.72)	714 (40.92)		
<b>Still at hospital or acute care at 30-day post-op</b>				
Yes	13 (2.83)	46 (2.63)	0.998 (0.981-1.015); p=0.82	0.996 (0.979-1.014); p=0.703
No	446 (97.17)	1699 (97.36)		
<b>Total length of hospital stay</b>			Difference (95% CI)	Difference (95% CI)
Mean (SE)	6.322 ± 0.3247	5.535 ± 0.1078	0.7865 (1.457– 0.1159); p=0.022	0.83 (1.48–0.18); p=0.012

etc. Finally, the databases report patients' data collected only during thirty postoperative days.

Despite the limitation, we believe that in the present study using ACS NSQIP database, the association between extramedullary and intramedullary implant in trochanteric fractures with weight-bearing on day one was systematically examined with a relatively higher number of cases, strengthening the statistical power of the analyses.

In conclusion this study reinforces the use of intramedullary implant in the treatment of trochanteric fractures. The data shows that intramedullary fixation allows early weight-bearing in patients, lowers the need for 28-day post-operative DVT prophylaxis and reduces patients' length of stay in the hospital.

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