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Journal of Orthopedics & Bone Disorders
ISSN: 2577-297X

Does Surgeon Experience Affect the Risk of Post-Op Complications for Patients Undergoing Fixation for Intertrochanteric Fractures

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Research Article

Volume 7 Issue 4

Received Date: October 06, 2023

Published Date: October 27, 2023

DOI: 10.23880/jobd-16000247

Abstract

Background: Intertrochanteric fractures compromise approximately one half of all hip fractures. Common complications following fixation of these fractures include cut-out, non-union and avascular necrosis (AVN). It is unclear what effect surgeon experience has on the risk of developing these complications following fracture fixation. The purpose of this study was to compare the post-surgical outcomes for patients treated with TFNA nail for intertrochanteric fractures between residents and fellow trained orthopedic surgeons.

Methods: Data was retrieved from the medical records of patients that underwent closed reduction and internal fixation (CRIF) for type 31A1, 31A2 and 31A3 (AO classification) fractures of the proximal femur. All of the fractures were treated with the Trochanteric Fixation Nail Advanced (TFN-A) nail between January 2017 and June 2018. Surgery was performed by either a fellowship-trained trauma surgeon or a resident who had completed his third year of residency. Data such as the duration of surgery, decreased hemoglobin levels, together with data on other hospitalization characteristics and any intraoperative and postoperative complications were retrieved from the medical files.

Results: The final study population consisted of 100 patients. Forty-nine patients were operated upon by a senior surgeon, while 51 were operated upon by a resident surgeon. No significant difference was noted between cohorts for the duration of surgery ($p = 0.66$), blood loss ($p = 0.13$), orthopedic complications ($p = 1$) or rates of re-operation ($p = 0.35$).

Conclusion: Residents may perform CRIF for intertrochanteric fractures without placing patients at an increased risk for post-surgical complications.

Keywords: Intertrochanteric Fracture; Pertrochanteric Fracture; TFNA Nail

Abbreviations: AVN: Avascular Necrosis; CRIF: Closed Reduction and Internal Fixation; SD: Standard Deviation.

Introduction

Hip fractures are a major public health problem affecting 1.5 million people per year worldwide. Due to the aging population, the number of hip fractures is expected to rise to 2.6 million by 2025 [1,2]. Many patients with hip fractures are at risk for cardiovascular, pulmonary and infectious complications, with a reported 5 to almost 8-fold increased hazard of all-cause mortality during the first three months after the fracture [3,4].

Intertrochanteric fractures compromise one half of all hip fractures and occur in a characteristic population with risk factors including increasing age, female gender, osteoporosis and a history of falls [4,5]. The standard care for intertrochanteric fractures involves surgical fixation. Post-surgical complications that can arise from fixation include cut-out, nonunion, avascular necrosis and medial migration. Several factors that increase the risk for these post-surgical complications include age, implant selection, surgical technique and poor bone quality [6,7]. Little is known however on whether surgeon experience impacts the patients' risk of developing post-surgical complications.

It has been shown that unsupervised junior registrars have a higher rate of re-operation for technically demanding proximal femoral neck fractures [8]. For intertrochanteric fractures, no significant difference was previously reported in the risk of re-operation between inexperienced and experienced surgeons [9]. However, this study did not address the association between surgeon experience and several post-surgical complications including cut-out, nonunion or blood loss. As a result of the serious complications that are associated with hip fractures in addition to the reported increase in post-injury mortality, minimizing the risk for post-surgical complications in these patients is of the utmost importance.

Several fixation methods have been developed for AO type 31-A1/A2/A3 hip fractures. The TFN-AdvancedTM Proximal Nail System (TFNA) is a novel fixation device that is synthesized from a Ti-15Mo (TiMo) titanium alloy material. Its design is intended to build upon the success of previous generation nails. It is thought that the nail's strength from the titanium alloy, along with the its proximal geometry that is intended to better fit the anatomic bow of the femur, will lead to improved outcomes. The TFNA additionally includes 2 types of short nails, sized 170 mm and 235 mm.

The goal of this study was to compare the post-surgical outcomes for patients treated with TFNA nail for intertrochanteric fractures between unsupervised residents and fellow trained orthopedic surgeons. Our hypothesis was that patients operated on by residents would have more complications compared to patients that were operated on by residents.

Methods

After receiving local ethics committee approval, data was retrieved from the medical records of consecutive patients with type 31A1, 31A2 and 31A3 (AO classification) fractures of the proximal femur. All of the fractures were treated with the TFNA nail between January 2017 and June 2018.

Excluded from our study were patients younger than 65 years, patients with a pathological fracture, patients who underwent revision surgery with a TFNA nail and patients who did not meet the minimum 1-year follow-up period required.

All patients underwent CRIF within 48 hours of presentation to our level 1 trauma center. Surgery was performed by either a fellowship-trained Trauma surgeon (T.B.T) or an unsupervised resident who had completed his third year of residency.

		Resident (n=51)	Attending (n=49)	P. value
Age, average (SD)		82 (7.5)	83.9 (9)	0.247
Gender, n(%)	Male	34 (66.7)	37 (75.5)	0.382
Laterality, n(%)	Right	26 (51)	28 (57.1)	0.554
ASA Score, n(%)	1	0 (0)	4 (9.8)	0.04
	2	17 (39.5)	19 (46.3)	
	3	22 (51.2)	16 (39)	
	4	8 (18.6)	2 (4.9)	
Body mass index, average (SD)		24.1 (4.2)	26.6 (7)	0.039
Age-adjusted Charlson co-morbidity index, average (SD)		5.9 (2.5)	5.6 (2.7)	0.556
Osteoporosis diagnosis prior to fragility hip fracture, n(%)		8 (15.7)	10 (20.4)	0.608

Table 1: Patient Characteristics.

Patients were operated under general or regional anesthesia and positioned supine on a fracture (Tables 1 & 2). Fracture reduction with rotational restoration was completed under fluoroscopy. The procedure was performed according to the standard protocol using the manufacturer's instructions.

		Resident (n=51)	Attending (n=49)	P. value
Fracture configuration, n(%)	31A1	16 (31.4)	15 (30.6)	0.369
	31A2	28 (54.9)	22 (44.9)	
	31A3	7(13.7)	12(24.5)	
Nail length, n(%)	Short	4 (7.8)	13 (26.5)	0.02
	Medium	46 (90.2)	33 (67.3)	
	Long	1 (2)	3 (6.1)	
Blood loss, Hb (gr/dl), average (SD)		2.7 (1.4)	2.3 (1.4)	0.131
Surgical length, min, average (SD)		60.4 (25.1)	63 (29.4)	0.662
Neck fixation, n(%)	Screw	35 (68.6)	31 (63.3)	0.674
	Blade	16 (31.4)	18 (36.7)	
AP PEG, n(%)	Superior	1 (2)	0	0.9
	Middle	39 (78)	39 (76.9)	
	Inferior	10 (20)	10 (20.4)	
Axial PEG, n(%)	Posterior	12 (24.5)	14 (28.6)	0.819
	Middle	37 (75.5)	35 (74.1)	
Tip axial difference (cm), average (SD)		2.1 (0.6)	2.1 (0.5)	0.828
Cerclage, n (%)		1 (2)	0	1
Non orthopedic complications, n(%)	Infectious disease	5 (27.8)	5 (20.8)	0.056
	Renal	5 (27.8)	5 (20.8)	
	Cardiovascular	4 (22.2)	1 (4.2)	
	Delirium	6 (33.3)	3 (12.5)	
	Pulmonary	2 (11.1)	8 (33.3)	
	Pulmonary embolism	0	1 (4.2)	
	Transfusion adverse effect	1 (5.6)	1 (4.2)	
Orthopedic complications, n(%)		3 (5.9)	3 (6.1)	1
Orthopedic complications, n(% of surgeries)	Periprosthetic fracture	0	3 (2)	
	Wound problems	2 (3.9)	0	
	Cut-out	1 (2)	1 (2)	
Revisions, n(%)		1 (2)	3 (6.1)	0.357
Length of follow-up (months), average (SD)		30.2 (8.4)	30.8 (9.7)	0.764
Died during follow-up		13 (25.5)	7 (14.3)	0.213

Table 2: Surgical Data.

Operational data such as the surgeons' level of experience, duration of surgery, decreased hemoglobin levels, together with data on other hospitalization characteristics and any intraoperative and postoperative complications were retrieved from the medical files.

Postoperative management included early mobilization, full-weight bearing, and thrombo- prophylactic treatment with enoxaparin. Patients were routinely examined at our outpatient clinic at 3 weeks, 6 weeks, 3 months, 6 months and one year postoperatively. Radiological evaluation of AP and axial films were performed by a senior surgeon to evaluate peg's position and TAD distance. Malunion was defined by more than 10 degrees of varus or valgus compared with the unaffected hip and more than 10 mm of shortening. Nonunion was defined by either no callus or or with callus that did not bridge the fracture site at least 15 weeks after the fracture [10].

Statistical Analysis

Continuous variables are presented with mean and standard deviation (SD). Quantitative variables are presented with absolute and relative frequencies. The chi-square and Fisher's exact tests were used for comparison of proportions. The Student's t-test was applied for normal variables for comparison of study variables between groups. When the basic assumptions for normality of the t-test were not met, the Wilcoxon test was used. All reported p-values are two-tailed. Statistical significance was defined as $p < 0.05$.

Results

Between January 2017 and June 2018, 167 patients with intertrochanteric fractures underwent CRIF with the TFNA nail at our center. Twenty-one patients were lost to follow-up, a further 39 patients had incomplete records, and 7 patients were younger than 65 years, leaving a final study population of 100 patients. Forty-nine patients were operated upon by a senior surgeon, while 51 were operated upon by a junior surgeon. Groups were similar in terms of age (p=0.24), gender (p=0.38), side of operation (p=0.55) and co-morbidities (p=0.55) (Table 1).

There was no difference between the group in terms of fracture configuration. Fracture type 31A2 was found to be the most frequent in the resident and in the senior group (54 % vs 44.9%, respectively). In addition, no difference was found between the resident's group and the senior's group in terms of peg type (p= 0.64) and peg position in the AP and lateral plain (p=0.9 and p=0.81, respectively). Other varying surgical parameters are described in Table 2. The average follow-up time for resident's group and the senior's group was similar (30.2 and 30.8 months, respectively, p=0.764).

The prevalence of post-operative orthopedic complications did not differ between groups (p=0.71). Similar results were found for the non-orthopedic complications as well (Table 2).

Revisions were required in one patient from the resident's group and 3 patients from the senior's group (p=0.35).

Discussion

The goal of this study was to determine whether surgeon experience had an association with the post-surgical complications that arise in patients treated for intertrochanteric fractures with the TFN-A nail. Our study showed that no significant differences were found between the groups in terms of duration of surgery, blood loss and post-surgical complications.

The amount of blood loss in the resident group was 2.7 gr/dl, compared to 2.3 gr/dl of blood loss by the surgeon group (p= 0.13). Previous studies have identified older age, low admission hemoglobin and intertrochanteric fractures as risk factors for requiring blood transfusion [11-13]. Moreover, the literature comparing blood loss in intertrochanteric fractures using intramedullary nails is inconclusive as some authors have reported reduced blood loss, [14,15] increased blood, [16] and no difference. Varela-Egocheaga JR, et al. [17] in spite of such heterogeneous findings, our results suggest that the experience of the operator has no significant influence on the risk of blood loss during surgery.

Our study reported no significant difference in the post-surgical orthopedic complications between residents and surgeons. For both cohorts in our study, cutout and infection were the most common complications, with revision rates similar to both groups. To our knowledge, this is the first study to evaluate the association between surgeon experience and complications of cutout and malunion in patients treated by fixation for intertrochanteric fractures.

The rate of cutout for patients treated by residents was 2%, which was the same as the rate for patients treated by surgeons. The tip to apex distance (TAD) has been proposed as the most important prognostic factor for cutout in intertrochanteric fractures [18]. Geller, et al. [19] reported a higher incidence of cutouts for a TAD of >25 mm. The TAD for both groups was less than 25 mm, suggesting a potential explanation for the lack of a difference observed between cohorts for this complication.

The re-operation rates of 2% and 6.1% between residents and surgeons, respectively, did not differ significantly in our study. In a study of 30,945 patients from a Norwegian hip fracture register, Authen, et al. [9] investigated whether a difference existed in the re-operation rates in hip fracture operations, between non-experienced (<3 years) and experienced surgeons (>3 years). For intertrochanteric fractures treated with an intramedullary nail, the authors reported comparable re-operation rates to the ones in our study (6.4% non-experienced, 4.8% experienced, p = 0.3). Interestingly however, displaced FNFs treated by screw osteosynthesis and hemi-arthroplasty by inexperienced surgeons exhibited higher rates of re-operation, highlighting the impact experience has on the outcomes of more complex procedures.

This notion was further explored in a study by Palm, et al. [8] who reported that unsupervised junior registrars had a higher rate of re-operation for technically demanding proximal femoral fractures. Such biomechanically complex fractures included Garden III-IV FNF, posterior angulated Garden I-II, Evans-5 trochanteric fractures, sub-trochanteric

fractures as well as pathological fractures. For technically demanding procedures, the different learning curves appeared to explain the higher rate of re-operation seen in the cohort with less experience. Bjorgul, et al. [20] aimed to characterize learning curves for different hip fracture surgeries using the cephalomedullary nail, cannulated screw fixation and hemiarthroplasty. Mean operating times in their study decreased for each procedure as the residents accumulated experience, though at different rates, highlighting the unique learning curves associated with each procedure. In our study, the mean operating time and the rate of re-operation did not differ between cohorts. As the resident in our study had completed three years of training, we believe our findings reflect an acquired learning curve for a relatively less technically challenging procedure.

The research question of the study, should residents be allowed to perform CRIF for intertrochanteric fractures is of particular interest for many surgeons, given the frequency of this injury. Our findings suggest that CRIF can be performed by residents, without putting patients at an increased risk for serious complications. The fact that a resident can perform this procedure adds significant value to fracture care, especially in the context of managing an overcrowded department.

The current study presents several limitations. First, this is a retrospective study. The study population could have been larger and was therefore susceptible to a sampling bias. The experience of residents could have varied as the residents that participated in this study were in different years of a 6-year training program. As the learning curve was not accounted for in the resident cohort, this could have confounded our results. Finally, it is likely that the higher re-operation rates seen in surgeons are explained by the fact that the more complex cases were analyzed and selected in advance by surgeons, introducing a bias into our study.

Conclusion

No significant differences were reported between residents and seniors performing closed reduction and internal fixation of intertrochanteric fractures for rates of duration of surgery, blood loss, orthopedic complications and revision surgeries.

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