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Original Article

Comparative Analysis of Functional Outcomes: Extramedullary Versus Intramedullary Fixation in Unstable Inter-Trochanteric Femoral Fractures

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ABSTRACT

Unstable trochanteric femoral fractures are challenging to manage. Two options exist for the operative treatment and management of unstable trochanteric fractures; i.e. extramedullary or intramedullary stabilization. However, there is a dearth of good evidence of the clinical efficacy of either of the two methods especially in terms of functional outcomes. **Objective:** To compare the functional outcome following fixation of unstable trochanteric femoral fractures via extramedullary versus intramedullary methods. **Methods:** This prospective cohort was conducted upon 46 adult patients and admitted at Liaquat University Hospital Hyderabad/Jamshoro, after taking written informed consent from parents. Functional outcomes utilizing the Timed Up and Go Test and Harris Hip Score, at 3 months and 6 months post-surgery and radiographic parameters were gathered to evaluate heterotopic ossification and femoral neck shortening at follow-up visits using a pre-structured questionnaire. The data was analyzed with SPSS V.21 and Microsoft Excel 2016. **Results:** The sample predominantly consisted of males, with a mean age of 31 ± 5 years. Intramedullary fixation showed superior early mobility outcomes and maintained better hip function scores compared to extramedullary fixation for unstable inter-trochanteric femoral fractures. Intramedullary fixation also demonstrated lower rates of heterotopic ossification and less femoral neck shortening, indicating potential benefits in reducing complications and preserving anatomical integrity. **Conclusions:** In conclusion, the study findings suggest intramedullary fixation as a favorable option for optimizing functional recovery and radiographic outcomes in such fractures.

INTRODUCTION

Managing trochanteric fractures presents significant challenges for trauma surgeons, encompassing issues ranging from nomenclature confusion to the absence of a standardized classification system and varying treatment approaches lacking consensus [1]. Moreover, dealing with an unstable trochanteric fracture adds complexity due to its biomechanically unfavorable nature. Accurate fracture classification, a pivotal step in treatment planning, typically starts with categorizing fractures as stable or unstable [2, 3]. Instability assessment often considers factors such as medial cortex comminution and posterolateral instability. The widely adopted AO/ASIF classification system divides trochanteric fractures into three primary groups. A1, A2 & A3. [4-6]. Treatment strategies for unstable trochanteric fractures commonly involve extramedullary or intramedullary stabilization methods [7, 8]. Extramedullary approaches typically involve utilizing sliding hip screws (SHS) attached to a plate at the lateral cortex, such as the Dynamic Hip Screw (DHS) or Compression Hip Screw (CHS). This method allows for

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direct open reduction of the fracture and is considered both safe and straightforward. On the contrary, intramedullary techniques entail percutaneously inserting a nail that is connected to neck screws capable of sliding through the nail. Examples include the Gamma Nail, Intramedullary Hip Screw (IMHS), and Proximal Femoral Nail (PFN) [9]. The minimally invasive nature of intramedullary fixation is associated with reduced blood loss and a lower infection rate. The implant should let patients put their full weight on it because it has good mechanical properties [10, 11]. However, there aren't many randomized clinical studies comparing intramedullary and extramedullary fixation methods for unstable trochanteric fractures, and the results of those that exist are inconsistent. Most studies compare these methods mainly for treating stable trochanteric fractures.

This comparative analysis was aimed to compare the functional outcomes of the two procedure following their use to treat unstable trochanteric fracture.

METHODS

This prospective cohort was conducted upon a sample of 46 adult patients, (divided into 2 equal groups of 23 each; labelled as A (Intramedullary group) and B (Extramedullary group), chosen via non probability convenience sampling, from January 2023 to June 2023. The study was approved by Research Ethics Committee of Liaquat University of Medical and Health Sciences (No. LUMHS/REC/-241, dated: 19/11/2022). Sample size was calculated using Open-Epi sample size calculator by taking mean time of 7.4 ± 3.83 vs 11.5 ± 5.71 sec for "Timed Up and Go Test" as functional outcome between intramedullary group vs extramedullary group, respectively, with confidence interval of 95% and power of study as 80%. [10]. Patients were admitted via both outpatient and casualty departments at Orthopedic of Liaquat University Hospital in Hyderabad/Jamshoro., after taking written informed consent from parents. Adults aged 18 to 45 years with unstable inter-trochanteric fractures were included in the study. Exclusion criteria included cases with poly-trauma, any pathological fracture, reverse oblique fractures or open fracture. Eligible patients were alternately assigned to either of the two study groups based on their admission sequence, ensuring each successive patient was allocated to a different group, thereby balancing group composition over time. The primary outcome variable assessed the success of surgery through functional outcome measurements, utilizing the Timed Up and Go Test and Harris Hip Score, at 3 months and 6 months post-surgery. Secondary outcomes included additional, specific radiographic parameters were gathered to evaluate femoral neck shortening and heterotopic ossification. Surgical success was determined by improved functional outcomes measured through the Timed Up and Go Test and Harris Hip Score at 3 and 6 months post-surgery. A decrease of more than 1-2 seconds in the Timed Up and Go Test, indicating improved mobility and a Harris Hip Score increase of 10 points or more reflects enhanced hip function and reduced disability following surgery. Secondary outcomes include radiographic assessments for femoral neck shortening, and heterotopic ossification, aiming for minimal complications and stable implant positioning post-surgery. Data was analyzed using SPSS v.21 and Microsoft Excel 2016. Comparative analysis between Group A and Group B was done via independent t-test for primary outcomes (Timed Up and Go Test, Harris Hip Score) at 3 and 6 months post-surgery. For secondary outcomes (radiographic parameters) frequency and percentage distributions was computed for heterotopic ossification while mean shortening was calculated for femoral neck shorting between groups.

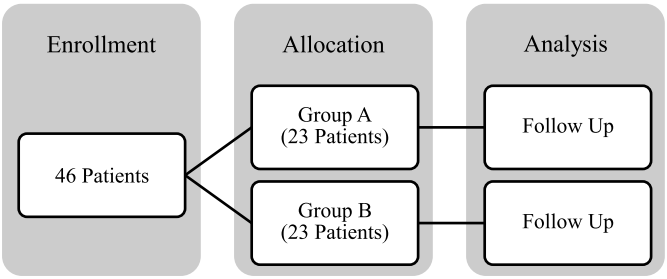

Figure 1: Patient Enrollment and Follow Up

RESULTS

A predominant majority of the sample comprised of males and the mean age of the sample stood at 31 ± 5 years as shown in table 1.

Table 1: Descriptive Statistics

Variables		Group A N (%)/Mean ± SD	Group B N (%)/Mean ± SD
Gender	Male	18 (78.3%)	21 (91.3%)
	Female	05 (21.7%)	02 (8.7%)
Mean Age (Years)		30 ± 5	32 ± 5

The results in table 2 showed that Group A (intramedullary fixation) had slightly better timed up and go test results at 3 months (12.5 ± 2.3 vs. 13.2 ± 2.1 seconds, p = 0.054) and significantly better at 6 months (10.8 ± 1.9 vs. 11.5 ± 2.0 seconds, p = 0.021) compared to Group B (Extramedullary fixation). Group A also showed higher Harris Hip Scores at both 3 months (85.2 ± 5.6 vs. 82.5 ± 6.3, p = 0.072) and 6 months (89.7 ± 4.8 vs. 88.3 ± 5.1, p = 0.193), although these differences were not statistically significant at 6 months. Overall, while Group A demonstrated better early mobility outcomes, both fixation methods yielded comparable improvements in hip function over the 6 months post-surgery period.

Table 2: Primary Outcomes-Functional Outcomes Measures

Variables	Group A (Mean ± SD)	Group B (Mean ± SD)	P-Value
Timed Up and Go Test (3 Months)	12.5 ± 2.3	13.2 ± 2.1	0.054
Timed Up and Go Test (6 Months)	10.8 ± 1.9	11.5 ± 2.0	0.021

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Harris Hip Score (3 Months)	85.2 ± 5.6	82.5 ± 6.3	0.072
Harris Hip Score (6 Months)	89.7 ± 4.8	88.3 ± 5.1	0.193

Table 3 outlines secondary outcomes for Groups A (Intramedullary fixation) and B (Extramedullary fixation) in unstable inter-trochanteric femoral fractures. Group A showed lower rates of heterotopic ossification (HO) stages, with 53.3% having no HO compared to 69.2% in Group B. Both groups exhibited minimal femoral neck shortening initially, but Group A maintained less shortening over time: 0.2 cm at 6 weeks, 0.2 cm at 3 months and 0.3 cm at 6 months, compared to Group B's increasing shortening to 0.9 cm, 1.0 cm, and 1.1 cm respectively. These results suggest potential benefits of intramedullary fixation in reducing HO and preserving femoral neck integrity compared to extramedullary fixation.

Table 3: Secondary Outcomes-Radiographic Parameters

Staining Of Heterotopic Ossification	Frequency N (%)	
	Group A	Group B
None	16 (53.3%)	18 (69.2%)
Stage-1	4 (13.3%)	2 (7.7%)
Stage-2	2 (6.7%)	1 (3.8%)
Stage-3	1 (3.3%)	2 (7.7%)
Duration vs Femoral Neck Shortening	**Mean Shortening (CM)**	
	Group A	**Group B**
6 Weeks	0.2	0.9
3 Months	0.2	1.0
6 Months	0.3	1.1

DISCUSSION

In this study, outcomes of intramedullary and extramedullary treatments were compared in a predominantly male sample with a mean age of 31 years. The findings revealed no statistically significant differences in primary or secondary clinical outcomes between the two treatment groups. However, radiographic assessments favored the intramedullary treatment group, showing less femoral neck shortening over time. Presently, treatment failure rates for intertrochanteric hip fractures range from 9% to 16%, often leading to successful union at the expense of considerable femoral neck shortening. Historically, implants aimed at restoring hip anatomy have shown high failure rates. However, intramedullary devices may offer biomechanical advantages due to their load-sharing nature, situated closer to the weight-bearing axis compared to plate-hip screw devices. Additionally, they tend to minimize femoral neck collapse [12-14]. Our study found significant differences in functional outcomes between Groups A and B for unstable inter-trochanteric femoral fractures. Group A, treated with Intramedullary fixation, showed better Timed Up and Go Test results at 3 months (12.5 ± 2.3 vs. 13.2 ± 2.1 seconds) and significantly better results at 6 months (10.8 ± 1.9 vs. 11.5 ± 2.0 seconds, p = 0.021). Group A also exhibited higher Harris Hip Scores at both 3 months (85.2 ± 5.6 vs. 82.5 ± 6.3) and 6 months (89.7 ± 4.8 vs. 88.3 ± 5.1), although the differences were not statistically significant at 6 months (p = 0.193). International research reveals similar trends favoring intramedullary fixation in improving functional outcomes for inter-trochanteric femoral fractures [15]. Studies from the United States and Europe, respectively, have demonstrated that intramedullary devices provide better stability and biomechanical advantages, which may contribute to enhanced post-operative mobility and hip function scores. However, international research also underscores the importance of patient-specific factors, surgical technique, and post-operative rehabilitation protocols in influencing outcomes [16, 17]. A meta-analysis found similar trends in favor of intramedullary treatment for femoral neck fractures, corroborating the radiographic findings of less femoral neck shortening observed in Group A of the current study [18]. Similarly, a retrospective cohort study conducted demonstrated comparable primary and secondary clinical outcomes between intramedullary and extramedullary treatments, aligning with the current study's findings [19]. However, studies did not specifically examine radiographic parameters, highlighting the unique contribution of the current study in assessing this aspect of treatment efficacy [20]. Conversely, a randomized controlled trial reported conflicting results, showing no significant differences in radiographic outcomes between intramedullary and extramedullary treatments for femoral neck fractures [21]. Additionally, literature suggests that other factors too play a role in the achievement of a good functional outcome. As surgeons gain more experience with different intramedullary fixation systems, treatment outcomes typically enhance, resulting in fewer intraoperative and postoperative complications. Making changes like adding specific options for locking screws at the end of bones has reduced how often bad things happen after surgery. Also, focusing on putting the fixation device exactly right in the hip bone after fixing the fracture well will help prevent the device from moving out of place. However, the current literature regarding intertrochanteric fracture treatment does not clearly favor one implant over another [22, 23].

CONCLUSIONS

In conclusion, intramedullary fixation showed superior early mobility outcomes and maintained better hip function scores compared to extramedullary fixation for unstable inter-trochanteric femoral fractures. Intramedullary fixation also demonstrated lower rates of heterotopic ossification and less femoral neck shortening, indicating potential benefits in reducing complications and preserving anatomical integrity. These findings suggest intramedullary fixation as a favorable option for optimizing functional recovery and radiographic outcomes in such fractures.

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Conceptualization: RAB, FM
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Formal analysis: RAB
Writing, review and editing: AHMJ, AA, LDM, AMH, FM

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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