Section: Orthopaedics

Original Research Article

A PROSPECTIVE STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNSTABLE INTERTROCHANTERIC FRACTURE OF FEMUR FIXED WITH CEPHALOMEDULLARY NAIL IN DIFFERENT MEDIAL CORTICAL SUPPORT POSITIONS

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Received : 05/10/2025
Received in revised form : 25/11/2025
Accepted : 14/12/2025

Keywords:
Intertrochanteric fractures, Fracture fixation, intramedullary nailing, prospective study, positive medial cortical support, neutral position, negative medial cortical support.

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DOI: 10.47009/jamp.2025.7.6.185

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (6); 700-704

ABSTRACT

Background: The main aim of our study was to observe the functional and radiological outcomes of operated unstable intertrochanteric fracture of femur reduced and fixed with positive reduction, negative reduction and neutral reduction positions using cephalomedullary nail. **Materials and Methods:** The study involves 48 patients with unstable intertrochanteric fractures based on the inclusion criteria who were operated with cephalomedullary nail and post operatively divided into 3 groups based on their reduction position and followed for minimum 3 months. The functional outcome assessment using Harris hip score (HHS) and radiological assessment such as neck shaft angle, tip apex distance, time of callus formation and complications were assessed. **Result:** There were 9 cases in positive reduction, 25 cases in neutral reduction and 14 cases in negative reduction with mean age of 68.25 years and male preponderance associated with 35% incidence in obesity and 12% and 8% incidence in DM and CKD comorbidities respectively. 77% of cases had callus formation by 8 weeks and remaining at 12 weeks. The positive reduction group had an HHS of 91% ($p = 0.01$) an excellent outcome and mean Neck Shaft Angle (NSA) of 124.22 ($p = 0.02$) with no complications which is statistically significant in comparison to other groups. Overall, 20.8% of cases had varus collapse. 8% of cases in neutral reduction and 57% occurred in negative reduction group had varus collapse at 3 months respectively. 2 cases (14.2%) had screw backout and 1 case (7.1%) with SSI in negative reduction group noted. **Conclusion:** Functional and radiological outcomes in PMCS position and neutral position are far better than NMCS. The chance of early varus collapse is high in NMCS position. So, delayed full weight bearing is recommended to avoid early postoperative varus collapse in such cases.

INTRODUCTION

Fracture of the intertrochanteric region is an extracapsular fracture of proximal femur. It is frequently noted in elderly female population after a trivial trauma. Historically the fracture was treated conservatively with splint and immobilization, and it resulted in high morbidity and high mortality due to complications like pressure ulcers, urinary tract infection, pneumonia and deep vein thrombosis.[1] In order to prevent these complications and early rehabilitation of the patient, closed reduction of the fracture and stable internal fixation has become the preferred mode of treatment.[2]

The commonly used methods of internal fixation are dynamic hip screw and the cephalomedullary nail. Due to biomechanical design of the implant, decreased blood loss and less soft tissue damage, it is the preferred treatment option for unstable fracture patterns.[3]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Despite the advent of cephalomedullary nails for surgical fixation, the incidence of complications like loss of reduction and early varus collapse, implant failure post operatively was high due to inappropriate reduction.[4] In our study we evaluated the functional and radiological outcomes of various medial cortical support positions in intertrochanteric fracture fixation with cephalomedullary nails.

MATERIALS AND METHODS

This is a hospital based prospective study to assess functional and radiological outcome of unstable intertrochanteric fracture of femur fixed with cephalomedullary nail in different medial cortical support positions. All patients who presented to the casualty and outpatient from November 2022 to February 2025 in the department of orthopaedics of Sri Manakula Vinayagar Medical College and Hospital with intertrochanteric fracture satisfying the inclusion criteria were recruited for the study. Based on the previous study with the prevalence ratio of 3.1 and two-sided significance level of 95, using epi info software version 7.2.6 the size of the sample size calculated as 47 and 48 patients fulfilled the inclusion criteria such as age more than 18 years, age of injury less than 12 weeks, traumatic aetiology and unstable fracture patterns according to Boyd and Griffin classification. The patients with pathological fracture and multiple ipsilateral fractures of the same lower limb were excluded from the study After obtaining permission from the Institutional ethics committee, (IEC-SMVMCH, IEC NO: EC/105/2022), the study was conducted. Informed consent was obtained from the participants before the study and their identity and information were maintained confidentially. The study participants were divided into 3 groups as positive, neutral and negative based on the reduction position postoperatively [Figure 1].

The preoperatively we collected data such as age, gender, body mass index, comorbidities, mechanism & side of injury and Boyd and Griffin fracture type from patients. Then they were operated with cephalomedullary nail with best possible reduction position with the help of traction table. The medial cortical reduction position is assessed postoperatively by plain radiograph and patients were grouped. The patients were not allowed to weight bear till 6 weeks, after which started on partial weight bearing followed by full weight bearing from 3rd month. The patients were followed on monthly visit with minimum for 3 months to assess the radiological parameters such as neck shaft angle, tip apex distance, time of callus formation, screw backout, screw penetration, screw breakage and varus collapse in the patients [Figure 2-4]. The functional outcome was assessed with Harris hip score 5. The data collected was entered into EPI INFO software version 7.2.6.0 and exported as an Excel file for Statistical Package for the Social Sciences (SPSS) software version 29 developed for analysis.

RESULTS

The study had 48 cases among them 26 cases (54%) males and 22 cases (46%) were females with peak incidence in 71 -80 years of age. Most individuals (35.42%) fall under obesity class I in BMI category with major comorbidity as diabetes (12.5%) followed by chronic kidney disease (8.3%) in the patients.66.67% of cases had trivial fall as their mode of injury with fracture often on their right side (58.33%). 81.2 % cases belonged to Boyd and Griffin type II fracture and whereas Type III and Type IV had 8.3% and 10.4% as incidence respectively. With best possible reduction intraoperatively, we achieved 25 cases in neutral reduction, 14 cases in negative reduction and 9 cases in positive reduction. Along the course of follow up there was a sliding of 1 case of positive reduction to neutral reduction and 6 cases of neutral reduction to negative reduction. The neck shaft angle was maintained in majority of cases, with mean value of 124.22 degree in positive reduction, 123.84 degree in neutral reduction and 118.64 degree in negative reduction. 2 cases had early varus collapse in their one-month post op and 8 cases had varus collapse around 3rd month of follow up in negative reduction group. The most common range of tip apex distance was 14-20mm and the two cases had screw backout in negative reduction group with tip apex distance more than 24 mm and stands in association to the early varus collapse cases. The time of callus formation was noted around 8-12 weeks of post op in all cases. The mean functional outcome (Harris hip score) in overall presentation was 87.87% which was good outcome, whereas in groups the positive reduction had 91.56% of excellent outcome, neutral reduction group had 88.64% of good outcome and 84.14% of good outcome. On correlation among the groups the positive reduction had statistically significant outcome in functional score and neck shaft angle with p value of 0.01 and 0.02 respectively [Table 1]. Complication [Table 2] such as Surgical site infection with Klebsiella pneumoniae (resistant strain) was noted in 1 case in a patient with negative reduction with associated obesity class II, diabetes and chronic kidney disease as comorbidity who was managed by implant removal, external fixator and intravenous antibiotics.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

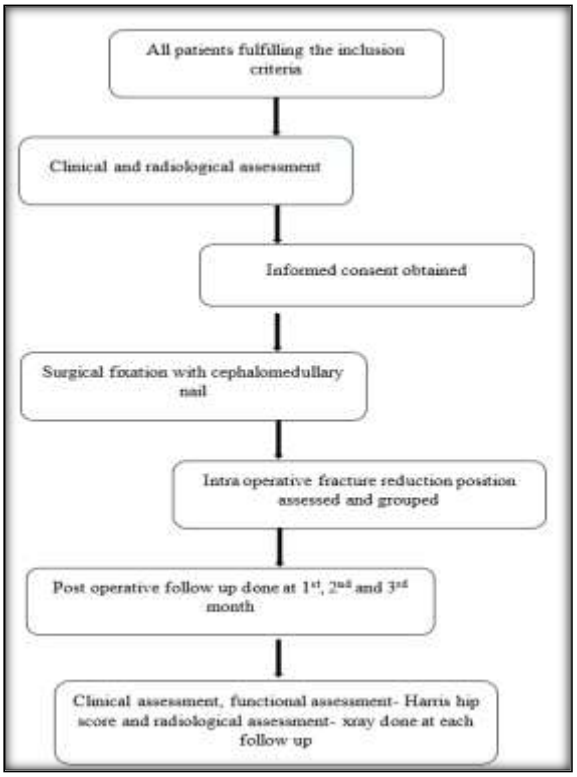

Figure 1 Flowchart of patient selection

Figure 2 Radiological and clinical follow up in positive reduction (Image a, b, c shows pre, post and final follow up xray of the patient and image d and e shows the range of movement on operated side).

Figure 3: Radiological and clinical follow up in neutral reduction. (Image a, b, c shows pre, post and final follow up xray of the patient and image d and e shows the range of movement on operated side).

Table 1: Comparison and correlation among the reduction type

Parameter	Positive	Anatomical (Neutral)	Negative	p-value
Age	68.44 ± 7.88	70.00 ± 12.39	65.00 ± 12.37	0.45
BMI	24.56 ± 2.92	23.88 ± 2.92	23.71 ± 2.23	0.76
Time for Callus formation (in weeks)	8.00 ± 0.00	9.12 ± 1.83	9.14 ± 1.88	0.20
Harris Hip Score	91.56 ± 1.13*	88.64 ± 3.03	84.14 ± 9.85	0.01*
Neck Shaft Angle	124.22 ± 3.46*	123.84 ± 4.88	118.64 ± 7.39	0.02*
Tip Apex Distance	21.00 ± 5.52	19.80 ± 5.92	18.86 ± 5.96	0.69

*Shows p-value <0.05

Table 2: Distribution based on the complications in patients

Complications	Frequency	Percentage
Screw backout	2	4.17
Varus Collapse	10	20.83
Surgical Site Infection	1	2.08
Nil	35	72.92
Total	48	100.00

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Figure 4: Radiological and clinical follow up in negative reduction. (Image a, b, c shows pre, post and final follow up xray of the patient and image d and e shows the range of movement on operated side).

DISCUSSION

In the surgical management of the intertrochanteric fractures the outcome of the treatment is based on the intra operative fracture cortical reduction position and stability of the fixation based on the biomechanical properties of the fracture. The standard operative procedure for any fracture is to try to achieve the cortex-to-cortex straight alignment.[6,7] This reduction position is difficult to achieve. Newer studies aimed for a non-anatomical reduction position on the medial wall to gain stability and outcome same as that in anatomical reduction and thus the positive reduction, neutral reduction and negative reduction positions was introduced by Gotfried et al.[8]

The positive medial cortical support in his study to surprise showed better outcome compared to neutral and negative reduction in preventing the sliding of the fracture fragment on weight bearing activity, which was noted in our study also.

This reduction positions and their effects on radiological and functional outcomes are affected by various factors like fracture type, bone density, co morbidities, different age groups and implant profile. The incidence of intertrochanteric fracture was found to be in elderly population with trivial fall as the mechanism of trauma with associated obesity, diabetes mellitus and chronic kidney disease as comorbidities which in similar to Mahajan et al and Cho et al studies.[9,10]

11.11% of sliding of reduction has occurred in positive reduction to neutral reduction position and 24% of sliding of neutral reduction to negative reduction had occurred in our study which is similar to Mahajan et al study. The positive reduction has the least incidence of sliding of fracture reduction.

The neck shaft angle in the study had an overall mean value of 123 degrees with +/- 3.17 degrees of standard deviation in the study population. The mean neck shaft angle at 6 months follow up for positive reduction group is 124.22 +/-3.46, for neutral reduction is 123.84 +/- 4.88 and for negative reduction is 118.64 +/-7.39. Out of 10 cases which had varus collapse, 1 case underwent revision surgery. Negative reduction population in our study had early postoperative varus collapse following full weight bearing activity similar to Mahajan et al study. 14.2% cases from negative reduction group had early varus collapse at 1 month and 57.1% cases in negative reduction group had peak incidence of varus collapse from 3rd month when the full weight bearing activity commenced. So, it is advisable to delay the full weight bearing at 3rd month in negative reduction population to avoid early post operative varus collapse.

The average tip-apex distance in this study was 19.88 mm with standard deviation of 5.80 mm which is found similar to study of Baumgaertner et al which had mean value of 24 mm.[11] The 2 cases in negative reduction group with varus collapse had TAD value of > 25 mm as predicted by Baumgaertner which led to screw backout, whereas other cases with varus collapse in negative reduction had mean TAD value of 20.9mm and showed no screw back out.

In this study, positive reduction population had a mean Harris hip score of 91.56+/-1.13 an excellent outcome when compared to mean value of neutral reduction of 88.64 +/-3.03% and negative reduction of 84.14 +/-9.85%. Positive reduction was found to be statistically and clinically significant in patients due to ability to achieve early ambulation as similar to Chang SM et al and Cho et al studies.[12] The lowest hip score of 59 with poor outcome was noted in a patient in negative reduction group who had complication of varus collapse and surgical site infections.

This study had 10 cases of varus collapse and 1 case of surgical site infection. 7.14% (1 case) had revision of fixation using proximal femoral nail. One patient with surgical site infection in the 6th month after surgery with antibiotic resistant organism (Klebsiella Pneumonia) was managed with wound debridement with implant exit Intravenous antibiotics and external fixator. All 10 cases of varus collapse were treated by adjuvants for bone healing such as bisphosphonates and teriparatide with physical rehabilitation.

Limitations

1. Small sample size
2. Short duration of follow up.
3. The role and treatment of osteoporosis in management of intertrochanteric fracture fixation is not considered in this study.

CONCLUSION

We conclude that positive or neutral medial cortical support reduction position in fixation of unstable intertrochanteric fracture achieved better post operative fracture stability, early ambulation and excellent functional outcome than the negative medial cortical support position. By achieving reduction in positive and neutral medial cortical support position the incidence of early postoperative

ISSN (O): 2687-5365; ISSN (P): 2753-6556

varus collapse of the fracture and further implant failure can be reduced.

We recommend positive medial cortical support position as a non-anatomical, acceptable reduction position for better post operative outcomes. In patients with intraoperative negative medial cortical support position delayed full weight bearing is recommended to avoid early varus collapse.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556