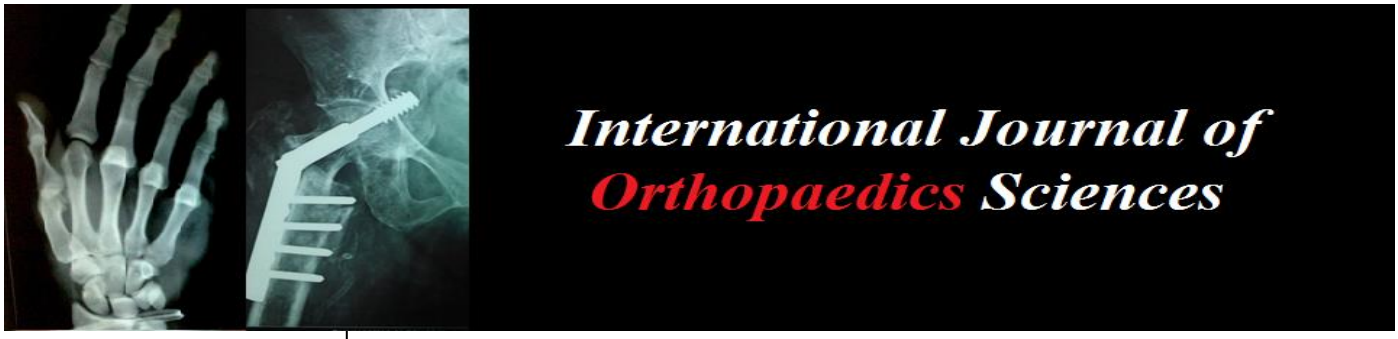

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2023; 9(2): 200-206

https://www.orthopaper.com
Received: 10-02-2023
Accepted: 11-03-2023

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Functional outcome of unstable intertrochanteric fracture treated with long PFN with or without augmentation

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DOI: https://doi.org/10.22271/ortho.2023.v9.i2c.3369

Abstract
Objective: To evaluate the functional outcomes of the patient having Unstable Inter-trochanteric fracture with or not with sub-trochanteric extension treated by long PFN with or without augmentation.
Materials and Methods: In our institute, a prospective study of 24 patients who underwent surgical intervention for inter-trochanteric fractures with or without sub-trochanteric extension using long PFN alone or along with augmentation and studied their mechanism of injury, sex prevalence, classification, outcomes and complications for a period of one year from January 2021 to January 2022.
Results: The patients were follow-up for duration of 9 months. At the 6th month, the mean Harris hip score was determined to be 86. Out of the total participants, 10 patients achieved an excellent score, 10 patients had a good score, 2 patients had a fair score, and 2 patients had a poor score.
Conclusion: Based on this study, both Long PFN with and without augmentation yield comparable outcomes in terms of functional results, implant-related complications, and fracture healing rates for unstable inter-trochanteric fractures with or without sub-trochanteric extension. The decision to augment the fixation with wire cerclage should be made on a case-by-case basis, considering fracture characteristics, bone quality, and surgeon expertise. Prospective randomized controlled trials.

Keywords: PFN-proximal femoral nail, augmentation, sub-trochanteric fracture

Introduction
Unstable Inter-trochanteric fractures with or without sub-trochanteric extension present a complex and challenging scenario in orthopedic trauma. These fractures involve the proximal femur and can result in significant morbidity and functional impairment, particularly in elderly patients. The choice of surgical management for these fractures is crucial in achieving optimal outcomes along with age of patients, osteoporosis, co-morbidities [1, 2]. The use of the Long Proximal Femoral Nail (PFN) has gained popularity as a reliable and minimally invasive technique for the treatment of unstable inter-trochanteric fractures. However, the addition of wire cerclage augmentation to enhance fracture stability remains a topic of debate among orthopedic surgeons.
The main principle of this fixation is Load-sharing device, sliding screw in femoral head-neck fragment, a biomechanically stronger implant with demanding surgical procedure through small exposure and less blood loss but having complications, such as cutout, nonunion, and implant breakage [3-5].
While Long PFN provides reliable fixation, the addition of wire cerclage may further enhance stability, particularly in fractures with sub-trochanteric extension. However, it is essential to evaluate whether the additional procedure offers significant benefits in terms of functional outcomes and fracture healing rates, while considering the potential risks and complications associated with wire cerclage.
This study aims to fill a gap in the existing literature by providing valuable data on the outcomes of Long PFN with augmentation in inter-trochanteric fractures with sub-trochanteric extension. The findings will help surgeons make informed decisions when choosing the most appropriate treatment strategy for these complex fractures, ultimately leading to improved patient outcomes and quality of life.

The AO classification of proximal femoral fractures is a widely used system for categorizing and classifying fractures based on their anatomical location and fracture pattern. Developed by the Arbeitsgemeinschaft für Osteosynthesefragen (AO) group, this classification helps in understanding the injury pattern, guiding treatment decisions, and facilitating communication among healthcare professionals.

The AO classification system for proximal femoral fractures consists of three main categories: type A, type B, and type C. Each category is further divided into subgroups based on specific fracture characteristics. Here is an overview of the AO classification for proximal femoral fractures:

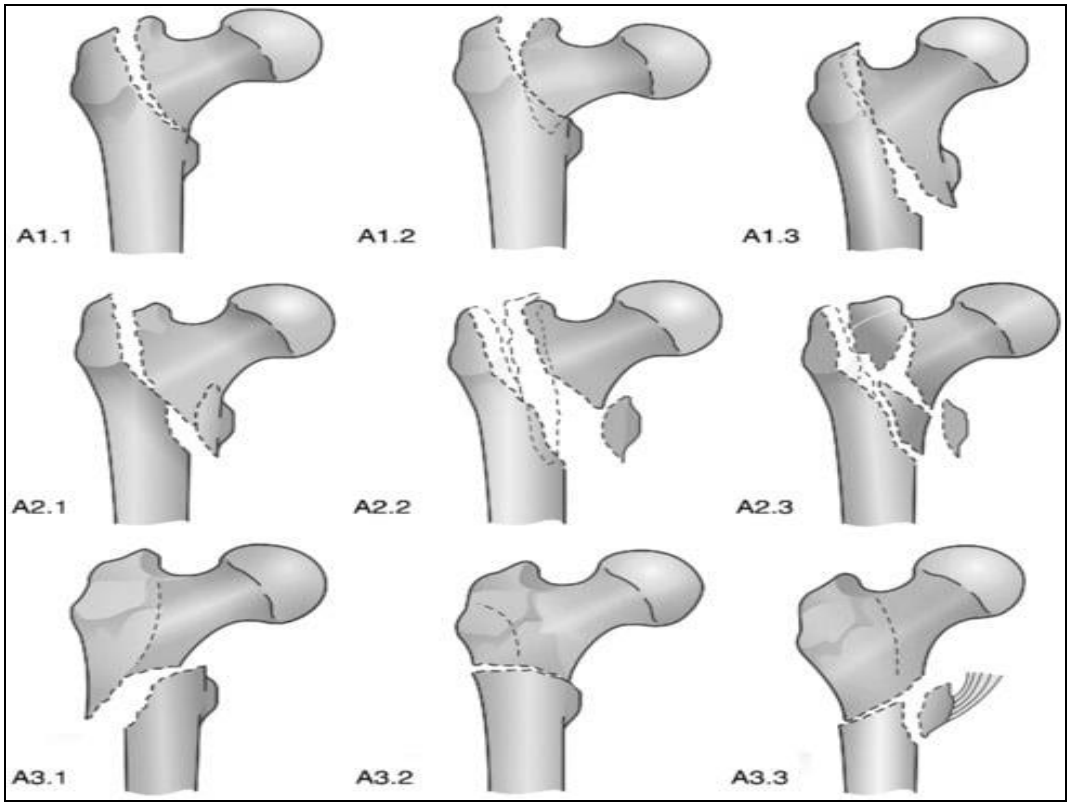


Fig 1: AO classification of IT fracture

Seinsheimer Classification-Sub-Trochanteric Fracture
Type 1 to 5 with sub-types

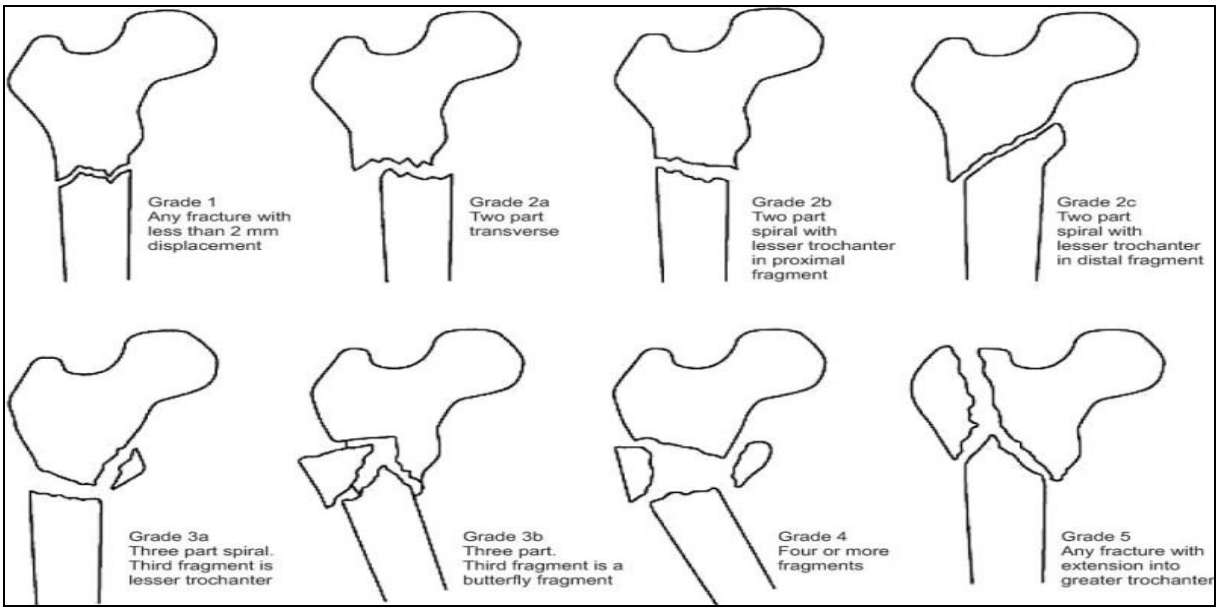


Fig 2: Sub-trochanter fracture classification

Materials and Methods

A prospective study of 24 patients conducted in Sri Lakshmi Narayana Medical College, Puducherry having Unstable inter-trochanteric fractures with or without sub-trochanteric extension treated by long proximal femoral nail with or without augmentation and studied about their fracture pattern, classification, complications. This study included all unstable inter-trochanteric fractures with sub-trochanteric extension

and aged not less than 18 years for a period of one year from January 2021 to January 2022.

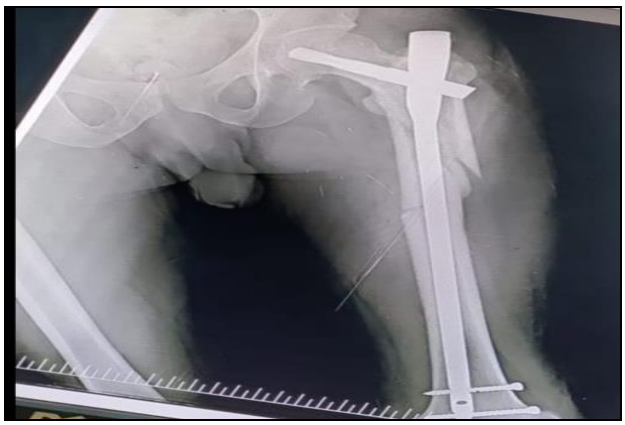
Results

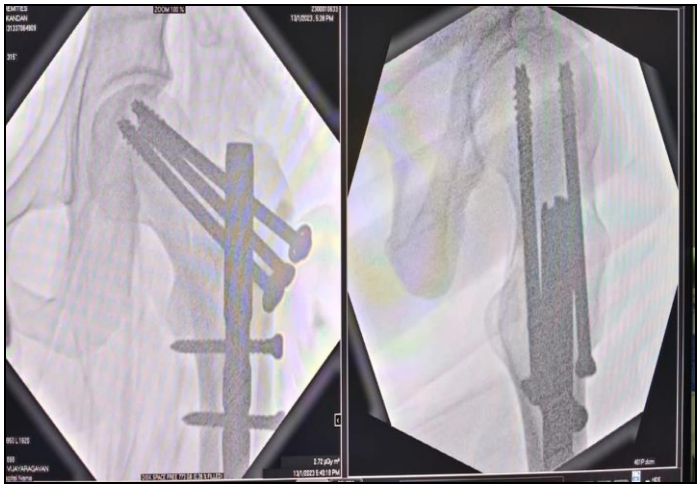
Our study included 24 patients with unstable intertrochanteric fractures, with an average age incidence of 56 years. The male-to-female ratio in our study was 6:2, indicating a higher prevalence of males. Accidental falls accounted for 14 cases, while road traffic accidents were responsible for 10 cases, No associated injuries. The right hip was affected in 14 patients, while the left hip was affected in 10 patients. Mean operating time was estimated to be 1 hour and 10 minutes.

We used Long PFN nails in 13 cases, Long PFN with augmentation of wire cerclage for 6 patients–having sub-trochanteric extension, comminution Greater trochanter and Long PFN with Trochanteric buttress plate for 5 patients–having lateral cortex breach and greater trochanter comminution. The decision to use longer nails was based on unstable reverse oblique fractures and fractures with subtrochanteric extension, aiming to minimize periprosthetic fractures resulting from stress concentration at the nail tip. It is crucial to match the radius of the nail curvature with the femoral bow to prevent impingement of the nail tip on the anterior cortex. In 3 cases, we experienced distraction at the fracture site during nail insertion, and we addressed this by reducing the fracture and temporarily by k wire and we also encountered varus reduction in 3 cases.

During the follow-up period, 12 patients exhibited abductor lurch, which gradually diminished over time. All patients were able to partially bear weight by the end of 2 weeks, and none required walking aids beyond 2 months. Within our series, 6 patients experienced varus collapse, averaging 10 to 15 degrees. 5 cases presented with failure of the de-rotation screw at the junction of the threaded portion and the screw shaft. Among these cases, 3 had varus reduction, 3 had distraction at the fracture site. 2 patients with implant failure got repeated follow-up approximately 6 months. Despite the implant failure and malunion, this patient achieved a good functional outcome.

On average, fracture union occurred within 14 weeks (range: 10-24 weeks). Consolidation was observed in all patients after 6 months. The average follow-up period was 9 months, during which functional outcomes were assessed using the Harris hip scoring system. At the 6th month, the mean Harris hip score was 88.75. Among the patients, 10 achieved an excellent score, 10 had a good score, 2 had a fair score, and 2 had a poor score.





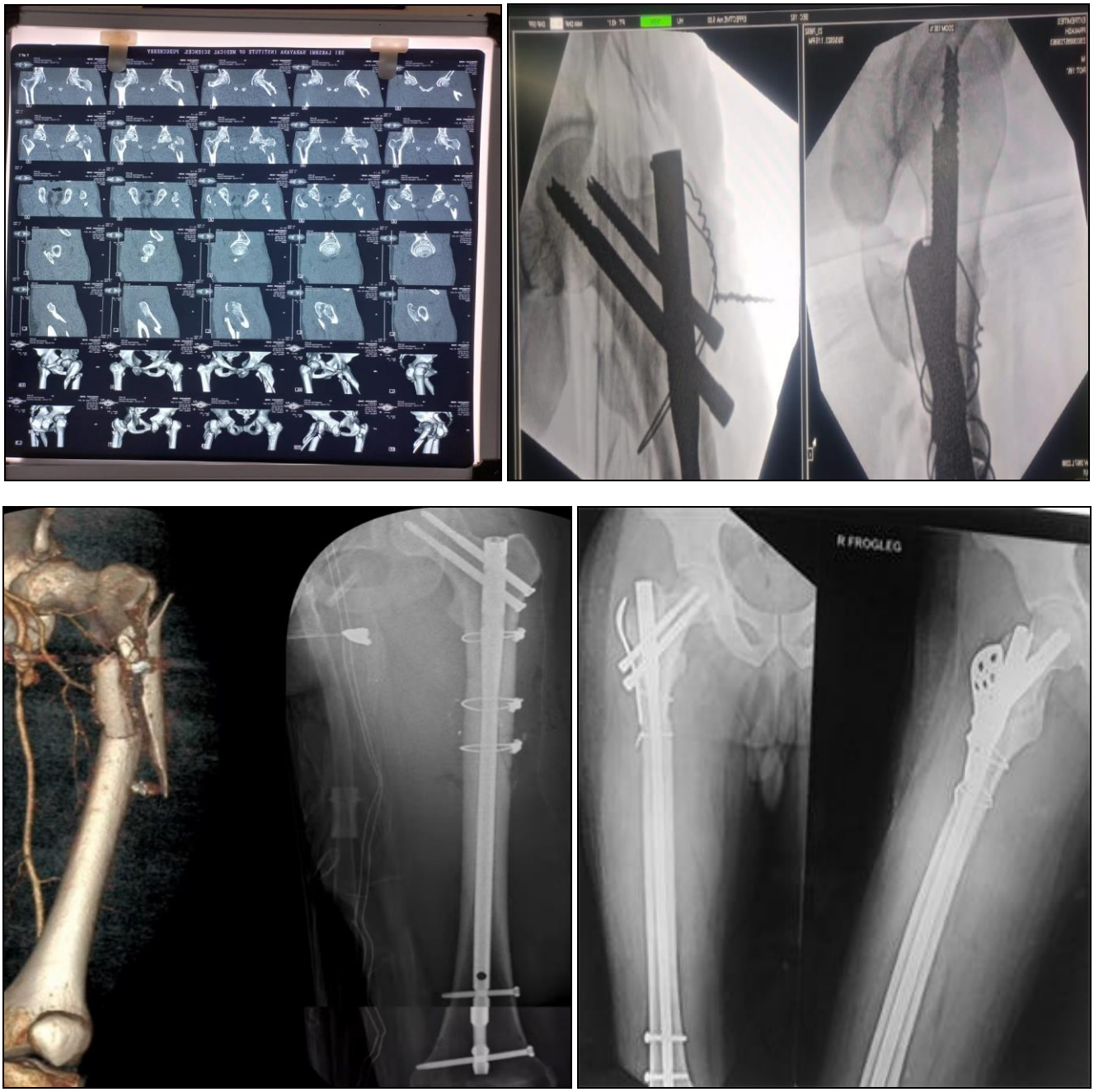


Fig 3: Long PFN alone, PFN augmented with trochanteric screws, PFN augmented with cerclage wiring, PFN with trochanteric buttress plating.

Table 1: Treatment Method

Treatment Method	Number of Patients	Percentage (%)
Long PFN alone	13	54.16
Long PFN augmented with cerclage wire	6	25
Long PFN augmented with Trochanter stabilizing plate/screw	5	20.83

In the table, Table no: 1, the "Treatment Method" column indicates the different techniques used with the Proximal Femoral Nail. The "Number of Patients" column displays the respective number of patients treated with each method. The "Percentage (%)" column represents the percentage distribution of patients for each treatment method.

Intra-OP complications:

1. Fracture displacement by nail insertion–3 patients
2. Failure of anatomical reduction–5 patients (negative varience-3 patients)
3. Varus angulation–3 patients
4. Guide wire breakage/drill bit–0

Post-op complications

1. Varus collapse-6 patients
2. Implant failure-2 patients
3. Z effect-1 patient
4. Periprosthetic fracture-1 patient
5. Lateral slide of proximal screw-6 patients
6. Mal-union, Limb length discrepancy, deformity–2 patients
7. Non-union–0 patients

Table 2: Harris Hip Score Questionnaire

Question	Score
1. Please describe any pain in your hip:	
A. No pain	44
B. Slight pain or occasional pain	40
C. Mild, no effect on ordinary activity, pain after unusual activity, uses aspirin or similar medication	30
D. Moderate pain that requires pain medicine stronger than aspirin/similar medications. I'm active but have had to make modifications and/or give up some activities because of pain	20
E. Marked or severe pain that limits activity and requires pain medicine frequently	10
F. Totally disabled—wheelchair or bed ridden	0
2. Amount and type of support used:	
A. None	11
B. Cane for long walks	7
C. Cane all the time	5
D. 2 canes	2
E. 1 crutch	3
F. 2 crutches or walker	0
G. Unable to walk	0
3. Limp. This should be judged at the end of a long walk using the *type* of support chosen in question 2.	
A. None	11
B. Slight	8
C. Moderate	5
D. Severe	0
4. Distance that you can walk. This should be judged with the aid of a support if you use one.	
A. Unlimited	11
B. 5–6 blocks	8
C. 1–4 blocks	5
D. In the house only	2
E. Unable to walk	0
5. Climbing stairs:	
A. Normally	4
B. Need a banister or cane or crutch	2
C. Must put both feet on each step/severe trouble climbing stairs	1
D. Unable to climb stairs	5
6. Shoes and socks:	
A. Can put on socks and tie a shoe easily	4
B. Can put on socks and tie a shoe with difficulty	2
C. Cannot put on socks and shoes	0
7. Sitting:	
A. Comfortable in any chair	5
B. Comfortable only in high chair, or can sit comfortably for only 0.5 hour	3
C. Cannot sit for 0.5 hour because of pain	0

Table 3: Results of Harris hip score of our study

Functional Outcomes	3rd Month	Percentage	6th Month	Percentage
Excellent	2	8.33%	10	41.66%
Good	6	25%	10	41.66%
Fair	9	37.5%	2	8.32%
Poor	6	25%	2	8.32%

Discussion

Definitions of unstable fractures vary but include those with a fractured lesser trochanter, reverse fracture line or intertrochanteric comminution associated with a big posteromedial component, a broken greater trochanter, and lateral cortex breach.

Unstable intertrochanteric fractures with subtrochanteric extension pose significant challenges due to the involvement

of multiple fracture lines and the potential for instability and displacement [6]. These fractures are often associated with high-energy trauma, such as motor vehicle accidents or falls from height. The fracture pattern typically involves a combination of intertrochanteric and subtrochanteric components, resulting in comminution and loss of stability.

Treatment options for these complex fractures include both surgical and non-surgical approaches. Non-surgical management, such as traction or casting, is rarely indicated due to the inherent instability and risk of malunion or non-union. Therefore, surgical intervention is the mainstay of treatment, aimed at achieving fracture reduction, stability, and early mobilization [7-9].

Several surgical techniques can be employed depending on the fracture characteristics and the surgeon's preference. The choice of surgical approach and implant is crucial in achieving optimal outcomes. Common surgical approaches include the lateral approach, modified Watson-Jones approach, and the extended trochanteric osteotomy. These approaches provide adequate exposure to address both the intertrochanteric and subtrochanteric components of the fracture.

The choice of implant is also critical in managing these fractures. The long proximal femoral nail (PFN) is a commonly used implant for stabilizing intertrochanteric fractures. Its advantages include superior rotational stability, load-sharing properties, and minimal soft tissue disruption. In cases with subtrochanteric extension, augmentation techniques may be employed to enhance stability. These include cerclage wiring, trochanteric stabilizing plate/screw, or augmentation with an intramedullary device [10, 11].

Cerclage wiring is often used to provide additional stability by encircling the proximal femur and improving the fixation of the fracture fragments. Trochanteric stabilizing plate/screw provides additional support by anchoring the trochanteric region and preventing displacement. These augmentation techniques can be combined with the long PFN to achieve stability and promote fracture healing.

The overall goal of treatment is to achieve fracture reduction, restore anatomical alignment, and provide stable fixation to facilitate early mobilization and functional recovery. Postoperatively, early mobilization, physical therapy, and rehabilitation play a crucial role in restoring hip function and preventing complications such as stiffness and muscle weakness.

In terms of functional outcomes, studies have reported variable results. Factors such as fracture severity, patient characteristics, surgical technique, and implant choice can influence the final outcome. Generally, good to excellent functional outcomes are reported in the majority of cases, with a significant proportion of patients regaining satisfactory hip function and pain relief.

It is important to note that the management of unstable intertrochanteric fractures with subtrochanteric extension requires a comprehensive and individualized approach. The surgeon's expertise, careful preoperative planning, and intraoperative decision-making are paramount in achieving successful outcomes.

Conclusion

Finally, we conclude that Long PFN shows more advantage in treating Unstable inter-trochanteric fractures alone, has unique betterment of closed reduction, hematoma preservation, less soft tissue damage. Augmentation with cerclage wiring/buttress plate/screw can be used when long spiral fracture extending to sub-trochanter or in comminution greater trochanter or in lateral wall breach. All these methods shows excellent stabilisation, low rates of clinical complications, few mechanical complications and better functional outcome results.

Hence, The Long PFN and potential augmentation techniques, correct approaches should be tailored to the specific fracture characteristics and patient factors. With appropriate surgical management, including stable fixation and early rehabilitation, favourable functional outcomes can be achieved in the majority of cases. Continued research and evaluation of outcomes will further refine the treatment strategies for these complex fractures.

Acknowledgement

Not available

Author's Contribution

Not available

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article
Nishanthan V, Siddarth R, Vijayaraghavan R. Functional outcome of unstable intertrochanteric fracture treated with long PFN with or without augmentation. International Journal of Orthopaedics Sciences. 2023;9(2):202-206.