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ORIGINAL RESEARCH

Functional outcomes of subtrochanteric fractures of femur treated with long proximal femoral nail (PFN)

[1]Sangameshkumar, [2]Chandrashekar V Mudgal, [3]Balaji Rajendran, [4]Rakshit M

[1,3,4]Junior Resident, Department of Orthopaedics, Karnataka Medical College and Research Institute, Hubli, Karnataka, India
[2]Professor and Unit Chief, Department of Orthopaedics, Karnataka Medical College and Research Institute, Hubli, Karnataka, India

Corresponding Author
Sangameshkumar
Junior Resident, Department of Orthopaedics, Karnataka Medical College and Research Institute, Hubli, Karnataka, India

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ABSTRACT

Background and Objectives: Subtrochanteric femur fractures are among the most challenging injuries for orthopedic surgeons. In elderly patients, they typically result from trivial falls while standing or walking, whereas in younger individuals, road traffic accidents are the predominant cause. Closed management of these fractures is often difficult due to challenges in achieving and maintaining reduction, making operative treatment the preferred approach. This study aims to evaluate the effectiveness of intramedullary fixation using a long proximal femoral nail for subtrochanteric fractures and to analyze the associated complications.**Methodology:** This prospective study included 25 cases of subtrochanteric fractures admitted to KMC &RI HUBLI DHARWAD between DECEMBER 2022 and MARCH 2025. All cases were selected based on inclusion and exclusion criteria, involving fresh subtrochanteric fractures in adults. Excluded from the study were pathological fractures, multiple fractures, fractures in children, and old neglected fractures. All patients underwent surgical fixation using a long proximal femoral nail.**Results:** Among the 25 cases, 23 were male and 2were female, with an age range of 18 to 75 years. The majority of patients (67%) sustained fractures due to road traffic accidents, followed by 23% from falls from height and 10% from trivial falls. The right side was more commonly affected. Seinsheimer Type IIIA fractures were the most prevalent, accounting for 36% of cases. The mean hospital stay was 1 week, and full weight-bearing was achieved at an average of 12 weeks. In our study, 80% of cases showed good-to-excellent outcomes.**Conclusion:** Based on our findings, the long PFN is a reliable implant for treating subtrochanteric fractures, providing a high rate of bone union with minimal soft tissue damage. Intramedullary fixation offers significant biological and biomechanical advantages; however, the procedure is technically demanding. A gradual learning curve and patience are essential to achieving truly minimally invasive outcomes.

Key words: Long PFN, subtrochanteric fractures, Seinsheimer classification, Harris hip score

INTRODUCTION

Subtrochanteric fractures occur in the femur between the lesser trochanter and approximately 5 cm distal in the shaft. This region, where trabecular and cortical bone meet, experiences high mechanical stress, making fractures more prone to comminution. These fractures account for 10%-34% of all hip fractures and are subject to significant axial, tensile, compressive, and rotational shear forces. Due to the region's thick cortical bone and limited vascularity, healing can be challenging, increasing the risk of complications. Closed management often fails to achieve and maintain reduction, making surgical fixation the preferred approach. The primary goal of surgery is to restore normal length and alignment, ensuring proper abductor tension and facilitating early mobilization and weight-bearing. This study aims to evaluate the union rate, complications, operative risks, and functional outcomes of subtrochanteric fractures treated with long proximal femoral nails.

MATERIALS AND METHODS

STUDY PERIOD: DECEMBER 2022 to MARCH 2025.

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PLACE OF STUDY: Karnataka Medical College and Research Institute, Hubli.

SAMPLE SIZE: 25 cases.

INCLUSION CRITERIA

- Subtrochantreric fractures. (Seinsheimer Type 1-5).
- Age more than 18 years.
- Type 1 open fractures.

EXCLUSION CRITERIA

- Type2 and type 3 Open fractures.
- Age > 85 years.
- Associated with neck of femur fractures.
- Patients with distal neurovascular deficits.
- Established non-union from previous fractures.

All of the assessed patients were admitted to the orthopaedic department of the hospital. Their sex, age, and injury mechanism were noted. Records were also kept of any immobilization techniques utilized as patients were being transported to the hospital. At admission, digital x-rays of the cervical spine (lateral), chest (PA), pelvis and long bone fractures were taken. In order to rule out other injuries, cross-references were made between the specialties of general surgery, neurosurgery, and cardiothoracic surgery when needed.

STATISTICAL ANALYSIS

The 30 subtrochanteric fractures in our study were classified according to Seinsheimer classification. In our study we had 9(30%) cases of type IIIA, 6(20%) cases of type IIIB,5(16.66%) cases of type IIB,4 cases of type IIA and type V each and 1 case of type IIC and type IV.

Table 1: Gender wise distribution

Sex	Number	Percentage
Male	23	92.00
Female	2	8.00
Total	25	100.00

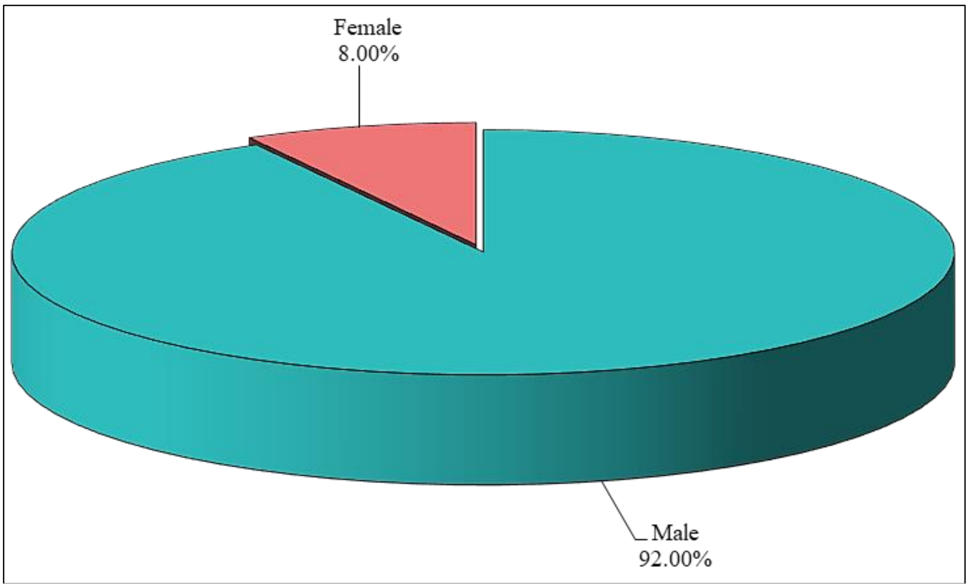

Figure 1: Gender wise distribution

Table 2: Age wise distribution

Age groups	Number	Percentage
20-29yrs	8	32.00
30-39yrs	3	12.00
40-49yrs	4	16.00
50-59yrs	2	8.00
>=60yrs	8	32.00
Total	25	100.00
Mean	43.64	
SD	18.36	

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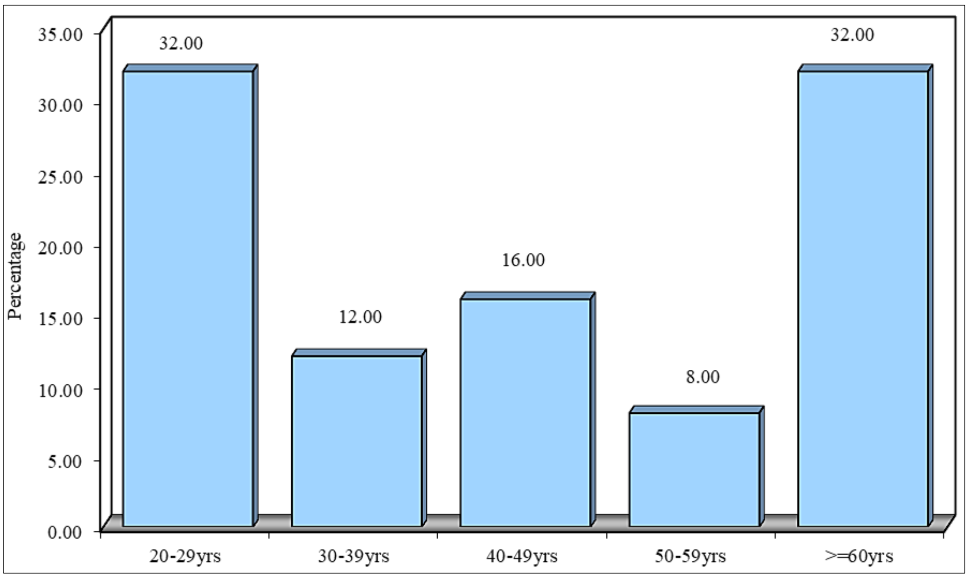

Figure 2: Age wise distribution

Table 3: Co-morbidities wise distribution

Co-morbidities	Number	Percentage
None	19	76.00
DM	3	12.00
HTN	3	12.00
Total	25	100.00

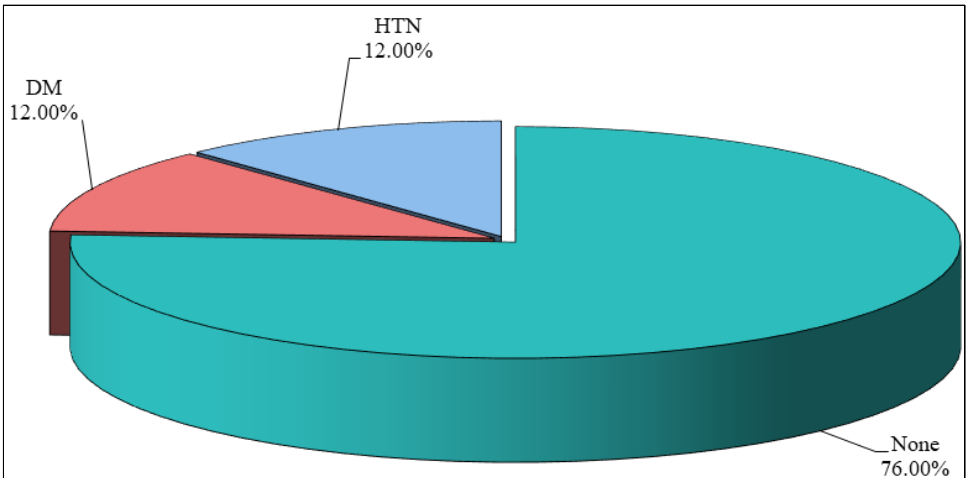

Figure 3: Co-morbidities wise distribution

Table 4: Seinsheimer classification wise distribution

Seinsheimer classification	Number	Percentage
1	0	0.00
2	7	28.00
3	9	36.00
4	5	20.00
5	4	16.00
Total	25	100.00

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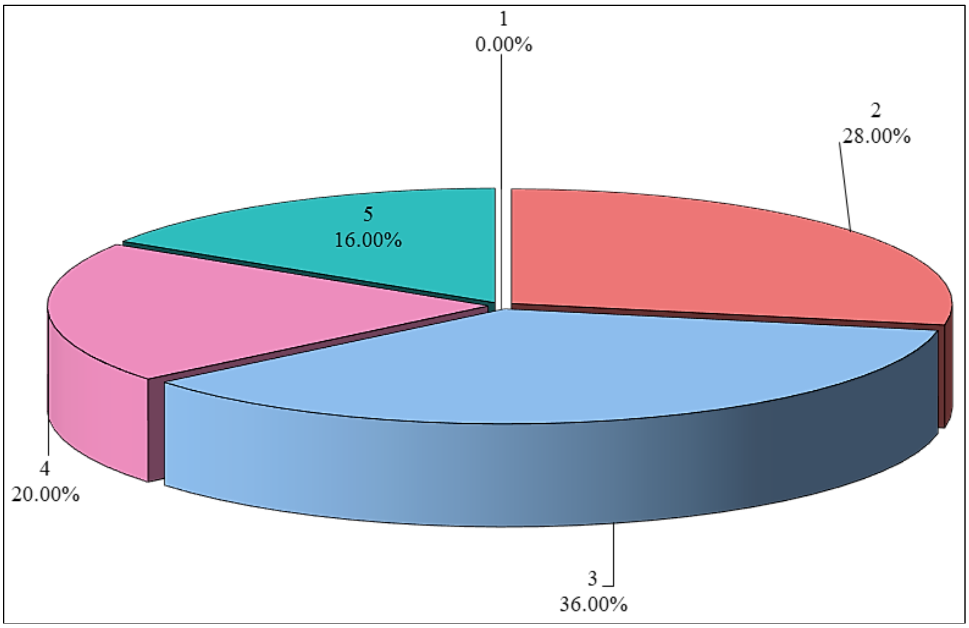

Figure 4: Seinsheimer classification wise distribution

Table 5: Reduction wise distribution

Reduction	Number	Percentage
Closed	19	76.00
Open	6	24.00
Total	25	100.00

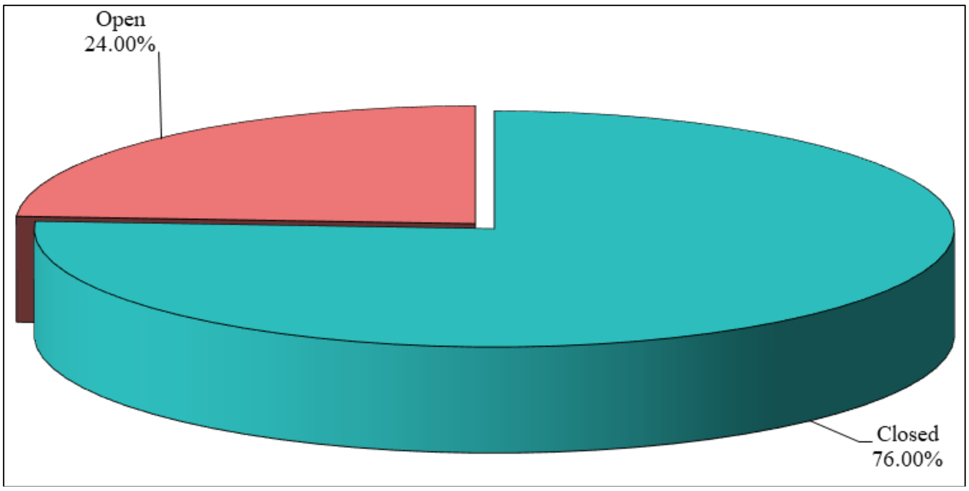

Figure 5: Reduction wise distribution

Table 6: Duration (in hrs)wise distribution

Duration (in hrs)	Number	Percentage
<1hr	3	12.00
1hr	5	20.00
>1hr	17	68.00
Total	25	100.00

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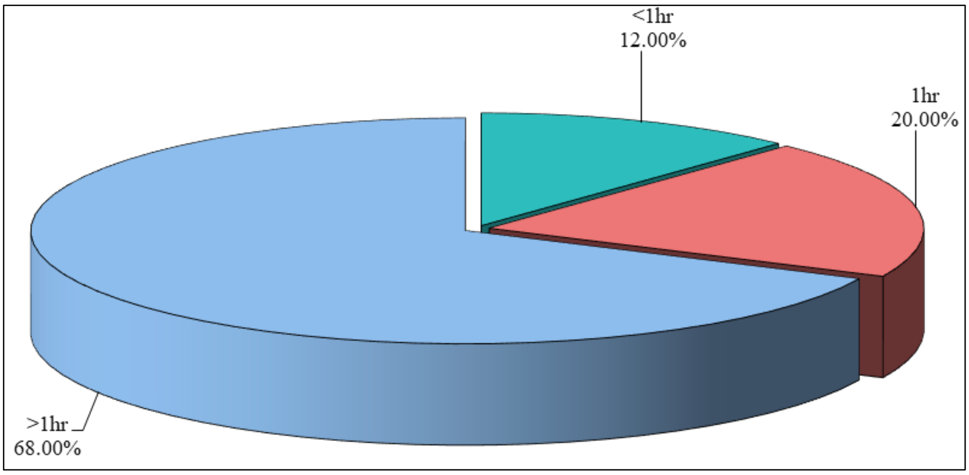

Figure 6: Duration (in hrs) wise distribution

Table 7: Comparison of different treatment time points with HIP flexion ROM (degrees) by dependent t test

Time points	Mean	SD	Mean Diff.	SD Diff.	% of effect	t-value	p-value
3 weeks	31.20	5.26					
3 months	46.20	10.34	15.00	7.64	48.08	9.8198	0.0001*
3 weeks	30.83	5.04					
6 months	63.13	13.34	32.29	11.03	104.73	14.3404	0.0001*
3 weeks	30.83	5.04					
1 year	84.17	20.41	53.33	17.86	172.97	14.6325	0.0001*
3 months	45.63	10.14					
6 months	63.13	13.34	17.50	11.13	38.36	7.7017	0.0001*
3 months	45.63	10.14					
1 year	84.17	20.41	38.54	16.38	84.47	11.5244	0.0001*
6 months	63.13	13.34					
1 year	84.17	20.41	21.04	14.14	33.33	7.2899	0.0001*

*$p<0.05$

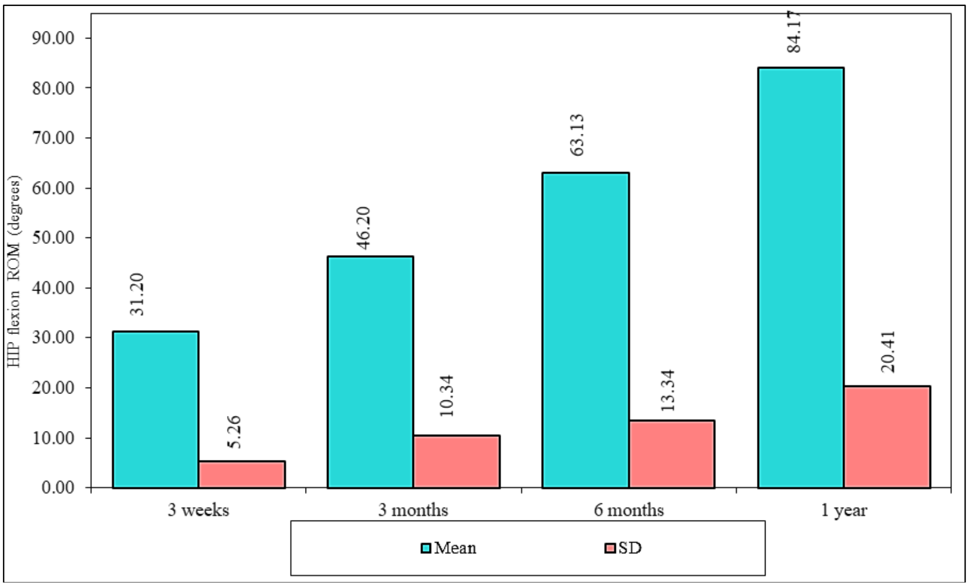

Figure 7: Table: Comparison of different treatment time points with HIP flexion ROM (degrees)

Table 8: Comparison of different treatment time points with HARRIS HIP scores by dependent t test

Time points	Mean	SD	Mean Diff.	SD Diff.	% of effect	t-value	p-value
3 weeks	40.36	9.00					
3 months	57.92	12.17	17.56	7.87	43.51	11.1500	0.0001*

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3 weeks	40.50	9.17					
6 months	71.33	11.77	30.83	11.81	76.13	12.7954	0.0001*
3 weeks	40.50	9.17					
1 year	82.13	11.92	41.63	15.05	102.78	13.5494	0.0001*
3 months	58.13	12.39					
6 months	71.33	11.77	13.21	8.75	22.72	7.3930	0.0001*
3 months	58.13	12.39					
1 year	82.13	11.92	24.00	14.37	41.29	8.1832	0.0001*
6 months	71.33	11.77					
1 year	82.13	11.92	10.79	9.04	15.13	5.8508	0.0001*

*p<0.05

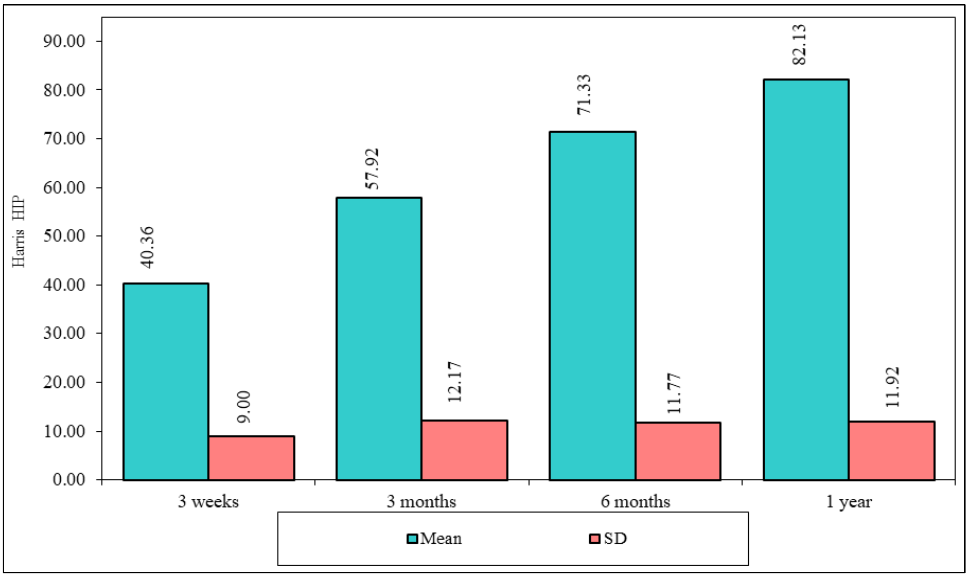

Figure 8: Comparison of different treatment time points with HARRIS HIP scores

Table 9: Comparison of different treatment time points with WEIGHT BEARING scores by Cochran Q test

Time points	Present	%	Cochran Q	P-value
3 weeks	20	80.00	4.5000	0.2122
3 months	24	96.00		
6 months	23	92.00		
1 year	23	92.00		

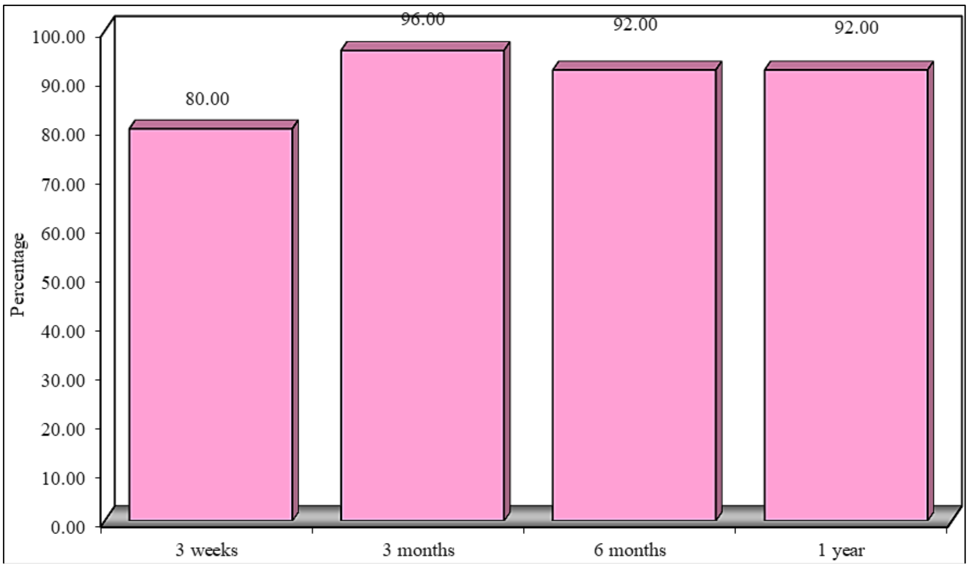

Figure 9: Comparison of different treatment time points with WEIGHT BEARING scores

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Table 10: Comparison of different treatment time points with Radiological union scores by Wilcoxon matched pairs test

Time points	Mean	SD	Mean Diff.	% of effect	Z-value	p-value
3 weeks	0.80	0.41				
3 months	1.52	0.59	0.72	90.00	3.7236	0.0002*
3 weeks	0.79	0.41				
6 months	2.42	0.58	1.63	205.26	4.2857	0.0001*
3 weeks	0.79	0.41				
1 year	2.83	0.38	2.04	257.89	4.2857	0.0001*
3 months	1.50	0.59				
6 months	2.42	0.58	0.92	61.11	4.1069	0.0001*
3 months	1.50	0.59				
1 year	2.83	0.38	1.33	88.89	4.1069	0.0001*
6 months	2.42	0.58				
1 year	2.83	0.38	0.42	17.24	2.6656	0.0077*

*p<0.05

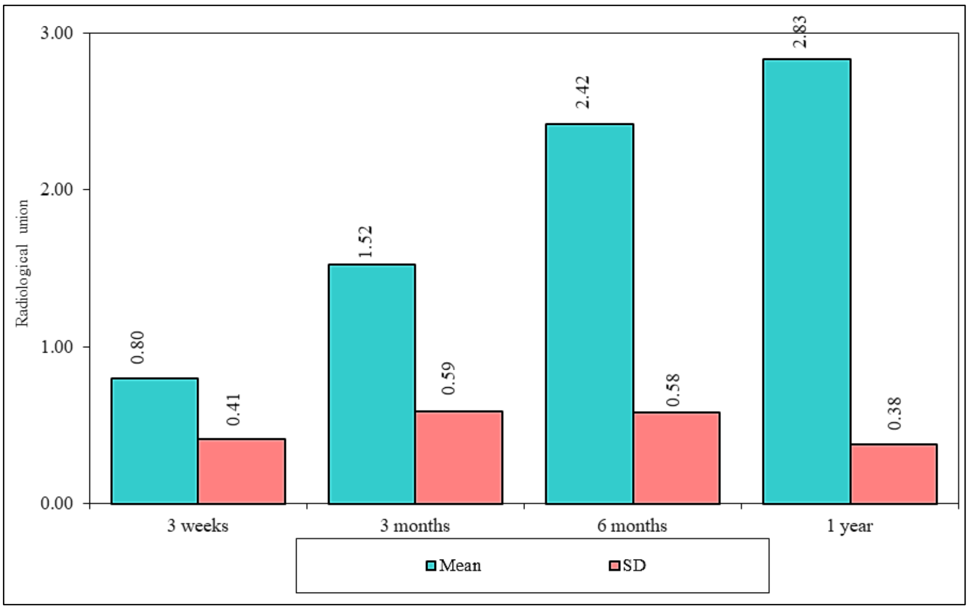

Figure 10: Comparison of different treatment time points with RADIOLOGICAL UNION scores

Table 11: Complications

Complications	No of patients	% of patients
Non-union/mal union	1	4.00
Delayed union	4	16.00
Varus collapse	0	0.00
Hardware failure	2	8.00
Infection	4	16.00

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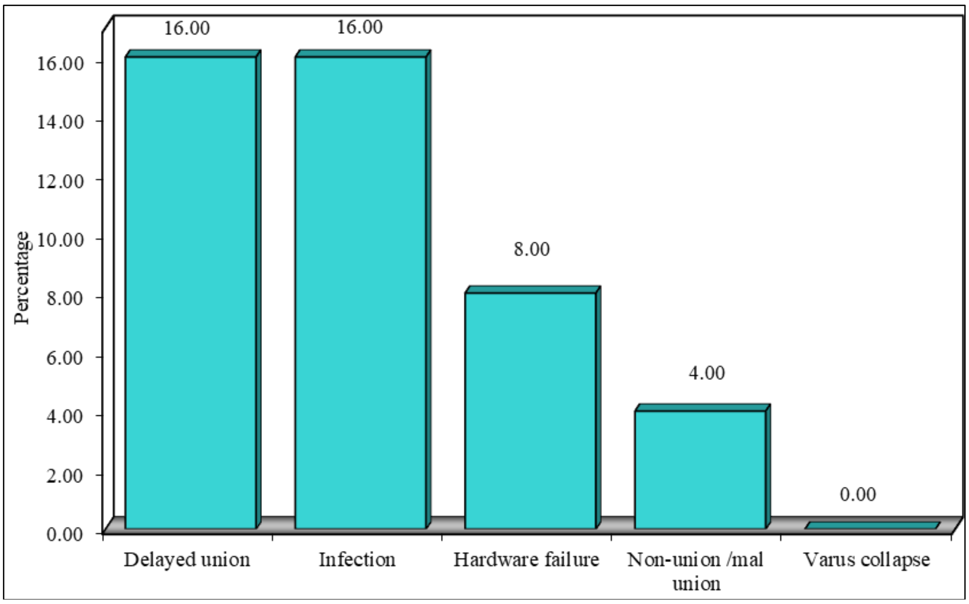

Figure 11: Complications

Table 12: Length of hospital stay (weeks)

Length of hospital stay(weeks)	No of patients	% of patients
1 week	25	100.00
2 weeks	0	0.00
3 weeks	0	0.00
Total	25	100.00

DISCUSSION

Subtrochanteric fractures typically result from high-energy trauma, often leading to significant displacement and making closed reduction through traction extremely challenging. Due to the high incidence of complications such as delayed union, malunion, and non-union, conservative treatment, as previously advocated by De Lee *et al.*, has been largely abandoned in modern trauma care.

Intramedullary nailing has gained prominence as it allows a minimally invasive approach, contributing to “biological internal fixation”. Compared to plate fixation, it offers significant mechanical advantages. This technique minimizes soft tissue dissection, thereby reducing surgical trauma, blood loss, infection risk, and wound-related complications. Recognizing these benefits, the AO ASIF introduced the long Proximal Femoral Nail (PFN) in 1996 to lower the risk of implant-related complications.

The long PFN incorporates an 8 mm load-bearing femoral neck screw and a 6.5 mm anti-rotation screw, enhancing the rotational stability of the neck fragment. Additionally, it helps distribute stress more evenly along the femoral shaft, reducing intraoperative and postoperative fractures. Like other intramedullary devices, the long PFN shortens the lever arm, preserves the fracture hematoma when inserted through a closed technique, and decreases blood loss, soft tissue disruption, and the risk of infection.

CONCLUSION

Subtrochanteric femoral fractures are predominantly managed surgically. Over the past decade, traditional extramedullary fixation methods, such as angular plates or compression hip screws with plates, have been increasingly replaced by advanced intramedullary techniques. These newer methods offer several advantages, including a faster surgical procedure, reduced blood loss, and improved bone healing with strong biomechanical fixation. This allows for earlier weight-bearing and minimizes both local and systemic complications.

With the rising incidence of subtrochanteric fractures in young, active males, surgeons face the challenge of restoring near-normal function. The long proximal femoral nail (PFN) provides superior rotational stability and controlled collapse at the fracture site, making it a biomechanically sound intramedullary implant. Its rigid fixation facilitates early postoperative mobilization.

Based on our study findings, the long PFN proves to be a dependable implant for managing subtrochanteric fractures, ensuring a high rate of bone union with minimal soft tissue disruption. While intramedullary fixation offers significant biological and biomechanical advantages, it remains a technically demanding procedure. Achieving true minimally invasive surgery with this method requires progressive learning and considerable patience.

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