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Original Research Article

Functional and radiological outcome of using proximal femoral nail for intertrochanteric fractures of femur among geriatric population in a tertiary care hospital: An evaluation study

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ABSTRACT

Background: The intertrochanteric (IT) fracture of the femur is an extra-capsular fracture that occurs between the greater and lesser trochanters. The introduction of proximal femoral nailing (PFN) is one of the fixation modalities for proximal femoral fractures that has shown positive results with relatively lesser intraoperative complications and considerably low post-operative complication rates. Hence, this study intends to analyse the functional and radiological outcomes of proximal femur fractures surgically managed with Proximal Femoral Nail.

Materials and Methods: A prospective study was done among 45 patients above 65 years from June 2022 to June 2023. The functional outcome was measured by Harris Hip Score (HHS), the radiological outcome by the time of fracture union, and the pain scores by Visual Analogue Scale (VAS). Patients were followed up at regular intervals for 6 months post-surgery.

Results: There were no post-operative complications observed. The average time of union was 18.5 (±4.1) weeks. The mean HHS and VAS Score at the end of 6 months was 86.978±4.0 and 0.4±0.49. The Comparison of mean VAS at different intervals was statistically significant. There was a significant association between age and VAS scores at 6 weeks, 3 months, and 6 months.

Conclusion: PFN has the advantage of requiring shorter exposure time and a lower likelihood of morbidity and operating time. Thus the treatment of intertrochanteric fracture with PFN has a more favourable outcome and it is one of the implants of choice for intertrochanteric fractures at present.

1. Introduction

A proximal femoral fracture is one of the most common causes of morbidity and mortality in the modern world. One of the proximal femur fractures is the Intertrochanteric (a.k.a peritrochanteric) fractures, extending from the extracapsular basilar neck region to the region along the lesser trochanter of the femur. Most commonly occurs in the elderly due to low-energy traumas such as accidental falls, osteoporosis, and poor bone quality, but high-velocity traumas can also result in similar fractures in young individuals. Various co-morbid medical conditions like diabetes, hypertension, pulmonary disease, renal disease, and cardiac disease can exacerbate the impact of these fractures.[1] The incidence of intertrochanteric fractures varies widely across countries, and it was predicted that by 2025 there will be 2.6 million hip fractures, and 4.5 million by 2050.[2] It is anticipated that 37% of hip fractures in Asia in 2025 and 45% in 2050 will be intertrochanteric fractures, up from 26% in 1990.[3] A ratio of 2:1 to 8:1

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exists between females and males. There is a higher risk of osteoporosis in Indian populations and associated hip fractures.[4] In addition, these patients are older than those who suffer from a femoral neck fracture. Typically, these fractures occur in young people as the result of high-energy forces.[5]

The goal of treating these fractures is to stabilize them early so the patient can regain mobility sooner. The end goal of any fracture treatment is early recovery and a quick return to daily routine functional life.[6] A Proximal Femoral Nail (PFN) was introduced in early 1997 in an effort to reduce implant-related complications. There is an anatomic 6° valgus bend in the coronal plane of the PFN, a narrower distal diameter, and a flexible distal portion. All these fractures eliminated the need for routine reaming of the femoral shaft and minimized tension and stress concentration, reducing the occurrence of peri-implant fractures.[7] All these features provide positive results with relatively fewer intraoperative complications and considerably fewer postoperative complications. As PFN has the potential advantage of clinical superiority and lower complication rates, we believe it should be enhanced and further investigated within our system. Therefore, this prospective study intends to analyse the functional and radiological outcomes of proximal femur fractures surgically managed with Proximal Femoral Nail.

2. Objectives

1. To observe functional outcome assessed by Harris Hip Score and post-operative knee pain by visual analogue scale.
2. To observe radiological outcome assessed by fracture union in the radiograph.
3. To find out complications like anterior knee pain, non-union, and surgical site infection.

3. Materials and Methods

This was a facility-based prospective study conducted in Asian Joint Reconstruction Institute at SIMS hospitals, the protocol of which was approved by the Institutional Ethical Committee of the medical college and is consistent with all the ethical standards. All participants provided written informed consent. Patients above 65 years with intertrochanteric fractures less than 3 weeks old and who were fit for surgery medically were included in the study using consecutive sampling techniques from June 2022 to June 2023. Patients who required revision surgery, patients who had open compound fractures, patients who were unable to walk before surgery, poly-trauma patients, and patients with neuromuscular injuries were excluded. Post-operatively patients were followed up at 6 weeks, 12 weeks, and 24 weeks.

At every Follow up patient was radiologically assessed with X-rays of the operated limb by AP and lateral views and clinical assessment was done based on pain, Range of Motion, when the patient started weight bearing, and return to works. Pain assessment was done by Visual Analogue Scale and Subjective assessment of Functional outcome with Harris hip score. All procedures were performed by a single senior orthopaedic trauma surgeon. All patients in the study received Smith and Nephew Trigen Intertan Nail that was inserted using appropriate instruments by the manufacturer's operative technique.

Data was entered in Microsoft Excel and analyzed in SPSS version 21.0. Descriptive statistics were carried out by frequency and percentage for categorical variables and mean and standard deviation for quantitative variables. To check the association between the variables chi-square test was used. A significance level of P value < 0.005 was considered to be statistically significant.

4. Results

Among 45 patients above 65 years, the majority of patients were female (55.6%) and reaming were males (44.4%).

Table 1: Distribution of study participants according to age and gender

Variable	Frequency (n)	Percentage (%)
Age group		
65-75 years	18	40
76-85 years	16	35.6
> 85 years	11	24.4
Total	45	100.0
Gender		
Male	20	44.4
Female	25	55.6
Total	45	100.0
Side Involvement		
Left	21	46.7
Right	24	53.3
Total	45	100.0
Hospital Stay (in days)		
3-6 days	24	53.3
7-10 days	18	40
> 10days	3	6.7
Total	45	100.0

The mean age of the study participants was 77(±8.5). It was observed that the highest number of females 12 (66.6%) were present in the 65-75 years age group. The most common side involvement was Right side 24 (53.3%) followed by the left side 21 (46.7%). The mean number of days in hospital was 6.9±2.4 days, with only 3(6.7%) more than 10 days, followed by 18 (40%) between 7-10 days and 24 (53.3%) within 3-6 days.

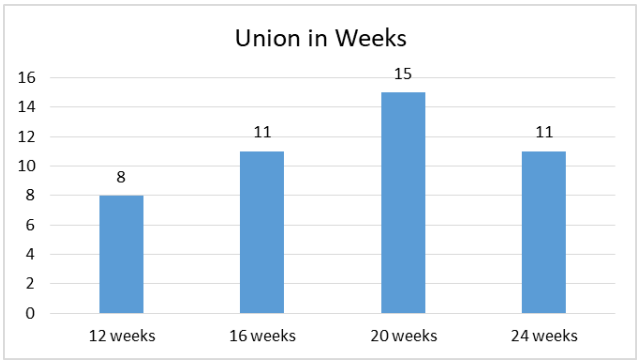

Figure 1: Radiological outcome by time of union in weeks

Figure 1 shows, the Union in weeks of study participants, where the mean timing of union was 18.5 (±4.1) weeks. At 20 weeks, most of the participants 15 (33.3%), had union, followed by 11(24.4%) participants at 16 and 24 weeks.

Table 2 shows the association between age, gender and side involvement with Time of Union in weeks. It is shown that there was a statistically significant association between age and Time of Union, which states that Timing of Union is dependent on age of the participants.

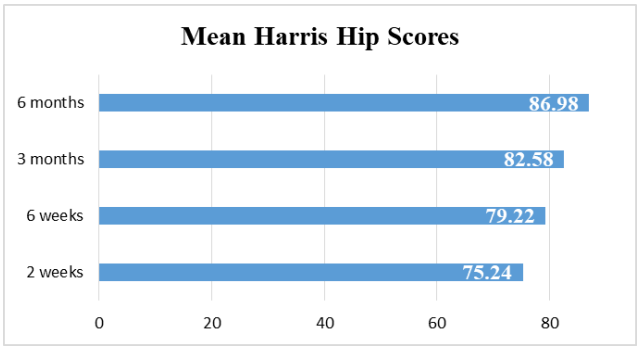

Figure 2: Comparison of Mean Harris Hip scores at different intervals

At 2 weeks the mean Harris Hip score was 75.244±3.6, while at 6 weeks it was 79.222±3.482.578±3.6 at 3 months and 86.978±4.0 at 6 months.

Table 3 shows the comparison of mean Harris hip Scores at different intervals. In the first comparison, the difference was found to be statistically significant (< 0.005), showing a higher Harris Hip Score at 6 weeks (79.222±3.4) in comparison to the 2 weeks (75.244±3.6). In the second comparison, the difference was found to be statistically significant (< 0.005), showing a higher Harris Hip Score at 6 months in comparison to the 3 months.

Table 4 shows the association of age and Harris Hip score at different intervals. There was no statistically significant association between age and Harris Hip score showing that Harris Hip score is not dependent on age of the patients at different intervals.

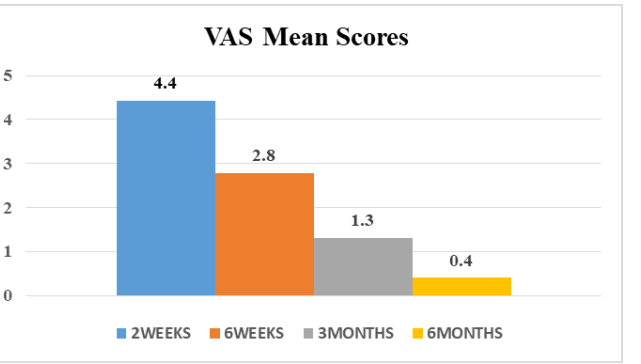

Figure 3: Comparison of VAS Mean Scores at different intervals

At 2 weeks the mean VAS Score was 4.4±1, while at 6 weeks it was 2.8±0.4, 1.31±0.8 at 3 months, and 0.4±0.49 at 6 months.

Table 5 shows the comparison of mean VAS Scores at different intervals. In the first comparison, the difference was found to be statistically significant (< 0.005), showing a higher Visual Analogue Scores at 2 weeks (1.2±0.4) in comparison to the 6 weeks (1.82±0.3). In the second comparison, the difference was found to be statistically significant (< 0.005), showing a higher VAS Score at 3 months in comparison to the 6 months.

Table 6 shows the association of age and VAS score at different intervals. At 6 weeks (p value=0.010), 3 months (p value = 0.025), and at 6 months (p value=0.001) there was a significant association showing that the VAS score is dependent on the age of the patients.

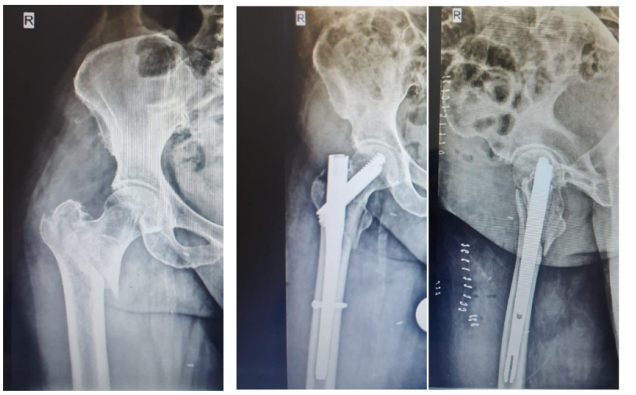

Figure 4: Pre-op, post- op and follow-up x-ray

5. Discussion

Most of the patients in the present study were in the age group of 65 to above 80 years. The mean age of the study participants was 77(±8.5). In this study number of male patients and female patients were 20 and 25. In a study by

Table 2: Association between demographic profile and time of union in weeks

Age Group	Time of Union in Weeks				
	12 weeks	16 weeks	20 weeks	24 weeks	Total
65-75 years	7 (38.8%)	4 (22.2%)	6 (33.3%)	1 (5.5%)	18 (100%)
76-85 years	1 (6.25%)	4 (25%)	5 (31.25%)	6 (37.5%)	16 (100%)
> 85 years	0 (0.0%)	3 (27.27%)	4 (36.36%)	4 (36.36%)	11 (100%)
Total	8 (17.7%)	11 (24.4%)	15 (33.3%)	11 (24.4%)	45 (100%)
Pearson Chi-square value=12.172, df = 6, p value=0.05, Significant					
Gender					
Female	6 (24%)	5 (20%)	8 (32%)	6 (24%)	25 (100%)
Male	2 (10%)	6 (30%)	7 (35%)	5 (25%)	20 (100%)
Total	8 (17.7%)	11 (24.4%)	15 (33.3%)	11 (24.4%)	45 (100%)
Pearson Chi-square value = 1.714, df= 3, p value = 0.634, Not Significant					
Side involvement					
Left	4 (19%)	6 (28.5%)	5 (23.8%)	6 (28.5%)	21 (100%)
Right	4 (16.6%)	5 (20.8%)	10 (41.6%)	5 (20.8%)	24 (100%)
Total	8 (17.7%)	11 (24.4%)	15 (33.3%)	11 (24.4%)	45 (100%)
Pearson Chi-square value= 1.656, df = 3, p value = 0.647, Not Significant					

Table 3: Functional outcome by comparison of mean Harris hip score at different intervals using paired t-test

Time Interval	No.	Harris Hip Score (Mean±SD)	't value'	P value
2 weeks	45	75.244±3.6	17.275 df=44	< 0.005
6 weeks	45	79.222±3.4		
3 months	45	82.578±3.6	14.981 df=44	< 0.005
6 months	45	86.978±4.0		

P value < 0 05 was taken as statistically significant

Table 4: Association between age and Harris hip score at different intervals

Age Group	Harris Hip Score at 2 weeks				
	Poor	Fair	Good	Excellent	Total
65-75 years	0 (0.0%)	15 (83.3%)	3 (16.6%)	0 (0.0%)	18 (100%)
76-85 years	0 (0.0%)	14 (87.5%)	2 (12.5%)	0 (0.0%)	16 (100%)
> 85 years	0 (0.0%)	11 (100%)	0 (0.0%)	0 (0.0%)	11 (100%)
Total	0 (0.0%)	40 (88.8%)	5 (11.1%)	0 (0.0%)	45 (100%)
Pearson Chi-square value=1.967, df= 2, p value=0.374, Not Significant					
Harris Hip Score at 6 weeks					
65-75 years	0 (0.0%)	6 (33.3%)	12 (66.6%)	0 (0.0%)	18 (100%)
76-85 years	0 (0.0%)	11 (68.75%)	5 (31.25%)	0 (0.0%)	16 (100%)
> 85 years	0 (0.0%)	10 (90.9%)	1 (9.0%)	0 (0.0%)	11 (100%)
Total	0 (0.0%)	27 (60%)	18 (40%)	0 (0.0%)	45 (100%)
Pearson Chi-square value=10.22, df= 2, p value=0.006, Not Significant					
Harris Hip Score at 3 months					
65-75 years	0 (0.0%)	1 (5.5%)	16 (88.8%)	1 (5.5%)	18 (100%)
76-85 years	0 (0.0%)	7 (43.75%)	9 (56.25%)	0 (0.0%)	16 (100%)
> 85 years	0 (0.0%)	5 (45.45%)	6 (54.5%)	0 (0.0%)	11 (100%)
Total	0 (0.0%)	13 (28.8%)	31 (68.8%)	1 (2.2%)	45 (100%)
Pearson Chi-square value=8.905, df= 4, p value=0.064, Not Significant					
Harris Hip Score at 6 months					
65-75 years	0 (0.0%)	0 (0.0%)	8 (44.4%)	10 (55.5%)	18 (100%)
76-85 years	0 (0.0%)	1 (6.25%)	12 (75%)	3 (18.75%)	16 (100%)
> 85 years	0 (0.0%)	0 (45.45%)	9 (81.8%)	2 (18.1%)	11 (100%)
Total	0 (0.0%)	1 (2.2%)	29 (64.4%)	15 (33.3%)	45 (100%)

Pearson Chi-square value = 8.167, df = 4, p value = 0.086, Not Significant

Table 5: Comparison of mean VAS score at different intervals using paired t-test

Time Interval	No.	Harris Hip Score (Mean±SD)	't value'	P value
2 weeks	45	1.82±0.3	8.513 df=44	< 0.005
6 weeks	45	1.2±0.4		
3 months	45	0.84±0.36	5.933 df=44	< 0.005
6 months	45	0.4±0.49		

P value < 0 05 was taken as statistically significant

Table 6: Association between age and VAS score at different intervals

Age Group	No pain	Mild Pain	VAS at 2 weeks Moderate Pain	Severe Pain	Total
65-75 years	0 (0.0%)	5 (27.7%)	13 (72.2%)	0 (0.0%)	18 (100%)
76-85 years	0 (0.0%)	1 (6.25%)	15 (93.75%)	0 (0.0%)	16 (100%)
> 85 years	0 (0.0%)	2 (18.1%)	9 (81.8%)	0 (0.0%)	11 (100%)
Total	0 (0.0%)	8 (17.7%)	37 (82.2%)	0 (0.0%)	45 (100%)
Pearson Chi-square value=2.687, df= 2, p value=0.261, Not Significant					
VAS Score at 6 weeks					
65-75 years	0 (0.0%)	18 (100%)	0 (0.0%)	0 (0.0%)	18 (100%)
76-85 years	0 (0.0%)	12 (75%)	4 (25%)	0 (0.0%)	16 (100%)
> 85 years	0 (0.0%)	6 (54.54%)	5 (45.45%)	0 (0.0%)	11 (100%)
Total	0 (0.0%)	36 (80%)	9 (20%)	0 (0.0%)	45 (100%)
Pearson Chi-square value=9.205, df= 2, p value=0.010, Significant					
VAS at 3 months					
65-75 years	6 (33.3%)	12 (66.6%)	0 (0.0%)	0 (0.0%)	18 (100%)
76-85 years	1 (6.25%)	15 (93.75%)	0 (0.0%)	0 (0.0%)	16 (100%)
> 85 years	0 (0.0%)	11 (100%)	0 (0.0%)	0 (0.0%)	11 (100%)
Total	7 (15.5%)	38 (84.4%)	0 (0.0%)	0 (0.0%)	45 (100%)
Pearson Chi-square value=7.412, df= 2, p value=0.025, Significant					
VAS Score at 6 months					
65-75 years	16 (0.0%)	2 (0.0%)	0 (0.0%)	0 (0.0%)	18 (100%)
76-85 years	9 (0.0%)	7 (6.25%)	0 (0.0%)	0 (0.0%)	16 (100%)
> 85 years	2 (0.0%)	9 (45.45%)	0 (0.0%)	0 (0.0%)	11 (100%)
Total	27 (0.0%)	18 (2.2%)	0 (0.0%)	0 (0.0%)	45 (100%)
Pearson Chi-square value = 14.368, df = 2, p value = 0.001, Significant					

Mehta et al,[8] 37 males and 23 females. Aktselis et al[9] study had 15 males and 56 females, and Cleveland et al[10] in their observations found that:

1. Females have slightly wider pelvis with a tendency to have coxa vara.
2. They are usually less active and are more prone to senile osteoporosis

Our present study shows that out of 50 cases 24 were right sided and 21 were left sided, while in a study by Kumar S et al,[11] 23 had the right limb involved and 27 had left limb involved. All of our patients had domestic falls (slip and fall at home), but in a study by Purohit et al,[12] 34 cases were of slip and fall at home and 16 cases got fracture by Road traffic accidents. As stated by Cummings and Nevitt[13] in 1994, this is due to inadequate protective reflexes that reduce energy below critical thresholds; insufficient local shock absorbers, such as hip muscle and fat; and inadequate bone strength at the hip as a result of osteoporosis or osteomalacia.

The average number of days in the hospital was 6.9±2.4 days, which when compared to a study by Anup Mostafa et al[14] showed a higher days number of days 11.7± 4.7 days. Kumar et al[15] study showed an average number of days in the hospital as 13.16 which was also higher when compared to our present study.

In this study, no postoperative complications were observed. When compared with other studies, Complications were Z- effect in 2, inadequate reduction in 1, varus deformity in 3, and failure to insert a distal screw in 1 case was reported by Kailash et al,[16] also a study by B. Kish et al[17] results revealed complications that included malfixation (internal-rotation, varus, valgus, shorting, bad position of the screw in the neck) –10%, deep infection 0.7%, non-union 1%, cut out 2%, nail breakage 0.6%, broken drills, and bad position of locking screws. Also, Bhakat et al[18] study showed 2 cases of varus angulation and 2 cases of infection.

In the present study, the mean Harris Hip Score at 2 weeks was 75.244±3.6, while at 6 weeks it was 79.222±3.4,

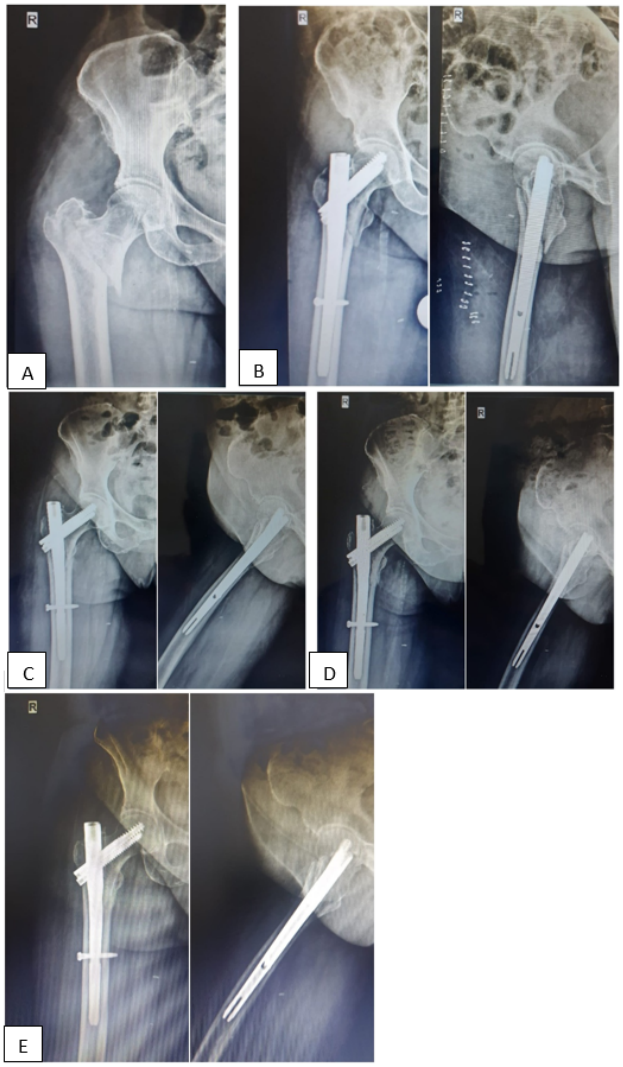

Figure 5: Pre-op, post- op and follow-up x-ray; **(A):** Right hip with thigh AP view; **(B):** PFN-Right hip with thigh AP lateral view (post-op); **(C) (D) (E):** PFN-Right hip with thigh AP lateral view at 6, 12 and 20 weeks.

82.578±3.6 at 3 months, and 86.978±4.0 at 6 months. The results are comparable with the Purohit et al,[12] where the average Harris Hip Score after 6 weeks was 34.23 ± 1.52 after 12 weeks was 57.75 ± 1.92 and after 24 weeks was 87.37 ± 2.14. Bhakat et al[18] study showed result with Harris Hip Score after 1 year with a mean of 92.5, SD(3.5). Kumar et al[15] study showed a similar result of Harris Hip Score after 1 year with a mean of 93, SD(2.7).

At 2 weeks the mean Harris Hip Score was 75.244±3.6, and at 6 weeks the mean score was 79.222±3.4. The difference was found to be statistically significant (< 0.005), showing a higher Harris Hip Score at 6 weeks when compared to 2 weeks. At 3 months the mean Harris Hip Score was 82.578±3.6, and at 6 months the mean score was 86.978±4.0. The difference was found to be statistically significant (< 0.005), showing a higher Harris Hip Score at 3 months when compared to 6 months. Thus, there was a significant improvement in Harris Hip Score from 2 weeks to 6 months, giving a good functional outcome. When comparing these mean scores of Harris Hip scores with the study by Purohit et al,[12] there was a significant improvement in Harris Hip Score from 6 weeks to 24 weeks, with a good functional outcome.

There was no association found between age and the Harris Hip Score at 2 weeks, 6 weeks, 3 months, and 6 months, which is similar to the results in a study done by Purohit et al.[12]

Additionally, the mean scores of the Visual Analogue scale were done at 2 weeks (4.4±1), 6 weeks (2.8±0.4), 3 months (1.31±0.8), and at 6 months (0.4±0.49). At 2 weeks the mean VAS score was 1.82±0.3, and at 6 weeks the mean score was 1.2±0.4. The difference was found to be statistically significant (< 0.005), between VAS Scores at 2 weeks with 6 weeks and 3 months with 6 months. There was a statistically significant association between age and VAS score at 6 weeks (p value = 0.010), 3 months (p value=0.025), and at 6 months (p value = 0.001) showing that VAS score is dependent on the age of the patients.

6. Conclusion

This study concludes that PFN is an important advancement in treating intertrochanteric fractures, owing to its unique advantages such as closed reduction, preservation of fracture hematoma, less tissue damage, early rehabilitation and early return to work, and good functional outcomes. In intertrochanteric fractures, PFN resulted in excellent stabilization, few complications mechanically, and good functionality. PFN has the advantage of requiring shorter exposure time and a lower likelihood of morbidity and operating time. Thus, the treatment of intertrochanteric fracture with PFN has a more favourable outcome and it is one of the implants of choice for intertrochanteric fractures at present.

7. Source of Funding

There was no source of funding in our study.

8. Conflict of Interest

None

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