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Research Article

PFN *versus* PFNA: functional and radiological outcome in intertrochanteric fractures of the femur

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Statistics

Figures	18
Tables	14
References	17

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Abstract

Introduction: Intertrochanteric fractures pose a major problem in elderly osteoporotic age group of patients and its incidence has been on the rise. There are several treatment options available for the fixation of such type of fractures. Newer implant designs such as PFN and PFN-A have shown promising results in the treatment of intertrochanteric fractures. Despite the availability of various implants for the treatment of these fractures, there is no common consensus as to which implant would be ideal in the scenario of intertrochanteric fractures. Therefore, there is a need for further clinical trials to establish the biomechanical and functional outcome superiority of implants such as PFN and PFN-A.

Aims and Objectives: The primary objective of this study is to compare the functional outcome using Harris Hip Score (HHS) and evaluation of complications with the use of PFN and PFN-A in the treatment of intertrochanteric fractures. The secondary objectives are the assessment of the comparative performance of PFN and PFN-A in the setting of osteoporosis and to compare the radiological outcome of the implants based on TAD, Cleveland's index, neck-shaft angle and type of reduction. The operative time for the two procedures is also compared.

Methodology: Intertrochanteric fracture patients, after meeting the inclusion criteria, were assigned into 2 groups based on the type of implant used, being PFN and PFN-A. A total of 152 patients were included in this study, 94 in PFN group and 58 in PFN-A group. Postoperatively radiological outcome was assessed and compared using parameters such as TAD, Cleveland index, neck shaft angle and type of reduction. Operative time for the procedure, pre and post-operative hemoglobin levels were recorded and compared. Fracture union rates were compared at follow up period of 6 weeks and 6 months. Functional outcome was compared between the two groups at follow up period of 6 months using parameters such as Harris hip Score and pre and post-operative Parker Palmer mobility Score. Complication rates were compared between the two groups even in osteoporotic patients. Also, the patients were graded based on Singh's index for osteoporosis and the radiological and functional outcome parameters were compared in this group based on the type of implant used.

Results: The radiological parameters were similar in both the groups. There was a shorter operative time and better postoperative hemoglobin levels in the PFN-A group. The complication rate in PFN group was 7.4% when compared to PFN-A group which was just 1.7%. The functional outcome based on HHS and PPS was found to be similar in both the groups. In osteoporotic patients which were graded based on Singh's index, similar results were observed with a higher complication rate seen in PFN group.

Conclusion: Intramedullary nailing with the PFN A has distinct advantages over conventional PFN like shorter operating time and lesser blood loss. The complication rates are significantly less in intertrochanteric fracture patients operated with PFN-A when compared to PFN even in the osteoporotic age group. The importance of adequate radiological parameters especially postoperative neck shaft angle, type of reduction, Tip Apex Distance (TAD) and Cleveland index for the success of the implant has been clearly demonstrated in this study. Thereby, concluding that PFN-A is a better option for the treatment of all types of intertrochanteric fractures in skeletally mature age group of patients.r.

Keywords: PFN, PFNA, intertrochanteric fractures, HHS, PPS, Cleveland index, TAD, neck shaft angle, complications, osteoporotic

INTRODUCTION

Intertrochanteric fractures of the femur commonly occur in elderly osteoporotic individuals. Recumbency post-hip fractures have been related to increased mortality among elderly patients. Surgical treatment is essential in such types of fractures for obtaining a reduction which is acceptable as well as for the early rehabilitation of the patients [1].

The need for a successful fixation is extremely important in intertrochanteric fracture patients as implant failure can have severe complications and surgeries to correct these complications can be a risky procedure depending on the already morbid condition of the patient. Therefore, evidence providing the detail of an ideal implant would ensure an appropriate fixation of intertrochanteric fractures. The need for an ideal implant for such type of fractures has been a topic for ongoing research since several years now.

The dynamic hip screw, which was considered to be the hallmark treatment of stable intertrochanteric fractures earlier, was found to be inadequate for the treatment of unstable type of intertrochanteric fractures [2]. For the purpose of fixation of unstable fractures, use of an intramedullary nail along with a dynamic femoral head/neck stabilization implant is now considered as the ideal method [3].

With constant evolution of treatment methods for intertrochanteric fractures, numerous nail designs which incorporate a single compression screw or a compression screw coupled with antirotation screw such as PFN are now popular for the treatment of intertrochanteric fractures. Although PFN proved to have an upper hand when compared with extramedullary devices for unstable IT fractures, screw cut-out, z effect and reverse z effect, varus collapse and rotational instability continued to pose as significant postoperative complications, accounting for 31% [4].

The PFN-A design was made to achieve better stabilization of the femoral head and neck by making use of a single helical blade rather than a screw system for the purpose of fixation of such fractures. This helical blade increased the bone-implant interface and resulted in compaction of cancellous bone, henceforth giving a provision of excellent stability in terms of fixation [5]. The helical blade's insertion without reaming out the bone from the head/neck fragment provides additional anchorage, especially in osteoporotic patients. Studies have further proven that helical blade, by causing the compaction of cancellous bone in its surrounding, provides better resistance to rotation as well as varus collapse [6].

There is a need for further clinical trials to confirm whether this superior biomechanical performance by PFN-A is also beneficial in terms of functional outcomes as well as complication rates. However, limited studies on surgical procedures with the helical blade showed that this implant can also be related with cut-through into the hip joint, cut-out and back-out similar to the previous implants.

Therefore, this study is being performed to compare the functional outcome and complication rates with the use of PFN and PFN-A in the treatment of intertrochanteric fractures and further makes an assessment of their comparative performance in osteoporotic intertrochanteric fractures.

MATERIAL AND METHODS

This was a prospective study conducted in the department of orthopaedics of JSS Hospital, Mysuru. A total of 152 intertrochanteric fracture patients from January 2018 till February 2020 were included in the study. The inclusion criteria were all cases of intertrochanteric fractures based on AO classification and patients with skeletal maturity of both the sexes who had undergone treatment with either PFN or PFN-A. The exclusion criteria were non-ambulatory patients before injury and patients with osteoarthritis of hip before injury. All the included patients were subjected to:

- The A.O. (alphanumeric) classification to classify the fractures based on preoperative ap and lateral radiographs of the affected side [7].
- Singh's index [8] was used to grade the radiographs for the degree of osteoporosis.
- Preoperative and postoperative hemoglobin was recorded.
- The operative time was recorded as per the anesthesia record sheet.
- The quality of reduction was assessed by comparing the neck-shaft angle of the operated hip, to that of the normal hip on the anteroposterior view of immediate postoperative x-rays. A variation of less than 5 degrees from the normal side was considered as 'good' reduction. Between 5 and 10 degrees of variation was considered 'acceptable' and more than 10 degrees variation was considered 'poor' [9].
- The quality of fixation was assessed using the Tip-Apex Distance (TAD) described by Baumgaertner and the Cleveland index [10]. The tip apex distance was measured using the Picture Archiving and Communication System (PACS) tool on the immediate postoperative radiographs.
- The Cleveland index [10] was used to assess the position of the compression screw in PFN and helical blade in PFNA. A centre-centre or centre-inferior placement of the compression screw or helical blade was considered optimal.
- Functional outcomes were assessed using the Parker and Palmer mobility score [11]. The pre-injury mobility score was noted and compared with the score at final follow up at the end of 6 months as a measure of return of mobility.
- The Harris Hip score [12] as calculated at follow up period of 6 months to assess hip function post-surgery was recorded. Any complications encountered during the follow-up period namely deep infection, acetabular penetration, blade/screw migration, nail breakage, non-union, rotation failure or screw/blade loosening was documented for both groups of patients. Complications occurring in patients with Singh's grade 3 in both groups were also compared.

Descriptive statistics was done with mean, SD and proportions. Inferential statistics were done using independent T-test/mann Whitney test and Fischer exact/chi square test. All measurements were done using SPSS 21.0.

RESULTS

A total of 152 patients with stable as well as unstable type of intertrochanteric fracture were included in the study. 94 patients underwent treatment with PFN whereas 58 patients with PFN-A. The majority of the patients (52%) were in the age group 61-80 years with 19% patients above 80 years and 29% below 61 years (Table 1). The Male and Female ratio was 1:0.8. Based on the preoperative radiographs, 79% patients belonged to the unstable group (AO 31-A2.2 to A3.3) whereas 21% patients belonged to the stable group (AO 31-A1.1 to A2.1). In the PFN group, 82.9% patients were in unstable group whereas in the PFN-A group, 77.5% patients were in the unstable group (Table 2).

AGE, SEX AND AO CLASSIFICATION

The neck-shaft angle (Table 3) was assessed in the immediate postoperative pelvis with bilateral hip radiographs (AP view). The values of both the groups were compared using the independent T-test and the difference was found to be insignificant (p=0.99).The type of reduction (Table 4) was compared among both the groups. Positive reduction was seen in 59.6% patients in the PFN group and 65.5% patients in the PFN-A group. Neutral reduction was seen in 23.4% patients in the

Table 1. Distribution of patients based on age, sex and AO classification

		Count	Column N %
Age group	<40	12	0.079
	41-60	32	0.211
	61-80	79	0.52
	>80	29	0.191
Sex	Female	68	0.447
	Male	84	0.553
AO	31-A1.1	1	0.007
	31-A1.2	3	0.02
	31-A1.3	11	0.072
	31-A2.1	14	0.092
	31-A2.2	29	0.191
	31-A2.3	36	0.237
	31-A3.1	27	0.178
	31-A3.2	24	0.158
	31-A3.3	7	0.046
	Total	152	1

Table 2. Type of implant used in different classification groups

		Type of implant used			
		PFN		PFN-A	
		Count	Column N %	Count	Column N %
AO	31-A1.1	0	0	1	0.017
	31-A1.2	3	0.032	0	0
	31-A1.3	5	0.053	6	0.103
	31-A2.1	8	0.085	6	0.103
	31-A2.2	16	0.17	13	0.224
	31-A2.3	23	0.245	13	0.224
	31-A3.1	18	0.191	9	0.155
	31-A3.2	14	0.149	10	0.172
	31-A3.3	7	0.074	0	0
	Total	94	1	58	1
p=0.25					

Table 3. Assessment of neck-shaft angle among both the groups

	Group			
	PFN		PFN-A	
	Mean	Standard Deviation	Mean	Standard Deviation
Neck shaft angle (Degrees)	130.61	3.04	130.61	2.87
p=0.99, independent t test				

Table 4: Comparison of type of reduction among both the groups

		Group			
		PFN		PFN-A	
		Count	Column N %	Count	Column N %
Reduction	**Negative**	16	0.17	6	0.103
	Neutral	22	0.234	14	0.241
	Positive	56	0.596	38	0.655
	Total	94	1	58	1
p=0.52, Chi square test					

PFN group and 24.1% patients in the PFN-A group. Negative reduction was observed in 17% patients in PFN group and 10.3% patients in the PFN-A group. On comparison using the chi square test, the result was found to be insignificant (p=0.52). Harris hip score (Table 5 and 6) was compared among both the groups at a follow-up period of 9 months. For PFN group, the mean score was 79.38 and for PFN-A group the mean score was 79.62. The values were compared using the independent t-test and it was found to be insignificant (p=0.78).

Postoperative parker palmer mobility score was compared between the two groups. The mean values in PFN group was 7.41 whereas in PFN-A group it was 7.09. The comparison was done using the independent t test and was found to be insignificant.

Operative time (Table 7) was compared among the two groups. The mean operative time for PFN group was 47.98 and for the PFN-A group was 36.12. The difference was found to be significant (p<0.0001).

The two groups were compared based on the Cleveland index (Table 8). C-C placement was seen among 48.9% in PFN group and 39.7% in PFN-A group. C-I placement was seen among 46.8% in PFN group and 39.7% in the PFN-A group. The difference among the two groups was found to be insignificant.

The percentage of reduction of hemoglobin (Table 9, Figure 1) postoperatively was compared between the two groups using the Mann Whitney test and the result was found to be significant.

Table 5. Comparison of Harris Hip Score (Functional Outcome)

	Group			
	PFN		PFN-A	
	Mean	Standard Deviation	Mean	Standard Deviation
Harris Hip Score	79.38	4.88	79.62	4.94
p=0.78, independent t test				

Table 6. Comparison of Parker Palmer mobility score (Functional Outcome)

	Group			
	PFN		PFN-A	
	Mean	Standard Deviation	Mean	Standard Deviation
Post op Parker Palmer mobility score (PPS)	7.41	0.88	7.09	1.11
p=0.046, independent t test				

Table 7. Comparison of operative time

	Group			
	PFN		PFN-A	
	Mean	Standard Deviation	Mean	Standard Deviation
Operative time min	47.98	10.2	36.12	9.82
p<0.0001				

Table 8. Comparison of Cleveland index (Radiological outcome)

		Group			
		PFN		PFN-A	
		Count	Column N %	Count	Column N %
Cleveland	C-C	46	0.489	23	0.397
	C-I	44	0.468	31	0.534
	C-S	4	0.043	4	0.069
	Total	94	1	58	1
p=0.5					

Complications (Table 10) were compared among both the groups. The PFN group had total 7 cases; 5 cases of z effect, 1 case each of reverse z effect and screw back out. The PFN-A group had 2 complications; 1 case of implant breakage and 1 case of wound infection. PFN group had a complication rate of 7.4% whereas the PFN-A group had 3.4%. On comparing the results of the two groups, the p-value was found to be significant.

The total number of osteoporotic patients (Singh's index 1-3) in the PFN group were 45 and in the PFN-A group were 32 (Table 11). Both the groups among osteoporotic patients were compared on the basis of neck-shaft angle, TAD, type of reduction, HHS, PPS and the number of complications.

The neck-shaft angle, TAD, HHS, PPS (Table 12) and the type of reduction (Table 13) among the two groups in osteoporotic patients was compared and the difference was found to be not significant.

The PFN group in the osteoporotic patients had 5 complications whereas in the PFN-A group no complications were seen (Table 14). The difference between the two groups was found to be significant.

Table 9. Comparison of percentage reduction in haemoglobin

	Group						
	PFN			PFN-A			
	Median	Q1	Q3	Median	Q1	Q3	p
Reduction of Hb	0.4	0.3	0.5	0.2	0.1	0.4	<0.0001
% Reduction of Hb	3.43	2.7	4	1.84	0.92	3.23	<0.0001

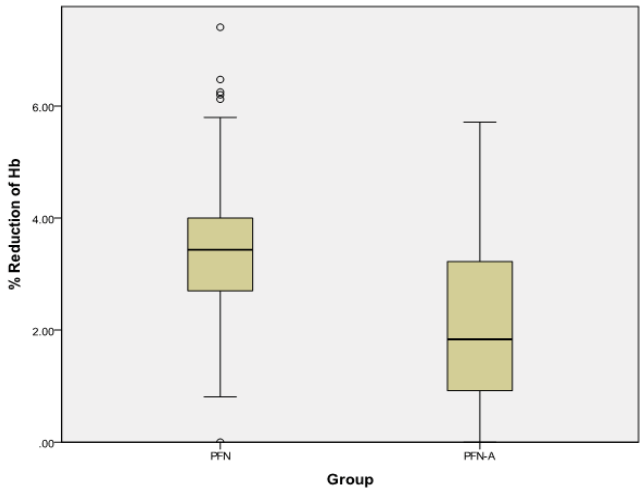

Fig. 1. Percentage reduction in Hb among two groups

Table 10. Comparison of various complications

		Group			
		PFN		PFN-A	
		Count	Column N %	Count	Column N %
Complications	None	87	0.926	56	0.966
	implant breakage	0	0	1	0.017
	Reverse z effect	1	0.011	0	0
	screw backout	1	0.011	0	0
	wound infection	0	0	1	0.017
	z effect	5	0.053	0	0
	Total	94	1	58	1
p=0.2					

Table 11. Comparison of Singh's index among osteoporotic patients

		Group			
		PFN		PFN-A	
		Count	Column N %	Count	Column N %
Singh's index	Singh's index (1-3)	45	0.479	32	0.552
	Singh's index (4-6)	49	0.521	26	0.448
	Total	94	1	58	1
p=0.38					

Table 12. Comparison of neck-shaft angle, HHS, PPS in osteoporotic patients among the two groups

	Group				
	PFN		PFN-A		
	Mean	SD	Mean	SD	p
Neck shaft angle (Degrees)	130.74	3.64	130.82	2.22	0.9
Harris Hip Score	79.11	5.08	79.25	4.77	0.9
Post op Parker Palmer mobility score (PPS)	7.18	0.72	6.47	0.92	0.001

Table 13. Comparison of the type of reduction in osteoporotic patients among the two groups

		Group			
		PFN		PFN-A	
		Count	Column N %	Count	Column N %
Reduction	Negative	11	0.244	3	0.094
	Neutral	10	0.222	6	0.188
	Positive	24	0.533	23	0.719
p=0.2					

Table 14. Comparison of complications in osteoporotic patients

		Group			
		PFN		PFN-A	
		Count	Column N %	Count	Column N %
Complications	None	40	0.889	32	1
	implant breakage	0	0	0	0
	Reverse z effect	1	0.022	0	0
	screw backout	1	0.022	0	0
	wound infection	0	0	0	0
	z effect	3	0.067	0	0
	Total	45	1	32	1

CLINICAL CASES

CASE 1

A 67-year-old male patient sustained an injury over the right hip following a fall from stairs. Pelvis with bilateral hip-AP x-ray (Figure 2) and right hip AP and lateral views (Figure 3) confirmed intertrochanteric fracture (AO31-A2.2).

The patient underwent Closed Reduction And Internal Fixation (CRIF) with PFN. Immediate post-operative x-rays showed adequate reduction by the measurement of neck-shaft angle, tip apex distance (Figure 4)

Fig. 2. Preop Pelvis with bilateral hip-AP x-ray

Fig. 3. Preop Right hip AP and Lateral views

and the Cleveland index. Also, the type of reduction was noted to be positive.

6 weeks follow up x-rays showed adequate radiological outcome in terms of maintenance of the neck shaft angle, TAD and radiological signs of healed fracture (Figure 5). Final follow up was done for the patient at 6 months where the hip range of motion (ROM) (Figure 6), HHS and post-op PPS were assessed which were found to be in the satisfactory range.

CASE 2

A 47-year-old female patient sustained an injury to the left hip following a Road Traffic Accident (RTA). Pre-operative radiographs of the pelvis with bilateral hip- AP view (Figure 7) showed unstable intertrochanteric fracture (AO 31-3.3). The patient underwent CRIF with long PFN-A.

Immediate postoperative radiographs were assessed for the type of reduction, cleveland index, TAD and neck shaft angle (Figure 8). Radiographs taken at 6 weeks follow up (Figure 9) showed signs of union at the fracture site with adequate radiological parameters which were further maintained in the radiographs taken at the final follow up (Figure 10).

Functional outcome was assessed at the final follow up of 6 months in terms of hip ROM (Figure 11), HHS and post-op PPS which were found to be in the satisfactory range.

COMPLICATIONS

CASE 1 (PFN)

A 70-year-old male patient who had undergone CRIF with PFN came to the OPD after 2 months post-surgery with the chief complaints of pain in the right hip and difficulty in walking. Pelvis with bilateral hip- AP view radiograph showed complication in the form of z-effect (Figure 12). The patient was then managed with hemiarthroplasty with bipolar (Figure 13).

The patient had sustained AO 31-2.3 type of right sided intertrochanteric fracture (Figure 14) for which CRIF with PFN was done. Important

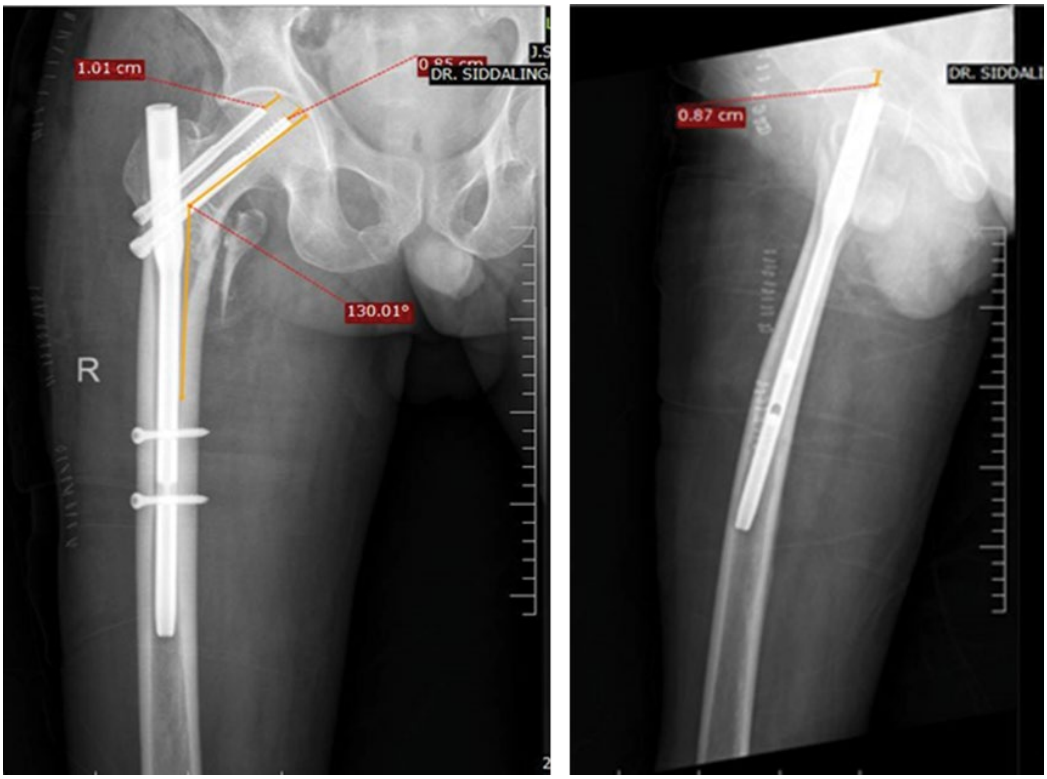

Fig. 4. Immediate postop-Right hip AP and lateral views

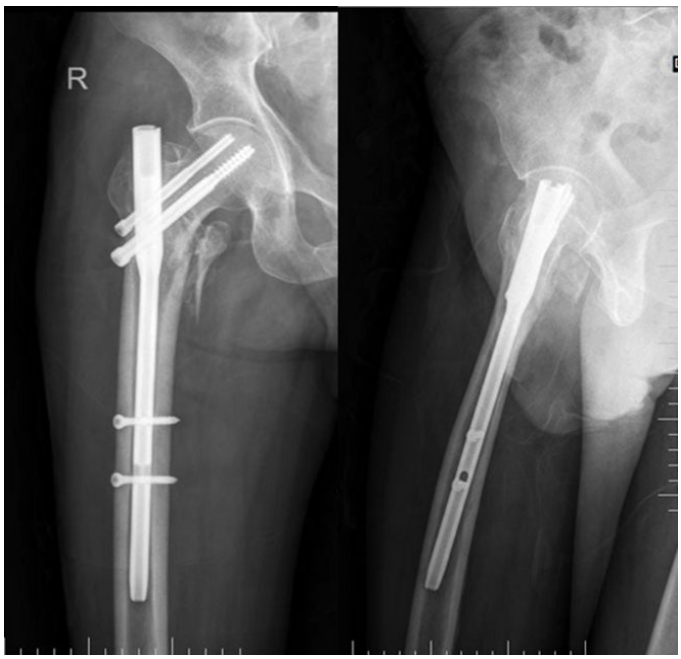

Fig. 5. 6 weeks follow up- Right hip AP and Lateral views

Fig. 6. Hip ROM at final follow up (6 months)

Fig. 7. Preop Pelvis with bilateral hip X-ray

Fig. 8. Postop left hip AP and Lateral views

Fig. 9. 6 weeks follow up- left hip AP and lateral views

Fig. 10. 6 months follow up radiograph

Fig. 11. Hip ROM at final follow up (6 months)

radiological parameters which must be noted in the post-op radiograph are the type of reduction (negative), neck shaft angle (120 degree) and TAD (34.3 mm) (Figure 15) which may have played a role in implant failure.

CASE 2

A 67 year old male patient came 5 months after surgery to the OPD

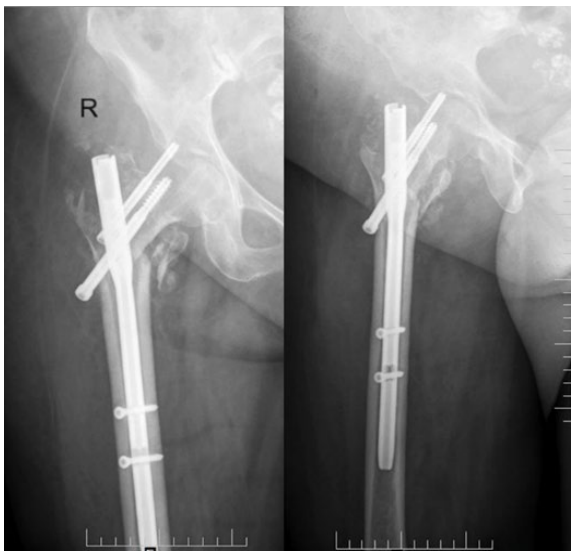

Fig. 12. Z effect- 2 months follow up right hip radiographs

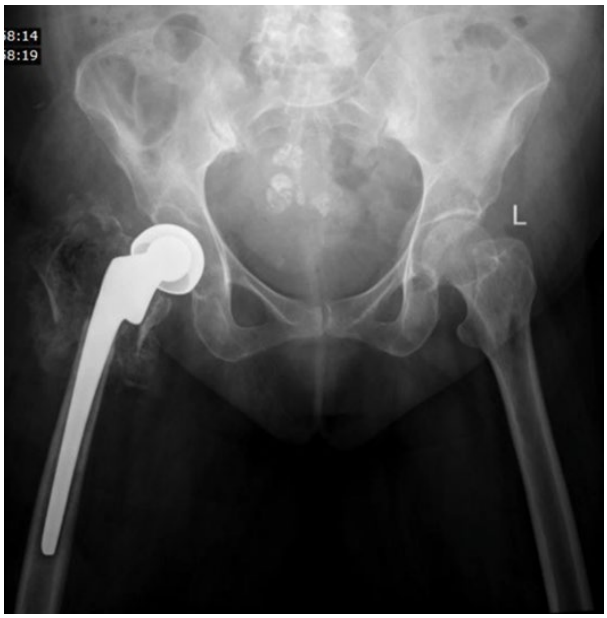

Fig. 13. _Hemiarthroplasty done following complication

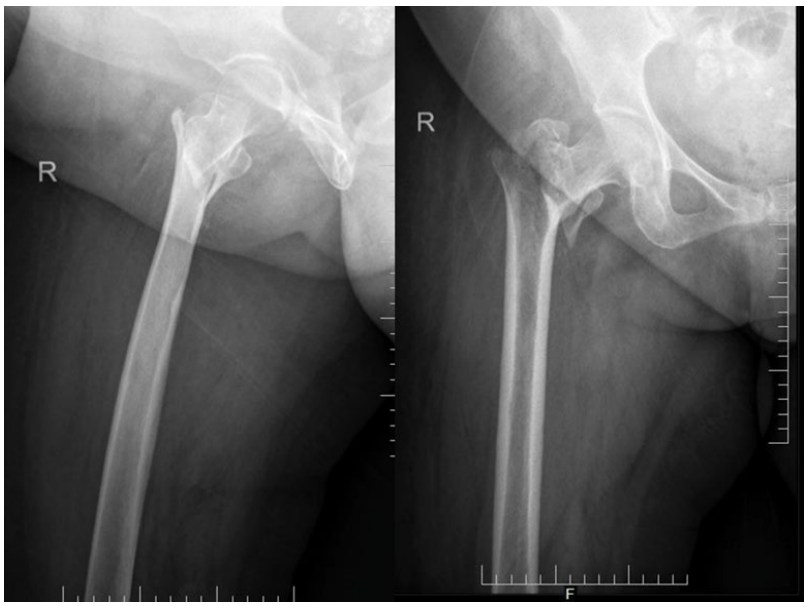

Fig. 14. Preop- Right hip AP and lateral x-rays

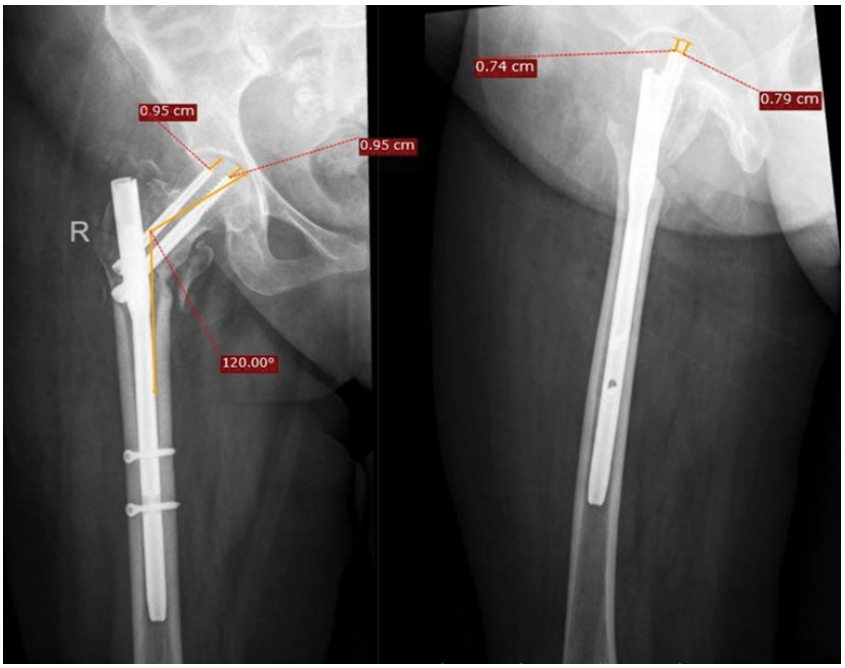

Fig. 15. Postop- Right hip AP and lateral X-rays

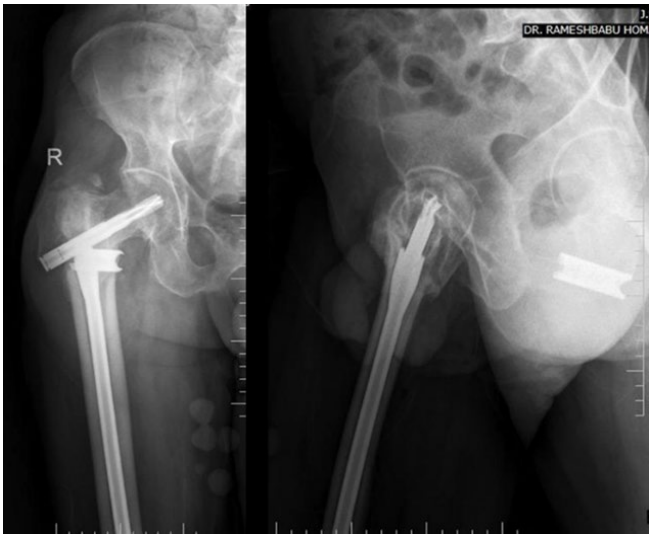

Fig. 16. 5 months follow up- Implant breakage

Fig. 17. Preop pelvis with bilateral hip x-ray

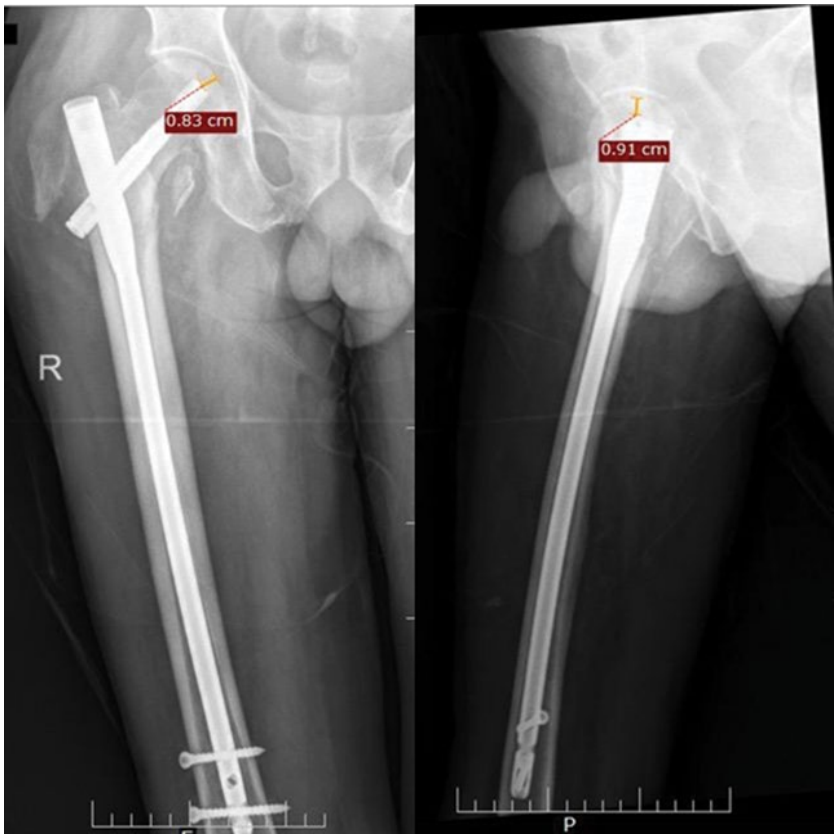

Fig. 18. Postop- Right hip AP and Lateral X-rays

with the chief complaints of pain in the right hip following a Road Traffic Accident (RTA). Radiographs following injury showed implant breakage (Figure 16).

5 months back patient had sustained AO 31-2.3 type of intertrochanteric fracture (Figure 17) for which he had undergone CRIF with long PFN-A. Postoperative radiographs showed adequate radiological parameters in the form of TAD (17.4 mm) (Figure 18). However, the implant had a slight varus angulation.

DISCUSSION

In this study, clinico-radiological outcome was compared between PFN and PFN-A group of patients based on various parameters such as operative time, preop and postop hemoglobin levels, Singh's index, neck shaft angle, type of reduction, Tip Apex Distance (TAD), Cleveland index, Harris Hip Score (HHS), pre and post-operative Parker Palmer Mobility Score.

A total of 152 patients were recruited prospectively into the study that had undergone treatment with either PFN or PFNA for intertrochanteric fractures. 94 patients were there in the PFN group whereas 58 patients were there in the PFN-A group. The age group which had the greatest number of patients was of the 61 to 80 years category which is in accordance to the etiology of intertrochanteric hip fractures. The mean age of group with PFN was 65 years and PFNA was 70 years. There were 84 male patients and 68 female patients which were at a ratio of 1:0.8. This discrepancy could not be avoided due to socioeconomic factors.

On the basis of Alpha Numerical System (AO Classification) [7], majority (23.7%) of the total patients belonged to 31-A2.3. This study included stable as well as unstable intertrochanteric fractures which have not been done in previous studies. Most of the previous studies done on intertrochanteric fractures evaluated the functional outcome of the implant used in unstable fractures. As a result, this study would shed light on the functional outcome of PFN and PFNA in all types of intertrochanteric fractures, whether stable or unstable and hence, provide a better insight into which type of implant would be best suited for a patient with intertrochanteric fracture.

Haemoglobin values were tested preoperatively to determine intra operative blood loss and the general nutritional status of the patient. Postoperatively the blood loss was quantified by measuring post-operative haemoglobin levels.

Based on the above values, it was noted that the PFN group of patients had a slightly lower postoperative haemoglobin level when compared to the PFNA group. The difference was found to be significant and it provides us with an indirect insight into the amount of blood loss which would have occurred during the procedure of both the implant groups. Thereby, indicating that the amount of blood loss was less in the patients who underwent intertrochanteric fixation with PFNA. This can be attributed to the fact that lesser operative time was required for the PFNA procedure. However, a better estimation of blood loss could have been the measurement of pre and post-operative hematocrit levels which can be done in future studies.

Coming to the operative time for the two procedures, the majority of them were completed between 30 minutes to 1 hour. A statistically significant difference was noted in the operative time in the PFNA group when compared to PFN group. A study done by Sharma, et al. [13], found that lesser operative time in PFNA which is similar to the current study. A study by Kashid M R, et al. [14], also found that the duration of surgery was significantly lower in the PFNA group, similar to the current study.

In the study majority (95.7%) of the patients had ideal Cleveland index (10). In the PFN group, majority of them had compression screw/helical blade positioned at centre- inferior (46.8%) and centre-centre (48.9%) whereas in the PFNA group 53.4% had centre-inferior and 39.7% had centre-centre. The study done by Sharma et al. [13] had 83% and 68% of patients in PFN and PFNA group with optimum position of implant. In the current study it was higher and was 95.7% and 93.1% respectively. Stern R, et al., in their study examined if using a single helical blade

improved the positioning of the device in the femoral head and found nil difference in implant positioning between nails employing blades and screws. In the current study, there was no significant difference seen but the optimum position was higher in the PFN group similar to the above-mentioned study. However, implants which were positioned in centre-superior had a higher complication rate when compared to the implants having an optimal position of the compression screw/ helical blade.

In this study majority of the patients had Harris Hip Score (40) of 80 to 90 which stands for good grade. Also, the mean HHS was similar in both the groups; 79.4 for PFN and 79.6 for PFN-A. It indicates that both PFN and PFNA when used for intertrochanteric fractures can help the patients to return back to their activity of daily living to a significant level. Therefore, there was no superiority among both the implants as far as the functional outcome of the hip is concerned. Kashid M R, et al [14] in their study found similar HHS between the groups which are similar to the current study.

As a part of the secondary objective of the study, we looked for the efficacy of both the implants among osteoporotic patients. This study found better union rates at follow up of 6 weeks and 6 months in osteoporotic patients (graded using Singh's index 35) who were treated with PFNA. This suggests that PFNA provides better radiological outcomes as compared to PFN in osteoporotic patients.

This study looked for complications and the type of implant used. We found more complications among the PFN group and the difference was found to be significant. 92.6% of the PFN patients had no postoperative complications. Out of the 7.4% which had complications, 1.1% had screw backout, 1.1% had reverse z effect and 5.3% had Z effect. 96.6% of PFNA patients had no post-operative complications. 1.7% had implant breakage and 1.7% had post-operative wound infection. The reason behind the higher complication rates in the PFN group can be attributed to the neck-shaft angle, type of reduction, tip apex distance and cleveland's index. Majority of the patient's having complications had neck-shaft angle less than 125 degrees. Also, negative reduction was observed in majority of the patients having complications. The tip apex distance was found to be more than 25 mm in most of the patients who had complications. Position of the compression screw/helical blade was found to be centre-superior in the patients having complications. The above factors might have led to the impending failure of the implant in patients who had complications. Thereby, implying the importance of the radiological parameters for the success rate of PFN and PFNA. The study by Anirudh Sharma, et al. [13] similar to the current study found significant difference in complications among the groups, higher number of complications were seen in the PFN group which was similar to the findings seen in current study. However, the neck shaft angle post reduction was not calculated in their study. Mora A et al. [15] found that in PFNA blade there were less complications which is similar to the current study. Yet another study by Choo SK, et al. [16], found similar findings as the current study where post-operative sliding was seen less among PFNA group. Gardenbroek, et al. [17], study found higher complications in PFN similar to the current study. In contrary to the current study Kashid M R, et al. [14], study found no difference between complications between 2 groups. However, the sample size of the patients in their study was small to come to a conclusive result.

In this study, we found that majority of the patients had positive reduction (61%) with 23% of the patients having neutral reduction. The remaining patients had negative reduction and it was observed that the patients in this group had a higher complication rate.

The neck shaft angle was in the range of good reduction (61.8%) and acceptable reduction (23.7%) for majority of the patients in the study. There were few patients with poor reduction (14.5%). This study had similar neck-shaft angle among both the groups. Complication rates were observed to be higher in the patients with neck-shaft angle in the range of poor reduction. Thereby, suggesting the importance of neck-shaft angle for the success of the implant.

This study had higher mean tip apex distance in the patients with PFN compared to the patients with PFNA, although the difference was not significant. Similar to the current study Sharma et al [13] study found the TAD within normal limits in both groups (<25 mm).

The postoperative Parker Palmer mobility Score (PPS) was found to be similar in both the groups thereby indicating a similar functional outcome of the patients in both the groups. This is in accordance with the previous studies done comparing the functional outcome of both the implants.

Most of the results obtained from this study support the evidence provided by previous similar studies, this study points out for the need of adequate radiological parameters for decreasing the complication rates. It stresses on the importance of adequate neck-shaft angle post-reduction. Also, the need of a positive reduction and appropriate positioning of the compression screw/helical blade has been pointed out in this study to reduce the chances of implant failure and further complications. An additional merit of the study is that it found a better union rate when PFNA was used in osteoporotic patients and suggests the use of the implant especially in osteoporotic age group. Also, this study included patients with stable as well as unstable intertrochanteric fractures and the patients who were of the skeletally mature age group. This has not been done in the previous studies. Therefore, this study provides a broader perspective of the advantages and disadvantages which can be encountered while using PFN and PFNA implants in patients of all age groups with stable as well as unstable type of intertrochanteric fractures.

Overall, the study finds PFNA to be superior to PFN in terms of reduced operative time, lesser complications and better union rates in osteoporotic intertrochanteric fractures.

CONCLUSION

Intramedullary nailing with the PFN A has distinct advantages over conventional PFN like shorter operating time and lesser blood loss. The complication rates are significantly less in intertrochanteric fracture patients operated with PFN-A when compared to PFN even in the osteoporotic age group.

The importance of adequate radiological parameters especially postoperative neck-shaft angle, type of reduction, Tip Apex Distance (TAD) and Cleveland index for the success of the implant has been clearly demonstrated in this study.

Thereby, concluding that PFN-A is a better option for the treatment of all types of intertrochanteric fractures in skeletally mature age group of patients.

LIMITATIONS

- Since the study was done in a single center, there is a limitation of small sample size
- Due to the short follow up period, long term complications could not be assessed
- Use of DEXA scan which is a better parameter for osteoporosis evaluation was not done for the patients due to financial reasons
- Intraoperative blood loss calculation and the number of blood transfusions done could have given an accurate estimation of blood loss during the two procedures

CONFLICT OF INTEREST

The author states that there is no conflict of interest involved in the study

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