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Dynamic Hip Screw Devices versus Proximal Femoral Nail in Treatment of Stable Intertrochanteric Femoral Fractures

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Abstract

Intertrochanteric fractures occur in the region between the greater and lesser trochanters of the proximal femur, occasionally extending into the subtrochanteric region. Dynamic Hip Screw (DHS) has been considered the gold standard of fixation for a long time, especially for stable fracture types. The Proximal Femoral Nail (PFN) was designed to overcome implant-related complications of DHS and facilitate the surgical treatment of unstable intertrochanteric fractures. To compare the radiological features and functional outcomes of patients who underwent DHS and PFN in the treatment of stable two-part (31A1:31A2"1) intertrochanteric femur fractures. This prospective study included 30 patients with stable intertrochanteric proximal femoral fractures (31A1:31A2"1) attending the emergency department of Al-Azhar university Al-Hussein hospital) and AlSalam Specialized Hospital starting from December 2020 and January 2022. Among our 30 cases of stable Inter-trochanteric femoral fractures. Of them, 15 were treated by PFN and 15 by DHS have been analyzed. There was no statistically significant difference regarding postoperative complications in both study groups. In the DHS group, the one-month mean hip score was less than that of the PFN group, though not statistically significant however at three months and six months follow up, the DHS group had higher mean scores than the PFN group. The use of PFN for the fixation of trochanteric fractures against the proven DHS offered better results along with a few advantages. PFN required smaller incisions, shorter duration of surgery, less blood loss, and faster recovery but still, PFN is technically more demanding than the DHS and was found to have longer fluoroscopy exposure. PFN is a better alternative to DHS in the treatment of intertrochanteric fractures, but it is a technically difficult procedure and requires more expertise compared to DHS.

Keywords: Dynamic Hip Screw; Proximal Femoral Nail; Intertrochanteric Femoral Fractures

1. Introduction

The upper end of the femur is anatomically and biomechanically a structural marvel, which is the best suited to its function. Its proximal part, especially the intertrochanteric region always is exposed to severe tremendous tensile and compressive stress during function and is only second to the lumbar disks in this respect [1].

Intertrochanteric fractures account for nearly 50% of all fractures of the proximal femur, Ninety percent in the elderly (osteoporotic) result from a simple a trivial fall injury in daily life activities, with the proportion of men to women 1:4, in younger individuals are the result of a high-energy injury. The combination of a growing elderly population and a rising incidence of high energy trauma makes understanding hip fractures
Essential [2].

Trochanteric hip fractures (AO/OTA type 31A) occur at the translational area of the cervicotrochanteric junction, extending from the extracapsular basilar neck region to the region along the lesser trochanter proximal to the development of the medullary canal. Most of the proximal femur is made up of cancellous bone and is very vascular which makes fractures in this area much less susceptible to osteonecrosis in terms of the extent of fixation and nonunion [3]. The stability of the intertrochanteric fractures is the ability of the fracture to support physiological loading and resist medial compressive loads once reduced and fixed. They will be minimally impacted on each other by the nearly perpendicular weight-bearing force of a single leg stance, which relates not only to the none of the fragment but the fracture plane as well [4]. The correct diagnosis is attained by performing an x-ray in the anteroposterior view after gentle traction with internal rotation. Unstable characteristics include posteromedial fragmentation, reverse obliquity pattern (subtrochanteric extension), basicervical patterns, and fracture of the lateral cortical buttress beneath the vastus ridge [5].

Nonoperative treatment is mainly reserved for patients who are unfit for surgery. Two parameters affect the decision-making (fracture pattern, and patient profile). implants for the fixation of stable intertrochanteric fractures can broadly be divided into 1-Extramedullary devices, ex: -.DHS 2-Intramedullary devices ex: - PFN. The DHS remains the primary mode of fixation of these fractures. Recently its usage has declined due to its complications [6]. To circumvent these issues, the proximal femoral nail was designed by the AO-ASIF group in 1997. The usage of PFN has greatly increased as it is considered to be associated with decreased operative complications and better functional outcomes [7]. We aimed to compare the radiological features and functional outcomes of patients who underwent DHS and PFN in the treatment of stable two-part (31A1:31A2"1) intertrochanteric femur fractures.

2. Patients and Methods

This Prospective study included 30 patients with stable intertrochanteric proximal femoral fractures (31A1:31A2"1) attending the emergency department of Al-Azhar university Al-Hussein hospital) and AlSalam Specialized Hospital starting from December 2020 and January 2022.

The inclusion criteria were skeletal matured Patients (Patients that are 19 years old or older) who were fit for surgery and freshly closed stable intertrochanteric fractures.AO31 A1 & AO31 A2.1 types, good bone quality at the femoral neck, and the ability to walk independently without aids before the fracture. The Exclusion criteria were skeletal immaturity patients younger than 19 years old, pre-existing femoral deformity preventing hip screw osteosynthesis or intramedullary nailing, severe osteoarthritis, Pathological fracture, medically unfit for surgery and subtrochanteric fractures or reverse obliquity patterns, ipsilateral lower-limb surgery or a contralateral IFF. All patients were subjected to clinical assessment with special emphasis on personal data, complaints, and history, physical examination with special emphasis on the affected side, deformity, swelling, tenderness, movement, neurovascular condition, skin condition, and other injuries.

2.1 Methods of Radiological Evaluation

AP pelvis and cross-table lateral of the affected limb plain X-ray views were done for all patients, sometime CT. for PFN, full-length femur AP, and lat radiographs for implant length selection, with special attention to the femoral bow. Checking the Nail curvature to prevent cortical breach by the nail, the nail diameter was measured at the level of the isthmus on AP X-ray. The neck shaft angle was measured on the unaffected side on AP X-ray using a goniometer. For DHS, the length of the compression screw was measured from the tip of the head to the base of the greater trochanter on AP view X-ray subtracting magnification. The neck shaft angle was determined to use a goniometer on an X-ray AP view on the unaffected side, and the length of the side plate was determined to allow the purchase of at least 8 cortices to the shaft distal to the fracture.

The ideal cephalic implant position of the DHS screw is a center–center within the femoral head, the ideal recommended position for the PFN screw is slightly inferior to center in the femoral head to allow for placement of the hip pin, With its tip 5 to 10 cm from the subchondral bone with a combined tip-apex distance measuring less than 25 mm on anteroposterior and lateral radiographs.

2.2 Methods of Treatment

2.2.1 First Aid Measures

On arrival, the patients were assessed clinically and were hemodynamically stabilized, Fracture was stabilized using skin traction. The patients received prophylactic first-generation cephalosporin antibiotics for half hour before surgery and twice a day for 3 days after surgery.

2.2.2 Anesthesia

All patients were operated on by a single surgical team under general anesthesia (GA) or spinal anesthesia (SA) while ensuring strict aseptic conditions.

2.2.3 Positioning and Draping

The surgeries were performed in a supine position with a traction table on a radiolucent table under image intensifier (C-ARM) control using the standard technique. Prepare the skin over the hip and square off the lateral aspect of the hip from the iliac crest to the distal thigh taking care to avoid undue pressure or tension on any part of the body.

2.2.4 Reduction of Fracture

Closed reduction was achieved in all patients on the traction table except 4 patients, for those open reduction and preliminary fixation with K wires through a lateral approach. The fracture was reduced by gentle traction in hip flexion and abduction in moderate external rotation followed by gentle extension and internal rotation. The reduction was checked by an image intensifier in both planes. The reduction was considered to be anatomical if the neck shaft angle was reproduced and the gap at the fracture site was less than 2 mm in both anteroposterior and lateral views.

2.2.5 Fixation

2.2.5.1 DHS Procedure

Through lateral approach splitting the vastus lateralis and a guide wire was inserted 1 to 2 cm below the vastus ridge and assessed by fluoroscopy. The femoral anteversion was estimated by advancing a free guide pin by hand up the anterior femoral neck and securing it in the anterior aspect of the femoral head. We placed the guide pin within 5 mm in the subchondral region of the joint line based on AP and Lateral views. Triple reamer was advanced under fluoroscope guidance after which sizing was done. The screw was inserted over the guidewire for proper insertion. Then the plate was inserted. a cannulated cancellous screw of suitable length with a washer was inserted onto the second pin to act as DRS The wound is finally closed in layers over a suction drainage system after securing homeostasis.

2.2.5.2 PFN Procedure

We started with a 3 cm incision about 3 cm proximal to the greater trochanter; it was liable to extension according to the body build. The awl was used to create the above entry point, and a guide pin was inserted down to the shaft of the femur just below the tip of the greater trochanter. 10 mm diameter nail and 240 mm length were used. After reaching the intended level, AP and lateral views were taken to assess the alignment then the guide pin was removed. A distal locking screw was instead through small incisions with the appropriate sleeve. Align the end cap with the nail axis using the hexagonal screwdriver to prevent tilting. Screw the end cap completely onto the nail until its collar touches the proximal end of the nail.

2.3 Postoperative Care

Postoperative radiographs (AP & lateral views) were obtained, Drain was monitored. Intravenous antibiotics were given for 3 days followed by oral antibiotics till suture removal, and deep vein thrombosis prophylaxis. The patients received low molecular-weight heparin during their stay in the hospital. (Enoxaparin sodium; Clexane4000 IU was injected once a day for 7 days, starting at admission. Blood transfusion was given depending upon intraoperative blood loss and post-operative hemoglobin.

Patients were encouraged to sit in bed after 24 hrs and remained in bed for 2 days following surgery. Formal physical therapy started on 3rd day working on core strengthening, dynamic lumbar stabilization, range of motion, strengthening, and conditioning. They were allowed to walk with a walker (non-weight bearing) before discharge if able. From day 3 to 6 weeks post-op gradually increased based on follow-up radiographs for callus and unions to full weight bearing with help of walkers after 6 weeks postop. The patients were discharged when mobile and primary complications had been excluded. They were discharged at variable intervals depending on their general condition and the status of the wound.

2.4 Follow-up:

Wound inspection is done on the 2nd, 5th, and 10th postoperative days. Suture removal was done on the 14th day. Follow-up at regular intervals of 4 weeks, 8 weeks, 12 weeks, and 6 months postoperatively until bone healing was radiographically present Plain AP and lateral radiographs and scored according to Harris hip score. They were examined clinically and radiographically.

2.5 Radiographic Assessment

AP and lateral radiographs of the hip during their follow-up visit were used to evaluate the following parameters: accuracy of the reduction, the position of the lag screw within the head of the femur, the tip-apex distance (TAD), changes in the femoral neck-shaft angle, postoperative shortening and medialization of the femoral shaft, screw cut-out, The cut-through, Collapse, postoperative fracture of the femoral shaft (peri-implant fracture), Union, Mal-union and Delayed union.

2.6 Clinical Examination

Deep and superficial wound infection. Evaluation of pain and active and passive range of motion by of hip and knee, limb length discrepancy, motor exam, sensory exam and Trendelenburg positivity, Able to sit cross-legged, squat, walking ability with or without support, Whether the patient assumes his/ her occupation to previous injury state.

The assessment of the final functional outcome was done by using the Harris hip score which gives a maximum of 100 points and the domains include pain, function, deformity, and motion. The excellent and good results were considered satisfactory while the fair and poor results are considered unsatisfactory.

2.7 Ethical Consideration

Approval of the managers of the hospital in which the study was conducted. Informed verbal consent was obtained from each participant sharing in the study. Confidentiality and personal privacy were respected at all levels of the study. The data collected was not used for any other purpose.

2.8 Statistical Analysis

Data were collected, coded, revised, and entered into the Statistical Package for Social Science (IBM SPSS) version 23. The data were presented as numbers and percentages for the qualitative data, mean, standard deviations, and ranges for the quantitative data with parametric distribution, and median with interquartile range (IQR) for the quantitative data with the non-parametric distribution. Then the appropriate statistical analyses were applied. The confidence interval was set at 95% and the margin of error accepted was set at 5%.

3. Results

This retrospective study included 30 cases of stable Inter-trochanteric femoral fractures. Of them, 15 were treated by PFN and 15 by DHS have been analyzed. nonlocked DHS four-hole long plate (135°), we failed to put an additional anti-rotational screw in 7 cases.

Short PFN used included 180- and 250-mm nails (130°, 135°) with two cephalomedullary screws (8 mm, 6.5 mm) and one or two distal locking bolts, we failed to put the hip screw in three cases as it could not be accommodated in the neck after putting neck screw. As shown in table 1 there was no statistically significant difference between both groups as regards Fracture classification (AO-OTA). As shown in table 2 there was no statistically significant difference between both groups as regards associated medical conditions. As shown in table 3 there was no statistically significant difference as regards the interval between injury and surgery in day, and duration of hospital stay. As shown in table 4 there was no statistically significant difference between both groups as regards reduction/reduction in quality. As show in table 5 there was no statistically significant difference in the radiological union but there was a statistically significant increase in operative time in the PFN group (103.13±13.34) more than in the DHS group (84.33±9.27). As shown in table 6 there was a statistically significant difference in the mean length of incision, radiation exposures, and Average blood, but there was no statistically significant difference in the average time to start partial weight bearing and Mean duration of allowing full weight bearing. As shown in table 7 there was no statistically significant difference as regards Intraoperative complications. As shown in table 8 there was no statistically significant difference as regards post-operative complications. As shown in table 9 there was no statistically significant difference BUT statistically significant difference concerning postoperative shortening (P=0.002). As shown in table 10 in the DHS group the one-month mean hip score was less than that of the PFN group, though not statistically significant (p value>0.05) however at three months and six months follow-ups, the DHS group had higher mean scores than the PFN group (p<0.02). While there was no statistically significant difference in total HHS in 6 months. As shown in table 11 there was not statistically significant according to functional outcome.

Table 1: Comparison between DHS & PFN as regards Fracture classification (AO-OTA).

		DHS No.15)		PFN (No.15)		Chi-square test	
		No	%	No	%	X^2	P value
AO Classification	31A1. 1	6	40.0 %	4	26.7 %	3.81 8	0.430
	31A1. 2	5	33.3 %	7	46.7 %		
	31A1. 3	4	26.7 %	4	26.7 %		

Table (2): Comparison between DHS & PFN as regards associated medical condition

		DHS (No.15)		PFN (No.15)		Chi-square test	
		No	%	No	%	X^2	P val ue
Associated medical condition	Asthma	1	6.7 %	1	6.7 %	3.6 67	0.5 98
	DM	1	6.7 %	2	13.3 %		
	HTN	1	6.7 %	2	13.3 %		
	DM/HT N	2	13.3 %	2	13.3 %		
	Liver cell failure	0	0.0 %	2	13.3 %		
	Medicall y free	10	66.7 %	6	40.0 %		

Table (3): Comparison between DHS & PFN groups as regards interval between injury and surgery in day and duration of hospital stay

	DHS (No.15)		PFN (No.15)		Independent t-test	
	Mean	SD	Me an	SD	t	P value
Interval between injury and surgery on day	3.40	1.1 2	4.1 3	1.6 8	- 1.40 3	0.171
duration of hospital stays	5.53	1.3 0	6.5 3	2.2 3	- 1.49 9	0.145

Table (4): Comparison between DHS & PFN groups as regards reduction/reduction quality

		DHS (No.15)		PFN (No.15)		Chi-square test	
		No	%	No	%	X^2	P value
Reduction/Reduction quality	Closed/a acceptable e	3	20.0 %	4	26.7 %	4.19 5	0.241
	Closed/good	10	66.7 %	9	60.0 %		
	Open/acceptable	2	13.3 %	0	0.0 %		
	Open/go od	0	0.0%	2	13.3 %		

Table (5): Comparison between DHS & PFN groups as regards operative time and radiological union

	DHS (No.15)		PFN (No.15)		Independent t-test	
	Mean	SD	Mean	SD		
Operative time (in minutes)	84.33	9.27	103.13	13.34	-4.483	0.001
Radiological union	13.73	4.20	14.67	5.05	-0.550	0.587

Table (6): Comparison of Intraoperative and outcome variables of both groups.

Intraoperative details/outcome variables	DHS(n=15)	PFN(n=15)	P value
Mean length of incision (ln cm)	7.9	4.9	<0.01
Mean radiographic exposure (No of times)	48.7	71	<0.01
mean blood loss in ML	221ml	109 ml	< 0.01
average time to start partial weight bearing in days	17.1	9.8	0001
Mean duration to full weight bearing in weeks	7.8	7.2	0.412

Table (7): Comparison between DHS & PFN as regards Intraoperative complications

Intraoperative complications	DHS (No.15)		PFN (No.15)		Chi-square test	
	No	%	No	%	X^2	P value
Fracture of the lateral cortex	0	0.0%	1	6.7%	1.034	0.309
Fracture displacement by nail placement	0	0.0%	3	20.0%	3.333	0.068
Failure to put the derogation screw	3	20.0%	4	26.7%	0.186	0.666
Drill bit breakage	0	0.0%	1	6.7%	1.034	0.309
Improper positioning of the lag screw	1	6.7%	0	0.0%	1.034	0.309
Varus angulation	1	6.7%	0	0.0%	1.034	0.309

Table (8): Descriptive data of postoperative complications in both study groups

Post-operative complication	DHS (No.15)		PFN (No.15)		Chi-square test	
	No	%	No	%	X^2	P value
Early complication						
Prolonged drainage	2	13.3 %	0	0.0 %	2.14 3	0.143
Superficial infection	1	6.7 %	0	0.0 %	1.03 4	0.309
Delayed complication						
Deep infection	1	6.7 %	0	0.0 %	1.03 4	0.309
Screw cut-out and Cut-through	1	6.7 %	0	0.0 %	1.03 4	0.309
Screw back out	0	0.0 %	3	20.0 %	3.33 3	0.068
Peri-implant fracture	1	6.7 %	0	0.0 %	1.03 4	0.309
Second surgery	3	20.0 %	2	13.3 %	0.24 0	0.624
Mortality	1	6.7 %	1	6.7 %	0.00 0	1.000

Table (9): Comparison between both groups as regards radiological evaluation.

	DHS Group Mean ± SD	PFN Group Mean ±S D	P value
Femoral neck-shaft angle (°)	133.6±3.1	132.5±4.2	0.83
AP tip apex distance (mm)	11.8±3.2	10.3±2.7	0.69
Lateral tip apex distance (mm)	10.4±3.7	9.9±1.9	0.87
Shortening	9.6mm±3.7	6 mm±1.8	0.002

Table (10): Mean Harris hip score in the two groups at 1, 3, and 6 months postoperatively

Average Harris hip score at	DHS	PFN	P values
1 month	24.8	26.1	0.10
3 months	53.4± 3.91	47.60± 3.91	< 0.10
6 months	79.15±18.01	72.86±16.70	0.355

Table (11): Distribution of cases according to functional outcome in both groups

	DHS (No.15)		PFN (No.15)		Chi-square test	
	No	%	No	%	X^2	P-value
Excellent	6	40.0%	3	20.0%	2.267	0.687
Fair	2	13.3%	3	20.0%		
Good	1	6.7%	2	13.3%		
Poor	4	26.7%	6	40.0%		

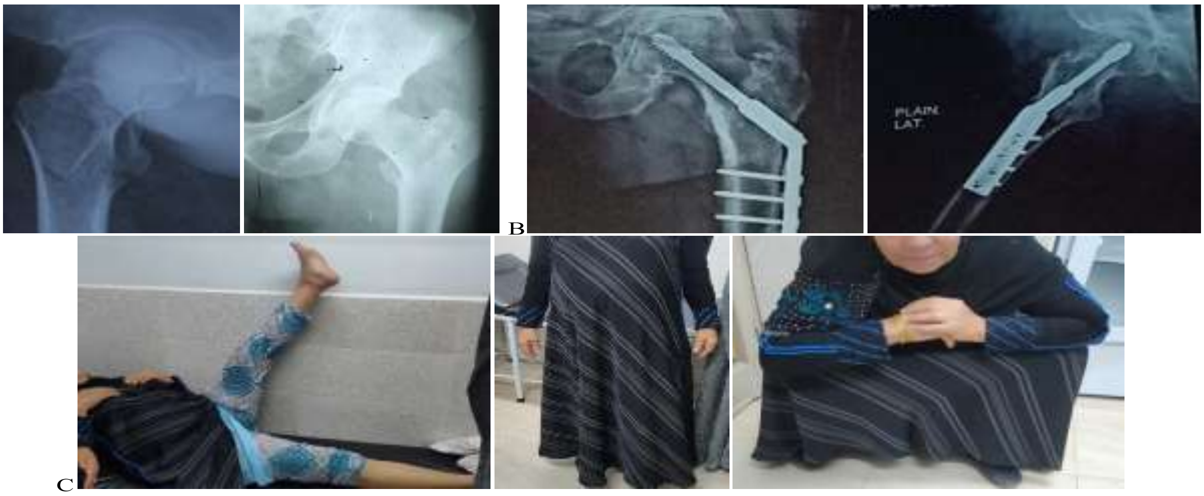

Figure (1): A female patient aged 58 years old with a history of slip and fall on the ground was presented to the ER and after examination, she was found to have an intertrochanteric fracture of the left side classification was 31, A1.1 according to AO classification with history of controlled bronchial asthma. The patient was operated on 3 days after admission. The patient was placed supine on a radiolucent traction table to allow for an image intensifier. The operative time was 70 minutes. 4 hole non-locked DHS plate with anti-rotation was used to fix the fracture. Post-operative IV antibiotics were administrated for 3 days followed by oral antibiotics for 7 days. Union was noticed 3 months postoperative. Using the Harris Hip score for hip fracture, the patient had excellent function with a total score of 99 points. **A)** Preoperative X-rays. **B)** Follow-up x-rays at 6 months showing union. **C)** Functional outcome Active SLR and range of motion at six-month follow-up

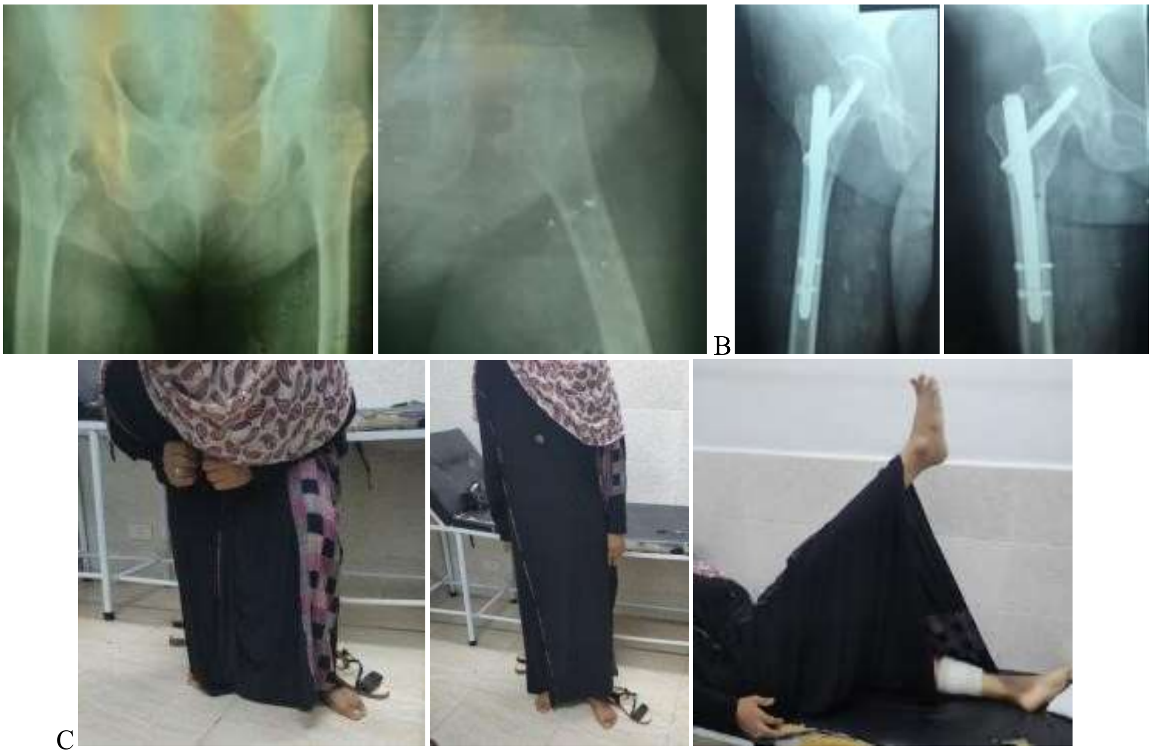

Figure (2): A female patient aged 50 years old had a Right intertrochanteric fracture with a history of RTA that was classified as 31, A1.2 according to AO classification. The patient had a history of controlled DM 5 years ago. After getting first aid and management protocol in the ER, the patient was admitted to the hospital. The patient was operated on 3 days after the admission. The patient was placed supine on a radiolucent table to allow the use of an image intensifier & fixation was achieved using short PFN without anti-rotation. Operation time was 110 minutes. Parenteral post-operative antibiotics were admitted for 3 days followed by oral antibiotics for 7 days. The patient was followed up periodically and the union was achieved after 10 weeks. Using the Harris Hip score for hip fracture, the patient had a good function with a total score of 81 points. A) Preoperative X-rays. B) Follow-up x-rays at 6 months showing union. C) Functional outcome Active SLR and range of motion at six-month follow-up

4. Discussion

In the last few decades, the treatment of intertrochanteric fractures has evolved significantly, and various methods of fixation devices have come and gone. The treatment still merits the type of fracture and quality of the bone. [8]

Intertrochanteric fractures occur in the region between the greater and lesser trochanters of the proximal femur, occasionally extending into the subtrochanteric region. These fractures occur in cancellous bones with an abundant blood supply. As a result, nonunion and osteonecrosis are less problematic than femoral neck Fractures [9].

DHS has been considered the gold standard of fixation for a long time, especially for stable fracture types. The PFN was designed to overcome implant-related complications of DHS and facilitate the surgical treatment of unstable intertrochanteric fractures. As it is an intramedullary implant, imparts a lower bending moment, compensates for the function of the medial column, and acts as a buttress in preventing the medialization of the shaft. [10]

However, in stable IT fractures, whether all these characteristics aid in improving the outcome as compared to the DHS, is still a matter of debate. In this study, we have compared the intraoperative observations, complications, and radiological and functional outcomes of DHS and PFN done in AO type 31A1, A2.1 fractures. [11]

Simple two-part fractures of the pertrochanteric area with A1.1 fractures along the intertrochanteric line, A1.2 fractures through the greater trochanter, and A1.3 fractures below the lesser trochanter. A2.1 fracture with one intermediate fragment. All these are stable fractures with an intact posteromedial cortex; the majority were type 31A1.2 in both groups followed by AO 31A1.1 type. [12]

The mean age of the study population is 52 (± 90) years, which is less than the usual age of incidence of intertrochanteric fractures, which are 66-76 years. [13] The average age of the study population of previous studies by Pajarinen et al. and Parker et al. was 80
years. [14,15]

Older people with the osteopenic bone are usually associated with unstable comminuted fractures while stable fractures are more common in the younger age group. This also correlates with the increased number of male patients in our study (1.3:1). Usual male: female ratio of IT fractures is 1:3, 4. [13] Sudan et al and Pajarinen et al in their studies noted that females were more affected than males. [16,17]

The higher incidence of intertrochanteric in the elderly due to a trivial trauma is similar to other series such as Hornby et al. [18] Pajarinen et al also reported that the most common cause was trivial trauma similar to the results of our study. [16]

The average blood loss for DHS and PFN groups was 220 ml and 108 ml, respectively. blood transfusion was needed in only 2 patients in the DHS group. comparable to the results reported by Pajarinen et al., Prasad et al, and Mundla et al. [16,19,20]

A recent meta-analysis by Zhang et al. in 2018 showed that there was no significant difference in the blood loss and requirement of blood transfusion between the two surgeries. [21]

There was no significant difference in operative time between the two surgeries (mean PFN 103.13 min, mean DHS 84.33 min). Duration of surgery was shorter in the PFN group by a mean of 12.8 min; although the duration of implant fixation was almost similar time required for wound closure was significantly longer in the DHS group, probably due to larger incision and extensive dissection as compared to the percutaneous technique of PFN.

Similar findings were noted by Pan et al. [22] Saudan et al., [23] Shen et al. [24] and Zhao et al. [25] Nuber et al in their study of 129 patients reported that the average duration of surgery for PFN was less than that for DHS.[26]

A meta-analysis by Huang et al. in 2013 showed that there was no significant difference in the operative time between DHS and PFN. [27] They concluded that operative time depends upon the skill of the surgeon and his experience with using the specific implant. All these studies included both stable and unstable intertrochanteric fractures for comparison of results. The mean length of incision was smaller in the PFN group compared to the DHS group. This was comparable to the findings in various other studies like those by Pan et al.[22] and Zhao et al.[25] The fluoroscopy time was found to be much more for the PFN than that for the DHS similar to that reported by Prasad [19] In our study, the duration of hospital stay was slightly less in the DHS group, all fractures showed union at the end of six months. These excellent results can be attributed to an anatomical reduction that was achieved intra-operatively in all cases.

A similar study by Portakal et al resulted in a complete union of the fracture within 4 months which is comparable to the DHS group was 13.73±4.20 weeks while in the PFN group 14.67±5.05 weeks as reported in our study. [28]

The duration of allowing full weight bearing was slightly longer in the DHS group (7.8 wks) compared to the PFN group (7.2 wks) but it was not significant in statistical analysis.

Early complications included superficial infections and prolonged discharge from the wound in the DHS group which were not noted in the PFN group and resolved with regular dressings. One deep infection was noted in the DHS, treated by local debridement and antibiotics as per culture and sensitivity.

The incidence of technical errors was higher in the PFN group at 8.67% as compared to 3.38% in the DHS group. These included varus angulation at the fracture site (one in the DHS group) and distal translation of the head and neck fragment due to it being pushed distally by the nail at the entry point.

Opening up of the fracture site in one case after insertion of the nail when the fracture was located at the entry point itself and protrusion of the nail at the entry point due to mismatch between the direction of neck screws and neck shaft angle. Thus, these errors were typically related to the entry point and trajectory of the nail. This further led to a higher incidence of loss of reduction, implant failure, and re-operation rate in the PFN group. This was comparable to the observations in various other studies. [29,30] Implant failure included one case of superior cut out in the DHS group that required revision and 3 cases of Effect type of failure in the PFN group. Loss of reduction was seen in the form of varus collapse in two cases that had to be re-operated and in one case Implant exited at 3rd month (united without any complications). Mean shortening at final follow-up was comparable in both the groups with PFN methods reporting less shortening (6 mm±1.8 SD) in comparison to those treated by the DHS method (9.6 mm±3.7SD). This was different from most other studies probably because in our study all cases were of stable type Intertrochanteric fractures which were reduced intraoperatively and thus not much scope was left for the sliding mechanism of DHS to take place to cause any shortening. There were significant differences in neither AP nor lateral tip apex distances between the two treatment groups (p=0.69 and p=0.87, respectively) the neck shaft angle of all patients was between 125 to 140 degrees was 132.5º in group PFN and 133.6º in group DHS (p=0.83).

Memon et al. reported that the PFN group demonstrated no implant cut-out and less mean limb length shortening. [31] Ricci et al. reported that [32] these fractures are not necessarily stable when treated with DHS and dual screw PFN seems to be most effective to maintain stability for patients with this fracture pattern. Protrusion of PFN implant over the greater trochanter tip, which was seen in 8 patients, was not associated with any discomfort. The actual effect might need longer follow-up. Dodenhoff et al. in 1997 showed that prominence of the nail proximally was not associated with pain, but protuberance of laterally based proximal locking screws caused problems like proximal thigh pain. [33]

Mean Harris hip scores were calculated at one month, three months, six months follow-ups and compared in both groups. Initially, these functional scores were slightly lower for the DHS group, but at three- and six-months follow-ups, it was noted that the DHS patients fared slightly better than the PFN group.

The functional outcome with DHS was found to be better than PFN At 6 months DHS group had HHS 79.15 ± 18.01 and PFN group 72.86±16.70.(P 0.355) This was probably due to abductor lurch while walking and slightly decreased range of abduction in PFN group as compared to DHS patients. Similar final clinical outcome could be achieved by the DHS at a much affordable price as compared to the PFN as noted by Giraud et al.[34] Pajarinen et al., Nuber et al, and also Cruz et al reported that PFN was an efficient means to treat extracapsular proximal femur fractures. (17,26,35) Zeng et al. in 2017 compared the outcome of PFN-antirotation and DHS in AO 31A1 fractures and showed that the PFN-A group had a better outcome and less radiographic complications compared to the DHS group. [36]

Older studies comparing Gamma nails or Targon nails with DHS showed no difference in functional outcome [37,38]. However, recent studies comparing PFN antirotation nails with DHS have shown that PFN is better for unstable intertrochanteric fractures while there is no significant difference in the case of stable fractures. [39,40]

5. Conclusion

We conclude that the use of PFN for the fixation of trochanteric fractures against the proven DHS offered better results along with a few advantages. PFN required smaller incisions, shorter duration of surgery, less blood loss, and faster recovery still PFN is technically more demanding than the DHS and was found to have longer fluoroscopy exposure. PFN is a better alternative to DHS in the treatment of intertrochanteric fractures but is technically difficult procedure and requires more expertise compared to DHS.

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