International Journal of Research in Orthopaedics
Latheef MB et al. Int J Res Orthop. 2023 May;9(3):545-552
http://www.ijoro.org

Original Research Article

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20231181

Comparison of functional outcomes of pertrochanteric fractures of the femur managed with dynamic hip screw with a locking side plate versus proximal femoral nail

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Received: 25 February 2023
Revised: 01 April 2023
Accepted: 10 April 2023

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ABSTRACT

Background: In current practice, proximal femoral nail (PFN) and dynamic hip screw (DHS) with locking side plate are the implant of choice in stable trochanteric fractures. Most of the deficiencies of the standard DHS have been addressed by the introduction of the Locking side plate. There are plenty of studies comparing standard DHS and PFN. But studies comparing locking DHS and PFN are scarce in current literature. This study aimed to compare the outcomes of both implants in stable pertrochanteric fractures.
Methods: The objective of this study was to assess and compare the clinical outcomes of using locking DHS and PFN for fixation in 40 patients who were admitted to SUT Academy of Medical Sciences between October 2017 and April 2019. The modified Harris hip score was used to evaluate the patients' progress, and regular follow-up was conducted to compare their outcomes.
Results: Among the DHS group, the mean Harris hip score was 83.05, with excellent results observed in 2 patients (10%), good results in 12 patients (60%), fair results in 5 patients (25%), and poor results in 1 patient (5%). In comparison, the PFN group had a mean Harris hip score of 85.50, with excellent results seen in 6 patients (30%), good results in 10 patients (50%), fair results in 3 patients (5%), and poor results in 1 patient (5%).
Conclusions: The DHS group had more patients with good and fair outcomes, while the PFN group had more patients with excellent and good outcomes. Based on these findings, we can conclude that both the PFN and DHS with locking side plate are similarly effective in treating stable intertrochanteric fractures.

Keywords: PFN, Stable, Locking DHS, Pertrochanteric, Outcomes

INTRODUCTION

Trochanteric fractures are commonly observed in the elderly population, particularly in women who are osteoporotic. Even a trivial fall can cause these fractures due to poor bone quality.[1] Intertrochanteric fractures caused by these types of falls are common. If left untreated, these fractures can result in death due to complications related to cardiac, pulmonary, or renal issues in addition to other factors such as old age and medical comorbidities.[2]

In the past, conservative management was the preferred method for treating these fractures. However, prolonged immobilization and recumbence resulted in malunited fractures, altered gait, and high mortality rates. Internal fixation was introduced to address these issues with the goal of early restoration of patients to their pre-injury status, increased comfort, and decreased complications associated with recumbency.[3]

The sliding hip screw was the gold standard for treatment in the past, but it had drawbacks such as prolonged surgical time, lateral wall blowout, lag screw cut out, and varus collapse.[4] The PFN was introduced as an intramedullary implant with advantages such as closer placement to the mechanical axis, shorter operating time, less blood loss, and early weight-bearing. However, it was not without complications such as jamming of the sliding mechanism, stress risers at the distal locking bolts, and the Z effect.[5]

The DHS with locking compression plate is a novel method of fixation for intertrochanteric fractures.[6] However, the advantages of intramedullary fixation using PFN over dynamic screw plate devices are still under debate and inconclusive. Furthermore, there are limited studies comparing PFN and DHS with locking compression plate.

Therefore, this study aimed to examine the management of trochanteric fractures, possible complications, and evaluate functional outcomes after fixation with PFN and locking DHS.

METHODS

Source of data

This was a prospective study conducted at SUT Academy of Medical Sciences from October 2017 to April 2019.

40 patients with Boyd and Griffin types 1 and 2 pertrochanteric fractures were selected for the study. 20 patients were treated with open reduction and internal fixation using DHS with locking side plate and the other 20 patients were treated with closed reduction and internal fixation using PFN. The cases were placed alternately into each group with odd numbered pts placed into the PFN group and even numbered pts placed into the locking DHS group.

Method of data collection

Upon presentation to the emergency department, a comprehensive account of the trauma and method of injury was gathered from the patient or their accompanying individuals.

A thorough clinical examination was then carried out, including general physical examination, systemic examination and local examination of the injured extremity. All the findings were recorded in the proforma.

On admission, all patients were given analgesics and skin traction was applied in the affected limb. Any comorbidities were noted and medication started for the same. All routine blood investigations were sent and a pre-anesthetic check-up was done regarding fitness for the surgical procedure.

All patients were taken for surgery only after an informed and written consent was obtained from the patient and patient's attenders.

40 cases with type 1 and type 2 pertrochanteric fractures were studied.

Instrument details

The study included the use of DHS with LCP and PFN.

Ethics

Permission of the institutional ethics committee was taken before commencement of the study. An informed written consent was taken from each participant before being included in the study.

Inclusion criteria

Patients with trochanteric fractures of the femur (Boyd and Griffin type 1 and 2); patients between 20 and 80 years of age; patients who were willing to participate in this study; and patients who presented within three weeks of fracture were included.

Exclusion criteria

Patients with trochanteric fractures of the femur (Boyd and Griffin type 3 and 4); patients with polytrauma and multiple fractures in the same limb; patients with open fractures and neurovascular injuries were excluded.

Period of follow-up

Patients were evaluated and assessed for radiological union and functional recovery post-operatively, at 3 weeks, 6 weeks, 3 months and 6 months with the help of modified Harris hip score and results were compared.

Parameters for evaluation

Patients were evaluated clinically, preoperatively and postoperatively.

Clinical outcome measurements were determined using modified Harris hip score and graded as excellent, good, fair or poor depending on the score.

The following investigations were done for all patients: complete haemogram; blood urea, serum creatinine, serum electrolytes; blood grouping and Rh typing; PT, aPTT,

INR; urine routine; RBS; FBS and PPBS wherever required; X-rays: pelvis with bilateral hips (AP view) and femur with hip (AP, lateral views in traction internal rotation); HbSAg; HIV; ECG, chest X-ray; 2D ECHO; CT hip (if required).

No investigations and interventions were conducted on other humans and/or animals.

Surgical intervention was undertaken after adequate pre-operative assessment was made, physician and anesthesia fitness were obtained and only after taking informed/written consent.

Initial management

Upon admission, all patients underwent a comprehensive musculo-skeletal examination and detailed history was obtained. Primary stabilization was achieved using a skin traction kit. The patients were evaluated for any medical issues during the 2-3 days interval between admission and surgery. Spinal anesthesia was administered to all patients, and in selected cases, it was combined with epidural anesthesia. The C-arm and fracture table were utilized for all patients during the surgical procedure.

Patient positioning

After administration of spinal anaesthesia, the patient was positioned supine on a fracture table with a radiolucent, padded countertraction post between the patient's legs.

The uninjured leg was kept flexed and abducted at the hip in a leg holder. The knee of the uninjured leg was padded in this position.

The injured leg was secured by a boot attached to the extension leg of the fracture table.

The adequacy of reduction in both antero-posterior and true lateral views was verified before surgical preparation.

Draping

Skin scrub and preparation was done over the hip till the umbilicus and the lateral aspect of the hip from the iliac crest to the distal thigh.

The operative site was draped with towels and drapes and towel clips placed so that they were not superimposed on the fracture during further imaging.

The C-arm was draped separately.

Reduction

A closed reduction of the fracture was performed under C-arm guidance.

The reduction was checked by both anteroposterior and lateral views in C-arm, paying special attention to cortical contact medially and posteriorly.

DHS with locking side plate

Exposure

Skin incision was made from the tip of the greater trochanter and then extended down the line of shaft of the femur for approximately 8 cm.

The fat and underlying deep fascia were incised and the cut edges of the fascia retracted to pull the tensor fascia lata anteriorly.

The fibres of vastus lateralis were split along its line of fibres and elevated from the lateral inter-muscular septum taking care to coagulate the perforating branches of the profunda femoris artery.

The greater trochanter was exposed for introduction of guide pin.

Insertion of guide pin

The level of insertion of the guide pin varies with the angle of the plate used.

The proximal aspect of the osseous insertion of the gluteus maximus and the tip of the lesser trochanter, which were approximately 2 cm below the vastus lateralis ridge, helped identify the level of entry of a 135-degree angle plate.

If higher angle side plate was used, the entrance site was moved 5 mm distally for each 5-degree increase in barrel angle.

The appropriate fixed-angle guide was fixed midway on the lateral cortex so that the guide pin entered at the designated level with the guide pin aimed towards the apex of the femoral head. The central placement was confirmed on the lateral view as well.

Another parallel guide pin was inserted to provide temporary stability, in which the reduction could be lost if the guide pin backed out and to prevent rotation of the femoral head during reaming.

Reaming

Once the guide pin had been inserted and measured, it was advanced an additional 5 mm and secured into the subchondral bone.

Reaming was done according to the exact measurement of the lag screw length, and a lag screw that matched the length measurement was selected.

The triple reamer was set to the lag screw length indicated by the measuring gauge and reaming was done until the distal aspect of the stop reached the lateral cortex.

Insertion of plate and lag screw

The appropriate locking side-plate and lag screw were assembled onto the insertion wrench.

The lag screw was inserted until the desired length. The lag screw was advanced into the proximal femur to the predetermined level and its position was verified with image intensification.

The position and depth of the screw was verified with image intensification in both planes.

The centering sleeve was removed and the side plate was advanced onto the lag screw shaft. The plate tamper was used to fully seat the plate. The threaded guide pin was then removed.

Plate fixation

The plate clamp was used to secure the plate to the shaft. Traction was slowly released to allow impaction of the fracture fragments.

The plate was attached to the shaft of femur using 4.5 mm locking cortical screws.

When all screws had been inserted and all traction had been released, the fracture could be compressed with the compression screw, (usually the 19 mm screw). If a short barrel was used, placement of compression screw was mandatory to prevent potential disengagement of the screw plate assembly.

PFN

Approach

A 3 cm incision was made proximal to the tip of greater trochanter slightly bent dorsally. Skin, subcutaneous tissue and deep fascia were incised. Gluteus maximus was split by blunt dissection and the tip of trochanter felt with finger.

Entry point

After confirming the anatomical reduction, entry point was made with bone awl over the tip of greater trochanter. By confirming the position in AP and lateral view, the awl was driven just proximal to the level of lesser trochanter.

Guide wire insertion and reaming

A 3.2 mm guide wire was inserted and driven into the distal fragment. Proximal reaming was done with 15 mm cannulated awl upto 7 cm distally to accommodate the proximal portion of the nail. Distal reaming was done 1mm more than the desired diameter of the nail.

Nail insertion

The nail closely matching to the neck shaft angle of the unaffected hip was selected and assembled in the jig. The nail was inserted by gentle twisting movements to the appropriate depth to allow placement of two screws within the femoral neck. The guide wire was then removed.

Proximal targeting

The nail with the jig was checked for alignment of proximal and distal targeting guide to the corresponding holes in the nail before insertion. Through a stab incision drill sleeves were inserted into the proximal targeting guide upto the lateral cortex with the help of trocar. Under C-arm control the guide pins for the lag screw and derotation screw were driven in through guide pin sleeves upto 5 mm from the articular surface of the femoral head. The lag screw and derotation screw of appropriate length was inserted after drilling with cannulated drill bit. The derotation screw was kept 10 to 15 mm smaller than the lag screw.

Distal targeting

Distal targeting was done with distal targeting guide and drill sleeves using 4.0 mm drill bit.

Post-operative regimen

Appropriate I/V and oral antibiotics were given. Static quadriceps, ankle range of motion exercises and mobilization was started immediately on post-op day 2. Aseptic dressing change and wound inspection was done on post-op day 3. Toe-touch weight bearing was started on post-op day 4. Suture removal was done on post-op day 14th. Partial weight bearing with walker support was started from 2nd week as tolerated by the patient and based on quality of fixation. Additional drugs were given if osteoporosis was noted and managed accordingly

Period of follow-up

Patients were evaluated and assessed post-operatively, subsequently for a minimum period of 6 months, at regular intervals of 3 weeks, 6 weeks, 3 months and 6 months for functional outcome with the help of modified Harris hip score and radiological union/fracture healing.

Statistical analysis

The quantitative data was represented as their mean±SD. Categorical and nominal data was expressed in percentage. The t test was used for analysing quantitative data, or else non-parametric data was analysed by Mann Whitney test and categorical data was analyzed by using Chi-square

test. All analysis was carried out by using SPSS software version 21.

RESULTS

The DHS group had an average score of 83.05, with 2 patients (10%) achieving excellent results, 12 patients (60%) having good results, 5 patients (25%) with fair results, and 1 patient (5%) with poor results.

Meanwhile, in the PFN group, the average score was 85.50, with 6 patients (30%) achieving excellent results, 10 patients (50%) having good results, 3 patients (15%) with fair results, and 1 patient (5%) with poor results.

Table 1: Mean modified Harris hip scores in present study.

Score	DHS	PFN	P value
	Mean±SD	Mean±SD	
Harris hip Score	83.05±7.21	85.50±7.59	0.302

Table 2: Implant-wise modified Harris hip scores in present study.

Modified Harris hip scores	Implant		
	Locking DHS	PFN	Total
	N (%)	N (%)	N (%)
Excellent	2 (10)	6 (30)	8 (20)
Good	12 (60)	10 (50)	22 (55)
Fair	5 (25)	3 (15)	8 (20)
Poor	1 (5)	1 (5)	2 (5)
Total	20	20	40

Table 3: Age distribution in present study.

Parameter	DHS	PFN
	Mean±SD	Mean±SD
Age	60.90±12.54	57.65±14.02

Table 4: Sex distribution in present study.

Sex	Number of cases	Percentage
Males	30	75
Females	10	25
Total	40	

Table 5: Present study.

Present study	Method of Fixation		Total
	DHS	PFN	
	N (%)	N (%)	
Excellent	2 (10)	6 (30)	8
Good	12 (60)	10 (50)	22
Fair	5 (25)	10 (50)	8
Poor	1 (5)	1 (5)	2
Total	20	20	40

Trochanteric fractures were common in the age group of 51-60 years in this study. Minimum age of the patient was 33 years. Maximum age was 79 years.

Majority of patients were males (75%) and only 25% were female patients.

Figure 1: Case 1 (locking DHS); pre-operative X-rays.

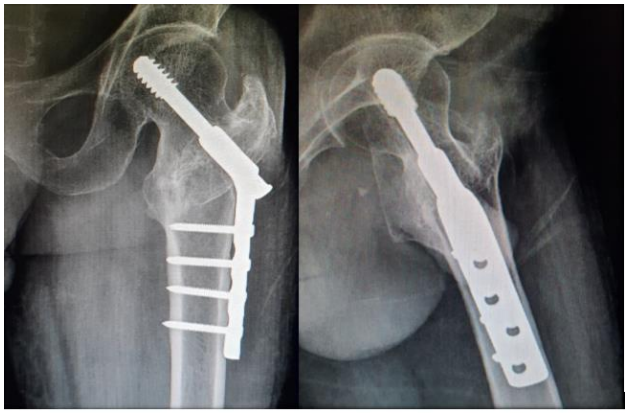

Figure 2: Case 1 (locking DHS); 1-year follow-up X-rays showing complete union.

Figure 3: Case 2 (PFN); pre-operative X-rays.

Figure 4: Case 2 (PFN); immediate post-op X-ray.

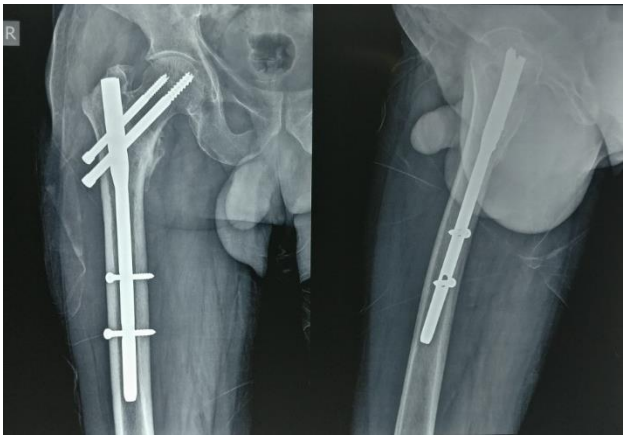

Figure 5: 6 months post-op X-ray showing union.

Figure 6: Case 3 (locking DHS); pre-operative X-ray.

Figure 7: Case 3 (locking DHS); immediate post-op X-ray.

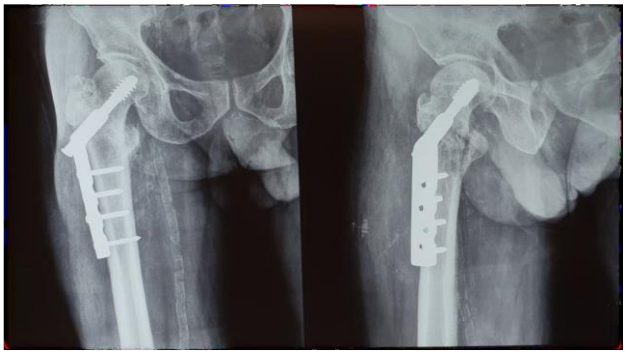

Figure 8: 3-months post-op X-ray.

Figure 9: 6 month follow-up X-ray showing malunion due to excessive collapse.

DISCUSSION

Functional outcome

In a study of 40 patients conducted by Amandeep et al the mean HHS in the DHS group was 83.75 and that in the PFN group was 84.4.[7] In his study of 80 cases, Shakeel et al found that the mean HHS in the DHS group was 73.73 while in the PFN group, it was 83.5.[8] In a study of 60 patients conducted by Sharma et al the mean HHS in the DHS group was 88.7 and that in the PFN group was 82.2.[9] In the present study mean HHS in the DHS group was 83.05 and the mean HHS in the PFN group was 85.50.

Kushal et al in his study of 52 patients noted that in the DHS group, excellent results were seen in 6 (23%), good results seen in 5 (19%), fair results seen in 13 (50%) and poor results seen in 2 (8%).[10]

In the PFN group, excellent results were seen in 4 (15%), good results seen in 14 (54%), fair results seen in 7 (27%) and poor results seen in 1 (4%).

Harish et al(11) in his study of 30 patients noted that in the DHS group, excellent results were seen in 6 (50%), good results seen in 2 (13.33%), fair results seen in 2 (13.33%) and no poor results were seen.[11]

In the PFN group, excellent results were seen in 8 (72.73%), good results seen in 1 (9.1%), fair results seen in 1 (9.1%) and no poor results were seen.

In Gill et al comparative study of 80 patients using the locking DHS and PFN, he noted that in the DHS group, excellent results were seen in 6 (15%), good results seen in 14 (35.0%), fair results seen in 12 (30.0%) and poor results seen in 8 (20.0%).[12]

In the PFN group, excellent results were seen in 8 (20.0%), good results seen in 130 (75.0%), fair results seen in 2 (5.0%) and no poor results were seen.

Assessment of functional outcome in our study was done using modified Harris hip score. The average score was 83.05 in the DHS group and 85.50 in the PFN group.

In the DHS group, the average score was 83.05 with excellent results seen in 2 patients (10%), good results seen in 12 patients (60%), fair results seen in 5 patients (25%) and poor results seen in 1 patient (5%).

In the PFN group, the average score was 85.50 with excellent results seen in 6 (30%), good results seen in 10 (50%), fair results seen in 3 (5%) and poor results seen in 1 (5%).

In our study, the DHS group had more patients with good and fair outcomes and the PFN group had more patients with good and excellent outcomes. The patients in our excellent outcome group had better range of movements, lesser restrictions in activities of daily living and absence of contractures. However, the study compared the outcomes of PFN and locking DHS on stable intertrochanteric fractures and has not compared between their outcome for type 1 and type 2 fractures independently.

We had one patient each in the DHS and PFN groups with a poor functional outcome. The patient in the DHS group had moderate restriction of activities of daily living associated with malunion due to excessive collapse and the patient in the PFN group had moderate restriction of activities of daily living associated with deformities which had resulted from prolonged immobilization against our orders.

During our study, we have observed that few patients (5 patients) in the DHS group required blood transfusions during the post-operative period due to the longer length of incision and associated blood loss. This was not seen in the PFN group, in whom we used a shorter length of incision. Also, the PFN surgeries were associated with a longer operating time and increased C-arm exposure than DHS surgeries. But patients in the PFN group were mobilized partial weight bearing earlier than those in the DHS group.

Limitations

The limitations of the study were the relatively smaller sample size and short period of study.

CONCLUSION

From this study, we conclude that both PFN and DHS with locking side plate have comparable results for stable intertrochanteric fractures.

While the DHS group had more good and fair outcomes, the PFN group had more excellent and good outcomes.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Latheef MB, Sheth S, Basu A, Karnati AKR, Sadalagi P. Comparison of functional outcomes of pertrochanteric fractures of the femur managed with dynamic hip screw with a locking side plate versus proximal femoral nail. Int J Res Orthop 2023;9:545-52.