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A COMPARATIVE STUDY OF PROXIMAL FEMORAL NAIL AND DYNAMIC HIP SCREW FOR INTERTROCHANTERIC FRACTURES OF THE FEMUR

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Dr. Vivek Chauhan Post-Graduate Trainee, Department of Orthopaedics, Pacific Institute of Medical Sciences, Udaipur, India

Dr. Aabid Husain Ansari* Assistant Professor, Department of Orthopaedics, Pacific Institute of Medical Sciences, Udaipur, India*Corresponding Author

Dr. Laxmi Narayan Meena Associate Professor, Department of Orthopaedics, Pacific Institute of Medical Sciences, Udaipur, India

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Abstract

Background: Intertrochanteric fracture is one of the most common fractures of the hip. But the implant of choice for type II intertrochanteric fracture is still under debate. The aim of this study was to compare the functional outcomes of proximal femoral nail (PFN) and dynamic hip screw (DHS) in treatment of intertrochanteric fractures. **Methods:** We did prospective comparative study on 60 patients of type II intertrochanteric fractures operated with closed/open reduction & internal fixation with either Dynamic Hip Screw (DHS) or Proximal Femoral Nail (PFN) between October 2018 to March 2023. During each follow-up the functional outcome of patients was calculated using the Harris Hip Score (HHS).**Results:** There was a statistically significant difference present in average functional scores between two groups at 1 month, 3 months, and 6 months; however no difference was seen at the end of 12th month follow up. Functional outcomes in DHS group were excellent in 34.78%, fair in 17.39%, good in 43.48%, and poor in 4.35%. In the PFN group, results were excellent in 56.52%, fair in 8.70%, good in 34.78% and no poor results were seen. **Conclusion:** In stable two-part intertrochanteric femur fractures both PFN and DHS are equally effective but because of minimal invasiveness PFN is a better implant of choice than DHS in the treatment of elderly patients with intertrochanteric fracture.

Introduction

Intertrochanteric fracture is one of the most common fractures of the hip especially in the elderly with osteoporotic bones.1 The treatment goal of these fractures is stable fixation, which allows early mobilization of the patient and reduce the associated morbidity and mortality. The conservative treatment has high complication rate like decubitus ulcers, U.T.I, joint contractures, pneumonia, and thromboembolism, varus deformity and shortening of limb etc. Hence, the conservative treatment should only be considered in nonambulatory patients, patients with terminal diseases with less than 6 weeks of life expectancy, surgically unfit patients and active infectious diseases.2 The surgical treatment of intertrochanteric fractures has evolved since usage of fixed nail plate, dynamic hip screws (DHS), modified DHS, and intramedullary devices. The advantages and disadvantages of the Dynamic Hip Screw (DHS) have been well established in several studies done in the past.3 But many studies compare the DHS with Gamma nail.4-6 There are limited studies that studies compare the DHS with Proximal femoral nail (PFN), which is being preferred by many.

This study was conducted to compare the functional and radiological outcome of Proximal femoral nail (PFN) with Dynamic hip screw (DHS) in treatment of intertrochanteric fractures.

Materials and Methods

We conducted a prospective comparative study from October 2018 to March 2023 on patients with type II intertrochanteric fractures operated with closed/open reduction & internal fixation with either Dynamic Hip Screw (DHS) or Proximal Femoral Nail (PFN) (Figure 1 & 2). Total of 60 patients have been included out of which 30 belonged to group 1 and were operated with PFN and rest 30 were group 2, operated with DHS. Informed consent was obtained from each patient. We included the surgically fit patients with age more than 50 years of age who has been diagnosed as having type II intertrochanteric fractures. Polytrauma patients, patients with compound fracture or pathological fractures or concomitant shaft femur fractures, patients unfit for the surgery and admitted for re-operation were excluded from the study. The fracture was classified using AO classification. Implant either DHS or PFN was randomly selected. For DHS the length of Richard's screw was measured preoperatively on AP view X-ray subtracting magnification. Neck shaft angle was measured using goniometer on AP view X-ray on unaffected side to determine the angle for barrel plate. At least 4 holes length side plate was used. PFN Nail diameter was determined by sequential reaming of femoral canal. A standard length PFN (180 mm or 240 mm) and 135 degrees angle was used in all our cases. All patients were operated on fracture table under spinal anaesthesia by single operating surgeon. Firstly closed reduction was tried for all the patients and open reduction was done only for fracture which were not reduced by closed reduction. Antibiotics were administered 30 minutes prior to incision and continue for 48 hours postoperatively. Immediate postoperative hip X-ray was taken to ascertain the fracture reduction and position of the implant. Physiotherapy was started from day 1, static quadriceps, knee and ankle mobilisation exercises were started and all patients were allowed to be weight-bearing as tolerated. Wound inspection and drain removal was done on day 2. Most of the patients were discharged on 5th or 6th post op day. Stitches were removed on 14th day. All patients were followed-up at 1 month, 3 months, 6 months and 12 months after the surgery. At each follow-up, pain, ambulatory status and functional outcome of patients using Harris Hip Score (HHS) were evaluated and hip X-ray were taken to check the status of fracture union. The HHS includes pain, function of joint, deformity, and range of movements. The HHS score gives a maximum of 100 points. The higher the HHS, the less the dysfunction. HHS <70 is considered a poor result; 70-80 is fair, 80-90 is good, and 90-100 is excellent.

Statistical analysis was performed with the SPSS version 19.0 (SPSS Inc./IBM, Chicago, IL). A p-value of <0.05 was considered to be statistically significant.

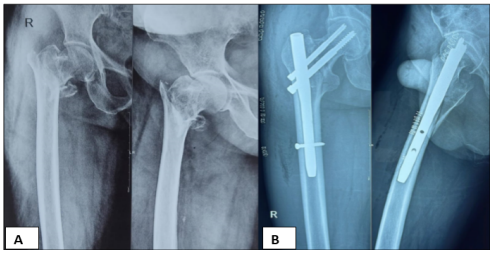

Figure 1: 72 Year-old female patient with intertrochanteric fracture fixed with PFN. (A) Pre-operative radiograph. (B) Immediate post-operative radiograph

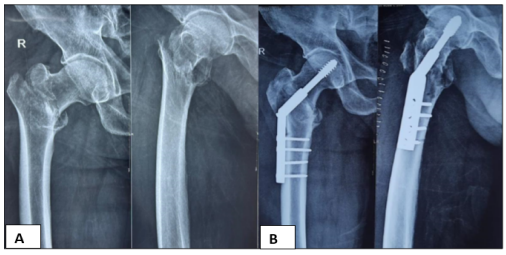

Figure 2: 68 Year-old male patient with intertrochanteric fracture fixed with DHS. (A) Pre-operative radiograph. (B) Immediate post-operative radiograph

Results

A total of 60 patients included in the study. The average age was 60 years (range: 66-86 years). In our study, the most common mode of injury was trivial trauma (77%). The patient characteristics of both groups were not significantly different (Table 1).

Table 1: Patient demographics.

	Group I (PFN)	Group II (DHS)
Number of patients	30	30
Mean patients age (Y)	60.25	62
Gender (Male / Female)	16/14	17/13
Side (Right / Left)	20/10	18/12

The average intraoperative blood loss was greater in DHS group (220ml vs. 80ml, p = 0.01). Five out of 30 patients in DHS group required blood transfusion postoperatively. The mean surgery duration was also more in DHS group (62 minutes vs. 45 minutes, p = 0.02). In PFN, incision was smaller and duration of surgery was shorter so there was less tissue damage and hence lesser blood loss.

Table 2: Variables compared between Proximal Femur Nail (PFN) and Dynamic Hip Screw (DHS).

	Group I (PFN)	Group II (DHS)	p-value
Average Length of incision (cm)	4.2 cm	15 cm	<0.05
Average Intraoperative Blood loss (ml)	80 ml + 16.40 ml	220 ml + 44.98 ml	0.01
Radiation exposure	40 + 1.6 (in no.)	20 + 4 (in no.)	<0.05
Mean Operative time (minutes)	45 min + 18 min	62 min + 3.2 min	0.02
Average Hospital stay (days)	7.35 days	8.24 days	0.001
Sliding	4.3 mm	6.9 mm	0.001
Shortening	4.72 mm	9.3 mm	0.02
Implant failure	1	2	<0.05
Non-union	0	1	<0.05
Deaths	1	1	>0.05
Infection	0	2	<0.05
Greater trochanter splintering	2	0	>0.05
Revision surgery	1	3	>0.05

The average sliding in the PFN group was 4.3 mm as compared to 6.9 mm in the DHS group (P=0.001). The average limb shortening in DHS group was 9.33 mm as compared with PFN group which was only 4.72 mm (P=0.02). Even though there was more shortening in the DHS group, it was not significant enough to cause any gait or functional impairment. The average hospital stay was 8.24 days (5-9 days) in case of DHS while 7.35 days (4-8 days) in case of PFN (P=0.001). Return to pre-injury walking ability in DHS group was on an average of 12 weeks compared to PFN which was 8 weeks (P=0.03). The average Tip-Apex-Distance (TAD) in DHS group was 18.3 mm (range 12-24 mm). As PFN is an intramedullary load sharing device as compared to DHS which is a load bearing device, full and partial weight bearing was started at an early stage for PFN patients (Table 2). The mean time for radiological signs of union were almost same in both groups (3±1 months).

Total 3 patients developed implant failure (1 in PFN group and 2 in DHS group) and revision surgery was done. In PFN group, 'Z' pattern of implant failure was the reason whereas in DHS group, implant failed due to lag screw cut out. In DHS group, one patient developed nonunion which was due to jamming and treated with bone grafting. In PFN group, greater trochanter was splintered intra-operatively in 2 patients which was fixed by tension band wiring. Two patients developed superficial surgical site infection in the DHS group which was managed by regular dressing and appropriate antibiotics. There was one death each in both groups after 3 to 4 months of surgery due to medical comorbidities.

There was statistically significant difference present in average functional scores calculated using the Harris hip score between two group at 1 month (33.33 & 25.25, respectively), 3 months (54.85 & 346.65, respectively), and 6 months (85.20 & 68.25, respectively); however this difference disappeared at the end of 12th month follow up with both scores being almost same (90.33 & 89.55, respectively).

Table 3: Average Functional Scores (Harris Hip Score)

Follow-up	PFN	DHS
1 Month	33.33	25.25
3 Months	54.85	34.65
6 Months	85.20	68.25
12 Months	90.33	89.55

Discussion

Hip fractures are the one of the most common fractures occurs in the osteoporotic elderly population which is significantly associated with higher mortality and morbidity rate.[7] In the last few decades, various treatment methods of intertrochanteric fractures has evolved. The treatment still merits the type of fracture, quality of bone and condition of patient. In the 1960 dynamic hip screw (DHS) was developed for fixation of Intertrochanteric fractures.[8-10] DHS allowed controlled compressive collapse at the fracture site without complications of screw cut out and implant breakage associated with a nail plate. However the extensive surgical dissection, more intraoperative blood loss and more operative time required for this procedure often made it a contraindication in the elderly with comorbidities. DHS also failed to achieve good results in extremely unstable and the reverse oblique fracture.[8-10] In 1997, intramedullary device (Proximal Femoral Nail, PFN) was introduced for fixation of Intertrochanteric fractures. It was designed to overcome implant-related complications and facilitate the surgical treatment of unstable intertrochanteric fractures.[11-14] PFN inserted by a minimally invasive procedure, which allows to minimize soft tissue dissection, thereby reducing surgical trauma and blood loss. The results of our study also demonstrates that operative time, intraoperative blood loss, and length of incision in the PFN group are significantly less than in the DHS group.

Pajarinen et al. noted that PFN allow faster post-operative

restoration of walking ability when compared to DHS.[2] In our study, patients treated with PFN returned to pre-injury walking status earlier than patients who underwent DHS. PFN creates a shorter lever arm, which translates to a lower bending moment and a decreased rate of mechanical failure.[12] We found PFN to be more useful in unstable and reverse oblique fracture patterns, because it is a load shearing device so it provides better axial telescoping and rotational stability compared to DHS.[15-17] PFN also have biomechanically more stronger than DHS because they can withstand higher static and several fold higher cyclical loading, so the fracture heals without the primary restoration of the medial support. Because of intramedullary implant, PFN is also acts as a buttress in preventing the medialization of the shaft.[18,19] Herman et al. suggested that in PFN placing of lag screw within the "safe zone" (second quarter of the head-neck interface line) could significantly reduce the mechanical failure rate.[20] There was no significant difference in the mean HHS between the two groups at 12th months follow-up. In this study, functional outcome in DHS group were excellent in 34.78%, fair in 17.39%, good in 43.48%, and poor in 4.35%. In PFN group, results were excellent in 56.52%, fair in 8.70%, good in 34.78% and no poor results were seen (Table 4 & 5 and Figure 3).

Table 4: Mean Harris hip score comparison between other studies.

	Mean Harris Hip Score	
	PFN	DHS
Present study	90.33	89.55
Amandeep et al.[21]	84.4	83.75
Shakeel et al.[22]	83.5	73.73
Anmol Sharma et al.[23]	82.2	88.7

Table 5: Functional outcome comparison between other studies. (all data are in percentage)

Functional outcome	Present study		Kushal et al.[24]		Harish etal.[25]		Gill et al.[26]	
	PFN	DHS	PFN	DHS	PFN	DHS	PFN	DHS
Excellent	56.52	34.78	15	23	72.73	50	20	15
Good	34.78	43.48	54	19	9.1	13.33	75	35
Fair	8.70	17.39	27	50	9.1	13.33	5	30
Poor	0	4.35	4	8	9.1	13.33	0	20

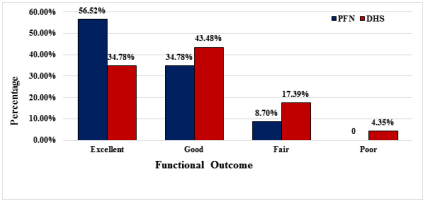

Figure 3: Bar diagram showing the functional outcome of the DHS and the PFN group based on Harris hip score.

In the present study, two patients developed superficial surgical site infection in the DHS group which was managed by regular dressing and appropriate antibiotics. Patients treated with DHS have high incidence of superficial infection because of lengthier incision.22,26 Three patients (two patients in the DHS group and one patient in the PFN group) developed limb length discrepancy of upto 1-2 cm, which is also similar to the study conducted by Amandeep et al. 21 The limitations of this study include small sample size and small follow up.

Conclusions

In stable two-part intertrochanteric femur fractures both PFN and DHS are equally effective but because of minimal invasiveness PFN is a better implant of choice than DHS in the treatment of elderly patients with intertrochanteric fracture.

Conflicts of interest

There are no conflicts of interest.

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