Research article
Orthopaedics

SHOULD PFN TAKE OVER FROM DHS IN UNSTABLE PERITROCHANTERIC FRACTURES OF FEMUR

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Abstract:

Expected age of human race is getting amplified, leading to augmented number of geriatric people with osteoporotic bones and falls associated with them resulting in hip fractures. We studied & grouped these according to AO classification. Biomechanical studies have shown that for these fractures intramedullary device with sliding screw is better as compared to DHS. This was a prospective study of 50 cases of peritrochanteric fractures of femur evaluated as per Harris Hip score for PFN76 % of the patients had excellent to good functional score with 24% of patients had fair to poor functional score due to presence of co-morbidity or affected by one of the complications mentioned further. In our study, the average Harris Hip Score was 82.12 with the range of 66.5-92.5.

Keywords: *Peritrochanteric, Femur, DHS, PFN.*

Introduction

The incidence of the hip fracture has been rising with an aging population in many parts of the world, and the number of hip fractures is expected to reach 512,000 in the year 2040.[1] Inter-trochanteric fractures account for approximately half of the hip fractures in elderly; Out of this, more than 50% fractures are unstable.[2,3] Damage usually happened due to falling in women over fifty years although it happens in young people with severe trauma and other fractions.[1] The goal of treatment is to restore mobility safely and efficiently and to restore the patient to pre-operative status. There are two main types of fixations for these fractures i.e. plate fixation and intramedullary implants.[4,5] Dynamic hip screw (DHS) has been the standard implant in treating trochanteric fractures.[6-11] It is the usual device but complications are frequent, particularly in unstable inter-trochanteric fractures. Proximal femoral nail (PFN) and Gamma nail are 2 commonly used devices in the intramedullary fixation. Earlier gamma nail did not perform as well as DHS because it led to a relatively higher incidence of post-operative femoral shaft fracture.[6,7] PFN, introduced by the AO/ASIF group in 1997, has become ubiquitous in treatment of intertrochanteric fractures in recent years because it was enhanced by addition of an anti rotation hip screw proximal to the main lag screw.[12-15] The additional advantage is that it provides a more biomechanically stable construct by reducing the distance between hip joint and implant.[5,9] Research shows that PFN fixation is more effective than DHS fixation in terms of diminishing operation time and blood transfusion, as well as plummeting hospital stay, wound complication, re-operation, and mortality. The goal of this study is to compare the clinical and radiographical results of the load bearing (DHS) versus Load shearing device (PFN) & to investigate & evaluate significant difference between PFN and DHS fixation if any.

Aims And Objectives

To accomplish fracture healing by using two dissimilar kinds of internal fixation devices in similar type of fractures & to have anassessment and appraisal of effectiveness and might of PFN versus DHS in the management of fractures of peri trochanteric fractures.

Material And Methods

A prospective study was conducted on 50 (25 in each group) patients with unstable IT fractures admitted in the orthopedics department of tertiary care hospital of Punjab in a period of one year. Ethical clearance was obtained from the institutional ethics committee and after obtaining written informed consent. 25cases were treated by proximal femoral nailing (PFN- group A) and rest were treated by dynamic hip screw (DHS-group B) with random allocation of patients. AO/OTA classification was used. According to AO/OTA classification-

31A1 - fractures are simple, two-part fractures, (stable fractures)

31A2 - fractures have multiple fragments (unstable fractures)

31A3 - fractures includes reverse oblique and transverse fracture patterns (unstable fractures)

Inclusion criteria

Patients in the age group of 20-90 years (skeletally mature) of either sex with unstable Intertrochanteric fracture type 31-A 1/2/3 (OTA classification)

Exclusion criteria

Patients unfit for the surgery or having pre-existing hip/femoral deformity; with polytrauma; open/ pathological/ bilateralfractures; patients with less than 01years of follow-up.

The relevant information like history, general, systemic and local examination initial radio-graph of the hip joint was conducted along routine pre anesthetic evaluations. All surgeries were performed on the traction table following closed reduction, confirmed with fluoroscopy. For PFN, the nail diameter was determined by measuring diameter of the femur at the level of isthmus and a standard length PFN (250 mm) was used. Neck shaft angle was measured in unaffected side.

Figure 1: Pre-op - IT fracture

Figure 2: Post-op - Proximal femoral nailing

Figure 3: Pre-op IT fracture

Figure 4: post DHS fixation

Figure 5: Pre-op - unstable IT fracture.

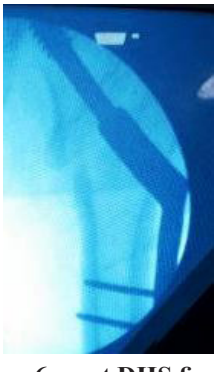

Figure 6: post DHS fixation

For DHS length of compression screw was measured. Neck shaft angle was determined& length of side plate was also determined. After insertion, wounds were closed in layers and antiseptic dressing was applied. Appropriate antibiotics, analgesics were given for 3 days& then switched over to oral antibiotics. Sutures were removed on 12th postoperative day. Muscle strengthening exercises and movements at hip and knee joint were happening on 5th day. Partial weight bearing initiated after substantiation of beginning of healing process. Full weight bearing was permissible post fracture union.All the patients were followed up clinically on the basis of Harris Hip Score, radiologically and functionallyuntill fracture union happened.

Results And Observations

Table 1: Age Wise Distribution Of Cases

Age(Year)	No.of patients in PFN	No.of patients in DHS
20-30	02(08.0%)	02 (08.0%)
30-40	03 (12.0%)	02 (08.0%)
40-50	03 (12.0%)	05 (20.0%)
50-60	07(28.0%)	05 (20.0%)
60-70	07(28.0%)	08 (32.0%)
70-80	02 (08.0%)	03 (12.0%)
80-90	01 (04.0%)	00 (00.0%)
Total	25 (100%)	25(100%)

54% were in age group of 50- 70 yrs, out of these 56% were in PFN and 52% in DHS group.Mean age in years of patients treated with PFN was 58.6& was 56.5 in DHS.

Table No .2: Sex Wise Distribution

Sex	No. of patients in PFN	No. of patients in DHS
Male	19(76.0%)	15(60.0%)
Female	06(24.0%)	10(40.0%)
Total	25(100.0%)	25(100.0%)

Table No.3: Mode Of Trauma

Mode of trauma	PFN	DHS
Road traffic accident	08 (32.0%)	08 (32.0%)
Domestic fall (fall at home)	16 (64.0%)	17 (68.0%)
Assault	01 (05.0%)	00 (00.0%)
Total	25(100.0%)	25 (100.0%)

Patients 50 years and above had domestic fall (66.0%), while in road traffic accident (32%, RTA) young patients were affected.

Table No.4: Side Of Injury

Side	PFN	DHS
Left	15 (60.0%)	11 (44.0%)
Right	10 (40.0%)	14 (56.0%)
Total	25(100.0%)	25 (100.0%)

Table No.5: Site Of Fracture

Type of facture	PFN	DHS
Intertrochanteric	15 (60%)	20 (80%)
Subtrochanteric	10 (40%)	05 (20%)
Total	25	25

We included patients with AOtype 31A1 - fractures were simple, two-part fractures, (stable fractures), 31A2 - fractures had multiple fragments (unstable

fractures), 31A3 - fractures included reverse oblique and transverse fracture patterns (unstable fractures), 60% cases of intertrochanteric fractures treated by PFN and 80% cases of intertrochanteric fractures seenamongst 25 cases treated by DHS.

Table no.6:
Association Between Type Of Fracture And Side Of Injury

Type of fracture	PFN		DHS	
	Left	Right	Left	Right
AO type 3.1 AI	11(64.7%)	06 (75.0%)	08(80.0%)	12(80.0%)
AO type 3.1A2, 3.1 A3	06(35.3%)	02(25.0%)	02 (20.0%)	03 (20.0%)
Total	17(100.0%)	08(100.0%)	10(100.0%)	15(100.0%)

Table No.7:
Stability Pattern Of Intertrochanteric Fractures

	PFN	DHS
Stable 3.1 A1	10 (40.0%)	16(64.0%)
Unstable 3.1 A2, 3.1 A3	15 (60.0%)	09 (36.0%)
Total	25 (100.0%)	25(100.0%)

Table No. 8:
Time Duration For Surgery

Time duration for surgery(Days)	PFN	DHS
0-5	18(72%)	18 (72%)
5-10	06 (24%)	05 (20%)
10-15	01 (04%)	02 (08%)
Total	25 (100%)	25 (100%)

Table No 9:
Type Of Reduction

Reduction	PFN	DHS
Open	06 (24.0%)	04(16.0%)
Closed	19 (76.0%)	21 (84.0%)
Total	25	25

Table No. 10:
Length Of Proximal Screws Used PFN
DHS

Lag Screw		
Length (in mm)	No. of cases	Percentage
50	00	00%
55	00	00%
60	00	00%
65	01	04%
70	02	08%
75	02	08%
80	10	40%
85	07	28%
90	02	08%
95	01	04%
100	00	00
105	00	00
110	00	00
115	00	00
Total	25	100%

Table No. 11:
Associated Injuries

Injuries	No.of patients	No.of patients
	PFN	DHS
Head injuries	00	02 (50%)
Blunt abdominal injury	00	00
Blunt chest trauma	00	00
Fracture lower end radius	02 (66.67%)	02 (50%)
Fracture calcaneum	01 (33.33%)	00
Total	03	04

Table No. 12:
Complications Seen

Complications	No. of patients PFN	No. of Patients in DHS
Systemic complications	0	0
Chest infection	02 (08%)	02 (08%)
Pulmonary embolism	0	0
Respiratory distress	0	0
Urinary tract infection	01(04%)	01 (04%)
Urinary retention	0	0
Deep vein thrombosis	0	0
Local complication	0	0
Superficial wound infection	02(05%)	02 (08%)
Deep wound infection	0	0
Death	0	0

Table No 13:
Rotational Malalignment

Rotational malalignment	No. of Patients	
	PFN	DHS
External rotation	01 (04%)	0
Internal rotation	0	0
Varus deformity of hip	01 (04%)	02 (08%)
Valgus deformity	0	0
Shortening	01 (04%)	03(12%)

Table No. 14:
Implant Related Intraoperative Complications (PFN)

Intra operative complications	No.of patients	Percentage
Ill fitting jig	05	20%
Impropriate length of proximal screws	00	0
Difficulty in distal locking	00	0
Fracture of greater trochanter	00	0
Fracture below tip of nail	00	0
Revision surgery	00	0

DHS

Intra operative complications	No.of patients	Percentage
Difficulty in Reduction	02	08%
Shattering of Lateral Cortex	01	04%
Fracture below the plate	0	0
Breakage of plate	0	0
Breakage of screw	0	0

Table No.15:
Radiological Complications Encountered (Post OP, PFN)

Complications	No of patients	Percentage
Cut out of neck screw	00	0
Z effect	00	0
Reverse Z effect	02	08%
Breakage of nail	01	04%
Bolt breakage	00	0

DHS

Complications	No of patients	Percentage
Excessive Lag Screw back out	02	08%
Plate breakage	0	0
Cortical Screw Loosening	0	0
Cortical Screw breakage/bending	0	0

Table no. 16:
Hip range of motion (Calculated by Harris Hip Score)

Range of Motion	PFN				DHS			
	Excellent	Good	Fair	Poor	Excellent	Good	Fair/Poor	Poor
Flexion	06(24%)	13(52%)	04(16%)	02(08%)	06(24%)	13(52%)	3(12%)/2(08%)	01(04%)
Abduction	05(20%)	13(52%)	05(20%)	2(08%)	05(20%)	13(52%)	04(16%)/01(04%)	02(08%)
Ex.Rotation	05(20%)	13(52%)	05(20%)	2(08%)	05(20%)	13(52%)	04(16%)/02(08%)	01(04%)
Int.rotation	05(20%)	13(52%)	05(20%)	2(08%)	05(20%)	13(52%)	4(16%)/01(4%)	2(08%)

We took less exposure time where reduction was not a problem. More exposure time was there to begin with but with know-how the radiation exposure was less.Duration of surgery was more initially in cases of subtrochanteric fractures when compared to trochanteric fractures and in fractures where open reduction was needed.Blood loss-measured by mop count (50ml each mop), more blood loss was seen in patients who required open reduction.

Table –
Intraoperative Details

Intra-operative details	PFN	DHS
Mean duration of screening(in seconds)	80	77
Mean duration of operation(in minutes)	90	97.5
Mean blood loss(in ml.)	120	135

Average time for which patient was admitted in our wards was 02 weeks i.e. 14 days irrespective of method of fixation.

Follow Up

We have done follow up examination at the end of 06 weeks, 12 weeks, 24 weeks following

Surgery in both modalities of fixation.

Average Time Of Union

Average time of union in all our 40 patients was 16 weeks (range: 12 - 20 weeks)in both modalities of fixation..

Discussion

Operative treatment permits early rehabilitation and best functional recovery, and is treatment of choice fortrochanteric fractures. The DHSstill remains the GOLD STANDARD for stable 3 1 A1 fractturesbut recently techniques of closed intramedullary nailing have gained recognition in unstable 3 1 A2 and 3 1 A3 fractures.

Majority of the cases i.e. 54% were seen in 50- 70 yrs of age, out of these 56% in PFN and 52% in DHS group. Mean age in years of patients treated with PFN was 58.6& with DHS was 56.5.This signifies that old aged patients are involved in low energy trauma like domestic fall. Gallaghar et al (1980) reported an eight fold increase in trochanteric fractures in men over 80 years and women over 50 years of age[16]. Average age reported by other workers is as follows Cleveland et al reported higher incidences of multiple fractures, as of the same or opposite side, which may occur at different occasions.[17]

Most were males; in 5th-7th decade, while young patients were in 2nd to 4th decade. Females were also in 5th-7th decade.[18] The ratio of males to femaleclearly reflected higher incidence of peritrochanteric fractures,the preference and better acceptance of surgery by males due to their ambulatory lifestyles. Davis G. Lovelle found trochanteric fractures more common in women than men (3:1).[19] Melton J.L., Ilistrup DM, Riggs BL et al (1982) reported a female to male ratio of 1.8:1.[20] Cleveland et al [17] in their study had 87.7% of female patients. This variation in our study is probably because of ambulatory style of males and more incidences of road side accidents now a day and thus more prone to accidents/ fall. Females play a more dormant role and are involved more in household activities& have slighter chances of fracture.

Name of the worker	Age in years
Cleaveland and Thompson, 1947[17]	76.0
Murray and Frew, 1949	62.5
Boyd and Griffin, 1949[21]	69.7
Scott, 1951	73.3
Evans 1951 Males Females	62.6 74.3
Wade and Campbell (1959)	72.0
Sarmiento, 1963	71.9
Gupta, RC, 1974	51.2

H. B. Boyd and L. L. Griffinin their study of 300 cases found that 226 (75.8%) of the patients were females and 74 (24.2%) were males.[21] St. Urnier K.M., Dresing K.(1995) suggested that peritrochanteric fractures ordinarily appears to women 10-15years later than to men.[22] In this series of 28 patients, 66.0% of patients were male and 32.0 % werefemales. Ratio of males: females in other series is given below:-

Series	Males	Females
Boyd and Griffith (1949)[21]	74	226
Murray and Frew 1949	56	46
Scott (1951)	35	65
Robey 1956	46	53
Clawson 1957	75	102

In the cases treated by (PFN & DHS) there were 66% due to domestic fall &32% due to RTA, in 02%, it was due to assault.

This may be attributed to the following factors as enumerated by **Cummings and Nevitt in 1994**;inadequate protective reflexes, to reduce energy of fall below a certain critical threshold. Insufficient local shock absorbers e.g. muscle and fat around hip,inadequate bone strength at the hip on account of osteoporosis orosteomalacia. Young patients with intertrochanteric or subtrochanteric fractures sustained trauma either as a result of road traffic accident or fall from height, there by reflecting the requirement of high velocity trauma to cause fracture in the young.[23] **Horn & Wang** stated that mechanism of injury is not direct but due to failure of Stress resisting forces during sudden bending or twisting.[24] Total 60% cases of intertrochanteric fractures were seen amongst 25treated by PFN and 80% cases of intertrochanteric fractures seen amongst 25 treated by DHS.

Fractures having intact posteromedial cortex are considered as stable fractures. Postero medial cortex constitutes mainly the lesser trochanter.[25,26] We had 52% stable fractures and 48% unstable ones. This correlated with the finding of Jacobs and coworker (1980) that incidence of comminuted unstable intertrochanteric fractures is increasing.[26]

72% in present study series were operated within 03 days following

admission. In 28% Patients operative procedure was delayed due to medical problems (Hypertension and Diabetes). Average time lapse for surgery was 4.25 days. Urgent surgical intervention is necessary, as it not only avoids development of complications like hypostatic pneumonia, catheter sepsis, cardio respiratory failure, decubitus ulcers, but also early rehabilitation and mobilization is possible, thereby improvement in the general well being of the patient occur.[25] In A1 and A2 fractures axial loading leads to fracture impaction, whereas in A3 fractures such impaction does not occur, and medial displacement of the distal fragment of the fracture is common due to the instability.[26,27] Presence of extensive comminution& marked angulations, displacement, sagging at fracture site (type 3.1 A2, 3.1A3) warrants use of extramedullary device like the DHS.[28]

Proximal femoral nail has provision to insert two proximal screws; larger lag screw (85-95 mm in 80% of cases in our study) with a uniform diameter of7.9 mm, Smaller anti rotation screw (75-80mm in 76% in our series) with a uniform diameter of 6.4mm. The length of the hip pin is less than the lag screw to prevent the 'Z' effect. Cut out rate of PFN is 6-8%.[29]but when hip pin was 10mm shorter than lag screw percentage of total load carried by hip pin ranged from 8-39% (average 2/7) & there was no cutout from the femoral head. So was in our series. Tip of lag screw should always be inferior to centre of femoral head. (TAD less than 25mm).[30] Cut out is usually as a result of poor positioning of the proximal screw.[31,32] Length of Richard's screw (Lag Screw) used in DHS were in the range of 65 mm to 95 mm length. Amongst them, in 04%- 65 mm screw was used, 08% -70 mm, 08% - 75mm screw, in 40% - 80 mm screw, in 28% - 85mm screw, in 08% - 90 mm screw while in 04% - 95 mm lag screw was used. In DHS the lag screw placement must be in the centre as far as possible.

Superficial would infection was seen in 16% cases; out of these 08% in patient operated by PFN while 08% were seen in those operated by DHS thus having equal incidence. The 08% patients operated by PFN had infection in distal lock site; while the 08% cases operated by DHS had superficial wound infection at the suture site. This may be attributed to low immunity status of patient as the patient was of asthenic built and belonging to low socioeconomic status & more soft tissue exposure, which is more in cases operated by DHS. In all these patients treatment with IV Antibiotics was prolonged. Dressings of wounds were done as per necessity.[33] In all the cases the wound healed. **A. Bodoky, U. Neff, M. Heberer & F. Harder** advocated the use of two doses of cephalosporin antibiotics preoperatively in the patients managed with internal fixation of hip fractures as it significantly reduced the incidence of woundinfection.[34] **Verley GW, Milner SA** (1995) in their study of 177 patients of proximal femoral fracture, in their surgeries they kept drain in the wound.[35] Those patients in which drain was kept showed better wound healing in terms of ASEPSIS wound scoring system and had a reduced rate of infection. We also did so.

We did not encouter any screw cut through. **Baumgaertner M.R Chvostoski (1995)** reported the incidence of fixation failure to be as high as 20% in unstable fracture patterns. Osteoporosis was found to be the most important predisposing factor for this complication.[36]

External rotation of 15° was noticed in 04% operated by proximal femoral Nail (PFN). Osteosynthesis with the PFN offers the advantages of high rotational stability of the head-neck fragment.[25] Varusdeformitity was noted in 04%.It might be seen due to early backing out of screws. In 04% we noted shortening of one cm. which was not significant functionally for patient. Shortening might have resulted due to comminution of variable degree at fracture site & concentric collapse at fracture site.[37] In 08% of Varus deformity was seen in the cases operated by DHS. There were 12% of shortening seen in the cases operated by DHS. This shortening ranged from 1-1.5 cm. In the series by **K.D Harrington**out of 72 cases there were 4 cases of coxavara and 56 cases of limb shortening at an average of 1.5 cms.[38] In the series by **Juluru P. Rao**of the 124 cases of intertrochanteric fractures, 5 cases of unstable fracture had limb shortening.[39] In present study, the cases that we operated by Proximal Femoral Nail (PFN) we have not encountered 'Z' effect while in 08% we have found reverse 'Z' effect.

In 04% nail was broken at site in between proximal screws & distal lock & it was found that patient had started unpermitted early full weight bearing leading to this complication.

PFN nail has been shown to prevent the fractures of the femoral shaft by having a smaller distal shaft diameter which reduces stress concentration at the tip.[40] In patients with unstable intertrochanteric fractures treated with proximal femoral nailing, technical or mechanical complications seem to be related to the fracture type, operating technique, and time to weight bearing rather than the implant itself.[41] In 04% operated by DHS, it was seen that there was excessive back out of the Richard's screw (lag screw).Average

time for which patient was admitted in was 14 days i.e. 2 Weeks. Partial weight bearing was allowed at six weeks and full weight bearing was allowed at 12 weeks due to lack of compliance in follow up. In the series of **B. Mall** (30 patients) average time of ambulation was 14 days.[42] In the series of **Dr. G.S kulkarni** ambulation was usually started after 11-12 days after the stitch removal.[43] Average time of union was about 16 weeks. (Range:12 to 20 weeks). We have used criteria for union as presence of bridging callus at fracture site, at most of the fracture circumference with density similar to adjacent cortical bone & clinically, absence of pain at fracture site.

Radiological Time Of Union In Our Study

Sr. No.	Series	Radiological union (in weeks)
1	Kevin D. Harrington[38]	16
2	Juluru- P. Rao[39]	18
3	B. Mall[42]	14
4	Present Series	16

We considered various intraoperative parameters such as duration of radiographic screening-more exposure in case of comminuted fractures with difficult reduction. We took less exposure time in cases of intertrochanteric fracture where reduction was not a problem by Proximal femoral Nailing (PFN). We took more exposure time for the initial few cases but as we got experience the radiation exposure was less.

Duration of surgery was more initially, more in cases of subtrochanteric fractures when compared to trochanteric fractures and in fractures where we had to do open reduction.

As compared to those peri trochanteric fractures operated by Dynamic Hip Screw, we found out the radiation exposure was definitely lesser than cases operated by Proximal femoral nail.

Secondly, Blood loss-measured by mop count, more blood loss was seen in patients who require open reduction. As the incisions taken in fractures treated by Proximal femoral nailing (PFN) are small, the mean blood loss was relatively lesser as compared to those treated by Dynamic Hip Screw (DHS).

The range of movement calculated by the Harris Hip Scoring system treated by both the implants i.e PFN and DHS was good and was almost the same. The range of movements namely flexion, extension, external and internal rotation was good in most cases, excellent in a few. In very few there were poor results. The poor result was attributed to other associated factors namely a long interval between trauma and surgery & development of postoperative infection.

Conclusion

- With Proximal femoral nail, a smaller exposure is required than, therefore associated with lesser blood loss, shorter operating time and less morbidity.
- It has mechanical advantages, a shorter lever arm and a lower bending movement on the device.
- In osteoporotic bones Proximal femoral nail fixation carries definitive advantage.
- Malrotation and deformity is found to be lower.
- Proximal femoral nails prove to be more useful in difficult fractures with a subtrochanteric extension or reversed obliquity and for high subtrochanteric fractures.
- The rotational stability was higher.
- The incidence of wound infection was found to be lower.
- A central position of screw is probably optimal for peritrochanteric fractures.
- Non-union of trochanteric fracture with these is a rare entity.
- No secondary femoral fracture in patients managed by PFN.
- Severely comminuted fractures were treated better with the Dynamic Hip Screw(DHS) device as compared to Proximal femoral nail (PFN).
- The learning curve for the treatment of fractures by Dynamic Hip Screw was smaller as compared to Proximal Femoral Nail.
- The screening time with the help of image intensifier was much lesser in the cases operated by DHS as compared to cases operated by PFN.
- The implant related complications were much smaller in the patients treated with DHS. Irritation at insertion site was common in cases treated with PFN.
- Operative management which allows early rehabilitation and offers the best chances for functional recovery is the treatment of choice for all trochanteric fractures. The preferred type of implant is still a matter to ponder.

However, the rate of union was similar in two groups.(PFN & DHS). Both the implants in their own right are excellent modalities in the management of peritrochanteric fractures of the femur depending upon

type and stability of fracture.

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