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**Original Research Article**

# A study of management of trochanteric fracture of femur treated with dynamic sliding hip screw-plate device vs. proximal femoral nail

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## ABSTRACT

**Background:** The incidence of intertrochanteric fractures has been increasing significantly due to the rising age of modern human populations. Generally, intramedullary fixation [proximal femoral nail (PFN) and gamma nail] and extra-medullary fixation [dynamic hip screw (DHS)] are the 2 primary options for treatment of such fractures. Objectives: The goal of this study is to compare the clinical and radiographical results of DHS and PFN for the treatment of trochanteric hip fractures.
**Methods:** Patients with trochanteric fractures were treated either with DHS or PFN in the Department of Orthopaedics, M.G.M. Medical College and L.S.K Hospital, Kishanganj, Bihar from October 2010 to October 2012 were included for this study.
**Results:** Forty three patients (24 male and 19 female, ratio of M:F 1.26:1) surgically treated for trochanteric fractures were divided into two groups. Group 1: 25 hips treated with DHS and group 2: 18 hips treated with PFN. The outcome for each group was analyzed, and total operative time, time to union, complications (early and late), and mortality were recorded. The results were statistically compared. Out of 25 cases of DHS, majority cases (13) took between 1 hour 36 minutes to 2 hours. Whereas, out of 18 cases of PFN, majority (8) took 1 hour to 1 hour 30 minutes. The mean time to union for group 1 was 2.09 months and 1.69 months for group 2. Early and late complication rates between treatment groups revealed no statistically significant differences. Total duration of surgery was significantly lower for PFN than it was for DHS. A comparison of time to union and overall mortality demonstrated no statistically significant differences.
**Conclusions:** We detected no differences between the two treatment groups in regard to early versus late complications, time to union, and overall mortality; however, with its shorter operative period, PFN is a good alternative to the DHS.

**Keywords:** Trochanteric fracture, Dynamic hip screw (DHS), Proximal femoral nail (PFN), Outcome analysis, Nail

## 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] There were an estimated 1.66 million hip fractures world-wide in 1990. According to the epidemiologic projections, this worldwide annual number will rise to 6.26 million by the year 2050. This rise will be in great part due to the huge increase in the elderly population of the world. However, the age-specific incidence rates of hip fractures have also increased during the recent decades and in many countries this rise has not leveled off. In the districts where this increase has either showed or leveled off, the change seems to especially concern women's cervical fractures. In men, the increase has continued unabated almost everywhere. Reasons for the age-specific increase are not known: increase in the age-adjusted incidence of falls of the elderly individuals with accompanying deterioration in the age-adjusted bone quality (strength, mineral density) may partially explain the phenomenon.[2]

Surgical treatment with stable fixation allows early mobilization and reduces complications. There are two main types of fixations for trochanteric fractures, which are plate fixation and intramedullary implants.[3] Generally, intramedullary fixation and extramedullary fixation are the 2 primary options for treatment of such fractures. The dynamic hip screw (DHS), commonly used in extramedullary fixation, has become a standard implant in treatment of these fractures. Proximal femoral nail (PFN) and Gamma nail are 2 commonly used devices in the intramedullary fixation.[4,5] Previous studies showed that the 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]

Dynamic hip screw (DHS) or sliding hip screw (SHS) has been the standard implant in treating trochanteric fractures.[4,6,8-11] However, when compared with the intramedullary implants, it has a biomechanical disadvantage because of a wider distance between the weight bearing axis and the implants.[12]

The proximal femoral nail (PFN) introduced by the AO/ASIF group in 1998 has become prevalent in treating trochanteric fractures in recent years.[13,14] Although there were several reports showing benefits of proximal femoral nail, it was still associated with technical failures.[15-17] The cost of PFN is also much more than DHS. Therefore, we conducted a meta-analysis to investigate whether there is a significant difference between PFN and DHS fixation in treating trochanteric fractures. The hypothesis is that PFN fixation is not more effective than DHS fixation in terms of decreasing operation time and blood transfusion, as well as reducing hospital stay, wound complication, reoperation, and mortality.

## METHODS

This was a prospective, comparative observational study. Patients with trochanteric fractures were treated either with dynamic hip screw (DHS) or proximal femoral nail (PFN) in the Department of Orthopaedics, M.G.M. Medical College and L.S.K Hospital, Kishanganj, Bihar from October 2010 to October 2012 were included for this study. Institutional ethics committee permission was taken before starting above study. Individual patient's written consent was taken before enrollment in the study.

### *Pre-operative planning*

*Dynamic hip screw*

Length of the Richard's screw is measured from the tip of the head to the base of the greater trochanter on AP View X-ray subtracting magnification. Neck-shaft-angle was measured using goniometer on X-ray AP view on the unaffected side. Length of the side plate is determined to allow purchase of at least 8 cortices to the shaft distal to the fracture.

*Proximal femoral nail*

Nail diameter was determined by measuring diameter of the femur at the level of isthmus on AP X-ray. Neck-shaft-angle was measured in the unaffected side in AP X-ray using goniometer. A standard P.F.N (250 mm) was used in all cases.

### *Operative procedures*

Spinal/epidural/general anesthesia was used depending upon anesthesiologist's preference. Supine position on the fracture table and the extremity has been secured in traction foot piece. Traction has been exerted longitudinally on the abducted extremity. Maintaining traction, the limb was adducted and internally rotated at the same time and checked in C-Arm.

*Technique for DHS*

After proper scrubbing and draping by antiseptic solution, a lateral incision was being made at the proximal femur from greater trochanter extending distally. Proximal aspect of insertion of gluteus maximum and the tip of the lesser trochanter, which are approximately 2 cm below the vastus lateralis ridge guide pin was inserted. To obtain reaming depth, tapping depth and lag screw length, subtracting of 10 mm of the length from the value obtained by measuring device. By setting of reamer to the correct depth, triple reamer is being inserted. If necessary, tapping is being done to the predetermined depth by tap assembly.

*Insertion of lag screw*

After proper selection of lag screw, assembly is being done with lag screw insertion assembly. Sliding the assembly over the guide pin and in to the reamed hole. Inserting of lag screw by turning the handle clock wise until the zero mark on the assembly align with the lateral cortex. After complete insertion of lag screw, alignment of the handle is being done at the same plane of the femoral shaft for proper placement of the DHS plate on the lag screw.

*Fixation of plate and application of DHS compression screw*

After releasing the traction, plate is being fixed with 4.5 mm cortical screws and compression screw is being applied.

*Postoperative follow-up*

I/V antibiotics in the form of third generation cephalosporins, aminoglycosides were given. Oral antibiotics were started from 4th post-operative day and continued till suture removal. Analgesics for 5 days and SOS. Drains were removed after 48 hours. Static quadriceps exercises were started from second day onwards. Early hip and knee assisted range of movements were started from third day. Suture removal after tenth day patient discharged after giving appropriate physiotherapy instructions like rehabilitation i.e. partial weight bearing exercises 2-4 weeks postoperatively. Full weight bearing was allowed after radiological and clinical signs of union, usually 6-8 weeks. All patients were advised to attend follow up clinic after 6, 10, 14, 18, 22, 26, 36, 48, 60 and 72 weeks.

*Clinical assessment*

Gait**,** pain**,** able to sit cross legged**,** able to squat**,** movement of the hip joint**,** power of abductor muscles of hip**,** limb length discrepancy**,** Kyle's Criteria**,** Friedman & Wyman criteria and whether to return to pre-injury occupation were assessed.

*Radiological assessment*

Sign of union, position of the implant, collapse and any specific findings were noticed.

Follow up were done at interval of 6 weeks considering the following parameters.

**Table 1: Clinical and radiological assessment.**

| Parameters | Grade I | Grade II | Grade III |
|---|---|---|---|
| **Pain** | No | Occasional | Moderate-Severe |
| **ROM of hip** | > 75% | 50-75% | < 50% |
| **Infection** | No | Superficial | Deep |
| **Shortening** | < 0.5 cm | 0.5-1 cm | > 1 cm |
| **Squatting and C/L sitting** | Easily Possible | With discomfort | Not possible |
| **Abductor power** | Grade 4 - 5 | 2 - 3 | 0-1-2 |
| **Radiological union** | < 16 weeks | 17-21 weeks | > 21 weeks |

## RESULTS

In our study of 43 patients, male and female patients were 24 [55.8%] and 19 [44.18%] respectively [Table 2]. In our study majority of cases were over 50 years old. 15 patients were between 51 – 60 years and 20 patients were over 60 years suggesting that this type of fracture is commonly seen in elderly population [Table 2].

**Table 2: Age and sex distribution of the study participants [n=43].**

| Age group | No. of patients | Percentage (%) |
|---|---|---|
| **<40 years** | 3 | 6.97 |
| **41 – 50 years** | 5 | 11.6 |
| **51 – 60 years** | 15 | 34.88 |
| **>60 years** | 20 | 46.51 |
| **Sex** | | |
| Male | 24 | 55.8 |
| Female | 19 | 44.18 |

In our study of 43 patients with different types of trochanteric fractures, DHS was done in 25 cases and PFN was done in 18 cases [Table 3]. About 58.13% of cases had right side trochanteric fractures and 41.86% of cases had left sided trochanteric fractures.

**Table 3: Types of implant used in the study participants [n=43].**

| Implant type | No. of cases | Percentage (%) |
|---|---|---|
| **DHS** | 25 | 58.13 |
| **PFN** | 18 | 41.86 |

Associated injuries mainly were head injuries (11.62%) followed by fracture shaft tibia (9.30%) and fracture of humerus (6.97%) [Table 4]. Majority of the cases were operated between 7 to 14 days after injury [Figure 1].

**Table 4: Associated injuries among the study participants [n=43].**

| Injury | No. of Cases | Percentage (%) |
|---|---|---|
| Head Injury | 5 | 11.62 |
| Distal Radial Fracture | 1 | 2.32 |
| Fracture Humerus | 3 | 6.97 |
| Fracture Clavicle | 1 | 2.32 |
| Rib Fracture | 2 | 4.65 |
| Fracture Shaft Tibia | 4 | 9.30 |
| Fracture Both Bone Forearm | 1 | 2.32 |

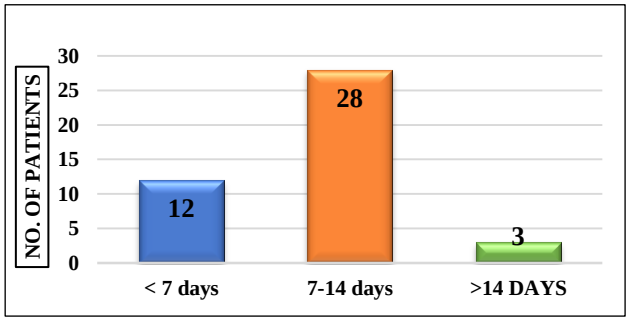


**Figure 1: Injury and surgery time interval in the present study.**

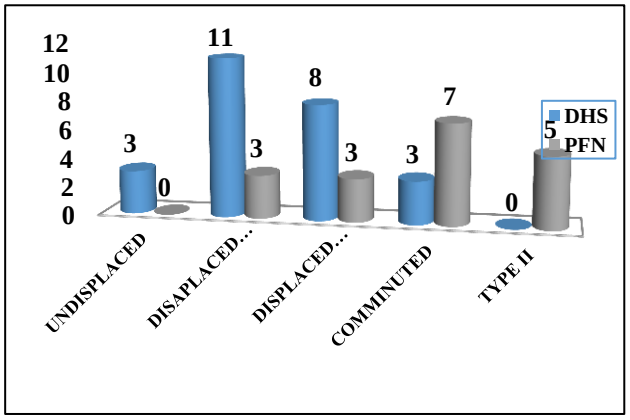


**Figure 2: Types of implant used in the present study according to Evan's classification.**

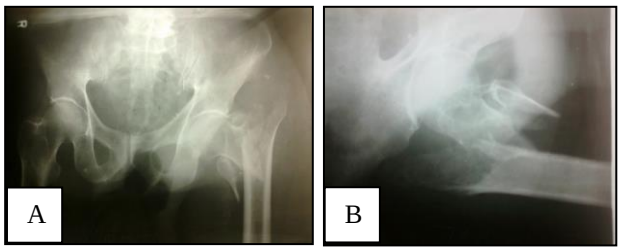


**Figure 3A and 3B: One case of fracture before reduction in the present study.**

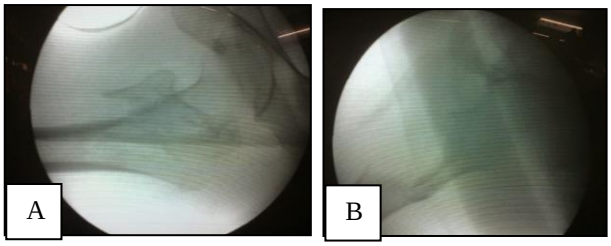


**Figure 4A and 4B: Reduction after traction of cases in the present study (AP View, Lateral View).**

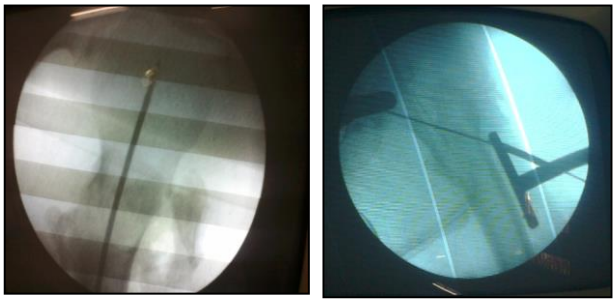

**Figure 5: Guide wire insertion with angle guide.**

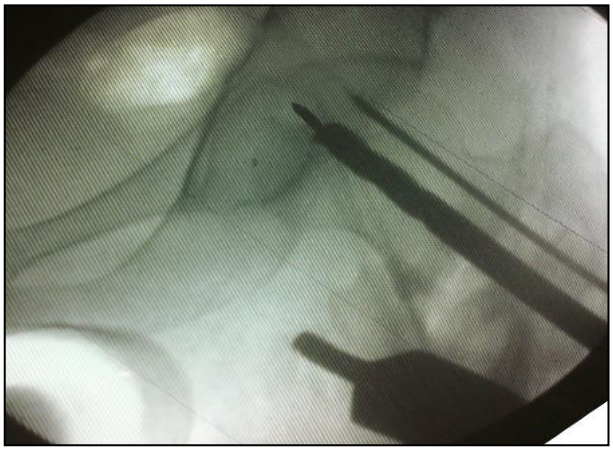

**Figure 6: Reaming and tapping.**

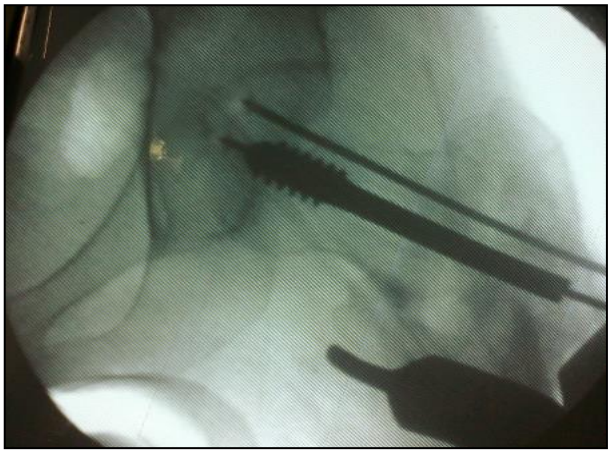

**Figure 7: Insertion of Richard screw.**

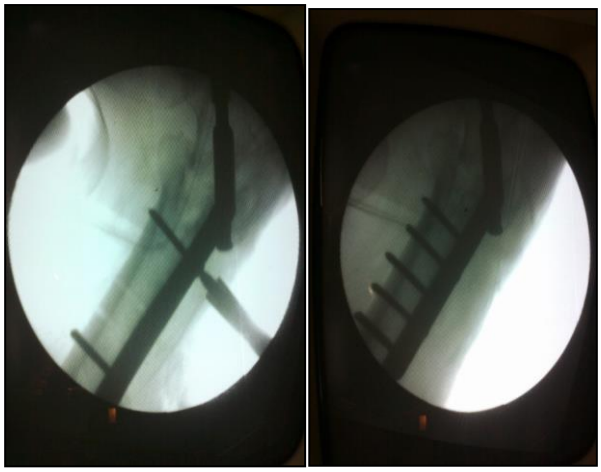

**Figure 8: Plate and screw fixation.**

In our study, out of 25 cases of DHS, majority cases (13) took between 1 hour 36 minutes to 2 hours. Whereas, out of 18 cases of PFN, majority (8) took 1hr to 1hr 30 minutes. In our study 37 patients had no pain whereas 3 patients complained of occasional pain and 3 patients complained of moderate to severe pain. In cases where DHS was done, 2 of the patients had mal-union, 1 patient had implant failure, 1 patient had bedsore and 3 patients had superficial infection. In cases where PFN was done, none of them had mal-union or bedsore. 1 patient had superficial infection and 2 patients had implant failure (nail breakage).

**Table 5: Range of movements after operation among study participants.**

| | | Grade I >75% | Grade II 50-75% | Grade III <50% |
|---|---|---|---|---|
| **Flexion** | DHS | 18 | 6 | 1 |
| | PFN | 15 | 1 | 2 |
| **Extension** | DHS | 4 | 10 | 11 |
| | PFN | 5 | 9 | 4 |
| **Abduction** | DHS | 11 | 8 | 6 |
| | PFN | 11 | 5 | 2 |
| **Adduction** | DHS | 15 | 2 | 8 |
| | PFN | 14 | 2 | 2 |
| **Internal Rotation** | DHS | 4 | 6 | 15 |
| | PFN | 1 | 10 | 7 |
| **External Rotation** | DHS | 0 | 10 | 15 |
| | PFN | 4 | 7 | 7 |

Majority of the cases had no shortening. No case had shortening of more than 1 cm. No shortening was noticed in 12 cases of PFN and 15 cases of DHS. In cases where PFN was done, majority (10 in no) had grade-4 abduction power. In cases where DHS were done, majority (18 in no) had grade-4 abduction power [Table 6]. Most of the cases showed radiological union between 17 to 21 weeks irrespective of the type of implant used [Table 7].

**Table 6: Abduction power after operation among study participants.**

| Power | DHS | PFN |
|---|---|---|
| **0** | 0 | 0 |
| **1** | 1 | 2 |
| **2** | 0 | 0 |
| **3** | 2 | 1 |
| **4** | 18 | 10 |
| **5 (Normal)** | 4 | 5 |

In cases where DHS was done majority i.e. 15 in numbers were graded as good, 5 as excellent, 4 as fair and 1 as poor. In cases where PFN was done majority i.e. 8 in numbers were graded as excellent, 6 as good, 2 as fair and 2 as poor [Table 8].

**Table 7: Radiological union time after operation among study participants.**

| Time of union | Grade | DHS | PFN |
|---|---|---|---|
| **< 16 Weeks** | Grade I | 3 | 5 |
| **17-21 Weeks** | Grade II | 18 | 9 |
| **> 21 Weeks** | Grade III | 3 | 2 |
| **Implant Failure** | | 1 | 2 |

**Table 8: Kyle's criteria of improvement among study participants after operation.**

| Kyle's criteria | DHS | PFN |
|---|---|---|
| **Excellent** | 5 | 8 |
| **Good** | 15 | 6 |
| **Fair** | 4 | 2 |
| **Poor** | 1 | 2 |

## DISCUSSION

The treatment of trochanteric fractures is still associated with some failures. High stress concentration subjects to multiple deforming forces which results in high incidence of complications after surgical treatment. This compels surgeons to give a second thought regarding selection of implants.

DHS is a popular device for internal fixation of different types of Trochanteric fractures. It requires less technical expertise and can achieve radiological union with early mobilization which avoids different medical complications caused by prolonged bed ridden state.[18]

The AO ASIF in 1996 developed the PFN with an anti-rotation hip pin together with a smaller distal shaft diameter which reduces stress concentration to avoid failures. From mechanical point of view an intramedullary device inserted by means of minimally invasive procedure seems to be better in elderly patients. Close reduction preserves the essential elements of the consolidation process. Intramedullary fixation allows the

surgeon to minimize soft tissue dissection there by reducing surgical trauma, blood loss, infection and wound infection. Whatever the choice of implant may be, our main aim was to achieve early mobilization, union at the fracture site and finally rehabilitation.[13,19-21]

In our study of 43 patients with different types of Trochanteric fractures, DHS was done in 25 cases and PFN was done in 18 cases. 60% of cases had right side Trochanteric fractures and 40% of cases had left sided Trochanteric fractures. All fractures of type 1 undisplaced variety were internally fixed with DHS and all type 2 fractures were explicitly treated with PFN. Apart from this majority of the cases with comminuted fractures were treated with PFN (7 in no) and majority of the displaced stable fractures were treated with DHS (11 in no). Majority of the cases (27 in number) had no shortening. No case had shortening of more than 1 cm. No shortening was noticed in 12 cases of PFN and 15 cases of DHS.

Sahin et al (2012) study showed the mean duration of surgery was 85.2 min for group 1 [DHS] and 55.3 min for group 2 [PFN].[22] The mean time to union for group 1 was 2.09 months and 1.69 months for group 2. Early and late complication rates between treatment groups revealed no statistically significant differences. Total duration of surgery was significantly lower for PFN than it was for DHS. A comparison of time to union and overall mortality demonstrated no statistically significant differences. They detected no differences between the two treatment groups in regard to early versus late complications, time to union, and overall mortality; however, with its shorter operative period, PFN is a good alternative to the DHS.[23]

Christophe Sadowski et al studied 20 patients of proximal femoral fractures treated by PFN.[24] Only one of the twenty fractures that had been treated with an intramedullary nail did not heal. Our study also showed similar results.

The surgery performed within the first 24 hours does not decrease the mortality rates during the first year of life in patients with transtrochanteric fractures.[25] The patient must be clinically compensated to be submitted to the an-esthetic and surgical procedures.[26] The factors related to mortality increase are: age > 80 years, presence of three or more comorbidities (mainly cardiac ones), mental impairment, institutionalized patient and male sex.[27]

The osteosynthesis with DSH plate and minimally invasive technique in the treatment of transtrochanteric fractures leads to lower blood loss, lower surgical time and lower degree of pain in the postoperative period, when compared with the DHS plate used in the conventional way, without sacrificing fracture stability and consolidation.[28]

After one year of surgical treatment with DHS, of both stable and unstable fractures, 69% of the patients are alive, of which 95% report no or mild pain, 85% return to the same accommodation and 50% return to the mobility level prior to the fracture. The rate of complications directly related to the surgical fixation is only 3.6%, leading to reoperation in 2.6% of the patients.[29]

The optimal fixation device for trochanteric fractures is still controversial at present. Jones et al compared the intramedullary nail (IMN), which involved gamma nail, intramedullary hip screw (IMHS), and PFN, with sliding hip screw for treatment of extracapsular proximal femoral fractures.[30] They concluded that there was no statistically significant difference in the cut-out rate between the IMN and SHS while total failure rate and reoperation rate were greater with IMN. The analysis of operation time showed no significant difference between the two groups. But there was a notable heterogeneity, which could probably be explained by the different levels of experience of surgeons, and the duration of PFN fixation could be shortened as surgical skills improved.[31] They showed no significant difference of blood loss and blood transfusion between the two implants. PFN and DHS are equally effective in the treatment of trochanteric fractures.[32-34] With future modifications to these two types of implants, more high-quality randomized controlled trials and further studies are needed to investigate whether these changes can lead to different outcomes.

## CONCLUSION

In our series, 43 patients with trochanteric fractures were treated either with Dynamic Hip Screw (DHS) or Proximal Femoral Nail (PFN) in the Department of Orthopaedics, M.G.M. Medical College and L.S.K Hospital, Kishanganj, Bihar from October 2010 to October 2012. Our results showed that both the methods were successful and acceptable for management of trochanteric fracture.

In our series, we could not find any significant difference between these two methods of fracture fixation with respect to intra-operative and post-operative variables. When compared with the results of other studies, our study showed no remarkable difference and was similar in many aspects.

However, in this series, with the small sample size, none of these methods can be declared superior to another.

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