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**Original Research Article**

# Comparative Study of Sub-Trochanteric Fractures of Femur with PFN and DHS Fixation

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**Conflict of interest: Nil**

**Abstract**

**Background:** Sub-trochanteric fractures of the femur, defined as fractures occurring within 5 cm distal to the lesser trochanter, present a significant challenge in orthopedic trauma due to their anatomical and biomechanical complexity. These fractures typically occur in two distinct patient populations: young individuals following high-energy trauma and elderly patients with osteoporotic bone after low-energy falls. The high stress concentration in the sub-trochanteric region, along with the strong deforming forces of surrounding muscles, complicates both fracture reduction and stabilization.

**Aim of the Study:** This study aims to compare the clinical and radiological outcomes of two commonly used surgical fixation methods: Proximal Femoral Nail (PFN) and Dynamic Hip Screw (DHS) in the management of sub-trochanteric femoral fractures.

**Methods**: A prospective analysis was conducted on a cohort of patients treated with either PFN or DHS, evaluating parameters such as operative time, intraoperative blood loss, duration of hospital stay, time to union, functional outcome (as per Harris Hip Score), and complication rates.

**Results:** Preliminary results suggest that PFN offers superior biomechanical stability, reduced operative time, and quicker mobilization, whereas DHS, though cost-effective, is associated with a higher rate of complications such as implant failure and varus collapse.

**Conclusion**: The study concludes that PFN may be the preferred method for sub-trochanteric fracture fixation, particularly in unstable fracture patterns, due to its minimally invasive approach and biomechanical advantages.

**Keywords:** Sub-trochanteric fracture, Proximal Femoral Nail (PFN), Dynamic Hip Screw (DHS), Internal fixation, Femoral fractures, Orthopedic surgery.

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## Introduction

Subtrochanteric fractures account for approximately 10% to 30% of all hip fractures and they affect persons of all ages. These fractures typically occur in the proximal femur between the inferior aspect of the lesser trochanter and a distance of about 5 cm distally. They generally occur in two patient age distributions: the young, high-energy, often polytraumatized and the elderly osteopenic population, typically resulting from a low-energy fall from a standing height. [1]

The first occurs during late adolescence and early adulthood, when high-energy trauma from motor-vehicle and motorcycle accidents causes displaced or comminuted fractures [2]. With these mechanisms of injury, severe injuries to other organ systems are frequent. Metastasis from tumors (e.g., lung and breast cancer) often cause pathologic subtrochanteric fractures through compromised bone stock. These troublesome injuries combine many of the least desirable features of intertrochanteric and femoral shaft fractures. Moreover, the predominantly cortical nature of the subtrochanteric region prolongs healing times [3].

Fractures in the subtrochanteric region present challenges to achieving stable fixation and appropriate reduction regardless of age. The subtrochanteric region of the femur is one of the highest stressed zones in the human skeleton where tensile or compressive stresses can exceed several multiples of body weight. Additional challenges include short proximal fragments which are deformed by the hip flexors and abductors which may make accurate reduction and fixation challenging. There are several internal fixation options for managing these fractures that generally fall into two categories: some form of intramedullary fixation or some form of plating. The dynamic compression hip screw (DHS) has been a popular method of internal fixation for subtrochanteric fractures. It provides compression along the femoral neck, and if the reduced fracture is stable, load-sharing between the bone and implant can occur, and if the fracture is not stable, progressive medial displacement of the femoral shaft can occur, which may result in fixation failure and nonunion. The concept of the DHS with a trochanteric stabilizing plate is to prevent or reduce medial displacement [4]. The Arbietsgemeinschaft fur osteosynthesefragen (AO/ASIF) in 1996 designed a new intramedullary device – the Proximal Femoral Nail (PFN) to overcome the technical difficulties and complications encountered with the earlier designs of the intramedullary proximal femoral nails, most importantly, the Gamma Nail [5].

The two main design differences between the PFN and other such devices are the introduction of an anti-rotational 6.5 mm of hip pin to reduce the incidence of the implant cut out, secondly the fluting of the nail tip, i.e., the tip has a smaller diameter and is specially shaped to reduce the stress at tip.

**Aims of the Study**

1. To evaluate outcomes of subtrochanteric femur fracture treated with PFN and DHS.
2. To compare PFN vs. DHS in surgical management of subtrochanteric fractures.
3. To assess complications associated with PFN and DHS fixation.

**Material & Methods** The present study was carried out in Government General Hospital, Wanaparthy, Telangana, from March 2021 to February 2023. The study consisted a total of 50 adult patients of Sub-trochanteric factures of femur satisfying the inclusion criteria, who are treated with Proximal Femoral nail (25cases) and Dynamic Hip Screw(25 cases).

**Inclusion Criteria:**

- Fielding’s Classification
- Seinsheimer’s Classification
- Russell Taylor Classification
- AO Classification
- Minimum of 6 months of follow up.

**Exclusion Criteria:**

- Patients who are medically unfit for surgery.

**Choice of Nail Used:**

A hollow tubular nail made of AISI 316L stainless steel was used. All nails were 25 mm long. The proximal diameter (first 8 cm) ranged from 14–17 mm, and the distal diameter from 9–12 mm. Proximal femoral nails of 130° and 135° with 10° anteversion were used, featuring a 3000 mm anteroposterior radius and 4° mediolateral curvature. The proximal portion accommodates two screws: a 7.9 mm lag screw (55–115 mm length) and a 6.4 mm anti-rotation set screw (55–115 mm length).

**Measurement of Nail Length**

In our study nails of uniform size length i.e 25 mm were used in all cases.

**Measurement of Diameter of the Nail**

It was done by taking conventional radiographs of normal femur & by measuring the inner diameter between the cortices at the level of the isthmus was made. However, nails of all sizes were kept ready for operation i.e 9 mm to 12 mm size.

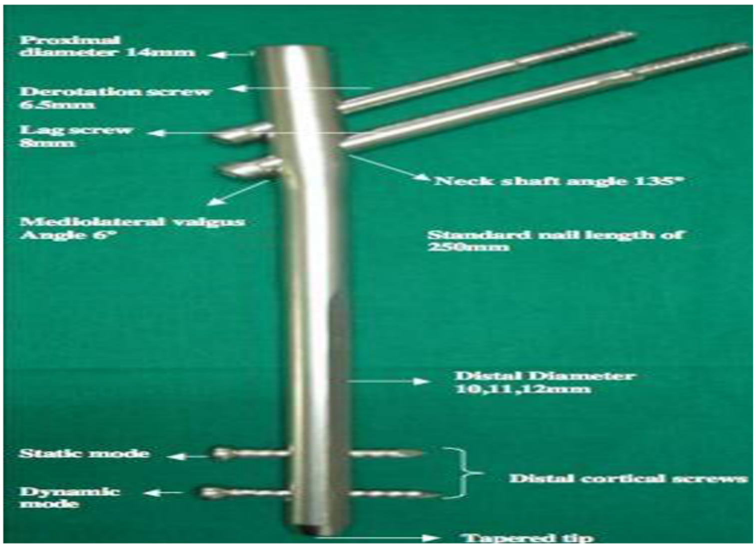


**Figure 1:**

**Richards Dynamic Compression Screw (DCS):**

A cannulated lag screw with a 19 mm or 29 mm threaded distal end (12.7 mm diameter) and an unthreaded shaft (8.7 mm diameter), available in lengths from 50–110 mm. It fits a 3.2 mm guide wire and slides into a keyed barrel on a side plate (2–20 holes for 4.5 mm cortical screws), typically using a 4- or 5-hole plate. The groove-key design prevents rotation.

**Steps of Operation:**

1. After anesthesia, patient placed on radiolucent fracture table with buttocks on pelvic rest.
2. Fracture reduction as per Tronzo type:
   a) Type 2: Traction only.
   b) Type 3: Traction + 20° abduction → gentle external, then internal rotation to neutral.
   c) Type 4: Same as Type 3; if unsuccessful, planned Dimon-Hughston medial displacement osteotomy.
   d) Type 5: Shaft notched to jam neck for stability.
3. Reduction checked using C-Arm or X-ray.
4. Pre-op scrubbing with Savlon and povidone-iodine for 10 minutes, mopped with spirit.
5. Painted with 5% povidone-iodine and spirit, then draped with sterile sheets.
6. **Incision:** Lateral skin incision from distal greater trochanter; subcutaneous tissue, fascia, and vastus lateralis split to expose greater trochanter and proximal shaft (~2 inches). Extended distally for plate application.
7. **Guide wire placement:** Kirschner wire placed over femoral neck to determine anteversion. K-wire inserted into head using DHS angle guide and T-handle.

**Muscles around Hip**

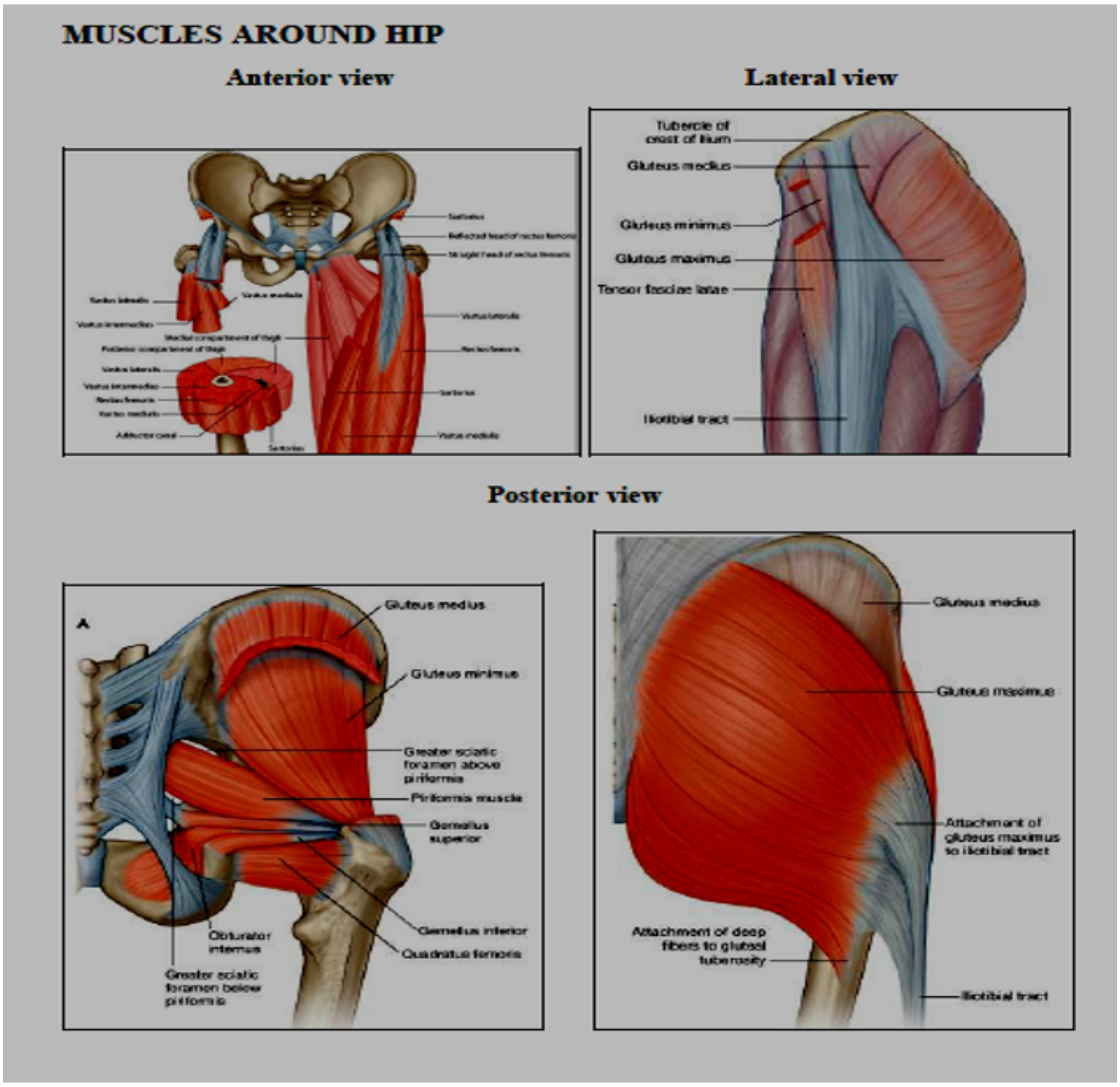
MUSCLES AROUND HIP
Anterior view
Lateral view
Tubercle of crest of ilium
Gluteus medius
Gluteus minimus
Gluteus maximus
Tensor fasciae latae
Iliotibial tract
Posterior view
A
Gluteus medius
Gluteus minimus
Greater sciatic foramen above piriformis
Piriformis muscle
Gemellus superior
Gemellus inferior
Quadratus femoris
Obturator internus
Greater sciatic foramen below piriformis
Gluteus medius
Gluteus maximus
Attachment of gluteus maximus to iliotibial tract
Attachment of deep fibers to gluteal tuberosity
Iliotibial tract

Figure 2:

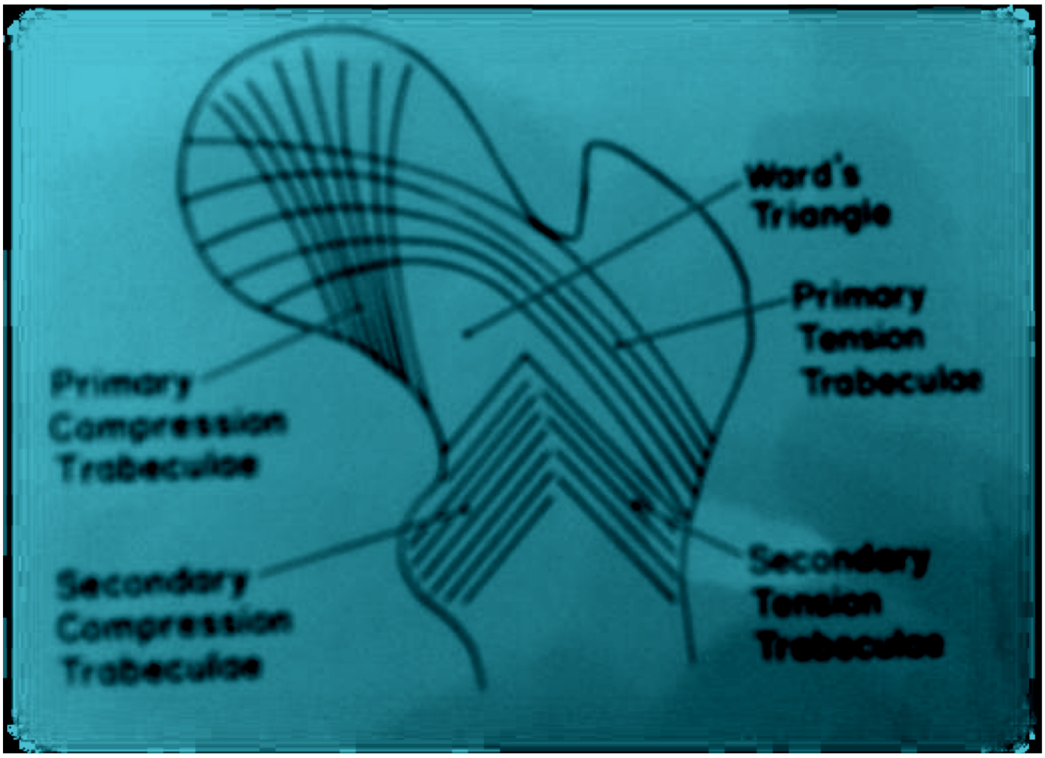


**Figure 3: Structure of proximal femur**

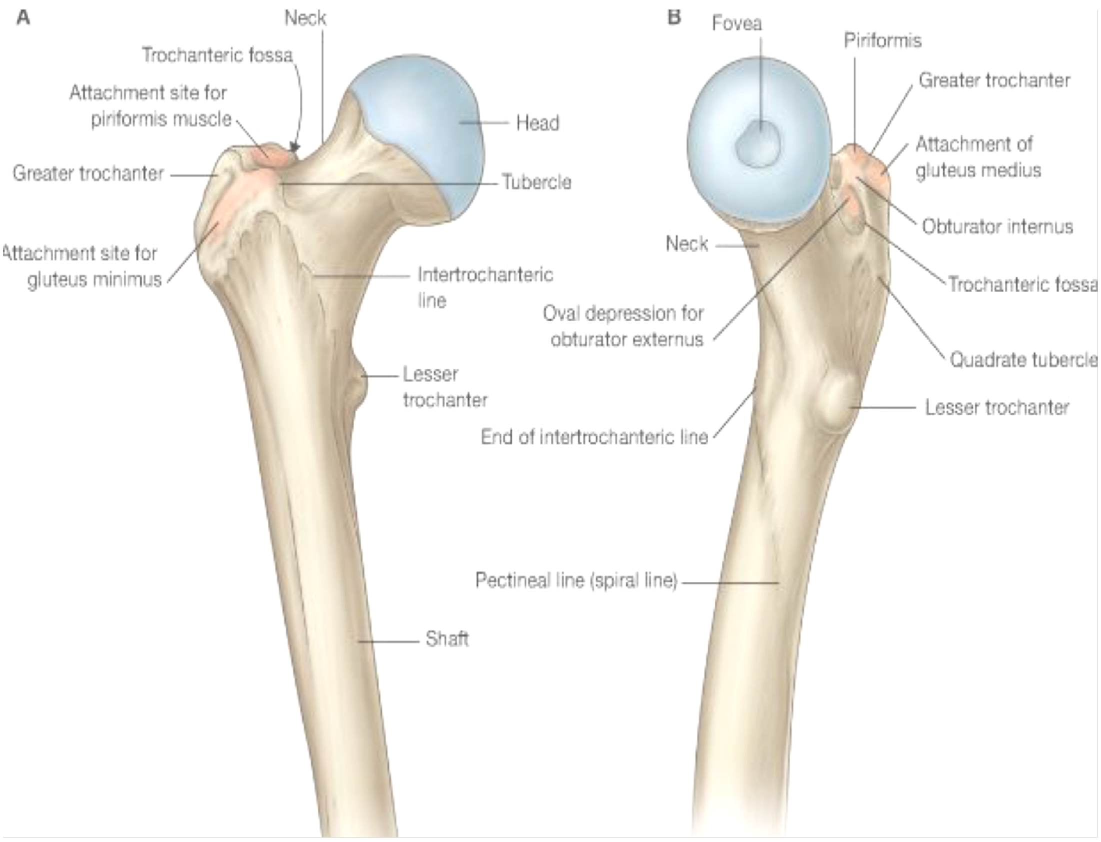


**Figure 4: Structure of proximal femur**

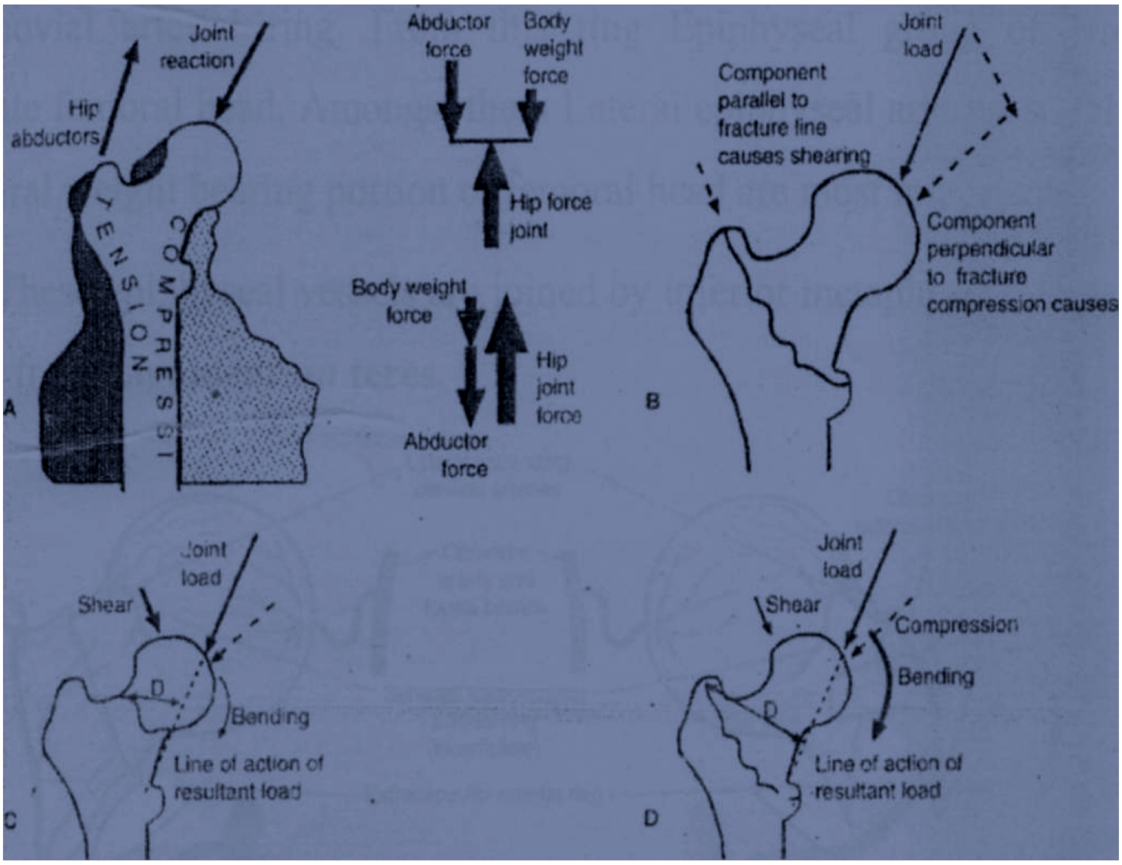


Figure 5: Forces acting on hip joint

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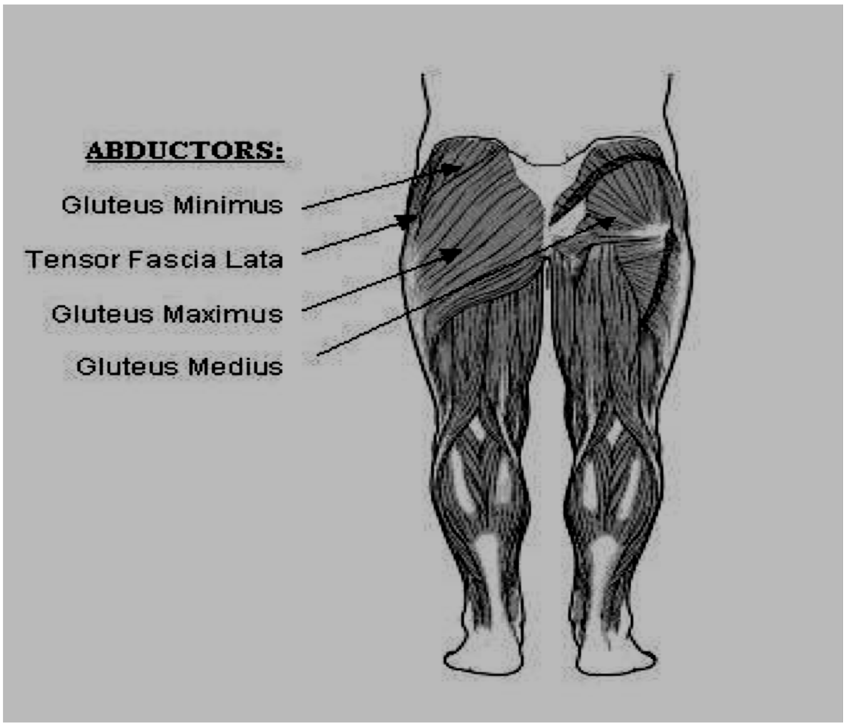



Figure 6: Abductors of the hip

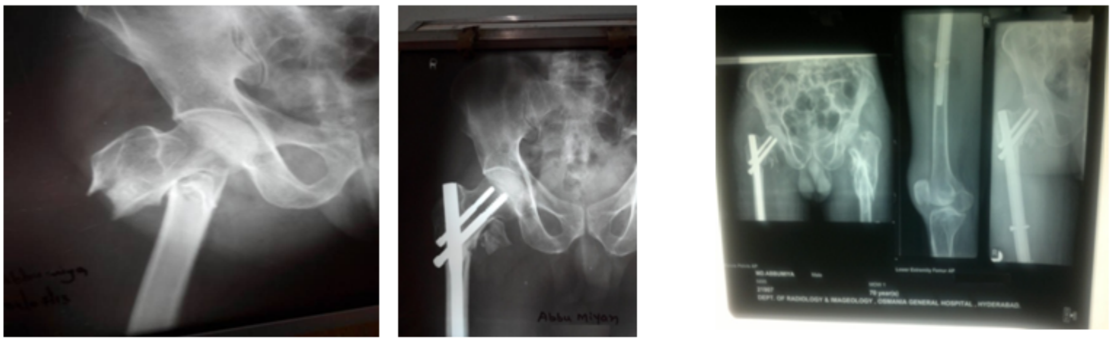
**Case-1**

Pre OP Xray | IMMEDIATE POST OP X-RAY | after 3 months

AFTER 6 MONTHS CLINICAL PICTURE AFTER 6 MONTHS

**Figure 7:**

CASE -2



PRE OP X-RAY IMMEDIATE POST OP X-RAY AFTER 3 MONTHS

AFTER 6 MONTHS CLINICAL PICTURE AFTER 6 MONTHS

**Figure 8:**

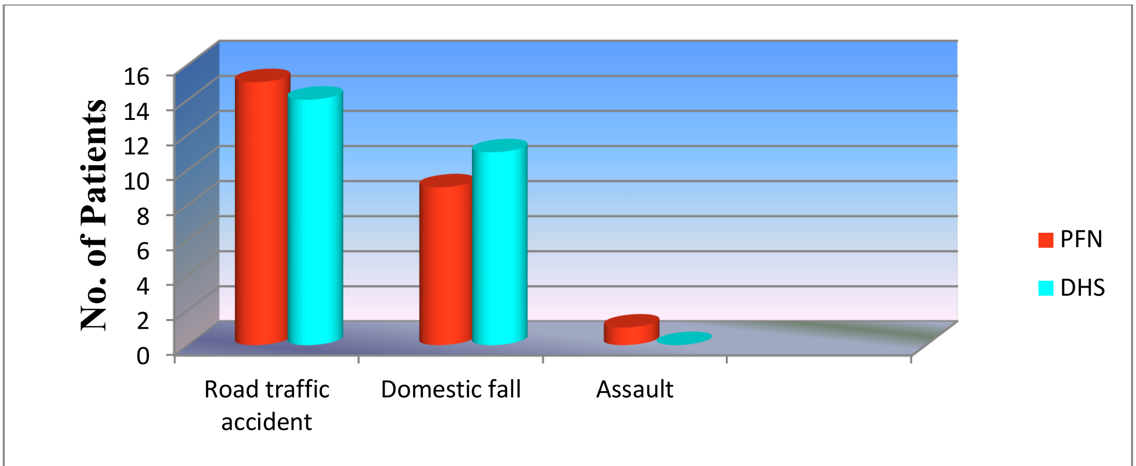
**Results**

**Table 1: Age Incidence**

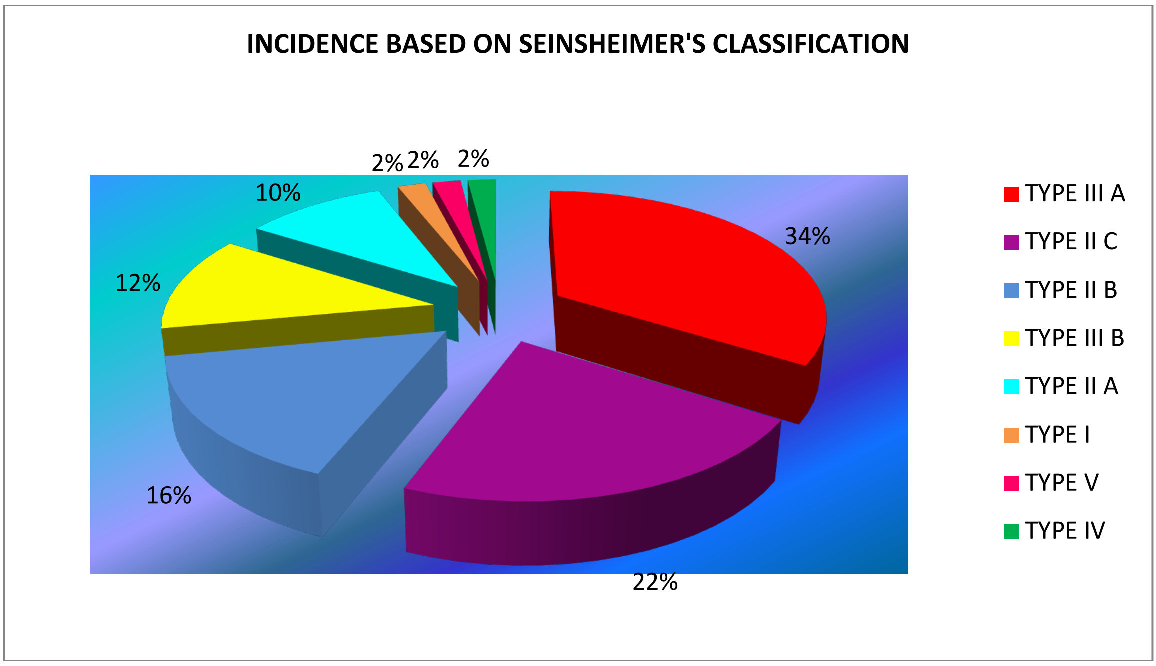
| Age in years | No. of patients (PFN) | Percentage (%) | No. of patients (DHS) | Percentage (%) |
|---|---|---|---|---|
| 20-30 | 2 | 8% | 2 | 8% |
| 30-40 | 4 | 16% | 3 | 12% |
| 40-50 | 4 | 16% | 3 | 12% |
| 50-60 | 7 | 28% | 8 | 32% |
| 60-70 | 5 | 20% | 4 | 16% |
| 70-80 | 2 | 8% | 3 | 12% |
| 80-90 | 1 | 4% | 2 | 8% |
| TOTAL | 25 | 100% | 25 | 100% |

**Table 2: Sex Incidence**

| Sex | No. of Patients (PFN) | Percentage (%) | No. of Patients (DHS) | Percentage (%) |
|---|---|---|---|---|
| MALE | 16 | 64% | 12 | 48% |
| FEMALE | 9 | 36% | 13 | 52% |
| TOTAL | 25 | 100% | 25 | 100% |




**Graph 1: Mode of Injury**




**Graph 2: Incidence based Seinsheimer's Classification**

**Table 3: Duration of Hospital stay for Surgery**

| Duration for surgery (days) | No.of patients (PFN) | Percentage (%) | No. of patients (DHS) | Percentage (%) |
|---|---|---|---|---|
| 0-5 | 11 | 44% | 10 | 40% |
| 6-10 | 8 | 32% | 11 | 44% |
| 11-15 | 5 | 20% | 3 | 12% |
| 16-20 | 1 | 4% | 1 | 4% |
| TOTAL | 25 | 100% | 25 | 100% |

**Table 4: Early Post-Operative Complications**

| Early post op complications | No. of patients (PFN) | Percentage (%) | No. of patients (DHS) | Percentage (%) |
|---|---|---|---|---|
| Systemic | 0 | 0 | 0 | 0 |
| Chest infection | 1 | 4% | 1 | 4% |
| Pulmonary Embolism | 0 | 0 | 0 | 0 |
| Respiratory distress | 0 | 0 | 0 | 0 |
| Urinary Tract infections | 1 | 4% | 1 | 4% |
| Deep Vein Thrombosis | 0 | 0 | 0 | 0 |
| Superficial wound infection | 1 | 4% | 3 | 12% |
| Deep wound infection | 0 | 0 | 1 | 4% |
| Death | 0 | 0 | 0 | 0 |

**Table 5: Implant related Intra-Operative complications**

| Intra operative complications | No. of patients (dhs) | Percentage (%) |
|---|---|---|
| Difficulty in reduction | 5 | 20% |
| Shattering of Lateral cortex | 2 | 8% |
| Fracture below the plate | 1 | 4% |
| Breakage of plate | 2 | 8% |
| Breakage of screw | 2 | 8% |

**Table 6: Radiological Complications**

| Radiological | No. of patients (PFN) | Percentage (%) |
|---|---|---|
| Cut out of neck screw | 0 | 0 |
| Z effect | 0 | 0 |
| Reverse z effect | 2 | 8% |
| Breakage of nail | 1 | 4% |
| Bolt breakage | 0 | 0 |

**Assessment at Final Follow-Up**

**Table 7: (A) PAIN**

| Quality of Pain | No. of patients (PFN) | Percentage (%) | No. of patients (DHS) | Percentage (%) |
|---|---|---|---|---|
| None or ignores it | 19 | 76% | 15 | 60% |
| Slight occasional | 3 | 12% | 6 | 24% |
| Mild | 2 | 8% | 2 | 8% |
| Moderate | 1 | 4% | 1 | 4% |
| Totally disabled | 0 | 0 | 1 | 4% |
| **Total** | **25** | **100%** | **25** | **100%** |

**Table 7: (B) Walking Ability**

| Walking Ability | No. of patients (PFN) | Percentage (%) | No. of patients (DHS) | Percentage (%) |
|---|---|---|---|---|
| None | 19 | 76% | 15 | 60% |
| Cane for long walks | 3 | 12% | 3 | 12% |
| Cane most of the time | 2 | 8% | 4 | 16% |
| Crutch | 1 | 4% | 2 | 8% |
| Not able to walk | 0 | 0 | 1 | 4% |
| **Total** | **25** | **100%** | **25** | **100%** |

**Table 8: (A) STAIRS**

| Stairs | No. of patients (PFN) | Percentage (%) | No. of patients (DHS) | Percentage (%) |
|---|---|---|---|---|
| Normally without using a railing | 19 | 76% | 15 | 60% |
| Using a railing | 3 | 12% | 3 | 12% |
| In any manner | 2 | 8% | 4 | 16% |
| Unable | 1 | 4% | 2 | 8% |
| **Total** | **25** | **100%** | **25** | **100%** |

**Table 8: (B) Shoes and Socks**

| Shoes and Socks Wearing | No. of patients (PFN) | Percentage (%) | No. of patients (DHS) | Percentage (%) |
|---|---|---|---|---|
| With ease | 20 | 80% | 17 | 68% |
| With difficulty | 4 | 16% | 4 | 16% |
| Unable | 1 | 4% | 4 | 16% |
| **Total** | **25** | **100%** | **25** | **100%** |

**Table 8: (C) Sitting**

| Sitting | No. of patients (PFN) | Percentage (%) | No. of patients (DHS) | Percentage (%) |
|---|---|---|---|---|
| Comfortably in ordinary chair for one hour | 21 | 84% | 19 | 76% |
| On a high chair for half an hour | 3 | 12% | 2 | 8% |
| Unable to sit comfortably in any chair | 1 | 4% | 4 | 16% |
| **Total** | **25** | **100%** | **25** | **100%** |

**Table 9: Hip Range of Motion**

| Total Harris Hip Score | PFN | DHS |
|---|---|---|
| Excellent (90 – 100) | 3 | 2 |
| Good (80 – 89) | 19 | 12 |
| Fair (70 – 79) | 2 | 8 |
| Poor (<70) | 1 | 3 |
| Total | 25 | 25 |

## Discussion

Subtrochanteric femur fractures, though relatively uncommon, present unique anatomical and mechanical challenges. They are a significant social and economic concern among long bone injuries. Closed intramedullary fixation, particularly with the Proximal Femoral Nail (PFN), offers advantages such as minimal surgical exposure, better load transfer via the calcar femorale, and reduced tensile strain due to a shorter lever arm. Multiple studies support PFN as a reliable, minimally invasive option for managing these fractures.

In this study, most patients were aged 20–80 years, with an average age of 60—lower than reported by Boldin (73 yrs) and Schipper [6] (82.2 yrs). Male dominance (67.85%) may be due to higher outdoor activity and trauma risk, while females, mostly in domestic roles, had lower exposure. Similar male predominance was noted by St. Urnier (1995) and Ohari & Shaikh (1957). In this study, 40% of fractures were from trivial falls (mainly elderly females), 58% from high-velocity trauma (mostly males), and 2% from assault. Similar trends were noted by W.M. Gadegone [7] (75% domestic falls) and Koval & Zuckerman [8] (90% low-energy falls in elderly, high-energy trauma in younger adults). Right femur was involved in 54% of cases, left in 46%, matching Schipper's findings.

Fractures were classified according to Seinsheimer‘s [9] classification and type III A fracture pattern constituted the highest percentage 34% (17) of all fracture patterns. SEINSHEIMER [10] in his original study also noted high incidence of type III A fracture pattern (38.29%) than other fracture patterns.

Admission operation interval in our study varied from 1-20 days. Majority of patients in our study were operated within 10 days following admission in hospital (40/50). But in some patients (10/50) operative procedure was delayed due to medical problems (Hypertension and Diabetes) and financial constraint of patients. Average time lapse for surgery: 3.75 days. Amongst patients who had a delay in operative intervention two patients came to hospital following 10 days of trauma when compared to I.B. Schipper’s [11] where it was 2 days.

The average intraoperative blood loss with PFN was 100 ml, significantly lower than with DHS (250 ml), mainly due to smaller incisions and less soft tissue disruption. Increased blood loss was noted in cases requiring open reduction. Patients treated with PFN began partial weight bearing by 6 weeks and full weight bearing by 12 weeks, earlier than those treated with DHS (8 weeks and 15 weeks, respectively).

Post- operatively 2 patients in our study (PFN -1 and DHS -1) had chest infections, 2 (4%) had urinary tract infections (PFN -1 and DHS -1), 4 (8%) had superficial wound infections (PFN -1 and DHS -3) and 1 (2%) had deep wound infections (PFN -0 and DHS -1) and this settled with parentral antibiotics. I.B.Schipper in his study noted 4.1% superficial infections and 2.5% deep infections.

In the PFN group, no ‘Z’ effect was seen, but 2 cases (8%) showed reverse ‘Z’ effect. One case (4%) had nail breakage due to early, unadvised full weight-bearing. Despite this, the patient remained mobile with support but declined further surgery.

PFN design, with a narrower distal shaft, helps reduce femoral shaft fractures. Radiological union averaged 3 months, compared to 4 months in Schipper’s series.

In the DHS group, complications included lag screw back-out in 3 cases (12%), plate breakage in 2 (8%), cortical screw loosening in 2 (8%), and bending in 3 cases (12%), mainly due to early weight-bearing and falls.

Both groups had generally good results per Harris Hip Score. PFN showed slightly better outcomes:

- No/slight pain: 88% (PFN) vs. 84% (DHS)
- Minimal/no limp: 92% (PFN) vs. 88% (DHS)
- Independent mobility: 76% (PFN) vs. 60% (DHS)
- Unlimited walking: 80% (PFN) vs. 72% (DHS); one DHS patient was bedridden
- Stair climbing without support: 76% (PFN) vs. 60% (DHS)
- Comfortable sitting for an hour: 84% (PFN) vs. 76% (DHS)
- Limb length discrepancy: 1 case (PFN) vs. 4 cases (DHS, 2 with >2 cm shortening)
- No deformity: 84% (PFN) vs. 76% (DHS)
- Range of motion was good to excellent in most cases, with poor outcomes linked to delayed surgery or infection.

In our study the final outcome as calculated by Harris Hip score, the number of PFN patients was excellent to good in 88% (22) patients and fair in 8% (2) of patients and poor in 4% (1) patients as compared with DHS patients with excellent to good in 56% (14) patients and fair in 32% (8) of patients and poor in 12% (3) patients

Most of the poor results were seen in the elderly age group patients with associated Osteoarthritis of the knee. The mean Harris Hip score was in our series was 80.76% which was higher than I.B. Schipper series where the mean was 77.6.

**Conclusion**

Study of 50 subtrochanteric fractures (25 PFN, 25 DHS) showed:

1. **PFN was less invasive** – smaller incision, less blood loss.
2. **Stronger fixation** – PFN's central alignment and shorter lever arm offered biomechanical advantage.
3. **Better in osteoporosis** – PFN worked well in weak bone.
4. **Lower malrotation risk** – closed nailing reduced deformities.
5. **Preferred for complex fractures** – PFN suited for reversed obliquity/high fractures.
6. **Improved rotational stability** – PFN provided better control.
7. **Lower infection rate** – intramedullary fixation aided early mobilization.
8. **Optimal screw alignment** – PFN screws better aligned with femoral neck.
9. **Lower non-union rate** – none seen with PFN, unlike DHS.
10. **Less blood loss** – average loss lower with PFN.
11. **PFN had steeper learning curve** – DHS was technically simpler.
12. **DHS had shorter screening time** – less intra-op imaging needed.
13. **Fewer implant issues with PFN** – DHS had more complications.
14. **Better rehab outcomes with PFN** – quicker and more effective recovery.

**Final Note**: PFN appears to be the preferred implant for subtrochanteric fractures, particularly in osteoporotic or complex cases, due to its mechanical and clinical advantages.

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