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## Study of the functional outcome following surgical management of intertrochanteric fractures with either proximal femoral nailing or dynamic hip screw fixation

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### Abstract

Intertrochanteric fractures are one of the most common injuries sustained predominantly in patients over 60 years of age. They are 3 or 4 times more common in elderly women who are osteoporotic, in whom trivial trauma is the most common mode of injury. A total of 98 patients of intertrochanteric fractures of the femur were operated during this period in our institute. Among these patients, 26 patients died after surgery and did not follow up and were not included in this study. The rest of the patients were not traceable via telephone, some even by home visitations by us due to difficulty in tracing certain home addresses. Patients who were followed up for upto 6 months to 1 year were included in this study. All patients were in Sahlstrand's Grade 1 walking ability before trauma. Post-op walking ability in this study shows 60% PFN patients walking without support with 33.3% DHS patients walking without support and 66.7% patients of DHS walking with cane and 13.3% patients of PFN needing 2 canes or walker post-operatively measured at 6 months post-op. It was found that proximal femoral nailing had better functional outcome in patients with especially unstable fractures and DHS had better functional outcome among the stable fractures.

**Keywords:** Functional outcome, intertrochanteric fractures, proximal femoral nailing, dynamic hip screw fixation

### Introduction

Intertrochanteric fractures are defined as 'Fractures involving upper end of femur through and in between both trochanters with or without extension into upper femoral shaft'. An increasing incidence of intertrochanteric fractures with advancing age is well known [1].

For many, this fracture is often a terminal event resulting in death due to cardiac, pulmonary or renal complications. Approximately 10 to 30% of patients die within one year of an intertrochanteric fracture.

Little attention was paid to these fractures in the past, as they occur through the cancellous bone with excellent blood supply and they healed without any active treatment. However conservative treatment usually resulted in malunion with varus and external rotation deformity resulting in a short limb gait and a high rate of mortality due to complication of recumbence and immobilization [2].

The incidence of intertrochanteric fractures varies from country to country. Gulberg *et al.* has predicted that the total number of hip fractures will reach 2.6 million by 2025 and 4.5 million by 2050. In 1990 26% of all hip fractures occurred in Asia whereas this figure could rise to 37% in 2025 and 45% in 2050 [3].

No studies are available from the Indian subcontinent regarding hip fracture incidence. With changing the demographic profile of Indian population, we are going to witness a sharp rise in hip fractures over the next three decades.

By 2040 the incidence is estimated to be doubled. In India the figures may be much more. Problems of these fractures are (1) association with substantial morbidity and mortality (2) malunion (3) implant failure, cutout of head, and penetration into hip. (4) great financial burden to the family (5) associated medical problem like diabetes, hypertension [4].

There is hope that hip fracture risk has begun to decline in certain areas of world but reason is unknown.

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Any medical condition associated with bone loss, like Diabetes mellitus, Hyperparathyroidism, Hyperthyroidism and Cushing's syndrome is associated with a 27-fold rise in the risk for hip fractures.

Intertrochanteric fractures are one of the most common injuries sustained predominantly in patients over 60 years of age. They are 3 or 4 times more common in elderly women who are osteoporotic, in whom trivial trauma is the most common mode of injury<sup>[4, 5]</sup>.

For many, this fracture is often a terminal event resulting in death due to cardiac, pulmonary or renal complications. Approximately 10-30% of patients die within one year after sustaining intertrochanteric fracture.

Little attention was paid to these fractures in the past, as they occur through the cancellous bone with excellent blood supply and they healed without active operative treatment. However conservative treatment usually resulted in malunion with varus and external rotation deformity resulting in a short limb gait and a high rate of mortality due to complications of recumbence and immobilization<sup>[4]</sup>.

The goal of treatment of an intertrochanteric fracture is the restoration of the patient to his or her pre-injury status as early as possible. This led to internal fixation of these fractures to increase patient comfort, facilitate nursing care, decrease hospitalization and reduce complications of prolonged recumbency<sup>[5]</sup>.

Intertrochanteric fractures pose a challenge to the Orthopaedic Surgeon in many ways, as in the nomenclature is often confusing, uniform classification is difficult because of the use of different classification systems and various treatment options exist. An unstable intertrochanteric fracture adds to the challenge of being biomechanically unfavourable. A good treatment plan therefore starts with proper fracture classification<sup>[7]</sup>.

It is universally agreed that the treatment of intertrochanteric fractures is stable internal fixation as early as possible. Stable fixation is the keystone of successful union of trochanteric fractures. Factors beyond the control of surgeon for successful treatment are: (i) fracture geometry and stability, (ii) bone quality, (iii) comminution<sup>[6]</sup>.

Factors under the control of surgeon are: (i) good reduction, (ii) proper choice of implant, (iii) proper surgical technique, and (iv) availability of modern operation rooms, entire set of implants, instrumentation and image intensifier<sup>[6]</sup>.

Several classification systems exist and the most basic and rational is to divide intertrochanteric fractures into stable or unstable fracture pattern. In general, the fracture stability is determined by the presence of a zone of comminution of the medial cortex and posterolateral instability<sup>[7]</sup>.

Nowadays, the most commonly used classification is that of AO/ASIF Group<sup>[7]</sup>. This classification has a good reproducibility as it basically divides the intertrochanteric fractures into 3 Groups – A1 Stable per-trochanteric fractures, A2 Unstable Pertrochanteric fractures with medial comminution including fracture of lesser trochanter and A3 Unstable intertrochanteric fractures with or without medial comminution.

The greatest problems for the Orthopaedic Surgeon treating such fractures are instability and complications of fixation that result from instability. In such fractures, varus collapse is common which leads to deformity and shortening which is aggravated if patient is osteoporotic, comminution of the fracture and also depend on choice of implant and its insertion technique.

The type of implant used has an influence on fixation and can

cause complications. Sliding devices like Dynamic hip screw (DHS) have been extensively used for fixation of intertrochanteric fractures. However if the patient bears weight early, especially in comminuted fractures, these devices can cut out through the femur head or neck or can bend or break. But Surgeons do not need high learning curve to perform this surgery as compared to Proximal femoral nail<sup>[8]</sup>.

Intramedullary devices like Proximal femoral nail have been reported to have advantage in comminuted fractures as they are placed more medially and closer to the femur mechanical axis, thereby decreasing the lever arm and bending moment on the implant. They can be performed in less time in the hands of experienced surgeons, usually with lesser blood loss and earlier weight bearing especially in comminuted fractures and less shortening usually, because of lack of excessive fracture collapse as seen in DHS.

The purpose of the present study is to verify the advantages and disadvantages of the proximal femoral nail over the dynamic hip screw device and also their effect each on the eventual functional outcome of the patient.

### Methodology

A total of 98 patients of intertrochanteric fractures of the femur were operated during this period in our institute. Among these patients, 26 patients died after surgery and did not follow up and were not included in this study. The rest of the patients were not traceable via telephone, some even by home visitations by us due to difficulty in tracing certain home addresses. Patients who were followed up for upto 6 months to 1 year were included in this study.

Adult patients with intertrochanteric fracture attending the hospital were evaluated pre-operatively and functional results were assessed post-operatively.

The patients were evaluated as per the history, mode of injury, clinical examination, necessary radiological investigations and haematology profile which was done on admission. Type of surgery and details were noted. The immediate post-operative X-rays were evaluated. All cases were evaluated through clinical and radiological methods at 3 months, 6 months, 1 year (as applicable).

Descriptive and comparative study of the functional outcome following surgical management of intertrochanteric fractures with either proximal femoral nailing and dynamic hip screw fixation were done.

All patients were given First Aid, Adequate fluid replenishment, Adequate immobilisation of the affected extremity (Thomas splint) and once the patient was stable, he/she was shifted to Ward and required X-rays and further investigations were done.

### Radiological assessment

Plain/Digital X-rays of the pelvis with both hips AP view, Cross table lateral view were taken. X-Ray chest for Pre-Anaesthetic Checkup.

Fractures classified as per AO/OTA Classification.

### Laboratory investigations

Haemoglobin, Complete blood cell count, Random blood sugar, Renal function tests, Blood grouping, Bleeding time, Clotting time, HIV and HBsAg, Chest XRay, ECG were done.

The sample was selected from patients admitted from the Casualty or OPD in Netaji Subhash Chandra Bose Medical College and Hospital.

**Inclusion criteria**

1. Patients aged above 18 years.
2. Patients with isolated intertrochanteric fractures types 31 A1, A2, A3.
3. Patients who were ambulatory before the injury.
4. Delayed union/ Non-union/ Failed intertrochanteric fractures.

**Exclusion criteria**

1. Patients younger than 18 years of age
2. Trochanteric fractures associated with any other fracture like neck or shaft of femur.
3. Compound fractures
4. Pathological fractures: Primary malignancy / metastatic disease, Osteomyelitis of the proximal femur, Bone marrow disease such as myelodysplastic syndrome, Metabolic bone disorders other than osteoporosis like Osteomalacia, Renal osteodystrophy.
5. Peri-prosthetic fractures
6. Patients who were non-ambulatory before the injury
7. Patients not giving consent for the surgery.

**Statistical tests used**

1. Unpaired Student t test
  2. Chi-square test
- p value < 0.05 was considered at 95% confidence level.

**Results**

**Table 1:** Age Distribution among the operated cases

Age in years	No of cases	Percent
< 30	3	7.5
30-40	10	30.0
41-50	5	10.0
51-70	11	47.5
Total	30	100.0

In the present study of the 30 Cases selected, maximum number of the Cases were seen in 51-70 years age group (47.5%) followed by 10 patients in age group 30-40 years (30%), followed by 5 patients in 41-50 years age group (10%) and least number of patients. In this study, about 30% patients are in productive age group and 47.5% in elderly age group.

**Table 2:** Type of fracture

Type of fracture	Frequency	Percent
Stable fracture (A1.1, A1.2, A1.3, A2.1)	12	40.0
Unstable Fracture (A2.2, A2.3, A3.1, A3.2, A3.3)	18	60.0
Total	30	100.0

Majority were unstable fractures (A2.2, A2.3, A3.1, A3.2, A3.3) 18 Cases (60%) followed by stable fractures (A1.1, A1.2, A1.3, A2.1) 12 Cases (40%).

**Table 3:** Duration of surgery (in hours)

Variables	DHS		PFN		Total	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Duration of surgery in hours	1.7	0.8	2.5	0.4	2.0	0.6

P=0.21

**Table 4:** Post-Op Complications in DHS and PFN

	DHS	PFN
NIL	11 73.3%	11 73.3%
Chronic infection	0 0.0%	2 6.7%
Cut through of proximal screws	0 0.0%	1 6.7%
Screw backout	4 26.6%	1 6.7%
Total	15 100.0%	15 100.0%

The duration of surgery was not significantly different in both groups.

More time was taken in performing PFN than in DHS. Chronic infection was seen in the PFN operated group which can be attributed to longer duration of surgery in PFN. Backing out of the screw in DHS was seen in 4 Cases of the 15 DHS operated patients and backing out of 8mm hip screw

was seen in 1 Case in PFN operated patient.

**Table 5:** Union in DHS and PFN

Union	Groups	
	DHS	PFN
Valgus malunion	1 6.7%	0 0.0%
Varus malunion	4 26.7%	1 7.1%
United normally	10 66.7%	14 100.0%

Varus malunion is defined as more than 10° varus angle when compared to normal side femur neck shaft angle and more than 10mm shortening.

From total of 15 patients each of DHS and PFN, 4 patients from DHS operated group showed Varus malunion and 1 patient from DHS group showed Valgus malunion and 1 patient from the PFN group showed Varus malunion and rest of the patients showed union in normal range.

**Table 6:** Post-op walking ability (at 6 months) as per sahlstrand's grading

Post op walking ability	Groups		Total
	DHS	PFN	
1	5	9	14
	33.3%	60.0%	46.7%
2	10	4	14
	66.7%	26.7%	46.7%
3	0	2	2
	0.0%	13.3%	6.7%
Total	15	15	30
	100.0%	100.0%	100.0%

**Sahlstrand's grading of walking ability**

Grade 1 – Walk without support

Grade 2 – Walk with a cane or minimal support

Grade 3 – Walk with 2 canes, crutches or living support

Grade 4 – Confined to bed or wheel chair

All patients were in Sahlstrand's Grade 1 walking ability

before trauma. Post-op walking ability in this study shows 60% PFN patients walking without support with 33.3% DHS patients walking without support and 66.7% patients of DHS walking with cane and 13.3% patients of PFN needing 2 canes or walker post-operatively measured at 6 months post-op.

**Table 7:** Functional outcome with harris hip score in dhs and pfn operated patients

Variables	DHS		PFN		Total	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Harris hip score	75.6	8.7	76.8	10.9	76.2	9.7

p=0.74; Not significantly different

Harris Hip score was found to be more in patients treated with PFN.

**Table 8:** Final functional outcome in dhs and pfn operated patients

Functional outcome	Groups		Total
	PFN	DHS	
Excellent	2	1	3
	13.3%	6.7%	10.0%
Good	2	5	7
	13.3%	33.3%	23.3%
Fair	8	5	13
	53.3%	33.3%	43.3%
Poor	3	4	7
	20.0%	26.7%	23.3%
Total	15	15	30
	100.0%	100.0%	100.0%

p=0.43

**Discussion**

In the present study of the 30 Cases selected, maximum number of the Cases were seen in 50-70 years age group (30%) but also 30% cases in the elderly age group (31-40 years). In patients of age group 50—70 years, the majority of them sustained trivial trauma by fall on ground and the 31-40 years age group sustained high energy trauma by Fall from height or Road Traffic Accident (RTA) because of active lifestyle and more mobility than old age group. In older age group patients, trauma occurred for trivial reasons because of the less active lifestyle, lesser mobility among old age persons and also osteoporotic bone quality (poor bone stock) which makes them more prone for fractures even from trivial trauma. White and colleagues did a study of prevalence of intertrochanteric fractures in elderly patients and concluded that the average age for trochanteric fractures is 75.4 years. Intertrochanteric extracapsular fractures also occur in a 3:1 female to male ratio. Intertrochanteric fractures show a bimodal distribution (20 to 40 years and over 60 years) according to a study by Brunner *et al.* Isolated trochanteric fractures occur more often in young, active adults between the ages of 14 and 25 according to Nyccion and Hunter *et al.* In

the present study, bi-modal distribution in age groups was seen similarly as in the study conducted by Brunner *et al.* [9] In the present study, 60% of the patients had unstable type intertrochanteric fractures (AO A2.2, A2.3, A3.1, A3.2, A3.3). The incidence of osteoporosis in patients with unstable fracture was 66.67 % (50 % of patients were with type A2.2 and type A2.3), whereas 1.7 % patients with a stable AO A1 fracture were found in the study conducted by Deepak Joshi and Anoop C in November 2014. Other studies also indicate higher fracture comminution among persons with poor bone stock and higher energy trauma. Our results match with these studies [10, 11].

Results of treatment of stable and unstable fracture have usually been reported together in the literature, and it is generally accepted that with increasing complexity of fracture pattern (stable to unstable), there is a higher risk of complication and poor outcome. The only complications encountered in the present study were malunion, screw backout and wound infection.

Chronic wound infection was seen in 2 Cases of PFN operated patients. 4 cases of DHS operated patients had Richard's screw backout, 1 Case of 8mm hip screw backout in PFN operated patient. In the present study, shortening of the limb was significantly ( $p=0.01$ ) more in DHS operated patients (Mean 1.8cm) than PFN operated patients (Mean 1.1cm).

The wound infection in PFN could be attributed to the longer time taken for the surgery, which can expose the incision to micro-organisms for longer time, sometimes frequent revision of the hip screws due to unsatisfactory fixation discerned by the operating surgeon on table which can put higher risk of the wound to infection and difficulty in washing smaller incision wounds than larger wounds.

In the present study, Varusmalunion was seen in 4 cases of DHS associated with Richard's screw backout and 1 case in PFN operated patients each and single case of valgus malunion was seen in DHS operated patient. One reason may be that the entry point of the PFN at the tip of the greater trochanter is located directly in the fracture region which can cause an intraoperative fracture displacement and varus

angulation. In DHS operated patients, varusmalunion is frequent due to medialisation of the distal fragment during excessive collapse of the lateral wall in case of unstable fractures. Screw backout was seen in a 4 cases of DHS associated with varusmalunion and 2-2.5cm shortening due to excessive fracture collapse in unstable fractures A2,2 and A2.3. Single case distal screw backout was seen in PFN because of the lack of maintaining proper Tip Apex Distance between the tip of the hip screw and the joint and positioning further away from the inferior border of the neck and the postero-medial cortex.

In the present study, the Functional outcome was taken according to the Modified Harris Hip Score and was found to be better for PFN treated patients (Mean score 76.8) than for DHS treated patients (Mean score 75.6), but was not statistically significant ( $p=0.74$ ). Excellent Functional outcome was seen in two DHS operated patients (13.3%) and in one PFN operated patient (6.7%), Good Functional outcome (33.3%) in PFN operated patients, Fair functional outcome 53.3% among DHS operated group.

On taking Age vs Functional outcome, upto age group 60 years, the patients have increasing Harris Hip scores but ages more than 60 years onwards the Harris Hip score values are depreciating. This could be attributed to various factors like post-op rehabilitation, activity level, motivation to perform active tasks, muscle strength, fracture consolidation which can all be affected by the age. Similar findings were seen in the series by Pajarinen and group. This suggests that the use of PFN may be favored in stable fracture when compared to DHS. In the study by Xiao Huang in 2009, there was no difference in the functional outcome between DHS and PFN [12].

On taking Type of fracture vs Functional outcome, as complexity of the fracture pattern increases, the Harris Hip score measurement was found to be in lower score values. This can be attributed to the decrease in stability in more complex fractures which has a bearing on the fracture consolidation, pain at fracture site, more period of non-full weight bearing on the limb which can indirectly cause reduced muscle strength. Similar results were observed in Jaswinder Pal Singh et. al. study of Stable and Unstable Intertrochanteric fractures treated by PFN and DHS in 2007.

In addition, with unstable intertrochanteric fractures, the PFN has a definite advantage over the DHS in terms of less limb length shortening, earlier restoration of pre-injury walking ability and a better overall functional outcome. In the present study, the pros of PFN surgery includes lesser blood loss, less shortening, earlier weight bearing, lesser union complications but more exposure of the surgeon and patient to fluoroscopy radiographic exposure intra-op and longer duration of surgery. DHS offered relatively easier method to the surgeon, which can be mastered at relatively shorter learning curve, measured by the lesser time taken to perform the surgery and lesser radiographic exposure than PFN but not very effective in more unstable fracture patterns as it tended to cause more shortening in unstable fractures associated with varus malunion as well, associated with shortening.

### Conclusion

In our study, Dynamic hip screw was compared with the Proximal femoral nail for the operative treatment of intertrochanteric fractures in terms of per-operative and post-operative variables.

Both Proximal femoral nail and Dynamic hip screw have their advantages and disadvantages in treatment of intertrochanteric

fractures. There are various variables which need to be considered in order to decide which patient should be treated with which kind of implant which is left to the safe discretion of the operating surgeon by his expertise, knowledge and experience.

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