A Comparative Study Of Proximal Femoral Nailing Versus Dynamic Hip Screw Device In The Surgical Management Of Intertrochanteric Fractures (Extracapsular)

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Citation

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Abstract
The intertrochanteric fractures were found to be the most common injuries sustained predominantly in patients over 60 years of age. They are three to four times more common in women who are osteoporotic, trivial fall being the most common mode of injury.

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.

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 leads to internal fixation of these fractures to increase patient comfort, facilitate nursing care, decrease hospitalization time, and reduce complication of prolonged recumbency.

The type of implant used has an important influence on results of fixation. Sliding devices like the dynamic hip screw have been extensively used for fixation.

Intra-medullary devices like the proximal femoral nail have been reported to have an advantage in such fractures as their placement allowed the implant to lie closer to the mechanical axis of the extremity, thereby decrease the lever arm and bending moment of the implant.

The purpose of the present study which was done in Department of Orthopedics, M.M.I.M.S.R., Ambala India is to verify the theoretical advantages of the proximal femoral nail over dynamic hip screw device and also whether it actually alters the eventual functional outcome of the patient.

Fourty adult patients with intertrochanteric fracture who were available for follow up at least 6 months post operatively were included in this study. The patients were selected for Dynamic hip screw fixation or proximal femoral nailing randomly. The study period was from JUNE 2012 to FEBRUARY 2014

The patients were evaluated as per the history, mode of injury.

Necessary radiological investigations and haematology profile was done on admission. Type of surgery and details were noted. The immediate Post-operative X-ray was evaluated. All the cases were again evaluated at 3 months interval till 6 months.

The assessment parameters included were the ability to bear weight, rate of union both clinical and radiological, degree of deformity and any limb length discrepancy

Data was collected on a detailed proforma and analysis.

Results
The PFN required significantly shorter incision, less blood loss and operative time. The DHS group required less fluoroscopy
time. Post-operative complication in both group included mal-union and infection, 5 malunion in DHS while in 1 in PFN, 2 wound infections in DHS while 1 in PFN and 1 screw back out in DHS. Patients treated with PFN had a significantly lower pain score at six months of follow up. Patient treated with DHS had more limb length shortening as compared to those treated with PFN. The outcome of the stable fractures treated with either DHS or PFN were similar. Unstable intertrochanteric fractured, treated with PFN, had significantly better outcome with all patients having good results.

Conclusion

Though both PFN and DHS have similar functional outcome in stable fracture and PFN has better functional outcome with unstable fractures, PFN requires short operative time and a smaller incision, it has distinct advantages over DHS even in stable intertrochanteric fractures. Hence, in our opinion, PFN may be the better fixation device for most intertrochanteric fractures.

INTRODUCTION

Trochanteric fractures are one of the most common injuries sustained predominantly in patients over sixty years of age. They are three to four times more common in women who are osteoporotic; trivial fall being the most common mechanism of injury.

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 complications of recumbence and immobilization.

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.

The greatest problems for the orthopaedic surgeon treating this fracture are instability and the complications of fixation that result from instability. Stability refers to the capacity of the internally fixed fracture to resist muscle and gravitational forces around the hip that tend to force the fracture into a varus position. Intrinsic factors like osteoporosis and comminution of the fracture and extrinsic factors like choice of reduction, choice of implant and technique of insertion, contribute to failure of internal fixation.

The type of implant used has an important influence on complications of fixation. Sliding devices like the dynamic hip screw have been extensively used for fixation. However, if the patient bears weight early, especially in comminuted fractures, these devices can penetrate the head or neck, bend, break or separate from the shaft.

Intramedullary devices like the proximal femoral nail have been reported to have an advantage in such fractures as their placement allowed the implant to lie closer to the mechanical axis of the extremity, thereby decrease the lever arm and bending moment on the implant. They can also be inserted faster, with less operative blood loss and allow early weight bearing with less resultant shortening on long term follow up.

The purpose of the present study is to verify the theoretical advantages of the proximal femoral nail over the dynamic hip screw device and also whether it actually alters the eventual functional outcome of the patient.

AIMS OF THE STUDY

To compare the surgical treatment of intertrochanteric fractures of the femur with the proximal femoral nail and dynamic hip screw device, with respect to:

- Fluoroscopic time
- Duration of surgery
- Blood loss
- Fracture union and
- Functional outcome.

REVIEW OF LITERATURE

HISTORICAL REVIEW

Until the 20th century, trochanteric fractures were treated non operatively. The treatment however has advanced greatly in the past few decades. In the 1930's, Jewett introduced the triflanged nail, which allowed the surgeon to achieve immediate stability of the fracture and early mobilization of the patient. However, use of the Jewett nail for the fixation of unstable intertrochanteric fractures
has been problematic and loss of fixation has been common. Such a rigid implant does not allow the impaction of comminuted fracture fragments to occur. As a result, there is increased stress on the implant if union does not occur rapidly; the implant would ultimately fatigue and fail, or it would penetrate and cut out of the femoral head.

The shortcomings of fixed nail-plate devices were recognized in the mid-1960s, and techniques were developed to recreate medial stability in patients who had an unstable intertrochanteric fracture. These techniques combined the use of rigid devices with various types of osteotomies. Dimon and Hughston7 advocated a procedure in which the lateral trochanter was osteotomized and the shaft was displaced medially to force the head and neck into the shaft. Sarmiento8 and Williams9 recommended a valgus osteotomy in which a laterally based wedge at the proximal end of the fracture of the shaft was resected and the neck fragment placed on the medial cortex in a valgus position to create a stable configuration. During the same period, Clawson10, as well as Massie11, introduced sliding devices that allowed impaction of the fracture fragments. After several modifications, the dynamic hip screw (DHS) was introduced by the AO/ASIF. This technique has produced results that are equal to or better than those of osteotomies and it remains the mainstay of treatment today.

In 1980 Jenson and co-workers13 showed that the telescoping of a 135° sliding hip screw by 10mm and 20mm improved implant strength by 28% and 80%, respectively, in part because of the shortening of the lever arm. Jacobs and co-workers14 demonstrated that the sliding hip screw acts as a lateral tension band in stable fracture patterns, transmitting forces through the medial cortex. Simpson and colleagues15, demonstrated that loss of this sliding capability lead to a functionally rigid construct and higher failure rates. In 1993 Rha16 found that excessive sliding was the major factor causing failure of fixation. An association was made between fracture settling and pain when Baixauli and associates17 found sliding of >15 mm to be associated with postoperative pain. Müller-Farber and associates18 found increased sliding of the hip screw to be associated with decreased postoperative mobility.

To overcome these complications, a trochanteric supporting plate attached to a traditional sliding hip screw device was used to increase the stability of intertrochanteric fracture fixation during revision surgery after initial failure by superior lag screw cutout19. This type of side plate provided a buttress effect for a comminuted greater trochanter during compression hip plating of associated intertrochanteric fractures and helped to reduce medial shaft displacement during fracture impaction. In osteoporosis, tightening of the lag screw leads to stripping of the screw and loss of fixation within the femoral head. Hence augmentation of the purchase strength of lag screws used with sliding hip screw devices was accomplished with the use of reversibly deployable talons which increased the purchase strength of the lag screw within the femoral head, resist torque forces between the head and the lag screw, and increase the amount of bone engaged by the screw, however ease of implant removal in clinical practice remained a concern20.

The Gotfried percutaneous compression plate (PCCP) was developed to be easily applied using a minimally invasive technique. The PCCP device included a chisel end for introduction through the vastus lateralis muscle along the lateral cortex of the proximal femur. The other unique feature of this device was the presence of 2 lag screws that could be placed into the femoral head. The clinical benefit of percutaneous insertion of this device however remained theoretical as cutout of lag screws through the femoral head with the PCCP occurred with similar frequency as with compression hip screws21,22.

The Medoff plate allowed compression in both the axis of the lag screw and the long axis of the femur. The proximal portion of the plate contains the barrel and lag screw. This portion of the implant telescopes along the lateral femur within a separate side plate that is securely fixed to the lateral femur. The biaxial compression axes provide theoretical advantages for more complex intertrochanteric femur fractures20. In a large multicenteric trial, the Medoff plate was found to have higher implant-related complications than the DHS23.

In the mid-to-late 1970s, flexible intramedullary devices for the fixation of intertrochanteric fractures were introduced in the form of the Ender nail and the condylocephalic nail. The advantage of these devices was due to their intramedullary position, which places them closer to the resultant force across the fracture and reduces the bending moment on the device. In addition, the use of distal sites of insertion to decrease operative time and loss of blood, compared with the use of proximal sites, was reported24,25. This operative technique was made possible by the use of image intensification and was promoted as a...
closed method for the fixation of intertrochanteric fractures. However, a high prevalence of varus deformity, as well as pain in the knee caused by distal migration of the pins, were reported in association with this procedure. These problems led to a high rate of re-operation for extraction of the pins and correction of deformity. A high rate of failure due to loss of reduction, shortening, and external rotation resulted both from Ender nails and from condylocephalic nails. Accordingly, most authors have recommended that these devices not to be used for the fixation of intertrochanteric fractures.

The first-generation intramedullary nails had a shorter lever arm, to decrease tensile strain on the implant, the lack of requirement of an intact lateral cortex, the improved load transfer (as a result of medial location), the potential for closed fracture reduction, percutaneous insertion, shorter operative time, and reduced blood loss are theoretical advantages of intramedullary devices compared with compression hip screw devices. The first-generation nail for treatment of intertrochanteric fractures, the Gamma nail, was associated with a relatively high incidence of peri-implant fracture of 2.2% to 17% approximately 4 times greater than seen with compression hip screws. Nail geometry and size were contributing factors. A large (10°) valgus bend, long (200 mm) length without an anterior bow, and relative stiffness caused by large proximal (17mm) and distal (12–16mm) diameters all provided for increased stress concentration at the tip of the nail. The rate of cutout of these first-generation nails, 2% to 4.3%, was no better than that seen with compression hip screw devices. Changes to implant geometry, a reduced valgus bend to 4°, a decrease in the distal diameter to 11 mm, and shortening of the length to 180 mm decreased the stress concentration at the tip of second-generation Gamma nails. The rate of peri-implant fracture reduced with these second-generation devices to between 0% and 4.5%.

The third-generation nails such as the proximal femoral nail (PFN), which incorporate multiple screws into the femoral head, have been recently introduced. Multiple points of fixation theoretically provide better rotational control of unstable fractures compared with a single lag screw. The smaller-diameter screws of these multiple screw devices allow a smaller diameter for the proximal section of the nail. The smaller nail diameter is advantageous by reducing the amount of the gluteus medius tendon that is injured on insertion and by improving bone integrity in this region. The theoretical concern about smaller diameter screws is screw cutout directly related to their decreased diameter that could be exacerbated by screw bending. Such bending can prevent sliding of the lag screw. Fracture of the smaller superior screws has been seen, especially when it is placed near the subchondral bone of the femoral head. In this position, it encounters large varus stresses that are not shared by the larger inferior screw.

**REVIEW OF COMPARATIVE STUDIES**

Bridle and associates prospectively compared fixation of 100 intertrochanteric fractures treated randomly by either dynamic hip screw or intramedullary device like the proximal femoral nail and found no difference in operating time, blood loss, wound complications and final mobility. In their study cut-out occurred in 3 cases with DHS and in 2 cases with intramedullary device. However 4 cases of fracture femur occurred close to the tip of the intramedullary device.

According to Rosenblum and his group, intramedullary devices provided three point fixation, a more efficient load transfer due to its medial location with a shorter lever arm and hence, less tensile strain on the implant, reducing the risk of mechanical failure. However they also found that the inherent stiffness of the intramedullary device imparted non–physiological loads across the proximal part of the femur and transmitted decreasing loads to the calcar with decreasing fracture stability hence bypassing the calcar and concentrating the compressive loads on the distal tip of the nail leading to shaft fractures.

In successfully treated intertrochanteric hip fractures, the average tip apex diameter was found to be 24mm and no constructs with a tip apex diameter of less than 25mm resulted in cutout from the femoral head as shown by Baumgaertner and colleagues. Hence they concluded that the tip apex diameter is the strongest predictor of cutout as seen in 84% of the patients in their study.

The rate of femoral shaft fractures as a complication of intramedullary device was found to be 5.3% in a study by Parker and colleagues. They also found that the rate of cut out of intramedullary device was 3.1% as compared to 2.5% in those intertrochanteric fractures treated with dynamic hip screw.

Baumgaertner and associates concluded that
fractures stabilized by an intramedullary hip screw required 10% less operative time and had significantly less blood loss (245cc V/s 340cc) than those stabilized with the sliding hip screw.

A prospective randomized study of 100 intertrochanteric fractures conducted by Hardy and associates showed that the mean mobility score was significantly greater at one month and three months for the patients who had an intramedullary nail and was had significantly less sliding of the lag screw and subsequent shortening of the limb as compared to those treated with dynamic hip screw device. They also found a relationship between thigh pain and use of two distal interlocking bolts. Kim and colleagues stated that the most important cause of dynamic hip screw failure was fracture instability.

Kukla and co-workers recommended the use of intramedullary device only for unstable peritrochanteric fractures after studying 1000 consecutive patients treated with this device between 1992 – 1998.

No difference was found in the outcomes comparing stable and unstable fracture patterns in a series by Adams et al.39 and they reported that only 21% of their 197 patients regained their pre-fracture independence. Hence they stated that the theoretical advantages of intramedullary devices have not been translated into an improvement in the treatment of intertrochanteric fractures as more re-operations were performed in the intramedullary hip screw groups (6%) as compared to 4% in the dynamic hip screw group, due to high number of lags screw cut outs. In addition incidence of femoral shaft fractures were higher (2%) as compared to none in dynamic hip screw group. Hence they advocated that the intramedullary hip screw should not be routinely adopted for the treatment of intertrochanteric fractures.

Saudan and associates showed that there was no statistically significant difference intraoperatively, radiologically or clinically between patients treated with dynamic hip screw or intramedullary hip screw in their study of 206 patients.

According to Ahrengart and associates, intramedullary device more frequently preserved the fracture position obtained pre-operatively. They also concluded that in the less comminuted fractures the compression hip screw method was the preferred method of treatment whereas the intramedullary nail was an alternative treatment for more comminuted fractures.

A study conducted by Bellabarba and colleagues involving the percutaneous treatment of peritrochanteric fractures using intramedullary hip screw showed a union rate of 98% with no cases of varus malunion exceeding 10° and only 3% had peri-operative femur fractures.

Kubiah and co-workers. compared the outcomes of patients with intertrochanteric fractures treated with either one large diameter or two small diameter lag screws along with the intramedullary hip screw device and concluded that there was no significant difference between the two in static or cyclical loading with respect to screw sliding or inferior and lateral head displacements.

Comparing the screw sliding characteristics and stability in four part unstable intertrochanteric femur fractures, Bong and colleagues found that a sliding hip screw attached with a lateral support plate provided stability and ability to resist medial displacement of the femoral shaft similar to that seen with intramedullary hip screw.

O’Brien and group concluded that no difference existed between sliding hip screws and intramedullary hip screws in terms of technical aspects (operating room time, screening time and blood loss), hospital stay, malunion, nonunion, failure of fixation, general post operative complications or final outcome measures for the treatment of intertrochanteric fractures. However intramedullary devices may be superior to extramedullary devices for the treatment of reverse obliquity intertrochanteric fractures.

According to Magit and colleagues, with union rates of greater than 95% the dynamic hip screw device represented the standard of treatment for trochanteric femur fractures, however, these implants had their own problems such as high screw cutout from femoral head, excess collapse at the fracture site, which in turn shortened the leg and reduced the lever arm of the hip abductors, increased intraoperative blood loss and extensive soft tissue dissection. They also stated that the less invasive treatment of intertrochanteric femoral fractures with intramedullary nail offers several potential advantages over dynamic hip screw, such as smaller incision, limited devascularisation and subsequently shorter operative time, less blood loss and less wound complications.

The use of intramedullary hip screw in the treatment of pre operatively irreducible fractures was advocated by Garnavos and co-workers to avoid an open reduction and therefore reduced blood loss and allows early mobilization.
of the patients.

Kregor and group\textsuperscript{48} found that the failure rates of dynamic hip screw device were too high to recommend its use and functional outcomes were much better using intramedullary hip screw in the management of unstable intertrochanteric hip fractures.

**MATERIALS AND METHODS**

The study was conducted at the MMIMSR hospital from November 2012 to December 2013 where 40 patients with 40 intertrochanteric fractures were selected.

Adult patients with intertrochanteric fracture attending the multispeciality Hospital were evaluated preoperatively and functional results were assessed post operatively.

The patients were evaluated as per the history and mode of injury. Necessary radiological investigations and hematology profile was done on admission. The type of surgery and other details were noted. The immediate post-operative x-rays were evaluated. All the cases were again evaluated through clinical and radiological methods at 6 weeks, 12 weeks, and 6 months for any morbidity and mortality.

Descriptive and comparative studies of functional outcome following surgical management of intertrochanteric fractures with either proximal femoral nailing or dynamic hip screw fixation was conducted.

A sample of size 40 was selected using purposive sampling technique.

20 patients have undergone proximal femoral nailing.

20 patients have undergone dynamic hip screw fixation.

All patients above 18 years of age with fresh intertrochanteric fractures and who were able to walk prior to the fracture were included in the study.

Patients with pathological fractures, active infection, unstable medical illness and non-traumatic disorder were excluded from the study.

The mode of injury was classified under 3 different categories taking into consideration whether the injury was due to a road traffic accident, trivial fall or a fall from height. In thirty out of 40 cases mode of injury was due to road traffic accident.

The youngest patient in the series was aged 27 years and the oldest was 80 years of age.

The pre-injury walking ability was recorded as per the classification of Sahlstrand\textsuperscript{74}. Anterioposterior and lateral radiographs of the affected hip were taken. The patients were then put on skin traction over a Bohler–Braun frame. All the patients were initially evaluated as to their general condition, hydration and corrective measures were undertaken. The fractures were classified as per Jensen and Michealsen’s modification of Evans classification of intertrochanteric fractures. Type I and type II were considered as stable fractures and type III, IV and V were considered as unstable fractures. No open fractures were encountered in this series. The patients were taken up for surgery on the next elective operation day. Adequate blood transfusion and other supportive measures were given depending on the preoperative condition of the patient and blood loss during surgery.

The fractures were fixed with either dynamic hip screw fixation or proximal femoral nailing. Allocation of the fractures to each treatment group was done by random selection. Of the 40 patients in the study, 20 were treated with dynamic hip screw fixation and 20 with proximal femoral nailing. The length of the incision, duration of surgery, blood loss and fluoroscopy time was recorded intraoperatively.

Descriptive and comparative studies of functional outcome following surgical management of intertrochanteric fractures with either proximal femoral nailing or dynamic hip screw fixation was conducted.

**Prophylactic medications:**

All patients received injectable antibiotic (cephalosporins) given one hour before surgery and continued post operatively for 2 to 3 days. Oral cephalosporins were continued for next 3 to 4 days. Aminoglycosides were added intraoperatively if the procedure was prolonged. Analgesic was initially given in IV or IM route for 2 to 3 post operative days and then orally for few days. We did use low molecular weight heparin as an anti deep vein thrombosis prophylaxis only in few of our patients.

**DESCRIPTION OF PROCEDURES**

All patients were positioned supine on a fracture table. The unaffected lower limb was flexed and abducted to allow easy access for the image intensifier.

Reduction:

The fracture was reduced by traction in neutral, slight...
internal or external rotation depending on the nature of the fracture and checked by anteroposterior and lateral views on the image intensifier. All fractures were reduced by the closed method. The objective of reduction is to confer weight bearing stability and correct varus and rotational deformities. In stable fractures this is achieved by reduction of the calcar femorale.

Method of fixation:

A. Dynamic hip screw:

A straight lateral incision is made. The vastus lateralis muscle is then split. Using the angle guide, a point of entry at the trochanteric flare is chosen under radiographic control. A 2.5mm tipped threaded guide wire is inserted into the center of the neck and head of the femur midway between anterior and posterior cortices to within 10mm from the joint under image intensifier control. The length of the wire outside is measured using an external measuring device to determine the length of the screw required.

The triple reamer is set to the length already measured and reaming is done over the guide wire under radiographic control. A tap is used to prepare the bone after which the lag screw of appropriate length is inserted. The position of the lag screw is again checked on the image intensifier. The barrel is then slipped over the lag screw. The guide wire is removed and the plate is fixed to the shaft of the femur with screws. Traction is then released and the fracture is compressed with the 19mm compression screw. A suction drain is inserted and the wound is closed in layers.

B. Proximal femoral nail.

A lateral skin incision is made extending from the hip of the trochanter proximally for 3-8 cm depending on the size or obesity of the patient. The gluteus maximus aponeurosis is split in line with its fibers from the hip of the trochanter proximally for 5 cms and then the gluteus medius is split in line with its fibers.

An entry point is made just medial to the tip of the greater trochanter with a curved awl. A 3.2 mm tip threaded guide pin is inserted through the tissue protection guide pin centering sleeve beyond the fracture site. The position of the pin is checked on the image intensifier. The proximal femoral reamer is then used to prepare the proximal portion of the femur. In this study a 9 or 10 mm nail was used depending on the diameter of the femoral canal with a different length of 250 mm, ultrashort and long PFN. The 6° mediolateral angle of the nail allows easy insertion. The proximal femoral nail was then attached to the jig and passed over the guide wire into the proximal femur and across the fracture site into the femoral shaft.

Once the proximal femoral nail is inserted, the head and neck of the femur are reamed for the cannulated hip screw, which is 8 mm in diameter and varying from 70 to 110 mm in length. Under radiographic guidance the hip screw is inserted into the lower half of the neck of the femur within 5-10 mm from the subchondral bone of the femoral head. The stabilization screw which is 6.4 mm in diameter cannulated and varying from 60-100 mm in length is then inserted into the proximal slot of the nail under radiographic guidance after the drilling for the same. Then incisions is then made and the distal locking bolts are inserted using the jig from the lateral cortex of the femur through the slot in the nail. All the incisions were closed and sterile dressings was applied.

Postoperative care:

There was no defined postoperative patient protocol, but all patients were given peri-operative antibiotics for 24 to 48 hours and deep venous thrombosis prophylaxis. The patients were allowed to sit up in the bed on the second post-operative day. Static quadriceps exercises where started on the second and third post-operative day. Sutures were removed after 10 to 14 days. The patients were mobilized using non-weight bearing as soon as the pain or general condition permitted. Weight bearing was commenced depending upon the stability of the fracture and adequacy of fixation, delaying it for patients with unstable or inadequate fixation.

All the patients were followed up at 6 weeks 3 months and 6 months intervals for a period of 6 months and follow-up x-rays were taken to assess fracture union and signs of failure of fixation. The walking ability of each patient was recorded and compared with pre-injury walking ability using the Sahlstrand74 grading. Post operative pain was evaluated using the four-point pain score as also used by Saudan40. The fracture union was considered as malunion if varus angulation was greater than 10 degrees.
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Figure 3
Implants and Instruments for dynamic hip screw fixation

Figure 4
Patient position on operation table for DHS

Figure 5
Skin incision for DHS

Figure 6
IT band opened along the line of skin incision

Figure 7
Bone exposed after deep dissection

Figure 8
Guide wire with 135 degree angle guide
Figure 9
Reaming with triple reamer

Figure 10
Hip screw insertion over the guide wire

Figure 11
Plate insertion

Figure 12
Compression Screw application Proximal femoral nail

Figure 13
Implants and Instruments for proximal femoral nailing

Figure 14
Patient position on operation table for PFN
Figure 15
Skin incision for PFN

Figure 16
Entry portal with AWL

Figure 17
Nail insertion with Gig on guide wire

Figure 18
Proximal guide wire insertion through the gig and sleeve

Figure 19
C-arm picture of proximal screw drilling
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**Figure 20**
Distal locking through the gig

![Distal locking through the gig](image)

**Figure 21**
Skin closure

![Skin closure](image)

The functional outcome was assessed based on the HARRIS HIP SCORE, which includes three sections.

**SECTION 1** includes pain, distance walked, activities (shoes and socks), support, public transportation, limp, stairs, sitting.

**SECTION 2**
- Less than 30 degree of fixed flexion
- Less than 10 degrees of fixed internal rotation in extension.
- Less than 10 degrees of fixed adduction.
- Limb Length discrepancy less than 3.2 cms (1.5 inches).

To score this section all four must be “yes” then get 4 points.

**SECTION 3 (MOTION)** includes total degree of flexion, abduction, external rotation, and adduction.

**Harris Hip Score (a)**

![Harris Hip Score](image)
Harris Hip Score (b)

To score this section all four must be ‘yes’, then get 4 points. Nb. Not 1 point for each four or nothing.

Does your patient have ALL of the following:

- Less than 30 degrees of fixed flexion
- Less than 10 degrees of fixed rotation in extension
- Less than 10 degrees of fixed adduction
- Limit length discrepancy less than 3.2 cm (1.5 inches)

Harris Hip Score (c)

**STATISTICAL ANALYSIS**

The statistical data was carried out using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL). Mean and standard deviation was calculated for all quantitative variables for description and measures of dispersion. For normally distributed data means of two groups was compared using the Student t-test. For skewed data or scores, the Mann Whitney test was applied. Qualitative or Categorical variables were described as frequencies and proportions. Proportions were compared by using Chi Square or Fisher’s exact test whichever was applicable. P value (less than 0.05) were considered statistical significant.

**RESULTS AND ANALYSIS**

**PRE OPERATIVE VARIABLES**

**Table 1**
Age Distribution

<table>
<thead>
<tr>
<th>Age (Yrs)</th>
<th>Method of Fixation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DHS</td>
<td>PPFN</td>
</tr>
<tr>
<td>21-40</td>
<td>5 (29%)</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>41-60</td>
<td>8 (40%)</td>
<td>5 (25%)</td>
</tr>
<tr>
<td>61-80</td>
<td>7 (30%)</td>
<td>14 (70%)</td>
</tr>
<tr>
<td>81-100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>20 (100.0%)</td>
<td>29 (100.0%)</td>
</tr>
</tbody>
</table>

Means±SD 54.25±15.33 63.11±16.45

The most common age group was in the range of 61-80, with a mean of 58.6 years.

**Table 2**
Sex Distribution

<table>
<thead>
<tr>
<th>Method of Fixation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHS</td>
<td>PPFN</td>
</tr>
<tr>
<td>Female</td>
<td>4 (20%)</td>
</tr>
<tr>
<td>Male</td>
<td>16 (80.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>20 (100.0%)</td>
</tr>
</tbody>
</table>

χ² = 12.29, p = 0.006

72.5% of the total patient was male in this series.

Excellent: An excellent result is considered with score between 90 to 100.

Good: A good result is with score between 80 to 89.

Fair: A fair result is with score between 70 to 79

Poor: A poor result is considered with score less than 70.
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Table 3
Mode of Injury

<table>
<thead>
<tr>
<th>Method of Fixation</th>
<th>DHS</th>
<th>PPN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall from height</td>
<td>1 (5.0%)</td>
<td>0 (0.0%)</td>
<td>1 (2.5%)</td>
</tr>
<tr>
<td>RTA</td>
<td>7 (35.0%)</td>
<td>5 (25.0%)</td>
<td>12 (30.0%)</td>
</tr>
<tr>
<td>Trivial fall</td>
<td>12 (60.0%)</td>
<td>15 (75.0%)</td>
<td>27 (67.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>20 (100.0%)</td>
<td>20 (100.0%)</td>
<td>40 (100.0%)</td>
</tr>
</tbody>
</table>

χ² = 1.667, p = 0.433

The most common mode of injury was trivial fall.

Table 4
Side of Injury

<table>
<thead>
<tr>
<th>Method of Fixation</th>
<th>DHS</th>
<th>PPN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>11 (85.0%)</td>
<td>9 (75.0%)</td>
<td>20 (85.0%)</td>
</tr>
<tr>
<td>Right</td>
<td>2 (15.0%)</td>
<td>3 (25.0%)</td>
<td>5 (25.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>13 (100.0%)</td>
<td>12 (100.0%)</td>
<td>25 (100.0%)</td>
</tr>
</tbody>
</table>

χ² = 1.756, p = 0.185

Left side was involved in 65.0% of the patients.

Table 5
Type of Fracture

<table>
<thead>
<tr>
<th>Type of Fracture</th>
<th>Method of Fixation</th>
<th>DHS</th>
<th>PPN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>1 (8.9%)</td>
<td>0 (0.0%)</td>
<td>1 (2.5%)</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>9 (45.0%)</td>
<td>12 (60.0%)</td>
<td>21 (52.9%)</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>7 (35.0%)</td>
<td>12 (60.0%)</td>
<td>19 (47.5%)</td>
<td></td>
</tr>
<tr>
<td>T4</td>
<td>2 (15.0%)</td>
<td>2 (10.0%)</td>
<td>4 (10.0%)</td>
<td></td>
</tr>
<tr>
<td>T5</td>
<td>0 (0.0%)</td>
<td>1 (5.0%)</td>
<td>1 (2.5%)</td>
<td></td>
</tr>
<tr>
<td>T6</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20 (100.0%)</td>
<td>20 (100.0%)</td>
<td>40 (100.0%)</td>
<td></td>
</tr>
</tbody>
</table>

All fractures were classified as per Jensen and Michealsen’s41,57 modification of Evans classification.

T1 : type I fracture
T2 : type II fracture
T3 : type III fracture
T4 : type IV fracture
T5 : type V fracture

There were 22 stable fractures and 18 unstable fractures.

Table 6
Pre-injury Walking Ability

<table>
<thead>
<tr>
<th>Method of Fixation</th>
<th>DHS</th>
<th>PPN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1 (Walk without support)</td>
<td>16 (85.0%)</td>
<td>15 (75.0%)</td>
<td>31 (77.5%)</td>
</tr>
<tr>
<td>Grade 2 (Walk with a cane or minimal support)</td>
<td>4 (20.0%)</td>
<td>5 (25.0%)</td>
<td>9 (22.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>20 (100.0%)</td>
<td>20 (100.0%)</td>
<td>40 (100.0%)</td>
</tr>
</tbody>
</table>

Fisher's p = 0.077 NS

The pre-injury walking ability of the patients was classified as per grades described by Sahlstrand74:

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

Pre-injury walking ability was similar in both the groups.

INTRA-OPERATIVE VARIABLES

Table 7
Length of Incision

<table>
<thead>
<tr>
<th>Method</th>
<th>N</th>
<th>Mean (cm)</th>
<th>Std. Deviation</th>
<th>(t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHS</td>
<td>20</td>
<td>16.15</td>
<td>16.15±1.34</td>
<td>22.59</td>
</tr>
<tr>
<td>PPN</td>
<td>20</td>
<td>8.1</td>
<td>8.1±0.96</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Patients treated with PPN required a significantly smaller skin incision.

Table 8
Duration of Surgery

<table>
<thead>
<tr>
<th>Method</th>
<th>N</th>
<th>Mean (cm)</th>
<th>Std. Deviation</th>
<th>(t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHS</td>
<td>20</td>
<td>87.25</td>
<td>87.25±2.66</td>
<td>8.225</td>
</tr>
<tr>
<td>PPN</td>
<td>20</td>
<td>69.5</td>
<td>69.5±3.65</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Proximal Femoral Nailing required a mean of 18 minutes less operating time compared to the Dynamic Hip Screw fixation group.

POST OPERATIVE VARIABLES

Malunion was seen in 25% of the patients in the DHS group while there was 5% malunion in the PPN group.
A Comparative Study Of Proximal Femoral Nailing Versus Dynamic Hip Screw Device In The Surgical Management Of Intertrochanteric Fractures (Extracapsular)

Wound infection was seen in 2 patients in the DHS group and in 1 patient in the PFN group. One screw back out was seen in the DHS group.

1 – No pain
2 – Mild pain not affecting ambulation
3 – Moderate pain affecting ambulation requiring regular analgesics.
4 – Severe pain, even at rest, requiring stronger analgesics.

In the PFN group 40% of the patients were pain free while 50% of the DHS patient had moderate to severe pain.

Fourteen patients in the PFN group regained their pre-injury walking ability during the third month follow up as compared to five months in the DHS group.

Significantly less limb length shortening was seen in the PFN group as compared to the DHS group with a mean of 1.25cms in the DHS group and 0.575cms in the PFN group.

There were significantly better mean post operative range of movement in PFN than DHS with 84.25 degree mean in the DHS group and 98.75 degree mean in the PFN group.

Excellent to good results were seen in 95% of patients in the PFN group and 50% of the patients in the DHS group.

Of the stable fractures 90 percent had excellent to good outcome, while 40% of the unstable fractures had a poor outcome in the DHS group.

The functional outcome of stable fractures is not significantly better with PFN compared to DHS.

Unstable fractures treated with PFN had a significantly better outcome with all the patients having good outcomes as compared to those treated with DHS.

SOME COMPLICATIONS SEEN

CLINICAL RADIOGRAPHS AND PHOTOGRAPHS: CASE NO. 2

CLINICAL PICTURES OF PATIENT

CASE NO 5.
A Comparative Study Of Proximal Femoral Nailing Versus Dynamic Hip Screw Device In The Surgical Management Of Intertrochanteric Fractures (Extracapsular)

CASE NO 13.

CASE NO.20

SOME CLINICAL PICTURES

DISCUSSION

The goal of the study was to compare the functional outcome of patients with intertrochanteric fractures treated by two different fixation devices, the extramedullary dynamic hip screw fixation and the intermedullary proximal femoral nail. Our study consists of 40 patients with 40 intertrochanteric fractures out of which 20 were treated with DHS and 20 with PFN.

Age Distribution:

The age of the patients ranged from 27 to 80 years with an average of 58.7 years. In case of Dynamic Hip Screw fixation it was 54.3 years and in cases of Proximal Femoral Nailing it was 63.1 years.

All the fractures that occurred in patients younger than 58 years were either due to a fall from height or a road traffic accident. This supports the view that bone quality plays an important role in the causation of fractures in the elderly, which occur after a trivial fall. No attempt was made to measure the degree of osteoporosis by the Singh index, as it involves a great inter-observer variability and depends on good quality x-rays. In addition, the accuracy of the Singh index has been questioned by authors such as Koot et al.56

White and colleagues64 did a study of the rate of mortality for elderly patients after fracture of the hip in the 1980's and they concluded that the average age for trochanteric fractures is 75.4 years.

The average age in our study nearly correlates to that of White and his colleagues64.

Sex Distribution:

In our study there were 29 males and 11 females showing male preponderance.

In the study by Dahl and colleagues65 65% of patients were females, explained by the fact that female are more prone for the osteoporosis after menopause.

SOME CLINICAL PICTURES
Sex distribution in our study not correlates with that of other studies.

Mode of Injury:

The most common mode of injury was trivial fall which was noted in 27 (62.5%), RSA (accidents) in 12 patients and history of fall from height in 1 patient.

All the fractures that occurred in patients younger than 58 years were either due to a fall from height or a road traffic accident.

Fracture Classification:

Our series consisted of 22 stable and 18 unstable intertrochanteric fractures as classified according by Jensen and Michealsen’s modification of the Evans classification. The distribution of stable and unstable fractures in both groups was similar. Out of the 22 stable fractures, 10 were in the DHS group and 12 in the PFN group. Out of the 18 unstable fractures, 10 were in the DHS group and 8 in the PFN group.

Preinjury Walking Ability:

The preinjury walking ability was similar in both groups of patients with DHS or PFN. 80 percent of the patients in the DHS group and 75 percent of the patients in the PFN group were walking without support prior to the injury. 22.5% of the patients in the study had a grade 2 walking ability prior to the fall. This is explained in the fact that intertrochanteric fractures occur in elderly patients.

Length of Incision:

The length of the incision in the DHS group ranged from 14 cm to 18 cm with a mean of 16.15 cm as compared to mean of only 8.1 cm in the PFN group. The smaller incision in the PFN group meant that there was less intra operative blood loss. This was comparable to the study conducted by Baumgaertner et al.35.

Duration of Surgery:

The duration of surgery in the DHS group ranged from 85 minutes to 105 minutes with a mean of 87.25 minutes. The duration of surgery in the PFN group ranged from 60 minutes to 90 minutes with a mean of 69.5 minutes. The difference in the operative times in both groups was found to be highly significant and we attributed this difference to the smaller incisions in the PFN group. Baumgaertner et al.35 also found that the surgical times were 10 per cent higher in the DHS group in their series. Saudan and colleagues40 found that there was no significant difference between the operative times in the two groups in their series.

Fluroscopy time:

The fluorscopy time in the PFN group (average 73.75 sec) was significantly higher as compared to that of the DHS group (average 57.5 sec). This was similar to the series by Baumgaertner and associates35 who also found a significant difference in the fluorscopic times in their series, with 10 per cent higher times for the PFN group. However in their study Saudan et al.40 found no difference between the fluorscopy times in both the groups.

Blood loss:

The DHS patients had significantly more blood loss intra-operative compared to the PFN group (average 235 ml). This is similar to the series by Baumgaertner and associates35 who also found a significant difference in the intra operative blood loss in their series, with 150ml higher for the DHS group.

Complication:

Results of treatment of stable and unstable fractures have usually been reported together in the literature, and it is generally accepted that with increasing security of fracture patterns (stable to unstable) there is a higher risk of complications and poor outcome.

The occurrence of femoral shaft fractures does not seem to be a major problem with the PFN due to a narrower distal diameter as compared to other intramedullary nails.75 Also, rotational control is inherent in the nail design and is not dependent on multiple parts that are likely to increase the risk of mechanical failure. Due to the smaller diameter lag screws in these intramedullary nails, the proximal aspects of the nail do not need to be flared to prevent mechanical failure of the nail and hence require less reaming of the proximal femur, thereby reducing the risk of iatrogenic proximal femoral fracture.43 This was similar to the findings of Saudan et al.40 in their study. Other studies have also reported femoral shaft fracture rates of 0-2.1 per cent.76,77. We did not encounter any intraoperative complication in this study.

The only complications we encountered in this series were malunions, screw back outs and wound infections.
There was no significant difference between the two groups with regards to time of fracture union as all fractures united at 12 weeks in case of DHS and 12.15 weeks in case of PFN. Five patients (25 percent) in the DHS group had malunions whereas 1 patient (5%) in the PFN group had a malunion. There was a statistically significant difference between the two groups regarding malunions.

In our series 2 patients of the DHS group had wound infections as compared to single patient in the PFN group, which was not statistically significant. We attributed the higher number of wound infections in the DHS group to the longer incisions and subsequently more soft tissue handling in this group as compared to the PFN group. However all were only superficial wound infections and healed without any further surgical intervention. Saudan and associates also did not find any significant difference between the infection rates in the two groups in their series.

In this study the average limb length shortening of patients in the DHS group was 1.25 cm as compared to 0.575 cm in the PFN group which was significant. This could be due to sliding of the lag screw in the DHS group, allowing greater fracture impaction as compared to the PFN group. Four of the ten patients in the DHS group with fair or poor results had 2 cm or more shortening, while 1 patient in the PFN group with fair result had 2 cm or more shortening.

One patient (5 percent) in our study had a hip screw back out. This was seen in the DHS group involving an unstable intertrochanteric fracture. However this patient was relatively mobile and hence re-operation was not necessary. There was no implant cut out in the PFN group which was similar to the series by Menezes and co-workers (0.7 per cent)

Post Operative Pain:

In our study we found there was significant difference in the post operative pain in the two groups. Even though 17 of DHS and only 12 of the PFN patients had post operative pain, 3 out of 17 patients in the DHS group had severe pain compared to none in PFN patients. It was noted that in the PFN patient who had moderate pain a wound infection was found post operatively.

Saudan and colleagues found that the amount of persistent pain was similar in both groups in their series.

Post Operative Range of Hip Movement:

The average range of motion the hip joint was 84.25 degree in the DHS group and 98.75 degree in the PFN group at 6 months of follow up. Hence, in our study the patients in the PFN group regained a significantly better range of motion as compared to those in the DHS group (p=0.002). This is comparable to the results put forth by Saudan and colleagues.

Functional Outcome:

The overall functional outcome of patients treated with PFN was significantly better compared to DHS (P=0.152). However when we compared the stable and unstable fractures separately, we found that there was no significant difference in the outcomes of the stable fractures in the two groups (p=0.198). While comparing the unstable fractures in the two groups we found that the functional outcome of the patients in the PFN group was significantly better than the outcome of the patients in the DHS group with good results for 87.5% of the unstable fractures treated with PFN compared to only fair and poor results for 90% of the unstable fractures treated with DHS. In our series, only 5 of the 20 patients (25 per cent) in the DHS group regained their pre-injury mobility level as compared to 14 of the 20 patients (70 per cent) in the PFN group at the fourth month of follow up. 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. There is some amount of shortening seen in the DHS group which can be explained as due to significantly greater impaction of the fracture in the DHS group.

The smaller incisions, shorter operative times, relatively less blood loss and less postoperative pain with the PFN indicate that the PFN has an advantage over the DHS even in the treatment of stable intertrochanteric fractures where the functional outcomes are similar. In addition, with unstable intertrochanteric 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.

SUMMARY

- The majority of the patients in our study were between 60-80 years old with a mean age of 58.7 years.
- 72.5 percent of the patients were male.

- Trivial fall was the most common mode of injury.
- The left hip was involved in 65.0% of the patients.
- Stable fractures constituted 55% of the cases; unstable fractures 45 percent.
- Twenty patients treated with PFN and 20 treated with DHS fixation were included in the study.
- The PFN required shorter incisions, less blood loss and operative times.
- The DHS required 16.25 sec less fluoroscopy time.
- Post operative complications in both group included malunion and infection, 5 malunions in DHS while 1 in PFN, 2 wound infections in DHS while 1 in PFN. One screw back out in DHS.
- Fourteen of the 20 patient treated with PFN and 5 of the 20 patient treated with DHS regained their pre injury walking ability at the fourth month of follow-up.
- Patients treated with PFN had a significantly lower pain score at the sixth month of follow up.
- Patients treated with DHS had more limb length shortening as compared to those treated with PFN.
- The outcomes of the stable fractures treated with either DHS or PFN were similar.
- Unstable intertrochanteric fractures, treated with PFN, had significantly better outcomes with all patients having good results.

CONCLUSION

We conclude that in stable intertrochanteric fractures, both the PFN and DHS have similar outcomes. However, in unstable intertrochanteric fractures the PFN has significantly better outcomes in terms of earlier restoration of walking ability. In addition, as the PFN requires shorter operative time and a smaller incision, it has distinct advantages over DHS even in stable intertrochanteric fractures. Hence, in our opinion, PFN may be the better fixation device for most intertrochanteric fracture

References
A Comparative Study Of Proximal Femoral Nailing Versus Dynamic Hip Screw Device In The Surgical Management Of Intertrochanteric Fractures (Extracapsular)

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