

An Outcome Assessment of Surgical Treatment of Trochanteric and Subtrochanteric Femoral Fractures using Proximal Femoral Nail: An Observational Study

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Conflict of interest: Nil

Abstract

Aim: Investigate the surgical treatment of trochanteric and subtrochanteric femoral fractures using proximal femoral nail in a tertiary care facility

Material and Methods: This study was conducted in the Department of orthopaedics, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India from October 2020 to September 2021. A retrospective study of all cases with peritrochanteric fractures admitted in a tertiary care hospital. A total of 116 cases were admitted of which 8 patients did not consent for the study and hence the number came to 108. All patients with peritrochanteric fractures including Intertrochanteric and Subtrochanteric region above 20 years of age, who consented for the study were included while those less than 20 years age, Compound fractures, very low Subtrochanteric fractures, previous wound or bone infections, previous operatively treated fractures or retained hardware in the same extremity and those who failed to consent were excluded from the study.

Results: In the present study 83 (77%) patients underwent closed nailing and 25 (23%) patients underwent open nailing due to delay for surgery and failure to achieve anatomical reduction due to deforming forces. The mean duration of surgery was 80 minutes and mean duration of screening (x-ray exposure) was 103 Seconds. Mean blood loss was 140 ml (measured by fully soaked (50 ml) mop count). In the present study the average duration of hospital stay was 17.54 days. The mean time for full weight bearing was 12.25 weeks. All patients enjoyed good range of motion at hip and knee joints except twelve patients had hip joint stiffness and seven patients had knee joint stiffness for some period of time. Post operative mobility was aided in immediate post operative period but later all patients were ambulatory independently with or without walking aid after 6 weeks, except two patients. At 12 weeks post-operatively, 72 (66.7%) patients had full range of movement at hip joint (0 to 110) and 84 (77.8%) patients had full range of movement at knee joint (0 to 120).

Conclusion: The introduction of PFN has broadened the indications for intramedullary fixation of difficult femoral fractures and to include the fractures at the level or below the lesser trochanter. PFN is an effective device in the management of complex femoral fractures. It offers superior stabilization than other currently used methods of internal fixation.

Keyword: Trochanteric and Sub-Trochanteric Femoral Fractures, Proximal Femoral Nail.

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Introduction

Trochanteric and subtrochanteric femoral fractures are common injuries, particularly among the elderly, resulting primarily from low-energy falls in osteoporotic bone. These fractures pose significant challenges for orthopedic surgeons due to their complex anatomy and the high mechanical stresses

in this region. Surgical management is often required to ensure proper alignment, stabilization, and early mobilization, which are crucial for reducing morbidity and improving functional outcomes. [1-4] Proximal femoral nailing (PFN) has become a widely accepted method for the surgical treatment of trochanteric and

subtrochanteric femoral fractures. The technique involves the insertion of a cephalomedullary nail through the proximal femur, which provides strong internal fixation and allows for early weight-bearing. PFN offers several advantages over other fixation methods, such as dynamic hip screws and plate fixation, including minimal soft tissue disruption, reduced operative time, and lower rates of complications like nonunion and hardware failure. [5-10] The choice of surgical approach and implant type should be tailored to the individual patient based on factors such as fracture morphology, bone quality, and the patient's overall health status. The less invasive nature of PFN, combined with its mechanical advantages, makes it particularly suitable for patients with comorbid conditions who may not tolerate more extensive surgical procedures well. [11,12]

Material and Methods

This study was conducted in the Department of orthopaedics, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India from October 2020 to September 2021. A retrospective study of all cases with peritrochanteric fractures admitted in a tertiary care hospital. A total of 116 cases were admitted of which 8 patients did not consent for the study and hence the number came to 108. All patients with peritrochanteric fractures including Intertrochanteric and Subtrochanteric region above 20 years of age, who consented for the study were included while those less than 20 years age, Compound fractures, very low Subtrochanteric fractures, previous wound or bone infections, previous operatively treated fractures or retained hardware in the same extremity and those who failed to consent were excluded from the study. A Predesigned and Pretested questionnaire containing questions about the detailed history with special reference to the mode of injury and severity of trauma was used. This was followed by physical examination including a comprehensive orthopaedic examination of the injured limb and other limbs. The involved extremity was examined for swelling, deformity, discoloration, skin integrity, neurological, motor and vascular compromise. Medical and General surgical evaluation was sought expeditiously for all high – energy accident victims to rule out polytrauma. Radiological examination of ipsilateral hip and knee joints both preoperatively and postoperatively were taken for evaluation. X-ray Chest, Routine blood investigations, Urine routine, ECG were all done and also medical and anaesthetist opinion were taken to explore fitness of the patients for surgery. The purpose of the study was explained in local language and a written informed consent was taken from the patients. They were free to withdraw from the study anytime they wished.

Management of Proximal Femoral Fractures: Following fixed pattern of management was followed for every patient.

Roentgenographic Evaluation and Radiological Parameters: After stabilization of vitals, radiographs of affected extremities were taken.

- Pelvis with both hip AP view
- Affected hip lateral view
- Shaft femur with knee joint AP/lateral views
- Any associated injury x-rays.

The fracture pattern was classified according to Seinsheimer Classification for Subtrochanteric fractures:[9] and Evans Classification for Intertrochanteric Fracture. [10]

Operative Procedure: All cases were operated under spinal epidural anaesthesia. Prophylactic IV antibiotic usually a third generation cephalosporin was given prior to surgery. Mean time interval between trauma and surgery was eight days. Twelve patients were treated after 2 weeks as they were having associated abdominal injury which was given initial treatment preference, followed by stabilization of systemic condition. Surgery was done in supine position on a fracture table, initially closed manipulation and reduction was attempted after patient is anaesthetized. The entry point in femur is made through the tip of the greater trochanter using an awl. Then, 3.2 mm curved guide wire was inserted using image intensifier. Fracture reduced and guide wire inserted to the distal part under image intensifier.

A. Reaming and Insertion

- Serial reaming was done over the guide rod in increments of 0.5 mm until the desired diameter was reached. The selected nail usually of 135 degrees was assembled to proximal zig. After assembling the drill guide to the nail, preliminary checking of sleeves with guide pin or drill bit was done to prevent mismatch later was done. Assembled nail is inserted over the guide rod with insertion instrument only and is not hammered.
- The proximal femoral nail is inserted to the appropriate depth to allow proximal screw placement in the femoral head.
- For determining the proper insertion depth for the PFN, the inferior drill sleeve is placed in the drill guide and guide pin is passed through the sleeve, its position superior to the calcar is confirmed with image intensification so that 2 proximal screws can be placed in femoral head.

B. Proximal Interlocking

- The 2.4 mm drive pin was inserted through the drill sleeve and advanced it into the femoral head at least 4 mm superior to the calcar to a level 5 mm below the subchondral level of the femoral head.
- The position of the guide pin within the head was confirmed on c-arm and the same procedure was used for the superior hole.
- The inner sleeve was removed and the cannulated step drill was inserted through the outer sleeve into the femoral head within 5 mm of the subchondral bone.
- The screw length was measured and 6 mm lag screw was inserted through the drill sleeve into the femoral head by means of cannulated hexagonal screw driver. The screw of 8 mm was inserted in a similar manner.

C. Distal Locking:

- The distal locking screws of 4.9 mm were inserted by using the distal jig. Haemostasis achieved and wound closed in layers over suction drain.

Post Operative Management: IV antibiotics in the form of third generation cephalosporins, aminoglycosides were given. Oral antibiotics started from fifth post op day and continued till

suture removal. Analgesics /Epidural top up for 2 days. Drain removal after 48 hrs. Static quadriceps exercises were begun from day 2. Early hip and knee assisted Range Of Movement exercises were started from third day. Suture removal done after 10 days. Patient discharged 1 week after operation after giving appropriate physiotherapy instructions. Partial weight bearing was started 2 to 4 weeks post operatively. Full weight bearing was allowed after radiological and clinical signs of union.

Follow up: Regular follow up of every patient was carried out at 4 weeks interval initially and later at 6 weeks interval until union. Clinical and radiological evaluation done. Following points were noted. At each follow up visit, clinically the patients were assessed for gait, pain, deformity, shortening, range of hip and knee motion, ability to sit cross legged, ability to squat, whether returned to pre injury occupation. Radiologically, they were assessed for signs of union, loss of fixation and failure of implant.

Assessment of Results

The results were assessed by Modified HARRIS HIP SCORE system[11]. This system is slightly modified according to needs of the Indian patients. i.e in place of “put on shoes and socks” we have used “squatting” and in place of “sitting” we have used “cross legged sitting”. Based on the total Harris Hip score functional outcome was graded as.

Table 1

0 - 69 Poor
70 – 79 Fair
80 – 89 Good
90 – 100 Excellent

Statistical Analysis: The data collected were entered in the Microsoft excel 2013 and double checked for errors. Analysed using SPSS version 22. A ‘P’ value of < 0.05 is considered statistically significant and < 0.01 highly statistically significant.

Results

About 36 (33.33%) of the patients were between 51 to 60 years, followed by 28 (25.92%) in 31 to 40 years, 20 (18.5%) in 1 to 30 years and 12 (11.11%) each in 41 to 50 years and above 61 years. Maximum age was 65 years and minimum age was 24 years. Majority 92 (85.2%) of the patients in this study were males and 16 (14.8%) were females indicating that males are highly exposed to the risk factor, due to highly demanding physical work and vehicular accidents. In this study, Sub-trochanteric fractures were classified based on Seinsheimer’s classification and intertrochanteric fractures based on Evan’s classification. Of the 85 (78.7%) subtrochanteric

fractures 36 (33.3%) were type III fractures followed by type V fractures 27 (25%) and 11 (10.2%) each of type IIc fractures and type IV fractures. Of the 23 (21.3%) Intertrochanteric fractures 7 (6.5%) were Stable while 16 (14.8%) were Unstable. (Table 2).

In the present study 83 (77%) patients underwent closed nailing and 25 (23%) patients underwent open nailing due to delay for surgery and failure to achieve anatomical reduction due to deforming forces. The mean duration of surgery was 80 minutes and mean duration of screening (x-ray exposure) was 103 Seconds. Mean blood loss was 140 ml (measured by fully soaked (50 ml) mop count). In the present study, 12 cases (14%) had intra operative complications. We experienced failure to put derotation screw in 6 (7%) cases, jamming of the drill sleeve in 3 (3.5%) cases and guide wire breakage in 3 (3.5%) cases. Other complications such as Fracture of lateral cortex, Fracture displacement by nail insertion, Failure to

get anatomical reduction, Failure of distal locking, Breakage of drill bit and varus angulation did not occur. No complications were reported in the immediate post operative period. In the present study, 38 (35.2%) cases showed delayed complications. In the present study the average duration of hospital stay was 17.54 days. The mean time for full weight bearing was 12.25 weeks. All patients enjoyed good range of motion at hip and knee joints except twelve patients had hip joint stiffness and seven patients had knee joint stiffness for some period of time. Post operative mobility was aided in immediate post operative period but later all patients were ambulatory independently with or without walking aid after 6weeks, except two patients. At 12 weeks post-operatively, 72 (66.7%) patients had full range of movement at hip

joint (0 to 110) and 84 (77.8%) patients had full range of movement at knee joint (0 to 120). Anatomical results were assessed by presence or absence of deformities, shortening, and hip and knee range of motions. In the present study, the union rates were 91.67% and three (2.78%) patients had shortening of >1 cms, seven patients (6.48%) had knee joint stiffness and twelve patients (11.11%) had hip joint stiffness. In this study of 88 operated cases, no deaths were reported during the study period. The results of the treatment of intertrochanteric and subtrochanteric fractures using Proximal Femoral Nail were assessed by HARRIS HIP SCORE system (Modified). In the present study the mean Hip Harris Score at final follow up was 83.2.

Table 2: Classification of Subtrochanteric and Intertrochanteric fractures

	Type	No. of cases	Percentage
Subtrochanteric fractures (Seinsheimer's classification)	IIC	11	10.2%
	III	36	33.3%
	IV	11	10.2%
	V	27	25.0%
Intertrochanteric fractures (Evans classification)	Stable	7	06.5%
	Unstable	16	14.8%

Table 3: Delayed complications following surgery

Complication	Number of cases	Percentage
Hip joint stiffness	12	11.11
Knee joint stiffness	7	06.48
Delayed union	6	05.55
Nonunion	3	02.78
Malunion(Varus)	3	02.78
Shortening of >1cms	2	01.85
Implant failure	2	01.85
Secondary infection	3	02.78

Table 4: Comparative studies for union following Proximal Femoral Nailing

Sl. No.	Series	No. of patient	Union	Non union	Delayed union
1	Schipper's ¹⁴	144	83.3%	1.3%	6.25%
2	Christophe's ¹⁵	20	90%	5%	5%
3	Boldin's ¹⁶	55	88%	5.4%	5.4%
5	Present	108	91.67%	2.78%	5.55%

Table 5: Functional Outcome using Harris Hip Score

Harris hip score	No. Of cases	Percentage
Poor (0 - 69)	14	12.9 %
Fair (70 - 79)	22	20.4 %
Good (80 - 89)	57	52.8%
Excellent (90 - 100)	15	13.9%

Discussion

About 36 (33.33%) of the patients were between 51 to 60 years, followed by 28 (25.92%) in 31 to 40 years, 20 (18.5%) in 1 to 30 years and 12 (11.11%) each in 41 to 50 years and above 61 years. Maximum age was 65 years and minimum

age was 24 years. The mean age was 69 years in a study conducted by Pavelka T et al [12], while in the present study, mean age was 48 years which is comparable to the mean age of 46 years reported by B Kanthimathi et al. [13] Majority 92 (85.2%) of the patients in this study were males and 16 (14.8%) were females indicating that males are

highly exposed to the risk factor, due to highly demanding physical work and vehicular accidents, similar to study by B Kanthimathi et al [13], in which males were 64% and females 36% as compared to 40.1% male patients and 59.86% of female patients in a study conducted by Pavelka T et al [12]. Right side 64 (59.3%) was predominantly involved, with 44 (40.7%) on left side comparable to findings of B Kanthimathi et al [13] (right side was affected in 60% and left side in 40%). RTA was the main cause of trauma. About 62 (57.4%) met with accident while 26 (24.1%) had self fall, 14 (12.9%) had fall from height and 6 (5.6%) had other causes resulting in fracture femur. While 72 (66.7%) of the patients had no associated injuries, there were 14 (12.9%) cases with head injury, 12 (11.11%) cases with minor abdominal injuries and pelvic injuries, 5 (4.63%) cases each with ipsilateral tibia and Colles fracture. Regarding fracture types, 85 (78.7%) were Sub-trochanteric fractures while 23 (21.3%) were Intertrochanteric fractures. In this study, Sub-trochanteric fractures were classified based on Seinsheimer's classification and intertrochanteric fractures based on Evan's classification. Of the 85 (78.7%) subtrochanteric fractures 36 (33.3%) were type III fractures followed by type V fractures 27 (25%) and 11 (10.2%) each of type IIc fractures and type IV fractures. Of the 23 (21.3%) Intertrochanteric fractures 7 (6.5%) were Stable while 16 (14.8%) were Unstable. (Table 2)

In the present study 83 (77%) patients underwent closed nailing and 25 (23%) patients underwent open nailing due to delay for surgery and failure to achieve anatomical reduction due to deforming forces. The mean duration of surgery was 80 minutes and mean duration of screening (x-ray exposure) was 103 Seconds. Mean blood loss was 140 ml (measured by fully soaked (50 ml) mop count). In the study conducted by B Kanthimathi et al [13] closed nailing was performed in 78% and open nailing in 22% and mean operative time was 71.5 minutes. In the study conducted by I. B. Schipper et al [14] the mean operating time was 60 minutes and open reduction was required in 8.1% with mean blood loss of 220 ml.

In the present study, 12 cases (14%) had intra operative complications. We experienced failure to put derotation screw in 6 (7%) cases, jamming of the drill sleeve in 3 (3.5%) cases and guide wire breakage in 3 (3.5%) cases. Other complications such as Fracture of lateral cortex, Fracture displacement by nail insertion, Failure to get anatomical reduction, Failure of distal locking, Breakage of drill bit and varus angulation did not occur. No complications were reported in the immediate post operative period.

In the present study, 38 (35.2%) cases showed delayed complications.

In the study conducted by Pavelka T et al [12] the average operative time was 56 min and X-ray exposure lasted on average 1 min. There were 14 intra-operative complications in nine patients, which included incomplete reduction in four cases, fixation in distraction in two, incorrect length of screws in one, fracture at the site of distal locking in two and incorrect insertion of femoral neck screws in five cases. Early post-operative complication involved seven cases and late complications occurred in two patients. In the study conducted by Christophe sadowski et. Al [15], 20 patients of proximal femoral fractures were treated by PFN. In the series conducted by Boldin C et. Al [16], 34 patients of unstable proximal femoral fractures were treated by PFN. In the series conducted by Schipper [14], 210 patients of proximal femoral fractures were treated by PFN, and they could in all assess 144 patients. The comparison of union rates in various series with the present series is as follows.

The mean hospital stay was 17.54 days while in a study by I. B. Schipper et al [14] the mean duration of hospital stay was 21.7 days. All patients were followed at 6 weeks, 12 weeks, 6 months and some patient's upto one year and further if necessary. At each follow up radiograph of operated hip with upper half femur was taken and assessed for fracture union and implant failure and screw cut out.

In the present study the average duration of hospital stay was 17.54 days. The mean time for full weight bearing was 12.25 weeks. All patients enjoyed good range of motion at hip and knee joints except twelve patients had hip joint stiffness and seven patients had knee joint stiffness for some period of time. Post operative mobility was aided in immediate post operative period but later all patients were ambulatory independently with or without walking aid after 6weeks, except two patients. At 12 weeks post-operatively, 72 (66.7%) patients had full range of movement at hip joint (0 to 110) and 84 (77.8%) patients had full range of movement at knee joint (0 to 120). The mean period of union in our study was 12.9 weeks comparable to findings of B Kanthimathi et al [12] (12.6 weeks). Anatomical results were assessed by presence or absence of deformities, shortening, and hip and knee range of motions. In the present study, the union rates were 91.67% and three (2.78%) patients had shortening of >1 cms, seven patients (6.48%) had knee joint stiffness and twelve patients (11.11%) had hip joint stiffness. In this study of 88 operated cases, no deaths were reported during the study period. The results of the treatment of intertrochanteric and subtrochanteric fractures using Proximal Femoral Nail were assessed by HARRIS HIP SCORE system (Modified). In the present study the mean Hip

Harris Score at final follow up was 83.2 comparable to the series conducted by I. B. Schipper, E. et al [14] (77.6).

Conclusion

The introduction of PFN has broadened the indications for intramedullary fixation of difficult femoral fractures and to include the fractures at the level or below the lesser trochanter. PFN is an effective device in the management of complex femoral fractures. It offers superior stabilization than other currently used methods of internal fixation. The use of PFN is technically demanding and needs expertise. Complications can be avoided by proper operative technique. Early post operative mobilization and physiotherapy improves the results of PFN.

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