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Original Research Article

A Prospective Study of Management and Outcome of Intertrochanteric Fractures Using Trochanteric Femoral Nail (TFN)

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Abstract:

Introduction: Fractures around the trochanteric area of the femur are among the most frequent fractures encountered in orthopedics and also among the most distressing injuries of the elderly. A burgeoning population and increased life expectancy have resulted in a rise in these types of fractures. Several implants have been designed for the treatment of these fractures. In this study, we analyze the functional and radiological outcome of intertrochanteric fractures managed with Trochanteric Femoral Nail.

Materials and Methods: This is a prospective study. 30 patients with intertrochanteric fractures treated by Trochanteric Femoral Nail, from November 2019 to November 2021 were included in the study. We analyzed these 30 patients for functional and radiological outcome and complications. The criteria for the assessment of efficiency of surgical technique included duration of surgery, number of intraoperative complications, and blood loss. Clinical assessment includes postoperative walking ability, hip and knee function, duration for fracture union, and implant bone interaction by modified Harris Hip Score.

Results: The fracture union rate was 93% and the average union time was 14 weeks. According to modified Harris Hip Score, overall, 7% of patients had excellent results, 47% of patients had good results, 33% of patients had fair results and only 13% of patients had poor results.

Conclusion: The result of our study shows that Trochanteric Femoral nail is an effective device for fixation of inter trochanteric fractures of femur with good functional and radiological outcomes. We conclude that the TFN is a highly accepted minimally invasive implant for fixation of intertrochanteric fractures, but careful surgical technique and selection of the patients should further reduce its complication rates.

Keywords: Intertrochanteric Fracture, Trochanteric Femoral Nail, TFN.

Introduction

Proximal femoral fractures occur typically at the junction between trabecular bone and cortical bone, where the mechanical stress across the junction is highest in thefemur, which is responsible for their frequent comminution. These fractures account for 10% to 34% of all the hip fractures [1].

These fractures occur typically in two age groups. In young and healthy individuals, the injury resultsfrom high-energy trauma, whereas in the elderly population, most of the fractures are osteoporotic, resultingfrom a fall. With the increase in the ageing population, there is also considerable growth in the number of pathological fractures and fractures around the hip prostheses (periprosthetic fractures) [2].

Also, the possibility of sustaining a proximal femoral fracture doubles every 10 years after age 50 years [3]. Since the femur is the longest and the strongest bone in the body and the principal load bearing bonein the lower extremity, fracture of this bone may result in drawn out morbidity and Far-reaching disability unless the treatment is adequate. Conservative management of intertrochanteric femoral fractures often yields poor therapeutic outcomes, and surgical fixation is generally needed [4]. Until 1960's non operative treatment was the option on hand for these types of fractures in the form of traction with

prolonged bed rest with fracture healing occurring in ten to twelve weeks (usually) followed by a prolonged program of physiotherapy.

Outcomes of treatment of intertrochanteric fracture depends on the quality of the bone, age of the patient, general health, trauma-surgery interval, adequacy of treatment, co-morbidities and stability of fixation [5,6,7]. The goal of operative treatment is restoration of normal length and angulation, to restore adequate tension to the abductors. The most widespread internal fixation device used today is the fixed angle extramedullary device, such as a 135-degree lag screw and side plate or blade plate. This implant includes a large lag screw positioned in the center of the femoral neck and head and a side plate alongside the lateral aspect of proximal femur. The advantage of the sliding lag screw, compared with a static screw, is that it permits impaction of the fragments; this impaction enhances the bone-on-bone contact, encouraging osseous healing while decreasing implant stress. DHS requires a relatively larger exposure, more tissue handling and anatomical reduction, all of which increase the morbidity, the probability of infection and significant blood loss, the possibility of varus collapse and the inability ofthe implant tosurvive until fracture union. The common causes of fixation failure are instability of the fractures, osteoporosis, lack of anatomical reduction, failure of the fixation device and incorrect placement of the lag screw in femoral head-neck region [8].

The other spectrum is intramedullary fixation with devices like the IMHS (intramedullary hip screw), Gamma nail, Russell - Taylor reconstruction nail, ATN (Ante grade trochanteric nail), TFN (Trochanteric femoral nail) and the PFN (Proximal femoral nail). The screw and side plate and blade plate have been revealed to have elevated rates of fracture union when used with fractures involving the piriformis fossa, but intramedullary nails have been suggested if the posteromedial cortical buttress cannot be established in unstable intertrochanteric fractures. Benefits of intramedullary devices include preserved blood supply to the bone fragments, less operative blood loss and less disruption of the soft tissue around the fracture.

This study consists of 30 cases of intertrochanteric fractures which were fixed with Trochanteric Femoral Nail and their outcomes are compared.

Objectives

- To determine the rate of union in intertrochanteric fractures treated by Trochanteric femoral nail.
- To assess functional outcome and complications in intertrochanteric fractures treated with Trochantericfemoral nail.

Materials

During the period between November 2019 to November 2021, 30 patients who were admitted in Vijayanagar Institute of Medical Sciences, Ballari with intertrochanteric fractures, those fitted into the inclusion criteria and managed surgically with Trochanteric Femoral Nail were included in the study.

Inclusion Criteria

- All intertrochanteric fractures
- Age more than 18 years

Exclusion Criteria

- Less than 18 years
- Medically unfit patients for surgery

Preoperative Management

After stabilization of vitals, radiographs of affected extremities were carried out. The fracture pattern was grouped according to classification/inclusion criteria. All the routine investigations were done.

Adequate blood reserved in blood bank. Shaving of the affected extremity, written and informed consent of the patient and their relatives for internal fixation was taken. Evaluation of the fracture anatomy was done according to classification. Clinical and radiological measurement of proper nail size was carried out.

Operative Procedure

All cases were done under spinal or epidural anesthesia. Prophylactic IV antibiotic, usually a third-generation cephalosporin was given 15 minutes before the start of the surgery. All patients were given supine positions following anesthesia, on a radiolucent tablet op to facilitate the use of image intensifier. The reduction is carried out mostly by closed method and rarely by open method**.** Extremity has been secured in the traction foot piece; traction is exerted longitudinally on the abducted extremity. Traction is maintained. The limb is adducted and internally rotated at the same time.

Procedure

A slightly curved incision was made from the level of the tip of the greater trochanter proximally foraround 5 cms. Gluteal muscle fibres are split along the length of its fibres by blunt dissection. The entry point was made through the tip of the greater trochanter using bone awl. The fracture was reduced, and guide wire was inserted to the distal part under image intensifier. Sequential reaming was done. The

selected nail usually of 135 degrees was assembled to the proximal jig. Assembled nail (first preference is given to 135^0 nail) is inserted over the guide wire with insertion instrument only and is not hammer. 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 TFN, 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 beplaced in femoral head. If proper positioning of guide pins is not possible in femoral head, then nails of different angles were tried. The proximal drill sleeves were pushed to the bone. The 2.4 mm guide pin was inserted through the drill sleeve and advanced into the femoral head at least 4 mm superior tothe calcar to a level 5mm 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 guide pin placement. 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 8 mm lag screw was inserted through the drill sleeve into the femoral head by means of cannulated hexagonal screwdriver. The superior screw of 6.4 mm was inserted in a similar manner. The distal locking screws of 4.9mm were inserted by using the distal jig. Hemostasis was achieved and the wound was closed in layers.

Postoperative management.

Limb elevation was given on Bohler's frame. IV antibiotics in the form of third generation cephalosporins,

aminoglycosides were given. Oral antibiotics started from the fifth post operative day and continued till suture removal. Analgesics/Epidural top up was given for 2 days. Drain removal was done after 48 hours. Static quadriceps exercises from day 2 were begun. Early hip and knee assisted ROM were started from third day. Suture removal was done after 10 days. Patient was discharged 1 week after operation after giving appropriate physiotherapy instructions.

Rehabilitation: partial weight bearing was started 2 to 4 weeks postoperatively. 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 intervals initially and later at 6 weeks intervals until fracture union. Clinical and radiological evaluation was done. The following points were noted. Gait, Pain, Deformity, shortening, Range of hip and knee motion, Ability to sit cross legged, ability to squat, whether able to return to preinjury occupation.

Radiologically assessed for:

- Signs of union: Dynamization was considered if there were delayed or no signs of union on both AP and Lateral views radiographically even after 3 months of operative procedure.
- Loss of fixation
- Failure of implant

Figure 1: Position of the patient on fracture table with C-arm AP and Lateral views

Figure 2: Draping

Figure 3: Incision from the tip of Greater Trochanter

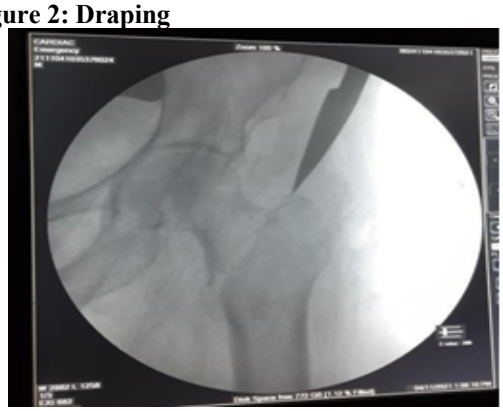

Figure 4: Entry point withbone awl

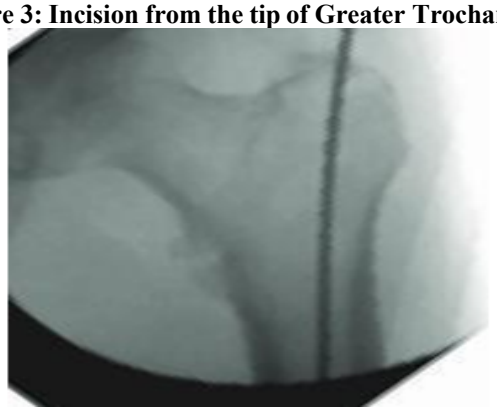

Figure 5: Guide wire beingpassed in AP view

Figure 6: Guide wire in lateral view

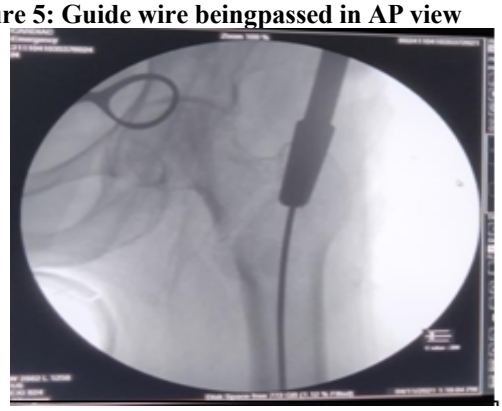

Figure 7: Entry point reaming

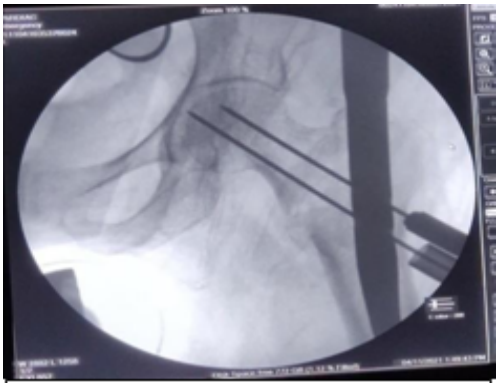

Figure 8: Guide pins in the neck and head segment

Figure 9: Lag screw and derotation screw placed

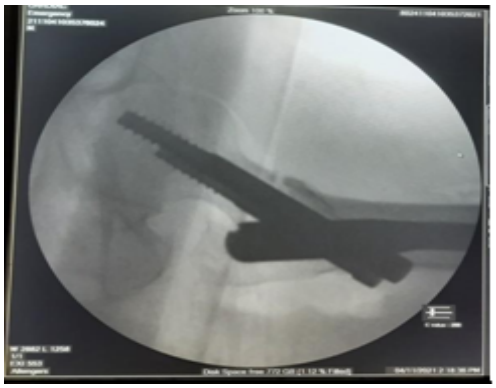

Figure 10: Screws placed centrally inlateral view

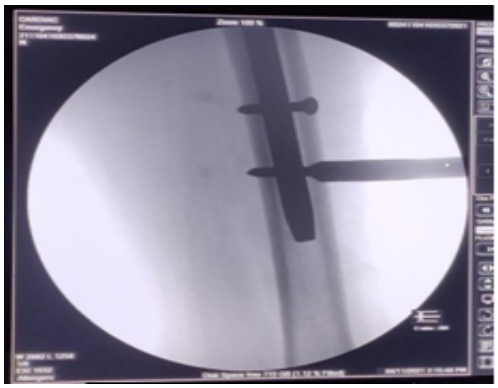

Figure 11: Distal locking

The study involved 30 confirmed cases of Intertrochanteric fractures of either sex from November 2019 to November 2021. All the cases were treated with Intramedullary fixation. "Trochanteric femoral nail". The analysis of the patient data, intraoperative data & postoperative outcome is as follows:

Table 1: Age distribution:

Age (in years)	Number of patients	Percentage (%)
31-40	3	10
41-50	7	23.3
51-60	10	33.3
61-70	3	10
71-80	6	20
81-90	1	3.3

The study involved patients above 18 years of age. The average age was 70.87 years. The largest group of patients being from 51 to 60 years.

Table 2: Sex distribution

Sex	Numbers of patients	Percentage (%)
Male	14	46.6
Female	16	53.3

There were 16 females and 14 males in the study.

Table 3: Distribution of Mode of Injury

Mode of injury	Number of patients	Percentage (%)
Domestic fall	23	76
Road traffic accident	7	23

Domestic fall and Road Traffic Accident (RTA) were the modes of injury in all the patients. Most ofthe patients with domestic fall were older in age or had osteoporosis.

Table 4: Side distribution of Fractures

Side of injury	Number of Patients	Percentage (%)
Right	22	73.3%
Left	8	26.6%

Table 5: Singh's index

Grade	Number of patients	Percentage (%)
I	0	0
II	5	16.6
III	4	13.3
IV	12	40
V	5	16.6
VI	4	13.3

All the patients' X-rays were graded based on Singh's index, most of them were Grade IV.

Table 6: Fracture distribution according to Evan's Classification

Type of fracture	Number of patients	Percentage (%)
Type I	28	93.3
Type II	2	6.6

All the fractures were classified according to Evan's Classification and most of them were of type I.

Blood loss was counted intraoperatively by number of mops used during the surgery. One mop is equal to 50ml blood loss approximately. The average blood loss was 1.62 mops, so 8lml (50- 150m1). 6 patients requiredintra operative blood transfusion as their pre-operative hemoglobin was less and 4 patients required blood transfusion postoperatively. Average operating time was 65mins (32mins-95mins) after anesthesia.

Reduction

Fracture was close reduced anatomically. If that was not achieved, then reduction was achieved by limited open reduction during surgery. Near anatomical reduction was achieved in 42 patients (88%).

Table 7: Type of Reduction

Reduction	Number of patients	Percentage (%)
Closed	26	86
Limited open	4	13

Intraoperative Complications

In our study, we had two instances of intraoperative complications. In one case we experiencedjamming of the drill sleeve and in one case we failed to put a derotation screw.

Table 8: Intraoperative Complications

Complications	Number ofcases	Percentage (%)
Jamming of Instruments	1	3
Failure to put derotation screw	1	3

Postoperative Complications

In the immediate postoperative period, we had no complications.

Delayed Complications:

- We had one case of implant failure.
- We had 2 cases of delayed union.
- We had a shortening of 1.5cms in one case.
- We had one case of secondary infection and varus malunion each.

Table 9: Post Operative Complications on Follow up

Complication	Numberof Cases	Percentage(%)
Hip joint stiffness	8	27
Knee joint stiffness	5	16
Delayed union	2	7
Malunion (Varus)	1	3
Shortening of >1cms	1	3
Implant failure (Z Effect)	1	3
Secondary infection	1	3

Hospital Stay

In our study, suture removal was done on postoperative day 12. Then patient was advised follow up for rehabilitation programme such as non-weight bearing with walker, partial weight bearing, crutch walking. The average hospital stay was less than 3 weeks.

Follow Up After Discharge

All patients were followed up at 4 weeks, 12 weeks, 6 months and some patients up to one year and further if needed. At every follow up, radiograph of operated hip with proximal half femur wastaken and evaluated for fracture union and implant failure and screw cut out. First Follow up was after4 weeks of discharge and then after 6 weeks intervals.

Period of Union

In our series, different fractures took different duration of time for union. Average period ofunion was as follows:

Type I- 3 months

Type II- 3 and a half month

The average period of union in our study was 14

weeks.

Functional Results

In our study of 30 operated cases, no deaths were reported during the study period. The results of the treatment of intertrochanteric fractures using Trochanteric Femoral Nail were assessed by modified Harris hip score system.

Table 9: Results of the treatment assessed using HARRIS HIP SCORE system.

HARRIS HIPSCORE	No. of cases	Percentage(%)
Poor (0 - 69)	4	13
Fair (70 - 79)	10	33
Good (80 - 89)	14	47
Excellent (90 - 100)	2	7

Case 1:

Figure 12: Pre-OP X-Ray

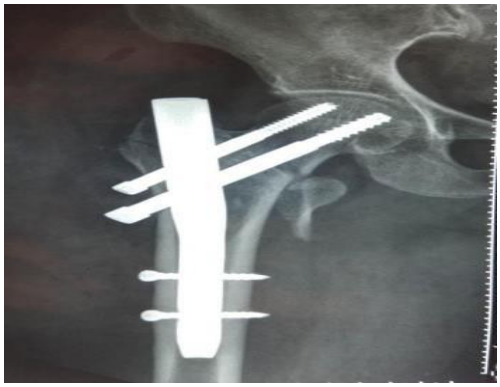

Figure 13: Immediate Post Op X-Ray

Figure 14: Cross Legged Sitting

Figure 15: Squatting

Figure 16: 3 Months Post OP X-Ray

Figure 17: Weight Bearing

Case 2:

Figure 18: Pre OP X-Ray

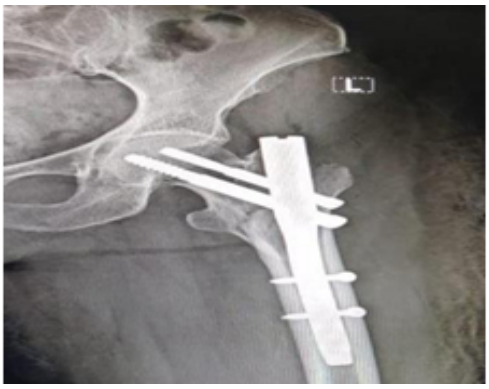

Figure 19: Immediate Post OP X-Ray

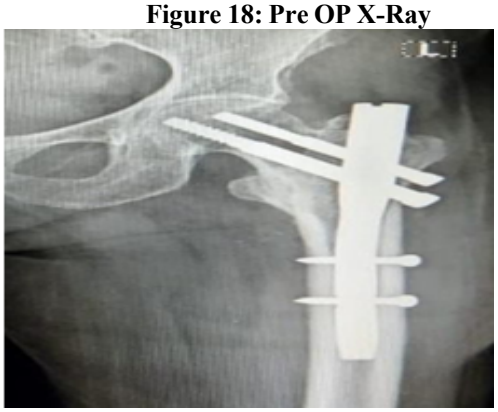

Figure 20: 3 Months Post OP X-Ray

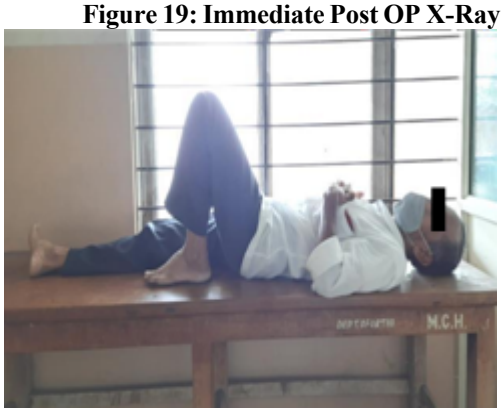

Figure 21: Hip Flexion

Figure 22: Cross Legged Sitting

Figure 23: Squatting

Discussion

Fractures of the Proximal femur are challenging injuries for many orthopedic surgeons. The managementof subtrochanteric and intertrochanteric fractures of the proximal femur are related with some failures. Severe osteoporosis, faulty operative procedures, unsatisfactory reductions and incorrect positioning of the lag screw are the most important factors responsible for the failed internal fixation [9].

Since its introduction in the 1980s, cephalomedullary fixation for intertrochanteric fractures in the elderlypatients has gained popularity. Apart from the theoretical advantage of being less invasive and biomechanically superior, these devices have been advocated in cases of unstable fracture patterns such as reverse obliquity, lateral wall incompetence, subtrochanteric extension, and medial calcar disruption [10]. Remarkable clinical results for unstable subtrochanteric and intertrochanteric fractures treated with second generation nails have been documented.

An intramedullary device inserted by means of minimally invasive procedure is suitable in the elderly patients. Closed reduction maintains the fracture hematoma, which is vital for the fracture healing. Intramedullary fixation is helpful to minimize soft tissue dissection and reduce surgical trauma, blood loss, infection, and wound complications. A precise reduction and proper surgical method are of utmost importance in the treatment of unstable trochanteric fractures with the TFN. TFN is a novel, recent intramedullary implant based on the experience with the gamma nail [11]. The gamma nail has technical and mechanical failure rates of about 10%.

The Arbeitsgemeinschaft fur osteosynthesefragen

(AO ASIF) in 1997 invented the Trochanteric femoralnail which has an anti-rotational hip pin with the smaller distal shaft diameter which decreases stress concentration to surpass these failures. The benefits of Trochanteric femoral nail are, it can be introduced by closed technique, which preserves the fracture hematoma, which is important in fracture healing, decreased blood loss, less surgical exposure time, decreases infection, minimizes soft tissue dissection andwound complications.

Windolf et al [12] reported identified intraoperative technical difficulties in 23 patients (19.1%). Seven cases showed postoperative local complications that required operative revision on six patients (4.9%). The main reasons for the failure of the operations involved were poor reduction and the wrong choice of screws.

An intraoperative fracture displacement during manual introduction of the nail into the femoral shaft has been a problem with the TFN. The rationale may be that the entry point of the TFN at the tip of the greater trochanter is located directly in the fracture region which can lead to an intraoperative fracture displacement. In our study, we did not face any intraoperative fracture displacement after nail insertion. In comparison to gamma nail, we did not face either any fracture of the femoral shaft nor any break in the implant, intraoperatively. The criteria for the evaluation of efficiency of surgical technique included interval of surgery, number of intraoperative complications, blood loss and radiographic screening time. Clinical evaluation includes post operative walking capacity, hip and knee function, fracture union time, and implant bone interaction by modified Harris Hip Score.

In our series, we have chosen the age group of more than 18 years of age, with the average age of 70.87 years. The maximum number of cases were found in the age group between 51 to 60 years, as compared to the average age of 70.2 years in a study conducted by Rowe et al. [14] The age specific incidence rate showed a gradual increase. The most common cause of injury was a simple domestic fall. Females were more common affected than males, females accounting to 16 cases contributing to 53.3 % of cases and males contributed to 14 cases making 46.6 % of cases, as compared to 48% male patients and 52% of female patients, in a study conducted by Rowe SM et al [14]. In our series, Evan's type I fracture was noticedin 28 cases, making 93.3 % and followed by type II contributing 2 cases making 6.3 %.

We performed closed procedure in 26 cases (86.6%) and open in 4 cases (13.3%). The average duration of radiation exposure was 100 seconds, average duration of surgery was 65 minutes and average blood loss was 81 ml with 6% intraoperative complications. In the intraoperative period, in one case we had jamming of the drill sleeve, however, the jammed drill sleeve was removed, and operation was continued using another drill sleeve and there was failure to put hip (derotation) screw in one case. In the study carried out by Papasimos et al [14] the average operating time was 71.2 minutes and open reduction was needed in 8.1% with mean blood loss of 220 ml. Seven cases showed local intraoperative complications (3.3%).

The average duration of hospital stay was 12.63 days; average time for full weight bearing was 14.5 weeks. Postoperatively all patients were mobile of which two of them required walking aids. One patient had 1.5cms shortening after fracture union, which was managed conservatively by shoe rise. All patientshad good range of hip and knee movements except eight patients had hip restrictions and five patients hadknee limitation of movements. In the study conducted by Papasimos et al [14] the average duration of hospitalstay was 8.8 days. In that study, the average weeks of fracture union was 13 weeks and complication rates were 25%. 2 patients had varus deformity of less than ten degrees and no attempt was made to revise. Fracture union was uneventful. One patient had malrotation and five cases of Z effect were observed. In the series conducted by Papasimos S, Koutsojannis CM, Panagopoulos A, Megas P, LambirisE and others, 40 patients of proximal femoral fractures were treated by PFN. In the series conducted by Boldin C, Seibert FJ, Fankhauser F and others, 34 patients of unstable proximal femoral fractures were managed by PFN [15]. According to modified Harris Hip Score, overall, 7% of patients had excellent results, 47 % of patients had good results, 33 % of patients had fair results and only 4 cases i.e., 13 % of patients had poor results. After comparing various studies, it was seen that our present series was comparable with most of the standard published series.

Conclusion

After analusing the results obtained from the present study, we believe that the TFN emerges as a valid option for the treatment of proximal femoral fractures of the trochanteric region, because of the simplicity and lack of aggressiveness of the surgical technique and the low level of technical complications associated, which is particularly important keeping in mind that the large majority ofpatients who suffer these types of fracture are elderly, and their general condition is frequently compromised.

Use of TFN in such fractures provides various benefits:

- Closed procedure
- Minimal soft tissue damage
- Improved rotational stability of the proximal fracture fragment.

Combining the features of an unreamed intramedullary femoral nail with a sliding, load bearing,

femoral neck screw to combine the advantages of semi-closed intramedullary nailing adynamic femoralneck screw. No stress risers in bone. Closer to weight bearing axis. Early postoperative weight bearing.It offers greater stabilization than other presently used methods of internal fixation. At present, we consider that the TFN is a highly accepted minimally invasive implant for unstable proximal femoral fractures, but careful surgical technique and selection of the patients should further reduce its complication rates. Early postoperative ambulation and physiotherapy improves the results of TFN.

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