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Study of Proximal Femoral Nail in the Management of Peritrochanteric Fractures Femur and Its Functional Outcome

Dr. Khalid Fiyaz M[1], Dr S Bharath[2], Dr S Adithya Vardhan Reddy[3]

[1]Associate Professor, Department of Orthopaedics, RRMCH, Bangalore, India.

[2] Assistant Professor, Department of Orthopaedics, RRMCH, Bangalore, India.

[3]Postgraduate, Department of Orthopaedics, RRMCH, Bangalore, India.

Corresponding Author: Dr S Bharath, Assistant Professor, Department of Orthopaedics, RRMCH, Bangalore, India.

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KEYWORDS

PFN;
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ABSTRACT:

Background: Peritrochanteric fractures are devastating injuries that most commonly affect the elderly population and also the young. Conservative methods of treatment results in malunion with shortening and limitation of hip movement as well as complications of prolonged immobilization like bed sores, deep vein thrombosis and respiratory infections. This study is done to analyze the surgical management of Peritrochanteric fractures using Proximal Femoral Nail.

Material and Methods: This is a prospective study of 40 cases of fresh trochanteric and subtrochanteric fractures underwent surgical management using Proximal Femoral Nail.

Results: In our series of 40 cases there were 31 male and 9 female, maximum age of 94 yrs and minimum age of 22 yrs, most of the patients were between 41 to 60 yrs. Mean age of 55.18 yrs. 45% of cases were admitted due to slip and fall and with predominance of right side. Out of 40 cases, 25 were trochanteric and 15 were subtrochanteric. In Trochanteric class 40% were Boyd and Griffin type 2, in Subtrochanteric class 33.3% were Sinsheimer type 3a and 20% were 2b. Mean duration of hospital stay is 20.67 days and mean time of full weight bearing is 16.5 wks. Out of 40 cases 2 cases expired before first follow up time of 6 wks. and 3 cases were lost for follow up. Out of 35 remaining cases 22 were Trochanteric and 13 were Subtrochanteric. Good to excellent results are seen in 90.9% cases of trochanteric fractures and 88.57% cases in subtrochanteric fractures.

Conclusion: PFN is an excellent implant for the treatment of Peritrochanteric fractures. The terms of successful outcome include a good understanding of fracture biomechanics, proper patient selection, good preoperative planning, accurate instrumentation, good image intensifier.

INTRODUCTION

Peritrochanteric fractures are devastating injuries that most commonly affect the elderly and also in young, have a tremendous impact on both the health care system and society in general. Peritrochanteric fractures mainly comprise of fractures of trochanter and subtrochanteric region.[1,2] Despite marked improvements in implant design, surgical technique and patient care, peritrochanteric fractures continues to consume a substantial proportion of our health care resources.

Trochanteric fractures are common in the elderly people. The frequency of these fractures has increased primarily due to the increasing life span and more sedentary life style brought on by urbanization. Trochanteric fractures occur in the younger population due to high velocity trauma, whereas in the elderly population it is most often due to trivial trauma. Since this fracture is more common in the elderly patients, the aim of treatment should be prevention of malunion, and early mobilization. Taking all the factors into consideration surgery by internal fixation of the fracture is ideal choice.[3,4]

There are various forms of internal fixation devices used for Trochanteric Fractures; of them the most commonly used device is the Dynamic Hip Screw

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with Side Plate assemblies. This is a collapsible fixation device, which permits the proximal fragment to collapse or settle on the fixation device, seeking its own position of stability. The latest implant for management of trochanteric fractures is proximal femoral nail, which is also a collapsible device with added rotational stability.[5] This implant is a centromedullary device and biomechanically sounder. It also has other advantages like small incision, minimal blood loss. Present study was aimed to study proximal femoral nail in the management of peritrochanteric fractures femur and its functional outcome

MATERIAL AND METHODS

Present study was prospective, observational study, conducted in department of Orthopaedics Raja Rajeswari Medical College and Hospital Banglore, India. Study duration was of 2 years (July 2022 to July 2024). Study was approved by institutional ethical committee.

Inclusion criteria

- Patients with sub trochanteric fractures or Stable and unstable intertrochanteric fractures (Reverse oblique fractures and inter trochanteric fractures with loss of posteromedial cortex), who were treated with Proximal Femoral nail, willing to participate in present study

Exclusion criteria

- Inter trochanteric fractures involving piriformis fossa
- Open hip fractures
- Pathological fractures
- Periprosthetic fractures
- Peadiatric fractures (before physeal closure)

Study was explained to participants in local language & written informed consent was taken. After the patient with subtrochanteric or trochanteric fracture was admitted to hospital all the necessary clinical details were recorded in proforma. Investigations such as Hb %, total leucocyte count, differential count, blood grouping, crossmatching, fasting blood sugar, blood urea, serum creatinine, serum electrolytes, urine (Albumin, sugar and microscopic examination) were done routinely on all the patients preoperatively. X-rays such as Pelvis with both hips-AP view, Involved side hip with femur full length-AP and Lateral view in all patients & Chest X ray PA view in necessary patients.

All the patients were evaluated for associated medical problems and were referred to respective departments and necessary treatment was given. Associated injuries were evaluated and treated simultaneously. All the patients were operated on elective basis after overcoming the avoidable anaesthetic risks.

Pre-op planning was done for Determination of nail diameter, determination of neck shaft angle: Neck shaft angle was measured on the unaffected side on an AP x-ray using goniometer & length of the nail. A standard length PFN nail(250mm)is used in all our cases.

After the fixation is over, lavage is given using normal saline. Incision closed in layers. Sterile dressing is applied over the wounds and compression bandage given. Postoperatively, patients pulse, blood pressure, respiration, temperature were monitored. Foot end elevation is given depending on blood pressure. Antibiotics were continued in the post operative period. Analgesics were given as per patients compliance.

Patients were discharged from the hospital when independent walking was possible with or without walking aids. All patients were followed up at an interval of 6 weeks till the fracture union is noted and then after once in 3 months till 1year. At every visit patient was assessed clinically regarding hip and knee function, walking ability, fracture union, deformity and shortening. Modified Harris Hip scoring system was used for evaluation. X-ray of the involved hip with femur was done to assess fracture union and implant bone interaction. Functional results were assessed based on Harris Hip Scoring System (Modified).

Statistical analysis was done using descriptive statistics. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version.

RESULTS

The following observations were made from the data collected during this study of proximal femoral nail in the treatment of 40 cases of Peritrochanteric fractures of proximal femur. In our series, majority of the cases i.e.16 (40%) was in the age group of 41-60 years, followed by 12 (30%) cases in the age group 61-80 years. The youngest patient was 22 years old and eldest patient was 94 years. The mean age was 55.18 years. Majority of the patients were males – 31 cases (77.5%) and 9(22.5%) were females. In present study, 18 cases (45%) affected were due to Slip and Fall, 16 cases (40%) due to RTA, and 6 cases (15%) due to Fall from height. Slip and fall was the most common mode of injury. Right side was involved in 23 (57.5%) cases and left in 17 (42.5%), right side was more commonly involved than left side.

Trochanteric fractures (62.5 %) were common than Subtrochanteric fractures (37.5 %).

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Four patients had closed head injury CT brain study impression normal report and were managed conservatively. Two patients had Facture shaft tibia out of which one was close managed with Intramedullary interlocking nail in different setting and another ipsilateral compound type GA 2 comminated fracture at junction of mid and lower thirds of right tibia treated with external fixator. Three patients had distal radius fracture. Two of them treated conservatively with reduction and below elbow cast application and other was treated with Open reduction and internal fixation with Locking compression plate. One patient had ipsilateral # clavicle and was treated conservatively.

Table 1: General characteristics

Characteristics	No. of subjects	Percentage
Age group (in years)		
21-40	8	20%
41-60	16	40%
61-80	12	30%
81-100	4	10%
Mean age (in years)	55.18	
Gender		
Male	31	77.5%
Female	9	22.5%
Nature of violence		
Motor vehicle accidents (RTA)	16	40%
Fall from height	6	15%
Slip and fall	18	45%
Side affected		
Right	23	57.5%
Left	17	42.5%
Type of fracture		
Trochanteric	25	62.5 %
Subtrochanteric	15	37.5 %
Associated injuries		
Head injury	4	10 %
Tibial shaft	2	5 %
Distal radius fracture	3	7.5 %
Clavicle fracture	1	2.5 %

In the present study, majority of the cases i.e. 10 (40%) had type 2, followed by 9(36%) cases had type 3 Boyd and Griffin type.

Table 2: Trochanteric Fractures are classified according to Boyd and griffin classification

Type of fracture	Number of cases	Percentage
Type 1	3	12 %
Type 2	10	40 %
Type 3	9	36 %
Type 4	3	12 %

In the present study, majority of the cases i.e. 5 (33.3%) had type IIIa, followed by 3(20%) cases had type IIIb Seinsheimer type.

Table 3: Subtrochanteric fractures are classified according to Seinsheimer Classification

Type of fracture	Number of cases	Percentage
Type I	0	0%
Type IIa	2	13.3%
Type IIb	3	20%
Type IIc	2	13.3%
Type IIIa	5	33.3%
Type IIIb	3	20%
Type IV	0	0%
Type V	0	0%

All the patients were operated at an average interval of 7 days from the date of trauma. In our study, we encountered certain complications intraoperatively. Complications encountered were open reduction (10 %), failure to get anatomical reduction (5 %), failure to put

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derotation screw (7.5 %), varus angulation (7.5 %) & breakage of screw during distal locking (2.5 %).

We had one case of superficial wound infection post operatively, which was managed with regular dressing, culture and sensitivity and appropriate intravenous antibiotics. No deep infection was seen. We encountered three cases of delayed union and three case of mal union (varus <10 degree). Two cases had shortening more than 1 cms who were treated with sole raise. We had no cases of nonunion or implant failure or cutting out of screws. Two patients had knee stiffness. Patient improved after rigorous physiotherapy.

Table 4: complications

Complications	**Number of cases**	**Percentage**
Intraoperative complications		
Open reduction	4	10%
Failure to get anatomical reduction	2	5%
Failure to put derotation screw	3	7.5%
Varus angulation	3	7.5%
Breakage of screw during distal locking	1	2.5%
Delayed complications		
Delayed union	3	7.5%
Varus malunion $<10^0$	3	7.5%
Shortening of >1cms	2	5%
Knee joint stiffness	2	5%

In our study the average duration of hospital stay was 20.67 days. The mean time for full weight bearing was 16.5 weeks. All patients enjoyed good range of hip and knee range of motion except two who Improved with physiotherapy. 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.

Table 5: Assessment of Results

Characteristics	**No. of subjects/ Mean**	**Percentage**
Mean duration of hospital stay (in days)	20.67	
Mean time to full weight bearing (in weeks)	16.5	
Mobility after surgery		
Independent	22	62.85 %
Aided	13	37.15 %
Non-ambulatory	0	
Mean range of movements (10 weeks postoperatively)		
Hip joint (0 to 110^0)	35	100 %
Knee joint (0 to 120^0)	35	100 %

All patients were followed at 6 weeks, 12 weeks, 6 months and some patients up to one year and further if necessary. Three patients failed to attend the first follow up and were lost for follow up. 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.

Anatomical results were assessed by presence or absence of deformities, shortening, hip and knee range of motions. In our study two patients had shortening >1cm, three patients had varus malunion <10 degrees.

In our series of 40 operated cases 2 cases expired before first follow up due to associated medical problems and old age, 3 cases were lost for follow up. Functional and anatomical results are assessed taking the remaining 35 cases into consideration using Harris Hip Scoring System (Modified).

In our study, According to Harris Hip Scoring System (Modified), Good to excellent results are seen in 90.9% cases of trochanteric fractures and 84.6% cases in subtrochanteric fractures. Overall, we had Good to excellent results in in 88.57%, Fair in 11.42 %.we had no case with poor results.

Table 6: Functional results

Functional results	**Number of cases**	**Percentage**
Intertrochanteric fractures (n=22)		
Excellent	12	54.54 %
Good	8	36.36 %

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Fair	2	9.1 %
Poor	0	0 %
Subtrochanteric fractures (n=13)		
Excellent	4	30.76%
Good	7	53.84%
Fair	2	15.39%
Poor	0	0%

DISCUSSION

The treatment of peritrochanteric fractures of the proximal femur is still associated with some failures. The reasons are: disregard for biomechanics, overestimation of the potentials of new surgical techniques or new implants or poor adherence to established procedures.[6] High stress concentration that is subject to multiple deforming forces, slow healing time because of predominance of cortical bone, decreased vascularity, high incidence of complications reported after surgical treatment compels the surgeon to give a second thought regarding selection of the proper implant.[7]

The most common current modes of fixation are Blade plate systems, Sliding screw systems and Intramedullary devices. From the mechanical point of view, a combined intramedullary device inserted by means of minimally invasive procedure seems to be better in elderly patients. Closed reduction preserves the fracture hematoma, an essential element in the consolidation process. Intramedullary fixation allows the surgeon to minimize soft tissue dissection there by reducing surgical trauma, blood loss, infection, and wound complications.[8,9]

PFN is a novel, modern intramedullary implant based on experience with the gamma nail. The currently used gamma nail as an intramedullary device also has a high learning curve with technical and mechanical failure rates of about 10%. The gamma nail is susceptible to fail at its weakest point, the lag screw-implant interface. Proximal femoral nail has all advantages of an intramedullary device,such as decreasing the moment arm, can be inserted by closed technique, which retains the fracture hematoma an important consideration in fracture healing, decrease blood loss, infection, minimizes soft tissue dissection and wound complications.[10]

In an experimental study, Gotze *et al.*,[11] compared the loadability of osteosynthesis of unstable per and subtrochanteric fractures and found that the PFN could bear the highest loads of all devices.

Simmermacher *et al.*,[12] reported technical failures of PFN after poor reduction, malrotation or wrong choice of screws in 5% of the cases. In our study poor reduction occurred in two cases, three with varus malreduction. A cut out of the neck screw occurred in 0.6% cases in the study conducted by Simmermacher *et al.*,[12] but we did not encounter such complication in our study. Anatomical fracture reduction was found in 86% of the patients and full weight bearing stability was achieved in 94%. In our study acceptable anatomical reduction was obtained in 93.5% cases but we open reduced four fractures.

An intraoperative fracture displacement during manual introduction of the nail into the femoral shaft has not been reported with the gamma nail but this has been a problem with the PFN. One reason may be that the entry point of the PFN at the tip of the greater trochanter is located directly in the fracture region which can cause an intraoperative fracture displacement.

However, Simmermacher *et al.*,[12] had no cases of intraoperative fracture displacement using the PFN mainly in 31- A2 fractures. In our study we had no case of intraoperative fracture displacement after nail insertion. In comparison to gamma nail, we found no fracture of the femoral shaft and no break in the implant.

W. M. Gadegone & Y. S. Salphale[8] reported that postoperative radiographs showed a near-anatomical fracture reduction in 88% of patients. The fracture consolidated in 4.5 months. No perceptible shortening was noted. Of the patients, 7% had superficial infections which were controlled with antibiotics, 82% had a full range of hip motion. We had a non-union in one case which was due to the primary distraction in a high subtrochanteric fracture. In our Study we had 95% near normal anatomical # reduction and # consolidated in 16.5 weeks. Two cases we had shortening of more than 1 cm. 88.57% had full range of hip motion. We encountered no nonunion.

Migration of the screws due to severe osteoporosis was detected during the follow up in seven patients. In three of our patients, we could see the ‘Z effect’ with the migration of hip pins into the joint. No cases of implant failure were observed. **Metin Uzun** *et al.*,[10] reported Long-term radiographic complications following treatment of unstable intertrochanteric femoral fractures with the proximal femoral nail and effects on functional results.

Reduction was assessed as good or acceptable in all the patients. Complete union was achieved in all

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but two patients. The mean Harris hip score was 82.1. The results were excellent in 11 patients (31.4%), good in 15 patients (42.9%), fair in seven patients (20%), and poor in two patients (5.7%). Radiographic complications mainly included secondary varus displacement in nine patients (25.7%). Secondary varus displacement was due to cut-out of the proximal screws (n=2), screw loosening due to collapse of the fracture site (n=2), and reverse Z-effect (n=5). In our study mean Harris hip score was 83.5. Radiological complication chiefly include 3 cases of varus malunion in 3 patients. We had no implant failure or reverse z effect.

The fixation of Peritrochanteric fractures with a PFN markedly reduces the morbidity and mortality, in the elderly individuals in whom the fracture is more common. Most of the complications are surgeon and instruments related which can be cut down by proper patient selection and good preoperative planning.

With the experience gained from each case the operative time, radiation exposure, blood loss and intraoperative complications can be reduced drastically. Though the learning curve of this procedure is steep, with proper patient selection, good instrumentation, image intensifier and surgical technique, PFN remains the implant of choice in the management of peritrochanteric fractures.

CONCLUSION

The mode of injury for Peritrochanteric fracture in the elderly is a trivial trauma, however in the young individuals it occurs following a high velocity trauma. Anatomical reduction can be achieved by closed manipulative or open methods. PFN has the advantage of collapse at fracture site and is biomechanically sound as it is done by closed technique, fracture opened only when closed reduction could not be achieved and it is an intramedullary device. Another advantage of this device is it prevents excess collapse at fracture site thus maintaining neck length.

Thus, we consider that PFN is an excellent implant for the treatment of Peritrochanteric fractures. The terms of successful outcome include a good understanding of fracture biomechanics, proper patient selection, good preoperative planning, accurate instrumentation, good image intensifier.

Conflict of Interest: None to declare

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