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Original Research Article

Prospective study of proximal femoral nail in management of trochanteric and subtrochanteric fractures of femur

S V Yadkikar*, V S Yadkikar, D V Prasad and Akshay Marawar

Department of Orthopaedics, Rural Medical College, Loni BK, Tal. Rahata, Dist. Ahmednagar, State – Maharashtra, India

***Correspondence Info:**
Dr. S V Yadkikar
Assistant Professor,
PMT Staff quarters no 760/3/15,
Pmt campus, Rural Medical College, Loni BK,
Tal. Rahata, Dist. Ahmednagar, State –Maharashtra, India
E-mail: yadkikarpushkar@yahoo.co.in

Abstract

Aims: 1) Evaluation of Effectiveness and strength of Proximal Femoral nail in management of Trochantric and Sub-Trochantric Fractures. 2) Early mobilization and functional recovery of patient
Objectives: 1) Stable Internal Fixation designed to fulfill biomechanical demands. 2) Toassist & enhance fracture healing.
Method: It is a prospective study carried out from 2008 to 2014 in the Dept. Of Orthopaedics, RMC, Loni. Total 39 cases were treated. Boyd and Griffins classification is used. Majority of cases were from of 5^{th} -8^{th} decade of life. Stability of fractures is judged by presence of posterior-medial femoral cortex integrity. In all cases standard 25 mm PFN of 135^0 /130^0 were used.
Results: After average follow-up of one year good to Excellent Hip range of motion was seen in 36 cases. All cases showed fracture union. No Z effect seen in any case. Except 2 cases which showed Reverse z effect and in 1 case nail breakage was seen without affecting functional abilities. Average fracture union time was 16 weeks.
Conclusion: Proximal Femoral Nail is biomechanically sound fixation, minimally invasive which permits early mobilization, prevents excessive varus collapse at fracture site, produces less stress riser effect below tip of nail. But it also appears from this series that Indications of fixation are limited, excessive Lateral cortex comminution may limit its use. Still Proximal femoral nail is to be time tested to call it as best treatment modality for inter torchanteric & subtrochanteric fractures
Keywords: Proximal femoral Nail

1. Introduction

Hip fractures are a growing concern for the orthopedic surgeons all over the world, because incidence of hip fractures is increasing dramatically and these fractures impose a significant challenge in their efficient management[3,10].

Among the fractures in upper end of femur, "Trochanteric and Sub trochanteric fractures" account for more than (56%) half of the hip fractures in elderly. These fractures are seen in 6^{th} -7^{th} decade frequently resulting from simple fall. Now-a-days due to rapid industrialization and automobiles these fractures are also common in young age group[3,17].

As compared to conservative treatment operative treatment is better tolerated by elderly because of greater comfort, early mobilization of patient, lowered morbidity and mortality of patient.In "Subtrochanteric fractures" operative treatment is imperative as there is no role for conservative management [3,10,17]

The varieties of implants for treatment of unstable trochanteric femoral fractures continue to increase from the biomechanical point of view. The first type of implant consists of sliding neck screw or bolt connected to a plate placed on lateral femoral cortex. This implant is inserted after closed reduction using a minimal invasive technique. Arbeitsegmenin Schaftfur Osteo Synthes Fragen (AO/ASIF) in 1996 designed a new medullary device, the "Proximal fermoral nail"[10,17]

The proximal femoral nail (PFN) has additional anti rotational screw (Hip Pin), Secondly nail tip is specially shaped to reduce the stress and therefore to prevent low energy fracture at the tip of the implant. Compared with DHS, PFN greatly reduces the "lever arm distance from the reactionary forces generated in hip joint as a result of movements at the hip joint and increases compressive forces implanted to the tension side application of DHS. Rapid in implant and instrumentation in quest of an ideal fixation has made proximal femoral nail superior. Less exposure time less soft tissue discretion less radiation exposure, less blood loss and most important is taking advantage of the "Natural Biomechanics" at the hip joint[10,17].

2. Material and Methods

It is a prospective study carried out in Department of Orthopaedics of Rural Medical College, Loni from year 2008 to 2014 in which total 39 patients with both intertrochantric and subtrochantric fractures were treated with Proximal femoral nail. Ethical approval was taken from institutional ethical committee prior initiation of this study. Patients from 18 years & above were included after taking informed consent. Mean age of patient was 60 years amongst them youngest patient was 23 years while oldest was 91 years [Table 1]. 30 males & 9 female cases were treated. In 80% geriatric patients most common mechanism of injury was domestic fall, while in young patients motorcycle accident was frequent.

Table 1: Age wise distribution of cases

Sr. No.	Age (Years)	No. of patients	Percentage
1	20-30	2	6%
2	30-40	2	6%
3	40-50	2	6%
4	50-60	24	59%
5	60-70	4	10%
6	70-80	4	10%
7	80-90	1	3%
	Total	39	100%

Youngest patient was 22 years while oldest is 83 years.

Amongst 39 cases there were 31 Intertrochantric[Figure 1] & 8 subtrochantric fractures[Figure 4] All cases were classified by Boyd & Griffins classification on preoperative radiographs[Table 2][17] According to the classification 24 cases were type I, 10 cases were type II & 5 were type III.

In 4 patients there were associated injuries (Ipsilateral distal end radius fracture in 2, contra lateral calcaneum fracture in 1 & contra lateral shaft humerus fracture 1)

All Patients were given traction preoperatively. Average duration between admission and operation was 8 days. No pre operative CT scan was done in any case to due economic constrains. In some it was delayed due to medical reason & socio economic constrains. All patients were operated in supine position on fracture table with affected limb given traction adduction. Fracture reduction was visualized on image intensifier in AP & Lateral views. Closed reduction achieved in 34 cases & in 5 cases required open reduction. Approximately 4-5 cm incision extending up wards from Tip of trochanter was given. Guide wire was passed from trochanter in to distal fragment. Reaming was done over guide wire. Standard stainless steel [316L] PFN (25mm length & 9-12mm diameter & of 135^0 /130^o was used in all cases. The commonest diameter used was 10mm.7.9 mm cervical screw & 6.4mm Hip pin were introduced after confirming guide wire position in femoral head on image intensifier in AP & Lateral views. In all cases central and infero-medial femoral neck cortex screw placement was observed [Figure 2]. As per fracture implant construct stability distal dynamic & static locks were done. Average operation time was 60 min. As per pain tolerance active hip and knee mobilization was started by day 4-5.Average duration of hospital stay was 3 weeks.

2.1 Statistical analysis method

Data was analyzed by Descriptive statistics as Mean, Standard deviation, percentage, & proportions etc. Comparison was done by applying Z test of proportion & P value was less than 0.05 & was considered as significant.

3. Results

Full weight bearing was allowed after clinical & radiological union of fracture. Average fracture union time was 16 weeks. Fracture union was seen in all cases[Figure 1,2,4,5,6].

Commonly used nail diameter was 10mm

All Patients were followed up for an average period of one year.

3.1 Harris Hip Score

It is developed for the assessment of the results of hip surgery, and is intended to evaluate various hip disabilities and methods of treatment in an adult population[18][Figure11]

Functional recovery was assessed by Harris Hip Score; Good to Excellent results were seen in 36cases [Figure 3,7]

There was superficial wound infection was seen in 2 patients & was treated by intravenous antibiotics.

Reverse 'Z' effect[16] i.e movement of the hip pin towards the lateral side was seen in 4 cases [Figure 8].

Shortening 0f 1cm, 10 ^{0}of external rotation was seen in one case each.

In one case of subtrochanteric fracture there was Breakage of nail noticed on 3ed follow up month but still fracture united & patient not only had full functional recovery but also refused implant removal.[Figure 9,10]

None of the above complications hampered patient's functional recovery. 'Z 'effect[16] i.e. impaction of the hip pin into the proximal hole of the nail while the neck screw is normally sliding back during the weight-bearing period, was not seen in any case. No revision surgery required in any case.

We have included patients with type I, II, and III fracture pattern as per Boyd & Griffins classification

Table 2 Boyd & Griffins classification

Fracture Type	Classification Description
I	Simple fracture that extend along the intertrochanteric line from the greater to the lesser trochanter
II	Comminuted fractures, the main fracture being along the intertrochanteric line, but with **multiple** fractures in the cortex
III	Fractures that are basically subtrochanteric with at least one fracture passing across the proximal end of the shaft just distal to or at the lesser trochanter. Varying degrees of comminution are associated. (**reverse subtrochanteric)**
IV	Fractures of the trochanteric region and the **proximal shaft**

3.2 Diameter of proximalfemoral nail used

Proximal femoral nail has proximal eight centimeter portion with 17mm diameter uniform in all nails irrespective of distal diameter which ranges from 9mm to 12mm. Commonly used nail diameter was 10mm. Amongst 39 cases 5 cases required open reduction

Complications observed: Urinary tract infection was seen in 1 while superficial wound infection was observed in 2 patients respectively.

Figure 1: **Intertrochanteric fracture pre operative radiograph**

Figure 2: **Intertrochanteric fracture post operative radiograph**

Figure 3: Final clinical of Intertrochanteric fracture Photographs at 4 months

Case Two

Figure 4: Subtrochanteric fracture Pre operative radiographs

Figure 5: Subtrochanteric fracture post operative radiographs

Figure 6: Subtrochanteric Farcture after fracture union at 4 months

Figure 7: Final Clinical photo graphs of range of motion

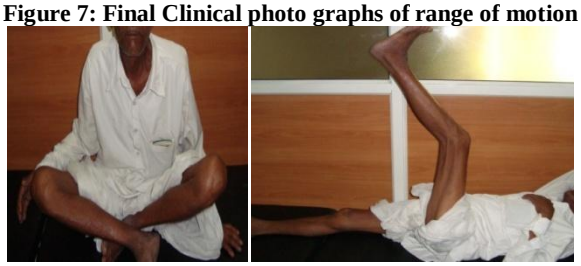

Figure 8: Reverse Z Effect

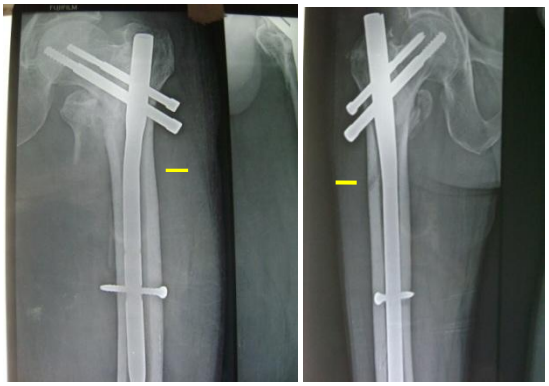

Figure 9: Fracture union even in the presence of nail breakage

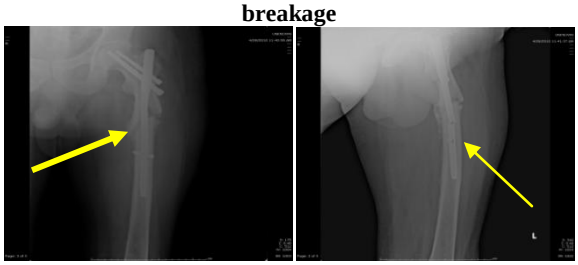

Figure 10: Patient with fracture union with broken nail having good range of motion

Figure 11 – Harris Hip Score

APPENDIX 1

Harris Hip assessment tool

I. Pain (44 possible)

A) None or ignores it 44
B) Slight, occasional, no compromise in activities 40
C) Mild pain, no effect on common activities, rarely moderate pain with unusual activity, may take simple pain medication 30
D) Moderate pain, tolerable, accepts limitations caused by pain. Some limitation of common activities or work. Occasionally takes pain medication stronger than aspirin 20
E) Pronounced, serious limitation of activities 10
F) Totally disabled, crippled, pain in bed, bedridden 0

II. Function (47 possible)

A. Gait (33possible)

1. Limp
a) None11
b) Slight 8
c) Moderate 5
d) Severe 0

2. Support
a) None 11
b) Cane for long walks 7
c) Cane most of the time 5
d) One crutch 3
e) Two canes 2
f) Two crutches 0
g) Not able to walk 0
(specify reason:_____)

3. Distance walked
a. Unlimited 11
b. 6 blocks 8
c. 2-3 blocks 5
d. Indoors only 2
e. Bed and chair 0

B. Activities (14 possible)

1. Stairs
a) Normally without using a railing 4
b) Normally using a railing 2
c) In any manner 1
d) Unable to do stairs 0

2. Shoes and socks
a) With ease 4
b) With difficulty 2
c) Unable 0

3. Sitting
a) Comfortably in ordinary chair one hour 5
b) On a high chair for one half hour 3
c) Unable to sit comfortably in any chair 0

4. Enter public transportation 1

III Absence of deformity points (4) are given if the patient demonstrates:

A) Less than 30° fixed flexion contracture
B) Less than 10° fixed adduction
C) Less than 10° fixed internal rotation in extension
D) Limb length discrepancy less than 3.2 centimeters

IV. Range of motion (index values are determined by multiplying the degrees of motion possible in each arc by the appropriate index)

A. Flexion
0—45 degrees X 1.0
45—90° X 0.6
90—110° X 0.3

B. Abduction
0—15° X 0.8
15—20° X 0.3
over 20° X 0

C. External rotation in extension
0—15 X 0.4
over 15° X 0

D. Internal rotation in extension
any X 0

E. Adduction
0—15° X 0.2

To determine the overall rating for range of motion, multiply the sum of the index values X 0.05. Record Trendelenburg test as positive, level or neutral.

4. Discussion

Inter Torchanteric & subtrochanteric fractures are very frequently faced by orthopaedic surgeons worldwide. Rapid industrialization &automobile use is increasing their incidence. Usually they are seen from 5th decade of life onwards[3,4] Osteoporosis, sluggish reflexes, diminishing vision are common associated factors in this age group[5], but now a day's following Road Traffic Accidents these fractures are often seen in younger population[5] conservative management is poorly tolerated by elderly patients & it is associated with complications like decubiuts ulcers, Deep Vein Thrombosis, Aspiration Pneumonitis, Malunion, limb shortening[1,3,5,6,10]

To avoid these complications operative treatment is favored[1,6,5]. Dynamic Hip Screw is time tested implant for Inter Torchanteric & Subtrochanteric fractures fixation [2,3,9,12,15]. It is better device than rigid implants like SP Nail & plate, Jewett Nail, as this extra medullary device works on principal of controlled concentric collapse [12]. But it also has some potential disadvantages like this being load bearing, has longer lever arm and placed away from mechanical axis of femur. It requires larger surgical exposure leading to loss of primary fracture hematoma, increasing chances of wound infection. Even Possibility of implant failure, varus collapse at fracture site, limb shortening is also there.

To avoid such complications AO/ASIF in 1997 introduced a third generation intramedullary device called Proximal Femoral Nail[14]. It also works on principal of controlled collapse at fracture site but being intramedullary it has short lever arm, placed closed mechanical axis of femur so it is a load shearing device[4,6,14]. The advantages of this device z are

less soft tissue dissection required [1,15]
Addition of 6.4 mm antirotation screw to reduce rotation of cephalocervical fragment [12,14]
It facilitates early mobilization [3,7,8,10,12] which
Longer implant length, small & higher level placed valgus angle [12]
Small diameter & fluting tip reducing stress riser effect[3]
Easy identification of entry portal i.e. Tip of Greater trochanter[1,15]
Higher placement of distal locking screws avoiding abrupt changes in stiffness of construct thereby reducing stress riser effect[3,6,14]

But Proximal femoral Nail also has some potential disadvantages like –Reverse Z effect, Z effect, high learning curve [15]

Total 39 cases of both Intertrochanteric & subtrochanteric fractures were treated from year 2008 to 2014. 30 cases were males & 9 females. In all patients standard 130 /135^0 stainless steel Proximal femoral nail was used. Closed reduction was achieved in 34 cases, while minimal open reduction in 5 cases. Average operation time was 60 minutes. Non weight bearing mobilization was started in all cases on post operative day 4-5 as per pain tolerance. Average hospital stay was 3 weeks. Fracture healing was assessed on clinical & radiological evidence of fracture union. Average fracture union was 16 weeks. Patients were assessed by Harries Hip Score & Good to Excellent results were seen in 95% cases. In all patients follow up was made for minimum period of 1year & there was no lost in follow up. In our series Reverse Z effect was seen in 4 cases, superficial wound infection was seen in 2cases while shortening of 1cm, 15^0 of external rotation were seen in one case each, but none of these complications hampered patient's functional recovery. In one case of subtrochanteric fracture there was nail breakage noticed on 3 month of follow up despite of that fracture united & patient was having full range of motion of hip joint & also reluctant to get implant removal done. In this series there was no evidence of Z effect[16]

Non union, varus collapse at fracture site, fracture below tip of nail was noted. Preoperative planning, implant size selection & optimal placement of implant i.e. placement of proximal screws in central & inferior quadrant of femoral head confirmed on AP & Lateral views are some of the probable important things which minimizes the complications[11,13]

Thus proximal femoral nail satisfies our needs for being –

Minimally invasive, biomechanically sound & stable load shearing device which facilitates early mobilization & weight bearing, less chance of post operative wound infection. Controlled collapse at fracture site leading to shortening can be minimized or prevented. Making this device technically more demanding than extramedullary fixation devices

5. Conclusion

From observations it appears that PFN is biomechanically sound fixation, minimally invasive which permits early mobilization, prevents excessive varus collapse at fracture site, produces less stress riser effect below tip of nail. But it also appears from this series that Indications of fixation are limited, excessive Lateral cortex comminution may limits its use. Still Proximal femoral nail is to be time tested to call it as best treatment modality for fixation of Inter torchanteric & subtrochanteric fractures & for this longer follow up series with larger sample size are needed.

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