National Journal of Clinical Orthopaedics

ISSN (P): 2521-3466
ISSN (E): 2521-3474

www.orthoresearchjournal.com
2020; 4(3): 34-37
Received: 26-11-2020
Accepted: 02-01-2021

Dr. Joseph Eugene
Assistant Professor, Department of Orthopedics, MVJ Medical College and Research Hospital, Bangalore, Karnataka, India

Dr. Hemanth R
Assistant Professor, Department of Orthopedics, MVJ Medical College and Research Hospital, Bangalore, Karnataka, India

Dr. Rajagopal HP
Professor, Department of Orthopedics, St. John's Medical College and Research Hospital, Bangalore, Karnataka, India

Dr. Ashok Kumar Reddy K
Senior Resident, Department of Orthopedics, MVJ Medical College and Research Hospital, Bangalore, Karnataka, India

Corresponding Author:
Dr. Hemanth R
Assistant Professor, Department of Orthopedics, MVJ Medical College and Research Hospital, Bangalore, Karnataka, India

A study on functional and radiological outcome of proximal femoral nailing

Dr. Joseph Eugene, Dr. Hemanth R, Dr. Rajagopal HP and Dr. Ashok Kumar Reddy K

DOI: https://doi.org/10.33545/orthor.2021.v5.i1a.257

Abstract
The proximal femoral nail, in titanium or steel and for left and right use, consists of a 240 mm long nail, the distal part of which is available in 10, 11 or 12 mm diameter. The proximal part measures 17 mm in diameter. The angle between both parts is 6 to 8 degrees, situated at 11 cm distally from the top of the nail. All patients were classified based on AO system of classification for intertrochanteric fractures. AO system was used because it needed only AP view of the pelvis. Standard preoperative evaluation was be followed with complete assessment by anesthetist. Routine institutional protocol was followed for preoperative preparation and surgery. According to the American society of Anaesthesiologists classification (ASA) majority of our patients (35) belonged to ASA grade 3. Intertrochanteric fractures are classified according to AO classification in our study. AO 2.2 was the most common type of fracture.

Keywords: Radiological outcome, proximal femoral nailing, ASA

Introduction
Before 1960s the treatment for intertrochanteric fractures were mainly treated conservatively. Modality available was non operative management of intertrochanteric fractures. The treatment consisted of long term immobilization with skeletal traction. Non operative treatment had the disadvantage of varus deformity, due to inadequate pull of the traction to counteract the muscle pull. And it also worsened the general condition of the patients by producing decubiti, pneumonia, joint contractures, urinary tract infections, thromboembolic complications [1, 2].

In the year 1996, the AO, ASIF developed the proximal femoral nail as an intramedullary device for the treatment of unstable pertrochanteric fractures.

The proximal femoral nail, in titanium or steel and for left and right use, consists of a 240 mm long nail, the distal part of which is available in 10, 11 or 12 mm diameter. The proximal part measures 17 mm in diameter. The angle between both parts is 6 to 8 degrees, situated at 11 cm distally from the top of the nail. Through the proximal part two screws can be inserted into the femoral neck, a lower 11.0 mm load bearing neck screw, the tip of which should be placed subchondrally in the lower half of the femoral head. Furthermore, an additional 6.5 mm antirotational hip pin is placed through the proximal part of the nail into the upper half of the femoral neck to prevent rotation of the head ± neck fragment. The tip of the nail is specially shaped to reduce stress concentration. Distally the nail can be locked statically or dynamically by using either the round or the oval locking hole [3, 4].

Proximal femoral nail has all the advantaged of an intramedullary device such as closed technique which retains the fracture haematoma, decreases the blood loss, minimises soft tissue dissection and wound complications. In an experimental study GOTZE *et al*. (1998) compared the loadability of osteosynthesis of unstable pertrochanteric fractures and found that the PFN could bear the highest load of all devices [5, 6].

Methodology
Standard Pre-operative work up
- All patients were classified based on AO system of classification for intertrochanteric fractures. AO system was used because it needed only AP view of the pelvis.

- Standard preoperative evaluation was be followed with complete assessment by anesthetist.
- Routine institutional protocol was followed for preoperative preparation and surgery

Operative procedure

Type of anaesthesia

1. Spinal anaesthesia
2. General anaesthesia

Operative technique

Patient positioning and fracture reduction

The patient is placed in supine position on fracture table with adduction and internal rotation of the affected limb by 10-20 degrees (under image intensifier) and closed reduction of the fracture was done by traction and internal rotation. The unaffected leg is fixed and abducted as far as possible or kept in wide abduction. The image intensifier was positioned so that the antero posterior and lateral views of the hip and femur could be taken. Open reduction is performed if closed reduction failed.

The patient is then prepared and draped as for any standard hip fracture fixation. Prophylactic antibiotic was given in all patients 30 mins prior to surgery.

Approach

The tip of the greater trochanter was located by palpation in thin patients and in obese individuals, we used the image intensifier. A 5 cm longitudinal incision was taken proximal from the tip of the greater trochanter and posterior to it. A parallel incision was made in the fascia lata and glutei was split in line with the fibres. The tip of the greater trochanter was exposed.

Determination of Entry point and insertion of the guide wire

In AP and LATERAL view on image intensifier, the entry point is on the tio or slightly lateral to the piriformis fossa, using awl. Guide wire entered and position is confirmed in the center of the medullary cavity.

Reaming

Using a cannulated conical reamer proximal femur is reamed initially using size 8 and upto size upto size 12 depending upon the isthmus

Insertion of PFN

An appropriate size nail as determined preoperatively and intraoperatively is assembled to insertion handle and is inserted manually. This step is done carefully without hammering by slight twisting movements of the hand until the hole for the 8 mm screw is at the level of the inferior margin of the neck.

Insertion of the guide wire for neck screw and hip pin

These are inserted with the help of aiming device lightly screwed to the insertion handle. A 2.8 mm guide wire is inserted through the drill sleeve after a stab incision. The final position of the guide wire should be in the lower half of the neck in AP view and in the center of the neck in lateral view.

A second 2.8 mm guide wire inserted through the drill sleeve above the first one for hip pin. The tip of this guide wire should be approximately 15 mm less deep than the planned neck screw.

Insertion of the neck screw and hip pin

Drilling is done over 2.8 mm guide wire until the drill is 8mm short of tip of the guide wire. Tapping is not done as neck screw is self tapping. Neck screw is inserted using cannulated screwdriver. Similarly appropriate length hip pin is inserted. Length and position of the screw is confirmed with image intensifier.

Distal locking

Distal locking is usually performed with two cortical screws. A drill sleeve system is inserted through a stab incision. A drill hole is made with 4mm drill bit through both cortices. Locking screw is inserted and position confirmed with image intensifier.

Closure

After fixation is over, lavage is given using normal saline and incision is closed in layers. Sterile dressing is applied over wound and compression bandage given.

Standard post-operative

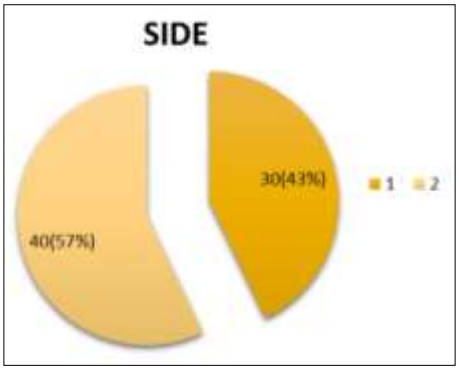
Postoperatively, patient's pulse, blood pressure, respiration and temperature were monitored. Foot end elevation was given. IV antibiotics were continued for 5 days in the postoperative period. Analgesics were given as per patient compliance. Blood transfusion was given depending on requirement. Sutures were removed on 12th post operative day.

Patients were encouraged to sit in the bed after 24 to 48 hours following surgery. Patients were taught quadriceps static exercise and knee mobilization in immediate postoperative period. Patients were started on non weight bearing walking on 2nd day. Ambulation was delayed in patients with unstable fracture pattern.

All patients were assessed in immediate post op, 1 month, 3 month, 6 month radiologically as mentioned below and functionally using Harris Hip Score

Results

Out of the 70 patients in our study 30 patients had sustained right side intertrochanteric fracture and 40 of them sustained left side intertrochanteric fracture



Graph 1: Side Affected

According to the American society of Anaesthesiologists classification (ASA) majority of our patients (35) belonged to ASA grade 3.

Table 1: ASA classification

ASA	Frequency	Percent
1	6	8.6
2	23	32.9
3	35	50.0
4	6	8.6
Total	70	100.0

Intertrochanteric fractures are classified according to AO classification in our study. AO 2.2 was the most common type of fracture.

Table 2: Type of fracture

AO	Frequency	Percent
1.1	2	2.9
1.2	12	17.1
1.3	4	5.7
2.1	15	21.4
2.2	19	27.1
2.3	12	17.1
3.1	1	1.4
3.2	2	2.9
3.3	3	4.3
Total	70	100

We classified osteoporosis according to Singh's index and according to this index we found most of our patients (21) belonged to grade 3. 12 patients had no eveidence of osteoporosis.

Table 3: Osteoporosis

Osteoporosis	Frequency	Percent
2	10	14.3
3	21	30.0
4	12	17.1
5	15	21.4
6	12	17.1
Total	70	100.0

Quality of reduction was assessed using Baumgaertner criteria and its modification by F. Fogagnolo *et al*. All the 70 patients in our study had good reduction.

Table 4: Reduction

Reduction	Frequency	Percent
Good	70	100.0
Acceptable	0	0
Poor	0	0
Total	70	100.0

Patients were followed up at 1 month, 3 months and 6 months.
Functional outcome was measured using Harris Hip Score
At 1 month of follow up all patients had poor score i.e < 70.
At 3 months of follow up 2 patients had a fair score i.e 71-80 and the other 68 patients had poor score i.e <70.
At 6 months follow up 37 patients had poor score of <70, 17 patients had a fair score i.e 71-80, 11 patients had a good score i.e 81-90 and 5 patients had an excellent score i.e 91-100

Table 5: Follow Up

	Mean	Std. Deviation	P value
1st follow up functional	44.650	5.7520	0.0001
2nd follow up functional	56.987	5.8391	
3rd follow up functional	73.116	9.4009	

The test for calculating p value is repeated measure anova

Table 6: Outcome

	1st follow up		2nd follow up		3rd follow up	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Poor	70	100.0	68	97.1	37	52.9
Fair	-	-	2	2.9	17	24.3
Good	-	-	-	-	11	15.7
Excellent	-	-	-	-	5	7.1

Discussion

This study was aimed to assess the functional and radiological outcome of proximal femoral nailing. In terms of functional outcome, we found out that, at one month the mean Harris Hip score was 44, at three months it was 56 and 73 at the end of six months.

All our patients had good reduction according to Fogagnolo[5] *et al*.

There was no significant association between type of fracture and Harris Hip score at successive follow up.

There was no significant association between osteoporosis and type of fracture.

There was no significant association between ASA grade and Harris Hip score at successive follow up.

The PFN is an effective intramedullary load - sharing device. It incorporates the principles and theoretical advantages of the Zickel Nail, Dynamic hip screw and locked intramedullary nail.[7]

In a study conducted by Parker and Pryor based on meta-analysis analysis of publications comparing the Gamma nail to DHS-type systems, including approximately 1,800 peritrochanteric fractures, they found a higher incidence of femoral fracture around the nail point when the Gamma nail was used, not recommending it for routine use in this type of fracture.[8] In an attempt to solve or at least minimise the complications that present with the use of intramedullary fixation devices, AO/ASIF has introduced the PFN, whose main biomechanical innovations include greater implant length (compared to the standard Gamma nail), less valgus in the nail, what angle there is being set at a higher level (11 cm from the proximal end) than in the Gamma nail, the availability of smaller distal diameters and a flexible distal end that reduces the concentration of stresses to a minimum, elimination of the need for diaphyseal reaming in order to introduce it and finally, the possibility of placing an additional antirotational screw in the femoral neck in order to avoid breakdown of the fracture line and rotation of the cervico-cephalic fragment. In this respect it should be borne in mind that during surgery, the cervico-cephalic screw must be adjusted to the calcar, taking into account the need to place the antirotational screw [9, 10].

Conclusion

Intramedullary nailing with the PFN has distinct advantages like shorter operating time and lesser blood loss for unstable trochanteric fractures. Early mobilization and weight bearing is allowed in patients treated with PFN thereby decreasing the incidence of bedsores, uraemia and hypostatic pneumonia. The incidence of perioperative and postoperative femoral shaft fractures in PFN can be reduced by good preoperative planning and correct technique, adequate reaming of the femoral canal, insertion of implant by hand and meticulous placement of distal locking screws.

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