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## The risk factors associated with complications in proximal femoral nailing

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### Abstract

Cephalomedullary nails are able to provide necessary bending and torsional stability to combat the displacement of the fracture fragments. Proximal femoral nail being an intra medullary device is a load sharing device and has the inherent advantage of shorter lever arm, thereby decreasing the tensile strain on the implant. 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. There is no significant association between type of fracture and Harris Hip Score at 1<sup>st</sup> follow up. There is no significant association between Harris hip score and ASA at 3<sup>rd</sup> follow up at 6 month.

**Keywords:** Proximal femoral nailing, risk factors, complications

### Introduction

Forces applied to the hip during ambulation produces stresses in the proximal femur because of combined effects of axial, bending and torsional loads. Normally the proximal femur is loaded so that the medial cortex is compressed and the lateral cortex is under tension. Major compressive stresses in the femur are greatest in the medial cortex 1 to 3 inches below the lesser trochanter, i.e. the subtrochanteric region and this region is considered to be one of the highly stressed region in the body. Tensile stresses of about 25% less occur at the lateral cortex slightly proximally<sup>[1, 2]</sup>.

Following the fracture, unbalanced muscle pull results in displacement of the fracture and this displacement is difficult to neutralize. The iliopsoas, with its insertion to the lesser trochanter, typically causes the proximal fragment to flex and externally rotate and the short abductors that insert onto the greater trochanter cause the abduction of the proximal fragment. Distal fragment because of the unopposed pull from the adductor magnus, always displaces it medially and further aggravates the deformity. In addition comminution of the medial cortex further adds to the injury. In addition comminution of the medial cortex further adds to the insult of this highly stressed area<sup>[3]</sup>.

Cephalomedullary nails are able to provide necessary bending and torsional stability to combat the displacement of the fracture fragments. Proximal femoral nail being an intra medullary device is a load sharing device and has the inherent advantage of shorter lever arm, thereby decreasing the tensile strain on the implant.

The hip screw and the anti rotational screw proximally provide increased rotational stability of the head-neck fragment. The two distal locking screws control the rotational stability of the distal fragment. A biomechanical analysis by Tencer Etal on various implants used for intertrochanteric fracture have found that bending stress, torsional stress, load to axial failure are superior in cephalomedullary implants than all the other implants. Another biomechanical evaluation done by Paul R.T. Kuzyk Etal in 2009, on reverse oblique trochanteric fractures concluded that intramedullary devices were significantly stiffer and had a greater load to failure than the 135 degree and 95 degree constructs, especially with a gap between the bony fragments.

Indirect fracture reduction, preserving the fracture hematoma, less soft tissue dissection, decreased amount of blood loss add to the decreased overall morbidity [4].

### Methodology

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

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.

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.

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

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.

### Inclusion criteria

- All patients where proximal femoral nail has been used
- All patients above 30 years of age

### Exclusion criteria

- Open fractures
- Non ambulant patients
- Polytrauma patients

### Results

**Table 1:** Association between type of fracture and HHS at first follow up visit

AO	1 <sup>st</sup> follow up		Total
	Poor	Fair	
1.1	2	0	2
1.2	12	0	12
1.3	4	0	4
2.1	15	0	15
2.2	19	0	19
2.3	12	0	12
3.1	1	0	1
3.2	2	0	2
3.3	3	0	3
Total	70	0	70

There is no significant association between type of fracture and Harris Hip Score at 1<sup>st</sup> follow up.

**Table 2:** Association between type of fracture and hhs at second follow up visit

AO	2 <sup>nd</sup> follow up		Total
	Poor	Fair	
1.1	2	0	2
1.2	11	1	12
1.3	4	0	4
2.1	14	1	15
2.2	19	0	19
2.3	12	0	12
3.1	1	0	1
3.2	2	0	2
3.3	3	0	3
Total	68	2	70

Fisher's exact test, p value=0.863

There is no significant association between type of fracture and Harris Hip Score at 2<sup>nd</sup> follow up

**Table 3:** Association between type of fracture and HHS at third follow up visit

AO	3 <sup>rd</sup> follow up				Total
	Poor	Fair	Good	Excellent	
1.1	1	1	0	0	2
1.2	4	4	2	2	12
1.3	4	0	0	0	4
2.1	5	5	3	2	15
2.2	10	4	4	1	19
2.3	10	2	0	0	12
3.1	0	0	1	0	1
3.2	0	1	1	0	2
3.3	3	0	0	0	3
Total	37	17	11	5	70

Fisher's exact test, p value=0.160

There is no significant association between type of fracture and Harris Hip Score at 3<sup>rd</sup> follow up

**Table 4:** Association between type of fracture and osteoporosis

AO	Osteoporosis					Total
	2	3	4	5	6	
1.1	0	0	0	1	1	2
1.2	1	3	1	2	5	12
1.3	0	3	0	0	1	4
2.1	2	2	4	4	3	15
2.2	6	5	4	3	1	19
2.3	1	5	3	3	0	12
3.1	0	0	0	0	1	1
3.2	0	0	0	2	0	2
3.3	0	3	0	0	0	3
Total	10	21	12	15	12	70

Fisher's exact test, p value=0.063

There is no significant association between type of fracture and Osteoporosis

**Table 5:** Association between ASA grade and HHS at follow up visits

HHS At 1 month	ASA				Total
	1	2	3	4	
Poor	6	23	35	6	70
Fair	0	0	0	0	0
Good	0	0	0	0	0
Excellent	0	0	0	0	70

Fishers exact test. p value

There is no significant association between Harris hip score and ASA at 1<sup>st</sup> follow up at 1 month

**Table 6:** HHS at 3 Months

HHS At 3 month	ASA				Total
	1	2	3	4	
Poor	5	22	35	6	68
Fair	1	1	0	0	2
Good	0	0	0	0	0
Excellent	0	0	0	0	70

Fishers exact test. p value =0.210

There is no significant association between Harris hip score and ASA at 2<sup>nd</sup> follow up at 3 month.

**Table 7:** HHS at 6 Months

HHS At 6 month	ASA				Total
	1	2	3	4	
Poor	0	17	19	1	37
Fair	0	5	9	3	17
Good	3	1	5	2	11
Excellent	3	0	2	0	5
Total	6	23	35	6	70

Fishers exact test. p value=0.0001

There is no significant association between Harris hip score and ASA at 3<sup>rd</sup> follow up at 6 month

## Discussion

Biomechanically PFN is more stiff, it has shorter moment arm i.e. from the tip of lag screw to the center of femoral canal whereas the DHS has a longer moment arm undergoes significant stress on weight bearing and hence higher incidence of Lag screw cut out and varus malunion. The larger proximal diameter (15 mm) of the PFN given additional stiffness to the nail. Minimal blood loss, shorter operative time, early weight bearing are all advantage of PFN whereas the DHS has a longer

operative time & more blood loss [5].

In the current study the union rate was 100%. There were no cases of peroperative and postoperative femoral fractures. Peroperative and postoperative femoral fractures have been documented in patients treated with the PFN. Multiple factors have been implicated like implant design and operative technique. Decreases in implant curvature, diameter, over reaming of femoral canal by 1.5 to 2mm, insertion of the implant by hand and meticulous placement of the distal locking screws without creating additional stress risers decreases the complication rate of femoral shaft fracture. Patients with narrow femoral canal and abnormal curvature of the proximal femur are relative contra-indications to intramedullary implants. We have followed these recommendations in our series. Hence in our series we don't have encountered any preoperative and postoperative femoral shaft fractures. In a study conducted by Menez and Daneil on 155 intertrochanteric fractures treated with treated with PFN, they found that there is a 2% failure of fixation and 0.7% of femur shaft fractures. A larger cohort of patients is necessary to document the incidence of preoperative and postoperative femoral shaft fractures, which is a limitation of our study [6, 7].

According to a study done by Ranjeetesh Kumar *et al.* the average Harris hip score for PFN in 25 patients was 33 at 1 month,  $p < 0.05$  and at 58 at 3 months and 88 at six months. In our study at one month Harris Hip score was 44, at 3 months it was 56 and 73 at the end of six months which is comparable [8].

In a study conducted by Korkmaz *et al.* to see outcomes of trochanteric femoral fractures treated with proximal femoral nail results revealed that HHS was negatively correlated with ASA score and patient's age. There was no association between ASA grade and HHS in our study.

## Conclusion

PFN is a significant advancement in the treatment of unstable trochanteric fractures which has the unique advantage of closed reduction, preservation of fracture hematoma, less tissue damage during surgery, early rehabilitation and early return to work.

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