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Role of long proximal femoral nail fixation in reverse oblique & subtrochanteric fractures of femur

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Abstract
Background: Reverse oblique & Subtrochanteric fracture both are variants of Peritrochanteric femur fractures. Incidence of these fractures is increasing due to high velocity automobile accidents. They are one of the most difficult fractures to treat and even treatment failure is common.
Aim: To study the functional outcome of Reverse oblique & Subtrochanteric fractures treated with Long Proximal femoral nail.
Material & Methods: Total 20 (18 Male & 2 Female) cases of Reverse oblique (8 cases) & Subtrochanteric (12 cases) fractures from 2011 to 2016 were treated by Long proximal femoral nail. Mean patient age was 50 yrs (25 – 75 yrs). All patients operarted on fracture table in supine position. Average hospital stay was 3 weeks.
Results: Road traffic accident was commonest mechanism of injury. 10mm was frequently used diameter. 4 cases required Open reduction. Non weight bearing mobilization was initiated by post op day 3(Average 2-5). Average fracture union time was 16 weeks. Average duration of follow up was 1 year. Shortening of 1cm was seen in 1 case, Reverse Z effect was seen in 2 cases, nail breakage was seen in 1 case which didn't affect the functional abilities. Good to excellent results as per Harris Hip Score seen in 90% cases. No Z effect & Non-union was seen in any case.
Conclusion: With the various choices of implants for the fixation of Reverse oblique & subtrochanteric fractures Long PFN can be considered a reliable implant due to following advantages of being minimally invasive, load shearing device, facilitates early mobilization. However anatomical reduction & optimal placement of implant is the key to success.
Limitations of study: Small sample size, Short follow up period, no comparison group

Keywords: Reverse oblique fracture, Subtrochanteric fracture, long proximal femoral nail

1. Introduction
Incidence of proximal femoral fractures is increasing now a days due to rapid industrialization & high energy trauma due automobiles [1]. It is one of the common cause of morbidity & mortality in elderly patients [1, 7]. Reverse oblique proximal femoral fractures have inherent instability [1, 2]. Biomechanical test have also confirmed that the subtrochanteric region of the femur is subjected to concentrated high stress and compressive stress in the medial cortex is significantly, greater than tensile stress in the lateral cortex [4, 5]. The biomechanical characteristics of the area, poor vascularity caused by the predominance of cortical bone, and inadequacy of reduction and internal fixation are responsible for malunion, delayed union and mechanical failure of implants used in the treatment [1, 6]
Treatment of both these fractures is challenging not only in terms of obtaining anatomical reduction but also in terms of selection of treatment modality [6]. Non operative treatment in the form of traction needs prolonged bed rest which might lead to complications like bed sores, Deep vein thrombosis, aspiration pneumonitis which is poorly tolerated specially in elderly [1, 7]. So early stable fixation & mobilization is key to success [7]
Many treatment modalities have been advocated i.e Extra medullary & Intramedullary. Amongst them Dynamic hip screw (DHS) is time tested & widely used device [7]. But they require larger surgical exposure leading to more blood loss and chances of wound infection are there. Strong stresses resulting from bending movements and compressive forces generated by body weight and the hip may lead to failure as these are load bearing implants [2, 7]. On the contrary intramedullary implants are load sharing since they are placed close to mechanical

axis [7]. They are considered biomechanically more stable than extramedullary implants which facilitates early mobilization [7] they also require less surgical exposure leading to less blood loos, less chances of wound infection and short operating time [1, 2, 6, 7]. [figure 4]

Objective of this series is to study the functional outcome of patients with Reverse oblique & Sub trochanteric proximal femoral fractures treated with long proximal femoral nail.

2. Material and methods

In this prospective study total 20 cases (8 Reverse oblique & 12 Sub trochanteric fractures) were treated with Long proximal femoral nail fixation in department of orthopaedics of RMC, Loni from year 2011 to 2016. Prior valid informed consent was taken from all patients

Patients from age of 18 years & above were included. Amongst them 2 females & 18 male cases were there. Youngest was of 26 years while oldest was 73 years of age. Road traffic accident was common mechanism of injury in young patients while it was domestic fall was in elderly

AO/ASIF classification was used. Medically unfit, terminally ill & patients not willing to participate in study were excluded.

Average duration between admission & operation was 8 days. Pre-operative upper tibial skeletal traction was given in 10 patients in whom there was delay in surgical intervention more than 8 days due socioeconomic & medical problems.

2.1 Surgical technique

All patients operated in supine position on traction table under spinal or general anesthesia. The affected limb was kept in an adducted position in order to make greater trochanter more prominent. Trunk of patient was pushed 10 to 15° to the contralateral side. Anatomical or near anatomical reduction was obtained under image intensifier control before introduction of guide wire. Adequacy of reduction was assessed by restoration of posteromedial cortex & Neck shaft angle to normal in both AP &Lateral view. 4 cases with long spiral fracture fragment in subtrochanteric & reverse oblique fractures required limited open reduction.

A 5 cm incision was taken from the tip of the greater trochanter proximally. The entry point is on the tip of the greater trochanter. A guide wire was passed through the tip of the trochanter distally. Reaming was done over the guide wire according to the planned nail. The nail of appropriate size (between 10 and 12 mm) and of adequate length (between 38 and 42 cm) was implanted manually. The nail is inserted, keeping the proximal holes of the nail parallel to the femoral neck [Figure 1, 6]. The reduction of the proximal femoral fracture was re-evaluated in AP and lateral views. Two parallel guide wires were passed. Inferior guide wire was placed above the calcar deep in subchondral bone. Strict parallel placement of guide wires was observed in both AP & Lateral view [figure 2, 3, 7]. Reaming over guide was done by step-drill and the cervical screw of 8.0 mm and the stabilizing screw of 6.4 mm were introduced depending upon the fracture configuration and the stability, the distal static and dynamic locking was done.

2.2 Post-operative protocol

As per pain tolerance active quadriceps strengthening exercises, knee mobilization was started by post op day 3 – 4. Intra venous antibiotics were administered for 5 days post operatively, Average duration of hospital stay was 21 days. Up to fracture union patients were followed at monthly interval after that every 3 months till completion of one year. At every visit AP & lateral view of affected thigh was taken. Partial weight bearing was allowed when bony trabeculae were seen across fracture site in both views (Average time 6 weeks). Full weight bearing was allowed only after complete fracture union clinically & radilogically. All patients completed their one year follow up

3. Results

All patients were evaluated by regular physical and radiographic examinations. Clinical and functional outcomes were assessed according to Harris hip score. Majority of cases were of right side (n=17). Closed reduction was obtained in 16 patients, while 4 cases with long spiral fracture fragment in subtrochanteric & reverse oblique fractures required limited open reduction. In all cases fracture united. Average fracture union time was 16 weeks (12-20 weeks) (figure 3). Superficial wound infection was seen in 2 patients which was treated with local antibiotics only. Delayed union was observed in two patients. There was no case of Non-union, malunion.

Nail breakage was seen in one case of subtrochanteric fracture undersized nail might be the reason but despite of nail breakage fracture united and patient had good range of motion so he refused revision surgery [Figure 8a,8b] [figure 9].

There was no case of Non-union, Z effect, AVN of femoral head seen in this series. Reverse Z effect was seen in 2 cases, shortening of 1 cm was observed in one patient but it did not affect the functions of patient. (Table 1)

Good to excellent result were seen in 18 cases, while fair & poor results were seen in one patients each as per Harris Hip Score (Table 2). (Figure 5)

Fig 1: Pre-operative X ray

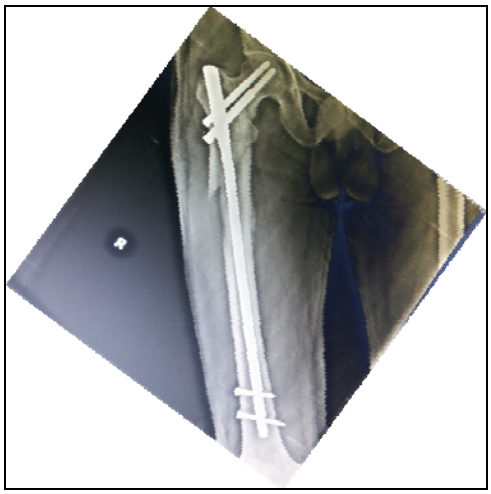

Fig 2: Post-operative X ray

Fig 3: fracture union

Fig 4: Scar photo

Fig 5: final range of motion

Fig 6: Reverse oblique fracture

Fig 8a: subtrochanteric fractures shattered walls during nail insertion

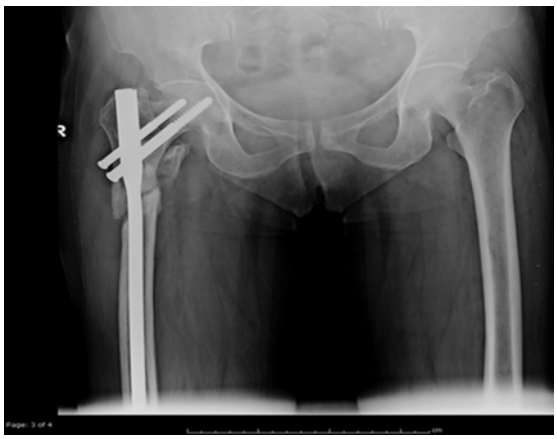

Fig 7: post-operative x ray

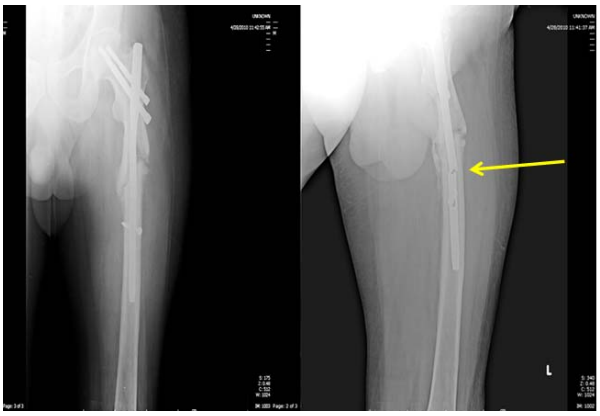

Fig 8b: Fracture union even In the presence of broken nail. Arrow is pointing towards broken nail

Fig 9: Good range of motion even in the presence of broken nail with fracture union, Patient refused revision surgery

Table 1

Number	Gender	Fracture type	Open / closed Reduction	Fracture healing time in weeks	Complications seen
1	M	Subtrochanteric	Closed	16	Nil
2	M	Subtrochanteric	Closed	16	Nil
3	M	Subtrochanteric	Open	20	Superficial wound infection
4	F	Reverse oblique	Closed	16	Nil
5	M	Subtrochanteric	Open	16	Nil
6	F	Subtrochanteric	Closed	16	Nil
7	M	Reverse oblique	Open	16	Reverse z effect
8	M	Subtrochanteric	Closed	12	Nil
9	M	Subtrochanteric	Closed	16	Nil
10	M	Reverse oblique	Closed	16	Nil
11	M	Subtrochanteric	Closed	12	Reverse z effect
12	M	Reverse oblique	Closed	12	1 cm shortening
13	M	Subtrochanteric	Closed	16	Nil
14	M	Subtrochanteric	Open	12	Nil
15	M	Reverse oblique	Closed	12	Nil
16	M	Subtrochanteric	Closed	16	Nil
17	M	Reverse oblique	Closed	16	Superficial wound infection
18	M	Subtrochanteric	Closed	20	Nil
19	M	Reverse oblique	Closed	12	Nil
20	M	Reverse oblique	Closed	20	Nail breakage

Table 2: Assessment by Harris Hip Score

Total Number Of Patients	Good – Excellent	Fair	Poor
20	18	1	1 Difficulty in cross leg sitting & squatting

4. Discussion

Trochanteric fractures are one of the major cause of morbidity & mortality specially in elderly [8]

Due to High velocity trauma subtrochanteric fractures are also getting common in young patient. Reverse oblique fractures have inherent instability, while in subtrochanteric fracture due to strong deforming forces of muscle there is always significant displacement at the same time it's difficult to obtain anatomical reduction [1,8,9]. Early stabilization of fracture & mobilization is key to success. Success of treatment depends not only upon stability of fixation but also on the degree of osteoporosis, fracture pattern [7].

Extramedullary implants are one of the preferred & time tested implants. DHS is familiar implant [10]. Extramedullary implants have disadvantages that they require larger surgical exposure, chances of blood loss are more [1, 7, 10] They are prone for fatigue failure specially in subtrochanteric & reverse oblique fracture considering their Load bearing nature as they have longer lever arm [5]. In these fractures in order to get stable fixation necessarily we have to use long DHS plate which requires large surgical exposure, more blood loss, and long operative time. Specially in subtrochanteric fractures deforming forces of adductors are very strong because of this there is lot of stress generated over DHS plate owing to its load bearing nature which can lead to implant failure [1, 5].

Intramedullary nails since they are placed close to mechanical axis they have short lever arm so they neutralize these deforming forces [1, 5, 11]. Recently introduced proximal femoral locking plate is also popular implant. But specially in subtrochanteric fractures with long oblique fragments it's difficult to be minimally invasive osteosynthesis [2]

Intramedullary implants are on the contrary are preferred over extramedullary implants because of following advantages – Minimally invasive, short lever arm, load sharing [1, 7]. Thus they can be considered as "biological internal fixation" [1], The recent development of reconstruction nail, which changes the direction of the proximal interlocking bolts, has greatly expanded the indication of intramedullary fixation for subtrochanteric fractures [12]. But it has entry portal through piriformis fossa. The surgical technique of guide wire and nail insertion through the fossa piriformis is much more difficult than that through the tip of trochanter [7]. There also exists the risk of split fracture of the femoral neck during the process of entry hole making, reaming, and nail insertion through the

fossa piriformis fossa [2]. It is also postulated that there can be damage to blood supply of femoral head due to pyriformis fossa entry portal [2].

To avoid these complications Gamma nail with provision of single cervical screw placement & entry portal through tip of trochanter was introduced. But it also has major disadvantages like fracture below the tip of nail, Joint penetration of cervical screw [2, 7].

Standard proximal femoral nail introduced by AO/ASIF in 1997 is not long enough for stable fixation in subtrochanteric fractures [1]. So Long PFN with entry portal through tip of grater trochanter is introduced which has following advantages – provision of Anti rotation screw along with load bearing screw proximally, variable length which can span fracture sufficiently, smaller shaft diameter, fluting tip reducing the possibility of fracture below the tip of nail, small valgus angle, higher level of distal locking hole positioning avoiding abrupt changes in stiffness of construct [1, 7]

But there are certain points which need to be emphasized about Long Proximal femoral nail - Prior to nail insertion Anatomical reduction is mandatory, Proper entry portal through the Tip of greater trochanter if entry is too lateral it can cause splintering of lateral cortex & implant may fail. Avoid fracture fixation in varus as it may exert excessive load on implant & Ideal screw placement [1, 8].

If the entry point shifted a little bit laterally, the lateral cortex of the greater trochanter could be easily shaved off during reaming of the femoral canal [1, 8]. On the other hand, if the entry point shifted medially, the awl might slip into the fossa piriformis. It is also postulated that entry of nail through pyriformis fossa might damage blood supply to femoral head leading to Avascular necrosis [2].

Time of partial weight & full weight bearing should be decided upon radiological evidence of fracture union preferably by 6 weeks as primary callus reduces stress on cervical screw [2].

In our series we have satisfactory results in both reverse oblique & subtrochanteric fractures treated with long proximal femoral nail fixation.

Thus considering results from our series long proximal femoral nail can be considered as reliable implant for fixation of subtrochanteric & reverse oblique fractures. However our series do have limitations like small sample size, short follow up period of one year, lack of comparison group.

5. Conclusion

Long PFN or long gamma nail can be considered as reliable implant for subtrochanteric & Reverse oblique fractures. However ideal implant for this fracture fixation is still awaited.

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