

How to Bail out of Trouble While Fixing Inter Trochanteric Femur Fractures using Proximal Femur Nail

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Abstract:

Background: Inter trochanteric fractures in elderly population with osteoporotic nature of bone are difficult to handle. Intra medullary fixation is ideal for these proximal femur fractures. PFN is a technically demanding surgery and outcome is affected by multiple factors which need to be closely monitored. A thorough knowledge of these guiding factors will improve the success rate and reduce complication. This study aims to identify those factors which have a say in the result of fracture management.

Patient and Methods: We here report a prospective observation study on patients with inter trochanteric fracture (stable and unstable) treated by proximal femur nail (PFN) and analyze the various factors and their influence on the functional outcome following surgery.

Results: As per Chang's reduction quality criteria (CRQC), excellent reduction (CRQC score 4) was observed in 33 (42.30%) patients, acceptable reduction (CRQC score 2, 3) in 38 (48.71%) patients and poor reduction (CRQC score 0,1) in 7 (8.97%) patients. The Harris Hip score recorded was found to be excellent in 37 (47.43%) patients, good or fair in 35 (44.87%) patients and poor in 6 (7.69%) patients.

Conclusion: PFN is a useful tool for management of these proximal femur fractures provided we acknowledge and consider factors known to affect the success of surgery.

Keywords: Cal Tip apex distance, Chang's reduction quality criteria, Harris Hip score, neutral variance, Parker's ratio.

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Introduction

Inter trochanteric fractures are common in elderly population and are challenging to treat. Surgical management of these fractures is preferred over conservative treatment in view of early return of function and reduced incidence of complications which is possible through strong internal fixation device [1].

Near anatomical reduction and optimum implant placement are crucial for determining the outcome and complication rate. Proximal femur nailing (PFN) is a commonly employed method for fixation of inter-trochanteric fractures [2]. PFN offers good stability owing to its consistency with anatomical shape of femur [3]. Cochrane data base proposes the use of intra medullary nail over dy-

namic hip screw in management of both stable and unstable inter trochanteric fractures [4,5]. These fractures are associated with poor functional outcome despite high union rates [6]. Osteoporotic nature of bone in elderly can lead to increased failure rate with more chance of complications and poor outcome [7,8]. To overcome the existing pitfalls leading to implant failure, it is important to understand the role of various parameters which influence or predict the outcome in unstable inter-trochanteric fractures. We here present a prospective case series of inter trochanteric fractures treated by PFN, analyzing the various parameters (clinical and radiological) and their role in predicting the outcome.

Patients and Method

A prospective observational study was carried out on 78 patients with inter trochanteric fractures of femur managed with proximal femur nailing. All patients with inter trochanteric fracture pattern admitted to our institute between August 2021 to Sept 2023 and consented for the procedure were included in the study. The study was approved by the institutional ethics committee. Informed written consent was taken from all the patients included in the study. Patients with pathological fractures, delayed presentation beyond three weeks after injury were excluded from the study.

Pre-operative evaluation included thorough history taking and clinical examination. Radiological evaluation was done to determine the fracture pattern and rule out other injuries. Routine blood investigation necessary for pre-operative anaesthetic clearance were done.

All patients were operated under spinal or epidural anaesthesia. Patients were positioned in supine position on traction table with reduction confirmed under c arm guidance prior to scrubbing and draping of the patient. All the surgeries were performed

by one of the two qualified orthopaedic surgeons with more than ten years of experience in handling of complicated trauma related to inter trochanteric fractures. Local PFN system with proximal 8 mm hip screw and 6.4mm derotation screw and two slots for distal locking screws were used.

Intra operative details like type of reduction method (closed, percutaneous or open), blood loss and duration of surgery were noted and analyzed in relation to outcome. Radiological parameters like entry point, reduction variance (negative, neutral and positive beak), anterior cortical alignment, position (Parker's ratio) and length of hip pin, length of de rotation screw, position of proximal tip of nail and other factors related to difficult reduction or failure of procedure were noted and analyzed.

Post-operative radiological analysis (Fig 1) included assessment of post reduction measurements like calcar tip apex distance, Parker's ratio and Chang's reduction quality criteria (CRQC) in relation to their effect on the outcome of surgery. All the measurements were made on the antero-posterior and lateral view of hip. Pre and post-operative radiographs of patients were taken in 15° of internal rotation for AP view and cross table position for lateral view.

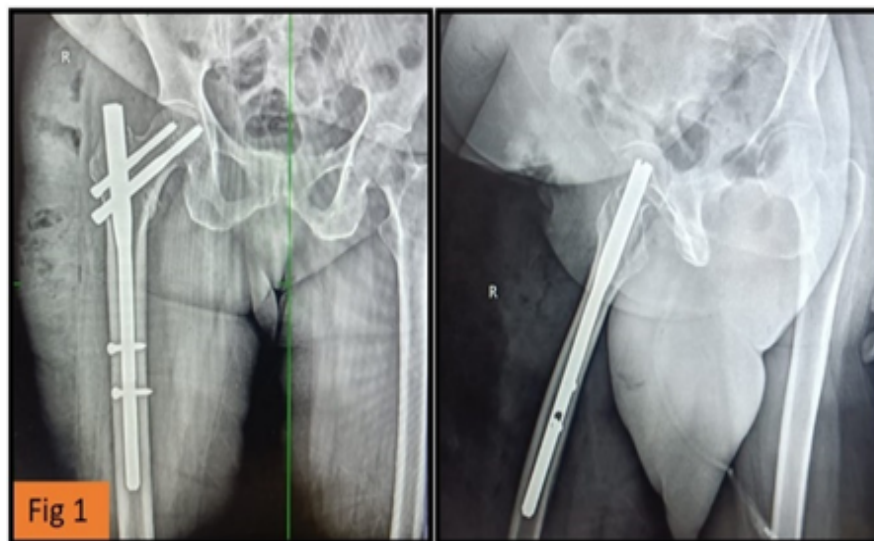


Figure 1: post-operative radiograph showing well reduced inter trochanteric fracture of femur with neutral variance in antero posterior view and good cortical alignment in lateral view.

IV antibiotics were started on the day of surgery and continued for three days. Post-operative day one protocol included active toe movements with pain permitted motion of hip and knee joints. Suture removal was done on the 10th day. Weight bearing was allowed between third to sixth week depending on the fracture pattern, reduction quality and overall general status of the patient. Clinical and functional evaluation of the patients was done at six months and one year follow up period using Harris hip score, Chang's reduction quality criteria.

Results

A total of 85 patients were initially enrolled for the study. 3 patients were lost in follow up and 4 patients expired during follow up period. 78 patients were successfully followed up for one year and their results are enumerated.

The mean age of the study was 57.87 ± 12.32 years. 56 (71.79%) of the total patients were male and 22 (28.20%) were females. Right side was

involved in 47(60.25%) patients and left side in 31(39.75%) patients. Road traffic accident was the most common mode of injury followed by accidental skid and fall.

Mean duration of presentation to the hospital following injury was within three days with a median of day one after injury. Patients were operated between three to seven days of admission based on their co morbidities, fitness for surgery, use of anticoagulant therapy and haemoglobin status demanding pre-operative blood transfusions. In 42 (53.84%) patients closed manipulation was enough to attain reduction. In 17(21.79%) patients percutaneous mode of reduction was needed to achieve fracture fragments alignment. In the remaining 19 (24.35%) patients open reduction was necessary which was attempted after two failed closed and percutaneous reduction attempts. Entry point was found to be medial to tip of greater trochanter in 56 (71.79%) patients, through the piriform fossa in 18 (23.07%) subjects and at the tip in 4 (5.12%) patients. Neutral variance was achieved in 44 (56.41%) patients, positive beak in 29 (37.17%) patients and negative beak in 5 (6.41%) patients.

Parkers ratio of <0.33 (inferior quadrant in AP view and posterior quadrant in lateral view) was observed in 63 (80.76%) patients. Parkers ratio of 0.34-0.66 (central quadrant) was observed in 15 (19.23%) patients. A standard 8mm hip screw and 6.4mm derotation screws were used in all patients. Screws were put simultaneously to avoid rotation of femoral neck and loss of reduction. 80 mm hip screw in 13 patients, 85 mm in 17 patients, 90 mm in 32 patients and 95 mm in 16 patients. A 15mm difference between two screws was followed in all patients. Derotation screw could not be applied in two patients.

Greater trochanter orthogonal line (GTOL) was drawn from the tip to GT parallel to the horizontal of femoral head to divide the head in four quadrants. Retainment of the relation between the centre of the femoral head and tip of nail can be assessed using this line. GTOL was observed to pass through second quadrant in 64 (82.05%) patients and through first quadrant in the remaining 14 (17.94%) patients.

The mean neck shaft angle was $131^{\circ} \pm 2.63^{\circ}$. The mean neck length reconstructed was 55.3 ± 3.87 mm. The mean reduction in horizontal offset achieved was 2.06 ± 1.74 mm. The mean Cal TAD was 21.3 ± 2.73 mm. As per Chang's reduction quality criteria (CRQC), excellent reduction (CRQC score 4) was observed in 33 (42.30%) patients, acceptable (CRQC score 2, 3) in 38

(48.71%) patients and poor (CRQC score 0,1) in 7 (8.97%) patients. The Harris Hip score recorded was found to be excellent in 37 (47.43%) patients, good or fair in 35 (44.87%) patients and poor in 6 (7.69%) patients. There was difficulty in attaining reduction leading to placement of only single screw in two patients. Difficulties like lateral wall collapse, split of GT or comminution was seen in 27 subjects. Lateral thigh pain was reported in 4 patients, abductor lurch in 11 patients, Z effect in 4 patients, screw cut out in 2 patients and implant removal was necessary in three patients.

Discussion

A total of 78 patients with inter trochanteric fractures were treated with PFN and followed up for one year. Intra operative and post-operative parameter were analysed with the view to determine their role in predicting the outcome, functional status and the possibility of an impending failure and need for revision or implant removal.

Use of intra medullary devices like PFN in management of inter trochanteric fractures allows early weight bearing and prevents excess collapse due to their load sharing nature [9]. Some the noted complications related to implant include fracture of lateral wall, Z and reverse Z effect, lateral protrusion and cut through of screw [10]. Lateral wall is one of the main predictor of revision surgery in these patients [11]. PFN can compensate for the postero-medial defect in the wall but fails to add stability to the lateral side. Fogagnolo et al reported a 23.4% complication rate with use of PFN for unstable inter trochanteric fractures [12]. Alexa and Cozma et al in their study suggested the use of bone cement to augment the screw fixation in patients with poor quality of bone [13].

Initial closed reduction was achieved using traction table in 42 subjects. Percutaneous reduction was needed in 17 patients and was achieved with the use of K wire or Steinmann pin. It is necessary to attain reduction through one of these techniques prior to placement of the nail. Jain et al study stresses the role of provisional fixation to avoid varus reduction, proper nail entry point and lag screw placement [14].

Once reduction was achieved through Steinmann pin, provisional fixation was done with help of two K wires passed through anterior part of femoral neck. Confirmation of variance and anterior cortex alignment on both AP and lateral view is done prior to provisional fixation. Lesser trochanter may be left alone if proper alignment of beak (neutral variance) is achieved (Fig 2).

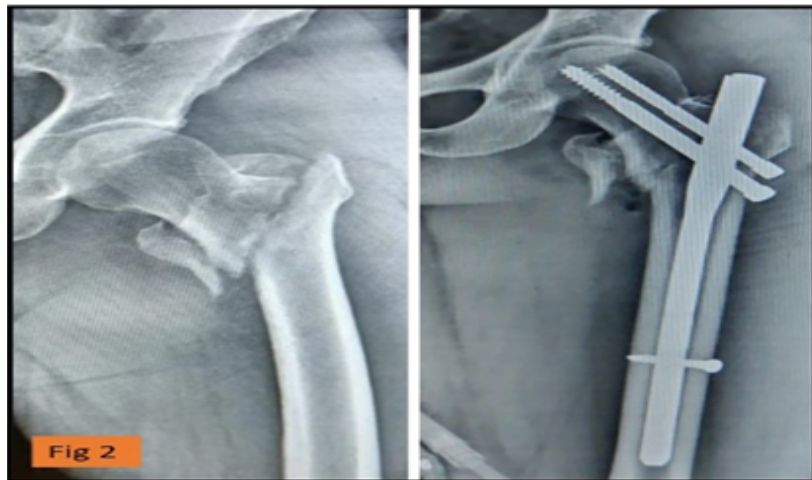


Figure 2: post-operative radiograph showing proper alignment of medial cortex of femoral neck and shaft which allows the lesser trochanter left alone.

Entry point of the nail has a role in deciding the reduction maintenance (Fig 3). A lateral entry point will lead to less or no lateral support leading to varus collapse and lack of space to accommodate two screws or improper placement of screws. A medial entry point in GT comminution allows more cortical hold. In our study complication were more associated with lateral entry point either through to tip of GT or lateral to it than in the medial side of GT and piriform fossa as demonstrated in study by Shivshankar et al [15].

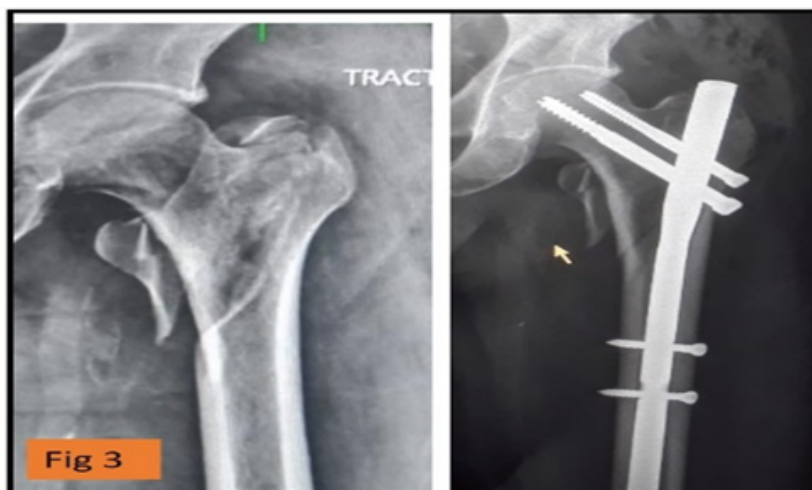


Figure 3: Immediate post-operative radiograph used to assess various parameters known to effect outcome

GTOL in second quadrant, Parker's ration less than 0.33, neutral variance, nail tip left proud, entry point through the tip, Cal TAP maintained, both screw lengths of appropriate length would lead to good outcome and complication like avoid Z effect.

Superior placement of screw was associated with more varus position and alteration of the neck shaft angle in the undesired plane as indicated by Parker's ratio. Murena et al. in their study highlighted the role of Parkers ration and neck shaft angle in determining the quality of reduction

[16,17]. Morihara et al stated that difference in the lengths of the two screws influences the mechanical complications like Z effect and screw cut out and that this can be reduced by maintaining a minimum of 15mm difference between the derotation screw and main hip screw [18].

Negative variance was observed in fracture patterns with more postero-medial comminution (Fig 4). Neutral and positive variances were associated with better outcome and near normal neck shaft angle retainment.

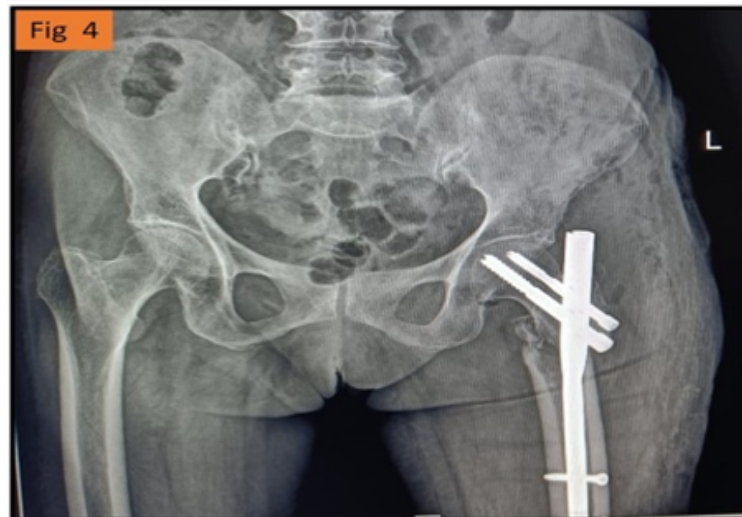


Figure 4: In this patient improper reduction and chance of implant failure can be predicted based on the negative variance noticed in the immediate post-operative radiograph.

Antapur and Prakash et al recommended the use of GT tip as a reference point for restoring the centre of femoral head [19].

Anterior thigh pain in some patients may be attributed to the anterior bow mismatch with the nail leading to impingement of the anterior cortex. In two patients only a single screw was placed due to lack of room for second screw (Fig 5). This was due to the poor quality of reduction associated with lateral wall comminution. Chandak et al in their

study proposed a method involving release of iliopsoas to maintain valgus reduction [20]. Use of percutaneous and open method of reduction helped to reduce the volume of patients with poor reduction.

Good quality of reduction and proper placement of screws allows better restoration of neck shaft angle. Release of traction prior to complete fixation of screws helps to reduce the post-operative collapse in neck length during weight bearing.



Figure 5: Only a single screw was placed due to lack of room to accommodate the second screw due to lateral wall comminution. Screw back out over course of time due to poor purchase and placement of screw in superior quadrant of femur head.

The functional outcome assessed using HHS was directly related to the pre-operative fracture status and quality of reduction attained (CRQC criteria). This relation was found to be statistically significant.

Detailed analysis of various parameters pointed towards features like good quality of reduction, neutral or positive variance, entry point medial to

GT, proper anterior cortical alignment, Parker's ratio <0.33 , inferior or central position if screw as reliable predictors of reasonably good functional outcome following management with PFN.

Limitations of the study include small sample size, single centre nature of the study, involvement of two different qualified surgeons in performance of surgeries, functional assessment with components

of subjective interpretation and loss of patients during follow up.

Conclusion

Trochanteric fractures in elder patients where osteoporotic quality of bone is a common occurrence need proper surgical management.

PFN is a useful implant which does not aid in reduction of the fracture. Hence it is vital to follow certain parameters which guide the surgeon in attaining reduction which allows better functional outcome.

Non varus, neutral or positive variance reduction, proper nail entry point and anterior cortical alignment, placement of screw in inferior quadrant and reduction maneuvers like percutaneous use of K wires or Steinmann pin help to reduce the fracture and produce a biomechanically stable construct with less complication rate and better functional outcome.

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