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Functional outcome of intertrochanteric fractures treated with proximal femoral nailing and role of tip apex distance: A retrospective study

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Abstract

Background: Intertrochanteric fractures of femur are one of the most commonly encountered fractures in day today orthopaedic practice. Since the introduction of proximal femoral nail, it has become an implant of choice for fixation of intertrochanteric fractures owing to their better outcomes with stable fixation and rotational stability in unstable fractures. The role of Tip-Apex Distance was clearly established with the Dynamic Hip Screw but there was inadequate data to establish the same with the use of a Proximal Femur Nail.

Aims: To determine the role of tip apex distance and evaluate the functional outcome of intertrochanteric fractures treated with proximal femoral nailing.

Methods: A Retrospective study of 60 patients who had intertrochanteric fractures treated with the PFN between December 2016 and December 2019. Post-operative radiographs of the affected hip in AP and Lateral view were taken and the Tip-Apex Distance was calculated in both the views by measuring the distance from the tip of the lag screw to the apex of the femoral head.

Result: The Average Tip-Apex Distance was found to be 23.5mm ranging between 19 mm to 28 mm. It was noted that 6 patients had a Tip-Apex Distance of more than 25 mm and 2 patients had a Tip-Apex Distance of less than 19 mm.

Conclusion: We conclude that a Tip-Apex Distance of ≤ 25 mm has a better predictive value in determining the outcome of intertrochanteric fractures treated with proximal femoral nailing.

Keywords: Intertrochanteric fractures, proximal femur nail, PFN, tip-apex distance

Introduction

Intertrochanteric fractures of femur are one of the most commonly encountered fractures in day today orthopaedic practice. The established benefits of internal fixation of intertrochanteric fractures are immediate pain relief, rapid mobilization, accelerated rehabilitation, maintenance of independent living [1]. Since the introduction of proximal femoral nail, it has become an implant of choice for fixation of intertrochanteric fractures owing to their better outcomes with stable fixation and rotational stability in unstable fractures [2]. The reduction criteria for stable fixation is determined by posterior-medial cortex support, tip apex distance and restoration of neck shaft angle. Tip apex distance plays an important role in determining the success of surgery [3,4].

Cut out of the screw from the femoral head has been reported as one of the most serious perioperative complications following internal fixation of intertrochanteric fractures, with an estimated prevalence of 1.9% to 3.2% [5, 6]. Cut out of the screw from the femoral head is defined as "the collapse of the neck-shaft angle into varus, leading to extrusion, or so-called cut out, of the screw from the femoral head," which needs to be addressed with reoperation under general anesthesia.

The role of tip apex distance is clearly established with respect to dynamic hip screw (DHS) by various studies done earlier. It was observed that a large number of these cut-outs was relative, and that a bimodal distribution was seen in the failures occurring as a result of differences in the tip-apex distance in the failures showed a bimodal distribution, unlike that which was previously seen with the use of the dynamic hip screw. Tip-apex distance (TAD), which

represents both the position and depth of a screw in the femoral neck and head, has been shown to be an accurate predictor of lag screw cut-out in sliding hip screw [7]. It was proposed placement too close to the subchondral bone could lead to cut-out through the head. There are only few studies done till date to find out the relationship between tip apex distance of proximal femoral nail and functional outcomes. The parameters that were restored during surgery are quality of fracture reduction, stability of fixation, calcar reduction and correction of varus deformity, posterior sag and excessive internal rotation and limb length discrepancy.

Aims and Objectives

To determine the role of tip apex distance and evaluate the functional outcome of intertrochanteric fractures treated with proximal femoral nailing.

Materials and Methods

This is a Retrospective study, done at R.L. Jalappa Hospital attached to Sri Devaraj Urs Medical College, Tamaka, Kolar of 60 patients who had intertrochanteric fractures treated with the PFN between December 2016 and June 2020 weretaken for this study. Post-operative radiographs of the affected hip in AP and Lateral view were taken and the Tip-Apex Distance was calculated in both the views by measuring the distance from the tip of the lag screw to the apex of the femoral head.

Following measurements were made on the immediate post op radiographs in AP and Lateral views

- A. Centre point of a line at the junction of head and neck was marked
- B. Straight line along the axis of femoral head through the centre point was drawn
- C. The distance from tip of lag screw to centre point at the head – the tip apex distance line



Intertrochanteric fractures are classified based on Boyd and Griffin classification

- Type 1- Fracture that extend along intertrochanteric line
- Type 2- Communited fracture with main fracture line along intertrochanteric line with multiple secondary fracture lines
- Type 3- Fractures that extend to or distal to lesser trochanter
- Type 4- Fractures of the trochanteric region and proximal shaft with fractures in at least two planes.

Inclusion criteria

Intertrochanteric fractures of Boyd and Griffin type 1 and 2. IT fractures treated with short proximal femoral nailing.

Exclusion criteria

- Open fractures
- Patients with associated medical illness
- Boyd and griffin type 3 and 4 fractures.

Methodology

Retrospective and Hospital-based study of 60 cases of Intertrochanteric fractures surgically managed by proximal femoral nailing procedure satisfying inclusion criteria were included in the study

Clinically, functional outcome was evaluated using Harris hip score at one year post surgery.

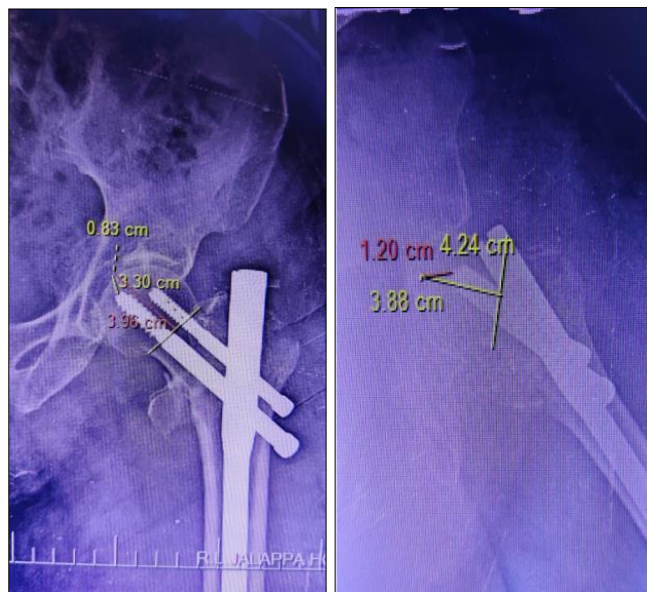


Fig 1: Measurement of tip-apex distance in radiograph of hip joint – AP and Lateral view

Results

In this study we found that most of the patients belonged to the age group between 56 to 88 years average age was 72 years. It was also found that males were more predisposed to intertrochanteric fractures than females. In our study we also observed that left hip (58.3%) was more affected than the right hip (41.7%). The mode of injury was reported most commonly due to road traffic accidents (93.3%) and rest occurring as a result of trivial fall (6.7 %). The Average Tip-Apex Distance was found to be 23.5mm ranging between 19 mm to 28 mm. It was noted that 6 patients had a Tip-Apex Distance of more than 25 mm and 2 patients had a Tip-Apex

Distance of less than 19 mm. The average time of union was noted to be 17 months ranging between 15 to 19 months. Complications such as screw cut out was observed in 3 patients, varus collapse in 3 patients and Z- Effect in 2 patients. Two patients had loss of follow up and there were no case of any infections and mal-union observed. The functional outcome at 1-yearpost-operative was calculated using Harris Hip Score and it was observed that 14 patients had excellent results (avg. TAD 23.1mm) and 43 patients had good results (avg. TAD 23.6mm). Of the remaining, 2 had moderate (avg TAD 25.2 mm) and 1 had poor result of which the mean tip apex distance was avg. 27.9 mm. A total of 38 patients had type 1 Boyd and Griffin fracture and 22 patients had type 2 fracture.

Table 1: Descriptive data

Parameter	Frequency (%)
Age categories	
29 – 50 years	4 (6.7%)
51 – 60 years	16 (26.7%)
61 – 70 years	17 (28.3%)
71 – 80 years	18 (30.0%)
81 – 92 years	5 (8.3%)
Gender	
Male	35 (58.3%)
Female	25 (41.7%)
Side of injury	
Left side	35 (58.3%)
Right side	25 (41.7%)
Mode of injury	
Trivial fall	4 (6.7%)
RTA	56 (93.3%)
HHS categories	
Poor (<70)	1 (1.7%)
Fair (71 – 80)	5 (8.3%)
Good (81 – 90)	41 (68.3%)
Excellent (91 – 100)	13 (21.7%)
Mean (SD) TAD	23.68 (2.04)

Table 2: Mean TAD values across four categories of HHS

Parameters	HHS - Poor	HHS - Fair	HHS - Good	HHS - Excellent
Mean age (In years)	55.0 (0)	68.6 (9.8)	67.9 (10.4)	66.5 (13.8)
Male	0	4 (11.4%)	25 (71.4%)	6 (17.1%)
Female	1 (4.0%)	1 (4.0%)	16 (64.0%)	7 (28.0%)
Mean TAD (AP)	14.8 (0)	13.4 (1.4)	12.7 (1.3)	12.4 (0.5)
Mean TAD (LAT)	13.1 (0)	11.8 (1.6)	10.9 (1.2)	10.7 (0.6)
Mean TAD (AVG)	27.9 (0)	25.2 (3.0)	23.6 (2.1)	23.1 (0.8)

Discussion

With the rise in an aging population and a limited amount of healthcare resources in the foreseeable future, it will be increasingly important to find ways to avoid complications when treating hip fractures. This cohort of patients is exceedingly fragile as evidenced by the occurrence of the fracture itself. Most of these patients will be unable to endure a second operation, let alone tolerate prolonged physical therapy. They will probably be placed into another rehabilitation institution for an extended period of time and face the problems associated with being placed out of the home environment after a secondary reconstructive procedure.⁸Even after one operation, the one-year mortality rate after a hip fracture is alarmingly high at 25%.

Baumgartner et al., in his initial landmark report documenting the ideal position of the lag screw in the centre-centre position, showed a small cohort of patients who were treated using a cephalomedullary implant. Other studies have

compared the IM devices versus traditional Sliding hip screw [7]. However, our literature review found no studies that specifically evaluated the lag screw cut-out rate using cephalomedullary implants.

The major disadvantages of this study are the retrospective nature and the difficulty we experienced trying to increase the follow-up data pool of patients. The investigation does, however, provide valuable analysis of this extremely common and likely increasingly needed surgical procedure.

In conclusion, IT fractures surgically fixed with TAD <25 mm in this study had better functional outcome. It stresses the importance of accurate surgical technique in the prevention of extremely unfortunate situations where revision fixation may be needed. As noted, it is probably exacerbated by the poor bone quality in the region surrounding the lag screw postoperatively and patients who have significantly comminuted intertrochanteric fractures may be more prone to IM device cut-out.

The unstable intertrochanteric femur fractures in elderly with osteoporosis need early fixation and mobilization to prevent morbidity and mortality. The intramedullary device has many advantages in terms of small surgical wound, easy implant insertion and stable fixation. According to the reduction criteria modified by Baumgaetner, most unstable fractures (31.A2-3) could only be achieved 'acceptable' reduction grade, i.e. good alignment. For these fractures, the Garden's alignments and anteromedial contact between the femoral head-neck and shaft fragments are extremely important [9]. Fujii T *et al.* [10] in their study of 56 female patients operated for intertrochanteric fractures concluded that Tip-Apex Distance is one of the most important parameters to predict screw cut out. They also concluded that a Tip-Apex distance of ≥ 20 mm was more prone for screw cut outs. Nikoloski *et al.* [11] in their retrospective study of 188 patients reported that a Tip-Apex Distance of ≤ 20 mm could lead to axial screw cut out. Geller JA *et al.* [12] concluded that a Tip-Apex Distance of ≤ 25 mm should be achieved as the possibility of screw cut out with Tip-Apex Distance of ≥ 25 mm is very high. Mallya *et al.* [2] also concluded that a Tip-Apex Distance of < 25 mm was essential for good functional outcome following fixation of intertrochanteric fractures with intramedullary devices. Sharma V [13] in his study of 124 patients of intertrochanteric fracture treated with intramedullary devices reported no cut out in patients with a Tip-Apex distance of < 25 mm. The study also reported a 33.3% increase in incidence of screw cut out if the Tip-Apex Distance was between 25-30 mm and a 78.2% increase in the incidence if the Tip-Apex distance was > 30 mm.

Conclusion

We conclude that a Tip-Apex Distance of ≤ 25 MM has a better predictive value in determining the outcome of intertrochanteric fracture treated with proximal femoral nailing.

The Functional Outcome was found to be excellent in cases with Tip-Apex Distance of < 25 mm and found to have less than excellent results when < 20 mm and > 25 mm with poor results if Tip Apex Distance was > 25 mm.

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