Hong Kong Journal of Orthopaedic Research
(An Open Access Journal for Orthopedics and Trauma Research)

Research Article

Hong Kong J Orthop Res
ISSN (e): 2663-8231
ISSN (p): 2663-8223
2020; 3(3): 60-62
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Outcome of Intertrochanteric Fractures Treated with Proximal Femoral Nail Antirotation (PFNA)

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Abstract

Background: The superiority of PFN (Proximal Femoral Nail) in treatment of intertrochanteric fractures of the hip are well documented but there is no well documented evidence regarding the superiority of PFNA (Proximal Femoral Nail Antirotation). The design of PFNA reduces bone loss and subsequently improves fracture fixation & union. **Aims & Objectives: i)** To evaluate the outcome of intertrochanteric fractures treated with PFNA. **ii)** To study the complications associated with the procedure and implant. **iii)** To compare with well-established studies in literature. **Study Design:** Prospective Observational Study. **Setting:** Department of Orthopaedics, Rajawadi Municipal Hospital, Mumbai. **Materials & Methods:** Total 70 cases of Intertrochanteric fracture satisfying inclusion and exclusion criteria were treated with PFNA from August 2017 to August 2018. The minimum follow up period was 1 year and maximum follow up was for 2 years. Patients were assessed for functional capacity and radiological fracture healing at each follow up. Harris Hip score was used to evaluate functional outcome. **Statistics:** 22 patients were males and 48 were females. The patient's age ranged from 40 to 94 years with a mean of 75 years. 32 fractures involved the right side and 38 involved the left side. Of the 70 fractures 14 were AO 31A1, 50 were AO 31A2, 6 was AO 31A3. The length of the nail was 170mm in all of the cases. Most commonly used blade was 95mm. The operative time ranged from 30 min to 100 min with an average of 44 min. Average blood loss was 82 ml. **Results:** Of 70 patients, 66 Patients (94%) showed radiological union by 3months. Average time for union was 3 months. 2 patients had non-union at the end of 1 year of follow up. No patients had infection or cut out of the blade. 8 patients had migration of the blade. 2 patients had varus collapse. No fractures below the tip of the nail were seen during the follow-up period. Outcome was assessed using Harris Hip Score. **Conclusions:** Based on our observations we hereby conclude that in intertrochanteric fractures treated with PFNA, we found excellent outcomes with high union rates & very few complications. A randomized trial comparing the PFNA with other devices in elderly patients will probably be required for definitive assessment.

Keywords: Intertrochanteric fractures, Hip fractures, Proximal Femoral Nail, Blade Migration, PFNA.

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INTRODUCTION

Intertrochanteric fracture is the most common fractures of the hip especially in the elderly. Stable internal fixation as early as possible is integral to the union of trochanteric fractures. In the treatment of these fractures factors under the control of the surgeon are good reduction, proper choice of implant & proper surgical technique. Factors such as fracture geometry and stability, bone quality and comminution are beyond the control of the surgeon. The surgical management of trochanteric fractures has evolved over the past two decades. The biomechanical advantages of intramedullary implants make gamma nail and proximal femur nail (PFN) an attractive option especially in unstable fractures. Initial reports have suggested that intramedullary nails may have an advantage over sideplate devices in unstable fractures but have not demonstrated a clear superiority and have a reported complication rate of around 20%. Those devices have suffered cut-out, implant breakage, femoral shaft fractures and subsequent loss of reduction in the clinical practice. The proximal femoral nail anti-rotation (PFNA) system is a new device introduced by the AO/ASIF in 2003. These devices were developed to obtain better fixation strength in the presence of osteoporotic bone and consist of an intramedullary nail with a proximal angulation of 6 degrees that is available in short and long versions. The primary innovation of the proximal femoral nail antirotation (PFNA, AO/ASIF) design is the helical neck blade that reduces the risk of bone loss and offers improved purchase in the femoral head as a result of compaction of cancellous bone around the blade during insertion. Compaction of cancellous bone by the helical blade into the femoral head increases rotational stability of cervicocephalic fragments and decreases load on the femoral head.

Aims and Objectives

i) To evaluate the outcome of intertrochanteric fractures treated with PFNA

ii) To study the complications associated with the procedure and implant.

iii) To compare with well-established studies in literature

MATERIALS & METHODS

Total 70 cases of Intertrochanteric fracture satisfying inclusion and exclusion criteria were treated with PFNA in Rajawadi Hospital from August 2017 to August 2018. The minimum follow up period was 1 year and maximum follow up was for 2 years. Patients were assessed for functional capacity and radiological fracture healing at each follow up. All the fractures in this series were post-traumatic. Functional Outcome was evaluated using Harris Hip Score.

Inclusion Criteria

Independently mobile patients with isolated Intertrochanteric fracture

Exclusion Criteria

- Poly trauma patients
- Intertrochanteric fracture with Subtrochanteric extension
- Pathological fractures

Surgical Technique

Fractures were classified according to the AO-ASIF classification. The patient is positioned supine on the fracture table and fracture is reduced with longitudinal traction followed by internal rotation under fluoroscopy. 5 cm incision proximal from the tip of the greater trochanter is made and the gluteus medius is split in line with the fibres. The entry point is on the tip or slightly lateral to the tip of the greater trochanter in the AP View & in line with the axis of the intramedullary canal in the lateral view. The guide wire is inserted into the femoral shaft & the trochanter is reamed to open the medullary canal. We chose a nail with a neck-shaft angle of 130 degree. The nail is inserted manually to a depth that it will allow the blade to be placed through the middle of the femoral neck. The ideal position of the guide wire for the blade is in the centre of the neck in both AP and Lateral views. The guide wire is inserted subchondrally and a blade 10 mm shorter than the measurement is chosen. In a young patient the neck is drilled with the 11.0 mm reamer to make room for the helical blade. In the elderly, after the lateral cortex is opened with a drill the helical blade is inserted by hand over the guide wire without reaming preserving the bone stock. The blade is inserted over the guide wire with hammer blows & locked, locking is verified under fluoroscopy. Distal locking is done through aiming arm. Final check is done for fracture reduction, position of the blade, Tip Apex Distance. Wound is washed thoroughly and closed in layers. Immediate postoperative radiographs were evaluated for fracture reduction, tip apex distance (TAD) and position of the helical blade. Fracture reduction was classified as satisfactory and not satisfactory according to modified Baumgartner's criteria [1]. Helical blade position in the centre of the femoral head with a tip-apex distance of <25 mm was considered satisfactory. Blade position was classified unsatisfactory if these criteria were not met. Patients were mobilized full weight bearing from first postoperative day. Patients were followed up at 6 weeks, 3months, 6months and 1 year. Average follow up period was for 9 months. During follow up patients were assessed clinically, radiologically by x-rays and functionally by Harris Hip Score. Follow up radiographs were assessed for union, loss of reduction and fixation, helical blade sliding (measured using the technique described by Watanabe *et al*. [2], migration and cut out.

Statistical Analysis

22 patients were males and 48 were females. The patient's age ranged from 40 to 94 years with a mean of 75 years. 32 fractures involved the right side and 38 involved the left side. Of the 70 fractures 14 were AO 31A1, 50 were AO 31A2, 6 was AO 31A3. The length of the nail was 170mm in all of the cases. Most commonly used blade was 95mm. The operative time ranged from 30 min to 100 min with an average of 44 min (Table1). Average blood loss was 82 ml (Table 2).

Table 1: Surgical Time

Surgical Time	**Number**
30min	26
45min	26
60min	16
100min	2
Average time	**44mins**

Table 2: Blood Loss

Blood loss	**Number**
50ml	30
100ml	34
150ml	6
Average	**82ml**

RESULTS

Of 70 patients, 66 Patients (94%) showed radiological union by 3months. Average time for union was 3 months. 2 patients had non-union at the end of 1 year of follow up (Table 3) No patients had superficial or deep infection. No patient had cut out of the blade. 8 patients had migration of the blade (Table 4). 2 patients had prominent distal end of the blade which caused irritation of fascia lata which was symptomatic for which the blade was removed and patient recovered well. 4 patients had prominent distal end of the blade which was asymptomatic hence it was ignored. 2 patient had migration of the blade into the hip joint 6 months after surgery for which they underwent implant removal as the fracture had united. 2 patients had varus collapse (Table 5). No fractures below the tip of the nail were seen during the follow-up period. Outcome was assessed using Harris Hip Score (Table 6).

Table 3: Time for Radiological Union

Radiological union	**Number**
3 months	66
Not united	2
Nil	2

Table 4: Migration of Blade

Blade Migration	**No**
Yes	8
No	60
Nil	2

Table 5: Varus Collapse

Varus collapse	No
Yes	2
No	66
Nil	2

Table 6: Harris Hip Score

Harris Hip Score	No
Excellent	62
Good	4
Poor	2
Nil	2

DISCUSSION

The best treatment for intertrochanteric fracture remains controversial. Intramedullary devices are used widely because of their mechanical and biological advantages. The preference of intramedullary or extramedullary fixation is not answered by meta-analysis as it appears that the advantage of immediate postoperative full weight-bearing after intramedullary fixation compared to extramedullary fixation, is outweighed by the disadvantage of a higher number of reoperations due to technical problems accompanying nailing [3]. Currently available devices all have their own specific problems although one complication is common to all: the cut-out of the head/neck device possibly as the result of varus collapse and rotation of the proximal fragment in combination with a retroversion leading to protrusion of the purchase-seeking screw-type column-device through the antero-superior part of the femoral head [4]. The contact surface area between the device and the cancellous bone of the femoral head is achieved by replacing the collum screw with a helical blade. The helical blade also compresses the limited amount of bone rather than removing it and prevents rotation of the proximal fragment once firmly locked [5]. Biomechanical tests have demonstrated that the blade has a significantly higher cut-out resistance than screw systems [4]. The helical blade is inserted by impaction to achieve compaction of the cancellous bone surrounding the implant. This is believed to be superior biomechanically as compared with reaming of the neck–head fragment as reaming damages the trabecular bone crucial to provide fixation for the blade. Biomechanical studies have shown that the increased contact between the implant and the bone reduces varus displacement and cut out [4, 5]. In unstable fractures, poor reduction lead to unsatisfactory implant placement which resulted in higher complication rates. An unsatisfactory blade position was due to poor fracture reduction rather than fracture stability [6, 7]. A cut out rate of 0% in this study indicates an excellent outcome compared with the reported rates of 5.4 % with IM devices [7] Of the 8 patients with complications like migration of the blade (11%), 2 patients had cut through. The cut through as mentioned here, and as previously described by Simmermacher *et al*. [8] must be considered as a novel and separate mechanism of implant failure. In contrast to the anterior cranial cut out seen with devices based on screw fixation, the cut through is characterized by a central perforation of the spiral blade into the hip joint. The perforation occurs through the femoral head along the axis of insertion the blade. To reduce the rate of cut through, proper fracture reduction and optimal implant placement are crucial [6, 7] In our study 2 patients died (2.8%) within the first week postoperatively due to causes not related to the implant. In comparable studies systemic complications were found in up to 21% and a mortality not related to the implant was found in up to 27% [9, 10]. The average time of fracture union was 3 months in 94% cases and the reoperation rate was 5%. There were 4 reoperations in our series. 2 were for cut through of the helical blade for which the implant was removed. 2 were for lateral migration of the blade with symptomatic irritation of fascia lata for which only the blade was removed after which the patients became asymptomatic. All the complications noted in our study were in patients with unstable fractures. The outcome was measured at final follow up using Harris Hip score. It was excellent in 62 patients (88%), good in 4 patients (6%), and poor in 2 patients which is significant compared to other studies [11]. Poor Harris Hip scores were due to inadequate fracture reduction which resulted in poor implant placement and consequently varus collapse with non-union at the fracture site.

CONCLUSIONS

Based on our observations we hereby conclude that in intertrochanteric fractures treated with PFNA, we found excellent outcomes with high union rates & very few complications. A randomized trial comparing the PFNA with other devices in elderly patients will probably be required for definitive assessment. Attention to the above mentioned factors and improvement in the learning curve can play a significant role in improving outcome and reducing complications with osteosynthesis using PFNA.

Conflict of Interest: None

Authors Contribution

Dr Mohanrao Garabadi (Principal & Corresponding Author): Data Collection, Data Compilation, Preparation of Manuscript.
Dr. Amit Grover: Performed the scoring systems & worked on the statistics.

Acknowledgements: None

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