Original Article

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Prospective Analysis of Extracapsular Fractures of the Proximal Femur Treated with Proximal Femoral Nail

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Abstract

Introduction: Extracapsular fractures of the proximal femur occur as a result of high energy trauma in the younger population and in the elderly, due to a trivial fall in an osteoporotic bone. Most of the fractures are unstable and require anatomic reduction. Sliding compression screw systems have been in vogue for many years. However, in the recent years, intramedullary systems are gaining in popularity due to their several distinct advantages. The purpose of this study was to assess the outcome of these fractures treated with a proximal femoral nail (PFN).

Materials and Methods: The study group included 44 patients with intertrochanteric and subtrochanteric fractures. The fracture was reduced either by closed reduction or an open reduction. Each case was followed-up for a period of 2-year at periodic intervals. The Evans classification system was used for grading the fractures, and the Harris Hip score (HSS) was used to assess the functional outcome.

Results: The average age was 69 years. The average duration of the surgery was 55 min, and the blood loss was around 120 ml. The complication rate was minimal and included superficial infection, implant failure due to screw cut out and Z effect. Average duration for union was 16 weeks, and the fracture union rate was 98.5%. According to the HSS 75% achieved excellent results, and 20% showed good results and 5% exhibited poor results.

Conclusion: The PFN is an ideal implant in the treatment of suitable inter-trochanteric and subtrochanteric fractures. Its advantages include reduced operative time and blood loss, early return to daily activities, and a reduced complication rate.

Key words: Femur, Fracture, Intertrochanteric, Osteosynthesis, Subtrochanteric

INTRODUCTION

Extracapsular fractures (intertrochanteric and subtrochanteric fractures) of the proximal femur primarily involve the cortical and compact cancellous bone. Because of the complex stress configuration in this region and its nonhomogeneous osseous structure and geometry, fractures occur along the path of least resistance through the proximal femur.[1] Intertrochanteric fractures are the most common in elderly population accounting for 50% of total hip fractures, of which more than 50% are unstable.[2] The incidence has increased significantly in the recent years due to the advancing age of the population. In young individuals, the injury results from a high energy trauma, whereas in the elderly group, most of the fractures resulting from a trivial fall are because of osteoporosis.[3] Internal fixation is the treatment of choice for managing intertrochanteric fractures of the femur as most of these fractures are highly unstable. These are treated by various methods which include; the dynamic hip screw (DHS) - is the gold standard for intertrochanteric fractures.[4] Intramedullary devices such as the proximal femoral nail (PFN) are biomechanically stronger and more rigid compared to the extramedullary devices such as DHS. They allow earlier weight bearing and better rehabilitation. Therefore, the PFN has increasing popularity in the treatment of intertrochanteric fractures.[5]

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Purpose of the Study

The purpose of this study was to assess the outcome of inter and subtrochanteric fractures treated with PFN and to study the complications.

MATERIALS AND METHODS

44 consecutive patients with intertrochanteric and subtrochanteric fractures were considered for study in Sanjay Gandhi Institute of Trauma and Orthopedics, Bengaluru, Karnataka, India between August 2011 and November 2014. Inclusion criteria were patients older than 18 years, with closed inter-trochanteric fracture and subtrochanteric fractures, whereas exclusion criteria were age below 18 years and above 70 years, associated co-morbid conditions, and open and pathological fractures.

Pre-operative evaluation was done with local examination, assessment of associated injuries and general health and fitness for surgery. Standard radiographs like anteroposterior (AP) view of the pelvis with both hips lateral view of the injured hip, and a full-length AP and lateral view of the injured femur were obtained. Evans classification system was applied for evaluation of the fractures.

Operative Technique

All patients were positioned on the fracture table, and the fracture was reduced under fluoroscopy. If closed reduction failed, an open reduction was performed. Post-operative management included an immediate range of motion (ROM) exercises of the hip and knee joint along with toe touch walking on the 2nd post-operative day and weight bearing as tolerated by the patient in the non-comminuted fracture, whereas in a comminuted fracture, the patient was advised non-weight bearing mobilization for 3 weeks followed by partial weight bearing after confirming callous formation radiologically. Each case was followed-up for a period of 2 years and follow-up assessments were carried at 4 weeks, 8 weeks, 12 weeks, 6 months, and annually thereafter. The functional outcome was assessed with the Harris Hip score (HSS).[6] At each follow-up, ROM at the hip and knee joint, signs of infection local/deep, and any associated complaints were noted. Standard radiographs were taken to assess the position of the nail and screws, as well as callus formation, and any loss of reduction and angulation were noted.

RESULTS

Of the 44 patients, four were lost during follow-up and hence, excluded from the study. The average age was 69 years with a female preponderance (Figures 1 and 2).

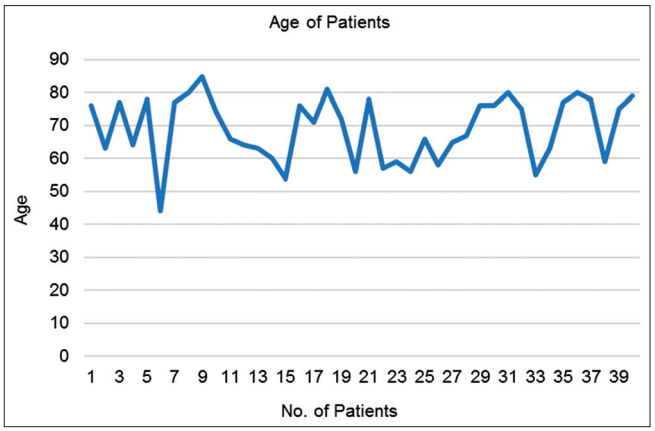

Figure 1: Distribution of patients based on age

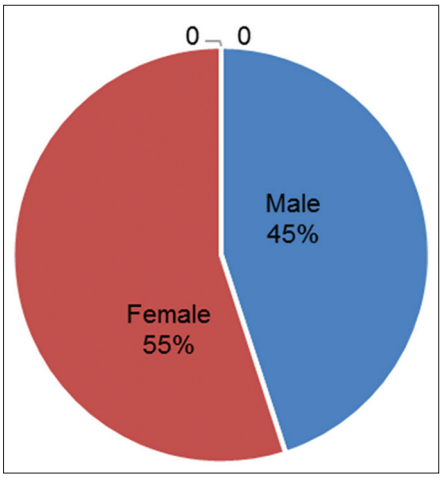

Figure 2: Sex distribution

The most common etiology was road traffic accident in younger patients and domestic fall in elderly patients. The average duration of the surgery was 55 min, and the blood loss was around 120 ml. The average incision size was 3 cm, and the average fluoroscopy time was 15 min. In four cases, as closed reduction was not achieved, an open reduction had to be performed. Superficial post-operative infection was seen in two cases which resolved with culture-specific antibiotics, and none of them developed deep infections requiring implant removal. Average duration for union was 16 weeks. One patient had implant failure due to Z affect which required revision surgery and bone grafting. During post-operative ambulation 20 cases (50%) gained pre-injury ambulatory status within 2 weeks, and another 20 cases (50%) gained in 8 weeks, and 4 cases had an abductor lurch. The HHS in 29 cases (72.5%) showed excellent results and seven cases (17.5%) showed good results, and two cases each (5%) showing fair and poor results (Figure 3).

DISCUSSION

PFN provides an intramedullary device inserted by means of a minimally invasive procedure which allows the surgeon

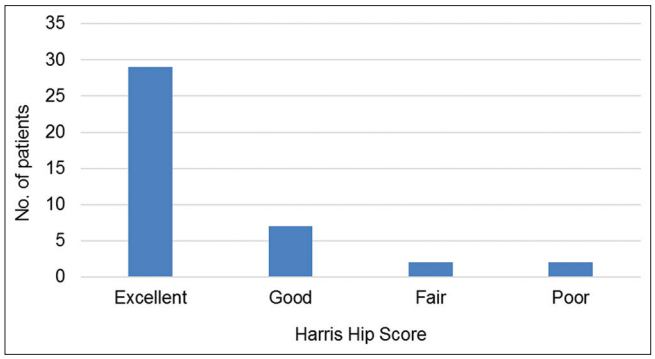

Figure 3: Distribution of cases based on Harris Hip score

to minimize soft tissue dissection, thereby reducing surgical trauma, blood loss and post-operative wound complications. It is best suited for the older patients.[7-9] Since the average age of the patient in the present series was 69 years, PFN is better implant to use for this age group.

The PFN itself serves as a buttress against lateral translation of the proximal fragment.[2] The intramedullary location of the junction between the nail and lag screw makes the implant stronger at resisting the binding force.[3] It has a reduced distance between the weight bearing axis and the implant leading to a shorter lever arm.[4] The PFN, like any other intramedullary device is a load sharing device, and bears the bending load which is transferred to the intramedullary nail and is resisted by its contact against the medullary canal.[5] The intramedullary hip screw is a more biological method of fixation. Götze *et al.*[10] compared the load bearing ability of osteosynthesis of unstable per- and subtrochanteric fractures and found that the PFN could bear the highest loads among all devices.

Friedl *et al.*[11] and Tyllianakis *et al.*[12] reported the need for open reduction in 8% and 6.66% cases in their respective series as closed reduction was not possible in a few unstable fractures. In this study, open reduction had to be performed in four cases (9%) as closed reduction was not achieved under fluoroscopy at the beginning of surgery.

Simmermacher *et al.*,[5] in a multicenter clinical study, reported technical failures of the PFN after poor reduction, malrotation or wrong choice of screws in 5% of the cases. A cut-out of the neck screw occurred in 0.6% cases. There was one case (4.4%) of implant failure in this study and reason for that was the occurrence of Z effect which required revision surgery. The Z effect refers to the movement of the hip pin toward the medial side into the hip joint with destruction of the cartilage of the joint. Menezes *et al.*[13] reported 3.45% of Z affect. Likewise, Boldin *et al.*[14] too reported a 7% failure rate.

The PFN has been shown to prevent femoral shaft fractures by having a smaller distal shaft diameter which reduces stress concentration at the tip.[5] However, Menezes *et al.*[13] reported 0.7% incidence of femoral shaft fractures. There were no cases of femoral shaft fracture in the current study.

The present study had a fracture union rate of 98.5%, and the results are similar to those of Tyllianakis *et al.*[12] and Boldin *et al.*[14] who had 97% and 100% union rates, respectively. The average operating time in this study was around 55 min, which is comparable to other studies. Pajarinen *et al.*[15] and Little *et al.*[16] reported operating times of 55 min and 54 min, respectively.

Pajarinen *et al.*[15] conducted a randomized study comparing the post-operative rehabilitation with the use of PFN and DHS, and concluded that PFN when used for trochanteric fracture have positive effect on speed of restoration of walking in comparison with DHS. During post-operative ambulation 20 of their cases (50%) gained pre-injury ambulatory status within 2 weeks, and another 20 cases (50%) gained in another 8 weeks; four cases had an abductor lurch. Kumar *et al.*[17] who compared the outcome of trochanteric fractures treated with DHS and PFN, had an average HSS of 97 in the PFN group at 2 years follow-up. In the present study, the average HSS was 91 at 2 years follow-up, and we had 72.5% excellent and 17.5% good results which are comparable to the results of Pajarinen *et al.* and Kumar *et al.* (Table 1).

Shortcomings of this study were a relatively lesser number of patients and a shorter follow-up. More comparative studies with other modalities of fixation are needed to establish the role of intramedullary devices in unstable intertrochanteric fractures of femur.

CONCLUSION

PFN is a useful device in the treatment of extracapsular fractures of the proximal femur (intertrochanteric and subtrochanteric fractures). It is a relatively easy procedure and a biomechanically stable construct which allows early weight bearing and helps in gaining pre-injury ambulatory status. The plate and screw device will weaken the bone mechanically. The common causes of fixation failure are instability of the fractures, osteoporosis, and the lack of anatomical reduction, failure of the fixation device and incorrect placement of the screw. At present, we consider that the PFN is a good minimally invasive implant for unstable proximal femoral fractures when closed reduction is possible.

In conclusion, the use of PFN for extracapsular fractures of the proximal femur has several distinct advantages, namely; lesser operative time with less operative blood loss, early return to daily activities, reduced complications like

Table 1: Comparison of few studies with our study

Name of the study	Number of cases	Implant used	Age	Blood loss (ml)	Operative time (min)	Complications
Pajarinen *et al.*	54	PFN	79	320	55	0
Little *et al.*	92	Holland Nail	83	78	54	5
Kumar *et al.*	25	PFN	63	100	55	0
Our series	40	PFN	69	120	48	3

PFN: Proximal femoral nail

infection, sliding, and limb length discrepancy. This study demonstrates that the PFN is more useful in unstable and reverse oblique patterns.

REFERENCES

1. Carter DR, Hayes WC. The compressive behavior of bone as a two-phase porous structure. J Bone Joint Surg Am 1977;59:954-62.
2. Falch JA, Ilebekk A, Slungaard U. Epidemiology of hip fractures in Norway. Acta Orthop Scand 1985;56:12-6.
3. Bucholz RW, Heckman JD, Court- Brown CM, Tornetta P III[rd]. Intertrochanteric fracture. In: Rockwood and Green's Fracture in Adults. 7[th] ed., Vol. 2. Lippincott Williams and Wilkins; 2006. p. 1597-640.
4. Kulkarni GS, Limaye R, Kulkarni M, Kulkarni S. Intertrochanteric fracture current concept review. Indian J Orthop 2006;40:16-23.
5. Simmermacher RK, Bosch AM, Van der Werken C. The AO/ASIF-proximal femoral nail (PFN): A new device for the treatment of unstable proximal femoral fractures. Injury 1999;30:327-32.
6. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: Treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am 1969;51:737-55.
7. Rosenblum SF, Zuckerman JD, Kummer FJ, Tam BS. A biomechanical evaluation of the Gamma nail. J Bone Joint Surg Br 1992;74:352-7.
8. Prinz S, Letsch R, Büscher D. Gamma-nagel und classic-nagel (intramedulläre stabilisierung) versus DHS (extramedulläre stabilisierung) beiproximalen femurfrakturen. Hefte Unfallchir 1996;262:14.
9. McKibbin B. The biology of fracture healing in long bones. J Bone Joint Surg Br 1978;60-B:150-62.
10. Götze B, Bonnaire F, Weise K, Friedl HP. Belastbarkeit von osteosynthesenbeiinstabilen per- und subtrochanteren femurfrakturen: Experimental leuntersuchungen mit PFN, Gamma-Nagel, DHS/Trochanter stabilisierungsplatte, 95 -Kondylenplatte und UFN/spiralklinge. Aktuelle Traumatol 1998;8:197-204.
11. Friedl W, Colombo-Benkmann M, Dockter S, Machens HG, Mieck U. Gamma nail osteosynthesis of per- and subtrochanteric femoral fractures 4 years experiences and their consequences for further implant development. Chirurg 1994;65:953-63.
12. Tyllianakis M, Panagopoulos A, Papadopoulos A, Papasimos S, Mousafiris K. Treatment of extracapsular hip fractures with the proximal femoral nail (PFN): Long term results in 45 patients. Acta Orthop Belg 2004;70:444-54.
13. Menezes DF, Gamulin A, Noesberger B. Is the proximal femoral nail a suitable implant for treatment of all trochanteric fractures? Clin Orthop Relat Res 2005;439:221-7.
14. Boldin C, Seibert FJ, Fankhauser F, Peicha G, Grechenig W, Szyszkowitz R. The proximal femoral nail (PFN) – A minimal invasive treatment of unstable proximal femoral fractures: A prospective study of 55 patients with a follow-up of 15 months. Acta Orthop Scand 2003;74:53-8.
15. Pajarinen J, Lindahl J, Michelsson O, Savolainen V, Hirvensalo E. Pertrochanteric femoral fractures treated with a dynamic hip screw or a proximal femoral nail. A randomised study comparing post-operative rehabilitation. J Bone Joint Surg Br 2005;87:76-81.
16. Little NJ, Verma V, Fernando C, Elliott DS, Khaleel A. A prospective trial comparing the Holland nail with the dynamic hip screw in the treatment of intertrochanteric fractures of the hip. J Bone Joint Surg Br 2008;90:1073-8.
17. Kumar R, Singh RN, Singh BN. Comparative prospective study of proximal femoral nail and dynamic hip screw in treatment of intertrochanteric fracture femur. J Clin Orthop Trauma 2012;3:28-36.

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