CASE SERIES

Evaluation of using PFN (proximal femoral nailing) in treatment of unstable intertrochanteric fractures in elderly patients

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Abstract

Intertrochanteric Fractures (ITF) are common among elderly age groups. Proximal Femoral Nail (PFN) is strong biomechanically in comparison with extra medullary device. The study was conducted at Al-Yarmouk Teaching Hospital & Iraqi Red Crescent Hospital, Baghdad, Iraq in the period 1st Jan 2017 to the 31st Dec 2019. In all 32 patients of age 50 years and above, the pre-operative and post-operative clinical and radiological evaluation, considering blood loss, operative time, fluoroscope time, time for union of the fracture, and post-operative complications were noted. Clinically the results were assessed by using Harris Hip score. The final results were found to be excellent in 21(65.6%), good in 7(21.8%), fair in 2(7%) and poor in 2(7%) patients. Radiological assessment showed 29 (90.6%) cases to have smooth union and 3 (9.4%) cases failure of fixation. The PFN is an appropriate device for unstable ITF of femur.

Keywords: Unstable intertrochanteric femur fracture, PFN, Elderly patients.

Introduction

The types of implants used for treatment of unstable intertrochanteric and sub trochanteric fractures of femur are variable and continue to increase in number.[1] PFN have been introduced relatively recently. The device was developed in 1996 for treatment of intertrochanteric fracture but has now replaced the traditional DHS. Intertrochanteric fracture of femur is more commonly encountered in elderly patients with osteoporosis and fixation of the fracture surgically has been the ideal and accepted method to achieve reduction and early mobilization. Studies have shown that using intramedullary nailing is one of the best options for surgical fixation and has better functional and clinical outcome when compared to other implants or arthroplasty.[2-4] In previous studies, the results gained with this implant had a varied outcome.[5,6] This may be related to many influencing factors like age, design of implant, type of fracture, reduction quality and fixation. The point of entry has a major impact in acceptable reduction, stability of fixation, and preventing complications related to implants.[7] One study has shown that a lateral entry point causes more damage to the tendon of the gluteus muscle during intramedullary nail insertion.[8] Intertrochanteric Femur fractures comprise of about approximately half of all hip fractures caused by mechanism of low energy force. These hip fractures are encountered in specific types of population having risk factors as old age, osteoporosis, female gender and history of fall.[9] Unstable intertrochanteric fractures are those with more than 50% of calcar affected (fragment lesser trochanter), reverse obliquity fracture or with a big posteromedial comminution of intertrochanteric region, fracture of greater trochanter and lateral cortex breach.[10] There are many different types of internal fixation used for treating these fractures. They are divided into two groups, some form of plating or some form of intramedullary fixation. PFN is a load-bearing device with rotational stability and short lever arm in addition to indirect fracture reduction.[11] In this case series, the role of proximal femoral nail in unstable intertrochanteric femur fracture has been discussed.

Case Series

A follow-up study on 32 elderly patients with unstable intertrochanteric fractures of femur operated with PFN at Al-yarmouk Hospital and Red Crescent Hospital in Baghdad with follow up of 6-12 months. (20 patients were seen at in Al-yarmouk Hospital and 12 patients in Red Crescent Hospital).

Twenty nine patients were above 50 years of age with 3 patients being below 50 years. All had proximal femur fractures and were admitted in the tertiary care centers after meeting the inclusion and the exclusion criteria. Patients were regularly followed up radiologically and clinically. Final outcome was measured with Harris Hip Score.[12]

Data of the patients was collected, a complete medical and surgical history was obtained and full clinical systemic physical examination was performed. The patient records were reviewed and then patients were

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followed up at intervals of 15 days, 1, 3, 6 months and 1 year.

Surgical technique: Every patient was given spinal or epidural anaesthesia (3 patients received General Anaesthesia) and shifted to an orthopaedic table in a supine position. The injured leg was slightly adducted and put on traction. Opposite limb was placed in full abduction to give place for the C-arm in between the legs. Reduction was achieved by traction of the leg and internal rotation firstly mid adduction or abduction as required. Reduction was checked in a C-arm with anterior-posterior and lateral views.

The chest and abdomen of the patient was pulled towards the normal unaffected side by an assistant or chest straps were applied. Under sterile conditions the affected side of the limb was scrubbed, painted and draped, an incision (5 cm length) was placed above the tip of the greater trochanter and then made deeper to reach the gluteus medius muscle.

Tip of the greater trochanter was palpated and minimal muscle attachment was separated then PFN was fixed in a manner by entry point taking the awl/guide pin with a protector sleeve, it should be on the tip of the greater trochanter at AP and lateral position. A 2.8 mm guide wire was introduced in to the femoral shaft and crossed the fracture in 600 of valgus. Its position was checked in the C-arm and the entry was widened with the awl. Then reaming of the proximal femur was done up to the proximal part of the nail to be inserted. The position of the holes for the proximal screw was checked in the C-arm for depth of nail. Guide wire for the screw was inserted via the jig and the drill sleeve was inserted. The correct position of the guide wire was parallel and in the lower part of the neck in AP views and in the center of the neck in the lateral views.

The guide pins were introduced up to 5mm from the articular surface of the femoral head and then the size of the lag screw determined. Reaming and tapping for lag screw was done and 10.5mm hip screw was introduced. This was checked by the C-arm and followed by introducing one 4.9 mm static screw in to the distal part of the nail. The traction was removed after tightening of the proximal screws by an adapter which was applied with the help of the Image Intensifying Television. Finally, the position of the nail in the C-arm was checked by X-rays in both views (AP & lateral) and the wound was closed and dressing was applied. One dose of Intravenous Cephalosporin was given pre-operatively. After surgery, twice daily dose was given for 72 hours or longer depending on the status of the wound. The total time of the surgery and the blood loss counted approximately by estimating 50 ml per mop used were documented.

Post-operative protocol comprised of: Injection Ceftriaxone 1gm intravenously 12 hourly with Garamycin 80 mg 12 hourly for first 3 days followed by oral doses.

Intravenous analgesics were given on the first day only and then followed by oral analgesics when required.

Quadriceps physiotherapy was performed as Strengthening exercises, Static quadriceps exercise and calf pumping. These were started as soon as the patient had recovered from anaesthesia. Knee and Ankle movement was instituted on the first post op day. Sutures were removed on 10th to 15th post-operative day. Immediate post-operative X-ray was done as seen in Figure-1.

Patients were discharged as soon as the wound and general condition of patient was satisfactory, varying from 2nd to 5th post-operative day.

After the sutures were removed walking was advised, usually being "non-weight bearing walking" as soon as patient could tolerate it.

Partial weight bearing walking was started around 3-8 weeks after radiological assessment if collapse was not

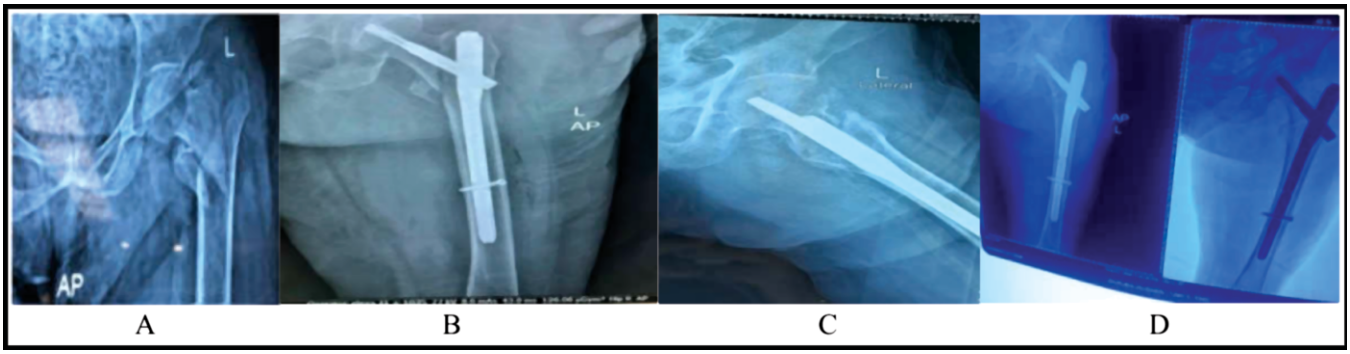

Figure-1: Preoperative (A) & postoperative (B&C) (AP & Lateral) views X-rays of 75 years old patient with unstable intertrochanteric left femoral fracture treated by PFN. (D) After 3 months.

anticipated. Full weight bearing walking was permitted after radiological and clinical assessment for union, which could take 8-12 weeks.

Follow-up: Patients were asked to come for follow up after 15 days, 1, 3, 6 months, and 1 year from the time of surgery. At each follow-up, all patients were assessed clinically using (Harris Hip score) and radiologically by X-rays of the hip and femur.

Results

The postoperative radiographs revealed near anatomic reduction of fracture taken in 32 patients. The fracture united in all 29 patients. The longest time of consolidation was approximately around 4 months. Twenty-nine cases were undergoing a smooth union and good follow up. Complications were encountered in 3 cases either during hospitalisation or in the postoperative period. One patient had an intraoperative displaced pertrochanteric fracture. This occurred during manual insertion of the nail straightway in the region of fracture at the tip of the greater trochanter causing the femoral head and neck shifted towards the medial side and both greater trochanter and the shaft towards the lateral side causing intraoperative fracture displacement. Open reduction had to be undertaken followed by augmentation of fracture by wire cerclage giving good results. No femoral shaft fractures were encountered in any patient. Three patients had complications postoperatively. One female patient expired after 15 days of surgery. The cause was not related to the implant or surgery, but was a medical reason. Two patients had cut-out of implant which was due to the use of too short hip screws (Figure-2). This can occur when patients are allowed full weight bearing which was not related to adequacy of fracture reduction or the type of fracture.

The ages of the patients ranged from 49 to 85 years with a mean age of 62±8 years; the commonest age group for unstable intertrochanteric fractures was between 50-59 years in 12(37.5%) followed by 60-69 years in 10(31.3%) and least common was less than 50 years in 3(9.4%). In this series the Male: Female ratio was 1:1.7 (Table-1).

Figure-2: X-ray beyond to 76 years old patient showing cut out of screw through femoral neck.

Table-1: The age and gender characteristics of patients in the study.

		No	%
Age	<50 years	3	9.4
	50---59	12	37.5
	60---69	10	31.3
	=>70 years	7	21.8
Gender	Male	12	37.5
	Female	20	62.5

Table-2: The operative characteristics of patients included in the study.

		No	%
Anaesthesia	Spinal	29	90.6
	General	3	9.4
Operative time	Mean	60 minutes	
Time of discharge	Before 5th post-operative day	26	81.3
	After 5th	6	18.7
Near anatomic fractures reduction	Yes	32	100
	No	-	-
Fracture healed	Yes	29	90.6
	No	3 (1 died after 2weeks)	9.4
Complications	Yes	3	9.4
	No	29	90.6
Type of complications	Intra-operative (displacement of per trochanteric fracture)	1	
	Post-operative	3	
	Cut-out of the implant	2	
	Expired	1	
After PFN	Partial weight bearing (3rd week)	8/31	25.8
	Partial weight bearing(8th week)	23 /31	74.2
	Full weight bearing (10th week)	28/31	87.5
	Full weight bearing (12th week)	5/31	12.5

The most common type of fracture was fracture with reverse obliquity 16(50%) followed by comminuted medial cortex 11(34.4%) and least was intertrochanteric with sub trochanteric extension 5(15.6%). The majority of the unstable intertrochanteric fractures occurred following low velocity trivial trauma mostly associated with a domestic accident like fall in bathroom or fall from stairs. The side of fracture in our study was more common on left side 20(62.5%) than right side 12(37.5%). Most patients had history of hypertension, diabetes and IHD respectively as the more common comorbid condition.

Anaesthesia used was, spinal anaesthsia for 29 patients out of 32 and 3 patients received general anaesthesia.

The average surgery duration was 60±10 minutes as PFN is a simple procedure and can be completed in a short

Table-3: The Harris hip score results of patients included in the study.

		No	%
Harris Hip Score	Poor	2	6.3
	Fair	2	6.3
	Good	7	21.8
	Excellent	21	65.6
	Total	32	100

duration when compared to other procedures which take a longer time.

Duration of hospitalisation varied with the majority of the patients 26(81.3%) being discharged before 5th post-operative day, while 6(18.7%) needed longer hospital stay (Table-2).

Functional analysis at final follow-up: The weight bearing was started early as per tolerance of the patients (3 patients below 50 years) and in those who had achieved good reduction and stable fixation. Most patients, specially the elderly, were advised to use an assistive device due to the weakness of upper extremity and presence of co-morbidities.

After PFN fixation, by 3rd week, partial weight bearing was allowed in 25% of patients whereas full weight bearing was allowed to 75% of patients at the end of 10 weeks. All the patients had final follow up at 18 months of surgery (Mean 11.2±2 months, minimum 6 months, and maximum 18 months). No notable differences were seen between implants in terms of fracture healing. Based on all the above criteria the functional outcome according to Harris Hip Score was found to be excellent in 21(65.6%), good in 7(21.8%), fair in 2(6.3%) and poor in 2(6.3%) patients (Table-3).

Discussion

Fracture in Intertrochanteric region mostly occurs in elderly age group patients, but increased technical implantation and increased number of road traffic accidents is the cause of this fracture even in younger age group subjects. There are different types of implants available for treating unstable intertrochanteric femoral fractures, but the research is still on-going to select the best method. In this study, 32 patients of unstable types of intertrochanteric fractures were treated surgically by PFN and the results were analyzed clinically and radiologically. Domestic fall which amounts to low velocity injury, was the major cause of fracture in 70% patients in this study, especially in the elderly female patients. Time of operation in our study for PFN (minimum duration time was 40 minutes and maximum duration time was 120 minutes) and mean duration was 60±10 minutes, according to three types of unstable intertrochanteric fractures, in the study, 16 patients had reverse oblique fracture, 11 with medial cortex comminution and 5 patients with sub-trochanteric extension.

The discussion about the ideal types of implants used for treatment of unstable fractures in intertrochanteric region is still on-going. From the technical and mechanical point of view, combination of a minimally invasive procedure used to insert intramedullary implant looks to be the best in elderly patients which has been observed by Langstaff et. al.[13] An essential element in the process of consolidation process was to preserve the fracture haematoma,[14] which was preserved by close reduction in our study. Fixation using intramedullary device permits the surgeon to reduce dissection of soft tissue minimally and hence decreasing unexpected trauma by surgery, loss of blood, infection, and also other complications of the wound. This was also experienced by Anglen and Boldin in their studies.[14,15] A recently introduced intramedullary device is the Gamma nail having a high learning curve with mechanical and technical failure rates of about 10% (fracture collapse, cut-out of the cephalic screw, diaphyseal fracture) which was experienced by (Guyer et al. 1991, Albareda et al. 1996, Friedl 1996, Valverde et al. 1998).[16,17] In our study the cut out of the cephalic screw occurred in 2 patients (6.25%). In our study there was no implant failure as a long term complication of PFN and this corresponds to the study done by Götze et al. (1998)[23] who compared the load ability of device of fixation of unstable intertrochanteric and subtrochanteric fractures and discovered that the PFN could carry the highest loads of all devices used in the study without any implant failure. Simmermacher et al.[3] conducted multicenter studies and found that mechanical and technical insufficiency of the PFN device was due to inadequate reduction, wrong choice of screws and malrotation which occurred in 5% of the cases. Whereas, cut-out of the neck pin was encountered in 0.6%. In our study, cut out of the cephalic pin occurred in 6.25% after full weight bearing and in these two patients, the screws used were too short with no consideration to the fracture type or adequacy of reduction. The distribution of the fracture type showed a large number of 31-A2 fractures (intertrochanteric fracture with one intermediate fragment (67%).[18,19] Anatomical and perfect reduction of fracture was found in 88% of the patients and stability after full weight bearing was accomplished in 86% in the study by Gadegone and Salphale 2007).[19] In our study, adequate and perfect anatomical reduction of the fracture was achieved post-operatively in only 90.6% in the follow up period and full weight bearing was

allowed in 87.5% patients immediately after clinical and radiological assessment at end of 10 weeks. In 2 (6.25%) patients cut-out of the neck screw was encountered because the neck screws used were too short. In the literature, cut-out frequencies in proximal femoral fractures have been reported in up to 10% by Friedl. Lustenberger and Ganz.[20] "An intraoperative displacement of fracture during manual inserting of the nail into the femoral shaft has not been reported with the use of Gamma nail in the studies "(Bridle et al.)",[21] but this has been a problem with the use of PF". One reason may be due to the entry point of the PFN being at the tip of the greater trochanter, it is directly located in the region of fracture of 31-A2 fractures which can produce displacement of the fracture intraoperatively.[22] However, Simmermacher et al. (1999)[3] had no cases of intraoperative fracture displacement by using the PFN mostly in 31-A2 fractures. In our study only one (3.1%) case of intraoperative fracture displacement was encountered during introduction of the nail in the patient with 31-A3 fracture. Since 1999, the Z-effect with migration of the hip pin into the joint has been avoided by using a ring on the lateral side of the hip pin. In one patient with 31-A3 fractures and subtrochanteric extension, intraoperative complications were encountered. Closed reduction of fracture was unsuccessful and open reduction with augmentation of fracture by using cerclage wire had to be undertaken. The latter method is used in some unexpected unstable intertrochanteric femoral fractures despite knowing that this is not the aim of the minimally invasive procedure. Götze B, et. al. (1994)[23] reported open reduction in 8% of the 31-A1, 13% of the -A2, and 52% of the -A3 fractures.[24] In comparison to the Gamma nail, we found no fracture of the shaft of femur and no nail breakage.[16] The most vastly used method for treating proximal femoral fractures is possibly still the Dynamic Hip Screw (DHS). A research in the Cochrane Database for a comparison of intramedullary and extramedullary devices for proximal femoral fractures, showed a lower complication rate with the DHS which has been confirmed by biomechanical characteristics. This is supposed to enhance the fracture healing but using the DHS needs a relatively large exposure, more tissue handling and all of these increase the rate of complications and morbidity as infection, surgical trauma, blood loss and collapse of the fracture with loss of anatomical reduction. In addition the side plate and screws weaken the mechanical bone condition and lead to osteoporosis and implant failure.[25] In our study, using PFN in unstable intertrochanteric fracture had better results than with DHS especially for more distal and uncommon trochanteric fractures as 31-A3, with regard to fracture fixation, intraoperative and post-operative outcome.[26] Radford et al. (1993) did not prefer the surgical technique by use of the Gamma nail because of the high incidence of diaphyseal (femoral shaft fractures). This problem was resolved by developing the PFN with a small diameter femoral shaft distally and this lead to decreased stress shielding at the tip of the nail.[27] We believe that the PFN is a suitable minimally invasive implant used for treatment of unstable intertrochanteric femoral fractures when reduction by closed method is successful. Careful surgical technique and the modulation of the PFN decreased the complication rates in our study.

Conclusion

Stable rigid fixation with anatomical reduction is considered vital in obtaining a good functional outcome. PFN is an appropriate and preferable device with minimal soft tissue handling and minimal invasive technique for unstable intertrochanteric femoral fractures that need open reduction and internal fixation. It can decrease the operating time and post-operative complications with good results.

Acknowledgment: None to declare.

Disclaimer: The author has nothing to disclose

Conflict of Interest: None to declare.

Source of Support: None to declare.

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