ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 04 | April - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE STUDY BETWEEN PROXIMAL FEMORAL NAIL AND PROXIMAL FEMORAL NAIL ANTIROTATION IN MANAGEMENT OF UNSTABLE TROCHANTERIC FRACTURES OF FEMUR

Orthopaedic

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ABSTRACT

Background: In the management of peri-trochanteric fractures, intramedullary (IM) devices have proven advantage over extramedullary devices. IM devices allow for stable anatomical fixation of more comminuted fractures without shortening the abductor lever arm or changing the proximal femoral anatomy. Between IM devices like proximal femoral nail (PFN) and proximal femoral nail antirotation (PFNA), the helical blade of latter is believed to provide stability, compression and rotational control of the fracture with higher cut out strength. The following study was undertaken in an attempt to compare these two types of Intra-medullary devices.

Methods: Between Jun 2018 and June 2020, 60 patients with unstable intertrochanteric fractures fulfilling inclusion and exclusion criteria, were randomized into 2 groups to undergo CRIF with either standard PFN (n=30) or PFNA (n=30). They were compared in terms of demography, per-operative variables and postoperative parameters including functional evaluation till 1year postoperatively.

Results: Background demographic variables, fracture type and pre-injury ambulatory status were comparable between the groups. Operative duration of surgery, amount of blood loss and number of fluoroscopic images were significantly lower in PFNA group as compared to PFN group. Post op complications like infection, non-union, cut out/z-effect, loss of reduction, re-operation and mortality rates didn't differ significantly between the groups. Post op functional recovery as evaluated by pain, use of walking aids and Harris hip scores were similar in both groups.

Conclusions: PFNA significantly reduces the operative time, amount of blood loss and fluoroscopic imaging as compared to PFN. However PFNA offers no significant benefits over PFN in terms of post-operative functional recovery or complications.

KEYWORDS

Proximal femoral nail antirotation, proximal femoral nail, Trochanteric fracture

INTRODUCTION

Proximal femoral fractures occur typically at the junction between trabecular bone and cortical bone, where the mechanical stress across the junction is highest in the femur, which is responsible for their frequent communition. These fractures account for 10% to 34% of all hip fractures. Trochanteric fractures are one of the most common injuries sustained predominantly in patients over sixty years of age.

These fractures occur typically in two age groups. In young and healthy individuals, the injury results from high-energy trauma, whereas in the elderly population, most of the fractures are osteoporotic; trivial fall being the most common mechanism of injury.[1] With the increase in the ageing population, there is also considerable growth in the number of pathological fractures and fractures around hip prostheses (periprosthetic fractures).

Closed management of these proximal femoral fractures thus poses difficulties in obtaining and maintaining a reduction, making operative management the preferred treatment. The goal of operative treatment is restoration of normal length and angulation to restore adequate tension to the abductors.

The type of implant used has an important influence on complications of fixation. Sliding devices like the dynamic hip screw have been extensively used for fixation. However, if the patient bears weight early, especially in comminuted fractures, these devices can penetrate the head or neck, bend, break or separate from the shaft[2].

Intramedullary devices like the proximal femoral nail have been reported to have an advantage in such fractures as their placement allowed the implant to lie closer to the mechanical axis of the extremity, thereby decrease the lever arm and bending moment on the implant. They can also be inserted faster, with less operative blood loss and allow early weight bearing with less resultant shortening on long term follow up.

The purpose of the present study is to verify the theoretical advantages of the proximal femoral nail over PFNA2 device and also whether it actually alters the eventual functional outcome of the patient.The following study was undertaken in an attempt compare these two types of Intra-medullary devices.

METHODOLOGY

During this period, 72 patients with intertrochanteric femur fractures were identified of which 68 patients were enrolled in the study at a tertiary care hospital in Surat from 2018 to 2020.

INCLUSION CRITERIA:

Both male and female patients above 20 years of age with isolated, closed, and type 31- A1, 2, 3 intertrochanteric fractures as classified with AO system who gave consent for surgery and participation.

EXCLUSION CRITERIA:

Pathologic fractures, polytrauma patients, fractures in skeletally immature patients, old neglected fractures, refusal to provide informed consent, fractures with neuromuscular disorders / neurovascular insufficiencies.

With 8 patients being lost to follow-up during the course of study before completing at least 6 months of follow-up, we had 60 patients in both age group (30 patients of PFN & 30 patients of PFNA2) remaining to study.

Operative protocol:

Background and demographic variables including age, gender associated comorbidities and pre-injury ambulatory status were recorded. Fractures type was assessed and recorded as per AO/ASIF classification system using orthogonal radiographs of the affected hip. All patients were administered spinal or epidural anaesthesia and positioned supine on a fracture table prior to closed reduction of fracture. Per operatively, the duration of surgery, amount of blood loss, number of images shot on the image intensifier was recorded. All patients received three doses of prophylactic antibiotics including the pre-op dose given within 30 minutes prior to skin incision. Post operatively all patients received thrombo-prophylaxis with low molecular weight heparin for the duration of hospital stay or first 10

post-op days, whichever was shorter, followed by Aspirin for 4 weeks. All patients were allowed touch down weight bearing ambulation using a walking frame starting from the first post op day till 6 weeks, following which progressive weight bearing was allowed depending on the status of fracture union. Clinical and radiological assessment of fracture union/complications for all the patients was done pre-operatively and post-operatively at 06 weeks, 3months, 6months and 1year. Functional evaluation was done at 1year post op using Harris Hip Score.

This study was mainly an observational prospective study. Such patients were followed up prospectively for a minimum of six months post-operative time. In all our patients we used PFN & PFNA2 nail. Implant length were evaluated according to length of the opposite limb. We selected PFN and PFNA2 nail in alternate patients.

RESULTS

The most common age group was in the range of 61 – 80 years, with a mean of 62.6 years.

69.93 % of the total patient was female in this series with male to female ratio was ~2:1.

Table 1: Mode of Injury

	Road Traffic Accident	Fall from Height	Domestic Fall
PFN	2(6.66%)	4(13.32%)	24(79.92%)
PFNA2	2(6.66%)	4(13.32%)	24(79.92%)
Total	4(6.66%)	8(13.32%)	48(79.92%)

The most common mode of injury is trivial fall. There were 17 stable fractures and 13 unstable fractures.

Table 2: Distribution according to Singh's Index

Singh's Index	Method of Fixation		Percentage (%)
	PFN	PFNA2	
6	2(6.66%)	0	2(3.33%)
5	4(13.32%)	2(6.66%)	6(9.99%)
4	12(39.96%)	14(46.62%)	26(43.29%)
3	10(33.33%)	10(33.33%)	20(33.33%)
2	2(6.66%)	4(13.32%)	6(9.99%)
1	0	0	0
	30	30	60

In most of the patient's level of osteoporosis was either 3 or 4 confirming that intertrochanteric fractures usually occur in osteoporotic bone.

Table 3: Duration of Surgery

Intra operative details	Method of Fixation	
	PFN	PFNA2
Mean surgical time (minutes)	89	67
Fluoroscopy Time	73	57
Blood loss (intra operative)	77.8	59.8

Average surgical and fluoroscopy time of PFNA2 fixation was significantly low as compared to PFN.

Table 4: Radiological union

Union	Method of Fixation		Percentage (%)
	PFN	PFNA2	
8-10weeks	4(13.32%)	2(6.66%)	6(9.99%)
10-12weeks	18(59.94%)	22(73.26%)	40(29.97%)
12-16weeks	8(26.64%)	6(9.99%)	14(23.31%)
>17 weeks	0	0	0
Total	**30**	**30**	**60**

Radiological union was said to be achieved on the evidence of obliteration of fracture lines and trabecular continuity between the two fragments on AP & lateral x- rays in three cortices.

40 cases showed union by 4 months, 14 cases showed union at 5 months and none of the cases showed non-union at 6 months duration. None of cases had implant failure at 6th month of follow-up.

Table 5: Outcome evaluation

Results	Method of Fixation		Percentage (%)
	PFN	PFNA2	
Excellent	14(46.62%)	16(53.28%)	30(49.95%)
Good	10(33.3%)	6(19.98%)	16(26.64%)
Fair	4(13.32%)	6(19.98%)	10(16.65%)
Poor	2(6.66%)	2(6.66%)	4(6.66%)
Total	**30**	**30**	**60**

Harris Hip score was applied to assess outcome. 46(77%) had good to excellent results. 14 (21%) had fair to poor results. However, radiologically none of the patients had poor results. We cannot readily rule out objective bias in our radiological assessment.

Intraoperative blood loss was less in PFNA2 as compared to PFN. Mild pain in activity was seen in (VAS <2 or =2) 56 patients. Discomfort in ordinary activity was seen in (VAS >2 to <4 or =4) 4 patients. Pain limiting routine activity was not found in (VAS 5 or more) any patient.

Table 6: P value for different groups

Groups		Mean	SD	P Value
Age	PFN	63	16.37	0.87
	PFNA2	***64***	***16.91***	
Union	PFN	11.8	1.55	0.91
	PFNA2	***11.86***	***1.49***	
Operating Time	PFN	*89*	*7.07*	*0.01*
	PFNA2	***67***	***7.65***	
Blood Loss	PFN	*77.80*	*17.39*	*0.01*
	PFNA2	***59.80***	***14.96***	

Interpretation of P value: P value >0.05 no significance, < 0.05 is Significant and <0.01 highly significant

In our study on comparing the operating time and blood loss in PFN and PFNA2 groups we observed that the differences were significant. This indicates that there is a decrease in the average blood loss and operating time in cases treated by PFNA2 when compared to PFN group but final outcome in form of union there is no difference in PFN and PFNA2.

DISCUSSION

Trochanter fractures are difficult to manage and need surgical management most of the time. Stable intertrochanteric fractures are those, in which posteromedial cortex remains intact and calcar femorale is not affected. Unstable intertrochanteric fractures are those, in which comminution of posteromedial buttress exceeds a simple lesser trochanteric fragment, those with subtrochanteric extension or those with reverse oblique fracture patterns.

Surgical management is the preferred treatment for unstable fractures. Successful treatment of intertrochanteric fractures depends on surgeon independent variables like bone quality (osteoporosis), fracture pattern & fracture stability. Surgeon dependent variables like quality of fracture reduction, choice & placement of implant.

The main advantages of the Proximal Femoral Nail over its precursor-gamma nail are that the 2 proximal screws are smaller in diameter. It is not necessary for the nail to be stout unlike gamma nail and hence theoretically induces less comminution of proximal segment and less disruption of abductor insertion. The 2 proximal screws provide better rotational control of proximal fracture fragment. Complications of proximal femoral nailing include lateral protrusion of screws, Z effect or reverse Z effect, fracture of the lateral wall of the trochanter, intra-operative femoral shaft fractures and anterior thigh pain.

In addition, the gamma nail and proximal femoral nail have a proximal diameter of 17 mm, which is too large for average Indian femora, and may lead to widening of the trochanter and fractures. Modification of the gamma nail by reducing its diameter and length has been performed in a Chinese population.

Gadegone WM, Salphale YS (April 2010)[3] reviewed outcomes of 100 Asian patients who underwent short proximal femoral nailing for stable and unstable intertrochanteric fractures. They concluded that short proximal femoral nail is a superior implant for stable and unstable intertrochanteric fractures in terms of operating time, surgical exposure, blood loss, and complications, especially for patients with relatively small femora. Further studies are needed to confirm the efficacy of the Short PFN in Asians.

This study was carried out at Department of Orthopaedics, Tertiary

care Hospital, Surat. During this period, 72 patients with intertrochanteric femur fractures were identified of which 68 patients were enrolled in the study based on the inclusion and exclusion criteria. With 8 patients being lost to follow-up during the course of study before completing at least 6 months of follow-up, we had 60 patients in both age group (PFN & PFNA2) remaining to study. The aim of our study was to assess clinically and radiologically the effectiveness of the Proximal Femoral Nail v/s PFNA2 in the management of intertrochanteric fractures and to identify the drawbacks, if any. The data collected from our study was analyzed with respect to epidemiology, intraoperative details, intra operative and post-operative complications, functional and radiological outcome.

Patients with intertrochanteric fractures satisfying the inclusion criteria were included in the study. They were thoroughly evaluated pre-operatively. Their details were collected and entered in a pre-formed proforma. The patients were operated upon and intra-operative details recorded. The patients were followed up regularly after being discharged from the hospital and their post-operative details were recorded.

In this study the post-operative screw placement shows that in 30 patients of PFNA2 group, it is centrally placed in 20 patients, superior in 2 patients, postero-inferior in 2 patients, centro-posterior in 4 patients, centro-inferior in 2 patients.

Patients with lag screw placed in central and centro-inferior positions had given good functional outcome. According to Vinay Parmar[4] also lag screw placement in central and inferior positions had given good outcomes.

Harris Hip score was applied at one year to assess outcome. 46(77%) had good to excellent results. 14 (23%) had fair to poor results. The functional outcome results show that even today intertrochanteric fractures treated with dynamic hip screw give good functional results.

Table 7: Comparison with other studies

Study	Mean HHS
YihShiunn Lee[5]	86.9 ± 5.3
M. Guven and Kjell matre[6] et al.	88.9 ± 6.27
Prajapati P et al[7]	86 ± 4.57
MV Valera[8] et al.	91.08 ± 5.9
Present study	86.13 ± 8.72

Regarding early post-operative complications**,** 58 patients had no early post-operative complication. 1 patient developed superficial infection, which was treated aggressively with intravenous antibiotics and adequate debridement, after which it healed well. With regards to delayed post-operative complications, pain in the hip region was the most common and the most important complication. Pain is an important criterion for evaluation of hip fractures. Persistent pain could be due to infection, implant failure, non-union, avascular necrosis etc.

In our study, 60% of patients had no pain. 25% of patients had occasional pain. 15% of patients had mild to moderate pain not affecting their daily activities which subsided with medication.

In our study more than 90% of the patients had a normal gait. 1 patient in our study had a limp on the affected side. Limp is due to coxa vara. Also more than 90% of the patients had a neck-shaft angle of 130° or more. 1 patient had varus angulation of 5°. No case had varus angulation of more than 15°. Varus angulation of up to 15° is acceptable and does not need re-doing.

In our study, none our patients had shortening, implant failures, screw back out, migration of plate or loosening of proximal screws.

CONCLUSION

Early surgery on patients with trochanteric fractures improved its ability to return to independent living and complications of prolonged immobilization are prevented.

Hip fractures are the leading cause of morbidity and mortality in elderly. Intertrochanteric fractures are common injury, mostly seen in elderly females and arising out of trivial fall. Patients with trochanteric fractures are bed- ridden for prolonged time, which leads to health problems and reduced quality of life which increases the burden on the caregivers.

Intramedullary fixation has biological and biomechanical advantages on extramedullary fixation. It is a closed method thus preserves the fracture hematoma and hence yields early healing with early union. The procedure is less invasive, less time consuming, provides stable fixation and allows early weight bearing that enhances the process of union, especially in unstable intertrochanteric fractures. It can further be used in all unstable configurations of trochanteric fractures with equally good results. However, functional outcome in fractures with severe osteoporosis varies.

The position of the implant should be such that the tip of the blade in case of PFNA2 should be in the lower half of the femoral head and the blade should pass below the superior cortex of the neck; and screws of PFN should be within femoral neck without cutting superior or inferior cortex and compression screw should be inserted deeply into the femoral head close to the subchondral bone maintaining the tip apex distance. We recommend, locking both static and dynamic bolts distally as it gives an option to dynamize, if needed. Dynamization should be done early, if needed.

PFNA2 has some advantages over PFN like less surgical time for fixation, less fluoroscopy time, optimum for small neck and less blood loss as compared to PFN.

This study showed both PFN & PFNA2 to be a versatile, stable, acceptable, reliable, and effective implant fixation in trochanteric fractures and can be used for both stable and unstable intertrochanteric fractures.

LIMITATIONS OF STUDY

A longer follow up period is needed to evaluate the late complications. As this was a descriptive study, due to the absence of a control or comparator group (extramedullary implant/DHS), it is difficult make a definitive conclusion whether intramedullary nail is the best treatment option for the intertrochanteric fractures. To make a definitive conclusion, a randomised controlled trial would be needed with extramedullary implant. A study with a larger sample size would have made a better assessment of this surgical intervention. As our study was time bound, the patients were followed up for a minimum of 6 months and a maximum of 1 year. Therefore, the long-term effects of this intervention remain unknown in our cohort. A longer follow up would have made a complete assessment of this surgical intervention.

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