

Original Research Article

A PROSPECTIVE COMPARATIVE STUDY OF PROXIMAL FEMUR NAILING (PFN VS PFNA2) IN RURAL INDIA

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Received: 21-05-2024 / Revised: 31-05-2024 / Accepted: 08-07-2024

ABSTRACT

BACKGROUND

Intertrochanteric femur fractures are typically treated with proximal femoral nails. There are two varieties of proximal femoral nails in our study: PFNA2, which has a single proximal blade, and normal PFN, which has two proximal screws.

AIM

Our study compares functional results and implant-related problems in individuals treated for proximal femur fracture using PFNA2 nails versus conventional PFN nails.

MATERIAL AND METHODS

After obtaining ethical clearance from Institutional ethical committee, this prospective study was conducted in the Department of Orthopaedics in Sri Madhusudhan Sai Institute of Medical Sciences and Research from Nov 2022 to Nov 2023. A series of 50 cases were included in the study. After obtaining prior informed and written consent from the patients. Fracture diagnosis confirmed by clinical examination and radiography. Pre-anaesthetic evaluation done as per protocols. 25 Patients underwent PFN nailing and 25 Patients underwent PFN- A2 nailing. Post operatively follow up was done until 6 months to assess various outcomes namely fracture healing, incidence of post-operative complications, rehabilitation and functional outcome.

RESULTS

Implant A2-PFN nails has better results than implant standard PFN nail in terms of operative time, operative blood-loss and functional outcome.

CONCLUSION

We concluded from the study that, in comparison to standard PFN nails, PFNA2 nails minimises surgical time, blood loss, and radiation exposure. When compared to standard PFN nail, PFNA2 nails offers substantially superior functional outcomes and a greater union rate.

PFNA2-treated patients are able to bear weight quickly. PFNA2 does not cause too many implant-related issues including screw backing out and cut-through of screws in the femoral head (also known as the z-effect and reverse z-effect). Consequently, we draw the conclusion that PFNA2 nails are better than standard PFN nails.

KEYWORDS

Extra capsular proximal femur fracture, intertrochanteric fracture, sub trochanteric, fracture proximal femoral nail (PFN), proximal femoral nail antirotation Asia (PFNA2 or PFNA II), and intramedullary nail.

INTRODUCTION

Proximal femur fracture is common in elderly population with osteoporosis, usually following trivial trauma, and its occurrence is expected to rise as life expectancy increases. In the younger age group, where it is uncommon, it is almost exclusively due to high velocity trauma.¹ Globally estimated that hip fractures affect approximately 18% of women and 6% of men.² Treatment options for proximal femur fractures include surgery and conservative measures. Recumbency post hip fractures have been related to increased mortality among elderly patients. Surgical treatment is essential in such type of fractures for obtaining a reduction which is acceptable as well as for the early rehabilitation of the patients.³

Using an implant that is minimally invasive, requires less time to operate and permits early mobilisation and weight bearing is the fundamental idea of surgery. The choice of surgical treatment (dynamic hip screw or proximal femoral nailing) is determined by the fracture's pattern and stability. The stated benefits of intramedullary nailing include a short incision, shorter operating time, minimal blood loss, and quick rehabilitation, which is necessary to reduce the risk of medical complications.⁴

The dynamic hip screw, which was considered to be the hallmark treatment of stable proximal femur fractures earlier, was found to be inadequate for the treatment of unstable type of proximal femur fractures. For the purpose of fixation of unstable fractures, intramedullary nailing has become a popular method of stabilization of unstable extra capsular proximal femur fractures in adults.⁵

Regular PFN consists of an intramedullary nail with two proximal screws and minimal one distal screw: the lag screw, which fixes the fracture as it collapses, and the anti-rotation screw, which provides rotational stability. Regular PFN is associated with post-operative complications, such as screw cut-out and back out of screw.⁶

PFN A2 nail comprise of an intramedullary nail with single proximal helical blade which is helical in shape and a distal locking screw, the helical blade is locked to prevent back out of screw and cutting through femoral head. This is the prime advantage of PFNA2 over regular PFN and it allows early weight bearing. Thereby essentially diminishing the possibility of failure of the implant in the osteoporotic bone of old patients⁷.

In our study as “Comparative study of PFN vs PFNA 2 in Proximal femur fracture: A randomised control trial”, we have made an endeavour to analyse both the intramedullary devices as functional outcome and implant related complications.

MATERIALS AND METHODS

After obtaining ethical clearance from Institutional ethical committee, this prospective study was conducted in the Department of Orthopaedics in Sri Madhusudhan Sai Institute of Medical Sciences and Research from Nov 2022 to Nov 2023. A series of 50 cases were included in the study. After obtaining prior informed and written consent from the patients. Fracture diagnosis

confirmed by clinical examination and radiography. Pre-anaesthetic evaluation done as per protocols. 25 Patients underwent PFN nailing and 25 Patients underwent PFN- A2 nailing. Post-operatively patients were followed up at 1 week, 2 weeks, 1 month, 2 month, 3 months and 6 months. Follow up during initial 2 weeks consisted of wound check and for signs of surgical site infections. 4th week, 8th week, 12th week and 6th month follow up consisted of radiological outcome of fracture healing and rehabilitation and functional outcome assessment.

Inclusion Criteria

1. Age > 18 years
2. Intertrochanteric fractures both stable and unstable
3. Reverse oblique type of intertrochanteric fracture
4. Intertrochanteric fractures with sub-trochanteric extension

Exclusion Criteria

1. Age < 18 years
2. Intracapsular proximal femur fractures – neck and head of femur fractures
3. Intertrochanteric fractures in polytrauma patients

RESULTS

The study was undertaken to assess on comparative basis effectiveness of implant A2-PFN and PFN in patients with extracapsular fractures of proximal femur and post-operative follow up and complications of each implant.

Age

Analysing the results based on age revealed that the mean age of the study participants was 71.46 (Range from 35 years to 98 years). Majority of the patients (17 patients- 34% of study population) were in the age group 70-79 years. (Table no 1).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	30 to 39	1	2.0	2.0	2.0
	40 to 49	2	4.0	4.0	6.0
	50 to 59	1	2.0	2.0	8.0
	60 to 69	15	30.0	30.0	38.0
	70 to 79	17	34.0	34.0	72.0
	80 to 89	12	24.0	24.0	96.0
	90 to 99	2	4.0	4.0	100.0
Total		50	100.0	100.0	

Table 1: Age Wise Analysis

Sex

Analysing the results as per sex of the patients, we observed that 33 were male (64%) while 17 (34%) were female.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	17	34.0	34.0	34.0
	Male	33	66.0	66.0	100.0
	Total	50	100.0	100.0	

Table 2 : Gender Wise Analysis

Side of Injury

In 25 cases (50%) of the fractures occurred on the left side, and 25 cases (50%) on the right side.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Left	25	50.0	50.0	50.0
	Right	25	50.0	50.0	100.0
	Total	50	100.0	100.0	

Table 3: Side of Injury

Implant

In 25 cases (50% study population) standard PFN nail was used for fracture fixation in the remaining 25 cases (50% study population) A2-PFN nail was used for fracture fixation.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	PFN	25	50.0	50.0	50.0
	A2-PFN	25	50.0	50.0	100.0
	Total	50	100.0	100.0	

Table 4: Implantation

Admission to Surgery Time

Analysing the results based on time interval between admissions to surgery, the mean interval was 9.24 days. Mean time in cases operated with implant- PFN was 6.52 days and implant A2-PFN was 7.88. Delay in surgical intervention due to multiple co-morbidities in the patients who are already elderly.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 to 9 Days	28	56.0	56.0	56.0
	10 to 19 Days	22	44.0	44.0	100.0
	Total	50	100.0	100.0	

Table 5: Time interval between admission to surgery

Operative Time

Analysing the results based on operative time revealed a mean of 56.6 minutes for PFN and 46.36 minutes for A2-PFN. This indicates reduced operative time for A2-PFN nails due to single screw placement in neck and head of femur.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	40 to 49 Minutes	20	40.0	40.0	40.0
	50 to 59 Minutes	18	36.0	36.0	76.0
	60 to 69 Minutes	10	20.0	20.0	96.0
	70 to 79 Minutes	2	4.0	4.0	100.0
	Total	50	100.0	100.0	

Table 6: Operative time

Surgical Blood Loss

Analysing the results based on blood loss during surgery revealed a mean blood loss of 95.8ml in PFN cases and mean blood loss of 75.4 ml in A2-PFN, owing to reduced surgical time in A2-PFN

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	100 to 109 ml	12	24.0	24.0	24.0
	60 to 69 ml	5	10.0	10.0	34.0
	70 to 79 ml	12	24.0	24.0	58.0
	80 to 89 ml	8	16.0	16.0	74.0
	90 to 99 ml	13	26.0	26.0	100.0
	Total	50	100.0	100.0	

Table 7: Blood Loss analysis

Functional Outcome

Analysing the results based on functional outcome – Harris hip score revealed a mean score of 74.92 in patients operated with implant PFN, which is a fair functional outcome. Mean score of patients operated with A2-PFN was 83.64, which is a good functional outcome.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	70 to 79	31	62.0	62.0	62.0
	80 to 89	13	26.0	26.0	88.0
	90 to 99	6	12.0	12.0	100.0
	Total	50	100.0	100.0	

Table 8: Functional Outcome

Complications

Complications in the form of screw back out and Z-effect were noted only in the group operated with implant – PFN

Screw backout (table no 9) was noted in 1 patient (2% of study population) and Z-effect was noted in 4 patients (8% of study population)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Screw And Blade Back Out	1	2.0	20.0	20.0
	Z effect	4	8.0	80.0	100.0
	Total	5	10.0	100.0	
Missing	9999	45	90.0		
Total		50	100.0		

Table 9 : Complication



Image 1: Patient 1 – Pre – Operative Radiograph of Patient Operated with PFN



Image 2: Post-Operative Radiograph of PFN (Antero-Posterior View)



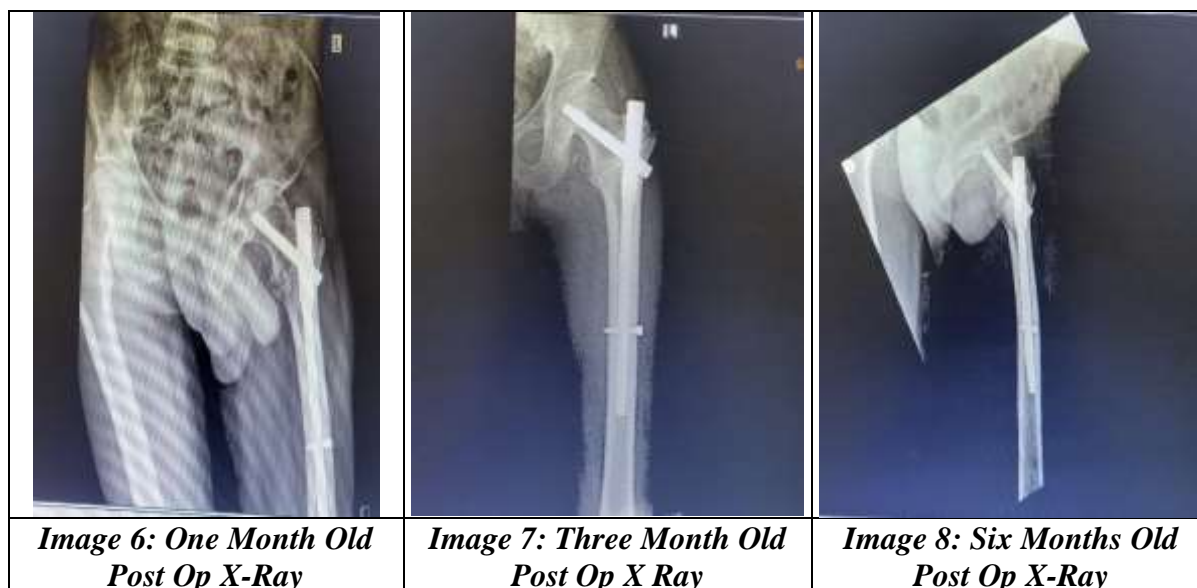
Image 3: Post-Operative Radiograph of PFN (Lateral View)



Image 4: Patient 2 -Pre Operative X-Ray Operated by Pfna2 Nail



Image 5: Day-1 Post Op X-Ray



DISCUSSION

In our study we compare the results and functional outcome in patients operated with PFN nails and A2-PFN nails. We compare the results in terms of age, admission to surgery time, operative- time, operative blood-loss, functional outcome and complications post-operatively

The mean age of patients was 71.46 (table no).34% of our study population were in the age group between 70-79 years. This indicates the prevalence of the fracture in elderly population. This is similar to study done by **Anjan Ramachandranath V et al.**⁸

The mean admission to surgery time in our study population is 9.24 days (table no 5). The delay in admission to surgery time can be attributed to management of multiple co-morbidities in elderly population namely uncontrolled diabetes and hypertension. This is similar to study done by **Liu F et al.**⁹

The mean operative time in A2-PFN nailing is 46.36 minutes and standard PFN nailing is 56.6 minutes (table no 6). Reduced operative time in A2-PFN due to placement of single screw in the femoral neck and head as compared to 2 screws in PFN and also placement of 2 screws in parallel to each other on antero-posterior view and in center-center position in lateral/oblique view of femoral neck and head. This is similar to study done by this is similar to study done by **Mallya S et al.**¹⁰

The mean blood-loss in A2-PFN is 75.4 ml and PFN is 95.8ml. Increased blood loss in PFN due to increased surgical time and also drilling of bone for 2 screws which causes increased medullary bleed from cancellous bone. This is similar to study done by this is similar to study done by **Khanam NS et al.**¹¹

The mean functional outcome in patients operated with A2-PFN nails is 83.64 which is a good functional outcome and standard PFN nails mean functional outcome is 74.92 which is fair functional outcome. Better outcomes can be attributed to increased bone stock in head and neck of femur after insertion of single lag screw in A2-PFN. Placement of 2 screws in neck and head of femur leads to reduced bone stock and delays healing of fracture and mobilization of patients leading to reduction in their functional outcome measured in terms of Harris Hip Score. This is similar to study by **Mallya S et al.**¹⁰

No post-operative infections were noted in both the groups. Z-effect was noted in patients operated with PFN. This can be attributed to better hold of lag screw in A2-PFN due to presence of flanges, while lag screw in PFN is a variant of threaded cortico-cancellous screw.

Screw pull out in a dual screw design due to osteoporosis in old age is the most common cause of implant failure. This is similar to study done by this is similar to study done by **Khanam NS et al.**¹¹

Clinical studies have also revealed that osteoporosis is linked to poorer outcomes in intertrochanteric and subtrochanteric fractures. This is similar to study done by this is similar to study done by **Broderick et al.**¹²

Several nail designs and augmentation techniques have been released into the market to improve fixation in both stable and unstable intertrochanteric and subtrochanteric fractures. Choosing the best implant for these osteoporosis patients presents a challenge in terms of functional outcomes. In view of the helical blade technology established in PFNA2 for osteoporotic bones. This is similar to study done by **Khanam NS et al.**¹¹

When the helical blade is inserted into the proximal femur, the cancellous bone is maintained, preserving the bone stock. This is the primary reason for preventing issues such as varus collapse, rotational stress, and screw cutout.¹³

CONCLUSION

We concluded from the study that, in comparison to standard PFN nails, PFNA2 nails minimises surgical time, blood loss, and radiation exposure. When compared to standard PFN, PFNA2 offers substantially superior functional outcomes and a greater union rate. PFNA2-treated patients are able to bear weight quickly. PFNA2 does not cause implant-related issues including screw backing out and cut-through of screws in the femoral head (also known as the z-effect and reverse z-effect). Consequently, we draw the conclusion that PFNA2 is better than standard PFN.

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