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A Prospective Comparative Study of Clinicoradiological and Functional Outcome of Intertrochanteric Fractures Treated with Proximal Femoral Nail as Against Proximal Femoral Nail-A2

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Abstract

Background: Stable fixation is necessary for the best recovery from intertrochanteric fractures, which are common in the elderly. Although both the Proximal Femoral Nail (PFN) and its variant, the Proximal Femoral Nail A2 (PFN A2), are commonly used implants, there are currently few studies comparing their results and our study aims to evaluate the clinic-radiological and functional outcomes of intertrochanteric fractures treated with Proximal Femoral Nail versus Proximal Femoral Nail A2.

Methodology: A comparative study was conducted among 60 patients with each group includes 30 intertrochanteric patients and treated with PFN & PFNA 2 at tertiary hospital in Kuppam. Clinical outcomes were assessed using parameters such as duration of surgery, blood loss. Radiological union was evaluated through follow-up X-rays. Functional outcomes were measured using the Harris Hip Score (HHS) at regular intervals postoperatively.

Results: PFN A2 group achieved a higher mean MHHP score and superior long-term functional outcomes, while maintaining better anatomical alignment and lower Tip apex distance, indicating improved fracture reduction stability and reduced complication risks, compared to the PFN group. On comparing two groups we found significant MHHP Score at 3 & 6 months, Neck shaft angle and Tip apex distance ($p<0.05$). No significant difference was observed between the two groups in the duration of union.

Conclusion: With minor variations in surgical and early postoperative parameters, PFN and PFN A2 both yield satisfactory results for intertrochanteric fractures. The surgeon's preference and the fracture pattern may influence the implant selection. Additional long-term research is required to confirm these results.

Keywords: Intertrochanteric fracture, PFN vs PFN A2, functional and radiological outcome.

Introduction:

One of the most frequent injuries seen in orthopaedic practice is an intertrochanteric fracture of the femur, which is especially common in the elderly due to osteoporosis and low-energy trauma like falls at home. Because of the high rates of morbidity and mortality linked to these fractures, orthopaedic surgery places a high priority on managing them effectively. Restoring pre-injury functional status, enabling early mobilisation, and achieving stable fixation are the main objectives of treatment (1,2).

Intramedullary nailing techniques are becoming more and more popular because of their biomechanical benefits, minimally invasive approach, and capacity to treat unstable fracture patterns. A variety of internal fixation devices have been developed for the management of intertrochanteric fractures. With advantages like rotational stability and a shorter lever arm, the Proximal Femoral Nail (PFN) has been used extensively and has been shown to improve results in both stable and unstable fracture types. However, issues like varus collapse, screw cut-out, and implant failure have led to the creation of modified implants (3,4).

An improved version called the Proximal Femoral Nail A2 (PFN A2) was created to overcome some of the drawbacks of the traditional PFN. It includes elements like a helical blade for increased biomechanical stability and bone compaction, which may result in shorter operating times, less intraoperative blood loss, and better functional results. Although some results suggest that the differences in functional outcomes may not always be statistically significant, recent comparative studies suggest that PFN A2 may offer advantages over the traditional PFN in terms of anatomical reduction,

early rehabilitation, and lower complication rates. (5,6)

Given the ongoing debate regarding the optimal fixation device for intertrochanteric fractures, this prospective comparative study aims to evaluate the clinico-radiological and functional outcomes of intertrochanteric fractures treated with Proximal Femoral Nail versus Proximal Femoral Nail A2.

Aim:

- To assess clinico-radiological and functional outcome of intertrochanteric fractures treated with proximal femoral nail as against proximal femoral nail A2.

Objectives:

1. To assess the clinical and functional outcome of surgical management and complications of intertrochanteric femur fracture with proximal femoral nail and proximal femoral nail A2.
2. To assess the radiological outcome between the proximal femoral nail and proximal femoral nail A2.

Methodology:

This study is a prospective and comparative design conducted over 18 months in the Department of Orthopaedics at PESIMSR Hospital, Kuppam. A purposive sampling technique will be used, with a total sample size of 60 participants. Exclusion criteria consist of patients with associated fractures in the same limb (ipsilateral limb fractures).

A common protocol of history taking, clinical examination, routine blood investigations and pre-operative x-ray imaging were performed as a part of the pre-operative preparation. Patient who are undergoing either PFN or PFNA2 as per standard protocol, intra-operative findings were obtained from operative procedure notes and Post operatively patients of both the groups were compared for their clinico-radiological and functional outcome and post operative finding and modified harris hip score were taken to assess the functional outcome. The unpaired t-test is used as a statistical test to compare the outcomes between two groups.

Inclusion Criteria:

- Patients aged above 18 years (both male and female) with intertrochanteric fractures.
- Patients with closed fractures.

Exclusion Criteria:

- Associated fractures of ipsilateral limb.

PERIOD OF FOLLOW-UP:

Follow-up intervals were at 0, 1, 3, and 6 months postoperatively to assess functional and radiological outcomes using Modified Harris Hip Score

Instrumentation:

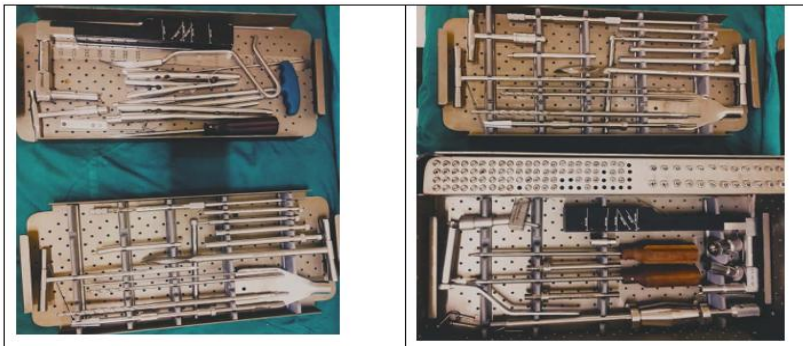


Fig.5: PFN instrumentation with nail

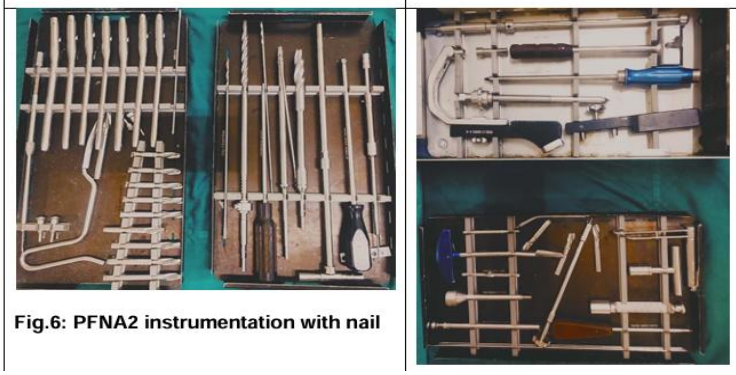


Fig.6: PFNA2 instrumentation with nail

SURGICAL TECHNIQUE:

Operative technique for PFN:

Patient positioning and fracture reduction:

The patient is positioned supine on a fracture table, with the injured limb elevated 10 to 15 degrees. Internal rotation and traction were used to close the fracture. The unaffected leg is maintained in a broad abduction or is flexed and abducted as far as feasible. The image intensifier was positioned to allow for the taking of lateral and anterior-posterior views of the hip and femur. If closed reduction is unsuccessful, open reduction is carried out. After that, the patient is dressed and prepped like they would for any other hip fracture treatment. Thirty minutes prior to surgery, all patients receive a prophylactic antibiotic. Approach: In thin individuals, the greater trochanter tip was found by palpation; in obese patients, an image intensifier was used. An incision of 5 cm in length was made proximal to the greater trochanter's tip. The fascia lata was cut parallel, and the gluteus medius was divided perpendicular to the fibers. The larger trochanter's tip is shown.

Determination of entry point and insertion of guide wire:

The entry point is on the tip of the greater trochanter, or slightly lateral to it, in the AP view on the C-arm with the help of straight awl or curved bone awl. However in intertrochanteric fractures fracture involves tip of trochanter with comminution. If it is a simple fracture extending to tip of trochanter without comminution, it is easy to put guide pin as fracture site itself provides the entry point. But in practice, there is always some comminution at tip of trochanter or fracture line is not exactly through tip. Due to this even if an entry is made in tip of trochanter, due to narrow bone bridge lateral to tip of trochanter and medial to fracture line, guide wire and subsequent reamers fall into fracture line thus making the entry lateral to tip of trochanter. Some times there will be comminution with an additional coronal split so that there is no lateral support at the entry region while reaming or putting nail. All these things lead to lateral entry of nail. However we believe these things will not affect the final outcome as comminuted fragments sit around the nail and mould and unite thus there will not be significant abductor weakness. Important technical aspect here is to start the entry from tip of trochanter and slightly anterior in the lateral plane and then aim to pass the guide wire into shaft of femur in the centre, once guide wire is passed into shaft we ignore the lateralization of guide wire at tip of trochanter.

Reaming:

Using cannulated proximal reamer, proximal femur is reamed for distance of 7cms.

Insertion of PFN:

An appropriate size nail, selected preoperatively, is attached to the insertion handle and manually inserted once sufficient fracture reduction has been confirmed. To accomplish this step, twist your hand slightly until the 8mm screw hole is at the level of the neck's inferior margin. When closed methods are unable to provide a suitable reduction, open reduction is carried out. Placement of guide wire for lag screw and derotation screw Using an aiming device that is loosely fastened into the insertion handle, these are inserted. After making a stab incision, a 2.8 mm guide wire is passed through the drill sleeve. The planned screw size is 5 mm larger than the guide wire's placement. At least 4 millimeters above the calcar to a position 5 millimeters below the subchondral bone, the guide wire is inserted into the femoral head. In both AP and lateral views, the guide wire's final location should be in the lower neck region and in the middle of the neck. For derotation screw, a second 2.8 mm guide wire was put through the drill sleeve above the previous one.

Placement of lag screw and derotation screw:

Drilling continues over the 2.8mm guide wire until the drill is 8mm away from the tip. Since neck screws self-tap, tapping is not necessary. A cannulated screwdriver is used to install neck screws. A hip pin of corresponding length is inserted. Using a C-arm picture, the screw's length and location are verified. Distal locking: Cortical screws are typically used in distal locking procedures. By use of a stab incision, a drill sleeve system is introduced. Both cortices are drilled through using a 4mm drill bit. Position is verified using an image intensifier once the locking screw is installed.

Closure:

Lavage with regular saline is administered following fixation, and the incision is then closed in layers. When performing an open reduction, a suction drain is utilized. Wound covered with sterile dressing, compression bandage provided. Total time of the surgery was noted intra-operatively.

Operative technique for PFNA Asia (PFNA II):

Patient positioning, fracture reduction, Drapping, Approach, entry point, guide wire placement and Reaming are same for PFN nailing

Insertion of PFNA II Nail:

An appropriate size nail, selected preoperatively, is attached to the insertion handle and manually inserted once sufficient fracture reduction has been confirmed. This phase involves carefully rotating the hand in small circles until the center of the neck contains the hole for the helical blade, without using any hammering. When closed methods are unable to

provide a suitable reduction, open reduction is If reaching a satisfactory reduction through closed methods is not feasible, open reduction is carried out. If closed methods are unable to provide a suitable reduction, open reduction is carried out.

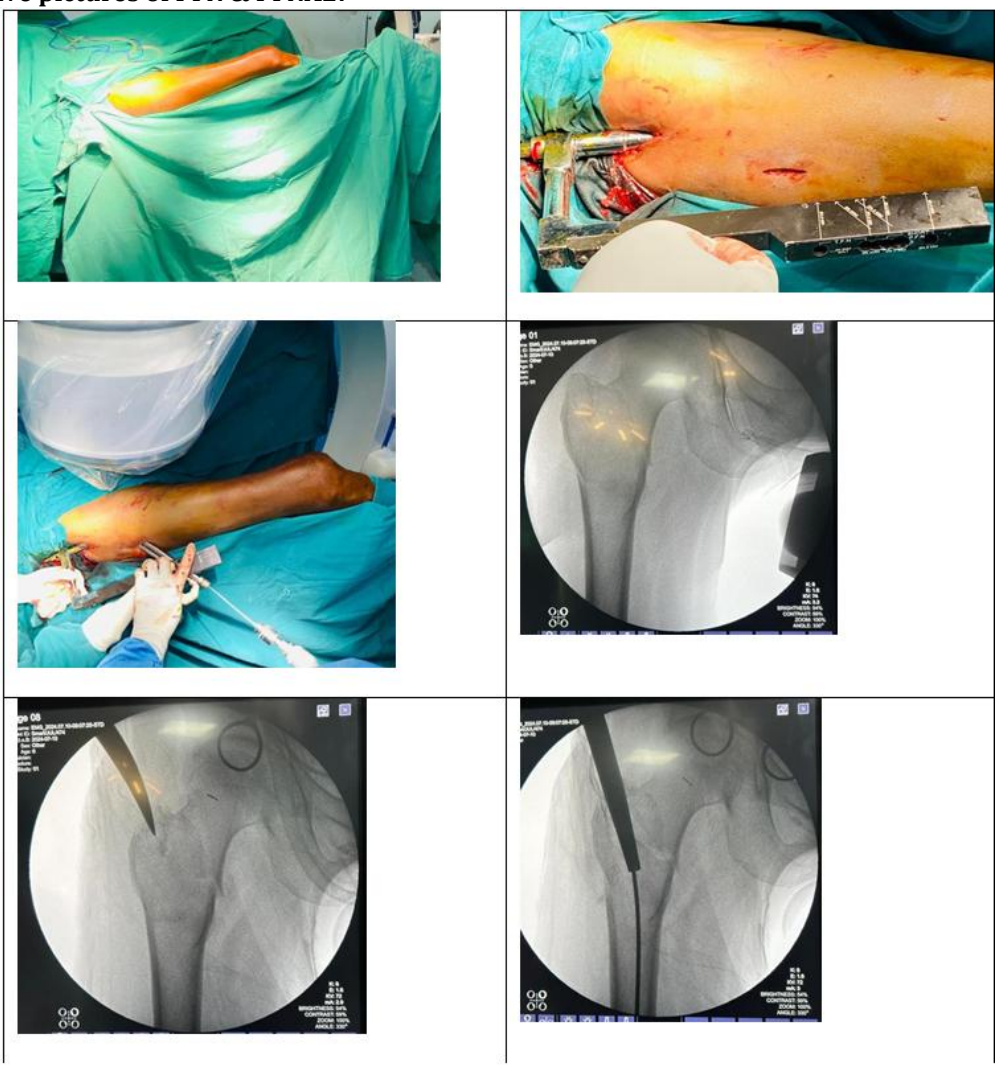
Placement of guide wire for helical blade:
A light-screwed pointing device attached to the insertion handle facilitates the insertion of the guide wire. A stab incision is made, and a 2.8 mm guide wire is threaded through 57 the drill sleeve. The intended screw size is 5 mm larger than where this guide wire is put. In order to reach a level 5mm below the subchondral bone, the guide wire must be inserted into the femoral head at least 4mm above the calcar. The guide wire's ultimate location should be in the middle of the neck when viewed in AP and lateral views.

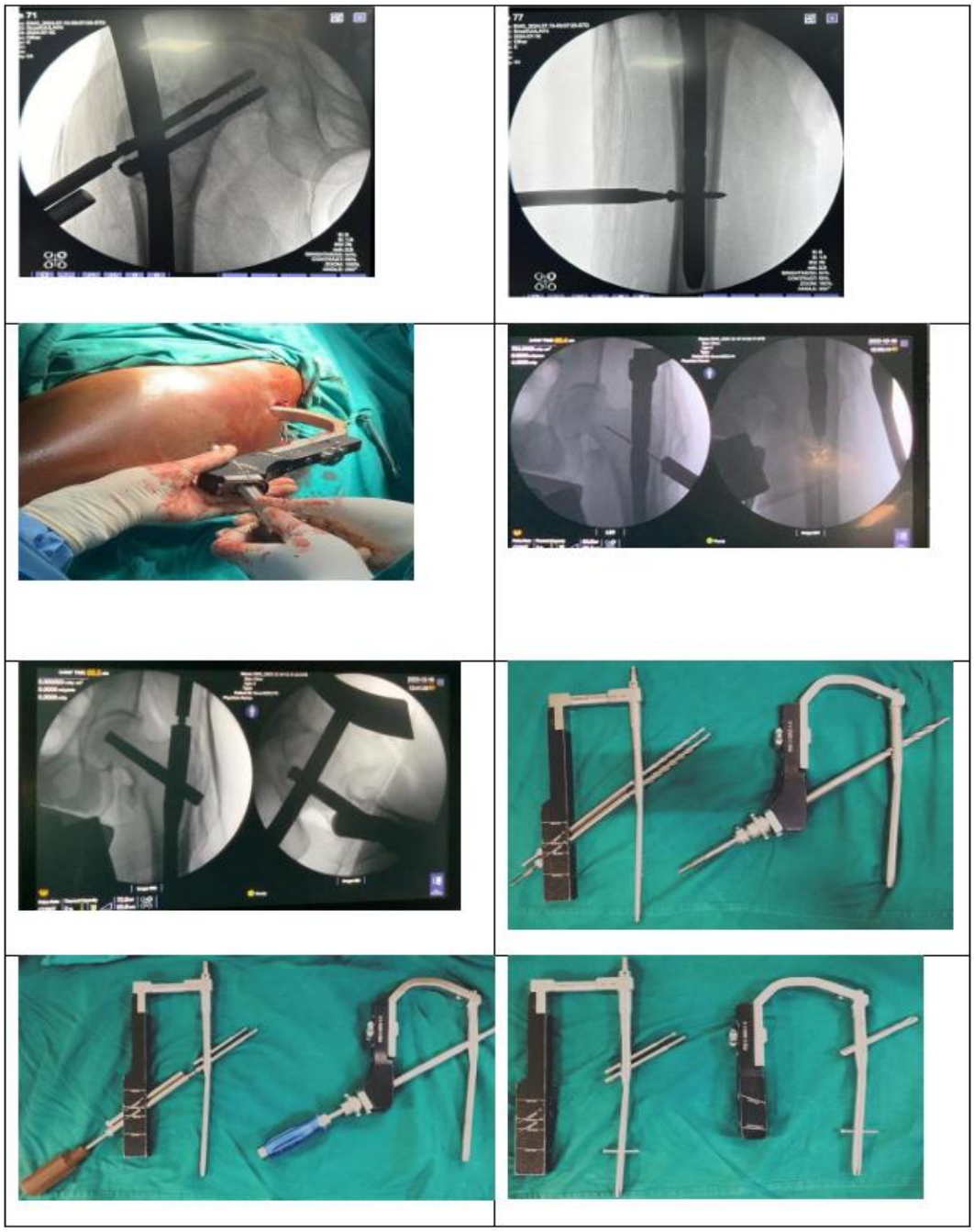
Placement of helical blade:
Drill over the 2.8mm guide wire until the drill bit is 8mm away from the guide wire's tip. Initially Helical blade is distracted by antirotation using impactor. After completion of distraction, Helical blade is inserted by using impactor by gentle tapping with mallet. Length and position of Helical blade is confirmed with help of c-arm. Now, helical blade is rotated clockwise causing compression at helical blade.

Distal locking:
Two cortical screws are often used for distal locking. Through a stab incision, a drill sleeve system is implanted. A 4mm drill bit is used to drill a hole through both cortices. The locking screw is inserted, and an image intensifier is used to validate its location.

Closure:
Lavage with regular saline is administered following fixation, and the incision is then closed in layers. When performing an open reduction, a suction drain is utilized. Wound covered with sterile dressing, compression bandage provided. Total time of the surgery was noted intra-operatively.

Intraoperative pictures of PFN & PFNA2:





Results:

Table 1: Demographic characteristics of patients

Variable		PFN (n = 30) (%)	PFN A2 (n = 30) (%)
Age		67.03 ± 17.77	68.70 ± 13.85
Gender	Male	16 (53.33)	22 (73.33)
	Female	14 (46.67)	8 (26.67)
Comorbidities	Present	15 (50)	8 (26.67)
	Absent	15 (50)	22 (73.33)
Side of Fracture	Left	15 (50)	16 (53.33)
	Right	15 (50)	14 (46.67)
Classification Boyd & Griffith	Type – 1	8 (26.67)	15 (50)
	Type – 2	22 (73.33)	15 (50)

Table 1 shows the Demographic characteristics of patients and the mean & SD of age among patients in the PFN and PFN A2 group are 67.03 ± 17.77 and 68.70 ± 13.85 years. The majority of the participants in our study is male. 50% of the participants in PFN group and 26.67% of the participants in the PFN A2 group had Comorbidities. The distribution of left and right fractures remains relatively balanced, with minor variations. The PFN group had predominantly Type–2 fractures (73.33%), while the PFNA2 group had an equal distribution of Type–1 and Type–2 (50% each).

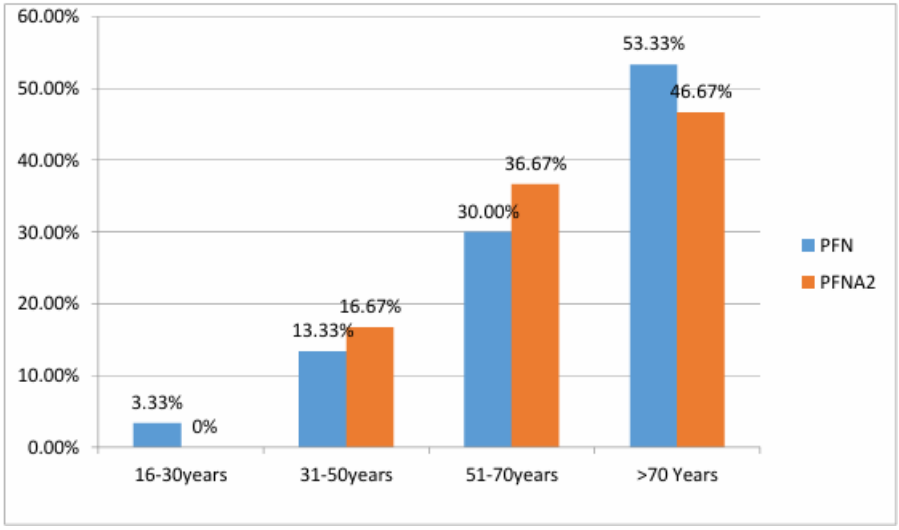


Table 2: Comparison of Surgical Outcomes Between PFN and PFN A2 Groups

Variable	PFN (n = 30) (%)	PFN A2 (n = 30) (%)
CRIF with IMIL nail	29 (96.67)	29 (96.67)
ORIF with IMIL nail	1 (3.33)	1 (3.33)
Duration of Surgery (minutes)	94.66 ± 15.19	66.50 ± 9.83
Blood loss	275 ± 65.32	243.33 ± 44.97

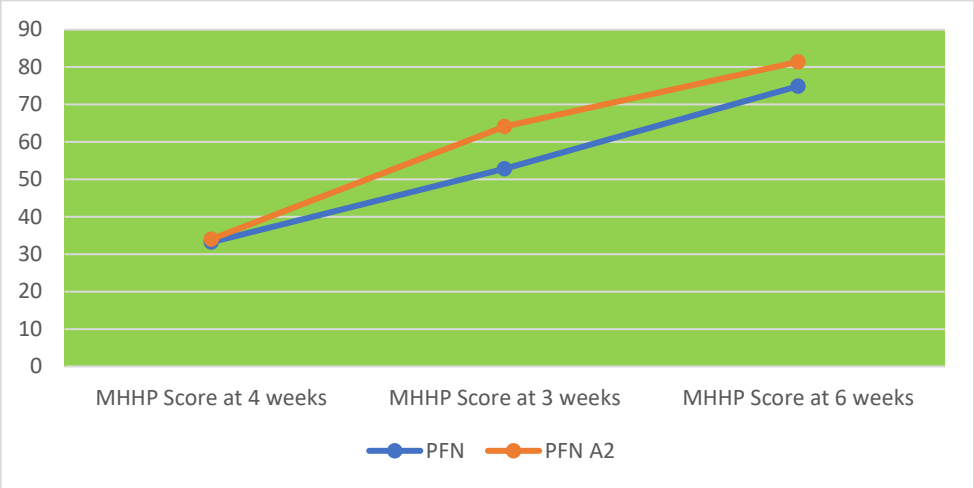
In both groups 96.67% patients had CRIF with IMIL nail and 3.33% of patient had ORIF with IMIL nail. The duration of surgery and blood loss were higher among the patients in the PFN group.

Table 3: Comparison of Postoperative Functional and Radiological Outcomes Between PFN and PFN A2 Fixation

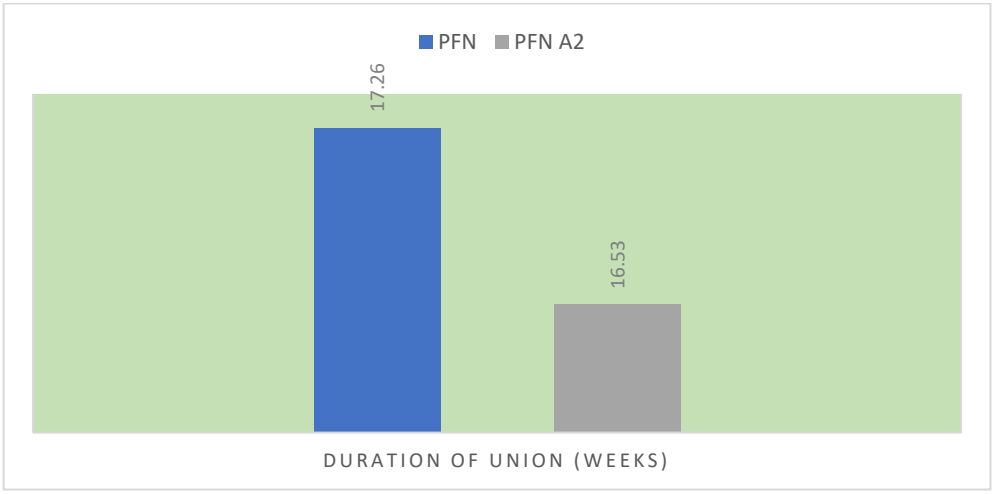
Variable	PFN (n = 30) (%)	PFN A2 (n = 30) (%)	p-value
MHHP Score at 4weeks	33.2 ± 3.18	34 ± 0.1	0.1746
MHHP Score at 3 months	52.86 ± 0.73	64.1 ± 3.44	***<0.0001****
MHHP Score at 6 months	74.9 ± 0.54	81.4 ± 1.88	***<0.0001****
Duration of union (weeks)	17.26 ± 2.43	16.53 ± 1.88	0.1965
Neck shaft angle	133 ± 2.49	135 ± 0	***<0.0001****
Tip apex distance (mm)	22.05 ± 2.61	17.48 ± 1.67	***<0.0001****

p = <0.05 considered as significant

Table 3 shows the Comparison of Postoperative Functional and Radiological Outcomes Between PFN and PFN A2 Fixation. At 4 weeks, there was no significant difference in Modified Harris Hip Pain (MHHP) scores between the PFN (33.2 ± 3.18) and PFN A2 (34 ± 0.1) groups and by 3 months, the PFN A2 group showed significantly better functional recovery (64.1 ± 3.44) compared to the PFN group (52.86 ± 0.73). This trend continued at 6 months, with the PFN A2 group achieving a higher mean MHHP score (81.4 ± 1.88) than the PFN group (74.9 ± 0.54), indicating superior long-term functional outcomes.



No significant difference was observed between the two groups in the duration of union. The PFN A2 group maintained a better anatomical alignment (135 ± 0°) compared to the PFN group (133 ± 2.49°), indicating improved fracture reduction stability. The PFN A2 group had a significantly lower TAD (17.48 ± 1.67 mm) than the PFN group (22.05 ± 2.61 mm), suggesting more precise implant placement, which is associated with reduced complication risks.



On comparing two groups with functional and radiological outcome we found significant with MHHP Score at 3 & 6 months, Neck shaft angle and Tip apex distance ($p < 0.0001$).

Discussion:

Our study compares clinico-radiological and functional outcomes of intertrochanteric fractures treated with Proximal Femoral Nail (PFN) versus Proximal Femoral Nail A2 (PFN A), a common issue in the elderly population.

A similar study by Harisankar M et al found the mean & SD of Harris Hip score at the end of 6 months of PFN and PFN A2 are 81.4 ± 10.1 and 80.6 ± 13.2, respectively, whereas in our study, the Harris Hip score among PFN and PFN A2 are 74.9 ± 0.54 and 81.4 ± 1.88, which shows PFN A2 is better in our study. In both studies, the duration of surgery is found to be higher with patients in the PFN group than the PFN A2 group. The union was quicker and a better outcome was seen in patients with PFN A2 (7). Our study results on functional outcome were supported by Mallya S et al and Kashid MR et al, which indicates that post-operatively MHHP Score was better among the patients with PFN A2 than the patients with PFN (8,9). Another contrary study by Gadhe SS et al found the mean HHS (Harris Hip score) in patients in the PFN group was 85.32 ± 12.96 while that of those treated with PFN A2 was 83.36 ± 11.57 (10).

In our study the duration of union among PFN and PFN A2 are 17.26 ± 2.43 and 16.53 ± 1.88 weeks and the duration of union was earlier among PFN A2. Similarly study by Mahendra M et al found the average fracture union time was 18.23 ± 2.09 weeks which is greater than our study and the difference may be due to differences in age (11). In the study by Bhasme VK et al found 4 patients in the PFN A2 and 6 patients in PFN group had more than 25 mm in Tip apex distance and in our study the mean & SD of Tip

apex distance in the patients with PFN and PFN A2 are 22.05 ± 2.61 mm and 17.48 ± 1.67 mm and found to be significant (0.0001). In the same study Neck shaft angle was better with patients in PFN A2 than patients with PFN which is consistent with our study results. The radiological union was 24 weeks in PFN A2 and 25 weeks in PFN, the author indicated that radiological union was earlier with PFN A2 which is same as our study results (12). Our radiological results were corroborated by earlier research. Kashid MR et al. and Mallya S et al.'s indication Patients with PFN had a higher rate of non-union than those with PFN A2 (8,9).

Intertrochanteric fractures can be effectively treated with both PFN and PFNA2, particularly when the pattern is unstable. Implant availability, patient bone quality, and surgeon preference may all influence the decision. Because of its improved anchorage and lower risk of cut-out, PFNA2 might be the better option for older patients with osteoporotic bone. Regardless of the device used, the best results depend on precise implant placement and proper surgical technique (13,14).

Among the study's drawbacks are its brief follow-up period and comparatively small sample size. More conclusive findings about the superiority of one implant over the other would come from a larger, multi center study with longer follow-up. Further research is necessary because patient-specific factors like comorbidities and bone quality, as well as the experience of the surgeon, may affect the results.

Conclusion:

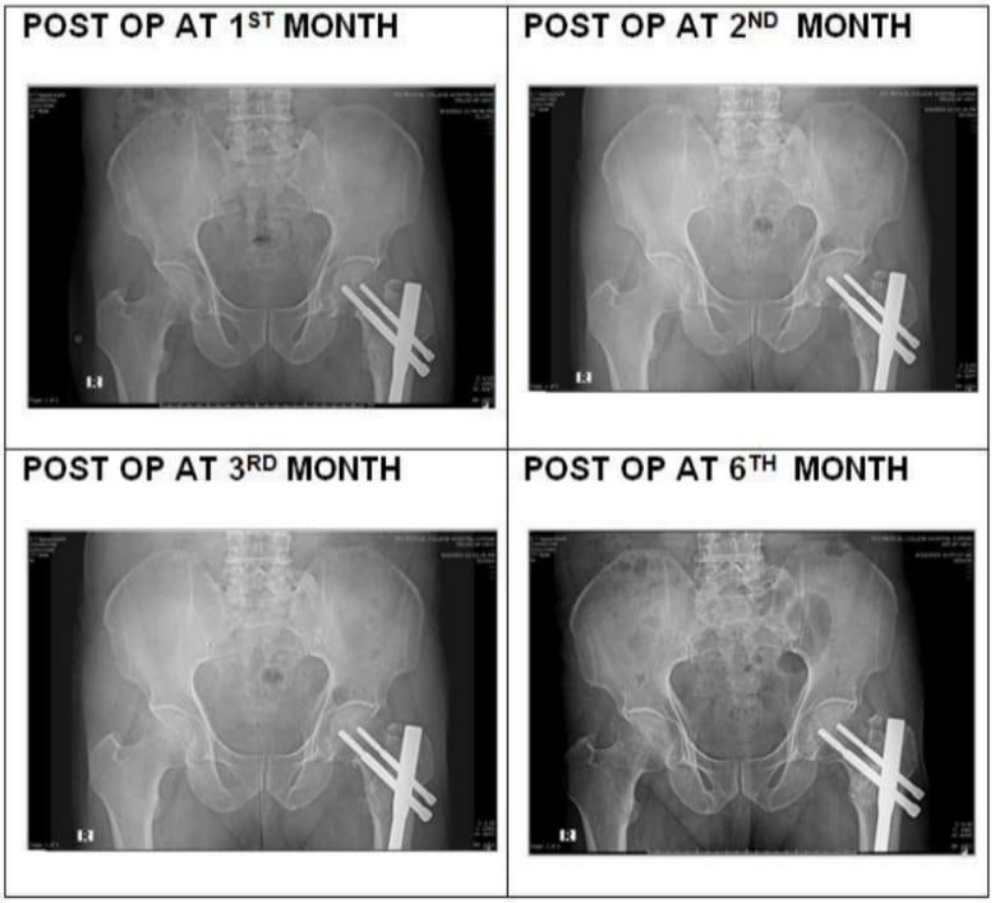
PFN A2 implants outperformed PFN in terms of functional recovery, surgical efficiency, and radiological reduction of fractures, with improved positioning stability and shorter operative times, indicating superior implant positioning. With the combined advantages of better surgical efficiency, better functional outcomes, and more favourable radiological parameters than conventional PFN, these findings suggest that PFN A2 may be a technically superior implant option for intertrochanteric fractures. As such, it is a better choice in clinical practice where early mobilisation and optimal functional recovery are given priority. Additional long-term research may be able to confirm these benefits and evaluate any possible variations in the two implants' rates of complications.

Conflict of interest: Nil
Funding: Nil

CASE – 1:

NAME	E T APPASWAMI
AGE/SEX	77 YEARS/MALE
MODE OF INJURY	RTA
FRACTURE SIDE	RIGHT SIDE
FRACTURE TYPE	BOYD & GRIFFITH TYPE 2
ASSOCIATED INJURIES	NO
RADIOLOGICAL UNION	16 WEEKS
MODIFIED HARRIP HIP SCORE	85
COMPLICATIONS	NO

X-Rays of case-1:

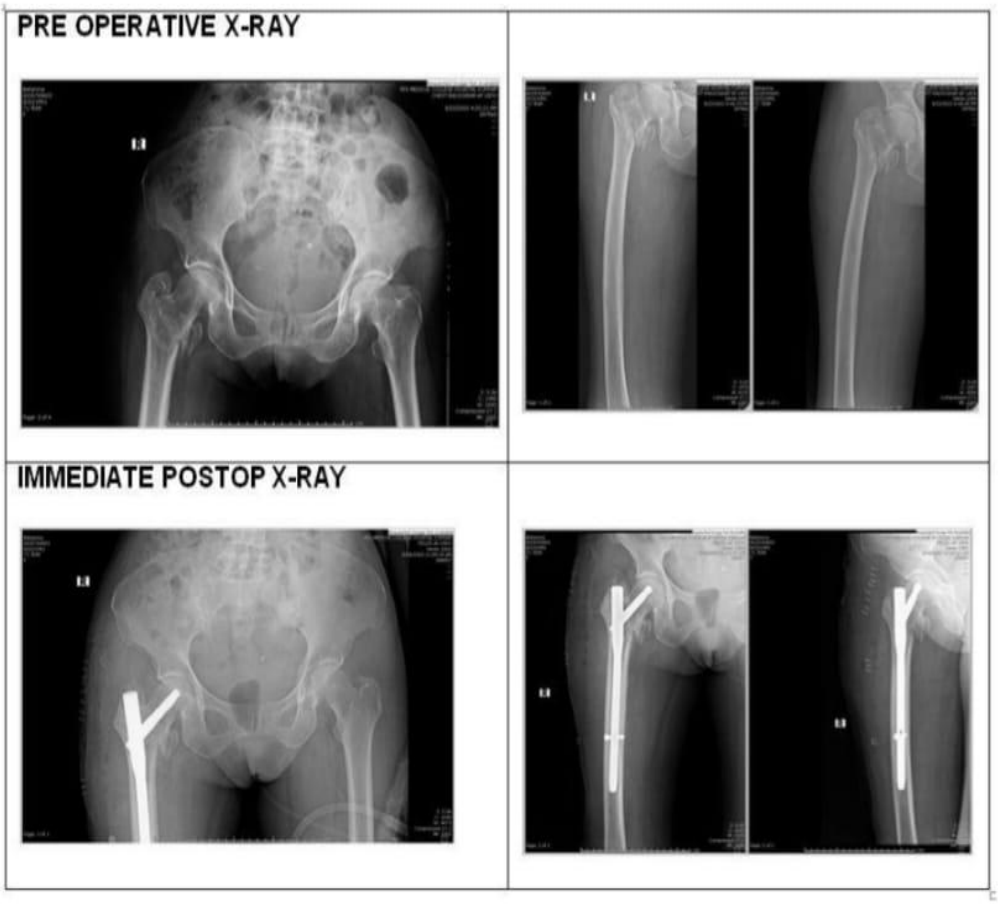


Clinical pics at 6th month followup:

CASE – 2:

NAME	BETAMMA
AGE/SEX	71 YEARS/FEMALE
MODE OF INJURY	TRIVIAL TRAUMA
FRACTURE SIDE & TYPE	RIGHT SIDE, BOYD &GRIFFITH TYPE 2
RADIOLOGICAL UNION	15 WEEKS
MODIFIED HARRIP HIP SCORE	85
COMPLICATIONS	NO

X-Rays of Case-2:



Clinical pics at 6th month followup:

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