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A Study on Functional outcome of Proximal Femoral Nail in Intertrochanteric Fracture among Agricultural Population using Modified Harris Hip Score

V. Manooj Kumar, M. Harri Vishnu, R. Arunmozhimaran Vijayababu, A. Shameen Raja

[1]Assistant Professor, Department of Orthopaedics, Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur, Tamil Nadu, India

[2]Associate Professor, Department of Orthopaedics, Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur, Tamil Nadu, India

[3]HOD, Department of Orthopaedics, Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur, Tamil Nadu, India

[4]Post Graduate, Department of Orthopaedics, Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur, Tamil Nadu, India

Corresponding Author: M. Harri Vishnu

Associate Professor, Department of Orthopaedics, Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur, Tamilnadu, India

KEYWORDS

Intertrochanteric fracture, proximal femoral nail, modified Harris hip score, functional outcome

ABSTRACT:

Background: Intertrochanteric fractures, being one of the most commonly encountered hip fractures with rise in elderly population unite's with conservative treatment, but with the risk of complications increasing the mortality and morbidity. Hence, surgical management is advised for early mobilization to reduce such complications of recumbency. Various implants were designed for surgical fixation such as proximal femoral nail, Dynamic Hip Screw, Gamma Nail. In 1996, AO designed PFN as an intramedullary device for unstable intertrochanteric fractures fixation. Implant designs are changing over a period of time such as helical blade PFN, addition of Trochanteric stabilisation plate, Gotfried percutaneous compression plating. The Purpose of this study is to analyse the radiological and functional outcome of intertrochanteric fracture patients surgically managed with PFN in agricultural population.

Materials and Methods: This study was carried out at Dhanalakshmi Srinivasan Medical College & Hospital among agricultural labourers from January 2020 to July 2022. 40 patients of age more than 60 years with intertrochanteric fractures of femur were treated with Proximal Femoral Nail. Radiological outcome and Functional outcome was assessed with Modified Harris Hip Score

Results: In our study, 18 patients (45%) suffered from fracture pattern 31A1, twenty two patients (55%) suffered from 31A2. Average operating time was 90 min. Complications and treatment failure were encountered in 12 (30%) patients. At 1 year of follow up using Modified harris hip Score, we had excellent results in 70% (28) of patients, good results in 10% (4) patients, fair results in 12.5% (5) patients and poor results in 7.5% (3) of patients.

Discussion: Our study indicates that PFN is an effective implants in osteoporotic and unstable trochanteric fractures even in Indian population where the neck diameter is small with narrow bones. complications like shaft fracture at tip of nail, avascular necrosis were not found. Good reduction of the fracture, and optimal positioning and length of the lag screw are crucial to avoid mechanical complication.

Conclusion: From this study we conclude that PFN still remains one of the implant of choice for intertrochanteric fractures providing Better radiological union & better functional outcome including squatting & sitting cross legged . Most important is to educate patients regarding surgery & postoperative protocol as patients residing in rural areas in developing countries are not educated enough regarding the need for surgical fixation & post-operative rehabilitation.

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INTRODUCTION

With the increasing elderly population over decades, intertrochanteric fractures are on rise with osteoporosis. About 50% of these fractures are unstable [1, 2].

A global epidemic of hip fractures involving intertrochanteric plus femoral neck fractures is predicted from 1.26 million in the year 1990, doubling by the year 2025, then 4.5-21 million by the year 2050, with a drastic increase in public health demand [3].

These intertrochanteric fracture unite's well with conservative treatment, but with the risk of complications such as malunion, coxa vara, external rotation deformity and medialization of shaft resulting in shortening of limb and limp [4].

Medical Co-morbid conditions such as diabetes, hypertension, renal, pulmonary and cardiac diseases all contribute to the fracture's insult. Elderly population are at risk of developing potentially fatal consequences such as pneumonia, pulmonary atelectasis, catheter-associated sepsis, decubitus ulcer and cardiopulmonary failure [5].

The primary goal of the treatment was early mobilization in order to avoid secondary complications as mentioned. Various operative procedures with different implants have been described for the treatment of intertrochanteric fractures. Treatment options include proximal femoral nail (intramedullary fixation), dynamic hip screw (extramedullary fixation) and gamma nai. The introduction of extramedullary devices (sliding compression hip screw and side plate device) till 1990 was considered the standard treatment of intertrochanteric fractures for nearly 40 years and provided excellent results with stable fractures [6].

The hip screw has been considered the implant of choice but it has been associated with complications such as collapse of the femoral neck, loss of hip offset leading to shortening of the leg. Although such sliding is expected in such devices, too much shortening is detrimental to the function of hip. Postero - medial comminution and absence of medial support of lesser trochanter in unstable fractures leads to implant failure, particularly cut-out and subsequent loss of reduction [7].

In 1996, for the treatment of unstable intertrochantric and subtrochanteric femur fractures, the AO/Association for the Study of Internal Fixation designed Proximal Femoral Nail as an intramedullary (IM) device [8].

Biomechanical studies have shown that intramedullary devices are more stable under load using a shorter lever arm and with controllable sliding [9].

PFN provides a more biomechanically stable construct by reducing the distance between hip joint and implant [10-12].

PFN prevents lateral translation of the proximal fragment and resist the bending force, thus allowing early weight bearing in unstable intertrochanteric fractures [12-14].

Numerous other studies recommend the use of proximal femoral nail as they demonstrate reduced surgical time [15-17], decreased blood loss [15, 16, 20], minimal incision [17] producing minimal soft tissue trauma/insult [18], advantage in unstable fractures [15, 16, 20], resulting in fewer reoperations [16], decreased duration of hospitalization [15, 16], faster recovery of mobility [4, 15] and less post-operative pain [18].

Surgical fixation of intertrochanteric fractures aids in early rehabilitation and early weight bearing and PFN definitely is advantageous over DHS both in terms of functional outcome, radiological union & post-operative complications [19].

Sitting in cross leg position and squatting on toes are essential activities for patients in the rural setting in the Indian sub-continent [20]. Hence, modified Harris hip score that includes items pertaining to squatting and sitting cross legged has demonstrated satisfactory construct validity, internal validity and responsiveness in cohort of patients with pertrochanteric fractures and treated with proximal femoral nail [22].

AIM AND OBJECTIVES

To analyse the radiological and functional outcome in patients with intertrochanteric fracture surgically treated with proximal femoral nailing using modified harris hip score which emphasis on squatting and sitting cross legged.

REVIEW OF LITERATURE

In 1996, the AO/ASIF developed the PFN as an intramedullary device & was designed to overcome difficulties encountered with earlier intramedullary proximal nail designs such as gamma nail. PFN creates biomechanically stable construct allowing early weight bearing [25].

With cephomedullary implant, it has advantage of shorter lever arm and less potential for the fracture collapse and limb shortening [26]. Tyllianakis *et al.* [27], in their study had 4.44% infection postoperatively. Gadegone and Salphale [23] in their study had shortening in 10% of their patients.

METHODS

PATIENTS

This prospective analytical study includes 40 patients with intertrochanteric fracture of femur managed in our institute, over a period of 24 months between January 2020 to July 2022 with a minimum follow-up of 24 weeks and maximum follow-up of 2 year.

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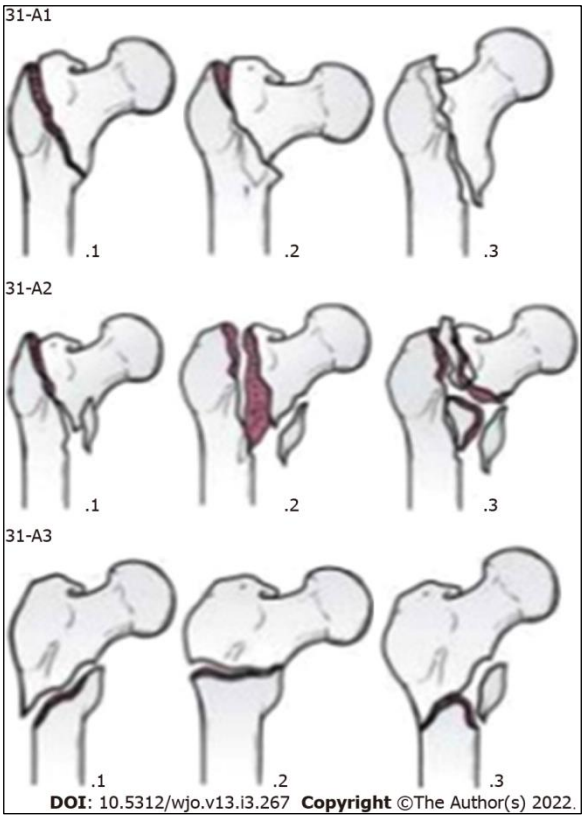

Fig 1: Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association classification of 31-A (Proximal femur) fractures

Arbeitsgemeinschaft für Osteosynthesefragen/ Orthopaedic Trauma Association classification as follows:

1. **A1:** Simple two part, lateral cortex remains intact.
2. **A2:** Comminuted with postero-medial fragment, lateral cortex remains intact.
3. **A3:** Line extend across both medial and lateral cortices, include reverse oblique.

INCLUSION CRITERIA WERE: Patients above 50 years of age; closed intertrochanteric fracture of less than 6 weeks; AO/OTA Types 31A1 & 31A2.

EXCLUSION CRITERIA WERE: Skeletally immature patients; pathological fractures of any cause other than osteoporosis, open fractures, AO/OTA Type 31A3, non-union, patients with multiple injuries, associated neurovascular injury, inability to walk independently prior to injury event; Neurological and psychiatric disorders that would preclude assessment (e.g., Parkinson disease, multiple sclerosis, severe depression).

Forty patients were treated with PFN (mean patients age, 71.4 years; men to female ratio, 1:1.22). There were 18 patients with 31A1 and 22 patients with 31A2 type in the study treated with PFN

OPERATION AND POSTOPERATIVE MANAGEMENT

In our institute, standard preoperative workup included radiographic evaluation of the fracture type along with baseline blood & medical investigations followed by anaesthetic assessments.

The PFN we used had a standard configuration with a length of 250 mm, mediolateral angulation of 6° and neck-shaft angle of 135°. The nail had a proximal diameter of 14 mm and distal diameter of 10, 11, and 12. We used a distal lag screw of 8 mm and proximal de-rotation screw of 6.2 mm. Distal locking was done with self-tapping 4.9 mm cortical screws, one of which were applied in static mode and the other in dynamic mode allowing 5 mm dynamization.

Operation was performed on fracture table in supine position under anesthesia. Closed reduction of fracture was confirmed by C-arm image intensifier. For PFN, the desired position of the lag screw was in the central femoral neck on the lateral view and in the central inferior femoral neck on

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the anteroposterior view, with the tip between 5 and 10 mm from the subchondral bone [21]. Distal locking was performed with help of jig. Closure was done in layers.

Postoperatively, the limb was elevated with a pillow. Postoperative protocol included intravenous antibiotics given for 5 days followed by oral antibiotics for next 7 days. On postoperative day 1 of surgery, static quadriceps exercises, knee and ankle mobilisation exercises were started under supervision of a physical therapist. Active quadriceps and hip flexion exercise were started on 6th and 7th postoperative day.

Postoperatively patient was assessed for any postoperative complications.

Dressings were done on 2nd, 5th and 8th postoperative days. Sutures were removed on 12th postoperative day. Patients were advised to do non weight bearing mobilisation with walker as soon as tolerable. Partial weight bearing was started at about 4 weeks postoperatively. Full weight bearing walking was allowed after assessing for the radiological and clinical union. The presence of callus radiologically and absence of tenderness was considered union.

FOLLOW-UP

Patient was followed up and were assessed clinically and radiologically. Functional assessment was done after 12 months as per Modified Harris Hip Score [22].

The patients were evaluated based on the following clinical and radiological parameters:

1. Age.
2. Gender.
3. Mode of Injury.
4. Side of fracture.
5. Fracture patterns according to the AO/OTA classification.
6. Time interval between injury and surgery.
7. Duration of surgery (starting from skin incision to skin closure).
8. Duration of Hospitalisation.
9. Time of radiation exposure.
10. Time to radiological union.
11. Implant-related complications like backing-out of proximal screws from the lateral cortex of the femur, 'Z' effect, screw breakage, cut-through of implant from femoral head, breakage of distal interlocking screw, and breakage of nail.
12. Length and rotation of the limb after healing.

Domains and items	Points
Pain	
None or ignores it	44
Slight, occasional, no compromise in activities	40
Mild pain, no effect on average activities, rarely moderate pain with unusual activity, may take diclofenac	30
Moderate pain, tolerable but makes concessions to pain, some limitation of ordinary activity and work: may require occasional pain medicine stronger than diclofenac	20
Marked pain, serious limitation of activities	10
Totally disabled, crippled, pain in bed, bedridden	0
Function: Gait.	
Limp	
None	11
Slight	8
Moderate	5
Severe or not able to walk	0
Support	
None	11
Cane for long walks	7
Cane most of the time	5
One crutch	3
Two canes	2
Two crutches or not able to walk	0
Distance walked	
Unlimited	11
Six blocks	8
Two or three blocks	5
Indoors only	2
Bed and chair	0
Functional activities	
Stairs	
Normally without using a rail	4
Normally using a rail	2
In any manner	1
Unable	0
Squatting	
With ease	4
With difficulty	2
Unable	0
Sitting cross legged	
With ease	5
With difficulty	3
Unable	0
Public transportation	
Able to use	1
Unable to use	0
Hip range of motion (Clinician assessed)	
Flexion (maximum = 140°)	
Abduction (maximum = 40°)	
Adduction (maximum = 40°)	
External rotation (maximum = 40°)	
Internal rotation (maximum = 40°)	
Range of motion scale (sum of the range of motion)	
211–300	5
161–210	4
101–160	3
61–100	2
31–60	1
0–30	0
Absence of deformity (Clinician assessed)	
•Less than 30° fixed flexion contracture – Yes/No	
• Less than 10° fixed abduction – Yes/No	
• Less than 10° fixed internal rotation in extension – Yes/No	
• Less than 3.2 cm limb length discrepancy – Yes/No	
If all 4 yes	4
If less than 4 yes	0

Fig 2: Shows the domains and items of the modified Harris hip score

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RESULTS

Parameters	PFN
1. Age	
a. Mean	71.4
b. Minimum Age	61
c. Maximum Age	80
2. Gender	
a. Male	18
b. Female	22
3. Mode of Injury	
a. Domestic fall	26
b. Road traffic accidents	14
4. Side of Fracture	
a. Right	24
b. Left	16
5. Fracture Pattern (AO Type)	
a. 31A1	18
b. 31A2	22

Table 1: Demographic Data

Parameters	PFN
Interval between Injury and Surgery (days)	6.8 (range 2-11)
Duration of Surgery (mins)	90.5 (range 45-120)
Duration of Hospitalisation (days)	7.3 (range 6-12)
Blood Loss (ml)	107 (range 90-120)
Radiation Exposure (mins)	12.5 (range 10-34)
Time of Radiological Union (weeks)	
a. 6 weeks	6
b. 3 months	24
c. 6 months	10

Table 2: Clinical Data

Duration	Mean Score
6 weeks	51.7 (range 37-71)
3 months	81.45 (72-92)
6 months	93.1 (range 87-98)
1 year	97 (range 88-98)

Table 3: Modified Harris Hip Score

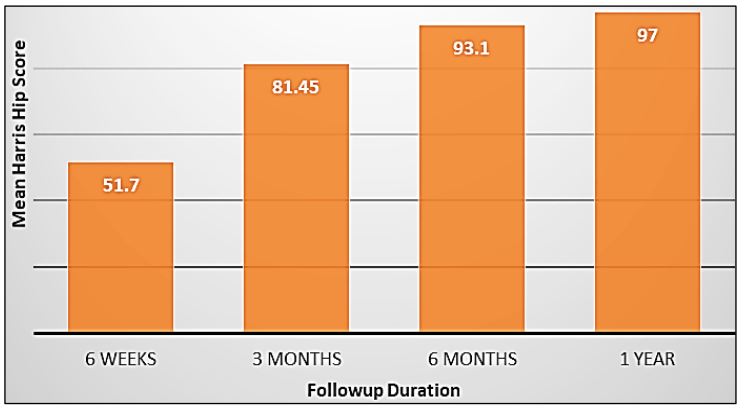

Fig 3: Graphical representation showing the mean Harris Hip Score at follow-up of 6 weeks, 3 months, 6 months & 1

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year

Grading	6 weeks	3 months	6 months	1 year
Poor	36	8	6	3
Fair	4	16	3	5
Good	-	12	10	4
Excellent	-	4	21	28

Table 4: Grading of Modified Harris Hip Score

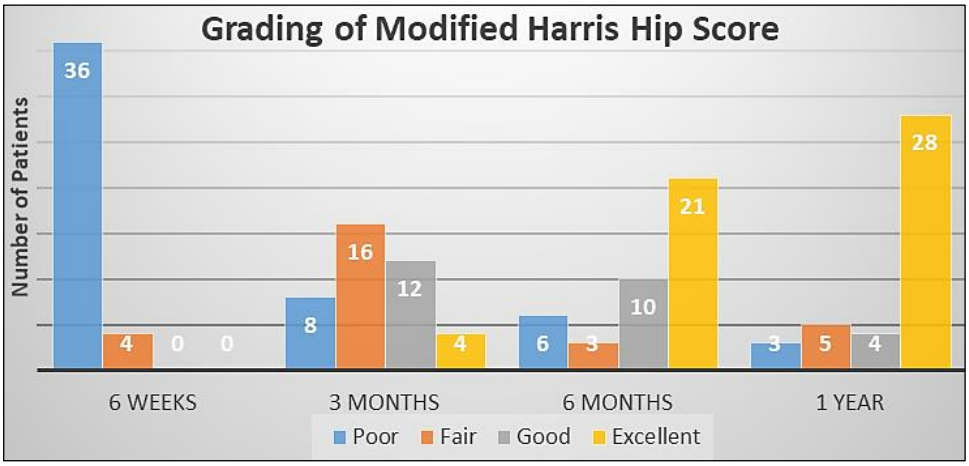

Fig 4: Graphical representation showing the Grading of modified Harris Hip Score at follow up of 6 weeks, 3 months, 6 months & 1 year

Domain of Squatting	Follow up at 3months (No of Patients)	Follow up at 6months (No of Patients)	Follow up at 1 year (No of Patients)
With ease	12	21	33
With difficulty	24	18	7
Unable	4	1	0
Mean Score	2.4	3	3.65

Table 5: Score of Squatting

Domain of Sitting Cross legged	Follow up at 3months (No of Patients)	Follow up at 6months (No of Patients)	Follow up at 1 year (No of Patients)
With ease	22	31	37
With difficulty	16	8	3
Unable	2	1	0
Mean Score	3.95	4.475	4.85

Table 6: Score of Sitting Cross legged

Complications	Number of Patients	Percentage
Inadequate Reduction	1	2.5
Failure to insert derotation screw	1	2.5
Difficulty in distal locking	1	2.5
Varus deformity	3	7.5
Shortening	2	5
Superficial Infection	1	2.5
Implant failure	1	2.5
Z effect	1	2.5
Malunion	1	2.5
Total	12	30

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Table 7: Complications

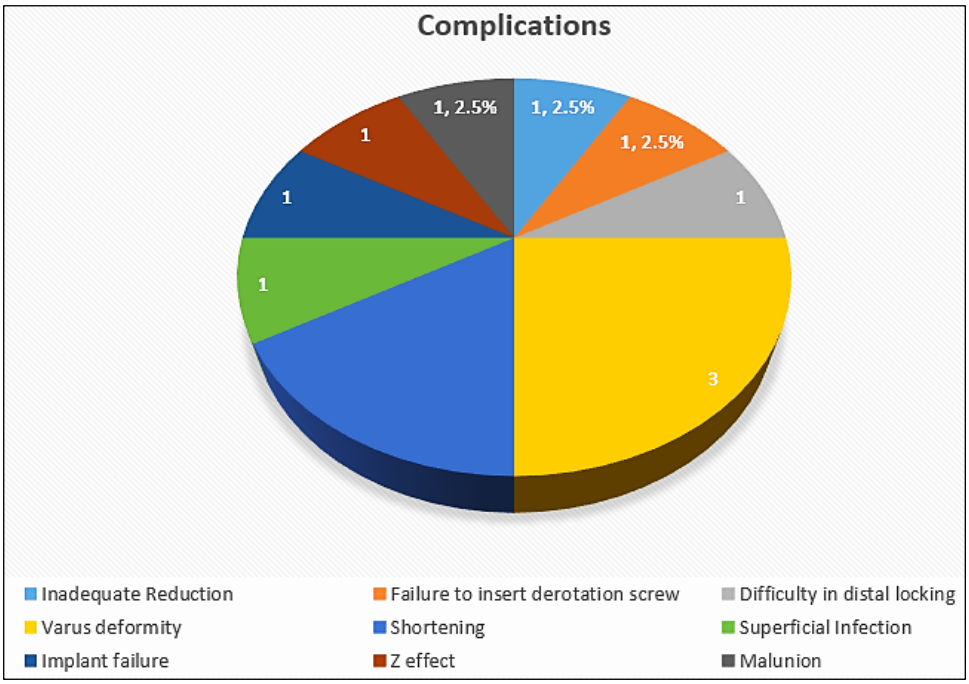

Fig 5: Pie chart representation showing the complications encountered in the study

This study involved forty cases of intertrochanteric fractures of either sex above the age of 50 years. All cases were treated by intramedullary fixation with a PFN. The age distribution was from 61 to 80 years (average 71.4 years). There were 18 males (45%) and 22 females (55%) in the study. Twenty six patients (65%) sustained the fracture due to a fall and 12 patients (35%) due to road traffic accident. Most of the patients who sustained the fracture due to fall were older in age and had osteoporosis. All the fractures were classified as per OTA classification [Table 1]. Fracture pattern, 31A1 was considered stable and 31A2 and 31A3, unstable fractures. In our study, 18 patients (45%) suffered from fracture pattern 31A1, twenty two patients (55%) suffered from 31A2. Average operating time was 90 min (45-120 min) after anesthesia. Closed reduction was achieved in all 40 patients (100%). The average hospital stay was 7.3days. It was more in patients with co-morbid conditions and complications with highest being 12 days. We encountered complications and treatment failure in 12 (30%) patients [Table 4]. Early complications include inadequate reduction in one patient (2.5%), failure to put derotation screw in one patient (2.5%), difficulty in distal locking in one patients (2.5%), varus deformity in three patient (3%),superficial infection in one patients (2.5%), implant failure in one patients (2.5%), and z effect in one patient (2.5%). Other complications include shortening in two patient (5%) and malunion in one patient (2.5%). Breakage of nail and inadequate fixation were considered implant failure.

According to modifed Harris Hip Score [22],

At 3 months, we had excellent results in 10% (4) of patients, good results in 30% (12) patients, fair results in 40% (16) patients and poor results in 20% (8) of patients.

At 6 months, we had excellent results in 52.5% (21) of patients, good results in 25% (10) patients, fair results in 7.5% (3) patients and poor results in 15% (6) of patients.

At 1 year of followup, we had excellent results in 70% (28) of patients, good results in 10% (4) patients, fair results in 12.5% (5) patients and poor results in 7.5% (3) of patients. Our results were comparable to similar studies done by Gadegone and Salphale [23].

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CASE REPORTS
CASE 1-75/M

PREOP X-RAY

IMMEDIATE POSTOP X-RAY

FOLLOWUP XRAY AT 6 MONTHS

HIP FLEXION

SITTING CROSS LEGGED

HIP FLEXION

EXTERNAL ROTATION

ABDUCTION

Clinical Follow up Picture at 6 Months

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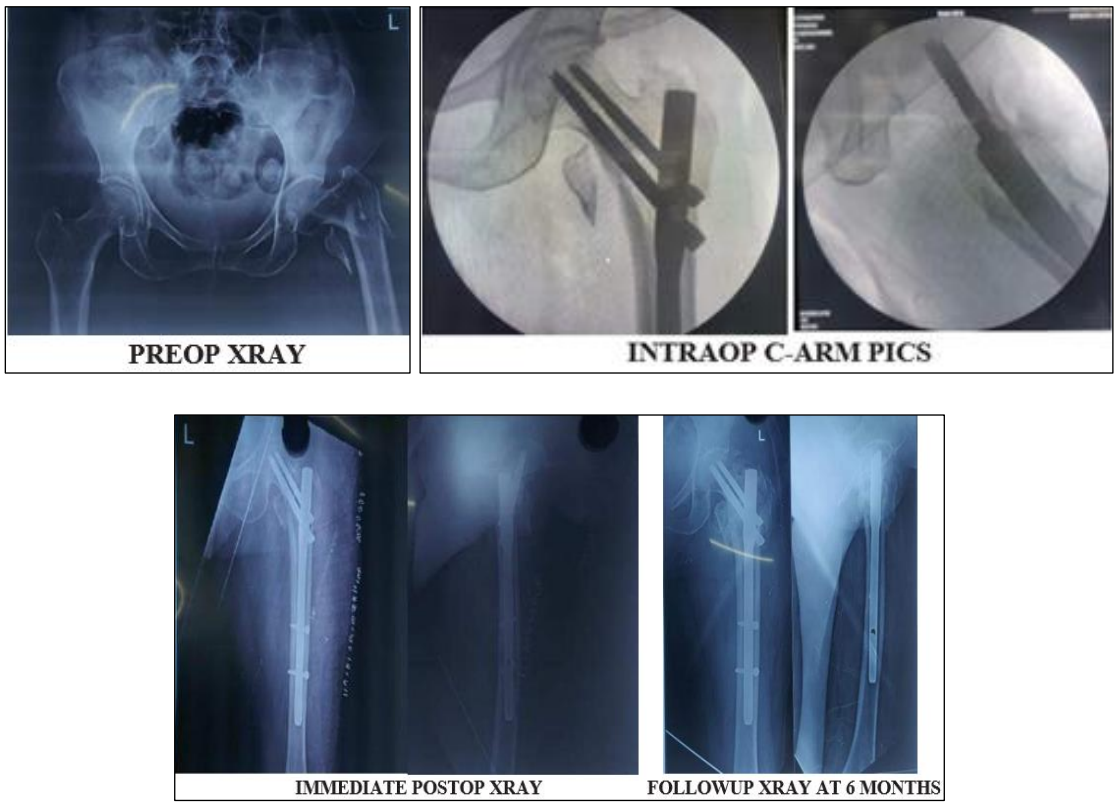
Case 2-80/F



Clinical Follow up Picture at 6 Months

DISCUSSION

Intertrochanteric fractures being one of the most commonly encountered hip fractures especially in elderly with osteoporotic bone is often due to low energy trauma like simple falls. The incidence is on rise with increasing number of elderly population. To avoid the complications of recumbency, the primary goal of treatment is to return the patients to his/her prefracture activity level as soon as possible & as well as for reducing mortality and morbidity. Kim *et al*. concluded in their study that unstable fractures with osteoporosis had more than 50% failure rate and dynamic hip screw should not be the preferred choice for treatment in such cases [24].

In 1996, the AO/ASIF developed the PFN as an intramedullary device & was designed to overcome difficulties encountered with earlier intramedullary proximal nail designs such as gamma nail. PFN creates biomechanically stable construct allowing early weight bearing [25]. With cephomedullary implant, it has advantage of shorter lever arm, less potential for the fracture collapse and limb shortening when used for intertrochanteric fracture [26].

In the present study, postoperatively 1 (2.5%) patient treated

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with PFN had superficial wound infection. Tyllianakis *et al*. [27] had similar finding, in their study they had 4.44% infection which is comparable to our study. Gadegone and Salphale [23] in their study had shortening in 10% of their patients which is comparable to our study. In cephalomedullary implant there was no telescoping reduction and less sliding because the proximal end of intramedullary nail was at the level of greater trochanter. When telescoping of the lag screw occurs the neck fragment abuts the intramedullary nail, thus preventing further collapse of the fracture, thus resulting in less subsequent shortening [28]. Center- center position in head of femur for lag screw and placement of antirotation screw is to be achieved to minimize rotation of the head of femur and to prevent further mechanical complication [29].

In our study, complications like shaft fracture at tip of nail, avascular necrosis as mentioned in various other studies were not found, as our follow-up was of short duration and it needs to be evaluated for longer duration to be statistically meaningful.

Our study indicates that PFN is an effective implants in osteoporotic and unstable trochanteric fractures even in Indian population where the neck diameter is small with narrow bones. Good reduction of the fracture, and optimal positioning and length of the lag screw are crucial to avoid mechanical complication.

CONCLUSION

From this study we conclude that PFN still remains one of the implant of choice for intertrochanteric fractures providing Better radiological union & better functional outcome including squatting & sitting cross legged . Most important is to educate patients where patients residing in rural areas in developing countries are not educated enough regarding the need for surgical fixation & post-operative rehabilitation.

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