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## Evaluating the Impacts of Proximal Femoral Nail Anti-Rotation (PFNA) Augmentation in Osteoporotic Intertrochanteric Fractures

Ramadan Mohamed Elsaïd Ahmed<sup>1\*</sup>

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### ABSTRACT

Surgical interventions are crucial for managing osteoporotic intertrochanteric fractures. Among these interventions, Proximal Femoral Nail Antirotation (PFNA) is preferred due to its advantages in reducing blood loss and surgical duration. This research study examined proximal femoral nail anti-rotation's clinical and radiological outcomes with augmentation in osteoporotic intertrochanteric fractures. The surgical approach encompassed 50 patients with osteoporotic intertrochanteric fractures treated between November 2012 and April 2014. The surgeries were performed in a supine position on a traction radiolucent table with general, regional, or spinal anesthesia. The incision and nail-blade angle were carefully selected, and postoperative outcomes, including range of motion, infection rates, and complications, were assessed. Results showed a 96% success rate with PFNA, with most patients regaining pre-surgery range of motion within six weeks. Fracture healing was effective in 94% of cases within six months, although some required revision surgery or experienced mechanical failure. Postoperative complications, including superficial infections and nonunion, were observed in a small percentage of cases. In conclusion, PFNA with augmentation is viable for treating osteoporotic intertrochanteric fractures, offering good clinical outcomes and a low complication rate. However, careful patient selection and surgical techniques are essential to minimize risks and ensure optimal results.

### INTRODUCTION

Intertrochanteric fractures, often in frail patients with multiple medical comorbidities, are increasing in prevalence due to ageing and resulting in long hospital stays, necessitating effective treatment strategies (Haidukewych, 3 march 2009). Intertrochanteric fractures are gender- and race-dependent, with elderly females experiencing 63 per 100,000 fractures in the US and 34 per 100,000 in males. Factors like advancing age, comorbidities, daily living dependency, and osteoporosis history contribute to these fractures and affect the regions shown in Figure 1. Proximal femoral fractures (PFFs) have high mortality rates and are increasing in France (Farahmand *et al.*, 2005; Green, 2010; Rosencher *et al.*, 2005).

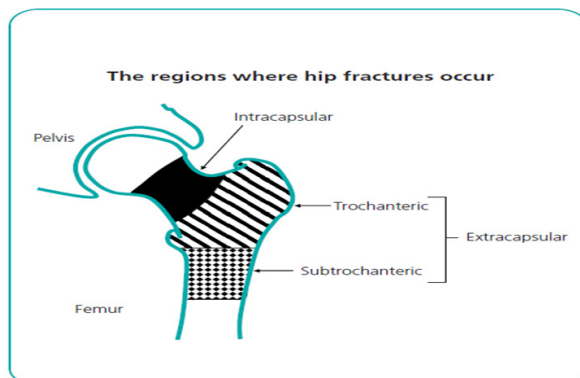
Extracapsular post-fracture fractures (PFFs) face instability due to comminution and rupture of the posteromedial

cortex. Dynamic screw plates, proximal intramedullary, and reconstruction nails have transformed management, but their superiority remains controversial. Mechanical complications, such as hardware-related fractures and blade cutouts, are high. The proximal femoral nail anti-rotation (PFNA) was designed to minimize these risks, with preliminary results suggesting it may have achieved this goal (Bhandari *et al.*, 2009; MishraA *et al.*, 2017; Sommers *et al.*, 2004).

Extracapsular fractures mainly involve cortical and compact cancellous bone, which occurs along the least resistance path through the proximal femur due to its complex stress configuration. The energy absorbed by the bone determines the fracture's complexity. Fatigue fractures can occur due to repetitive loading, causing microscopic damage to the osseous structure and stress riser (Moroni *et al.*, 2005; Smit Jakheria *et al.*, 2020).

Intertrochanteric fractures can be unstable due to several risk factors, including loss of medial buttress, markedly displaced fractures, reverse obliquity fractures, severe osteoporosis, and comminution at the fracture site. These fractures can result from severe soft tissue damage and loss of stability due to the original bone contact. Wide gapping at the fracture is not considered marked displacement (Chen *et al.*, 2016; Moroni *et al.*, 2005).

Intertrochanteric fractures in the femur are classified into four types: Type 1, which extends along the intertrochanteric line; Type 2, which is comminuted with multiple fractures in the cortex; Type 3, which is subtrochanteric with at least one fracture passing across

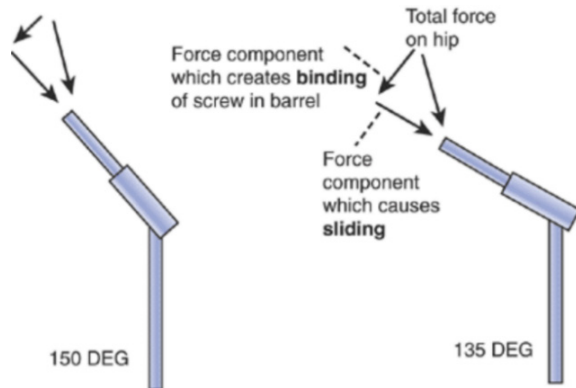


**Figure 1:** The regions where hip fractures occur

<sup>1</sup> Rashid Hospital Trauma Centre, Dubai, UAE

\* Corresponding author's e-mail: [ramadanahmed456@outlook.com](mailto:ramadanahmed456@outlook.com)

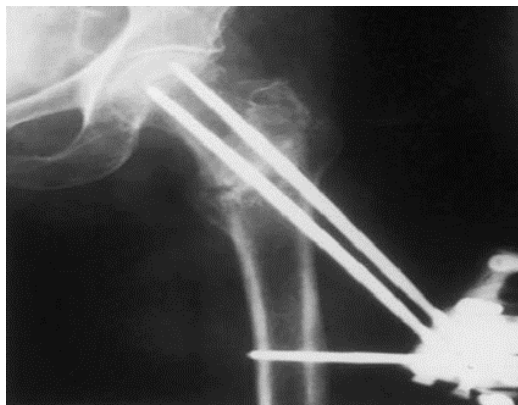
the proximal end of the shaft, and Type 4, which is fractures of the trochanteric region and the proximal shaft with fractures in at least two planes, often difficult to see on routine radiographs (Azar *et al.*, 2020). The biomechanics of fixation devices involve ensuring the dynamic hip screw can slide freely in the side plate barrel. Adherence to two basic mechanical principles enhances the screw's ability to slide. A higher-angle hip screw is more effective at accommodating dynamic and should be engaged deeply within the barrel (Wang *et al.*, 2020), as shown in Figure 2.



**Figure 2:** The joint reaction force in the femoral head consists of two main components: the force producing dynamic force and the transverse force resisting dynamic force

Dynamic hip screws with two- or four-hole side plates offer comparable resistance to physiologic compressive loading, with longer screws reducing resistance (Davey *et al.*, 2020).

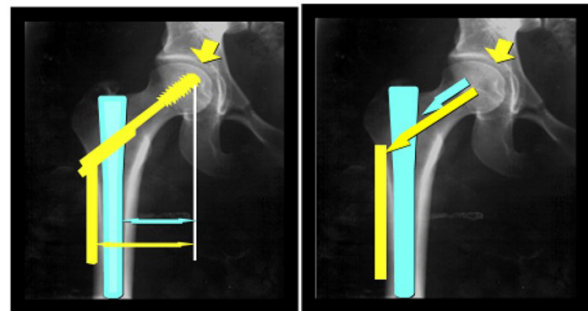
The Sliding Hip Screw (SHS) is a commonly used extra medullary implant consisting of a lag screw attached to a plate on the side of the femur. These 'dynamic' implants allow for collapse at the fracture site, while the Medoff plate has an inner and outer sleeve that can slide between each other. Static implants like fixed nail plates and the 90 or 95-degree blade plate are also used. External fixation can provide similar or better results than conventional



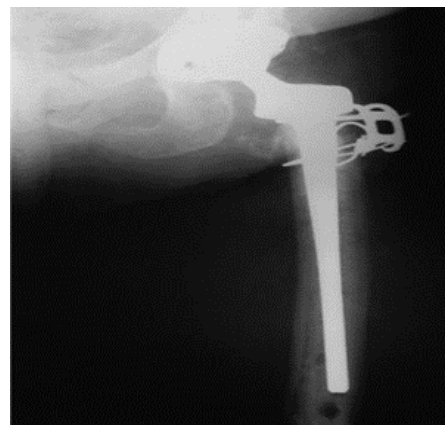
**Figure 3:** A radiograph reveals a pertrochanteric fracture with a slight valgus reduction, with the fixator in a satisfactory position

internal fixation techniques, with recent evidence supporting better results in pertrochanteric fractures treated with newly developed external fixators. The device typically consists of one or two half pins placed into the femoral neck to reduce the fracture and enhance callus formation. Load sharing between the fractured bone and the fixation is usually achieved, reducing damaging stresses on the fixator. Hydroxyapatite-coated external fixation pins can improve mechanical stability and reduce the risk of pin loosening and infection in osteoporotic bone (Moradi *et al.*, 2021), as shown in Figure 3.

Intramedullary nails, such as condylocephalic nails, internalize extracapsular fractures due to their reduced distance between the hip joint and implant, reducing bending moment, as shown in Figure 4. Examples include the Gamma nail, intramedullary hip screw, proximal femoral nail, Targon PF, Holland nail, and Kuntscher-Y nail. However, the Gamma nail has a higher risk of adverse events, including intra-operative and later fractures around or below the implant (Huang & Wu, 2021; Moon *et al.*, 2022).



**Figure 4:** Intramedullary nails over screw and plate fixation are attributed to a reduced distance between the hip joint and the implant



**Figure 5:** Salvage of failed intertrochanteric fracture fixation with calcar replacement prosthesis

Hip arthroplasty is a crucial procedure for treating intertrochanteric hip fractures. Still, it presents unique challenges, such as the need for calcar replacement prostheses and managing the fractured greater trochanteric fragment, as shown in Figure 5. Bony deficiency from

fractures often results in a bone deficiency below the standard resection level for primary total hip arthroplasty. Femoral components with modular calcar augmentations are available for intraoperative flexibility. Either cemented or uncemented femoral-component fixation can be effective, with cemented fixation advantageous for elderly patients with osteopenic femoral canals (Masters *et al.*, 2020).

**Evans’s Classification of Trochanteric Fractures**

The Evans classification of trochanteric fractures is a system that categorizes intertrochanteric hip fractures based on the proximal femur’s fracture pattern, encompassing five types.

“Type I: Undisplaced 2-fragment fracture.

Type II: Displaced 2-fragment fracture.

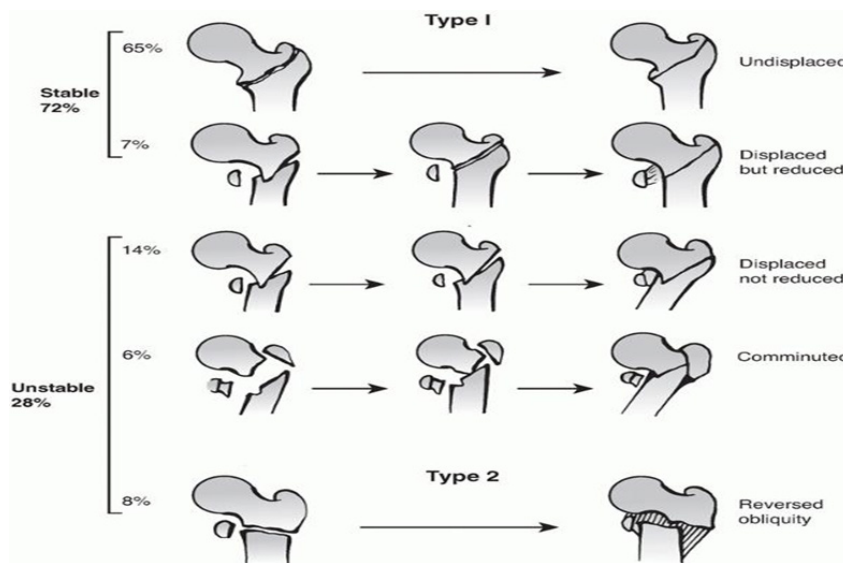
Type III: 3-fragment fracture without posterolateral support, owing to displacement of greater trochanter fragment.

Type IV: 3-fragment fracture without medial support, owing to displaced lesser trochanter or femoral arch fragment.

Type V: 4-fragment fracture without posterolateral and medial support (combination of Type III and Type IV).

R: “Reversed obliquity fracture”, shown in Figure 6.

This research study aimed to evaluate the clinical and radiological outcomes of proximal femoral nail antirotation with augmentation in osteoporotic intertrochanteric fractures, hypothesizing good results due to improved support around the nail blade and early weight-bearing mobilization.



**Figure 6:** Evans classification of trochanteric fractures

**LITERATURE REVIEW**

Osteoporotic intertrochanteric fractures often require surgical interventions, including open reduction and internal fixation (ORIF) methods like dynamic hip screw, compression hip screw, Percutaneous Compression Plate (PCCP), Medoff sliding plate, and intramedullary fixation like Gamma nail, proximal femoral nail, and Proximal Femoral Nail Antirotation (PFNA). The PFNA technique is optimal due to lower blood loss and operative time (Cheng & Sheng, 2020).

Impaction or fixed angle plating is more commonly used for corrective osteotomies than primary hip fracture treatment. Mac Eachern found medial penetration with Jewett Nail compared to sliding hip screws, but modifying nail plates with osteotomies failed (Parker & Handoll, 2009).

In a meta-analysis, Chinoy *et al.* examined sliding implants vs precisely fixed nail plates, involving 2855 individuals. Comparing fixed nail plates to sliding implants, the results indicated a higher risk of cutout (13% vs 4%), nonunion (2% vs 0.5%), implant breakage (14% vs. 0.7%), and reoperation (10% vs. 4%). Furthermore, the death rate

was greater for patients treated with fixed nail plates, and those who survived were more likely to experience hip pain that persisted and limited their range of motion. These problems led to the abandonment of fixed nail plates in favour of the sliding hip screw, which was superior in the 1980s (Parker *et al.*, 2002).

External fixation is a recommended treatment method for elderly high-risk patients with intertrochanteric hip fractures. Most of these fractures occur in older populations with an average age of around 80. The study found that external fixation was a better option than dynamic hip screws (DHS) in terms of surgical time and pain reduction. The study also found that external fixation had benefits such as simple application in local anaesthesia, decreased time of surgery, minimal blood loss, and less need for blood transfusion. It also provided satisfactory stability and early weight-bearing. External fixation could be considered an alternative for elderly high-risk patients, especially those with multiple injuries, religious refusal of transfusions, and those who cannot tolerate routine spinal or general anaesthesia and open surgery (Mobushir *et al.*, 2020).

The study examined the clinical and radiological results of external fixation and proximal femoral nail anti-rotation (PFNA) to manage unstable intertrochanteric fractures in older patients. The findings indicated that PFNA resulted in more blood loss, a lengthier surgery, and increased fluoroscopy time. Functional outcomes in PFNA were superior to those in external fixation. External fixation did not result in fewer overall problems than PFNA (Liang *et al.*, 2022).

In a comparative study between Proximal Femoral Nail (PFN) and Dynamic Hip Screw (DHS) for intertrochanteric hip fractures, PFN performed better in terms of range of motion, limb length discrepancy, blood loss, postoperative pain, and infection incidence (Gill *et al.*, 2017).

The most popular technique for treating stable intertrochanteric fractures, or type 1 and type 2 Boyd and Griffin fractures, is still the sliding hip screw and plate. The objectives include reduced blood loss, shorter hospital stays for the fixation procedure, and the ability to bear weight at an early age. With an average size of 3 cm, the mean incision length of the MIDHS is much shorter than the typical 8–10 cm of a 4-5 holed DHS barrel plate. The average operating time for our patients was 28 minutes, which is less than usual. Since there is less soft tissue dissection after surgery, the incidence of postoperative problems is still low in MIDHS. Therefore, in stable intertrochanteric fractures, the results of a minimally invasive procedure utilizing a two-hole DHS plate are comparable to those of a conventional DHS requiring a longer incision (Walia *et al.*, 2010).

According to Alobaid *et al.*, a minimally invasive approach for fixing intertrochanteric hip fractures dramatically minimizes blood loss and operating time without compromising fixation stability or bone healing (Alobaid *et al.*, 2004).

To produce unstable three-part intertrochanteric fractures, McLaughlin *et al.* examined the biomechanical strength and stiffness of a DHS with a 2-hole side-plate in Comparison to a 4-hole side-plate design. They concluded that the 2-hole DHS is just as biomechanically stable as the 4-hole DHS (McLoughlin *et al.*, 2000).

Bulhofner *et al.* found that using a 135-degree sliding hip screw with a two-hole side plate results in satisfactory healing, minimal blood loss, shorter surgery time, and preservation of side plate fixation (Bolhofner *et al.*, 1999). A novel self-dynamically implant and a minimally invasive technique for internal fixation of femur fractures were presented. Between 2000 and 2008, the self-dynamically internal fixator (SIF) was used on 849 patients for 871 fractures. The average operating time was 44 minutes, the average fluoroscopy duration was 12 seconds, and the average blood loss was 90 millilitres. There were no reported problems during the intraoperative phase. The SIF is particularly useful for minimally invasive surgery and helps treat femur fractures, especially comminuted fractures (Mitkovic *et al.*, 2012).

A dynamic hip screw (DHS) with two horizontal blades has been developed in a novel way to improve fixation stability. Under the biaxial rocking motion, nine standard DHSs and nine DHSs from the Orthopedic Device Research Center (ODRC) were tested. Concerning the traditional DHS, the ODRC DHS showed fewer axial migration, more loading cycles, and reduced bending and torsional strain. With the addition of two horizontal wings, the suggested ODRC DHS enhanced the contact surface between the implant and bone, reduced the load on the screw, enhanced anti-rotational implant effect, and enhanced migration resistance (Chen *et al.*, 2017).

When treating unstable senile intertrochanteric fractures with osteoporosis, a study comparing cemented hemiarthroplasty and proximal femoral nail anti-rotation (PFNA) found no statistically significant differences in the rate of reoperation, length of surgery, or Harris Hip Score at a one-year follow-up. On the other hand, PFNA offers benefits for hospital stays, medical problems, transfusion rates, and intraoperative blood loss. Higher surgical trauma and a higher frequency of postoperative medical issues have been linked to hemiarthroplasty. According to the research, PFNA is superior to hemiarthroplasty in treating intertrochanteric fractures in older people (Luo *et al.*, 2017).

The study examined the prognostic implications of bipolar hemiarthroplasty (BHA) and proximal femoral nail anti-rotation (PFNA) for elderly patients with unstable comminuted intertrochanteric fractures (ITFs). Comparing hospitalization, surgery, blood loss, weight-bearing duration, Harris hip scores, 10-m walking speed, gait, and postoperative complications comparing the two groups, the study examined 62 ITF patients. The hospital stay, length of operation, blood loss, length of weight bearing, Harris hip score, walking speed, gait, and postoperative problems did not significantly differ, according to the results. The study found that although BHA permits a faster return to weight-bearing activities, it eventually offers treatments as effective as PFNA (Song *et al.*, 2022).

## METHODOLOGY

### Study Design

The present research study was prospective to assess the clinical and radiological results of proximal femoral nail antirotation with augmentation in osteoporotic intertrochanteric fractures, with a surgical process of 7 days.

### Study Setting Duration

The current study was conducted involving 50 cases with osteoporotic intertrochanteric fractures caused by minimal or trivial trauma for the period of November 2012 to April 2014. Patients underwent surgical management at a governmental hospital, with cases ranging from 6 months to 1 year, involving internal fixation and proximal femoral nail antirotation.

**Patients Selection**

**Inclusion Criteria**

- Male and female patients of old age were included in the study.
- Patients with osteoporotic intertrochanteric femur fractures
- Patients who have experienced osteoporotic intertrochanteric femur fractures due to indirect trauma, where the fracture does not involve the neck of the femur.

**Exclusion Criteria**

- Patients with non-osteoporotic intertrochanteric femur fractures
- Patients who refused surgery.

**Patients Demographics**

**Sex Distribution**

They were 38 females (76%) and 12 males (24%).

**Age Distribution**

The age ranged from 44 to 90 years, with a mean age of 73.

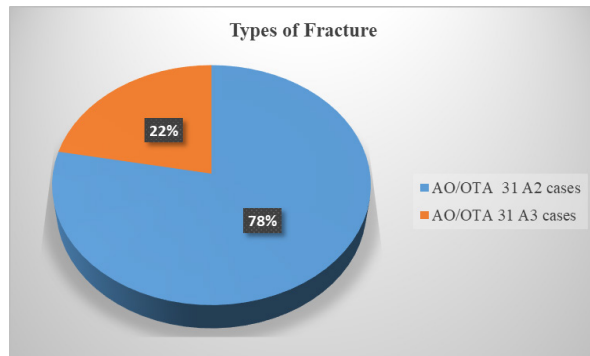
**The Preoperative Period between Trauma and Surgery**

The mean preoperative period was 1.3 days (0-6).

**Preoperative Preparation of the Patient**

Two units of blood were saved for each patient, and the affected limb was marked with a permanent marker pen before surgery.

**Types of Fractures-according to AO Classification**



**Figure 7:** Classifying fractures according to AO classification in patients

**Cement Augmentation**

Without cement augmentation, 35 cases (70 %) and 15 cases (30 %) with cement augmentation.

**Operative Stage**

**Asepsis**

Patients underwent surgery in a conventional operating room, ensuring complete aseptic condition for the affected femur and hip, with skin edges sealed with opposite sheat.

**Surgical Procedure**

The operations were performed under regional, spinal, or general anaesthesia, with patients placed on traction tables with one or two c-arms and routine scrubbing and draping performed.

**Antibiotic Prophylaxis**

Cefuroxime 1.5 g intravenously was administered preoperatively at the time of induction of anaesthesia.

**Implants Used in the Series**

Proximal femoral nail anti-rotation (PFNA) with a helical blade is used in all cases with a special cannula, and cement augmentation is used in 15 cases (Fig. 43 A and B).

**Experimental Procedure**

**Patient Positioning**

All of the patients underwent supine surgery on a traction radiolucent operating table. The unaffected leg was abducted as much as possible and placed on leg support to enable free fluoroscopic examinations. The upper body was then abducted by roughly 10 to 15° to the unaffected side, or both together, and the inter-point was finally made easy.

**Fracture Reduction**

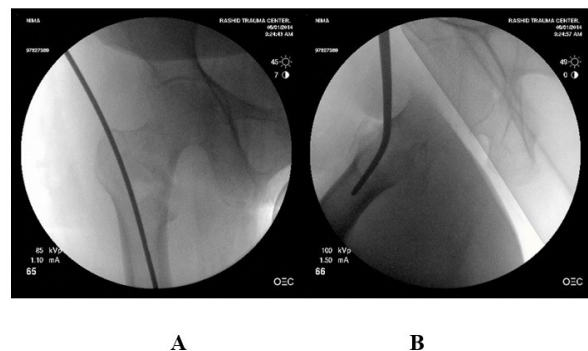
Every patient underwent general, regional, or spinal anaesthesia during their operations. Following anaesthesia, all patients had a closed reduction using a traction radiolucent table guided by a C-RAM. Of these, 48 patients (96%) had a successful outcome, while 2 (4%) required an open reduction. Reduction and surgery were performed under one c-arm only, and a check X-ray was performed before starting surgery in all patients.

**Approach**

After scrubbing and draping as standard, time out is done in all cases, and a confirmed surgical incision marked 3-5 cm starting proximally from the tip of the greater trochanter or may be proximal in obese patients. A parallel incision of the fasciae of the gluteus medius and split the gluteus medius in line with the fibres.

**Determination of Entry Point**

The entry point in the anteroposterior and lateral views



**Figure 8:** Femur guide wire position in AP (A) and lateral (B) views case no. 6

was determined in all cases. With an ML angle of 6°, the PFNA entrance site in the curved expansion of the medullary cavity was on the tip, or slightly lateral to, the greater trochanter tip in AP view. The entrance point aligned with the intramedullary canal's axis when viewed laterally, as shown in Figure 8.

### Femur Opening

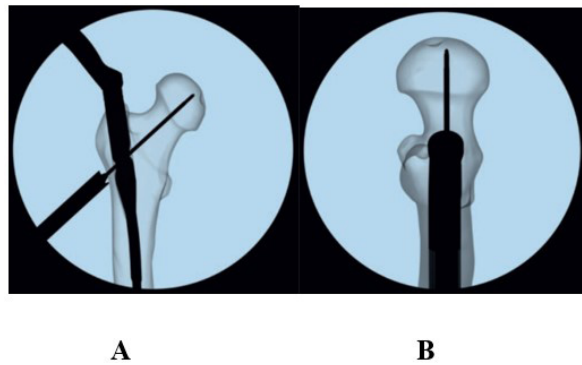
The femur was then opened using a cannulated drill with sleeve protection, ensuring proper nail size, angle and diameter per the preoperative plan, which was reconfirmed before nail insertion. Out of 47 patients (96%), no reaming of the medulla was required before nail insertion, while in 3 patients, reaming was necessary with a 1mm larger diameter than the nail.

### Selection of Nail Blade

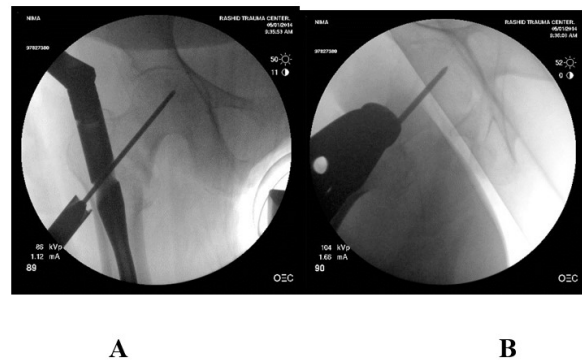
The preoperative AP x-ray view was utilized to determine the nail-blade angle; however, if the measurement of the angle is not available, the maximum valgus angle (130 degrees) was employed; in 44 cases (88%), the angle was 130 degrees, and in 6 cases (12%) it was 125 degrees.

### Insertion of the Guide Wire into the Neck

After that, a neck guide wire was inserted; in 40 cases (80%), it was central in AP and lateral views; in 10 cases (20%), it was posterior and inferior. The guide wire trail typically stops 5 to 10 mm from the joint after insertion, especially in cases where cement augmentation is required; however, in two instances, it was planned for the cement



**Figure 9:** Central position of the guide wire in AP (A) and lateral (B) views

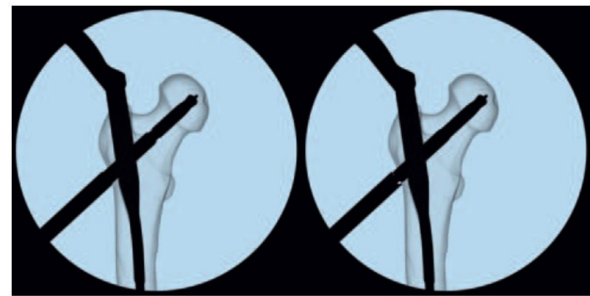


**Figure 10:** Guide wire central in AP (A) and lateral (B) views case no 06

augmentation wire to reach the joint, so no leakage test was performed for these cases, as shown in Figure 9&10.

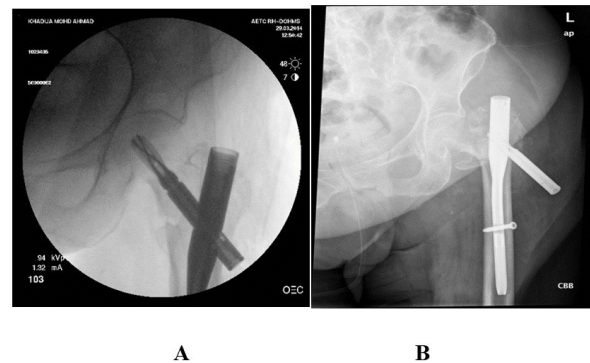
### Open Lateral Cortex for PFNA Blade Insertion

Following the completion of the lateral cortical opening, the blade was hammered inside and halted 5–10 mm from the joint line in 49 cases (98%) and 14 mm from the joint line in one case in both the AP and lateral views. Blades are entirely locked after insertion (figs. 49 and 51); failure is presumed if they are not fully locked, as shown in Figures 11 and 12.



**A** PFNA blade unlocked    **B** PFNA blade locked

**Figure 11:** PFNA blade unlocked in A and after fully locked in B



**Figure 12:** Intraoperative incomplete blade locking because of metal mechanical problem and surgery needed (B) Metal failure case no 8

### Determination of Possible Cement Leakage into Joint

Leakage testing was performed in 17 cases, including planned cement augmentation; of those, 2 cases (11.7%) tested positive; these 2 cases were at the start of the series, with the wire piercing the joint; the test was not repeated if the wire reached the joint.

A tiny quantity of cement reached the fovea in one case (6.6%), but the patient was joined and mobilized with full range of motion, and no osteoarthritis symptoms were observed in the joint until the end of the series. Fifteen patients (30%) had cement augmentation.

Distal locking was completed, one oblique screw for short nails and one or two distal locking screws for long nails, after clinical and x-ray verification of the rotation by comparing the lesser trochanter to femoral condyles.

**RESULTS**

**Mobilization**

34 (94%) of patients regained their pre-surgery range of motion within six weeks, one patient with revised surgery regained the range of motion after 3 months from the first surgery, with one patient requiring arthroplasty, and no difference was reported in mobilization between cemented and non-cemented cases.

**Pain**

There was no pain in 34 patients (94%); one had mild pain from a protruded blade, and the other had surgery revised.

**Radiological Outcome**

The fracture healed without incident in six months, on average between ten and sixteen weeks. Thirty-four fractures healed effectively (94%), 2 patients (5%) needed revision surgery before being united, and 1 patient's blade protruded and needed to be removed six months after the patient's arthroplasty and surgery.

**Mechanical Failure**

One case (2.7%) of a female patient 76 years old (case no. 8) reported a mechanical failure of the blade, resulting in

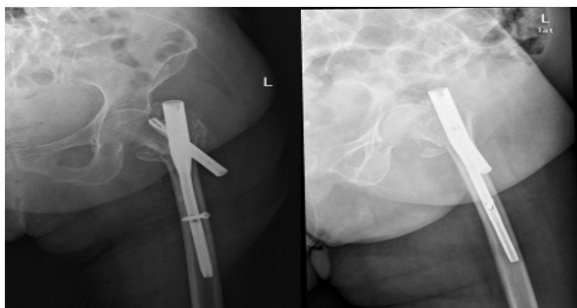
a fall one month after surgery. It was caused by the blade not being fully unlocked, which caused it to come out again, as shown in Figures 13 A, B and 14.

After revision, cement was used, causing a mild collapse at the fracture site and a protruding blade that was not clinically palpable, as shown in Figures 15 A and B.



**A** **B**

**Figure 15:** Blade back out AP (A) and lateral views (B) case no. 8



**A** **B**

**Figure 13:** Blade back out AP (A) and lateral views (B) case no. 8



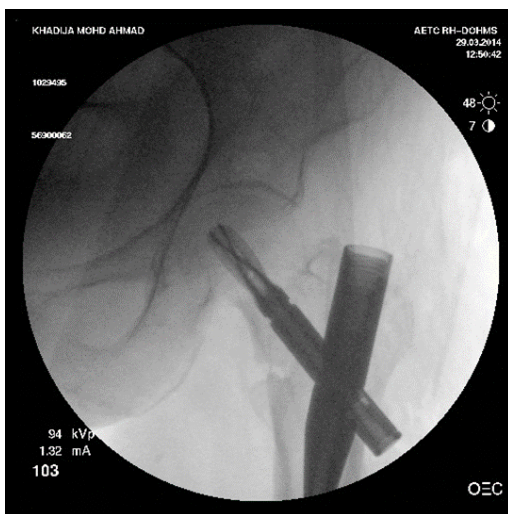
**Figure 16:** Collapse at the fracture site with mild pain case no.26

**Nonunion**

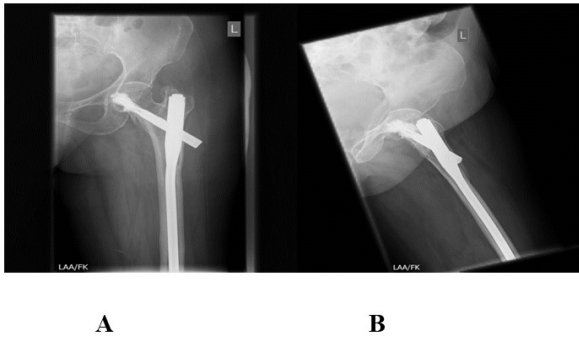
In a case (26), a 2.7% nonunion was observed in a patient requiring arthroplasty after blade removal, who had a history of fall and refracture, as shown in Figure 16.

**Cement in the Joint Case no. 16**

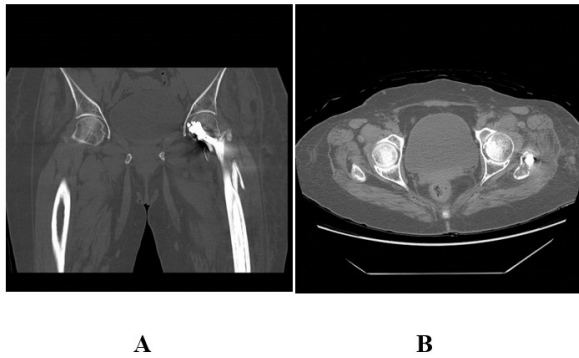
A 2.7% hip joint cement case was diagnosed, and a CT scan was performed, showing no significant issues with hip pain, AVN, or arthritis, with the full range of motion, as shown in Figures 17 and 18.



**Figure 14:** Incomplete locking of blade case no 8



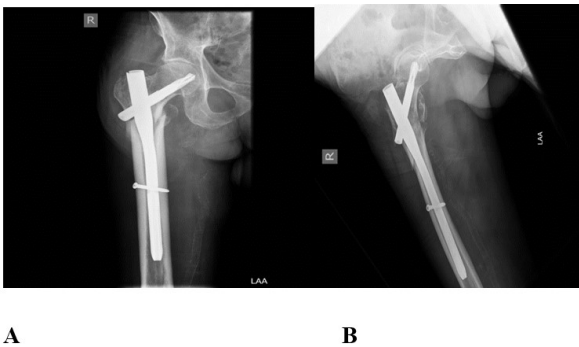
**Figure 17:** Left hip X-ray case no.16 showed cement reaching the hip joint in both the AP (A) and lateral views (B)



**Figure 18:** CT scan of left hip coronal (A) and axial (B) cuts showing cement in fovea case no 16

**Fracture Lateral Wall**

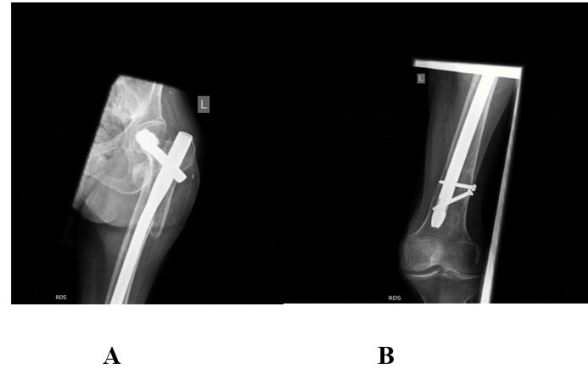
In 4 cases (11%), the undisplaced lateral wall fracture was reported after surgery; these individuals were mobilized to full weight bearing and united in 3-6 months without requiring additional surgery, as shown in Figure 19.



**Figure 19:** Fracture of lateral cortex in 2 different views

**Back Out of Distal Locking Case no.46**

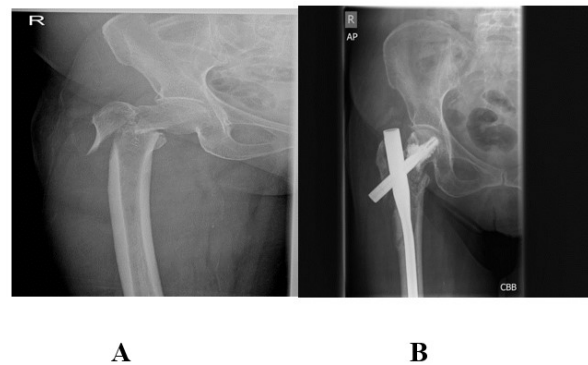
In one case, there was no need for adjustments or the removal of screws since the fracture combined with local irritation or infection but showed back out of distal locking, as shown in Figure 20.



**Figure 20:** Distal locking screws loose (B) but fracture united (A) case no.46

**Metal Jamming**

In one case, no 25, metal jamming occurred once after the locking blade screwdriver was left in place and the case was cemented. The screwdriver was removed along with the blade and replaced with a new one, at which point the case began full weight-bearing mobilization the day after the operation and was united within three months, as shown in Figure 21.



**Figure 21:** Case no. 25 had a screwdriver jammed in the blade, which was removed with a blade, changing the preoperative AP view (A) and the postoperative AP view (B) three months later

**Table 1:** Comparison between cemented and non-cemented cases

|              | No | Age  | F: M | ASA Score | Blood Loss | Intra-opt Complication | Post Opt Complication | Stay | Singh Index |
|--------------|----|------|------|-----------|------------|------------------------|-----------------------|------|-------------|
| Cemented     | 12 | 80   | 11:1 | 3.1       | 150        | 16%                    | 16%                   | 10.4 | 1.6         |
| Non cemented | 24 | 71.9 | 17:7 | 3         | 150        | 12%                    | 4%                    | 10.5 | 2.6         |

### Summary of Outcomes

The series involved 50 patients, with 70% without cement augmentation and 30% with cement augmentation, ranging in age from 44 to 90 years, with a mean age of 74. The study involved 36 cases (72%), 66% non-cemented and 33% cemented, with follow-up lasting 6-12 months. Two cases died within a month post-operatively in the hospital before discharge; both of them had an ASA score of 4 preoperative; the first one extubation failed and died in ICU one month after respiratory failure, and the other one had acute myocardial infarction and died in CCU after 2 weeks from the surgery.

The study analyzed 34 cases, resulting in 97.2% uncomplicated outcomes, with only 2 requiring revision surgery, one requiring a hip joint replacement, and two patients experiencing superficial infection recurrence after multiple debridement.

### Results Grading

- Excellent result - 31 cases (86.1%)
- Good result - 3 cases (8.3%)
- Fair result - one case (2.7%)
- Poor result - one case (2.7%)

### DISCUSSION

Surgical interventions are frequently necessary for osteoporotic intertrochanteric fractures. These interventions include intramedullary fixation, which provides for gamma nails, proximal femoral nails, and proximal femoral nail anti-rotation (PFNA), as well as open reduction and internal fixation (ORIF) techniques like dynamic hip screws, compression hip screws, Percutaneous Compression Plate (PCCP), and Medoff sliding plates. The PFNA approach is the best option because it requires less blood loss and less time during surgery.

PFNA is more successful in treating unstable fractures in elderly individuals; however, it may lead to higher bleeding, prolonged surgical procedures, and longer fluoroscopy times. PFN performs better regarding blood loss, postoperative discomfort, limb length disparity, range of motion, and infection incidence.

In osteoporotic intertrochanteric fractures, the present research assessed the clinical and radiological outcomes of proximal femoral nail anti-rotation with augmentation in 50 osteoporotic intertrochanteric fractures from November 2012 to April 2014, involving internal fixation and proximal femoral nail anti-rotation at a governmental hospital.

The study involved patients who underwent supine surgery on a traction radiolucent operating table, with the unaffected leg abducted to allow free fluoroscopic examinations. After surgery, all patients underwent general, regional, or spinal anaesthesia, with 96% having a successful outcome. The approach involved a marked 3-5 cm incision, a parallel incision of the fasciae of the gluteus medius, and splitting the gluteus medius in line with the fibres.

The entry point was determined using an ML angle of 6°, and the femur was opened using a cannulated drill with sleeve protection. The nail-blade angle was selected using the preoperative AP x-ray view. A neck guide wire was inserted into the neck, with 80% being central in AP and lateral views.

The blade was hammered inside and halted 5-10 mm from the joint line in 49 cases (98%) and 14 mm in one case in both AP and lateral views. Leakage testing was performed in 17 cases, with 2 (11.7%) testing positive. In one case, a tiny amount of cement reached the fovea, but the patient was joined and mobilized with a full range of motion.

It was found that 94% of patients regained their pre-surgery range of motion within six weeks after surgery, with one patient requiring arthroplasty. No difference was reported in mobilization between cemented and non-cemented cases. In six months, fractures healed without incident, with 94% healing effectively. However, two patients needed revision surgery before being united, and one patient's blade protruded and needed removal six months after the surgery. Mechanical failure occurred in one case, causing a fall one month after surgery. Two cases collapsed at the fracture site, resulting in a protruding blade.

A 2.7% nonunion was observed in a patient requiring arthroplasty after blade removal. A 2.7% hip joint cement case was diagnosed, and a CT scan showed no significant issues with hip pain, AVN, or arthritis. In four cases, undisplaced lateral wall fractures were mobilized to full weight bearing and united in 3-6 months without additional surgery.

Out of 36 cases (72%), two died post-operatively. The study found that 97.2% of cases were uncomplicated, with only two requiring revision surgery and one requiring hip joint replacement. Two patients experienced superficial infection recurrence after multiple debridement.

### LIMITATIONS

➤ The study sample of 50 osteoporotic intertrochanteric fractures may not fully represent the diverse population of patients with such fractures, limiting the generalizability of the findings.

➤ Because of its unique patient demographics, surgical techniques, and protocols, the research conducted at a single governmental hospital may introduce bias and potentially impair the results' external validity.

➤ The study's retrospective nature may introduce selection bias and hinder the control for confounding variables that may affect the outcomes of interest.

### CONCLUSION

It was concluded that surgical interventions, particularly PFNA with augmentation, are crucial in managing osteoporotic intertrochanteric fractures. PFNA offers advantages such as reduced blood loss, shorter surgical durations and improved clinical outcomes compared to other techniques like dynamic hip screws or compression

hip screws. Despite potential drawbacks like increased bleeding and longer fluoroscopy times, PFNA remains a preferred option, especially for unstable fractures in elderly patients. Comprehensive assessments of these presented 50 cases yielded a high success rate of 96% with minimal complications. Noteworthy outcomes included a high percentage of patients regaining pre-surgery range of motion within six months, effective healing rates within six months, and few instances of mechanical failure or nonunion. Complications such as postoperative deaths, revision surgeries, and infections were relatively low at 2.8%, highlighting the overall efficacy and safety of the PFNA approach with augmentation in treating osteoporotic intertrochanteric fractures.

## RECOMMENDATIONS

➤ A systematic surgical approach with uniform entry locations, nail-blade angles, and protective sleeves during drilling is recommended for proximal femoral nail anti-rotation with augmentation in osteoporotic intertrochanteric fractures.

➤ Choosing the right implant size and shape can help minimize intraoperative difficulties. It can be achieved through careful preoperative planning, which includes an accurate assessment of the kind of fracture, the quality of the bone, and patient-specific characteristics.

➤ Develop a comprehensive strategy that involves a multidisciplinary team of orthopaedic surgeons, infectious disease specialists, and rehabilitation specialists to treat issues such as infections, nonunion, mechanical failures, and blade protrusion.

## REFERENCES

- Alobaid, A., Harvey, E., Elder, G., Lander, P., Guy, P., & Reindl, R. (2004). Minimally invasive dynamic hip screw: prospective randomized trial of two techniques of insertion of a standard dynamic fixation device. *Journal of orthopaedic trauma, 18*(4), 207-212.
- Azar, F. M., Canale, S. T., & Beaty, J. H. (2020). *Campbell's Operative Orthopaedics*, E-Book. Elsevier Health Sciences.
- Bhandari, M., Schemitsch, E., Jönsson, A., Zlowodzki, M., & Haidukewych, G. J. (2009). Gamma nails revisited: gamma nails versus compression hip screws in the management of intertrochanteric fractures of the hip: a meta-analysis. *Journal of orthopaedic trauma, 23*(6), 460-464.
- Bolhofner, B. R., Russo, P. R., & Carmen, B. (1999). Results of intertrochanteric femur fractures treated with a 135-degree sliding screw with a two-hole side plate. *Journal of orthopaedic trauma, 13*(1), 5-8.
- Chen, C.-Y., Huang, S.-W., Sun, J.-S., Lin, S.-Y., Yu, C.-S., Pan, H.-P., Lin, P.-H., Hsieh, F.-C., Tsuang, Y.-H., & Lin, F.-H. (2017). Wing-augmentation reduces femoral head cutting out of dynamic hip screw. *Medical Engineering & Physics, 44*, 73-78.
- Chen, P.-H., Wu, C.-C., & Chen, W.-J. (2016). Factors affect stability of intertrochanteric fractures when elderly patients fall. *Biomedical journal, 39*(1), 67-71.
- Cheng, Y.-x., & Sheng, X. (2020). Optimal surgical methods to treat intertrochanteric fracture: a Bayesian network meta-analysis based on 36 randomized controlled trials. *Journal of Orthopaedic surgery and research, 15*, 1-14.
- Davey, M. S., Flynn, S. O., Hayes, J., Feeley, I., Grant Freemantle, M. C., & Burke, N. (2020). Two-hole versus four-hole plate dynamic hip screw: a systematic review of current evidence. *Irish Journal of Medical Science (1971-), 189*, 1317-1322.
- Farahmand, B. Y., Michaelsson, K., Ahlbom, A., Ljunghall, S., & Baron, J. A. (2005). Survival after hip fracture. *Osteoporosis International, 16*, 1583-1590.
- Gill, S., Mittal, A., Raj, M., Singh, P., Kumar, S., & Kumar, D. (2017). Dynamic hip screw with locked plate VRS Proximal Femoral Nail for the management of intertrochanteric fracture: A comparative study. *Int J Orthop Sci, 3*(2), 173-180.
- Green, D. P. (2010). *Rockwood and Green's fractures in adults (Vol. 1)*. Lippincott Williams & Wilkins.
- Haidukewych, G. J. (3 march 2009). intertrochanteric fractures: ten tips to improve results. *The Journal of bone & joint surgery volume 91-A JBJS*
- Huang, C., & Wu, X. (2021). Surgical selection of unstable intertrochanteric fractures: PFNA combined with or without cerclage cable. *BioMed Research International, 2021*.
- Liang, Y., Liu, S., Li, L., & Zhong, F. (2022). Proximal femoral nail antirotation versus external fixation for unstable intertrochanteric fractures in elderly patients: A randomized controlled trial. *Medicine, 101*(28), e29384.
- Luo, X., He, S., Zeng, D., Lin, L., & Li, Q. (2017). Proximal femoral nail antirotation versus hemiarthroplasty in the treatment of senile intertrochanteric fractures: Case report. *International journal of surgery case reports, 38*, 37-42.
- Masters, J., Metcalfe, D., Ha, J. S., Judge, A., & Costa, M. L. (2020). Surgical site infection after hip fracture surgery: a systematic review and meta-analysis of studies published in the UK. *Bone & Joint Research, 9*(9), 554-562.
- McLoughlin, S. W., Wheeler, D. L., Rider, J., & Bolhofner, B. (2000). Biomechanical evaluation of the dynamic hip screw with two-and four-hole side plates. *Journal of orthopaedic trauma, 14*(5), 318-323.
- Mishra, A., Bairagi, B. M., & Mahawar, C. S. (2017). A prospective study to evaluate functional outcome in trochanteric fractures using proximal femoral nail antirotation (pfn-aii) in elderly.
- Mitkovic, M., Milenkovic, S., Micic, I., Mladenovic, D., & Mitkovic, M. (2012). Results of the femur fractures treated with the new selfdynamisable internal fixator (SIF). *European journal of trauma and emergency surgery, 38*, 191-200.
- Mobushir, M., Ghazali, U., Latif, S., Farooqui, F., & Altaf, H. N. (2020). Comparison of External Fixation VS

- Dynamic Hip Screw in Treatment of Elderly Inter-Trochanteric Hip Fractures. *National Editorial Advisory Board*, 31(11), 130.
- Moon, J.-K., Lee, J. I., Hwang, K.-T., Yang, J.-H., Park, Y.-S., & Park, K.-C. (2022). Biomechanical comparison of the femoral neck system and the dynamic hip screw in basicervical femoral neck fractures. *Scientific Reports*, 12(1), 7915.
- Moradi, A., Moradi, M., Emadzadeh, M., & Bagheri, F. (2021). Comparison of the dynamic hip screw with the dynamic hip external fixator for intertrochanteric fractures: Report of a randomized controlled trial. *Archives of Bone and Joint Surgery*, 9(6), 665.
- Moroni, A., Faldini, C., Pegreff, F., Hoang-Kim, A., Vannini, F., & Giannini, S. (2005). Dynamic hip screw compared with external fixation for treatment of osteoporotic pertrochanteric fractures: A prospective, randomized study. *JBJS*, 87(4), 753-759.
- Parker, M., Handoll, H., & Chinoy, M. (2002). Extramedullary fixation implants and external fixators for extracapsular hip fractures. *Cochrane Database Syst Rev*, 4(4).
- Parker, M. J., & Handoll, H. H. (2009). Osteotomy, compression and other modifications of surgical techniques for internal fixation of extracapsular hip fractures. *Cochrane Database of Systematic Reviews*(2).
- Rosencher, N., Vielpeau, C., Emmerich, J., Fagnani, F., & Samama, C. (2005). Venous thromboembolism and mortality after hip fracture surgery: the ESCORTE study. *Journal of Thrombosis and Haemostasis*, 3(9), 2006-2014.
- Smit Jakheria, D., Mitna, N., Dubey, V., & Singh, J. (2020). Analysis of pertrochanteric fractures managed by intramedullary or extramedullary fixation. *International Journal of Orthopaedics*, 6(2), 280-283.
- Sommers, M. B., Roth, C., Hall, H., Kam, B. C., Ehmke, L. W., Krieg, J. C., Madey, S. M., & Bottlang, M. (2004). A laboratory model to evaluate cutout resistance of implants for pertrochanteric fracture fixation. *Journal of orthopaedic trauma*, 18(6), 361-368.
- Song, Q.-C., Dang, S.-J., Zhao, Y., Wei, L., Duan, D.-P., & Wei, W.-B. (2022). Comparison of clinical outcomes with proximal femoral nail anti-rotation versus bipolar hemiarthroplasty for the treatment of elderly unstable comminuted intertrochanteric fractures. *BMC Musculoskeletal Disorders*, 23(1), 628.
- Walia, J., Gupta, A., Singh, M., Walia, S., & Singh, S. (2010). Role of minimal invasive DHS in intertrochanteric fracture femur-A study of 25 cases. *Pb J Orthop*, 12(1), 12-13.
- Wang, C.-C., Lee, C.-H., Chin, N.-C., Chen, K.-H., Pan, C.-C., & Su, K.-C. (2020). Biomechanical analysis of the treatment of intertrochanteric hip fracture with different lengths of dynamic hip screw side plates. *Technology and Health Care*, 28(6), 593-602.