**Intramedullary Nail versus Proximal Femoral Locked Plate Fixation for Unstable Intertrochanteric Hip Fractures. A Prospective Comparative Study.**
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**Abstract**

**Background:** Intertrochanteric hip fractures are one of the most common fractures. Although stable fractures can be successfully treated with conventional implants as DHS, the optimal implant for fixing unstable fractures remains a matter of debate. The purpose of this study was to compare the outcomes of PFLCP versus intramedullary nails (PFN and gamma nails) in treatment of unstable intertrochanteric hip fractures.

**Patients and Methods:** this is a prospective study on sixty adult patients with unstable intertrochanteric hip fractures. All cases had been treated by Proximal Femoral Locked Plate PFLCP (30 patients), Intramedullary (IM) nail (30 patients; 20 by PFN, and 10 by gamma nail). The mean follow up period was 14±1.5 months, with serial clinical (using Harris hip score) and radiographic evaluations.

**Results:** There was no statistically significant difference between both groups as regard patients’ demographic data, hospital stay, and time interval between admission and the operation. The procedure of plating was more time consuming than intramedullary nailing. There was more radiation exposure to the patients in the IM group. The intramedullary fixation was less in the intra- and post-operative blood loss. Sound union had been achieved in all cases except 2 cases in PFLCP group and one case in IM group with no significant difference between both groups regarding the mean time to fracture healing. Regarding the Harris hip scores, there was no statistically significant difference between the two groups at 6 months and 12 months evaluation. Superficial infection had occurred in 6 patients (3 patients from PFLCP group and 3 patients from IM group). Although the rate of mechanically-related complications (loosening, medialization of the femoral shaft, and varus collapse) in PFLCP group and IM group was 30% and 10% respectively, there was no statistically significant difference between the two groups (p=0.127).

**Conclusion:** The current study regarding treatment of unstable intertrochanteric fracture does not clearly favor one implant over another. Although intramedullary fixation shows apparent superiority over extramedullary fixation as it is minimal invasive, has better biomechanical stability, and associated with fewer complications, this did not translate to a significant difference in the final functional outcome.

**Key words:** Unstable intertrochanteric fractures, Intramedullary fixation, Extramedullary fixation, Proximal femoral locking compression plate, Harris hip function score.

**Level of evidence:** level I prospective comparative cases series study.

**Introduction**

Intertrochanteric hip fractures are one of the most common fractures especially in elderly osteoporotic patients [1,2]. In young and healthy individuals, the injury results from high energy trauma, whereas in the elderly, most of the fractures are resulting from a trivial fall [3]. Although stable fractures can be successfully treated with conventional implants as dynamic hip screw (DHS) [4,5], the optimal implant for fixing unstable fractures remains a matter of debate [6,7] as these fractures are challenging, prone to complications [8], and the functional outcomes still tend to be disappointing [9].

Intact lateral wall plays an important role in stabilization of unstable intertrochanteric fractures by providing a lateral buttress for the proximal fragment, and its deficiency leads to excessive varus collapse [10]. The use of DHS in treating unstable intertrochanteric fractures, is associated with high failure rate due to shortening, medial displacement of the distal fragment resulting from excessive sliding of screw within the barrel, screw cut-outs, uncontrolled lateralization of the proximal fragment, and varus collapse[11,12]. The proximal femoral locking compression plate (PFLCP) can address the complications of DHS which merges locking screw technology with conventional plating techniques [13]. Theoretically, this technique could offer optimum fixation of unstable fractures that are associated with more shearing and pull-out forces [14,15]. Intramedullary (IM) nails have been widely used for the treatment of unstable intertrochanteric fractures as they have a good biomechanical stability and acceptable clinical outcomes, and have some theoretical advantages over extramedullary devices as they give support to postero-medial wall and resist excessive collapse [16-19]. However, certain complications may
occur as proximal screw cut-out [20], diaphyseal fracture at the distal tip of the nail [21], and iliotibial band irritation [5]. Also, intramedullary devices are not suitable for patients with excessive femoral bow [22].

The purpose of this study was to compare the clinical and radiological outcomes of PFLCP versus intramedullary nails (PFNs and gamma nails) in treatment of unstable intertrochanteric hip fractures.

Patients and methods:
This prospective case series study comprised sixty adult patients with unstable intertrochanteric hip fractures that were admitted and managed in multicentre (Benha University and Health Insurance Hospitals) from April 2015 to January 2017. Patients were randomly divided into two groups, each comprised 30 cases. Patients with odd number were included in group I, while patients with even number were included in group II. Patients in group I were internally fixed by proximal femoral locking compression plate (PFLCP) while in group II, patients were internally fixed by intramedullary (IM) nails (PFN and gamma nails).

The procedures followed in this study were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000 and 2008. This study was authorized by the institutional review board and all patients gave informed consent before explaining the surgical procedure and its possible complications before inclusion in the study.

Any surgically fit post traumatic adult patient who has been diagnosed as having recent (a fracture that had occurred less than two weeks before the time of surgery) unstable intertrochanteric fractures (AO/OTA type A2, A3) was included in this study [23]. Any patient with pathologic fractures, open fractures, patients less than 20 years were excluded from this study.

Careful history taking was done for all patients and included personal data, special habits of medical importance, and associated co-morbidities. Clinical examination was carefully done to detect any associated injuries, skin condition, and ecchymosis on the affected side. All the patients included in this study underwent radiological assessment in the form of plain X-ray AP and lateral view of hip joints and ipsilateral knee joint, CT scan to detect the extension of the fracture to the piriformis fossa. Skin traction in bed and good padding to all the bony prominences were done with DVT prophylaxis by low molecular weight heparin that was stopped 12-24 hours preoperative.

The mean age for the PFLCP group was 58.5 ± 13.9 years (range: 27–80) while in the IM group the mean age was 53.5 ± 16.7 years (range: 25–75). In the PFLCP group, there were 21 males and 9 females while in the IM group there were 15 males and 15 females. In the PFLCP group, the right side was affected in 15 patients, and the left side was in 15 patients. In the IM group, the right side was affected in 21 patients, and the left side was in 9 patients. The mean follow up period was 14±1.5 months (range: 12-22).

Surgical technique:
The surgical procedure for all the patients included the use of a fracture table with an attempt at closed reduction of the fracture with use of fluoroscopic guidance. Following this, the surgical procedures differ substantially according the implant used.

Technique of plating:
Proximal femoral locking compression plate (PFLCP, 4.5/5.0, Zimmer, USA) was used in all cases in group I. Under complete aseptic condition, a lateral approach to the proximal femur was typically performed by a straight incision from the greater trochanter, extending distally according to the fracture extension. After a longitudinal incision of the iliotibial band, the fascia of the lateral vastus was incised in an L shape at its proximal insertion and then the muscle was retracted anteriorly. Great care had been taken not to dissect the comminution zone, to preserve vascularity of the fracture fragments. For more complex and comminuted fractures, interfragmentary screws were used when possible.

After ensuring perfect anatomic placement of the plate to the proximal fragment, a 2.5-mm guide wire was inserted to the most proximal hole (7.3 mm) at a predetermined 95° angle. Another two guide wires were then inserted to the second (7.3 mm) and third hole (5.0 mm) in a 120° angle, and 135° angle respectively. The tips of guide wires were kept one cm under the articular surface of femoral head and their correct placement was confirmed by fluoroscopy. The plate can be held to the shaft by a reduction clamp and perfect anatomic reduction and neck–shaft angle must be ensured again under fluoroscopy. A conventional 4.5-mm screw was used in the most distal combi-hole of the plate for holding the alignment of the plate to the shaft. The most proximal two screws (7.3 mm) with appropriate length were inserted into the femoral neck. The plate is then distally fixed with bicortical 5.0 mm locking head screws. Then, the 5.0 mm locking head screw was inserted in the third proximal hole in 135° angle to converge with the 95° 7.3 mm screw to create a buttress that increases the stability of fracture fixation. A minimum of 3 locked screws were used to fix the proximal end of the fracture to the plate, and 3 bicortical locked screws for the distal end. In metaphyseal comminution, at least 3 to 4 holes of the plate were left empty at the level of the fracture to allow a larger area of stress distribution on the plate and reduce the strain at the fracture. Closure was then done in layers after proper haemostasis.

Technique of intramedullary nailing:
Open reduction was performed when closed reduction could not be achieved, in which case a longer incision and additional exposure was required. A skin incision 3–5 cm in length was made, 10 cm proximal to the tip of the greater trochanter on the proximal extension of the anatomical femoral bow. Then the subcutaneous tissue and deep fascia were incised and the gluteal
muscle was split along its fiber, and IM nail (Smith & Nephew, uniform standard length short nail) was inserted in a standard manner. Briefly, the bone awl was used to start the entry point on the tip of the greater trochanter in anteroposterior view, and between the anterior one-third and posterior two-thirds in the lateral view. A guide wire was inserted, and then adequate reaming was performed to allow for smooth nail insertion. The nail was inserted manually as far as possible into the femoral opening. This step was performed carefully without hammering by slight twisting movements of the hand. The nail was then fixed into the femoral head with a single screw (gamma nail) or double screws (PFN). The devices were not locked proximally to maintain the dynamic nature of the implant and to allow compression across fracture site. The final position was confirmed with an image intensifier. Rotation of the distal fragment was then confirmed, followed by distal locking with use of a guide arm, and closure of the wound in layers.

Postoperative follow up:
Same postoperative protocol was followed for both groups of patients. Low molecular weight heparin was given 12-24 hours postoperative to all patients for 28 days. Active and active-assisted ROM of the hip and knee of the affected side was initiated on the second day postoperatively. Partial weightbearing was initiated after 6-8 weeks, when radiographic crossing trabeculae appeared. Full weightbearing was allowed when sound union was achieved. Union was defined as appearance of bridging callus and disappearance of fracture line on radiographs, and the patient was able to freely perform activities without pain [1,24].

Results:
Sixty adult patients with unstable intertrochanteric hip fractures were included in this study, and were internally fixed by PFLCP (30 patients), IM nail (30 patients; 20 by PFN, and 10 by gamma nail). The patients’ data were recorded, and included demographic characteristics, operative time, amount of blood loss, fluoroscopy time, hospital stay, and clinical & radiographic outcomes. All the patients were followed up with serial clinical and radiographic evaluations. The radiographs were evaluated immediately postoperatively and at 4 weeks, 12 weeks, 6 months postoperatively, and at final follow up. The clinical evaluations were performed using Harris hip function score [25] at 3 months, 6 months, and 12 months postoperatively.

Continuous normally distributed variables were presented as mean and standard deviation and compared between groups by the Student’s t test, whereas categorical variables were expressed by number and percentage, and the Chi-square test was used to compare groups. IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA) was used for all statistical analyses, and p value < 0.05 was considered statistically significant.

The mean time interval between admission and the operation was 3.1 ± 1.53 days in the PFLCP group and 2.7 ± 1.69 days in the IM group. According to AO/OTA [23] classification; there were 17 patients with type 31-A2 fractures and 13 with type 31-A3 fractures in the PFLCP group, while in the IM group, there were 12 patients with type 31-A2 fractures and 18 patients with type 31-A3 fractures. Table 1 outlines the patients’ criteria in both groups. There was no statistically significant difference between both groups as regard age (p =0.539), gender (p =0.361), affected side (p =0.361), mode of trauma (p =0.478), associated fractures (p =0.509), fracture classification (p=0.425), associated co-morbidity (p =0.191), and time interval between admission and the operation (p =0.539).

In the PFLCP group, all the patients had open reduction while in the IM group 20 patients had closed reduction and 10 patients had open reduction. The procedure of proximal femoral plating was more time consuming than intramedullary nailing. The mean operative time for PFLCP group was 123.7 ± 17.65 minutes (range: 95 – 135), and for IM group was 94.6 ± 9.85 minutes (range: 75 – 115), with statistically significant difference (p =0.016). The mean fluoroscopy time was 32±3.1 seconds in the PFLCP group, and 45.5±4.3 seconds in the IM group with a statistically significant difference between the two groups (p < 0.001). Table 2 outlines the differences between the two groups regarding the clinical, functional, and radiological outcomes and also the rate of complications.

The blood loss was estimated in all patients; intraoperative by the anesthetists, and postoperative by the blood lost in the suction drain. The mean intraoperative blood loss for PFLCP group was 247 ± 59.86 cc while in IM group was 175 ± 65.5 cc with statistically significant difference between both groups (p = 0.001). Intraoperative blood transfusion was done in 6 patients in PFLCP group; (each case receive one unit of packed RBCs), while it was not done in any case in IM group. The mean postoperative blood loss for PFLCP group was 165 ± 80.35 cc while in IM group was 90 ± 39.45 cc. Postoperative CBC was done for all patients in the 2nd day and any patient with result less than 10 mg/dl received blood transfusion. Postoperatively, 9 patients from PFLCP group received one unit of packed RBCs while 3 patients from IM group received one unit of packed RBCs. Although the difference between both groups as regard the postoperative blood loss was not statistically significant (p = 0.077), the intramedullary fixation was less in the postoperative blood loss.

The mean postoperative hospital stay in PFLCP group was 3.9 ± 2.18 days while in IM group was 4 ± 1.25 days. The mean total hospital stay in PFLCP group was 7 ± 3.75 days while for IM group was 6.7 ± 2.46 days. There was no statistically significant difference between both groups as regard postoperative and total hospital stay (p=0.903, p=0.831 respectively).

Sound union had been achieved in all cases (Figs.1&2) except 2 cases in PFLCP group and one case in IM group where replacement arthroplasty was done. The mean time to fracture healing in PFLCP group was 12 ± 3.73 weeks (range: 10-16 weeks) while in IM group was 9 ± 4.75 weeks (range: 8-12weeks) with no significant difference (p =0.187).
Table 1: demographic data of both groups. (NS, nonsignificant; HTN, hypertension; DM, diabetes mellitus; HCV, hepatitis C virus).

<table>
<thead>
<tr>
<th>Demographic Data</th>
<th>PFLCP Group</th>
<th>IM Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years): Mean ± SD (range)</td>
<td>58.5 ± 13.9 (27 – 80)</td>
<td>53.5± 16.7 (25 – 75)</td>
<td>0.539(NS)</td>
</tr>
<tr>
<td>Sex (n, %): Male</td>
<td>21(70%)</td>
<td>15(50%)</td>
<td>0.361(NS)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>9(30%)</td>
<td></td>
</tr>
<tr>
<td>Side (n, %): Right</td>
<td>15(50%)</td>
<td>21(70%)</td>
<td>0.361(NS)</td>
</tr>
<tr>
<td></td>
<td>Left</td>
<td>15(50%)</td>
<td></td>
</tr>
<tr>
<td>Associated # (n, %):</td>
<td></td>
<td></td>
<td>0.509(NS)</td>
</tr>
<tr>
<td>Olecranon</td>
<td>3(10%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>Both bone leg</td>
<td>0(0%)</td>
<td>3(10%)</td>
<td></td>
</tr>
<tr>
<td>Distal end radius</td>
<td>0(0%)</td>
<td>3(10%)</td>
<td></td>
</tr>
<tr>
<td>Inferior pubic ramus</td>
<td>3(10%)</td>
<td>3(10%)</td>
<td></td>
</tr>
<tr>
<td>Surgical neck humerus</td>
<td>0(0%)</td>
<td>3(10%)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>24(80%)</td>
<td>18(60%)</td>
<td></td>
</tr>
<tr>
<td>Mode of trauma (n, %):</td>
<td></td>
<td></td>
<td>0.478(NS)</td>
</tr>
<tr>
<td>Electric shock</td>
<td>3(10%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>High energy</td>
<td>15(50%)</td>
<td>21(70%)</td>
<td></td>
</tr>
<tr>
<td>Low energy</td>
<td>12(40%)</td>
<td>9(30%)</td>
<td></td>
</tr>
<tr>
<td>AO/OTA classification (n, %):</td>
<td></td>
<td></td>
<td>0.425(NS)</td>
</tr>
<tr>
<td>31A2</td>
<td>17(56.7%)</td>
<td>12(40%)</td>
<td></td>
</tr>
<tr>
<td>31A3</td>
<td>13(43.3%)</td>
<td>18(60%)</td>
<td></td>
</tr>
<tr>
<td>Co-morbidity (n, %):</td>
<td></td>
<td></td>
<td>0.191(NS)</td>
</tr>
<tr>
<td>None</td>
<td>6(20%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>HTN only</td>
<td>6(20%)</td>
<td>15(50%)</td>
<td></td>
</tr>
<tr>
<td>DM only</td>
<td>0(0%)</td>
<td>6(20%)</td>
<td></td>
</tr>
<tr>
<td>HCV only</td>
<td>3(10%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>HTN+DM</td>
<td>12(40%)</td>
<td>9(30%)</td>
<td></td>
</tr>
<tr>
<td>HCV+DM</td>
<td>3(10%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>Admission/ operation interval (days):</td>
<td></td>
<td></td>
<td>0.587(NS)</td>
</tr>
<tr>
<td>Mean ± SD (range)</td>
<td>3.1 ± 1.53 (0 – 7)</td>
<td>2.7 ± 1.69 (1 – 5)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Clinical, functional, and radiological outcomes. (NS, non significant; S, significant)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>PFLCP Group</th>
<th>IM Group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time (minutes): Mean ± SD (range)</td>
<td>123.7 ± 17.65 (95 – 135)</td>
<td>94.6 ± 9.85(75 – 115)</td>
<td>0.016(S)</td>
</tr>
<tr>
<td>Fluoroscopy time (seconds): Mean ± SD (range)</td>
<td>32±3.1 (19-40)</td>
<td>45.5±4.3 (25-60)</td>
<td>&lt; 0.001(S)</td>
</tr>
<tr>
<td>Blood loss (cc): Mean ± SD (range)</td>
<td>247 ± 59.86 (150 – 400)</td>
<td>175 ± 65.5 (100– 200)</td>
<td>0.001(S)</td>
</tr>
<tr>
<td>Blood transfusion (cc): Mean ± SD (range)</td>
<td>165 ± 80.35 (100 – 500)</td>
<td>90 ± 39.45 (50 – 150)</td>
<td>0.077(NS)</td>
</tr>
<tr>
<td>Hospital stay (days): Mean ± SD (range)</td>
<td>3.9 ± 2.18 (2-10)</td>
<td>4 ± 1.25 (2-60)</td>
<td>0.903(NS)</td>
</tr>
<tr>
<td>Time of union (weeks): Mean ± SD (range)</td>
<td>12 ± 3.73 (10-16)</td>
<td>9 ± 4.75 (8-12)</td>
<td>0.187(NS)</td>
</tr>
<tr>
<td>Harris hip score: Mean ± SD (range)</td>
<td>47 ± 11.37 (35-70)</td>
<td>65 ± 8.96 (50-75)</td>
<td>0.001(S)</td>
</tr>
<tr>
<td>Complications (n, %): Infection</td>
<td>3(10%)</td>
<td>3(10%)</td>
<td>0.127(NS)</td>
</tr>
<tr>
<td>Varus</td>
<td>6(20%)</td>
<td>None</td>
<td>0.158(NS)</td>
</tr>
<tr>
<td>Medialization</td>
<td>None</td>
<td>2(6.7%)</td>
<td></td>
</tr>
<tr>
<td>Loosening</td>
<td>3(10%)</td>
<td>1(3.3%)</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 1: (A) preoperative plain x-ray of the right femur showing unstable intertrochantric fracture with subtrochanteric extension. (B) Postoperative x-ray after 3 months showed consolidation. (C) Follow up x-ray showed united fracture with no varus collapse or loosening (C).

Although, there was a statistically significant difference in Harris hip score [25] between both groups after 3 months (p =0.001), there was no statistically significant difference between the two groups at either 6 months or one year postoperative (p=0.158, p=0.598 respectively). The Harris hip scores [25] in PFLCP group were 82 ± 11.35 at 6 months and 85 ± 9.34 at one year postoperative, respectively, and in the IM group were 86 ± 9.09 at 6 months and 86 ± 9.56 at one year postoperative, respectively.

Superficial infection had occurred in 6 patients (3 patients from PFLCP group and 3 patients from IM group) that were treated by antibiotics and repeated dressings for about 3 weeks. None of them needed surgical debridement. Six patients in PFLCP group had varus collapse of the hip joint (Fig.3), none in IM group. Loosening occurred in one or more of the proximal screws in 3 patients in the PFLCP group; however, no plate or screw breakage occurred. One patient in IM group had loosening in the most proximal hip screw. Two patients in IM group had medialization of the femoral shaft (Fig.4); none in PFLCP group. Although the rate of mechanically-related complications in PFLCP group and IM group was 30% and 10% respectively, there was no statistically significant difference between the two groups (p=0.127).

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Fig. 2: (A) preoperative plain x-ray of the left femur showing unstable intertrochantric fracture. (B) At 2 weeks follow up, x-rays show stable fixation with no secondary displacement. (C) After 6 months follow up, x-rays show complete union.

Fig. 3: (A) preoperative plain x-ray of the right femur showing unstable intertrochantric fracture with subtrochanteric extension. (B) Postoperative x-ray after 6 weeks. (C) Follow up x-ray after 4 months showed varus collapse with screw penetration in the joint.
Fig. 4: (A) Preoperative plain x-ray of the left femur showing a reverse oblique intertrochanteric fracture. (B) At 6 weeks follow up, x-rays show callus formation. (C) At 3 months follow up, x-rays show medialization of the femoral shaft over the proximal segment. (D) After 6 months follow up, x-rays show malunion in a medialized position.

Discussion

Management of unstable intertrochanteric fractures remains difficult and challenging, particularly regarding the improvement of mobility and functional outcome [23,26]. In general, there are four important factors that govern the outcome of intertrochanteric fracture treatment. These are patient-related (age, concomitant diseases, quality of bone, initial level of mobility), fracture-related (intrinsic stability, quality of reduction), surgeon-related (experience, skills, mood), and implant-related (availability, cost, suitability for fracture) [27,28].

Suitable implant selection according the type of fracture is an important factor to decrease the rate of complications for unstable fracture especially in elderly patients [29]. Several fixation devices have been developed to overcome the difficulties encountered in the treatment of such fractures, including extramedullary and intramedullary devices [30]. So this study was conducted to compare the clinical, functional, and radiological outcomes of PFLCP as an extramedullary fixation with PFN or gamma nail as an intramedullary fixation in treatment of unstable intertrochanteric fractures.

The intramedullary fixation has multiple theoretical advantages over the extramedullary fixation [28]. From a biomechanical standpoint, it is a load-sharing device, located more closely to the axis of weightbearing [31]. Intramedullary fixation is able to provide necessary bending and torsional stability to resist the displacement of the fracture fragments especially in unstable fractures [32]. Furthermore, it has a shorter lever arm, here with decreasing the tensile strain on the implant, thus reducing the risk of varus collapse and failure [32]. However, it was inferior to extramedullary fixation in controlling rotational stability [28]. Worse still, the endosteal blood supply may be destroyed in the process of reaming [28]. Also, the large diameter of the proximal aspect of the implant may require excessive reaming of the greater trochanter and partial detachment of the gluteus medius may occur with abductor weakness and Trendelenburg gait [33,34].

PFLCP has many advantages in fixation of unstable intertrochanteric fractures. It is anatomically pre-contoured to fit the proximal femur and provide stabilization through the placement of multiple locking screws at different angles that increase the bone purchase in the femoral neck [3]. The kickstand screw had an important role in preventing varus collapse as the PFLCP with that kickstand screw was reported to have similar biomechanical properties of 95º angle blade plate [35,36]. Furthermore, it can provide a stress shield for the lateral trochanteric wall and prevent lateral migration of proximal fragments as PFLCP locks the fracture in a position without controlled collapse, so varus malalignment is avoided. So, PFLCP does not fail at the screw bone interface and it is appropriate for complex proximal femoral fracture fixation even in osteoporotic bone [2,3,37,38]. However, there were some limitations with the use of the locking plate system [39,40]. The main disadvantage of PFLCP is open reduction which can result in increase blood loss [40,41]. Sometimes, it is difficult to insert screws accurately within the femoral neck, as
the screws and the plate are combined with a fixed angle, and the direction of screws cannot be adjusted. Furthermore, compression between the ends of fracture fragments may not be achieved with the locked plate [1].

In this study, the procedure of proximal femoral plating was more time consuming, and less radiation exposure than intramedullary nailing with statistically significant difference. The intramedullary fixation was less in the intra- and postoperative blood loss. So, the authors’ preference is to do intramedullary fixation in elderly patients especially those having bad bone quality, and associated high co-morbidities. There was no significant difference between the two groups regarding the mean time to fracture healing, and functional outcome (Harris hip score) at either 6 months or one year postoperative, and the rate of mechanically-related complications (varus collapse, medialization, and loosening).

There are conflicting results in the literature regarding differences in functional outcome, and the rate of complications between intramedullary and extramedullary fixation [42-44]. However, most of the recent studies have reported little difference in the outcome of the intramedullary and extramedullary fixation, making it difficult to determine the ideal implant to use [45-48].

Hou et al. compared the operative data and outcomes of unstable intertrochanteric fractures that were treated with percutaneous non-contact bridging (NCB) plates (52 cases) and with gamma nails (36 cases) [1]. There was a significant difference in fluoroscopy time between the two groups. Hospital stay in the NCB plate group was significantly shorter than the gamma nail group. Harris hip scores were similar between the groups at 6 months and 1 year postoperatively. There were 3 proximal screws that loosened in 2 patients in the NCB plate group without occurrence of plate or screw breakage. There was no statistically significant difference between both groups regarding the average time to fracture healing. In a study done by Streubel et al., 29 unstable intertrochanteric fractures were internally fixed by locking compression plate [49]. They reported 37% mechanical failure rate. One hundred and one intertrochanteric fractures (39 cases were A1, 44 cases were A2, and 18 cases were A3) were internally fixed by Proximal Femoral Nail Anti-rotation (PFNA) [27]. There were two revision surgeries; one patient complained about irritation and pain over the blade due to excessive sliding, and the other patient had femoral head perforation due to migration of the blade. Otherwise, there was no cut-out of the blade, no femoral shaft fracture, and no nonunion. There was 20% incidence of postoperative lateral wall fracture of A1 and A2 fractures. As for the PFN, Fogagnolo et al.[50], and Ekström et al.[51] reported complication rate as 23.4% and 8% respectively while Uzun et al. [52] reported non-union 5.7%, screw cut-out 5.7%, secondary varus displacement 25.7%, and reverse Z effect 14.3%.

A meta-analysis was conducted to compare the relative advantages of intramedullary nail and extramedullary fixation in treatment of unstable intertrochanteric fractures. It was concluded that the functional outcomes were markedly better for patients of the intramedullary nail group, although evidence remains controversial. Although no significant differences in implant-related complications were observed between the two groups, extramedullary fixation had a higher incidence of all complications [28]. Another meta-analysis recommended the intramedullary nail for the treatment of unstable femoral intertrochanteric fractures due to better functional outcomes and reduced blood loss [30]. Comparing the current series to the previous studies is difficult owing to variable treatment modalities (variable implants used as intra- or extramedullary fixation), and different functional assessment scores used as Parker and Palmar mobility score [3], new mobility score (NMS) [9], Salvati and Wilson hip function [9], The Lower Extremity Measure (LEM), The Functional Independence Measure (FIM), the timed “Up & Go” (TUG) test, as well as a timed two-minute walk test [34]. Also some of these studies included in their research stable and unstable fracture patterns [3], while others include the elderly patients only [1,16].
There were some limitations of this study. The number of cases was relatively small with a short follow up period. Also, we did not calculate the tip-apex distance (distance between the screw tip and the apex of the femur) in the radiological evaluation. Lastly, postoperatively partial weightbearing was allowed before full weightbearing which could be difficult for many elderly patients.

Conclusion:
The current study regarding treatment of unstable intertrochanteric fracture does not clearly favor one implant over another. Although intramedullary fixation shows apparent superiority over extramedullary fixation as it is minimal invasive, has better biomechanical stability, and associated with fewer complications, this did not translate to a significant difference in the final functional outcome.

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