Management of Unstable Intertrochanteric Fractures with Proximal Femoral Locking Plate- A Prospective Study of 30 Patients

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**ABSTRACT**
Intertrochanteric fractures are quite common in the elderly age group due to the osteoporotic nature of the bone. Unstable fracture patterns are challenging to treat and would require an implant which would address the requirements. This study was performed to evaluate the functional outcome following management of these fractures with PFLP (Proximal femoral locking plate). Thirty patients with unstable intertrochanteric fractures who presented between January 2012 to January 2015 were managed by ORIF (Open reduction and internal fixation) with PFLP and were followed up for three years. Functional assessment was performed using the Harris hip score. There was a female preponderance seen in our study with the left side being more commonly affected. The most common mode of injury was slip and fall, and Boyd and Griffin type 3 was the most common fracture type seen. The mean Harris hip score was 83.6(82-95). We were able to achieve a 100% union rate in our series with minimal complications. ORIF with PFLP is a good treatment option in the management of unstable intertrochanteric fractures and gives good rates of union and functional outcomes.

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**INTRODUCTION**

Intertrochanteric fractures are common injuries typically seen in an elderly age group and more commonly seen in women due to osteoporosis. Elderly patients have problems such as a decrease in visual acuity and muscle imbalance which causes them to slip and fall, resulting in a fracture. In the younger population, a considerable force is required to cause a fracture, and they occur following high-velocity injuries such as road traffic accidents and fall from height (Nieves et al., 2010; Jensen, 1980; Seinsheimer, 1978). These fractures, especially in the older population, are associated with increased morbidity and mortality. These fractures are essentially managed by surgical means with conservative treatment only reserved for patients who are medically unfit to undergo a surgical procedure due to multiple comorbid conditions. Conservative management leads to prolonged recumbency which is associated with problems such as pressure sores, lung compromise, deep vein thrombosis, which could be a cause of morbidity and mortality for the patient (Lorich et al., 2004). Aim of treatment would be to do an ORIF with internal fixation and mobilize the patient as early as possible to prevent complications. The principles to be followed would be to perform an anatomical fracture reduction with a stable internal fixation while preserving the blood supply to the bone and promoting an early mobilization of the patient. Stable frac-
Fracture patterns are relatively straightforward to fix. While unstable fracture patterns are associated with issues such as loss of posteroomedial buttress, the comminution of the greater trochanter and posterolateral wall comminution, which poses difficulty in selection of the implant and fixation method. The various methods of fixation would include ORIF with DHS (Dynamic hip screw), PFN (Proximal femoral locking nail), PFLP as well as Hemiarthroplasty. DHS is the implant of choice in stable fracture patterns. It provides controlled collapse at the fracture site and gives good functional outcomes but has been associated with high rates of failure in unstable fracture patterns. PFN is an ideal implant in the management of these fractures but is not indicated in cases where the integrity of the lateral wall or the greater trochanter is not preserved. Hemiarthroplasty is a good treatment option in unstable fractures, and it’s associated with a steeper learning curve. It can be associated with a higher complication rate if not performed in an ideal manner (Schipper et al., 2004; Werner-Tutschke et al., 2002; Streubel et al., 2013). In this situation, the PFLP would be an ideal implant as lateral wall comminution, and greater trochanter fracture and comminution are not contraindications in this situation. The PFLP would serve to buttress the lateral wall as well as the greater trochanter and helps to preserve the abductor mechanism of the hip. The PFLP is an anatomically pre-contoured plate which has options for passing three proximal screws at angles of 95°, 120° and 135°. The first and second screws are 7.3mm screws, and the third one is a 5mm screw. The holes in the shaft are combi holes which provide options for either a 4.5mm cortical or a 5mm locking screw. The advantages of the PFLP are that it’s a pre-contoured plate, it has cannulated locking screws which provide good purchase in osteoporotic bone, provides angular stability and axial load compression, provides a stable and rigid fixation construct and gives good support to the lateral wall as well as the greater trochanter (Crist et al., 2009). This study was performed to evaluate the functional outcome of unstable trochanteric fractures treated with ORIF with PFLP.

MATERIALS AND METHODS

This was a prospective study of 30 patients with unstable trochanteric fractures who presented between January 2012 to January 2105 treated with ORIF with PFLP and followed up for 3 year period. This study was approved by the ethical committee of our institution. All patients with Boyd and Griffin type 2,3 and 4 fractures willing for surgery and followup were included in our study. While Type 1 fractures, compound fractures, patients with neurovascular compromise in the affected limb and patients with active infection or inflammation in the affected limb were excluded. The patients were admitted, and the limb was immobilized in a Thomas splint, and were assessed clinically. The vitals were recorded and documented. Any associated comorbid conditions were noted and documented along with the treatment history. All fractures were classified according to the Boyd and Griffin classification (Figure 1).

Figure 1: Boyd and Griffin Classification

The patients were then subjected to a radiological evaluation where radiographs of the affected hip AP view and pelvis with both hips AP view were taken. The fracture type was noted and documented. CT scans were not routinely done and were reserved for cases where there was gross comminution to assess the fracture geometry and aid in planning for surgery. Routine blood investigations were then sent, and the patients were worked up for the surgical procedure after obtaining the necessary medical and anaesthetic opinions. All surgeries were performed by the same orthopaedic surgeon who was well versed in the procedure. The procedures were performed either under regional or general anaesthesia under antibiotic cover. Injection Cefazolin 1 gm was given at the time of starting the surgical procedure and was continued for three days in the postoperative period. Proper informed and written consent was taken from the patient before the procedure. The patient was placed in the supine position on the fracture table, and traction was first given, followed by external rotation to disimpact the fracture site and the limb was then taken into internal rotation. The fracture reduction was checked fluoroscopically in AP and lateral views. Prepping and draping was done and a 15cm incision was made starting from the tip of the greater trochanter and was extended distally. Subcutaneous tissues and fascia were incised, and the iliotibial band was split followed by the vastus lateralis which was erased.
from the bone after making an L shaped incision proximally. Care was taken to minimize stripping to preserve the blood supply to the bone, especially in cases where there was extensive comminution. Once the reduction was found to be satisfactory, the plate was then applied.

In certain situations where the closed reduction was not found to be satisfactory, the fracture site was directly visualized, and bone levers were used to manipulate the fracture reduction. Provisional fixation was done under fluoroscopic guidance. Appropriate drill sleeves were attached to the plate, and it was then placed on the proximal femur at the level of the greater trochanter. The first and second 7.3mm cannulated screws were applied at angles of $95^\circ$ and $120^\circ$ respectively followed by application of the third 5mm screw at an angle of $135^\circ$. The convergent pattern of the three screws serves to provide good purchase in osteoporotic bone. The screws were advanced to the subchondral region and position confirmed with AP and lateral views. At this junction, a lateral view of the shaft was taken to make sure that the distal aspect of the plate was well aligned to the bone distally. The plate has combi-holes which allow placement of 4.5mm cortical or 5mm locking screws. We routinely used 4.5mm cortical screws as they provide a good approximation of the plate to the bone and used locking screws only in cases where there was severe osteoporosis to gain a good purchase in the bone. A minimum of 5 screws was placed distal to the fracture site to provide a right working length and stability to the fixation construct. Final fluoroscopic images were then taken in AP and lateral projections and were found to be satisfactory. A wound wash was then given, and after ensuring haemostasis and placing a drain in situ, wound closure was done in layers, and a sterile dressing was applied. The patients were made to recline in bed on the same day after surgery, and the knee was actively mobilized. They were made to stand and walk on day 1 with strict non-weight bearing walking with walking frame support. Wound inspections were done on the 3rd and 5th postoperative day and the drain tube was removed at the time of the first wound inspection. Suture removal was done on day 12.

Postoperative radiographs were taken to assess the fracture reduction and the patients were discharged. They were asked to review at periods of 1,3,6 months, and the Harris hip score performed yearly intervals after that where serial radiographs were taken to assess for signs of fracture union and functional assessment. The findings were noted and documented in the case records. Data analysis was performed using IBM SPSS Version 22.0. Armonk, NY:

RESULTS AND DISCUSSION

The mean age of the patients was 68.1 years which ranged from 48 to 86 years. There was a female preponderance seen in our study with the left side being more commonly affected. The most common mode of injury was slip and fall, followed by road traffic accidents and fall from height (Figure 2). Boyd and Griffin type 3 was the most common fracture type seen followed by type 2 (Figure 3).
Table 1: Patient demographics and data

| S.No | Age | Sex | Side | Mode of injury | Fracture type | Surgical time | Blood loss (ml) | Time to union (weeks) | Harris hip score |
|------|-----|-----|------|----------------|--------------|---------------|-----------------|----------------------|-----------------|
| 1    | 64  | M   | L    | SAF           | 2            | 78            | 350             | 12                   | 83              |
| 2    | 70  | F   | R    | SAF           | 3            | 84            | 300             | 13                   | 85              |
| 3    | 68  | F   | R    | SAF           | 2            | 76            | 310             | 11                   | 90              |
| 4    | 86  | F   | L    | SAF           | 3            | 90            | 270             | 10                   | 95              |
| 5    | 72  | M   | L    | SAF           | 4            | 100           | 250             | 14                   | 86              |
| 6    | 54  | F   | L    | RTA           | 3            | 96            | 275             | 11                   | 83              |
| 7    | 61  | F   | R    | RTA           | 2            | 98            | 320             | 11                   | 84              |
| 8    | 68  | F   | R    | SAF           | 3            | 79            | 310             | 12                   | 87              |
| 9    | 70  | F   | L    | SAF           | 3            | 84            | 330             | 14                   | 91              |
| 10   | 54  | M   | R    | RTA           | 2            | 86            | 350             | 13                   | 93              |
| 11   | 51  | M   | L    | FFH           | 2            | 100           | 290             | 11                   | 90              |
| 12   | 48  | F   | L    | RTA           | 3            | 110           | 270             | 10                   | 95              |
| 13   | 70  | F   | R    | SAF           | 2            | 104           | 300             | 12                   | 91              |
| 14   | 72  | F   | L    | SAF           | 3            | 98            | 310             | 12                   | 89              |
| 15   | 76  | M   | R    | SAF           | 2            | 115           | 350             | 10                   | 85              |
| 16   | 68  | F   | L    | RTA           | 4            | 96            | 290             | 11                   | 86              |
| 17   | 64  | F   | L    | SAF           | 3            | 84            | 280             | 12                   | 84              |
| 18   | 62  | M   | R    | SAF           | 3            | 98            | 310             | 10                   | 82              |
| 19   | 54  | M   | L    | FFH           | 2            | 105           | 285             | 11                   | 89              |
| 20   | 67  | F   | R    | SAF           | 2            | 110           | 310             | 12                   | 94              |
| 21   | 60  | F   | L    | SAF           | 3            | 98            | 275             | 10                   | 91              |
| 22   | 86  | M   | L    | SAF           | 2            | 88            | 290             | 12                   | 90              |
| 23   | 78  | F   | L    | RTA           | 2            | 92            | 280             | 11                   | 95              |
| 24   | 74  | M   | R    | RTA           | 2            | 100           | 310             | 13                   | 86              |
| 25   | 69  | M   | L    | FFH           | 3            | 104           | 320             | 12                   | 91              |
| 26   | 71  | F   | R    | SAF           | 3            | 106           | 330             | 12                   | 84              |
| 27   | 80  | F   | L    | SAF           | 3            | 110           | 310             | 12                   | 82              |
| 28   | 82  | M   | L    | FFH           | 2            | 98            | 320             | 11                   | 87              |
| 29   | 76  | F   | R    | RTA           | 2            | 96            | 330             | 14                   | 88              |
| 30   | 68  | F   | L    | RTA           | 2            | 110           | 310             | 12                   | 93              |

RTA: Road traffic accident. SAF: Slip and fall. FFH: Fall from height.
days. The mean surgical time was 96.76 minutes ranging from 76 to 115 minutes, and the average blood loss was 304.5ml ranging from 250 to 350ml. The mean time to full weight-bearing walking was 11.3 weeks which ranged from 12 to 15 weeks. The mean Harris hip score was 83.6 ranging from 82 to 95 (Table 1).

The average range of movements achieved were: Flexion-100°, Abduction-45°, Adduction-25°, External rotation 40° and Internal rotation 30°. There was no mortality in our series. We were able to achieve a 100% union rate, and we had minimal complications such as superficial skin infections in 2 patients which settled down with a course of antibiotics, skin necrosis in 1 patient. One patient had a screw back out one year after fracture union for which metal exit was performed (Figure 4).

There were no complications such as nonunion, malunion, loss of reduction, deep infection or implant failure seen in our study. We did not lose any of our patients to follow up.

Intertrochanteric fractures are quite common in the elderly age group and are associated with increased morbidity and mortality. A trivial injury such as a slip and fall can result in a fracture due to the osteoporotic nature of the bone in elderly individuals. In contrast, a high-velocity injury is necessary to bring about a fracture in younger individuals, and they are often caused by injuries such as road traffic accidents and fall from height. These fractures are essentially managed by surgical means with conservative treatment only reserved for patients who are medically unfit to undergo a surgical procedure due to multiple comorbid conditions. Stable fracture patterns are relatively straightforward to treat, and a DHS would be the ideal implant for fixation of these fractures. It gives reasonable union rates by causing controlled collapse at the fracture site. PFN is another ideal implant for these fractures, but it would not be indicated in cases where the integrity of the greater trochanter and the lateral wall are not preserved. Unstable fracture patterns are associated with issues such as loss of posteriormedial buttress, comminution of the greater trochanter and posterolateral wall comminution, which poses difficulty in the selection of the implant and fixation method. In these fracture types, if the greater trochanter comminution and migration are not addressed with a proper implant, it would lead to abductor insufficiency, which could result in a decreased functional outcome to the affected hip (Wieser and Babst, 2010; Glassner and Tejwani, 2011). The PFLP is a pre-contoured plate which is closely applied to the bone and buttresses the greater trochanter as well as the lateral wall. It has the mechanical advantage of providing a three-dimensional fixation. The convergent screw pattern in the head provides both angular stability and axial compression. The cannulated cancellous screws provide good purchase in osteoporotic bone, and the plate stabilizes the lateral cortex and acts as an internal fixator (Hasenboehler et al., 2007). The PFLP should rest on the tip of the greater trochanter, and varus reduction should be avoided as it would tend to place the plate in a proud position. The plate should be closely applied to the bone as leaving a gap between the bone plate interface would act as a cantilever mechanism by causing an increase in the bending mechanism about the screw which can lead to breakage of the screw at a later stage. To prevent this, 4.5mm cortical screws can be a plate on the shaft holes to pull the plate closer to the bone before application of the proximal screws. These steps are essential to prevent mechanical failure of the implant. To improve the stability, the proximal screws should be advanced to a position 10mm from the subchondral bone. Most cases of implant failure in PFLP are due to an insufficient reduction of the fracture and improper placement of the implant, and they need to be addressed adequately to provide an excellent functional outcome to the patient (Streubel et al., 2013). Guo-Chun Zha et al. study of 110 patients they were able to achieve a union rate of 95% with good results. One patient had breakage of the implant, and they reported no significant complications (Zha et al., 2009). Shah et al. studied 20 patients and reported a mean union time of 18.75 weeks ± 3.67, and they had excellent results in 10 cases and four poor results. The mean Harris hip score was 82 ± 20.54, and they had complications such as four superficial and two deep infections and 2 cases with coxa valga (Shah et al., 2017). In Kumar N et al. study of 30 patients, they achieved a union rate of 100% with the meantime to fracture union being nine weeks ranging from 8 to 10 weeks. They had a few cases with mild varus fixation, which was well tolerated and no cases of hardware failure (Kumar et al., 2014). In our study of 30 patients, we were able to achieve a union rate of 100% with the meantime to fracture union being 11.7 weeks ranging from 10 to 14 weeks. The mean Harris hip score was 83.6 ranging from 82 to 95. We had complications such as superficial skin infections in 2 patients with settled down with a course of antibiotic. One patient had screw backout one year after the union of the fracture and hence metal exit was performed. We had no cases of deep infection, varus collapse or implant failure encountered in our study. Lesser number of complications in our
study could be due to the fact that care was taken to perform an anatomic fracture reduction and to utilize good surgical techniques during placement of the implant. We conclude by stating that the PFLLP is a good implant in the management of unstable trochanteric fractures, and it gives good rates of union and functional outcomes to the patient.

CONCLUSION

The PFLP is a good implant in the management of unstable intertrochanteric fractures and has advantages of providing mechanical stability and a three-dimensional fixation and gives good functional results as long as proper fracture reduction and plate application using good surgical techniques are employed.

Conflict of Interest

The authors declare that there is no conflict of interest for this study.

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