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Clinical analysis using proximal femoral locking plate in the management of complex, comminuted pertrochanteric femoral fractures in adults: a prospective study

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ABSTRACT

Background: Pertrochanteric fractures consume major part of orthopaedic injuries with high morbidity and cost factors. They affect almost all age groups. The treatment options vary a lot depending on the type of fracture and age. Despite marked improvement in implant design, surgical technique and patient care; pertrochanteric fractures continue to consume a substantial proportion of our health care resources.
Methods: This prospective study consists of 20 adult patients of pertrochanteric fractures of femur, who were treated with internal fixation using PFLP. All patients were followed up at an interval of 4 to 6 weeks till fracture union and then once in 3 months till 1 year.
Results: Anatomical results are noted as good or poor depending upon shortening, varus deformity, hip movements and knee movements and functional result as excellent, good, fair and poor depending upon the hip pain, ambulatory status, ability to squat, and sit cross leg. In the study 2 patients had shortening of l cm. None of the patients had any varus deformity. Overall excellent to good results were achieved in 85% cases.
Conclusions: The potential advantages of the proximal femoral locking plate over intramedullary devices are better biomechanical design, ability to bear more stress due to, strong biomechanical stability shows that this technique holds considerable promise in complex, comminuted fractures in revision cases and in osteoporosis.

Keywords: Pertrochanteric region, Proximal femoral locking plate, Valgus, Non-union, Load-bearing

INTRODUCTION

Hip fractures form a large chunk of orthopaedic injuries. The age at which they occur vary a lot right from young people with high energy trauma having pertrochanteric fractures which are complex and comminuted due to velocity of injury, to geriatric population suffering from complex comminution pertrochanteric fractures due to osteoporosis. The treatment has evolved from conservative methods like skeletal traction, skin traction, hip spica cast, to vide array of implants used the commonly used implants have being juvette nail plate, smith Peterson nail, dynamic hip screw, dynamic condylar screw, angular blade plates and cephalo-medullary nails. Locking plate have gained popularity due to superior biomechanical stability and better hold and grip in osteoporotic fractures due to plate and screw head threading interlock design constituting more rigidity and stability in fixation. They are nowadays widely used in many metadiaphyseal communited region, with common use being around the knee. Proximal femur locking plates (PFLP) have being used for fixation of fractures of the proximal femur. It has pre-contoured shape, providing three dimensional fixation mechanical

advantage and multi-angular stability with locking screws in the femoral head and simultaneously preserving bone stock especially in osteoporotic bone.[1-6] Operative treatment of pertrochanteric fractures is challenging due to complexity, communition, osteoporis, high muscle stresses that deform the fracture fragments and malalign them.Hence surgery of pertrochanteric fractures is challenging associated with high incidence of per-operative and post-operative complications and failure.[7-9] Biomechanical studies have shown superior bio-mechanical stability and durability of the PFLP as compared to other contemporary implants available for fixation of proximal femur fractures.[10,11] This provides less torsional stiffness and cyclic loading deformation.[12] Literature has shown variable results from good functional outcomes to high rates of implant failure and complications.[13,14]

METHODS

This prospective study consists of 20 adult patients of pertrochanteric fractures of femur, who were treated with internal fixation using PFLP at the authors working place between August 2015 march 2018. This study was carried out to study the functional outcomes of treatment with PFLP. All these 20 patients included in the study were followed up at regular intervals. After the patient with pertrochanteric fracture was admitted to the hospital, all the necessary clinical details were recorded in proforma prepared for this study. After discharge, these patients were followed up at regular intervals at the outpatient level for clinical and radiographic evaluation. The patients were followed up till fracture union and functional recovery after surgery. As soon as the patient with pertrochanteric fracture was seen in the casualty, necessary clinical and radiological evaluation was done and the patient was immobilized using skeletal traction (upper tibial pin). All the patients were evaluated with routine investigation before surgery and fitness for surgery and consent for the operation were taken.

Surgical technique

All patients were operated under spinal and/or epidural anaesthesia. The patient was placed in lateral position on a radiolucent table with adduction of the affected limb by 10 to 15 degrees and the unaffected limb was partially flexed at the hip and the knee to prevent it from interfering with image intensification. The advantage of lateral position is easy access of greater trochanter and shaft femur, useful in obese patients, easy to achieve reduction by open reduction technique. The tip of the greater trochanter was located by palpation and a longitudinal incision was taken. The incision started 4 to 5 cms proximal to the tip of the greater trochanter. A parallel incision was made in the fascia lata and the gluteus medius was split in line with its fibers. Tip of the greater trochanter was exposed. The fracture was open reduced and stabilized with a circalage wire or interfragmentary screws. After confirming satisfactory fracture reduction, the appropriate sized plate was fixed. Final position confirmed on C arm. Plate was temporarily fixed to shaft by k-wires, and both, alignment of plate and reduction was checked in anteroposterior and lateral views. Guide wires (3.2 mm) were inserted through guide sleeve in proximal hooded portion.

After checking the correct position of guide wire in AP & lateral views, guide wire is removed and drill is inserted through drill sleeve and screws of adequate length inserted making sure that satisfactory subchondral purchase is obtained. The position and length for all screws is rechecked on image intensifier, in both AP and lateral views. The plate is then fixed distally to the femoral shaft with a minimum three cortical screws of 4.5 mm (6 cortical purchases). In comminuted fractures 3–4 holes of plate were left empty at the level of fracture to increase working length. All comminuted fractures with calcar comminution were additionally bone grafted, primarily. Soft tissue was closed in layers with drain in situ.

After the fixation, thorough lavage is given with normal saline. Hemostasis is achieved and incision is closed in layers over suction drain. Sterile dressing is applied over the wound and compression bandage is given.

Postoperative protocol

Drain removal done by 48 hours. The epidural catheter was kept for 48 hours for postoperative analgesia. Sutures removed between 12th to 14th postoperative day. Patients were encouraged to sit in bed 24 hours after surgery. Static quadriceps exercises and knee mobilization was started in the immediate postoperative period. Gait training was started as per individual pain tolerability before discharge. Non weight bearing mobilization was done in comminuted unstable fractures, but in stable fractures, partial toe touch weight bearing was started early with two axillary crutches or a walker.

Follow up

All patients were followed up at an interval of 4 to 6 weeks till fracture union and then once in 3 months till 1 year. At each visit, patients were assessed clinically regarding hip and knee function, walking ability, fracture union, deformity and shortening. Fresh x-rays were take during each visit till fracture union progressive partial weight bearing was taught with help from physiotherapist up to full weight bearing.

RESULTS

Functional outcome of surgery was done on the basis of Anatomical results in to good or poor depending upon shortening, varus deformity, hip movements and knee movements And Functional result in to excellent, good, fair and poor depending upon the hip pain, ambulatory

status, ability to squat, and sit cross leg. In our series maximum age was 86 years and minimum age was 21 years. Most of the patients were in the age group of 28 to 75 years with mean of 53.33 years. In this series with 20 patients 12 were males and 8 were females. This shows preponderance of males over females. Out of 20 cases, 7 gave history of motor vehicular accidents, suggestive of high energy trauma, 4 gave history of fall from height, while 9 gave history of slip and fall. None of our patients had any associated bony injuries. In 10 cases left side was affected and in the remaining 10 cases, right side was affected. We used the Seinsheimer classification.

Table 1: Intra operative complications.

Complication	Number of cases	%
Bone graft	01	05
Failure to get closed reduction	07	35
Drill bit breakage	01	5
Varus angulation	00	00

All the cases in our study group were fresh fractures who underwent surgery as early as possible according to the medical fitness of the patients. All patients were operated at an average interval of 2 days from the date of trauma. In our study, we encountered certain complications intra operatively. In 7 patients, due to comminution and postero-medial cortical void, bone grafting was required. There was 1 case of drill bit breakage. In 1 case there was heavy bleeding from one of the deep perforators while passing the circalage wire around the femur which was explored and ligated (Table 1). None of our patients had any significant postoperative complication. There were no wound healing problems. 1 patient had delayed union. 2 patients with comminuted fractures and had shortening of 1 cm. 1 patient had backing out of the cortical non locking screw into soft tissue which required removal of the screw. 4 patients (20%) had restriction of terminal hip flexion. None of our patients had knee stiffness due to the fracture and surgical procedure. Since many patients were from the elderly age group, knee osteoarthritis was present pre injury. There was no varus malunion or nonunion. There was no mortality recorded in our series till fracture union. One case of implant breakage or cutting out of screws was recorded. No case of superficial or deep infection was recorded (Table 2).

Table 2: Delayed complications.

Complication	Number of cases	%
Hip stiffness	04	20
Knee stiffness	00	00
Delayed union	01	05
Non union	00	00
Shortening >1	00	00
Malunion	00	00
Implant failure / screw cut out	00	00
Screw backout	01	05

Figure 1: Case 1. (A) Pre op x-ray hip; (B) post op x-ray hip; (C-E) clinical pictures.

Table 3: Functional result.

Functional results	Number of cases	%
Excellent	11	55
Good	06	30
Fair	03	15
Poor	00	00

In our study, the average duration of hospital stay was 13.46 days. The mean time for full weight bearing was 14.35 weeks. All patients enjoyed full pre injury range of motion at knee joints. 20% patients had 10 to 20 degree terminal restriction of hip flexion. Postoperative mobility was aided in the immediate postoperative period but later all patients were ambulatory independently with or without walking aids. In our study anatomical results were assessed by presence/absence of deformities, shortening, and hip and knee range of movements. In the study 2 patients had shortening of l cm. None of the patients had any varus deformity. 4 patients had terminal 10 to 20 degrees of hip flexion restriction. All patients achieved full pre injury range of movements at knee joints. Some patients had pre injury restriction of knee range of movements due to preexisting osteoarthritis. And functional result was assessed by the scoring system framed by Kyle et al overall excellent to good results were achieved in 85% cases (Table 3).

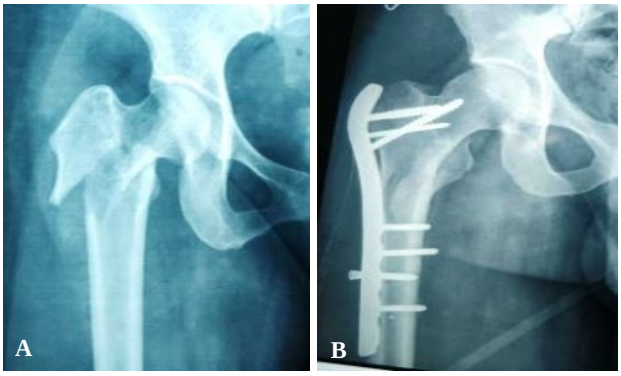

Figure 2: Case 2. (A) Pre-operative x-ray hip, (B) Post-operative x-ray hip.

Figure 3: Case 3. (A) Pre-operative x-ray and (B) post-operative x-ray.

Statistical analysis

Statistical analysis was carried out on SPSS 16.0 version (Chicago, Inc., USA). The results are presented in mean±SD and percentages. The anatomical and functional results were compared by using Wilcoxon rank sum test. The $p<0.05$ was considered significant.

DISCUSSION

Our study had one case of delayed union requiring secondary bone grafting procedure with one case of drillbit breakage, Zha et al reported study including 110 cases with per-trochanteric fractures and reported one case each of non-union and implant breakage and 2 cases of infection.[2] He reported that the PFLP fixation achieved a union rate of 100% in 110 patients with pertrochanteric femoral fractures at one year follow-up.[2] Saini et al did not report implant failure in their study, including 32 patients with sub-trochanteric fractures although they reported 2 cases of delayed union as compared to one case in our series, and infection each, two patients with limb shortening and one with external rotation deformity.[7] We had to open reduce 7 cases to achieve optimal reduction, If the PFLP is used, the fracture must be adequately reduced and all proximal femoral locking screws should be inserted to increase the mechanical strength of the construct.[10] Johnson et al reported 41.4% failure rates.[15] Gunadham et al reported 23% failure rate in a comparative analysis of 26 patients with sub-trochanteric fractures including 2 broken plates, 1 broken screw, 1 non-union and 2 varus collapse.[16] Glassner et al reported a case series including 10 patients with implant failure in 7 cases (70%) with 2 plate and 2 screw breakages and loss of fixation from varus collapse and implant cut-out in 3 cases.[17] Our short series did not have any case of varus collapse.

Reported complications include loss of fixation with and without screw breakage and plate breakage; the failure rate was independent of the surgeon's experience.[17] The PFLP was reported to be the strongest construct for vertically orientated femoral neck fractures among 4 different fixation techniques.[18] The PFLP was reported to have similar biomechanical properties as the 95º-angled blade plate. Screw breakage after PFLP fixation is a complication in pertrochanteric fractures with missing posteromedial corners, which leads to high axial bending forces around the fracture site with eventual varus collapse of the fracture and screw breakage.[19] PFLP fixation is appropriate for complex proximal femoral fracture fixation (e.g. osteoporotic bones, complex multi-fragmentary subtrochanteric fractures, and revision surgeries). Multiple locking screws increase bony purchase of the femoral neck and are especially advantageous in factures with bone loss, comminution, osteoporosis.

CONCLUSION

The potential advantages of the proximal femoral locking plate over intramedullary devices are better biomechanical design, ability to bear more stress due to, strong biomechanical stability shows that this technique holds considerable promise in complex, comminuted fractures in revision cases and in osteoporosis.

Limitations

The sample size was small, with retrospective evaluation, especially within each fracture group. This study had several limitations. Larger series are required with longer follow ups for establishing the efficacy and supremacy of proximal femoral locking plates.

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