IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 16, Issue 4 Ver. VII (April. 2017), PP 07-14
www.iosrjournals.org

Proximal Femur Locking Plate: An Alternative Implant For Unstable Proximal Femoral Fractures.

Harindra Himanshu[1], Mani Bhushan Prasad[2], Ajay Kumar Verma[3], Lal Bahadur Manjhi[4]
[1]Senior Resident, [2]Associate Professor, [3]Associate Professor, [4]Associate Professor
Department Of Orthopaedics, RIMS, Ranchi -834009, Jharkhand, India.
Address Of Correspondence : Dr. Harindra Himanshu, Senior Resident, Department Of Orthopaedics, Rajendra Institute Of Medical Sciences (RIMS), Ranchi -834009, Jharkhand , India .
Email : dr.hhimanshu@gmail.com , 09430851456

ABSTRACT
Pertrochanteric fractures are of intense interest globally. Incidence has increased significantly during recent decades and this tendency will probably continue to rise in near future due to increased span of life. Before the introduction of suitable fixation devices, the treatment was predominantly conservative. This conservative approach has now fallen into disrepute because of the high complication rate , making operative management preferred treatment. The present study is undertaken to study the role of surgical management and assess its functional outcome in Pertrochanteric and subtrochanteric fracture .The study was carried out in patients treated for closed displaced pertrochanteric and subtrochanteric fractures , from Feb 2015 to Jan 2017. A total of 45 patients with closed pertrochanteric and subtrochanteric fracture were included in the study. Patients were between the age group of 24 to 76 years with 30 males and 15 females. Fractures were classified according to Boyd and Griffin and Seinsheimer's for intertrochanteric and subtrochanteric fractures respectively**.** Functional Outcome was evaluated according to HARRIS HIP SCORE , with mean score of 87.6. Excellent score was noted in 51.11% , Good in 31.11% , Fair in 17.7% with no poor results. Treatment goal of unstable proximal femoral fractures is stable fixation, early mobilization with least complications. This was achieved more satisfactiorily with the use of PFLCP . So, finally to conclude PFLCP represents a feasible alternative for unstable proximal femoral fractures($\pm$ osteoporosis).

Keywords: pertrochanteric fractures, subtrochanteric fractures, internal fixation, Boyd and Griffin, Seinsheimer's

I. Introduction

Pertrochanteric fractures are most frequently operated fracture and are of intense interest globally . Its serious health resource issue because of the high cost of care required after injury. The reason for the high cost of care is primarily related to the poor recovery of functional independence after conventional fracture care in many patients [1] . Pertrochanteric fractures are those occurring in the region extending from the extra capsular basilar neck region to the region along the lesser trochanter before the development of the medullary canal. Intertrochanteric and peritrochanteric are generic terms for pertrochanteric fractures [1]. Subtrochanteric fractures typically occur in the proximal femur between the inferior aspect of the lesser trochanter and a distance of about 5 cm distally [2] . In 1997 Gullberg et al. estimated that the future incidence of hip fracture worldwide would double to 2.6 million by 2025, and 4.5 million by 2050 [3]. The percentage increase will be greater in men (310%) than women (240%). In 1990 26% of all hip fractures occurred in Asia, whereas this figure could rise to 37% in 2025 and 45% in 2050 [4]. Hagino et al. Reported a lifetime risk of hip fracture for individuals at 50 years of age of 5.6% for men and 20% for women [5] . Before the introduction of suitable fixation devices, the treatment was predominantly conservative but this approach has now fallen into disrepute because of the high complication rate [6,7]. The common problems of prolonged immobilization, i.e : decubitus ulcers, U.T.I., joint contractures, pneumonia and thromboembolism contribute to the high mortality rate [7]. The increased incidence of varus deformity and shortening results in poor function , making operative management preferred treatment. Operative treatment for hip fractures was introduced in 1950s with expectation of improved functional outcome and reduced complications [8,9]. Since then, a variety of treatment options have evolved like Extramedullary , Intramedullary implants , External fixator and Arthroplasty . Internal treatment of these fracture has gained wide spread acceptance but the problems i.e. Malunion, nonunion, implant failure, refracture and infection encountered after surgical correction , have prompted continued development of new devices and treatment programmes .

II. Aims And Objectives

This study is intended to evaluate the outcome of fixation of pertrochanteric and subtrochanteric fracture using Proximal femoral locking compression plate at our institute with respect to -

1. Stability at fracture site .
2. Early mobilization.
3. Functional restoration .
4. Union at fracture site.
5. Complication.

III. Materials And Method

This study was conducted from Feb 2015 to Jan 2017. During this period 45 cases of adult patients with unstable proximal femur fractures , attending the Orthopaedic emergency and outpatient department were selected .

INCLUSION CRITERIA

1. Close displaced pertrochanteric and subtrochanteric femur fractures.
2. Skeletally mature patients.
3. No medical contraindication for anesthesia.
4. Patients willing to give written and informed consent for participation in the study **.**

EXCLUSION CRITERIA

1. Pertrochanteric and subtrochanteric femur fractures in polytrauma patients .
2. Open fractures of proximal femur .
3. Pathological fractures.
4. Medical contraindication to anaesthesia and/ or surgery .
5. Active skin lesion & infection at operative site .
6. Skeletally immature patients .
7. Patients neurologically unstable (Glasgow Coma Scale < 12)
8. Ipsilateral fracture shaft femur and tibial.
9. Injuries around the knee, ankle & foot in the ipsilateral side

After taking detail history , local and general examination was done. Distal neurovascular survey was done and recorded. During the evaluation period , below knee skin traction was applied and limb was elevated on the Bohler Braun splint . After taking appropriate x ray,the fractures were classified according to Boyd and Griffin and Seinsheimer's for intertrochanteric and subtrochanteric fractures respectively. Tentative length of plate determined by templating the x ray . After pre operative medications and spinal anaesthesia , all patients were positioned supine on fracture table. Closed reduction of fracture was performed under image intensifier in both anteroposterior and lateral views . If closed reduction fails , open reduction was performed and k- wire was passed to hold the reduction temporarily making sure it dose not interfere with the holes of the plate. Lateral approach using a straight incision extending from greater trochanter to 7–10 cm distally on the shaft of femur given. Distally, length of incision was determined by fracture extent. Plate was temporarily fixed to shaft by k-wires, and both, alignment of plate and reduction was checked in anteroposterior & 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. Wounds were closed in layers over negative suction drain , and removal after 48 hrs. . During post operative, limb was elevated on bohler frame to reduce swelling .The wounds were inspected on the 3rd & 7th post operative day. Stitches were removed on the 13th day . Wounds showing any suspicious signs of infection were treated with higher antibiotics & subsequently by debridement. Blood transfusion was given if required.

Postoperative Mobilization & Rehabilitation

- Day 1: Static quadriceps exercises .
- Day 2: Knee flexion with the patient sitting by the edge of the bed .
- Day 3: Patient was put on CPM machine for passive range of motion 0 to 30 degrees and was gradually increased depending on pain tolerance and continued till 90 degrees of flexion was achieved.

- Day 4 -5 : Walking with the aid of a walker without weight bearing , sit on chair or high stool

Follow Up Protocol

All patients were followed for at least six months . The follow up visits were done at: 1,3,6,12,18 ,24 months . On every visit clinical evaluation was done by Harris Hip score and radiological by X-ray . Radiologically the presence of callus, and complications were seen.

IV. Observation And Results

The Study involved 45 patients of pertrochanteric and subtrochanteric fractures, which were operated in Orthopeadic department in our hospital. The study was limited to age group between 24-76 years. Maximum cases were in the age group between 40-60 years i.e. 21 cases (46.66%) with an **average age** of 56.7 years. Youngest was 24 while oldest was 76 years . **Mean Weight** of the patients in study group was 64.7 kgs.The Study involved 30 (66.66%) **males** and 15 (33.33%) females . **Left Side** was involve in 21 (46.66%) and right in 24 (53.33%). Out of the 45 patients , 39 (86.66%) were **Intertrochanteric** and rest 6 (13.33%) was Subtrochanteric . According to Boyd and Grrifin classification we have 21 (53.8%) Type 2 , 8 (20.5%) Type 3 and , 10 (25.6%) Type 4 Intertrochanteric fractures but in Seinsheimer classification we have none in Type 1 ,7 (77.77%) in Type 2 , 01 (11.11%) in Type 3 , 01 (11.11%) in Type 4, none in Type 5. **High energy trauma** (RTA , fall from height) being most common mode of injury accounting 66.66% of all the cases . 18 patients (40 %) were **smokers** . 21 patients , which constitute about 46.66% have inadequate **serum vitamin D** – 3 level .100% of the patients were **community ambulators prior to fracture** . **Mean duration of surgery** was 100 minutes (range 90 – 150 mins) . Initially duration was high which latter on decreases with increasing number of cases and familiarity with the implant system. **Average blood loss** was 650 ml as per calculation of anaesthesist and assisting staff. Average time for **delay in fixation** was 7 days ranging from 3 to 10 days with an **average hospital stay** of 14 days (range 10 to 18 days). Mean follow up was 11 months (range 6 to 18 months) . **Complications:** Some difficulties in operating room while performing surgery were : inability to do close reduction in 9 (20%) , unable to accommodate three screws in head and neck in 8 (17.7%). Various complications are seen during post operative and follow up time , superficial wound infection is seen in 6 (13.3%) patients in post op period and rest of the complications are seen during the follow up period i.e . shortening < 2 cms in 3 (6.66 %), varus collapse in 3 (6.66 %), delayed union in 2 (4.44%) and hardware failure in terms of screw brekage in 3 (6.66 %) and plate brekage in 1 (2.22 %) .Over all complications rate is 20 % seen in 9 out of 45 patients . Patient with varus collapse simultaneously shows shortening. **Union** was defined clinically and radiologically by taking the x ray in anteroposterior and lateral view of the affected Hip. Clinically, absence of pain at fracture site and radiologically the presence of bridging callus at fracture site are the signs of fracture healing . Union occurs in 42 (93.33%) cases by the end of 6 months . Mean duration for union was 17 Weeks with range from 12-24 weeks. Patients were **evaluated** according to Harris Hip Score , with mean score of 87.6 . Excellent score was noted in 51.11% , Good in 31.11% , Fair in 17.7% with no poor results.

V. Discussion

Treatment of Proximal femoral fractures is challenging [10]. The treatment goal is to achieve anatomic reduction with a stable fracture fixation to allow early functional rehabilitation. Over the past decades, intertrochanteric and subtrochanteric fractures were predominantly treated by dynamic hip screw [11]. It provides compression along the femoral neck, and if the reduced fracture is stable, load-sharing between the bone and implant can occur [12] . However, if the fracture is not stable, progressive medial displacement of the femoral shaft can occur, which may result in fixation failure and nonunion. Failures increase sevenfold if medialization of more than 1/3 of the femoral diameter at the fracture site occurs [13]. The most common mode of mechanical failure of the sliding hip screw is the progressive varus collapse of the femoral head with proximal migration and eventual cutting out of the femoral head screw [14]. The complication rate , specially for unstable fractures with DHS , has shown to be as high as 3% to 26% [15]. Role of intramedullary devices like proximal femoral nail (PFN), gamma nail (GN) and Proximal femoral nail antirotation (PFNA) in the treatment of stable and unstable intertrochanteric fractures are also controversial with varying results, though they have some theoretical advantage over the DHS. Various authors have shown high complication rate with the use of these implants. Failure rate of gamma nail for the treatment of these fractures ranges from 12.7% to 15% [16,17] . Fogagnolo et al., showed a complication rate of about 23.4% with the use of PFN for the treatment of these unstable fractures [18]. In another study done by Uzun et al., [19] nonunion was seen in 5.7%, secondary varus collapse in 25.7%, cut out of proximal screws in 5.7% and reoperation in 14.3% cases. As for PFNA, Takigami et al., [20] showed complications in 14% of the cases and 4% required reoperation. In another study by Yaozeng et al., intraoperative complications were seen in 20% cases and 9.1% cases had femoral shaft fracture [21] . The locking compression plate was introduced in the 21st century as a new implant that allows angular stable plating for the

treatment of complex , comminuted and osteoporotic fractures. The Locking Compression Plate (LCP) has the option of using the dynamic compression hole or the threaded locking hole or both. This combination provides the flexibility of cortex screw or locking screw fixation [22]. More recently, locking plates especially designed for the proximal femur, PF-LCP have become available especially for the management of complex trochanteric and subtrochanteric fractures [23] .The plate is anatomically precontoured for the metaphysis of the proximal femur.

The locking compression plate for the proximal femur is a precontoured, angular stable, with large fragment screw (7.3/5.0/4.5mm).

The first two proximal threaded holes of the plate are designed for cannulated 7.3-mm locking head screws that are inserted at 95° and 120° in relation to the shaft of the femur. The third threaded round hole is for a cannulated 5.0-mm locking head screw that is inserted at the level of the calcar at 135° angle, and this screw intersects with the most proximal 7.3-mm screw, serving as a so-called "kickstand screw".The remaining screw holes, which range from 4 to 16 in the PF-LCP, are LCP-combi-holes that allow the placement of either a conventional (4.5 mm) or a locking head screw (5.0 mm) at the level of the shaft. The most distal hole allows the use of a Kirschner wire for temporary fixation to achieve correct positioning of the plate. Plate length allows spanning of entire diaphysis in segmental fracture patterns. Biomechanically PFLCP is stronger and stiffer to other fixation methods for fractures of the trochanteric and subtrochanteric region [24]. Intertrochanteric fractures have no problem with getting united. Concern should be to prevent medialization, achievement and maintenance of proper reduction and hence to get negligible limb length discrepancy as far as possible. PF-LCP is ideal in such fractures. It acts as a buttress and prevents excessive fracture collapse. It substitutes for an incompetent lateral cortex. Glassner PJ et al., [24] in their study on 10 patients showed 70% failure including 30% with varus collapse, 20% each with breakage of screw and plate when treated with PFLCP as compared to 24.44% failure rate (shortening, varus collapse ,plate brekage and screw breakage) in our study. In Berkes and collegues study [25], the use of locking plates in proximal femoral fractures leads to 36.8 % device failure compared to 8.88% of device falure in our study. Failure is attributed to the stiffness of this implant that prevents any fracture site micromotion, placing the mechanical burden on the implant, which can result in failure at the bone - screw interface or fatigue failure of the implant itself. Karl Wieser et al., [26] in their study on 14 patients showed 4 cases with failure when they used PFLCP. In post operative period 2 cases showed a slight varus malalignment on x - ray , predisposing to implant failure. They concluded in their study that the prerequisite in using the PFLCP specially in unstable facture pattern, is restricted weight bearing until callus formation is seen. As seen with all other study ,our study too has two limitations : 1).since it's a case series , there is a lack of an alternative treatment or control group whose results could be compared with those of the treatment group. 2). Small sample size to conclude strongly. But it has two main strengths, first it is a unique study describing a new technique with new implant, second the data analysed here pertain to a specific type of injury; all the fractures were unstable proximal femoral fractures.

VI. Conclusion

Treatment goal of unstable proximal femoral fractures is stable fixation, early mobilization with least complications. This was achieved more satisfactiorily with the use of PFLCP. so, finally to conclude PFLCP represents a feasible alternative for unstable proximal femoral fractures($\pm$ osteoporosis).

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Table - 1

S.No.	Operative Outcomes	Total (N=45)
1.	Average time to fixation	7 days
2.	Average hospital stay	15 days
3.	Mean operative time	110 mins
4.	Blood loss during operation	650 ml
5.	Blood transfusion (units)	1
6.	Mean union time	17 weeks
7.	Mean follow up time	11 months
8.	Average Harris Hip Score	88.6
9.	Complications	20 % (9/45)
	A. shortening < 2 cm	
	B. varus collapse	
	C. screw brekage	
	D. plate brekage	
	E. delayed union	
10.	Ambulatory status at the end of follow up.	
	➢ Community ambulators	42
	➢ Household ambulators	3

Table - 2

s.no.	pre operative charactersistics		no.
1.	Age distribution		
	a. < 40 yrs.		9
	b. 41 – 60 yrs		21
	c. 61 – 70 yrs		9
	d. 71 – 80 yrs		6
2.	Mean age in years		56.7
3.	Gender		
	❖ Male	30	
	❖ Female	15	
4.	Affected side		
	➢ Right	24	
	➢ Left	21	
5.	Mean Weight in kgs.		64.7
6.	Smokers (> 10 cigarettes per day)		18
7.	Vitamin D Status		
	• Adequate (20 - 50 ng/ml)	24	
	• Inadequate (< 20 ng/ml)	21	
8.	Mode of injury		
	▪ Road traffic accident	22	
	▪ Fall from height	8	
	▪ Low energy	15	
9.	Classification		
	✓ Inter trochanteric	36	
	✓ Subtrochanteric	9	
10.	Pre injury ambulatory status		
	➢ Community ambulators	45	
	➢ Household ambulators	none	

CLINICAL PHOTOGRAPHS

Skin incision

flexion at hip joint

straight leg rasing


Adduction at hip joint


abduction at hip joint


cross leg sitting


Squatting


weight bearing

COMPLICATIONS


Broken screw


Broken implant

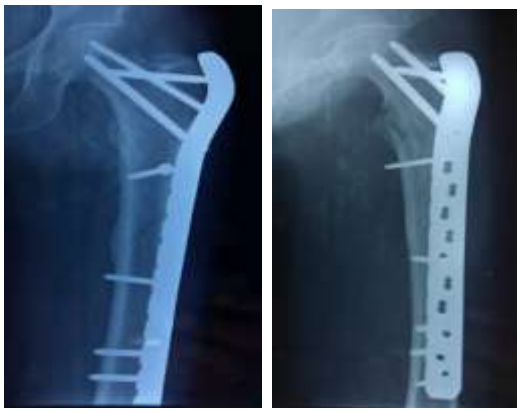

shortening < 2 cm

SERIAL X – RAYS


Pre operative AP & Lateral


Immediate post op


1 month post op



3 month post op

9 month post op