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## Treatment of displaced intra capsular fracture neck of femur by proximal femur locking compression plate (PFLCP): A case series evaluation

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### Abstract

**Introduction:** Treatment of choice for fracture neck of femur has always been a matter of debate since time immemorial. Till date there is no definite consensus regarding best implant for fixation of unstable intracapsular fracture neck of femur. We conducted this study to assess the results of fixation in such femoral neck fractures using proximal femur locking compression plate (PFLCP).

**Materials & Methods:** The present study includes 10 cases of acute unstable fracture neck of femur in the age group of 18 to 65 years irrespective of sex treated by CRIF using PFLCP in our unit of Orthopedics department, Assam medical college and Hospital.

**Results:** Six cases showed unfavorable results which later got converted to hip replacement in subsequent follow up. Four cases showed clinic-radiological union. Intra-articular penetration of screws was a common complication encountered in this study.

**Discussion & Conclusion:** We conclude from our study that though this implant provides a rigid fixation at proximal femur but definitely requires some modifications during process of fixation while dealing with fracture neck of femur. Initially the results were encouraging but with subsequent follow up we encountered a higher failure rate with conventional sequence of fixation using PFLCP.

**Keywords:** Unstable intracapsular fracture neck of femur, CRIF, PFLCP, HHS, HRA

### Introduction

Intra-capsular fracture neck of femur, “The unsolved fracture” so far has been a challenge to orthopaedic surgeons since time immemorial. Femoral neck fractures are difficult injuries to treat because of a variety of reasons that include osteopenia, fracture displacement, potential vascular compromise and patient compliance. Even though there are several implants available for fracture fixation but there is lack of clear consensus regarding the best ideal implant for internal fixation till date <sup>[1]</sup>. The gold standard treatment modality for fracture neck of femur in adults is still a matter of debate <sup>[2]</sup>. Results of minimally invasive internal fixation with three cancellous screws have been satisfactory in initial post-operative periods and is considered as the standard of care for past several decades <sup>[3]</sup>. However, in subsequent follow up such conventional technique has shown to be associated with poor outcomes in 20% to 48% cases <sup>[2]</sup>. Aminian *et al.* conducted a cadaveric study on stability in vertical femoral neck fracture using four surgical implants in thirty two cadaveric femurs and concluded that the strongest construct was the proximal femur locking compression plate (PFLCP) and the weakest construct was the cannulated screw (MCS) configuration <sup>[4]</sup>. The design of the PFLCP allows for multiple points of angled fixation in the femoral head and neck. Varus forces encountered during physiological weight bearing are transmitted from the bone to the plate through rigid screw-plate interface that prevent screw toggle <sup>[5, 6]</sup>. The justification for PFLCP in fracture neck of femur fixation are, a) the locking plate technology has significantly improved treatment in other periarticular fractures such as the proximal and distal tibia, distal fractures of femur, radius, humerus etc. b) we hypothesise that locking plate technology will provide rigid fixation and resist any femoral neck collapse or shortening <sup>[7]</sup>. This would in turn result in better preservation of intraoperative reduction and improve clinical outcomes when compared with other length stable constructs.

### Material and Methods

From June 2017 all patients admitted in our unit in the Department of Orthopedics, AMCH with displaced neck of femur fracture were included in our study that fulfilled our inclusion and exclusion criteria. It was a hospital based prospective study. We included all patients between age group of 18-65 years with an acute displaced intra-capsular femoral neck fractures with or without neck resorption.

### Operative technique

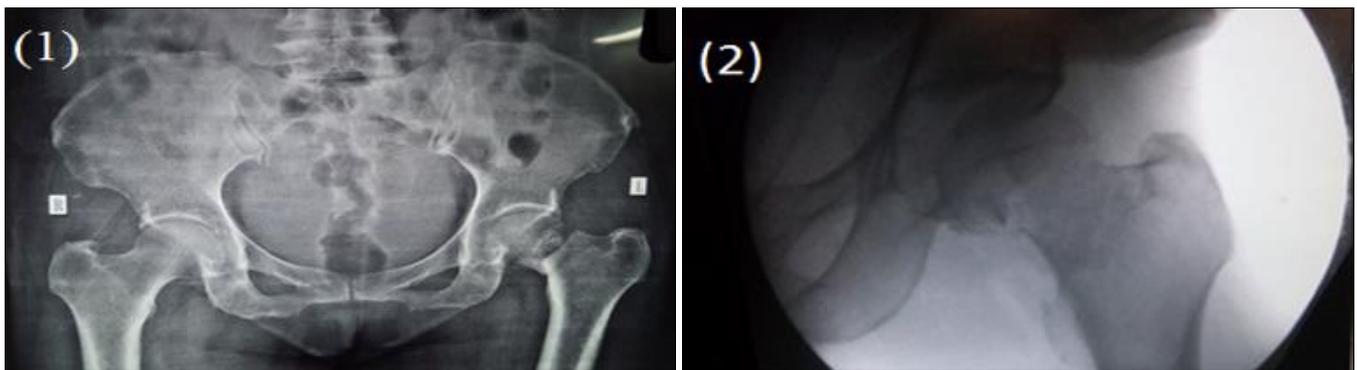
The patients were placed in supine position on fracture table and closed reduction of the fracture done by gentle traction and internal rotation (Whitman maneuver) or by the Lead better technique. The cases where anatomical reduction was not possible Gottfried non-anatomic reduction or inferior cortical buttress reduction was done [8]. The acceptability of reduction was graded as per Garden alignment index.

The features of implant include a pre-contoured 4.5 mm thick side plate accommodating two 6.5 mm (95° and 120°) and one 5.0 mm (135°) locking cancellous screws (Partially or fully threaded) at the proximal end that are directed into the femoral head in a converging configuration. The plate was anchored to shaft with conventional non-locking or locking head cortical screws. The direct lateral approach to the proximal femur was performed for all cases for internal fixation.

Tip toe touch weight bearing was allowed at around 3<sup>rd</sup> day

after pain has subsided and partial weight bearing was allowed in cognitively intact patients after 4 weeks. However full weight bearing was only allowed after radiological and clinical signs of union. All patients were followed up at 1 month, 3 months, 6 months and 6 monthly thereafter or earlier when required. The minimum follow up period was 1 year as the union usually occurred within 3 months following surgery and the complications like fixation failure and non-union occurred within 6 months and 1 year period is sufficient to look for the biological and mechanical deficiencies [9, 10, 11, 12]. Modified Harris Hip scoring system (HHS) was used to assess functional outcome and radiological outcome was assessed by plain x-ray of the operated hip. Bony union was defined as radiological obliteration of the fracture line with presence of bridging trabeculae across the fracture as well as clinically asymptomatic patient. Nonunion was defined as absence of bridging trabeculae across the fracture line 6 months after operation. Fixation failure was defined as loss of fixation within the first 2 months post operation resulting in displacement of fracture.

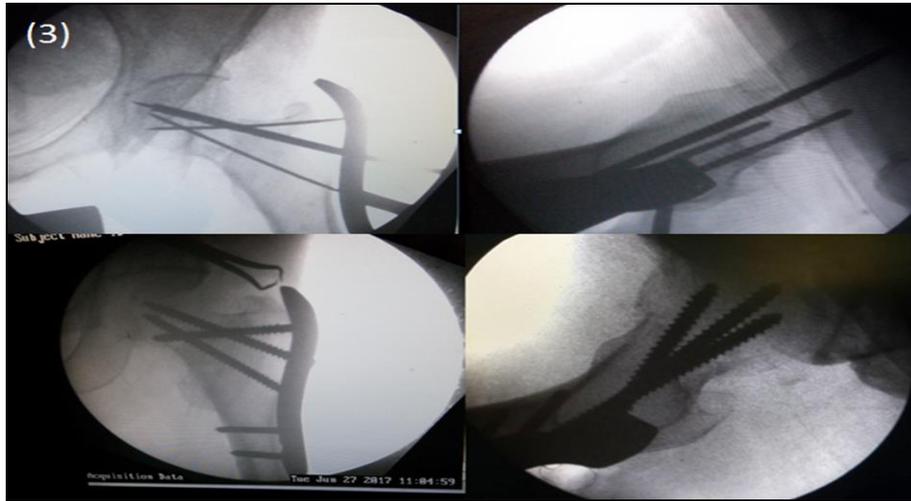
**Statistical analysis:** The statistical analysis of data was performed using the computer program, Statistical Package for Social Sciences (SPSS for Windows, version 20.0.Chicago, SPSS Inc) and Microsoft Excel 2010. For all analysis, the statistical significance was fixed at 5% level (p-value <0.05).



**Fig 1:** Pre reduction AP & Lateral view



**Fig 2:** Intra-Operative reduction under IITV



**Fig 3:** Fracture fixation with proximal femur locking compression (PFLCP)



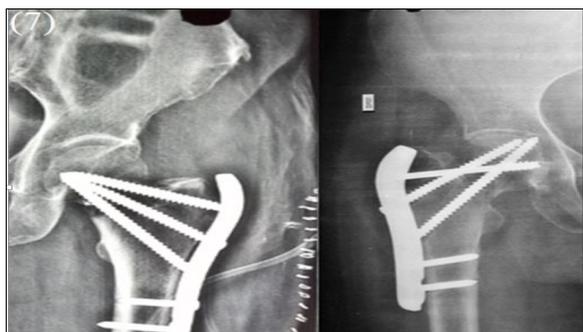
**Fig 4:** Incision for lateral approach



**Fig 5:** Immediate post-operative x –ray



**Fig 6:** Radiological union at 4 months follow up



**Fig 7:** Non – union at 7 months follow up



**Fig 8:** Intra – articular migration of screw

**Results**

Ten femoral neck fractures were identified that underwent internal fixation using PFLCP. All cases had adequate clinical

and radiographic follow-up based on inclusion/exclusion criteria. There were no documented cases of weight bearing non-compliance. The average age was 58 years with 6 female and 4 male patients. The majority of fractures were classified as Garden III (6 out of 10, 60%), Pauwels grade II (7 out of 10, 70%). Intra-operatively anatomic reduction was achieved in eight cases. Most common mode of failure included intra-articular penetration of the fixed-angle screws (Fig.8). Six of these patients were later converted to HRA because of persistent pain and disability. The average follow-up Harris Hip Score in these patients was 68. Fracture displacement was strongly associated with clinic-radiological outcome as 6 out of 10 cases resulted in failure. Additionally higher level femoral neck fracture location had an impact the success or failure rate, as 30% of the subcapital fractures experienced higher failure rate. Patients in the failure group were mostly from older age groups.

**Table 1:** Baseline description and results of cases

Features	Cases of PFLCP
Age (years)	58.18 ± 6.26
Self-fall from standing height	08 (80%)
Road traffic accident (RTA)	02 (20%)
Time interval between injury and surgery (days)	7.86 ± 06.13
Length of incision (cm)	12.40 ± 1.45
Duration of surgery (mins)	55.93 ± 9.98
Blood loss (ml)	204.63 ± 8.81
Average union time (weeks)	13.24 ± 2.08

**Table 2:** Classification of fractures as per Garden's classification

Garden Classification type	No. of cases
III	06 (60%)
IV	04 (40%)

**Table 3:** Complications

Non-union	06
Screw migration into joint	04
Deep infection	-

## Discussion

The treatment of choice for displaced femoral neck fractures has been a matter debate since decades. Recent publications have shown that a primary total hip replacement is superior to internal fixation for the treatment of displaced femoral neck fractures [13, 14]. However, the optimal treatment for a young or adult patient under 70 years old is controversial. Criticisms against internal fixation are due to its association with high rates of failure due to loss of fixation, osteonecrosis, and non-union. Several studies have attempted to identify predictive factors of failure in femoral neck fracture treatment. There is little agreement among these studies regarding which fractures are more likely to fail because they analysed both displaced and non-displaced fractures, different clinical and radiological factors, different implants for internal fixation, different weight bearing times, and so forth.

The results of osteosynthesis in young patients are debatable by presenting a considerable complication rate. However, there is little doubt that the main complication is the occurrence of osteonecrosis. Various explanations have been elaborated, including high energy trauma and its correlation with dislocated fractures in the young adult. The rate of osteonecrosis ranges from 12% to 86% [15, 16]. To our knowledge, there are no biomechanical studies comparing locking plate technology with traditional-fixed angle constructs. In a clinical report of 37 cases, Haidukewych *et al.*

found a trend towards fixed angle devices providing improved fracture stability and decreased rates of non-union and osteonecrosis when compared to cannulated screw fixation [17]. The results of study conducted by Aminian *et al.* Showed superior strength of the PFLP in comparison to the DHS, DCS and the 3 cannulated screw constructs in stabilizing a simulated Pauwels' III fracture [4]. Contrary to that 60% of cases in our study showed non-union which later underwent hip replacement.

Femoral neck shortening after internal fixation is a common outcome. The standard construct consists of 3– 4 parallel, partially threaded cancellous screws, which apply compression across the fracture site to enhance bony healing. Unfortunately, this construct also allows for progressive postoperative shortening due to the lack of purchase provided by the unthreaded portion of the screw in the per trochanteric area and lateral cortex. This can result in telescoping of the distal fragment along the longitudinal axis of the screw, producing a controlled collapse. This phenomenon has been shown to occur in both displaced and non-displaced fractures treated in this fashion [18]. In this study 40% cases showed intra-articular penetration of screws during follow up which was a common feature in cases where partially threaded screws were used. Similar results were found in the study conducted by Berkes *et al.* There was a high rate of implant failure, particularly with displaced fractures. We submit that femoral neck union requires a degree of micromotion along the axis of the neck to counteract the presence of any fracture site resorption or distraction.

The locking plate construct used is simply too stiff to accommodate micromotion at the fracture site, which can result in early implant loading beyond fatigue strength. Although this implant possesses all the ideal qualities to obtain and maintain an anatomic reduction to prevent femoral neck shortening, it seems that a certain amount of dynamization may be necessary for bony union to occur, which this construct will not allow for.

The stiffness of the locking plate construct prevented any such auto dynamization, placing the mechanical burden entirely on the implant, which can ultimately result in failure at the bone –screw interface or fatigue failure of the implant itself. The use of a fixed angle locking plate implant should be abandoned in favour of length stable fixation, thus allowing for a more flexible construct.

## Conclusion

Fixation of femoral neck fractures should mimic the normal physiological and biomechanical changes and need for such an implant is still demanding. In our study taking into consideration regarding biomechanical properties of PFLCP fractures were fixed, the results of which were not satisfactory. Thus we conclude from our study that this mode of fixation requires some modifications in the process of fixation in patients with intracapsular neck of femur fracture. Initially results were encouraging in our study but with subsequent follow up we encountered a higher failure rate the reasons of which are yet to be fully explored.

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