

Original Research Article

Surgical management of proximal humerus fracture treated with locking compression plate

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ABSTRACT

Background: Proximal humerus fractures accounts for about 4 to 5% of all fractures. Treatment of unstable, displaced, and comminuted fractures of the proximal humerus remain challenging. Significant controversy continues regarding the best methods of treating displaced proximal humerus fractures. Various operative procedures are carried out, the recent trend in internal fixation has moved on to locking plates. The present study is undertaken to evaluate the functional outcome and complication of proximal humerus fractures treated by locking compression plate.

Methods: This is a prospective study comprising of 30 patients with fractures of proximal humerus were treated by open reduction and internal fixation with locking compression plate were evaluated at Velammal Institute Of Medical Sciences, Madurai from the period of April 2015 to December 2016. Clinical and radiological evaluation was done. Patients will undergo open reduction internal fixation with locking compression plate for the sustained fracture under general anesthesia.

Results: In our series, the majority of the patients were males, elderly aged, with RTA being the commonest mode of injury, involving 2 part, 3 part and 4 part fractures of the proximal humerus. Excellent and satisfactory results were found in 76.7% of patients with unsatisfactory results in 23.3 % according to Neer's criteria. There were 100 % union rates and no failures.

Conclusions: In conclusion locking Compression, the plate is an advantageous implant in proximal humeral fractures due to angular stability, particularly in comminuted fractures and in Osteoporotic bones in elderly patients, thus allowing early mobilization.

Keywords: Proximal humerus fractures, Open reduction, Internal fixation

INTRODUCTION

Proximal humerus fractures are one of the commonest fractures occurring in the skeleton. They account for approximately 4–5% of all fracture. The incidence of fracture is more common in elderly because of decreased bone density. But it can occur in younger age group following high-velocity trauma. Because of increasing incidence of high-velocity trauma, the fracture pattern in proximal humerus fracture is becoming complicated. ¹It has been always enigma of management because of

numerous muscles attachment and the paucity of space for fixing the implant in fracture of the proximal humerus. The treatment is more controversial for articular fractures which carry a high risk of the humeral head necrosis.² In Neer's classification, these are two part anatomical neck, three-part and four-part fracture and those with dislocation of the head of the humerus. A review of published result suggests that there is no universally accepted form of treatment. conservative management may be associated with nonunion, malunion, and avascular necrosis resulting in painful dysfunction

surgery should be carried out as soon as the patient's general condition permit.³ A delay of several days makes reduction more difficult and a significant delay results in absorption of bone, making secure internal fixation impossible. The object of the osteosynthesis is to reduce the displacement (usually rotation) of each fragment and hold it in place with an implant. Thus the greater tuberosity fragment which has usually been displaced proximally and rotated upward by rotator cuff muscles inserted into it, fixed to the major humeral head fragment, lesser tuberosity fragment similarly displaced by subscapularis is fixed. Three and four-part fractures represent 13 to 16% of proximal humeral fractures. Treatment options for these displaced fractures include open reduction and fixation. Neer recommended open reduction and internal fixation for displaced two and three parts fractures. Most of the poor results following open reduction and internal fixation of three-part fracture are due to imperfect technique.⁵ In a three or four part fracture dislocation when the head of the humerus is entirely devoid of any blood supply it can be replaced by a humeral prosthesis. However, the goal of Proximal Humerus fracture fixation should be stable reduction allowing early mobilization. This study conducted to analyze fractures of the proximal humerus that were treated with the locking compression plate and documents their clinical and functional outcome.⁶

METHODS

This is a prospective study comprising of 30 patients with fractures of proximal humerus were treated by open reduction and internal fixation with locking compression plate were evaluated at Velammal Institute Of Medical Sciences, Madurai. During the period of April 2015 to December 2016. The study purpose to include patients with proximal humerus fractures admitted and examined according to protocol, associated injuries noted. Clinical and radiological evaluation done. Fractures classified using Neers classification. A routine investigation carried out to get fitness for surgery. Patients will undergo open reduction internal fixation with locking compression plate for the sustained fracture under general anesthesia. Postoperative physiotherapy followed according to protocol, to evaluate the functional outcome.

Inclusion criteria

Patients with two-part, three-part, four-part proximal humeral fractures, acute fracture, patients with age above 18 years and patients fit for surgery.

Exclusion criteria

Patients with associated humerus shaft fracture, associated neurovascular injury, acute infection, pathological fractures, old fractures and compound fractures.

On admission of the patient, a careful history was elicited from the patients and/or attendants of injury and the severity of trauma. The patients were then assessed clinically to evaluate their general condition and the local injury. The general condition of the patient and the vital signs were recorded. The methodical examination was done to rule out fractures at other sites. The local examination of the injured shoulder was done for swelling, deformity loss of function and altered attitude. Any nerve injury was also looked for and noted. The local neurologic deficit of axillary nerve was also assessed by looking for the anesthetic patch over the lateral aspect of the shoulder. Radiograph of proximal humerus was taken and fractures were classified according to Neer's classification. The patient was taken for surgery after routine investigation and after obtaining physician fitness towards surgery. The investigations are as follows: Hb%, urine for sugar, FBS, blood urea serum creatinine, HIV, HBsAg, and ECG. The consent for surgery was also taken from the patient and attendants after explaining the procedure and possible complications. The limb was shaved from shoulder to hand including axilla 1 day before the surgery. Injection tetvac and antibiotics were given 1 hour preoperatively.

Statistical analysis

The statistical analysis was carried out with SPSS VER. 18.0 Software. All the data were presented as mean, standard deviation, and percentage of efficacies. Chi-square and paired 't' test is used to evaluate the statistical significance in Neer's study ($P < 0.05$) is considered as significant.

Surgical approach

Deltopectoral approach

Incision starts just above the coracoid process, which is palpated in deepest point in the clavicular concavity distally towards acromioclavicular joint. An 8 to 10 cm incision started from just above coracoid process advanced following the line of the deltopectoral groove. The intravenous plane is between the deltoid muscle which is supplied by axillary nerve and the pectoralis major muscle, which is supplied by the medial and lateral pectoral nerves. Retract pectoralis major medially and deltoid laterally, splitting the two muscle apart. The vein is retracted either medially or laterally. The short head of biceps and the coracobrachialis must be displaced medially before access can be gained to the anterior aspect of the shoulder joint beneath the tendons lie the transversely running fibers of the subscapularis muscle. Apply an external rotation to the arm to stretch the subscapularis, bringing the muscle belly into the wound and making its superior and inferior borders easier to define. Pass a blunt instrument between the capsule and the subscapularis, then divide These-scalp laris in from insertion onto to the lesser trochanter of the humerus.

Incise the capsule longitudinally to enter the joint wherever the selected repair must be performed.⁷

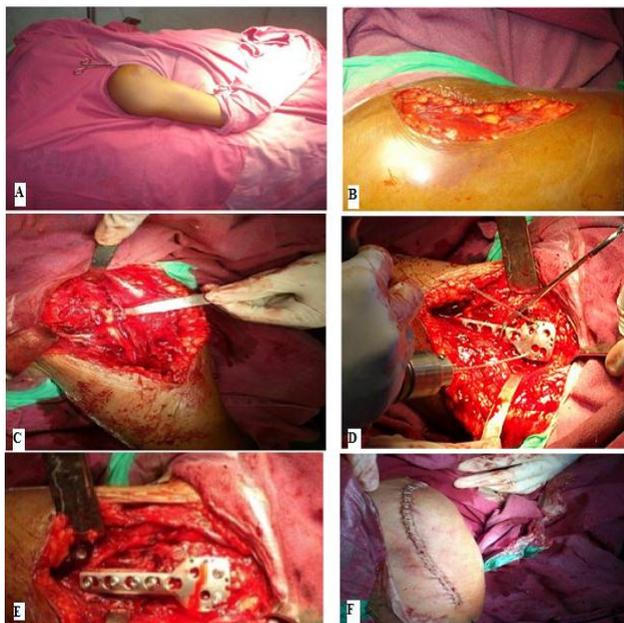


Figure 1: Deltopectoral approach. A- Position of patient, B- Incision, C-Fracture exposed, D- Reduced fixed with K-Wire, E-Reduced fixed with LCP screw, F- Wound closure.

Procedure

All patients received a prophylactic dose of 1 gm ceftriazone+sulbactam intravenously preoperatively. The operation was done in the supine position with a small sandbag under shoulder, under general anesthesia. Through deltopectoral approach, the fracture was exposed and reduced with minimal soft tissue dissection. Briefly, the anatomical relationship between humeral head and greater tuberosity was reduced and fixed temporarily with K wires. In case of obvious rotation or displacement of the humeral head, a joystick technique was used. Then the shaft fragment was reduced by abduction, traction, and rotation of the arm. The reduction was checked under image intensifier. Definitive fixation with locking plate was done with the plate positioned laterally to bicipital groove sparing tendon of long head of biceps and 1cm distal to the greater trochanter. The screws were chosen according to preoperative planning, and all the four head screws were supposed to be inserted into the head. The inferior screws supporting the humeral head were considered critical. Proximal locking screws were inserted to hold the humeral head. All proximal locking screws were placed in a uni-cortical fashion through an external guide and confirmed to be within the humeral head with intraoperative fluoroscopy. AP (internal and external rotation) views and axillary views 90 degrees to each other were used to visualize screw placement. The distal shaft screws were placed bi-cortically. A minimum of three bi-cortical screws was used. Fluoroscopic images

were taken to confirm satisfactory fracture reduction, plate positioning and proper length of screws in the humeral head. In case of severe comminution or instability, the rotator cuff, the greater tuberosity, and the lesser tuberosity were fastened to the plate using non-absorbable sutures. The range of motion of shoulder was checked on the table for impingement. Wound was closed under negative suction, which was removed after 48 hours.^{8,9}

RESULTS

Thirty patients with closed displaced proximal humerus fractures were treated by open reduction and internal fixation with locking compression plate. The following observations were made of the data collected from the study.

Age variation in the series was from 30 to 70 years. Proximal humerus fractures were found to have a high incidence in the 41 to 50 age group. The incidence of the study was given in Table 1.

Most of the injuries were caused by road traffic accident and another cause was fall from height and following a slip and fall (Table 2).

Table 1: Age distribution of patients.

Age in years	No. of patients	Percentage (%)
31-40	7	23.3
41-50	10	33.4
51-60	9	30.0
61-70	4	13.3
Total	30	100.0

Table 2: Mode of injury among patients.

Mode of injury	No. of patients	Percentage (%)
RTA	16	53.3
Fall	14	46.7
Total	30	100.0

Out of 30 patients, 3 (10%) had plate impingement, 2 (6.7%) had varus malunion and 2 (6.7%) had stiffness (Table 3).

Table 3: Complications among patients.

Complications	No. of patients (n=30)	Percentage (%)
Nil	23	76.6
Present	7	23.4
Plate impingement	3	10.0
Varus malunion	2	6.7
Stiffness	2	6.7

The Neer's scoring system of the severity of pain, function, range of movement, anatomy, was done to determine the end results. The end results of 30 patients with proximal humerus fractures which were surgically treated with locking compression plate. In our study 4 (13.3%) case had excellent results and 19 (63.4%) had satisfactory results. 7 (23.3%) had unsatisfactory results and there was no failure (Table 4).

Table 4: The final output score among patients after surgery.

Final result	No. of patients	Percentage (%)
Excellent	4	13.3
Satisfactory	19	63.4
Unsatisfactory	7	23.3
Total	30	100.0

The final results are graded according to Neer scoring criteria. We had good to excellent results in 23 (76.7%) of patients treated in our institution. All patients with excellent results and satisfactory results had normal muscle function and functional range of motion according to Neer's criteria as in Table 5.

Table 5: Range of movements in excellent and satisfactory results.

Movements	Range	Average
Flexion	130°-170°	150°
Abduction	70°-170°	120°
External rotation	60°-90°	75°
Internal rotation	60°-90°	75°

DISCUSSION

The incidence of proximal humerus fractures has increased in last few years due to changes in lifestyle and increase in road traffic accidents.¹⁰ The best management of these injuries is still uncertain. Most of the proximal humerus fracture which is un-displaced can be treated conservatively. Even if the injury is thoroughly analyzed and the literature is understood, treatment of displaced fracture or fracture-dislocation is difficult.¹¹ Moda et al have shown that the displaced fracture of the proximal humerus has a poor functional prognosis when left untreated because of severe displacement of fragments. However, with the aim of getting anatomically accurate reductions, rapid healing and early restoration of function, which is a demand of today's life, open reduction, and internal fixation, is the preferred modality of treatment. Overall, open reduction and internal fixation, although not in all Institution, have yielded satisfactory results. The best results are obtained if the fracture is well reduced and planned rehabilitation program followed.¹²

Szyszkowitz et al showed that fractures for open reduction and internal fixation which can be anatomically reduced. The present study was conducted to assess the results of two-part, three-part and four proximal humeral fractures treated by open reduction internal fixation by locking compression plate.¹³ Proximal humerus fractures occur more commonly in elderly age group. Robinson, related studies point towards this and our study is consistent with this finding.¹⁴ In our study majority of the patients i.e. 19 (63%) were from age group of 41 to 60 years followed by 4 patients (13%) in above 60 yrs. The average age of the patient was 49 yrs. Majority of the patient in our group are elderly in our study. We had unsatisfactory results in 7 (23.3%) patients. Out of which 3 patients had plate impingement who had the restriction of abduction beyond 90. The plate should be placed 1 cm below the tip of greater tuberosity and lateral to bicipital groove sparing tendon of long head of biceps. The proximal positioning of the plate may lead impingement of plate to acromion leading to limitation of abduction beyond 90°.¹⁵ 2 Cases developed varus malunion. In Koval et al, neck shaft angle decreased to <120°. It was probably due to the communication of underlying osteoporotic bone which may go impaction at the fracture site after reduction leading to varus malunion. Two patients had stiffness with restriction of movements and with persistent mild to moderate pain which considered as unsatisfactory. These patients had poor regular follow-up and compliance was poor.¹⁶

CONCLUSION

The present study was done to evaluate functional outcome and complication following surgical management of proximal humerus fracture by locking compression plate. Proximal humerus locking compression plate. In this system locking of the threaded heads of the screws in the plate itself provides for a construct with angular and axial stability, eliminating the possibility of screw toggling (windscreen wiper effect), or sliding of the screws in the plate holes. Coupled with a divergent or convergent screw orientation to head of humerus provide improved resistance to pull out and failure of fixation. Also, whereas conventional plating systems depend on compression between the plate undersurface and bone for stability, this is not the case for the locking plates. This lessens the chance of stripping the thread in osteoporotic bone, as the plate/bone interface is not loaded along the screw axis. This also allows for a more biological fixation as the underlying periosteum and blood supply to the fractured regions are much less compressed. Results are best when the operative method results in stable fixation. Fixation should be followed by early physiotherapy. The rehabilitation program plays important role in functional outcome of surgical management of proximal humerus fracture. In conclusion locking compression plate is mechanically

and biologically an advantageous implant in proximal humeral fractures particularly in comminuted fractures and in osteoporotic bones in elderly patients, thus allowing early mobilization.

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Ethical approval: The study was approved by the institutional ethics committee

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