

Philos Plating in Displaced Surgical Neck of Humerus Fracture.

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ABSTRACT

Background: Fracture of the proximal humerus is the most common upper extremity fracture after distal end of radius fractures and hip fractures in older age group. The incidence of fracture of proximal humerus is 63/1000 individuals per year. In young individuals, the fracture is associated with dislocation due to high energy trauma. Most of the proximal humerus fractures are stable and minimally displaced, while remaining are displaced, unstable and have disrupted vascular supply. There are several ways to classify the fractures of neck of humerus depending upon the fracture fragment, displacement and angulation. Codman (1934) was first to observe fragments: articular surface of the humeral head, greater tuberosity, lesser tuberosity and the shaft in neck of humerus and postulated that these fragments are displaced depending on the mechanism of the injury. Later, Neer (1970) published the classification by modifying the Codman's classification. The treatment of surgical neck of humerus fractures is divided into non-operative and operative methods. The non-operative method gives good results in stable and minimally displaced fractures. The comminuted displaced fractures are complicated by loss of reduction, malunion, non-union, stiffness and ultimately poor functional outcome. In the operative management, the systematic approach to surgical fixation was first described by Lambotte in Belgium and Lane in Great Britain (Anand et al., 2009). Subsequently various modalities of treatment of the fractures have been evolved which include closed reduction and percutaneous pinning, nailing, open reduction and internal fixation with various techniques like tension band wiring, transosseous suture fixation, conventional plate, advanced locking plate and hemi-arthroplasty, etc.

Methods: This descriptive study is based on the prospective study of 25 patients admitted with the neck of humerus fracture in the Post Graduate Department of Orthopaedics, Mahant indresh hospital, dehradun. All the patients having displaced or unstable proximal humerus were treated with open reduction and internal fixation using proximal humerus internal locking system (PHILOS).

Results: The results were analysed on the basis of constant scoring. The final gradation of the outcome of the procedure was done as Excellent (48%), Good (20%), Moderate (20%), Poor (12%). All the fractures in the present study united clinically and radiologically in an average time of 12.32 weeks. One patient present with superficial infection while other one with subacromial impingement. Two other patients present with varus displacement of the proximal fragment as complication.

Conclusion: Pre-contoured proximal humerus locking plate was observed to hold firmly on the bone. Superior overall functional and radiological outcome in patients with displaced proximal humeral fractures indicate that proximal humerus locking plate is likely to be a useful option in the management of these fractures.

Keywords: Fracture, Philos Plating, Humerus.

INTRODUCTION

The function of upper limb is to provide powerful, accurate and wide range of movements for different daily activities and therefore special care is necessary for good functional outcome. The treatment of surgical neck of humerus fractures is divided into non-operative and operative methods. The non-operative method gives good results in stable and minimally displaced fractures. Non-

surgical management traditionally has been recommended for non-displaced and minimally displaced neck of humerus fractures.

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Subsequently various modalities of treatment of the fractures have been evolved which include closed reduction and percutaneous pinning, nailing, open reduction and internal fixation with various techniques like tension band wiring, transosseous suture fixation,^[5] conventional plate, advanced locking plate and hemi-arthroplasty, etc. Operative management is required for the displaced, unstable fractures and fractures associated with dislocation.^[17] The current recommendation is that the fractures of proximal humerus that are displaced greater than 450 or 1 cm should be managed with closed or open reduction and operative fixation. Closed reduction and percutaneous fixation with either threaded pins or screws is a reasonable option. The advantage of closed reduction with percutaneous fixation is that it requires minimal surgical dissection with less disruption of the remaining vascular supply.^[6,16,21] But in osteoporotic bone and fracture with extensive comminution it is difficult to get adequate cortical purchase.

A variety of intramedullary devices used alone or in conjunction with supplemental forms of fixation has been reported. K-wires can be used as intramedullary device and tension band can be used in conjunction. Polarus nail is useful for displaced two-part,^[18,40] three-part and even in four-part proximal humeral fractures and enables early postoperative mobilization with a limited amount of pain. Tension band wiring and figure of 8 constructs incorporating the rotator cuff tendons have proved to be an excellent method of fixation for tuberosity fractures. Transosseous suture fixation using strong non-absorbable sutures also provides the similar advantage of incorporating the rotator cuff insertion to augment the fixation in patients with poor bone quality. The locking neck of humerus plate was designed to maintain a stable fracture reduction even in osteoporotic bones. Locked plates are single beam constructs by design. A single beam construct is created when there is no motion between the components of the beam i.e., the plate, screw and the bone. Single beam constructs are four times stronger than the load-sharing beam constructs where motion occurs between the individual components of the beam construct. When implanted, locked plates act as "internal external fixators", because of their close proximity to the bone. Stability in a locking plate is maintained at the angular-stable screw-plate interface. As a result of this monoblock of the locking internal fixators, the pullout strength of locking head screws is substantially higher than that of the conventional screws. Locking plates no longer rely on frictional force between the plate and bone to achieve compression and absolute stability, thus allowing the local blood supply under the plate to be preserved.

MATERIALS AND METHODS

The main advantage of the locking proximal humerus plate include gentle fracture reduction with the use of indirect maneuvers, a high resistance to avulsion even in patients with poor bone stock. It is possible due to the combination of fixed-angle screw-plate locking and three-dimensional placement of screws in the humeral head and the possibility of early exercise and a short-period of immobilization because of the high initial stability achieved.

Inclusion criteria

- Close fracture of surgical neck of humerus: 2 part, 3 part and 4 part fractures within 4 weeks.

Exclusion criteria

- Minimally displaced fracture of neck of humerus.
- Open fracture of proximal humerus.
- Pathological fracture of proximal humerus (history of metastasis, primary tumour).

Preoperative Evaluation

Extensive preoperative evaluation was performed. This included comprehensive data collection (as per the proforma) of the patient's name, age, sex, address, date of injury, date of surgery and date of discharge. Every patient was evaluated clinically for pain, swelling, deformity, tenderness, distal neuro-vascular deficit and any wound. The mechanism of injury and underlying co-morbidities were recorded. All the routine investigations like complete hemogram, biochemistry were done. The radiographic evaluation by X-ray of proximal humerus included antero-posterior view and lateral view of the shoulder joint in internal and external rotation was done to see fracture type, displacement and any intra-articular involvement. Fine-cut coronal and sagittal CT scans of the shoulder were obtained when intra-articular involvement was suspected, including articular comminution of the humeral head or suspected glenoid involvement and when it was difficult to evaluate on plain radiographs. The information obtained from both plain radiographs and CT regarding the characteristics of the fracture was useful for fracture classification as well as for the intraoperative reduction manoeuvre.

Informed and written consent was taken from the patients. Type of anaesthesia given was documented. Antibiotic prophylaxis with cefuroxime and gentamycin were given to all patients, one hour before.

Operative Technique

The date of surgery with date of injury was noted to assess the time in which surgery was done after fracture occurred. The patient was positioned in supine position on operating table and head of bed elevated. Special beach chair device type posture was made and standard deltopectoral approach was used. Surgical dissection was done more on lateral to bicipital groove so as to avoid disruption of

vascular supply to humeral head. The fracture was reduced after removing any interposed soft tissue in anatomical position. Anatomical reduction was checked under image intensifier. Locking compression plate was then applied and fixed with screws. The tuberosity fixation was done through plate holes. Intraoperative assessment was done on image intensifier to check the fracture fixation and range of motion

Post-operative Evaluation

The patient's arm was immobilized in a shoulder immobilizer. The patient continued with the injectable antibiotics for few days depending upon the condition of the wound and was given oral cefuroxime till the stitches were removed. Sutures were removed at about 12 days after surgery. The elbow, wrist and hand exercises were immediately began with pendular exercises started after pain relief. Active shoulder isometric exercises were begun at 3 weeks, progressing to isotonic strengthening and stretching exercises at 6 to 12 weeks. The patient was followed-up for a period of 6 months.

Follow-up Evaluation

Follow up appointments were at 2 weeks, 6 weeks, 3 months, 6 months and 12 months. In each visit, patient was assessed by clinical examination and radiological examination.

Clinical examination included the status of surgical wound, severity of pain, swelling, tenderness, distal neurovascular deficit, deep infection and range of motion. X-rays with anteroposterior view and lateral scapular view in internal and external rotation were done to see fracture reduction, position of plate, fracture healing, tuberosity attachment (union), non-union, malunion (varus deformity) and avascular necrosis.

After 3, 6 and 12 months, patients were assessed as per Constant shoulder score which included severity of pain, activities of daily living, range of motion in terms of forward elevation, lateral elevation, internal rotation, external rotation and strength.

RESULTS

A total of 25 patients of displaced neck of humerus fractures were managed operatively to evaluate the possible advantages of proximal humerus internal locking plate system (PHILOS) in management of these fractures in respect to radiological and functional end results.

- The mean age in the present study was 43.64 years with a significant preponderance of male patients.
- The most common mode of trauma was observed to be fall(15;60%) followed by road traffic accidents(8;32%) and assault(2;8%).
- Average delay in reporting time was 2.84 days. However, the mean interval between injury and operation was 3.28 days.

- There were 17 patients with two-part (68%), 7 with three-part(28%),1 with four-part fracture(4%) according to Neer's classification for proximal humerus fractures.
- Maximum number of patients was observed to be in the 4th decade with average being 43.64 years.
- There was a significant male preponderance in the present study, accounting to 76%. Male to female ratio was 3.17:1.
- Occupation-wise, patients were divided into light workers, heavy workers and sedentary. Light workers constitute maximum 68% of all the patients.

No intraoperative or immediate postoperative complication in the form of neurovascular injury/complication related to general anaesthesia was observed in the present study. One of the patients presented with loss of fixation at his first follow-visit that resulted in good functional outcome with fracture union in 16 weeks. One patient presented with superficial infection at the first follow-up visit, which was initially managed with debridement and aseptic dressing followed by secondary closure after five days. Subacromial impingement was seen in 1 patient where plate was fixed proximally. Varus displacement of reduced proximal fragment was observed in 2 patients. There was no incidence of screw backing, plate or screw breaking.

- Most of the patients in the present study did not have any limitation/recreational activity. However, one (4%) patient reported to have moderate limitation in the form of not being able to play tennis.
- Majority of the patients 14 (56%) were able to perform above head activity without pain in the shoulder. Seven (28%) patients reported their ability to perform painless activity upto the level of head, while 2 (8%) patients each could use the limb upto neck and could perform painless activity upto Xiphoid level.
- Most of the patients had forward flexion more than 120°. Maximum forward flexion achieved was 170°, whereas minimum was 65°, with an average of 125.40.
- Most of the patients were able to abduct their shoulders more than 120°. Maximum abduction was 170° with an average of 133.80.
- A significant number of patients were able to reach 12th thoracic spine level, whereas 40% of patients were able to reach up to waist level. In 4 (16%) patients, the level of internal rotation was up to shoulder blades level.
- Most of the patients achieved full range of external rotation.
- Most of the patients could lift more than 15 pounds with their arms abducted at 90° or at their maximum limit of abduction, whichever was higher. Most of our patients (17; 68%) were pain free at final follow-up at 6 months. Eight (32%) of

our patients' complaint of mild pain on shoulder at extremes of movements.

- Majority of the patients did not suffer any limitation of activity of daily living or occupation. Moderate limitation of activity was reported in one (4%) patient of four-part fracture group.

Final results were analyzed on the basis of Constant score⁷. The final gradation of the outcome of the procedure was done as excellent, good, moderate and poor depending upon the scoring of 86-100 (12; 48%), 71-85 (5; 20%), 56-70 (5; 20%) and 0-55 (3; 12%).

Table 1: Table showing results based on constant scoring system.

Result	Number of patients (No.)	Percentage (%)
Excellent (86 to 100)	12	48.00
Good (71 to 85)	5	20.00
Moderate (56 to 70)	5	20.00
Poor (0 to 55)	3	12.00
Total	25	100.00

Table 2: Table showing percentage of different complications.

Complications	Number of patients (No.)	Percentage (%)
Loss of fixation	1	4.0
Delayed union	1	4.0
Non-union	0	
Extraosseous placement of screw	1	4.0
Superficial infection	1	4.0
Deep infection	0	
Wound dehiscence	0	
Head penetration by screw	0	
Backing out of screw	0	
Head osteonecrosis (total)	0	
Secondary varus displacement	2	8.0
Implant breakage	0	
Decubitus ulcer	0	
Total	6	24.0



Figure 1: Pre-operative picture showing the mark for incision.



Figure 2: Pre-operative skiagram showing displaced surgical neck of humerus fracture.



Figure 3: Intraoperative picture showing placement of the philos plate.



Figure 4: 3 months post-operative skiagram showing in situ philos plate showing healing surgical neck of humerus fracture.

DISCUSSION

Displaced proximal humerus fracture continues to be a challenge to the orthopaedic surgeons. In order to return to activity as soon as possible and to avoid complications associated with conservative management³⁴ for a patient with displaced proximal humerus fracture, internal fixation has been accepted as the standard procedure, except for a few indications for conservative treatment³⁴ like elderly patient whose medical condition carries an excessively high risk of mortality from anaesthesia and surgery or the demand of the patient is low.

Surgical management of the displaced proximal humerus fractures aims at restoring the prefracture functional status of the patients, as far as occupational and recreational activities are concerned. To achieve this goal, a variety of implants of internal fixation have been employed with variable success. Implants can range from percutaneous k-wiring conventional plates such as T plate^[9,36,39,44] blade plate one third tubular plate⁴³, circlage or tension band wiring using a stainless steel wire,^[26,38,24] helix wiring,^[35] external fixator,^[28,30] intramedullary nail,^[14,20,23,24,25,27,41] locking plate,^[1,4,8,14,16,29,32,33,37,38,42] to hemiarthroplasty.^[19]

The best treatment for displaced proximal humerus fracture remains controversial and the discussion about ideal implant for such cases still continues. The diversity of fixation devices available for the treatment of displaced proximal humerus fractures illustrates the difficulties encountered in the actual treatment. The optimum outcome of treatment of any fracture depends upon:

- Anatomical reduction.
- Stable internal fixation.
- Preservation of the blood supply to the bone fragments and the soft tissues by means of atraumatic surgical technique.
- An early active pain-free mobilization of muscles and joints, adjacent to the fracture.

Proximal humeral locking plate has the possible advantage of providing stable internal fixation because of angular stability due to locking screws. The provision of inter-digitising and diverging multiple locking screws in proximal fragment is likely to provide additional stability in the presence of comminution and osteoporosis. The provision of suture holes is likely to make it easier to stabilize the separated greater and lesser tuberosity fragments. Even otherwise all locking plates prevent secondary displacement during reduction thereby facilitating percutaneous fixation. Keeping in mind the various possible advantage of proximal humerus locking plate.^[1,4,8,14,16,29,32,33,37,38,42]

In the present study, the average age was lower because a sizeable number of the patients (8 patients) sustained a high energy trauma in road traffic accident. It is pertinent to mention that younger age group is more likely to be outgoing and exposed to road traffic accident as compared to older age group. Therefore, it is expected that the road traffic accident subgroup is likely to have lower age which was reflected in the present study also.

There was a significant male preponderance in the present study with males accounting for 76% of the patients. However, it can also be explained by the fact that a sizeable number of the patients in the present study had road traffic accident as their mode of trauma and males are much more often exposed to road traffic accidents as compared to the

female population on account of the fact that in our society males are more likely to go out for earning their livelihood.

Two part fracture was observed to be most common fracture pattern in the present study.

There was a significant associated injuries in the present study with 6 (24%) of our patients suffering additional fractures besides fracture surgical neck humerus. In the present series, we observed trochanteric fracture in 1, fracture tibia ipsilateral in 1, fracture ulna in 1, chest injury 2 and head injury in 1 patient.

Higher incidence of associated injuries in the present study is again attributable to road traffic accident with high energy trauma as the sizeable mode of injury.

Average interval between injury and operation in the present study was 3.28 days. It was primarily on account of some of the patients who presented late to the hospital (6 days) and some of older patients taking longer than usual time for anaesthesia fitness because of pre-existing comorbid conditions.

Radiologically, fractures were classified according to Neer's classification. Majority of cases were placed in 2 part (17 patients), followed by 3 part (7 patients) and 4 part (1 patient) in the present study.

Though we did not observe any concomitant neurovascular injury in the present study, few authors have reported neurological deficit sustained by the patients with proximal humerus fractures.

Average time for radiological union in the present series was 12.32 weeks. Delayed union was observed in 2 patients in whom fracture healed within 16 weeks without any further intervention. One patient, who suffered loss of reduction at first follow-up, was managed conservatively. Average time of union in the present study was comparable with that of literature.

In the present study, 17 (64%) of 25 patients had no pain and the remaining 8 complained of mild pain which was occasional or associated with prolonged activity involving the shoulder.

Most of the patients in the present study resumed their previous job except one, three patients had a poor outcome as per Constant score⁷. The patient also had trochanteric fracture which further limited his activity.

In the present study, 80 and 110 of secondary varus displacement was seen in 2 adult patients, 1 with 2 part fracture and other with 3 part fracture. In presence of good bone quality and stock, the medial comminution was overlooked leading to varus displacement of proximal fragment. Cost of implant had further prevented to put extra screws in inferomedial region to prevent varus displacement. However, we observed good in one and excellent outcome in another patient. We did not observe loss of reduction or displacement of segments in elderly osteoporotic patients except one who

suffered loss of reduction at his first follow-up visit. His loss of reduction was attributed to poor bone quality and accidental use of larger drill bit at shaft resulted in poor hold of cortical screws.

Most complications that might arise are related to technique. The proximal humerus locking plate provides excellent fixation to the humeral head, even in the osteoporotic bone. Angular stability, adequate buttressing and load sharing support prevent collapse of the fragments. It is suitable for two, three and four part fracture (not involving humeral head) in young and the elderly patients, providing that the correct surgical technique is used.

CONCLUSION

The ideal treatment of displaced proximal humeral fractures had been controversial for several years. Several treatment modalities have been suggested to improve upon the clinical outcome in these difficult fractures. The present study does indicate that the proximal humerus locking plate is a promising implant to have a good functional outcome even in osteoporotic bones. Along with giving buttressing effect laterally, it also has provisions of giving inferomedial support by locking screws, which prevent varus displacement of proximal fragment in presence of medial comminution. However, the implant is very demanding in terms of operative technique. Superior overall functional and radiological outcome in patients with displaced proximal humeral fractures indicate that PHILOS proximal humerus locking plate is likely to be a better option in the management of these fractures.

To draw a definite concluding regarding approach to the fracture, a larger study is required with comparable fracture patterns in two groups. In the present study, majority of the patients were adult which left very few osteoporotic fractures for evaluation. It was very difficult to definitely conclude the outcome of proximal humerus locking plate in all kinds of fractures in elderly osteoporotic fractures. However, proximal humerus locking plate achieved excellent to good result in all 2 and 3 part fractures in adult patients.

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