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Functional outcome of proximal humerus fracture using PHILOS plating

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Abstract
Aim and Objective: Fracture of the proximal humerus, part 2, 3 and 4 have been a challenge to achieve stable fixation .The goal is to achieve near anatomical reduction, preserve biology, stabilization and achieve early mobilization. PHILOS plate provide rigid fixation, more angular stability and good union rate. In this study we have assessed the functional outcome of patients who have undergone PHILOS plating for proximal humerus fracture.
Material and Method: Study was conducted in department of orthopaedics, Rajah Muthiah Medical College and Hospital. Total of 20 patient with fracture of proximal humerus treated using PHILOS plate. Open reduction and internal fixation was performed in 20 patients. Result were assessed by constant and murley shoulder outcome score
Result: The average follow up time was 6 months. Results were analysed in respect to union of fracture, range of motion of shoulder joint. The mean union time was 8 weeks.
Conclusion: PHILOS plating is effective in treatment of proximal humerus fracture with high rate of bony union and early mobilization with excellent clinical and radiological outcome.

Keywords: Proximal Humerus Fracture, Philos, Constant and Murley Sholuder Outcome Score.

Introduction
Proximal humeral fractures is the second most common fractures of the upper extremity accounting upto 5% of all fractures. Majority of undisplaced proximal humeral fractures can be treated conservatively with a sling immobilization [8]. However, approximately 20% of displaced proximal humerus fractures requires surgery.
Conservative treatment is usually associated with nonunion, malunion and avascular necrosis resulting in a painful dysfunction.
Various surgical modalities used are transosseous suture fixation [9], closed reduction and percutaneous fixation [10, 11], open reduction and internal fixation with conventional plates, locking plate fixation, locking nail [3] and hemiarthroplasty. Pre-countoured locking compression plates are fixed angled devices which prevent subsidence in the metaphyseal areas. These plates alleviate the risk of malreduction and preserve the blood supply to the bone [7]. The aim of this study was to assess the functional outcome in proximal humeral fractures treated with locking plates (PHILOS).

Materials and Methods
The study was conducted on 20 patients with proximal humerus fractures treated with PHILOS. All the patients presenting to the emergency/outpatient department in Rajah Muthiah Medical College. U slab was given to all patient for brief period of time preoperatively. Patient was followed at the regular interval 1, 3 and 6 month interval. Fracture union, range of motion, residual deformities were assessed. Constant and murley score was used for evaluation [8].

Surgical procedure
Patient in supine position under regional block with a dose of third generation cephalosporin given preoperatively. A deltopectoral approach was utilized. An 8 cm to 10 cm incision

starting from coracoid process was taken along deltopectoral groove. The plane between deltoid and the pectoralis major muscle was identified and separated. The cephalic vein was retracted laterally or medially depending upon the exposure. The subscapularis muscle was made taut with external rotation and incised in line of its fibres. The fracture fragments were identified and the haematoma was cleared off completely.

Reduction was done with the help of K wires and checked in c-arm. PHILOS plate was fixed about 5-8 mm distal to the greater tuberosity and around 2-4 mm posterior to the bicepital groove. The plate was first fixed to the distal fragment and then screws were inserted. Final reduction was checked under c-arm and wound closure was done in all the cases. All the patients were kept in arm pouch postoperatively. Similar pain management protocols were followed in all the cases. All the patients were assessed at a interval of 1, 3 and 6 months. Clinical assessment was done in the form of pain, function and range of movements. Antero-posterior X-rays were performed for all the patients at each follow up to assess the fracture union.

Fig 1: Positioning of Patient

Fig 2: Approach

Fig 3: Plate Fixation

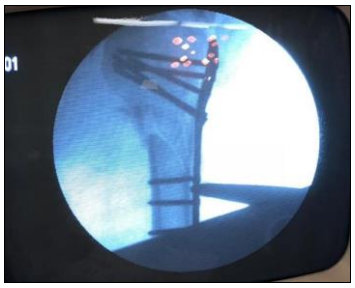
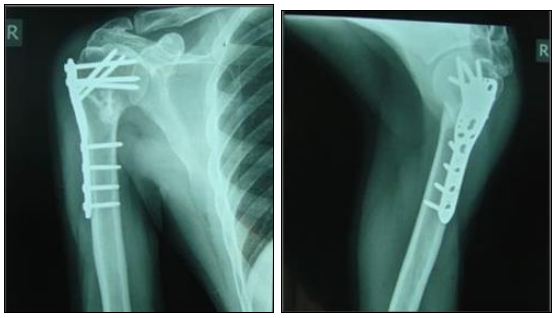


Fig 4: Fracture reduction

Fig 5: Wound Closure

Case study

Pre Op **4 week post-operative**



12weekpost operative **24 week post-operative**

Clinical Picture

Criteria in order to evaluate functional outcome our study used constant and murley scoring system [1].

Subjective Parameters assessed are as follows

Table 1: Scoring For Individual Parameters

Parameters	Points
Pain	15
Activities of daily living	20
Range of motion	40
Power	25
Total	100

Table 2: Scoring For Pain

PARAMETERS	POINTS
None	15
Mild	10
Moderate	5
Severe	0

Table 3: Scoring For Activities of Daily Living

Activity Level	
Full work	4
Full recreation/sport	4
Unaffected sleep	2
Arm Positioning	
Upto waist	2
Upto xiphoid	4
Upto neck	6
Upto top of head	8
Above head	10
Total for Activities of Daily Living	**20**

Objective Parameters assessed are as follows

Table 4: Points for Forward Flexion and Lateral Elevation (10 points each)

Forward Flexion & Lateral Elevation (°)	Points
0-30	0
31-60	2
61-90	4
91-120	6
121-150	8
151-180	10

Table 5: External Rotation Scoring

Position	Points
Hand behind head, elbow held forward	2
Hand behind head, elbow held back	2
Hand on top of head, elbow held forward	2
Hand on top of head, elbow held back	2
Full elevation from on top of head	2
Total	10

Table 6: Internal Rotation Scoring

Position	Points
Dorsum of hand to lateral thigh	0
Dorsum of hand tobuttock	2
Dorsum of hand to lumbosacral junction	4
Dorsum of hand to waist(3rd lumbar vertebra)	6
Dorsum of hand to 12th dorsal vertebra	8
Dorsum of hand to interscapular region(D7)	10

Power was assessed using MRC grading

Grade 0 - No contraction
Grade 1 - Flicker of contraction
Grade 2 - Able to move eliminating gravity
Grade 3 - Able to move against gravity
Grade 4 - Able to move against resistance
Grade 5 - Normal muscle power

Table 7: Range Of Motion

Range of Motion	Number of Patients	Percentage (%)
Abduction		
0-30°	0	0
31-60°	0	0
61-90°	14	70
91-120°	6	30
121-150°	0	0
151-180°	0	0
Flexion		
0-30°	0	0
31-60°	0	0
61-90°	1	5
91-120°	11	55
121-150°	4	20
151-180°	4	20

Six (30%) patients had abduction between 91-120°, fourteen patients (70%) had abduction between 61-90°, which is a reasonable range available for day-to-day activities.
Four (20%) patients had flexion between 150-180°, four (20%) patients had flexion between 121-150°, eleven (55%) patients had flexion between 91-120° and one (5%) patients had flexion between 61-90°.
Internal and external rotation ranged between 20°-80°
In our study all 20 patient had good outcome with regards to radiological and range of motion [2]

Complication

In our study 1 patient had pathological fracture which was fixed with philosplate and intra operatively bone biopsy was sent and was reported to be secondaries and patient had one more fall and had refracture with implant failure, hence implant was removed and u slab applied. Patient later referred to surgical oncologist in view of secondaries with biopsy report.

Discussion

Proximal humerus fractures comprise the third most common fracture in the geriatric population (court and brown *et al* [6]) after hip and distal radius fractures. The goal of surgical treatment in patients is to achieve effective stabilization of an adequately reduced fracture to maximize functional outcomes. In my study deltopectoral approach was used because this approach can be a fairly extensile exposure, allowing access to the anterior, medial, and lateral aspects of the shoulder, Can be extended distally to incorporate the anterior approach to the humerus and cephalic vein and axillary nerve can be secured. The functional outcome after operative treatment of any periarticular fracture is better when articular fragments are anatomically reduced, the key fracture fragments are rigidly fixed and the joint is moved early. These tenets are especially important in treating fractures around the shoulder because of its extensive range of movement. The optimal method of treatment for these fractures continue to be both a challenge and a controversy.
A good functional outcome is abduction and elevation of 90°, external rotation of 25° and an internal rotation good enough to touch the L1 vertebrae.
To avoid pitfalls and to maximize outcome, the treating

surgeon needs to follow three simple rules: (1) Know the patient; (2) Know the fracture; and (3) Know the bone.

Know the patient: The surgeon needs to treat the patient based on hand dominance, occupation, pre-injury level of function, expectations postoperatively, ability to follow a rehabilitation protocol, and associated co-morbidities.

Know the fracture: The surgeon needs to obtain adequate imaging studies for an accurate assessment of fracture pattern.

Know the bone: Assessment of bone quality and the ability to achieve secure fixation will determine the choice of fixation.

The recent evolution of locking plate technology for proximal humerus fractures have revolutionized the management of these fractures as a solution to screw toggle, pull out in osteoporotic bone seen in conventional plating thus diminishing the possibility of primary or secondary loss of reduction.

Misra A *et al*[12] in their series of patients treated with internal fixation, 76% had better pain relief and 67% patients had good functional range.

In our series of 20 operative patients, all patient had good pain relief

Koval *et al.* [13] in their series of 104 cases pointed out that the use of plates required more extensive soft tissue stripping, which may increase the risk of osteonecrosis.

In our series, operative patients treated with plate fixation had no features suggestive of osteonecrosis at the end of 6 month, but our series had a small number of cases

Hertel *et al* l [4] studied osteonecrosis of proximal humerus which was intraarticular by assessing the perfusion and stated the criteria

Hertel's criteria

- <8 mm of calcar length attached to articular segment
- disrupted medial hinge
- increasing fracture complexity
- displacement >10mm
- angulation >45°

Sudkamp N *et al*[14] reported that the most common complication encountered in their study was primary screw perforation of the humeral head (in 21 out of 155 patients, 13.5%). This was purely related to incorrect surgical technique of initial malreduction and delayed loss of reduction.

In our series, there were no screw penetrations into the joint and the best way to avoid this was to get radiographs throughout the arc of rotation with drill bit in-situ to get the exact length of the screw.

There were no screw pull-outs either, in our series and we personally feel that the best way to tackle this problem is to put as many screws in the head as possible.

George Osterhoff *et al*[15]and Juan Agudelo *et al.* [5] observed that a follow-up of 6 months is sufficient for evaluation of varus malalignment and screw cut-out as the bone-plate interface in plate osteosynthesis of these fractures usually fails during the first 3-4 weeks post-operatively.

In our study, two patients had shoulder stiffness at 8 weeks post operatively, which improved with regular, intensive physiotherapy and active range-of-motion exercises

There were no cases of infection, axillary nerve palsy, axillary artery injury, non-union or delayed union encountered in our study.

Augmentation with PMMA cement is an option and Matsuda *et al*. [16] have reported a series of 5 such cases. However, we do not have any personal experience with cement augmentation.

Conclusion

- The PHILOS plating technique gives moderate to excellent results in cases with proximal humerus fractures, depending on the fracture pattern [90% cases in our study].
- Patients treated with early fixation and early mobilization were found to have a better functional outcome irrespective of the fracture type and helps in early bony union.
- Operative treatment demands increased surgical competence, strict adherence to locking plate principles and requires a complete armamentarium of equipment to deal with such fractures.
- Good surgical results can only be obtained by vigorous physiotherapy imparted by an expert team and strong motivation from the patient side.
- Although our study comprises only a small cohort of patients, we can confidently say that the PHILOS plating technique is an effective method for treating unstable proximal humeral fractures due to its overall good functional outcome.

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