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Morphological landmarks of proximal humerus fracture in functional outcome post fixation by philos plate

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Abstract

Proximal humerus fractures present with different configurations in patients with varying comorbidities and expectations. Various treatment options are available for treating proximal humerus fractures. A good functional outcome with context to the early joint mobilisation and rigid fixation of the fracture can be achieved with PHILOS plate in proximal humerus fractures.Patients admitted with proximal humerus fractures as inpatient in department of orthopaedics were included in the study satisfying the inclusion and exclusion criteria.30 patients with proximal humerus fracture were treated by open reduction internal fixation with PHILOS plate. Improvement of Constant-Murley score at 6 weeks of 47.83 to 64.67 at 12 weeks(p=<0.001), 75.27 at 24 weeks(p=<0.001) and 78.33 at final follow up(p=<0.001). Most of the patients had excellent (43.3%) followed by good (33.3%), poor (16.7%) and fair (6.7%) outcome. Varus malunion 6(20%) was the most common complication.Proximal humeral internal locking system (PHILOS) is the implant of choice for treating displaced proximal humerus fractures which leads good functional outcome in patients.

Keywords: Open reduction internal fixation, proximal humeral internal locking system (PHILOS) plate, proximal humerus fractures, constant-murley score

Introduction

Proximal humerus fractures accounts for approximately 4-5% of all the fractures and are next to hip fractures and distal radius fractures in the elderly population. The incidence is approximately 3/10,000 persons a year and is rapidly increasing with age[1-3].Women are affected twice as often as men[2].

The majority of patients with this fracture are elderly, which increases the risk for their bones to be osteoporotic or brittle. The quality of the bone seems to be crucial both for the surgical intervention and the functional outcome[2].An elderly patient's physical and mental status can create difficulties during the rehabilitation to return to normal status[2, 3, 4, 5].

The majority of Proximal Humerus Fractures are caused by what is called low energy trauma, for example, a fall from a standing position with an arm stretched out [2-5].

Proximal humerus fractures remain a significant and growing medical concern due to the strongly associated morbidity and epidemiological trends indicating an aging population[3, 5].

Most patients with undisplaced fractures will regain a functional shoulder by treating conservatively. Surgery should be considered in approximately 20% of patients[6],either to regain better functional outcome or due to its complexity of the fracture. An ever expanding range of reconstructive options are available to treat these injuries, each with its own advantages and disadvantages[7].

A wide variety of treatment modalities have been used in the past. These include transosseous suture fixation, tension band wiring, standard plate and screw fixation, hemireplacement arthroplasty, percutaneous wire, and screw fixation. Precontoured locking plates work on the principle of angular stability, less disruption of vascularity, and less chances of plate failure[8]. Improved fixation by locking plates are attributed to the angular stability of the screws locking in the plate and their three-dimensional distribution in the humeral head. But their use for the treatment of proximal humerus fractures demands an accurate surgical technique, long learning curve to avoid plate impingement, and screw perforation of the articular surface. Also, like with all locking plates, fracture reduction must be achieved prior to plate application which can be challenging[8].

Techniques for treating complex proximal humerus fractures vary and include fixations using tension bands, percutaneous pins, bone suture, T-plates, intramedullary nails, double tubular plates, hemiarthroplasty, Plant Tan humerus fixator plates, Polarus nails and blade plates. Complications of these techniques include cutout or back out of the screws and plates, avascular necrosis, nonunion, malunion, nail migration, rotator cuff impairment, and impingement syndromes. Insufficient anchorage from conventional implants may lead to early loosening and failure, especially in osteoporotic bones[9].

The Proximal humeral internal locking system (PHILOS) plate fixation provides greater angular stability than do conventional implants. It works as a locked internal fixator and provides better anchorage of screws in osteoporotic bone[10, 11],with good functional outcomes[12, 13].

Complications associated with the PHILOS plate fixation include screw penetration into the glenohumeral joint or humeral head, screw loosening and back out, avascular necrosis of the humeral head, pseudoarthrosis with a broken plate, subacromial impingement requiring plate removal, nonunion, malunion due to loss of purchase in the humeral head, broken distal screws with separation of the plate from the boneand transient axillary nerve palsies[9].

A good functional outcome with context to the early joint mobilisation and rigid fixation of the fracture can be achieved with PHILOS plate in proximal humerus fractures. The locking plate can be used with a minimally invasive technique which permits indirect fracture reduction thus lowering the possibility of avascular necrosis (AVN) and also lowering of time of immobilization reduces the possibility of frozen shoulder. Furthermore, the proximal locking screw having the capability of being applied in multidirections makes it a fixating device with a high stability in osteoporotic bones[14].Considering these advantages this study is intended to analyse the functional and radiological outcome of proximal humerus fracture operated with PHILOS plate.

Methodology

Study design

The study design is a prospective study.

Source of data

Patients admitted with proximal humerus fractures as inpatient in department of orthopaedics

were included in the study.

Sample size

A total of 30 cases were enrolled in the study satisfying the inclusion criteria.

Inclusion criteria

1. Patients with 2-, 3-or 4-part proximal humeral fracture.
2. Patients of either sex aged >18 years and <80 years.

3. Willingness and written informed consent of patient to participate in the study.

Exclusion criteria

1. Open fractures.
2. Pathological fractures.
3. Pregnancy.
4. Patients of age group < 18 years.
5. Patients unfit for surgery.

Informed consent

Patients fulfilling the selection criteria were informed about the nature of the study. The consent for surgery and anaesthesia was also taken from the patient and attendants after explaining the procedure and possible complications in their own vernacular language.

Data collection

At the arrival of the patient with these fractures a careful history was elicited from the patients and/or attendants about age, sex, details of injury, duration were obtained through an interview. Patients were evaluated for associated medical problems and associated injuries and were addressed. Patients were subjected to clinical and local examination. These findings were recorded on predesigned and pretested proforma.

Results

Table 1: Age distribution of patients studied

Age in years	No. of patients	%
18-30	2	6.7
31-40	10	33.3
41-50	8	26.7
51-60	5	16.7
>60	5	16.7
Total	30	100.0

Mean ± SD: 46.17±12.25

Patients were aged between 27 to 79 years in the group with maximum incidence in 31-40years age group (33.3%) with mean age being 46.17 years.

Table 2: Pre op Metaphyseal extension distribution of patients studied

Pre op Metaphysealextension	No. of patients(n=30)	%
>8 mm	23	76.7
<8 mm	7	23.3
Total	30	100

In our Study Pre op Metaphyseal Extension More than 8 mm was seen in 23(76.7%) and Less than 8 mm in 7(23.3%) patients.

Table 3: Post op CCD Angle (Deg) distribution of patients studied

Post op CCDAngle(Deg)	No. of patients (n-30)	%
<127	9	30.0
127-145	20	66.7

148	1	3.3
Total	30	100.0

In our study Post op Centrum Collum Diaphyseal Angle (CCD) was Less than 127 deg(Varus) in 9(30%),127-145 deg(Normal) in 20(66.7%) and 148 deg(Valgus) was seen in 1(3.3%). Results show predominantly fixed in 127-145 deg.

Table 4: Post op Medial hinge Displacement distribution of patients studied

Post op MedialHinge Displacement	No. of patients (n=30)	%
<2 mm	15	50.0
>2mm (2-4)	15	50.0
Total	30	100

In our Study Post op Medial Hinge Displacement Less than 2 mm was seen in 15(50%) and more than 2 mm which ranges from 2 to 4 mm was seen in 15(50%) patients.

Table 5: Post op Sub Acromial Space Maintenance distribution of patients studied (Normal is 7-11 mm)

Sub Acromial SpaceMaintenance	No. of patients (n=30)	%
>50 % of normal	19	63.3
<50% of normal	11	36.7
Total	30	100

In our Study Post op Sub Acromial Space of more than 50% of normalwas maintained in 19(63.3%) and less than 50% of normal in 11(36.7%) patients.

Table 6: Radiological union distribution of patients studied

Radiological union	No. ofpatients (n=30)	%
6 weeks FU	4	13.3
12 weeks FU	27	90.0
24 weeks FU	30	100.0
36 weeks FU	30	100.0

Mean ± SD: 12.4±12.25

In our Study 4(13.3%)patients achieved radiological union in 6 weeks follow up, 27(90%) patients achieved radiological union in 12 weeks follow up and all 30(100%) achieved radiological union in 24 weeks follow up. Most of the patients 27(90%) achieved radiological union in 12 weeks follow up. Mean union time was 12.4 weeks.

Table 7: Association of Radiological Parameters and fracture classification of patients studied

Radiological Parameters	Fracture classification			Total (n=30)	P value
	2part(n=6)	3part(n=14)	4part(n=10)		
Pre op Meta Physeal extension					
More than 8 mm	4(66.7%)	13(92.9%)	6(60%)	23(76.7%)	0.131
Less than 8 mm	2(33.3%)	1(7.1%)	4(40%)	7(23.3%)	
Post op Medial Hinge Displacement					
Less than 2 mm	2(33.3%)	10(71.4%)	3(30%)	15(50%)	0.107
More than 2 mm	4(66.7%)	4(28.6%)	7(70%)	15(50%)	
Post op Sub acromial space maintenance					

More than 50% of normal	4(66.7%)	11(78.6%)	4(40%)	19(63.3%)	0.175
Less than 50% ofnormal	2(33.3%)	3(21.4%)	6(60%)	11(36.7%)	
Post op CCD Angle(Deg)					
<127	2(33.3%)	3(21.4%)	4(40%)	9(30%)	0.502
127-145	4(66.7%)	11(78.6%)	5(50%)	20(66.7%)	
148	0(0%)	0(0%)	1(10%)	1(3.3%)	

In our study pre op Metaphyseal extension >8 mm was mostly seen in 3 part fracture 13/14(92.9%) cases and least 6/10(60%) in 4 part fracture cases. Metaphyseal extension <8 mm was highest seen in 4 part fracture 4/10(40%) cases and least in 1/14(7.1%) in 3 part fracture cases. The association of metaphyseal extension to fracture classification was not statistically significant (p= 0.131).

In our study post op Medial hinge displacement <2 mm was mostly seen in 3 part fracture 10/14(71.4%) cases and least 3/10(30%) in 4 part fracture cases. Medial hinge displacement >2 mm was highest seen in 4 part fracture 7/10(70%) cases and least in 4/14(28.6%) in 3 part fracture cases. The association of medial hinge displacement to fracture classification was not statistically significant (p= 0.107).

In our study post op subacromial space >50% of normal was mostly maintained in 3 part fracture 11/14(78.6%) cases and least 4/10(40%) in 4 part fracture cases. Sub acromial space <50% of normal was highest seen in 4 part fracture 6/10(60%) cases and least in 3/14(21.4%) in 3 part fracture cases. The association of subacromial space maintenance to fracture classification was not statistically significant (p= 0.175).

In our study post op CCD angle <127 deg was mostly seen in 4 part fracture 4/14(40%) cases and least 3/14(21.4%) in 3 part fracture cases. CCD angle 127-145 deg was highest seen in 3 part fracture 11/14(78.6%) cases and least in 5/10(50%) in 4 part fracture cases. CCD angle 148 deg was only seen in 1/10(10%) in 4 part fracture case. The association of post op CCD angle to fracture classification was not statistically significant (p= 0.502).

Table 8: Association of Radiological parameters and Outcome of patients studied

Radiological Parameters	**Outcome**				**Total (n=30)**	**P value**
	Excellent (n=13)	**Fair (n=2)**	**Good (n=10)**	**Poor (n=5)**		
Pre op Meta Physeal extension						
More than 8 mm	12(92.3%)	2(100%)	6(60%)	3(60%)	23	0.186
Less than 8 mm	1(7.7%)	0(0%)	4(40%)	2(40%)	7	
Post op Medial HingeDisplacement						
Less than 2 mm	10(76.9%)	0(0%)	5(50%)	0(0%)	15	0.010**
More than 2 mm	3(23.1%)	2(100%)	5(50%)	5(100%)	15	
Post op Sub acromial spacemaintenance						
More than 50%of normal	13(100%)	0(0%)	6(60%)	0(0%)	19	<0.001**
Less than 50%of normal	0(0%)	2(100%)	4(40%)	5(100%)	11	
Post op CCDAngle (Deg)						
<127	0(0%)	2(100%)	3(30%)	4(80%)	9	<0.001**
127-145	13(100%)	0(0%)	7(70%)	0(0%)	20	
148	0(0%)	0(0%)	0(0%)	1(20%)	1	

In our study pre op metaphyseal extension in association to functional outcome was not statistically significant (p=0.186).

In our study post op medial hinge displacement in association to functional outcome was statistically significant (p=0.010).

In our study post op sub acromial space maintenance in association to functional outcome

was statistically significant (p=<0.001).
In our study post op CCD angle in association to functional outcome was statistically significant (p=<0.001).

Discussion

Many studies conducted in the past support non-operative management of undisplaced proximal humerus fractures. The indications for non-operative treatment patients with undisplaced or minimally displaced fractures, valgus impacted fractures[15], patients not medically fit for surgery and elderly patients with low functional demand. Many studies have shown that the displaced fracture of the proximal humerus have a poor functional prognosis when left untreated because of severe displacement of fragments[16] causing chronic pain at the affected arm.

The main aim of the surgical fixation of displaced proximal humerus fracture is to achieve anatomical reduction and rigid fixation restore the rotator cuff mechanism and to give a functional outcome which is near normal to the preinjury status of the patient. Open Reduction and Internal Fixation is the preferred method for surgical treatment. It allows direct visualization of the fracture fragments and facilitates the direct reduction and aids in achieving anatomical reduction. It also helps in proper positioning of the implant.

Fixation with compression plates and screws has been the standard treatment modality. But high rates of postoperative fracture displacement and varus collapse has been reported with conventional compression plate and screw fixation[17].

In our Study 4(13.3%) patients achieved radiological union in 6 weeks follow up, 27(90%) patients achieved radiological union in 12 weeks follow up and all 30(100%) achieved radiological union in 24 weeks follow up. Majority of the patients (90%) had radiological union by second follow up (12 weeks). In study by Patil SN, *et al.* [18] also reported similar results with (90%) of fracture union by 12 weeks. Radiological union was independent to mode of injury, type of fracture and osteoporosis as no statistically significant association was noted between mode of injury, type of fracture and osteoporosis and radiological union (p= >0.05).

In our study 12(40%) cases had complications of which Varus Malunion (20%) was the most common complication seen. Other complications were stiffness 2(6.7%), superficial infection 2(6.7%), avascular necrosis 1(3.3%) and implant failure 1(3.3%). No patient was taken for revision surgery. A systemic review by Sproul RC, *et al.*[19]showed overall complications rate was (48.8%) where varus malunion was (16.3%) which were similar to our study.

AVN of the humeral head is a known complication of proximal humeral fracture,reported most commonly seen with four-part fractures. Kilic*et al.* [14]used Philos for fixation of proximal humeral fractures and reported AVN in only one of 22 patients in their series. In our study only one of 30 patients AVN was seen which was a 4-part fracture. The case was operated 7 days after injury as the patient presented to us late. The patient had pre op metaphyseal extension <8 mm, post operatively CCD angle was 148 deg, post op medial hinge displacement was 3 mm and post op sub acromial space was<50% of normal side. First signs of AVN with sclerosis and osteopenia were noted at 24 weeks follow up which progressed to flattening and collapse at 36 weeks follow up. The patient had poor functional outcome.

In our study Constant score was used for outcome measure which corresponds to other studies where Constant score was used for outcome measure. All the cases in our series were assessed according to Constant Score and graded accordingly as Excellent, Good, Fair and Poor at 6 weeks,12weeks, 24weeks and 36 weeks.

At 6 weeks follow up Constant Score was 47.83±2.68. Fair outcome was seen in 10(33.3%) patients and Poor outcome was seen in 20(66.7%). Most of the patients complained of moderate to severe pain at 6 weeks follow up as only 13.3% of patients achieved fracture union. The patients also had restricted range of movements. All these factors resulted in fair

to poor outcome at 6 weeks follow up.
At 12 weeks follow up Constant Score was increased to 64.67±16.05 which was statistically significant (p=<0.001). Excellent outcome was seen in 2(6.7%) patients, Good outcome in 11(36.7%) patients, Fair outcome was seen in 9(30%) and Poor outcome in 8(26.7%) patients.
At 24 weeks follow up Constant Score was increased to 75.27±16.48 which was statistically significant (p=<0.001). Excellent outcome was seen in 9(30%) patients, Good outcome in 13(43.3%) patients, Fair outcome was seen in 1(3.3%) and Poor outcome in 7(23.3%) patients.
At final follow up at 36 weeks Constant Score was 78.33±15.07 which was statistically significant (p=<0.001). Excellent outcome was seen in 13(43.3%) patients, Good outcome in 10(33.3%) patients, Fair outcome was seen in 2(6.7%) and Poor outcome in 5(16.7%) patients in the final follow up. There was no statistically significant association between outcome and fracture classification (p=0.172).
Constant score increased from 47.83±2.68 at 6 weeks to 78.33±15.07 at 36 weeks which was statistically significant (p=<0.001). Final Constant score was 78.33 which was good functional outcome. There was no statistically significant association between Constant score and mode of injury (p=0.398). When Constant score was divided by fracture type, the mean score was least in the 4-part fracture and greatest in the 3-part fracture. The mean score in 2-part fracture was 81.83, in 3-part fracture was 83.64 and in the 4-part fracture was 68.80 which was statistically significant (p=0.042). Our final score was concurrent with the results of similar studies in the past.

Conclusion

Functional outcome was Excellent in 13(43.3%) patients, Good in 10(33.3%) patients, Fair outcome in 2(6.7%) patients and Poor in 5(16.7%) patients at the end of the study.

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