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A comprehensive study of proximal humerus fractures and osteosynthesis in adult

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Abstract

Background: Proximal humerus fractures are one of the commonest fractures accounting approximately 4–5% of the fracture attendance at the hospital. They occur more commonly in elderly patients, after cancellous bone of the humeral neck has weakened by senility but these fractures are seen in patients of all ages & merge with epiphyseal separations. Because of increasing incidence of high velocity trauma, complicated fracture patterns are becoming increasingly common. It has been always enigma of management because of numerous muscles attachment and paucity of space for fixing implant. Preservation of function and prevention of complication is the goal of any surgery. A prospective study was done to understand the various patterns and displacements of proximal humerus fracture and how these fractures behave to different types of surgical modalities being offered. So at the end of the study, some tentative conclusions can be drawn:

(A) Type of treatment options could be offered for various fracture patterns, taking in considering age, occupation, expectations and associated problems

(B) Steps and care should be taken to minimize the complications

(C) Ideal time of rehabilitation program

Methods: In this study, 55 patients presented to the Orthopedic Unit C (Wednesday and Saturday), V. S. General Hospital and N.H.L. Medical College (Gujarat University, Ahmedabad) with proximal humerus fractures from April 2009 to March 2012 were included and treated with various surgical modalities. All patients were followed-up for minimum 2 years and final outcome assessment included all the complications, ASES and Neer's scoring.

Results: Type of fracture and mode of fixation are the two most important factors determining the results amongst all. In our study, we have found that average chances of getting excellent to satisfactory results lies between 65–80%. Proper understanding of fracture pattern, appropriate mode of fixation and timely physiotherapy are the keys to achieve good results even in seemingly difficult cases.

Keywords: Proximal Humerus, Osteosynthesis, velocity trauma.

Introduction

Fractures of the proximal humerus have not been given their share of attention as compared to that of the other injuries in the body^[1, 2, 3]. Voluminous literature is available on this topic and treatment pattern differs very much. The preferred treatment varies depend on the patient's age and bone quality, the expertise surgical team and the patients expectations^[4]. Although a number of report have described the outcome of treatment of proximal humeral fractures, comparison of these fractures is hampered by inconsistency in fracture classification, treatment and evaluation method^[5]. Not much work has been done on the surgical management of proximal humerus fractures. The reason for this appears to be that most of these fractures were doing well even after conservative treatment. The factors responsible for such an observation are:

1. Even a great degree of malunion and restricted mobility does not produce much disability because,
 - a. Shoulder joint being a polyaxial joint, restricted mobility at one plane may be compensated by over mobility at some other plane.
 - b. Scapulothoracic joint movements compensate for restricted movements at scapulo humeral joint.
 - c. Some shortening of the upper limb does not create much disability as compared to that in the lower limb.
 - d. Day to day activities can be taken care of by minimal mobility at the shoulder joint.
2. Most of the proximal humerus fracture patients are old and women in particular, who are unfortunately neglected by the society.
3. Since not much work has been done in the field, so even the surgeons were reluctant for

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aggressive treatment of such fractures.

- Osteoporotic nature of the bone in this region does not allow stable fixation with the implants to allow early mobilization (aim of the surgery).

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, is replaced and fixed to the major humeral head fragment, lesser tuberosity fragment similarly displaced by subscapularis is replaced and fixed.

Methods

This study was carried out in V.S. HOSPITAL, AHMEDABAD from April 2009 to March 2012. All the patients gave the informed consent for inclusion into study and the study was performed in accordance with the Ethical standards of the 1964 Declaration of Helsinki as revised in 2000. We had included 55 patients of fracture involving proximal humerus after applying inclusion and exclusion criteria. Out of 55 patients, 2 were died during follow up period and 3 had lost follow up leaving effective sample size of 50.

Among 50 patients, 2 patients had poly-trauma, 1 had fracture neck femur, 1 had fracture intertrochanteric femur, 1 had fracture proximal tibia, 1 had fracture olecranon, 1 had fracture distal end radius, 1 had rib fracture and 1 had D-12 wedging. Other 41 patients had isolated unilateral proximal humerus fracture. All other associated conditions were treated either same or different occasion, details of them are not discussed here.

All the necessary details were recorded in a proforma sheet. All the routines investigations were done and after radiographic evaluation according Neer's trauma series consisting

- AP SCAPULAR VIEW
- TRANSAXILLARY VIEW
- All the fractures were classified into Neer's classification (1970): [6, 7]

This is based on the anatomical relationship of the four major anatomical segments: articular segment, greater tuberosity, lesser tuberosity and the proximal shaft beginning at the level of the surgical neck. Fractures types are based upon the presence of displacement of one or more of the four segments. Displacement more than 1 cm or angulations more than 45° is considered as displaced fragment. Accordingly

there are two parts, three parts, or four parts fractures. Besides these there are fracture dislocations i.e. two part, three part or four part proximal humerus fractures with either anterior or posterior dislocation of articular segment.

Neer also described articular surface fractures of two types (1) Impression fracture (2) Head splitting fracture.

Following factors were taken into consideration while deciding the modality of treatment to be used:

1. Neer's classification with associated displacement
2. Presence of humeral head dislocation or head split
3. Valgus impaction and metaphyseal extension.
4. Comminution
5. Quality of bone
6. Open or compound fracture
7. Age of patient
8. Associated general and medical condition
9. Other associated injuries e.g. vascular injury, brachial plexus injury
10. Functional requirements of patient

Operative Position: Beach Chair position.

Reduction Method

Closed Reduction: By traction and manipulation according fracture pattern

Open Reduction: With the help of bone spike, hook or clamp to lever fracture segment

Mode of fixation

(1) CRPP (Closed Reduction Percutaneous Pinning) or Cc Screw

Used in partially displaced fractures with good bone stock [8, 9]

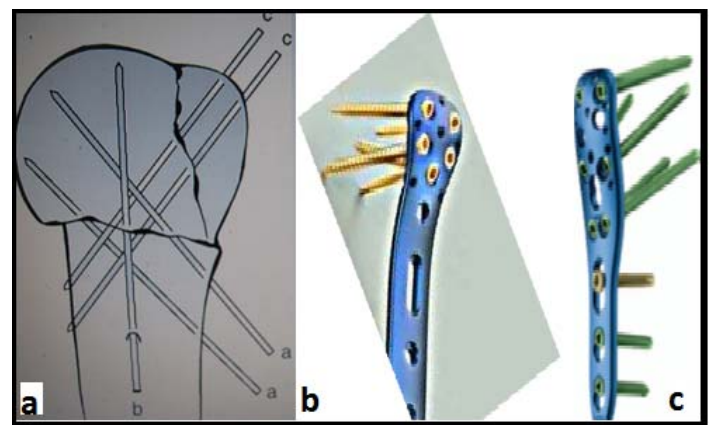


Fig 1: Implants (a) K wires (b) LPHP (c) PHILOS

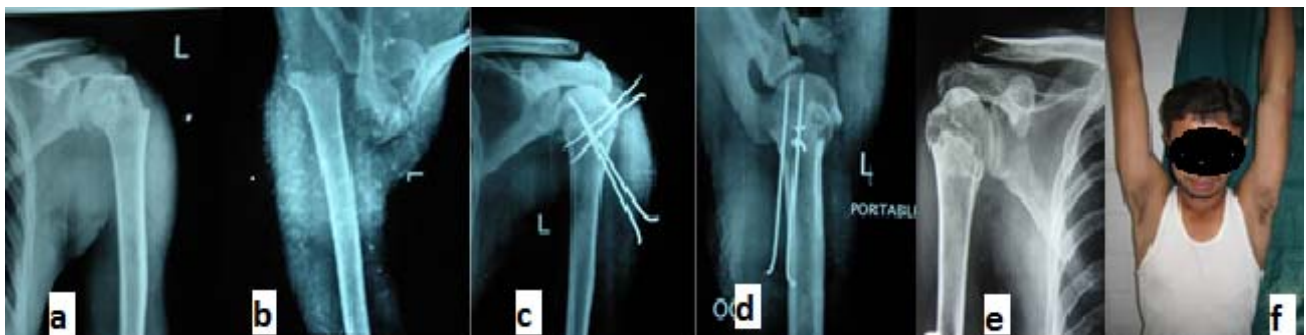


Fig 2: Case of K wiring (a) Pre-Operative X ray AP View (b) LAT View (c) Post-Operative AP View (d) LAT View (e) Fracture united in 6 month (f) Clinical ROM

Technique: 3 or 3.5 mm preferably threaded pins engaged in cortex, 2 from head to shaft, 2 from shaft to head and 1 from

head to shaft in AP direction.

(2) External Fixator:

Used in open fracture with varus fracture pattern.

Technique: Pin in head is fixed with pin in shaft to maintain valgus according to tension band principle [10].

(3) Orif (Open Reduction Internal Fixation)

Used in displaced fractures with medial calcar comminution with poor stock or fracture dislocation not reduced by closed methods or head split fracture [11, 12].



Fig 3: Case of PHILOS (a) Pre-Operative X ray (b) 3D CT scan (c) Post-Operative X ray (d) Fracture united in 8 months (e) Clinical ROM

Implants

Locking plates

1. LPHP (locking proximal humerus plate)
2. PHILOS (proximal humerus interlocking system)

Approach: Deltopectoral Approach

It is more commonly used approach. Deltopectoral interval and the cephalic vein and in are identified. The conjoined tendons are then retracted. Biceps tendon is used as landmark to identify the fragments of greater tuberosities with their attached tendons. Articular fracture should be anatomically reduced and relationships of the tuberosities and their

associated rotator cuff insertions should be restored. Unlike DELTOID SPLIT APPROACH, there are no chances of injury to the axillary nerve in this approach [13, 14, 15, 16]

(4) Intramedullary Nailing

Implants: Rush pin, Enders or Ten nail

Used in associated fracture shaft humerus [17].

(5) Hemiarthroplasty

Used in non-re-constructible fracture and poor bones quality [18].

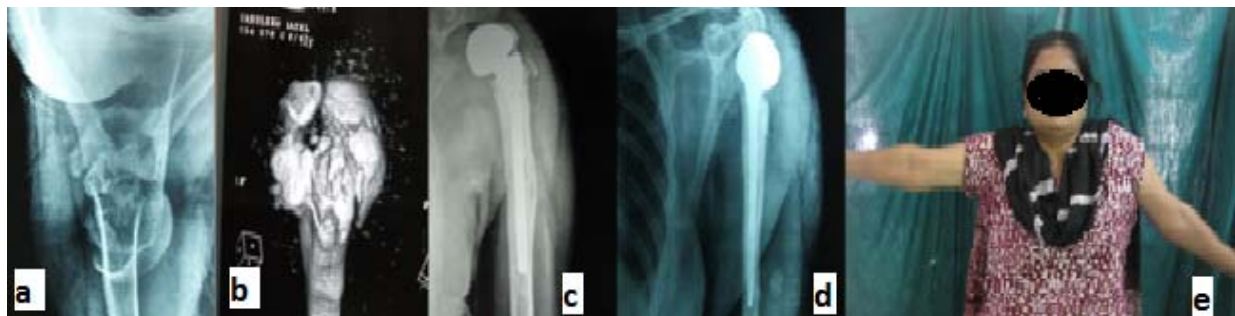


Fig 4: Case of Hemireplacement (a) Pre-Operative X ray Axial View (b) 3D CT Scan (c) Post-Operative AP View (d) Lateral View (e) 2 month Clinical ROM

Technique: HTD (head tuberosity distance) is kept 10mm from articular surface of head and height of prosthesis is best determined off the superior edge of pectoralis major tendon. Circalage of prosthesis with tuberosities improves fracture stability.

Final patient's self-assessment was done according to ASES Scoring.

Final surgeon assessment was done according to Neer's Scoring.

Results

In this series, we have studied 50 cases of fractures of the proximal of humerus treated by operative intervention. The male-female ratio was almost equal. Age varied from 22 to 85 years with mean age 52 years. 54% fractures occurs in right side with no fracture occurs bilaterally. The mode of injury was mostly road traffic accidents 56% and domestic falls and other causes 44%. Compound fracture accounts for

only 2% of total cases. According to Neer's classification, amongst the fractures requiring surgical intervention 3 part fracture is the most common variety. Close reduction and k wiring is the versatile modality of treatment used in most of 2 part, many 3 part and a few 4 part fractures. Follow-up period is ranging from minimum 2 to 3 years with average follow up of 30.4 months. Radiological union occurs during 8-12 wks in 61% cases. Young patients had excellent end results as compared to older patients. Excellent results with Neer's 2 part and 3 part fractures as expected. In patients operated with k-wires alone, more than 35% had unsatisfactory and poor results while almost 80% of patients treated with plating had good to excellent results. 66% of excellent result patients are those in whom early mobilization was started.

Tables

Table 1: Fracture according to Neer's type

NEER'S Fracture	No of patients	%
2 Part	05	10
3 Part	27	54
4 Part	06	12
Any Head Split	05	10
Any Dislocation	07	14
Total	50	100

Table 2: Method of fixation according to type of fracture

Neer's Fracture	Closed	ORIF	Hemi.	Total
2 Part	05	00	00	05
3 Part	23	04	00	27
4 Part	00	04	01	05
Head Split	00	04	01	05
Dislocation	01	06	01	08
Total	29	18	03	50

Table 3: Results according to Neer's type

Neer's Fracture	Excellent	Satisfactory	Unsatisfactory	Failure	Total
2 Part	04	01	00	00	05
3 Part	14	03	04	06	27
4 Part	04	02	00	00	06
Head split	02	02	00	01	05
Dislocation	03	01	01	02	07
Total	27	09	05	09	50

Table 4: Results according to method of fixation

Fixation	Excellent	Satisfactory	Unsatisfactory	Failure	Total
Closed	17	03	02	07	29
Orif	08	04	03	03	18
Hemi.	01	02	00	00	03
Total	26	09	05	10	50

Table 5: Complications according to method of fixation

Complication		Closed	Orif	Hemi.	Total
Early	Pin Infection & Loosening	3	0	0	3
	Wound Infection	0	1	0	1
	Wound Necrosis	1	0	0	1
	Pin Cutthrough	1	0	0	1
	Impingment	3	1	0	4
	Varus Collapse	0	1	0	1
Delayed	Stiffness	2	1	0	3
	Arthritis	0	1	0	1
	Malunion	0	1	0	1
	Non Union	0	1	0	1
	Delayed Union	1	0	0	1
	Nonunion + AVN	1	0	0	1
	AVN	1	1	0	2
	Subluxation	1	0	0	1
Keloid	0	1	0	1	
Total	14	9	0	23	

Discussion

- Younger patients give better results as compared to elderly patients irrespective of fracture type and fixation. The reason being, good hold of the implants in young bones than in osteoporotic bones and therefore early mobilization is possible in young patients.
- Fixation with cannulated cancellous screws or with plating gives better results than K wire alone. The cause for that could be that early mobilization is possible. Infection and loosening are the chief causes of k wire failure which can be reduced by proper dressing and usage of threaded pins instead of simple ones.
- Intramedullary implants are a good method of fixation of proximal humerus fractures but due to metaphyseal region and sufficiently wide canal in upper region, they may not provide adequate fracture reduction. As well as, impingement of proximal part of implant may hamper the ultimate result due to lack of proper physiotherapy. Although later on remodeling compensates faulty reduction. External fixator is very good implant in preventing varus collapse.

- Plating of fracture of proximal humerus may provide advantage of anatomical reconstruction of the fracture fragments but have the disadvantage of extensive soft tissue dissection and lack of proper holding in osteoporotic bone. Suturing of the fragments along with repairs of rotator cuff tear is a not good alternative to implant intervention.
- Anatomical reconstruction should be considered in young patients even if it requires extensive dissection and internal fixation of the fractures site as young patients tolerate such surgeries well, internal fixation devices give good stability in young patients. On the other hand, reluctance for opening such widely displaced fracture fragments and accepting anything less than good reduction would jeopardize the end results with nonunion or malunion. While, in older patients or severely comminuted fractures, head replacement prosthesis should be considered. New implants like shoulder hemi replacement prosthesis still requires to be studied and evolved further extensively.
- PHILOS is costlier implant than PHLF but have following advantages
 - 1) Multidirectional and more screws placement in proximal cancellous head part
 - 2) More holes for tuberosity fixation
 - 3) More elasticity better for osteoporotic bone
 - 4) Possible plate placement lateral to bicipital groove and pectoralis major tendon to avoid injury to ascending branch of anterior humeral circumflex artery.
- There is no major difference between radiological and clinical union time. Radiological evaluation by head shaft angle does not always reflect functional outcome.
- Early mobilization after fracture fixation gives excellent results. For early mobilization, stability of the fixation should be good i.e. with either plating or cannulated cancellous screws.

Conclusion

Treatment of fractures of the proximal humerus can be

challenging. Proximal humeral fractures may have many different personalities and the treating surgeon must understand the fracture pattern, the quality of the bone, other patient-related factors, and the expanding range of reconstructive options. Although there is a potential for frequent complications, many can be avoided with careful preoperative planning and meticulous surgical technique and aftercare. Optimal function of the shoulder after acute trauma requires anatomic or near-anatomic reconstruction. Newer techniques, instruments, implants may improve clinical results.

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