RESEARCH ARTICLE

STUDY OF OPERATIVE MANAGEMENT FOR COMPLEX FRACTURE OF UPPER END OF HUMERUS

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ABSTRACT

Background: Proximal humerus fractures are very common fractures occurring in the skeleton. They account for approximately 4 – 5% of the fracture attendance at the hospital. It is the most common fracture of shoulder girdle. It is the 3rd most common fracture in elderly. Till date various methods are used including percutaneous and open reduction & fixation according to fracture type.

Aims & Objective: To study the occurrence, mechanism of injury and displacement of various types of fractures and different modalities of the fixations in proximal humerus fractures. Come to conclusion about preferred modality of treatment of proximal humerus fractures according to the pattern of fracture.

Material and Methods: In present study 44 patients of complex fracture of proximal humerus treated with either open reduction internal fixation or percutaneous fixation from 2009 to 2012. Follow up assessment was done by Constant score.

Results: Radiological union occur at about 8 to 12 weeks. Closed reduction and percutaneous k wire or cancellous screws fixation showed excellent results in majority cases of 3 -part fracture. All 4 part fractures are treated with ORIF. Open reduction and internal fixation with locking compression plates showed good results among all implants used.

Conclusion: Principle of fixation is reconstruction of the articular surface, including the restoration of the anatomy, stable fixation, with minimal injury to the soft tissues preserving the vascular supply, should be applied. Majority of poor results are due to poor surgical techniques and lack early physiotherapy.

Key-Words: Complex Proximal Humerus Fracture; Locking Plate; Percutaneous Fixation; Hemiarthroplasty; Deltopectoral Approach

Introduction

Proximal humerus fractures are very common fractures occurring in the skeleton. They account for approximately 4 – 5% of the fracture attendance at the hospital. It is the most common fracture of shoulder girdle. It is the 3rd most common fracture in elderly. Complex fracture of proximal humerus includes 3 and 4 part fracture with or without dislocations. Male: female is 2:1.[1] 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. These fractures can be extremely disabling and their management often demands experienced surgical skills. Because of increasing incidence of high velocity trauma, complicated fracture pattern in proximal humerus are becoming increasingly common. The preferred treatment varies depend on the patient's age and bone quality, the expertise surgical team and the patients expectations and need.

The proximal humerus includes the humeral head, greater tuberosity, lesser tuberosity and shaft. In sagittal plane, humeral head is retroverted an average of 30 degrees relative to shaft in coronal plane it is angled 130 to 150 degrees cephalad relative to diaphysis.[2] Fracture through the anatomical neck can result in significant vascular compromise to humeral head leading to avascular necrosis.[3]

Although a number of report have described the outcome of treatment of proximal humeral fractures. Comparison of these fractures is hampered by inconsistence in fracture classification, treatment and evaluation method. Three & four part fractures represent 13 to 16 % of proximal humeral fractures. Treatment options for these displaced fractures include open reduction and fixation with simple (T plate, Cloverleaf plate, DCP) or locking plates (LPHP, PHILOS). Percutaneous fixation (K wires, cannulated screws, external fixators) is minimally invasive technique.[4] Good outcomes are reported

with percutaneous fixation in patient with good bone quality, intact medial calcar, less comminution and stable fixation under dynamic fluoroscopy.[5] Neer recommended open reduction and internal fixation for displaced two and three parts fractures. Classically indication for plate fixation are 4 part fracture with valgus impaction with preservation of medial capsular blood supply.[6] Most of the poor results following open reduction and internal fixation of three part fracture are due to imperfect technique. In a three or four part fracture dislocation when the head of the humerus is entirely devoid of any blood supply or nonreconstructable fractures are treated with hemiarthroplasty.[7,8] Patient who present with varus collapse more than 30 degrees are at increased risk for fixation failure, and thus hemiarthroplasty may decrease risk of reoperation.[9]

The bone density of the proximal humerus is relevant to fracture fixation, and generally the bone density of the subchondral bone just underneath the articular surface is strongest, while the bone of the central humeral head and neck is more porous.[1,10]

Biomechanics of fracture displacement[11,12]:

- Shaft: pectoralis major & lattisimus dorsi tends to displace it medially & anterior.
- Greater tuberosity: pull of subscapularis on lesser tuberosity rotate head medially & supraspinatus, infraspinatus, teres minor pull greater tuberosity upwards, backwards& laterally.
- Lesser tuberosity: pull of external rotator muscles rotates head externally with subscapularis pulls the lesser tuberosity medially.
- 3 part fracture with lesser tuberosity displaced, head will be externally rotated by pull of greater tuberosity.
- 3 part fracture with greater tuberosity displaced, head will be internally rotated by pull of lesser tuberosity.

Materials and Methods

This study was carried out from May. 2009 to November 2012. We have included 44 patients of proximal humerus fractures after applying inclusion and exclusion criteria. We collected records of the patients by special proforma. Essential investigations of all the patients were done. Patients coming for follow up were studied regularly.

Inclusion criteria are (A) Adults patients (B) Proximal humerus fractures complex variety. [Neer's classification: grade 3 to grade 4[13]].

Exclusion criteria are (A) Medically unfit patients. (B) Fractures in pediatric age group. (C) Shaft humerus fractures with proximal extension. (D) Neer's one part & two part fracture.

After the patients with proximal humerus were admitted all the necessary clinical details were recorded in a trauma sheet. Radiographic evaluation of the shoulder was done according to Neer's trauma series which consists of: Anteroposterior (AP) view of the scapula and Axillary view.

Fractures were classified according to the Neer's classification and patients were shifted to the ward after initial temporary immobilization with Universal shoulder immobilizer. All the routine investigations were done on all the patients pre-operatively with complete medical and anaesthetic fitness of patient for surgery.

Factors were taken into consideration while deciding the modality of treatment to be used are[14] (1) Neer's classification three or four part fracture with associated displacement. (2) Presence of humeral head dislocation and humeral head split fracture. (3) Valgus impaction and metaphyseal extension. (4) Comminution. (5) Quality of bone. (6) Open or compound fracture. (7) Age of the patient. (8) Associated general and medical condition of the patient. (9)Other associated lesions e.g. brachial plexus palsy, vascular injury. (10) Functional requirements of the patient.

Patients are operated on beach chair position back of the table elevated 30–45°. The entire shoulder girdle must be unsupported off the edge of the operating table. Reduction methods are (1) close by traction, elevation of shaft, and manipulation

according to fracture pattern and (2) Open with help of spike, clamp or bone hook to lever the fracture segment. Deltopectoral approach is used for ORIF.[15,16]

Figure-1: ORIF

Figure-2: Percutaneous Fixation

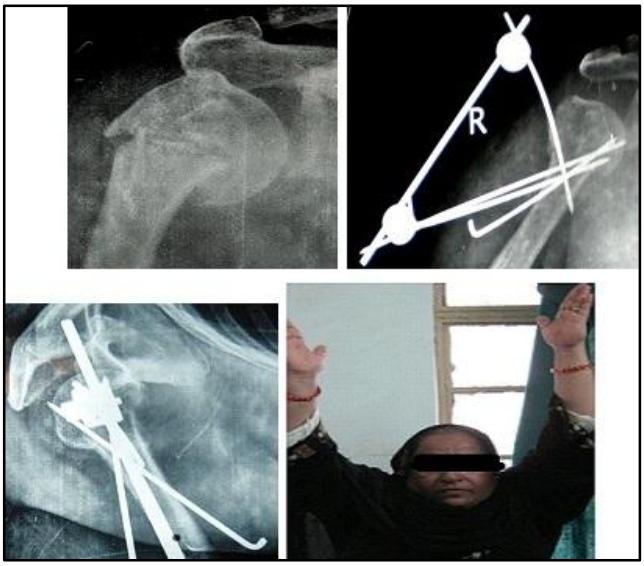

Figure-3: Percutaneous Fixator

Figure-4: Hemiarthroplasty

Post-operative protocol: (a) Antibiotics: In our institute we give antibiotics up to stitch removal. (b) Analgesics are given as and when required (c) Rehabilitation: (i) Immediate post-operative period: shoulder immobilizer with finger and wrist mobilization. (ii) 2 to 3 weeks: Shoulder pendulum exercise & Elbow mobilization. (iii) 3 to 5 weeks: Shoulder ROM exercise & Scapular strengthening exercise. (d) Sutures are removed on 12th post-operative day (e) Hospital stay: Patient is discharged as soon as the wound and general condition of the patient is satisfactory usually 4 to 5 days. (f) Follow up: Patient is asked to come for follow up 1, 2, 3 and 6 months from the date of surgery. At each follow up patient is assessed clinically as per Contant score[17] and x ray AP/Axilary view is taken.

Results

Age variation in the series was from 20 to 90 years (table 1). Mean age is 49.22. From 44 cases there were 27 males and 17 females. Male: female = 1.58:1. Males predominated over females in our study. Right sided was involved in more patients. 28 cases had right side involved. None had both the sides involved in the same patient. Most of the injuries were caused by domestic fall (table 2). Among total 7 head split fractures, 4 are treated by ORIF method and 3 by hemiarthroplasty (Age: 77years, 53 years, 34 years). 32.25% of 3 part fractures are treated with open method includes plating and hemireplacement. All 4 part fractures (29.54%) are treated with open reduction and internal fixation. Percutaneous method is used only for 3 part fractures (table 3).

Table-1: Age Distribution

Age Group	N	%
20-30	4	9.1
31-40	15	34.09
41-50	4	9.1
51-60	11	25
61-70	8	18.18
>70	2	4.5
Total	44	100

Table-2: Mode of Injury

Mode of Injury	N	%
Domestic	24	54.54
RTA	20	45.45
Total	44	100

Table 3: Type of Fracture and Method of Fixation

Types of Fractures	Per Cutaneous		ORIF		Total	
	N	%	N	%	N	%
Three Part	21	100	10	43.47	31	70.46
Four Part	0	0	13	56.52	13	29.54
Total	21	100	23	100	44	100

Table 4: Radiological Union according to Method of Treatment

Radiological Union		Per Cutaneous		ORIF		Total	
		N	%	N	%	N	%
Duration (Weeks)	<4	0	0	0	0	0	00
	4-8	2	10.5	1	5	3	7.14
	8-12	17	89.5	10	42.5	27	64.28
	12-16	0	0	10	42.5	10	23.80
	16-20	0	0	1	5	1	2.38
	>20	0	0	1	5	1	2.38
	Total	19	100	23	100	42	100
Type	Malunion	2	9.52	1	4.34	3	6.81
	Nonunion	2	9.52	1	4.34	3	6.81
	Union	17	80.95	22	95.65	39	88.63
	Total	21	100	23	100	44	100

Table 5: Head Shaft Angle Measurement according to Method of Fixation

Head Shaft Angle	Per Cutaneous		ORIF		Total	
	N	%	N	%	N	%
Good: 130°-150°	13	61.90	10	52.63	23	57.5
Fair: 115°-130° & 150°-175°	7	33.33	6	31.58	13	32.5
Poor: <115° & >175°	1	4.76	3	15.79	4	10.0
Total	21	100	19	100	40	100

Table 6: Duration of Post-Operative Immobilization and Physiotherapy

Immobilization (Days)	Per Cutaneous		ORIF		Total	
	N	%	N	%	N	%
<20	1	4.8	4	17.39	5	11.38
21- 30	15	71.4	18	78.26	33	75
31-40	2	9.5	1	4.34	3	6.81
>41	3	14.3	0	0	3	6.81
Total	21	100	23	100	44	100

Table 7: Restriction of Range of Motion in Different Method of Treatment

Restriction of Range of Motion	Per Cutaneous		ORIF		Total	
	N	%	N	%	N	%
Yes	12	57.14	16	69.56	28	63.63
No	9	42.85	7	30.43	16	36.36
Total	21	100	23	100	44	100

Table 8: Occupation Status after Operation

Types of Fractures	Per Cutaneous		ORIF		Total	
	N	%	N	%	N	%
Same	14	66.66	19	82.60	33	75
Changed	2	9.52	0	0	2	4.54
Retired	5	23.80	4	17.39	9	20.45
Total	21	100	23	100	44	100

Table 9: Average Range of Motion of Shoulder according to Method of Treatment

Different Movements	Per Cutaneous	ORIF
Abduction	121.42°	133.26°
Flexion	118.57°	130.43°
Extension	27.38°	31.52°
External Rotation	34.76°	38.04°
Internal Rotation	43.33°	48.04°

Table 10: Grading of Constant Score according to Method of Fixation

Types of Fractures	Per Cutaneous		ORIF		Total	
	N	%	N	%	N	%
Excellent	3	14.28	7	30.43	10	22.72
Good	8	38.09	8	34.78	16	36.36
Fair	3	14.28	4	17.39	7	15.90
Poor	7	33.33	4	17.39	11	25
Total	21	100	23	100	44	100

Poor: >30; Fair: 21-30; Good: 11-20; Excellent: <11

Total of 64.28% fractures shows radiological union between 8 -12 weeks period. 2 fracture shows non-union and 1 patient of non-union was open grade and other patient of non-union treated with LPHP re-operated with bone grafting (table 4). 33.33% of patients are operated by percutaneous method and 26.87% of patients operated by open method shows varus collapse. Average is 29.54% varus collapse. 4.76% of patients, operated by percutaneous method show poor results and 15.79% patients operated by open method show poor result. 4 patients are operated by hemireplacement are not included. Among ORIF group 1 patient has plate angulations, 1 patient has good functional outcome with poor angle group and 1 patient has poor outcome. In close group 1 patient with poor angle shows fair result (table 5).

Majority of patients are immobilized for 21-30 days and early mobilization was started in ORIF group. ROM exercise was started on 43.5th day on average in all group patients (table 6). 42.85 % in close method and 39.13% in open method shows restriction of range of motion (table 7). Total 75% of patients had same occupation (table 8). Average range of motion is better in ORIF group (table 9). Mean constant score in percutaneous method is 73 (SD=20.54) and ORIF method is 80.26 (SD=14.23) (table 10).

Discussion

The results of present study are compared with Study carried out in 2010 by Mohamed MH Sayed.[18] In present study 44 patients of complex type proximal humerus fracture, among them 31 cases of 3 part and 13 cases of 4 part fracture. Fracture dislocation in 6 and head split in 7 patients. Metaphyseal extension in 8 patients. Study carried out in 2010 by Mohamed M.H. Sayed[18], included 59 patients of complex type proximal humerus fracture. Among them 12 cases were of 3 part fracture and 29 of 4 part fracture. Fracture dislocation in 10 and head split in 8 patients. Metaphyseal extension in 3 patients.

In present study age groups are 20 to 90 and mean age is 59 years. Male to female ratio in previous study was 2:1 and in our study is 1.58:1. Age groups taken in previous studies were 31 to 55 and mean age was 42. In present study follow up is 6 months to 24 months and average is 11 months. In previous study, last follow-up ranged from 24 to 67 months with a mean of 42 months. In present study mean Constant score for the 3 part fracture group is 75.7 and 78.76 in the 4 part fracture group. The mean score is 80 in the fracture dislocation group and 77.86 in the split head type fractures. An overall mean Constant score of 75.40 is recorded.

The mean Constant score for the 3 part fracture group was 75 and 67 in the 4 part fracture group. The mean score was 61 in the fracture dislocation group and 61 in the split head type fractures. An overall mean Constant score of 65 was recorded at the final follow-up visit. In present study varus displacement in 12, osteonecrosis in 3, nonunion in 3, malunion in 3 and infection in 5 number of patients. In previous study intra-articular screw cutout in 12, varus displacement in 13, and osteonecrosis in 2 patients.

It was noted that the variation in the final end-results between different reports could be due to the following main points: (i) different types of fractures were included in different studies and not all the studies focused on the 3 and 4 complex fracture patterns. Moreover, fracture-dislocations, and split head fractures were excluded from some studies, while others included open and closed fracture patterns; (ii) the approach used and surgical experience and preference vary between different centers and the level of the trauma center at which the patients were treated influenced the final outcome; (iii) different types of commercially available designs were used. It is of value here to mention that the plates which enable the surgeon to attach the rotator sutures to the suture eyelets, after provisional fixation of the plate, provided more proper plate positioning and were easily applied; (iv) the variation in the follow-up period was of great importance as some late complications were recorded in some middle-term studies, specially osteoarthritis and avascular necrosis of the humeral head. (v) Different methods of treatment available for same fracture patterns lead to different outcome in different age group of patients.

Conclusion

Now a day's incidence of proximal humerus fracture is increased, more commonly in younger age group patients with more complex fractures. We have included 44 cases of complex proximal fracture in our study. Principle of fixation is reconstruction of the articular surface, including the restoration of the anatomy, stable fixation, with minimal injury to the soft tissues preserving the vascular supply, should be applied. An adequate surgical technique will minimize complications and an aggressive rehabilitation regime will ensure the best possible result. Minimally displaced 3 part fracture gives better result with percutaneous methods. Fracture with head split and/or dislocation are better treated with ORIF and locking plates like PHILOS and LPHP. Nonreconstructable fractures give better result with hemiarthroplasty. Radiological features (Head shaft angle) do not always correlate with outcome of the patient. Majority of poor results are due to poor surgical techniques and lack early physiotherapy.

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