The Professional Medical Journal
www.theprofesional.com

DOI: 10.29309/TPMJ/18.5027

ORIGINAL PROF-5027

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Article received on:
26/06/2018
Accepted for publication:
20/10/2018
Received after proof reading:
03/12/2018

HUMERAL SHAFT FRACTURES;
FUNCTIONAL OUTCOME OF OPERATIVE MANAGEMENT OF HUMERAL SHAFT FRACTURES

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ABSTRACT… Objectives: To determine the functional outcome of operative management of humeral shaft fractures. **Study Design:** Prospective cohort study. **Place and Duration:** At the Department of Orthopaedics, Benazir Bhutto Hospital, Rawalpindi, for a duration of 02 years from 12th January 2016 to 11th January 2018. **Patients and Methods:** 45 patients presenting with humeral shaft fractures and meeting the inclusion criteria were included. All patients underwent fixation with a Dynamic Compression Plate (DCP). Functional outcome assessed at six months post-operatively using the American Shoulder and Elbow Surgeons Scoring System (ASES). **Results:** Mean age of patients included in the study was 34.6 ± 10.3 years. Out of the 45 patients, 31 (68.9%) were males and 14 (31.1%) females. Pre-dominant condition resulting in operative management was humeral shaft fracture in poly trauma patients (n=27, 60%). Shoulder functioning following surgery was good with a mean ASES score of 81.1±10.6. **Conclusion:** Plating in humeral shaft fractures results in a good functional outcome post-operatively.

Key words: American Shoulder and Elbow Surgeons Scoring System (ASES), Dynamic Compression Plate (DCP), Functional Outcome, Humeral Shaft.

Article Citation: Khan J, Liaqat RU, Aftab MI, Urooj T, Akhtar RR, Ahmed R. Humeral shaft fractures; functional outcome of operative management of humeral shaft fractures. Professional Med J 2018; 25(12):1809-1813.
DOI: 10.29309/TPMJ/18.5027

INTRODUCTION

Fractures of the shaft of humerus are not uncommon and they have an incidence around 5%. Majority of these fractures are managed conservatively.[1] Their common mechanisms of injury are either a road traffic accident or a fall from height.[2] Traditionally these fractures have been managed conservatively leading to primary healing. There are increased chances of losing the fracture reduction when managed in a cast. With the evolution in designs of implants and operative procedures, these fractures are more often being managed operatively.[3] Fixing these fractures with a plate has always been the gold standard.[4]

Conservative treatment in these fractures has been the primary modality of management, with healing observed in above 90% cases.[5] Open fractures, poly trauma patients, ipsilateral humeral shaft and forearm fractures, associated neurovascular injuries and cases of failure of alignment in a brace are all managed operatively.[6] Operative treatment has the advantage of early mobilization and good functional outcome.[7] This operative procedure is not without risks which can either be in the form of a technical error or post-operative complication like infection, injury to nerve, etc.[8]

Most of the studies have used fracture union as the major determinant of the outcome and very few studies have examined the functions at the shoulder and elbow. As functional outcome of treatment of these injuries has not been studied in our local population, so this study was conducted to determine the functional outcome of humeral shaft fractures.

MATERIAL AND METHODS

This prospective, cohort study was conducted in the Department of Orthopaedics, Benazir

Bhutto Hospital, Rawalpindi, Pakistan from 12th January 2016 to 11th January 2018. Inclusion criteria were diaphyseal fractures of humerus with less than two weeks duration and patients older than 18 years of age. Exclusion criteria were patients with previous osteomyelitis of humerus, pathological fractures, Severe head injury with associated humeral shaft fractures, previous history of fracture of humerus/shoulder and those treated conservatively having more than 2 weeks duration. Calculation of sample size of study was done with OpenEpi version 3.0, using 95% confidence interval and 80% power. An informed consent was taken from patients who met the inclusion criteria. All information recorded on a pre-formed questionnaire. All patients underwent surgical management of humeral shaft fractures by the same consultant Orthopaedic surgeon. All patients were operated under general anaesthesia using a standard posterior triceps splitting approach. Radial nerve was identified in all cases. A dorsal 3.5 or 4.5mm Dynamic Compression Plate (DCP) was utilized.

Initially for the first 2 weeks post-operatively, a poly sling was applied for the patients' comfort. Post-operative rehabilitation included gentle pendulum and active assisted shoulder and elbow range of motion exercises which were initiated at 2 weeks post-op. These were followed-up by strengthening and passive range of motion exercises.

Patients were followed up at 2 and 6 weeks, and at 3 and 6 months post-operatively. Radiographs were taken at 6 weeks, and 3 and 6 months post-op. Assessment of functional outcome was done at 6th month post-op by the American Shoulder and Elbow Surgeons Scoring System (ASES).

The ASES consisted of two parts; patient self-evaluation and a physician assessment. Patient self-evaluation part comprised of Visual Analog Pain Scale (VAS) and questions on daily living activities. The physician assessment consisted of assessing the range of motion (ROM), specific physical signs, strength, and stability.

Data analysis was done using SPSS version 23 and descriptive statistics for variables presented in the form of frequencies and percentages. Chi Square test applied for distribution of gender and side of fracture. Repeated measures ANOVA were used to show any variations in the dependent variables. Data was considered significant if p-value less than 0.05 and presented with 95% confidence interval.

RESULTS

A total of 45 patients were included in the study. 31 (68.9%) patients were male while 14 (31.1%) female (Table-I). 26 (57.8%) patients had fracture of right humerus while 19 (42.2%) had involvement of left humerus.

		No. of Patients (n) (%)	P-value
Gender	Male	31 (68.9%)	0.42
	Female	14 (31.1%)	
Side of fracture	Right Arm	26 (57.8%)	0.76
	Left Arm	19 (42.2%)	

Table-I. Gender and operative side distribution Chi-square test applied

The mean age of patients was 34.6 ± 10.3 years. The common age group was 35 - 44 years with 17 (37.8%) patients falling in this category. Major indication for surgery was humeral shaft fracture in poly trauma patients accounting for 27 (60%) cases.

3 (6.7%) patients had iatrogenic radial nerve injury while none of the patient had post-operative infection. Based on a visual analogue scale ranging from 1 to 10 for severity of pain, 22 (48.9%) patients rated pain severity associated with humeral fracture at 0 and 14 (31.1%) rated pain at 1. The maximum pain severity reported was 6 out of 10, rated by one patient.

The findings of the physical assessment of patients with humeral fractures conducted by a physician are shown in Table-II. The range of motion in 42 (93.3%) patients was characterized by an arc of motion > 100 degrees and 41 (91.1%) patients had shoulder joint stability. Functional ability was retained for most activities of daily living: combing hair (100%); bathing (93.3%); self- feeding and dressing (86.7%).

	Frequency (n)	Percentage (%)
Pain Intensity		
None	23	51.1%
Mild	20	44.4%
Moderate	2	4.4%
Range of motion		
Arc of motion > 100°	42	93.3%
Arc of motion 50-100°	3	6.7%
Stability		
Stable	41	91.1%
Moderately unstable	4	8.9%
Functional ability		
Can comb hair	45	100%
Can feed themselves	39	86.7%
Can bath	42	93.3%
Can wear shirt	39	86.7%
Can wear shoes	42	93.3%

Table-II. Physician assessment of pain, motion, stability and functional ability

The median shoulder functionality scores in the different age groups ranged from 80 to 85 out of 100. The oldest age group (45 years and above) had lower scores with median score of 80 and range 48.3 to 85 (Table-III).

	ASES Shoulder Index		
Age group	Median	Minimum	Maximum
18-24 years	83.3	71.7	90.0
25-34 years	85.0	66.7	90.0
35-44 years	83.3	46.7	91.7
45 + years	80.0	48.3	85.0

Table-III. ASES shoulder functionality scores according to patient age groups

Functional Outcome was assessed using ASES score for shoulder function derived from patient self-reported visual analog score (50%) rating of pain and cumulative activities of daily living scores (50%), yielding a maximum score of 100. On average shoulder functioning following surgery was good with a mean ASES score of 81.1±10.6 and range 46.7 to 91.7. (Table-IV).

	Characteristic present	Characteristic absent	P-value
	Median ASES (IQR)	Median ASES (IQR)	
Night Pain	75 (71.7 – 85)	90 (83.3 – 90)	< 0.001
Pain medication	73.3 (66.7 – 81.7)	90 (83.3 – 90)	< 0.001
Stronger medication	64.2 (48.3 – 73.3)	85 (80 – 90)	0.0003
Unstable feeling	47.5 (46.6 – 48.3)	85 (76.7 – 90)	0.02

Table-IV. Pain characteristics and shoulder functionality in humeral fractures

DISCUSSION

Operative indications for humeral shaft fractures include patients with multiple injuries, open fractures, fractures associated with neurovascular compromise or associated shoulder, elbow or forearm fractures of the same limb; bilateral humeral fractures, failed conservative methods and pathological fractures.[9] In this study humeral shaft fractures in poly trauma patients was the leading cause of operative management (60% cases) which was in accordance with a study done by Pidhorz.[1]

The mean age of patients presenting with humeral fractures in our study was 34.6 ± 10.3 years which was comparable to a study done by Pal et al in which mean age was 34.4 years.[10] The modal age group was 35-44 years with 17 patients in this age category. The second most common patient age group was 25-34 years accounting for 14 patients. In our study, 31 (68.9%) patients were male while 14 (31.1%) female. Similar gender statistics were shown by a study done by Sarwar et al at Allied Hospital Faisalabad, Pakistan in which 57.6% patients were male.[11]

Of the 45 patients operated, 26 (57.8%) had right sided humeral fracture while 19 (42.2%) had left side involvement. This was in contrast with a previous study done by Bergdahl et al which showed humeral shaft fractures pre-dominantly affecting the left arm (54%).[12] The humeral shaft extends between the upper borders of the insertion of the pectoralis major muscle proximally to the supracondylar ridge distally. The proximal portion of the humeral shaft assumes more of a cylindrical shape, but it develops into a triangular shape as you move distally.[13] A study done by

Kim et al found 50% of the fractures occurred at the proximal end of humerus while the next common site was distal humerus.[14]

All 45 patients were managed operatively by plating. This could be due to surgeon's preference/experience and good previous results with this mode of fixation. In a study carried out by Wei et al, he reported a mean time of healing of 15.9 weeks in patients with plating which was in accordance to our study which had a mean healing time of 17.4 weeks.[15] In a study by Govindasamy et al incidence of non-union in humeral shaft fractures was around 15% but in our study no case of non-union was seen.[16]

6.7% cases had an iatrogenic radial nerve injury in our study. These statistics were favoured by a study done by Pal et al which had 7.6% patients with nerve palsy.[10]

Based on a visual analogue scale (VAS) ranging from 1 to 10 for severity of pain, 22 (48.9%) patients rated pain severity associated with humeral fracture at 0 meaning they had no pain and 14 (31.1%) mild pain rated at 1. The maximum pain severity reported was 6 out of 10, rated by one patient.

The findings of the physical assessment of patients with humeral fractures conducted by a physician were similar to patient self-reports. Physician established that 23 (51.1%) patients were not in pain. Of the remaining 22 patients, 20 had mild pain.

The range of motion in 42 (93.3%) patients was characterized by an arc of motion > 100 degrees and 41 (91.1%) patients had shoulder joint stability. Functional ability was retained for most activities of daily living: combing hair (100%); bathing (93.3%); self-feeding and dressing (86.7%). Clement in a similar study found good range of motion post operatively.[5]

Functional Outcome was assessed using ASES score for shoulder function derived from patient self-reported visual analog score (50%) rating of pain and cumulative activities of daily living scores (50%), yielding a maximum score of 100. On average shoulder functioning following surgery was good with a mean ASES score of 81.1±10.6 and range 46.7 to 91.7. This was similar to a previous study by Fan et al whose ASES score on average was 90.33±1.32.[17] Limitations of our study were a sample size and no comparison with other treatment modalities was done. Studies should be done in future comparing functional outcomes of different operative modalities.

CONCLUSION

In patients with indication for operative management of humeral shaft fractures, plating can be done because of good functional outcome and healing potential.

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Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
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2	Raja Umar Liaqat	Data collection and final approval of the version to be published.	
3	Muhammad Imran Aftab	Literature serach and data collection.	
4	Talia Urooj	Data analysis and data collection.	
5	Rahman Rasool Akhtar	Data collection.	
6	Riaz Ahmed	Critical revision of the article.