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HUMERAL DIAPHYSEAL FRACTURE;

TO DETERMINE THE OUTCOME OF CLOSE REDUCTION AND CONSERVATIVE MANAGEMENT IN CLOSED HUMERAL DIAPHYSEAL FRACTURE IN TERMS OF NORMAL UNION AND DELAYED UNION.

Farhan Sarwar[1], Hafiz Salman Saeed[2], Sajjad Iqbal[3], Iqra Fayyaz[4]

1. MBBS, FCPS (Orth), Consultant Orthopaedic Surgeon, National Hospital, Faisalabad, Pakistan.
2. MBBS, FCPS (Orth), Assistant Professor of Orthopaedics, Independent Medical College, Faisalabad, Pakistan.
3. MBBS, FCPS (Orth), Senior Registrar of Orthopaedic, Allied Hospital Faisalabad, Pakistan.
4. Pharm-D, M.Phil, PhD Scholar, Government College University, Faisalabad.

Correspondence Address:
Dr. Hafiz Salman Saeed,
Assistant Professor of Orthopaedics,
Independent Medical College,
Faisalabad, Pakistan.
hafizsalman167@gmail.com

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ABSTRACT… Objectives: To determine the outcome of close reduction and conservative management in closed humeral diaphyseal fracture in terms of normal union and delayed union. **Study design:** Descriptive case series. **Setting:** Orthopedic Department of Allied and DHQ Hospital Faisalabad. **Duration of study:** 15th December 2012 to 15th December 2014. **Material & Methods:** 170 patients with mean age of 36.68 ± 14.16 including 98 (57.6%) males and 72 (42.4%) females falling in inclusion criteria were managed conservatively with the technique i.e. application of u-shaped plaster slab initially for 3 weeks then replaced by humeral brace (Sarmiento) uptil 12 weeks. **Results:** 170 patients with mean age of 36.68 ± 14.16 including 98 (57.6%) males and 72 (42.4%) female patient. Simple transverse fractures were 103 (66.47%), spiral fractures 31 (18.23%) and oblique fractures 36 (15.30%). Union was achieved in 158 patients (92.94%), 12 patients (7.05%) progress to delayed union. Mean healing time was 10 weeks ± 1.81 with a range of 7 to 15 weeks. **Conclusion:** When choosing conservative methods close reduction and conservative management initially with u-slab of plaster of paris later replaced by humeral brace (Sarmiento) is the treatment of choice because of low complication but very high success rates.

Key words: Humeral shaft fractures, hanging arm cast, coaptation splint or u-slab, functional humeral brace, union, delayed union.

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INTRODUCTION

Fractures of humeral shaft are common, representing 1-3% of all fractures.[1] Incidence is 11.5 per 100,000 per year. Fracture of humeral shaft have a bimodal age distribution, a peak in 3rd decade in males due to trauma to arm, a blow or motor vehicle accident and 2nd peak is in fifth to seventh decade of life in females due to fall, as osteoporosis is common in this age group.[2] Fractures of humerus also related to some severe complications like radial nerve damage, brachial artery injury. Non operative treatment is recommended if fracture alignment is achived by close manipulation and plaster of paris.[2]

There are two modalities for management of humeral diaphyseal fractures, operative and non operative. Among operative and non operative treatment in past few decades, close manipulation and reduction is ideal treatment option for humeral fractures, with acceptable union rates of 90%.[3] Non-operative methods include hanging arm cast, velpeau dressing, coaptation splint or u-slab, shoulder spica cast, functional brace and rarely skeletal traction.[3]

Operative management includes open reduction and internal fixation with Dynamic compression plate and intramedullary nailing. Operation is indicated in segmental, non- united, open severely distracted fracture with vascular injury, fracture with concomitant ipsilateral forearm fracture, the so called “floating elbow”, pathological fracture and fracture with unacceptable alignment treated by conservative management.[3]

The closed reduction with plaster of Paris cast is a method applicable to many types of humeral shaft fractures. Good union is achieved in more than 90% cases, and remaining 10% goes into

delayed union .[3]Average healing time is 11 weeks and it ranges from 10 to 16 weeks.[4] Conservative management is still the mainstay of stabilization in developing countries.

This study has not been conducted in our set up yet. We usually apply u-slab of plaster of paris for fracture shaft of humerus and it is applied till union is achieved. In this study application of Sarmiento brace (Humeral Brace) on third week will prevent complications of prolonged immobilization of plaster slab. The outcome of this study in form of union and delayed union will provide a reliable background data regarding management of this type of fracture.

OBJECTIVES

To determine the outcome of close reduction and conservative management in closed humeral diaphyseal fracture in terms of normal union and delayed union.

MATERIAL AND METHODS

Setting

Department of Orthopedic Surgery, Allied Hospital Faisalabad.

Duration of study

15th December 2012 to 15th December 2014.

Study design

Descriptive case series.

Sample size

According to Sample size calculator by WHO.
Confidence level = 95%
Expected population proportion = 10%
Absolute precision required = 5%
Sample size, n = 170 patients.

Sampling technique

Non probability consecutive sampling.

Inclusion criteria

Adults of both gender age ranges from 16-60 years.
Closed humeral shaft fracture.
Fracture not more than 02 weeks old.
Stable humeral shaft fracture, diagnosed on X-rays (involving less than 50% of bone cortex).

Exclusion criteria

Open fractures type 2 and 3 according to Gustilo Anderson classification.
Pathological fractures, diagnosed on history and x-rays (a broken bone that occurs in an area of weakened bone caused by disease).
Gunshot fractures, diagnosed on history.
Segmental shaft fracture, diagnosed on X-rays (a long bone fractured at two places creating a separate segment).

DATA COLLECTION PROCEDURE

After taking permission from hospital ethical committee, patients were selected according to inclusion criteria admitted through emergency department. We evaluated all those patients for life threatening conditions in the emergency department as per Advance Trauma Life Support protocol. We entered all the demographic details of the patient on the proforma. After getting informed consent from the patient, all fractures were immobilized by U-slab of plaster of Paris involving acromioclavicular joint to elbow joint with elbow in 90 degree flexion after reducing fracture by traction and counter traction under general anesthesia then confirmation was done by the X-rays.Post operative radiographs AP and Lateral were done for future follow up.

Follow up was done for 4 months by taking their contact numbers. Outcome in follow up dates were measured for time of union and delayed union. On each follow up radiographs were advised to look for union. After one week of procedure, patients were checked for any swelling and cast loosening, patients were encouraged to use extremities as tolerated avoiding active abduction of shoulder joint. After two weeks of procedure, patients were checked for any loosening of cast and skin maceration. After third week u-slab was replaced by Sarmiento Brace (Humeral Brace), patients were advised gentle active and passive movements of joints to avoid stiffness.

Then monthly visits were advised till there will be full union seen on radiographs. Radiographs

were done from hospital radiology department and reported by radiologist. All the information about union and delayed union were entered on a pre designed proforma .

Data Analysis

All the data was analyzed by the using SPSS version 10.

Quantitative variables like age and time of union were presented as Mean +/- SD.

Qualitative variables like gender, normal union and delayed union were presented as frequency & percentages. Stratification with respect to age and gender was done. Post stratification chi-square test was applied. $P<0.05$ was taken as significant.

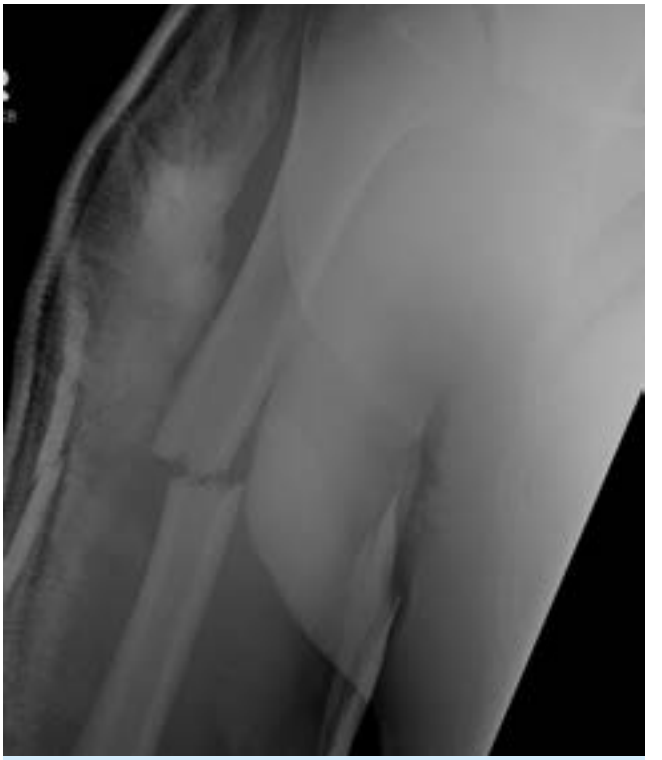
RESULTS

170 cases were selected in this study. All patients were managed with close reduction and application of u–shaped slab of plaster of paris which was later replaced by Sarmiento brace (Humeral brace). Mean age of patients were 36.68 ± 14.16 years.

Youngest patient selected was 18 years old while oldest one was 60 years old (Table I).
There were 98 (57.6%) males and 72 (42.4%) females (Table III). Humeral shaft fractures encountered in this study were described according to their respective geometry of fractures. Simple transverse fractures were 103 (66.47%), spiral fractures 31 (18.23%) and oblique fractures 36 (15.30%) (Table III).

Union was achieved in 158 patients (92.94%), 12 patients (7.05%) went into delayed union (Table IV). Mean healing time was 10 ± 1.81 weeks with a range of 7 to 15 weeks (Table V).

It was also observed that union was greater in younger age group 18-31 year (98.9%) and delayed union was greater in elderly patients 46-60 years (15.9%) (p-value = 0.002) (Table VI). The union was also greater in males (94.9%) as compared to females (90.3%) (p-value = 0.245) (Table VII).



HUMERAL BRACE WEEK 3

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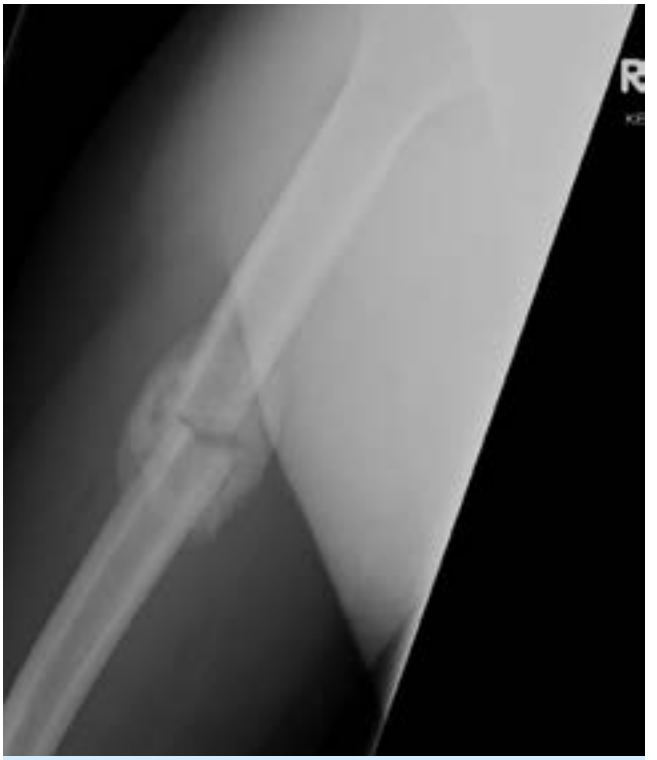

X-RAYS WEEK 8

	N	Minimum	Maximum	Mean	Std. Deviation
Age	170	18.00	60.00	36.68	14.16

Table-I. Age distribution

	Frequency	Percent
Male	98	57.6
Female	72	42.4
Total	170	100.00

Table-II. Gender distribution

	Frequency	Percent
Simple transverse fractures	103	60.6%
Spiral fractures	31	18.2%
Oblique fractures	36	21.2%
Total	170	100.00%

Table-III. Geometry of fracture distribution

	Frequency	Percent
Normal union	158	92.94
Delayed union	12	7.05
Total	170	100.00

Table-IV. Distribution of union and delayed union

	N	Minimum (weeks)	Maximum (weeks)	Mean (weeks)	Std. Deviation
Time of union	170	7	15	9.94	1.81

Table-V. Time of union

Age	N	Normal union	Delayed union
18-31	88	87 (98.9%)	01 (1.1%)
32-45	19	18 (94.7%)	01 (5.3%)
46-60	63	53 (84.1%)	10 (15.9%)

Table-VI. Distribution of union and delayed union according to age
Chi-square value = 12.259
p – value = 0.002

Gender	N	Normal Union	Delayed union
Male	98	93 (94.9%)	5 (5.1%)
Female	72	65 (90.3%)	7 (9.7%)

Table-VII. Distribution of union and delayed union according to gender
Chi-square value = 1.350
p- value = 0.245

DISCUSSION

Humeral shaft fractures are seen with a rate of 5% in all the fractures. Since humerus does not bear the body weight like bones of the lower extremity, it is under traction forces rather than compressing forces. Therefore, fractures of the humerus can be treated mostly with conservative methods[5]. In the literature, it has been reported that treatment with brace of the humeral shaft fractures is more successful than surgical treatment with high rates of healing and good functional results. Therefore, there is consensus that the treatment should be conservative in cases other than the indication of surgery is absolute.

There are several features about the humeral fractures that differentiate humeral fractures from other long bone fractures. These features are:

1. Among the long bones, humerus is freely mobile bone and its movements can be augmented by the wide range movement of the scapula. So if there is malrotation or malalighnment it can overcome by wide range movement of scapula and humerus.

2. As whole function of humerus is that of a lever, so that nearly all stress is in tension or along the long axis of bone. So that in compression there is little stress on fracture ends.

3. In resting state or when person is standing, the long axis of the bone is vertical and this vertical axis is influenced by gravity alone, this is very effective and helpful in maintaining alighnment and later on union.

4. As humerus is covered by group of muscles and these muscles also very much vascular so that malunion in any plane can be masked by these muscles.

The acceptable criteria is:
<20° anteroposterior angulation
<30° varus or valgus

As there are free movements at upper limb and large muscle bulk over humerus so that malunion in any plane can easily be masked.[6]

Close reduction and conservative management is the corner stone of treatment with acceptable union rates of 90%, among non operative methods functional humeral brace (Sarmiento) is ideal modality. The current strategy for nonoperative management involves the immediate stabilization of the injured limb via a sling or coaptation splint to provide pain control, initial fracture stability, and subsidence of the edema. Once the soft-tissue edema settled, that takes 0 to 16 days, the initial splint is removed and humeral functional brace applied that provides support to fracture ends and soft-tissue compression.[5]

Stability of the fracture with functional brace is ensured by peripheral compression on the soft tissues surrounding the fracture. In addition, together with the stability ensured by the brace, spontaneous reduction is ensured with the effect of gravity. When the fracture is stabilized with the brace, active movement is started in early period, blood supply is increased at fracture ends, and micro movement helps in callous formation and early union and decrease the chances of joint stiffness. Not draining the haematoma of the fracture positively contributes to the healing of the fracture. In the U-splint, which is another frequently used mode of conservative treatment, cotton wool is wrapped around the arm after giving the proper position to humerus, and elbow is brought to 90 degrees flexion. Splint is applied with a width of 10cm and in 8-10 layers, to get hold of the shoulder and while the forearm is in neutral position. Since shoulder and elbow joints are fixated in this method and shoulder fixing bandage (velpeau) bandage applications, complications like stiffness in the elbow joint, or atrophy of the deltoid muscle, and temporary downwards subluxation of the shoulder develop and require a long rehabilitation period. In addition, these two methods have the disadvantages like not fully relieving the pain and partially preventing body care. Healing in humeral fractures occur within the first 3 months in general. Healing occurred in four months is called delayed union, and if healing has not occurred till six months is called nonunion.[5]

In this particular study outcome of close reduction and conservative management in close humeral diaphyseal fracture with application of u-slab of plaster of paris later replaced by Sarmiento brace (Humeral Brace) on third week was assessed in terms of normal union and delayed union. There were a total of 170 cases falling in the inclusion criteria. All those patients were managed with same technique. Mean age was 36.68 ± 14.16, out of those 98 (57.6%) were males and 72 were (42.4%) females.

A review of sixteen case series and two comparative studies by Papasoulis E, Drosos GI, Ververidis AN, Verettas DA showed that

fractures of shaft of humerus when treated with humeral functional brace, the union rate is on average 10.7 weeks. In this study, union rate is 94.5%.[4]

Muzahim, M. Taha during the period from Jan 2008 to June 2009. Seventy-eight fractures of humeral shaft were treated at Orthopaedic Department in the Tikrit Teaching hospital. Total 20 patients were selected for the study. The patients treated conservatively by 'U' shaped slab. The study shows that 19 fractures (95%) had union time on an average 42 days. There is no correlation between sex, type of fracture, the effect of manipulation and the rate of union. One patient is uncooperative and progress to delayed union and the time of union in this case 13 weeks. So the incidence of delayed union was 5%.[6]

In the study of van Middendorp JJ, Kazacsay F, Lichtenhahn P, Renner N, Babst R, Melcher G. Forty-seven patients were included. Of the 47 cases, 14 were treated non-operatively and 33 operatively. After follow up of 1 year, 11 fractures (100%) healed in the non-operative group and 89% healed in the operative group. There were no significant differences in pain, range of motion (ROM) of the shoulder and elbow, and return to work after 6 weeks, 12 weeks and 1 year.[7]

Bulent Ozkurt, Murat Altay, Cem Nuri Aktekin, Ali Toprak, Yalcin Tabak selected 30 patients full healing was seen in 24 patients (80%) out of 30 treated with functional brace after a mean follow-up period of 20 ± 3.7 (range 10-58) months.[5]

Oztürk I, Ertürer E, Uzun M, Akman S, Seçkin F conducted a study including 38 patients treated with functional humeral bracing, which was applied after a mean of 2.4 weeks. Complete union was achieved in all the patients in a mean of 11.4 weeks (range 10 to 16 weeks). Radiographic and functional results were very good in 31 patients (81.6%) and good in seven patients (18.4%).[8]

Koch PP, Gross DF, Gerber C reported 87 % of union at 10 weeks. Only nine patients had nonunion and out of these nine patients, six patients had transverse fractures. Functionally, 95 % had an excellent or good result.[9]

An interesting report that is published by Fjalestad et al, who reported a union rate of 91% in a total of 67 patients.[10]
Wallny et al included 87 patients in the study and got 95 % of good results. There is no restriction and full range of motion at shoulder and elbow in 86 % of cases. Functional and clinical outcome was excellent in two thirds of cases. Wallny also compared a group of 44 fractures treated non operatively to 45 patients treated with intramedullary nailing. The functional end results were somehow better in the nonoperative group and these authors recommend non operative management is the treatment of choice.[11,12]

Balfour et al. (1982) reported 42 patients with a fracture of shaft of humerus treated with a functional humeral brace. Union rate in this study was 97%. The average time of union was 54 days. Varus deformity was 9°. Deformity in the anteroposterior plane was 6.2°. Thirty-eight patients (90%) had full range of movement at shoulder and elbow joints after four months of fracture.[13]

In my study union was achieved in 158 patients (92.94%), 12 patients (7.04%) progress to delayed union. Mean healing time was 10 ± 1.81 weeks with a range of 7 to 15 weeks. According to our results and proper indications, humeral functional brace applied after settling of edema may be the ideal treatment for fractures shaft of humerus.

CONCLUSION

Humeral shaft fractures are common fracture among the young age with high energy trauma and in old age with low energy fall. The primary aim of treatment is to make the patient return to his or her pre-fracture functional state. Close manipulation and reduction for humeral shaft fractures is an ideal treatment, with its advantages like bearing no surgical risks, ease of application, causing no work power loss, being economically advantageous and union rate is high and functional outcome is excellent. So it

is recommended to operate only those fractures in which there is absolute indication for surgery. Close reduction and conservative management of fracture shaft of humerus remains the best treatment modality.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Farhan Sarwar	Concept, Study Design & Data Collection	
2	Hafiz Salman Saeed	Article Writing	
3	Sajjad Iqbal	Data analysis	
4	Iqra Fayyaz	Proof reading, Final Draft	