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Research Article

The Outcome of Close Reduction and Conservative Management in Closed Humeral Diaphyseal Fracture in Terms of Normal Union and Delayed Union

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ABSTRACT:

Fracture shaft of humerus is a common orthopedic problem representing 3% - 5 % of all fractures. Close reduction and conservative management is the best treatment modality. Non-operative methods include hanging arm cast, velpeau dressing, coaptation splint or u-slab, shoulder spica cast, functional humeral brace and rarely skeletal traction. The closed reduction and application of plaster of Paris u-slab later replaced by humeral brace (Sarmiento) 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. Average healing time is 11 weeks and it ranges from 10 weeks to 16 weeks.

Objective: 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

Settings: Orthopedic department of Allied and DHQ hospital FSD.

Duration of Study: 25th December 2012 to 25th June 2013.

Results: 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 same technique i.e. application of u-shaped plaster slab initially then replaced by humeral brace (Sarmiento). 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, fracture, Non-operative

INTRODUCTION:

Fractures of humeral shaft are common, representing 1to3% 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].Humerus fractures are a complex group of injury with many potential complications like radial nerve damage, brachial artery injury. Non operative treatment is advisable provided satisfactory alignment of the fracture in plaster is achieved early on [2].There are two modalities for management of humeral diaphyseal fractures, operative and nonoperative. Among conservative and surgical treatment in past few decades, close reduction remains the corner stone of treatment, 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]. Operativemanagement 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.

MATERIALS AND METHODS:

This descriptive case study was conducted in the orthopaedic department of surgery of Allied hospital Faisalabad after approval from ethical review committee 25 December 2012 to 25 June 2013. All adults of both genders from 16-60 years were admitted with 02 weeks old closed humeral shaft fracture and stable humeral shaft fracture, diagnosed on X-rays (involving less than 50% of bone cortex) and were included in the study.Union was defined as when the strands of ossified callus can be seen to be stretching continuously from one bone end to another end on radiographs. Normal union is that which occurs within 6 to12 weeks for fracture shaft of humerus. Delayed union was defined that occur after the time of normal union i.e.upto16 weeks. Closed reduction was defined as external manipulation to fractures to restore the length, alignment, and rotation of the involved bone. A closed fracture is a broken bone that does not penetrate the skin. Diaphysis is defined as the shaft of a long bone, between the epiphyses. Fracture of humerus is the break in the continuity of bone due to trauma i.e. road traffic accidents, firearm injury, fall.

Adults with open fractures of type 2 and 3 according to Gustilo Anderson classification and pathological fractures were diagnosed on history and x-rays (a broken bone that occurs in an area of weakened bone caused by disease) while adults with gunshot fractures (diagnosed on history) and segmental shaft fracture (diagnosed on X-rays (a long bone fractured at two places creating a separate segment) were excluded from the study.

Sample size of 170 patients calculated using WHO sample size calculator with anticipated population portion 10%[3] with absolute precision requirement of 5% along with confidence level of 95%. Sample collection done through non-probability consecutive

sampling.All those patientsfor life threatening conditions in the emergency department as per Advance Trauma Life Support protocol (ATLS) were excluded. All the demographic details of the patient were entered on the performa. After getting informed consent from the patient, all fractures were immobilized by U-slab of plaster of paris involvingacromio-clavicular 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. Check X-rays in both planes were advised to keep in record.

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 visit X-rays AP and Lateral view were taken 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 evidence of full union seen on X-rays. X-rays were done from hospital radiology department and reported by radiologist. All the information about union and delayed union were recorded on performa.

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:

Total 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 No.1).There were 57.6% (n=98) males and 42.4% (n=72) females (Table No. 2).

Humeral shaft fractures encountered in this study were described according to their respective geometry of fractures.

Simple transverse fractures were 66.47% (n=103), spiral fractures 18.23% (n=31) and oblique fractures were 15.30% (n=36) (Table No.4). There were around 92.94% (n=158) patients in whom union was achieved and 7.05% (n=12) patients went into delayed union (Table 4). The time noted for mean healing was 10 ± 1.81 weeks in a ranging between 7 to 15 weeks (Table 5). It was also observed that union was greater in younger age group 18-31 year 98.9% (n=88) and delayed union was greater in elderly patients 46-60 years (15.9%) (p-value = 0.002) (Table6).

Chi-square value = 12.259.The union was also greater in males (94.9%) as compared to females (90.3%) (p-value = 0.245) (Table No.7). Chi-square value = 1.350.

Table 1: Age distribution (n=170)

	n	**Minimum**	**Maximum**	**Mean**	**Std. deviation**
Age	170	18.00	60.00	36.68	14.16

Table 2: Gender distribution (n=170)

	Frequency	**Percent**
Male	98	57.6
Female	72	42.4
Total	170	100.00

Table 3: Geometry of fracture distribution (n=170)

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

Table: 4 Distribution of union and delayed union (n=170)

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

Table: 5 Time of union (n=170)

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

Table:6 Distribution of union and delayed union according to age

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: 7 Distribution of union and delayed union according to gender (n=170)

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

X-RAYS IN U-SLAB(SPLINT) WEEK 1

HUMERAL BRACE WEEK 3

HUMERAL BRACE WEEK 3

X-RAYS WEEK 8

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. Several features about the humerus cause fractures of that bone to present special attention in treatment make it necessary to depart from common lines of treatment of fractures of long bones. Thesefeatures are:

1. It is the most freely movable long bone and its movement can be amplified by the movement of the scapula. So it can overcome wide range of malalignment and mal –rotation.
2. Its entire function is that of alever, so that nearly all stress is in tension or at an angle to its long axis. The bone has to stand comparatively little stress in compression.
3. When at rest while the person is standing, the axis of the bone hangs vertically and is influenced by gravity alone, this can be used effectively for treatment.
4.It is a single bone, well enclosed in soft tissues (mainly muscles) which give very good vascularsupply and can mask malunion in any plane with acceptable cosmetics.

The acceptable alignment is:

1. <20° anteroposterior angulation
2. <30° varus or valgus

With very good functional outcome because of wide range of movement in the upper limb which can overcome these deformity[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.Thecurrent strategy for non-operative management involves the immediate immobilization of the injured extremity via a coaptation splint, sling, and/or swath to provide initial fracture stability, pain control, and

resolution of the edema. Once the majority of the soft-tissue swelling subsides, typically after 0 to 16 days, the initial splint is exchanged for a functional brace that provides circumferential 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. With the stable reduction ensured with the brace, active movement is started in early period, blood circulation is increased in the fracture area, micro movements enhance bone production, and range of motion can be conserved in the neighboring joints. Not draining the hematoma 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 humeral shaft fractures when treated with functional bracing heal in an average of 10.7 weeks. Union rate is high (94.5%) [4].Muzahim, M. Taha during the period from Jan 2008 to Jun. 2009 seventy-eight fractures of humeral shaft were treated at Orthopedic Department in the Tikrit Teaching hospital. 20 fractures considered suitable for the study. The patients treated conservatively by using the‘U’ shaped coaptation slab. In our study 19 fractures (95%) had union with an average time 42 days in males and 44 days in females. No correlation was found between sex, or type of fracture and the effect of manipulation and the rate ofunion.One fracture in uncooperative male patient more than 30 years old progress to delayed union and the fracture took 13 weeks to get safe union clinically and radiologically. So the incidence of delayed union was 5% [6].

In the study of van Middendorp JJ, et al. 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, MuratALTAY, CemNuri 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 had 87 % of clinical healing at 10 weeks; of the 9 cases that failed to heal there were 6 transverse fractures. Functionally, 95 % had an excellent or good result [9]. An interesting report is the onepublished by Fjalestad et al, who found a 91 % healing rate in a total of 67 patients [10]. Wallny et al found 95 % of good results based on subjective criteria in 87 patients, with no objective restriction in shoulder and elbow motion in 86 % of cases. Functional outcome was good to excellent in two thirds of cases followed up. Wallny also compared a group of 44 fractures conservatively treated to 45 patients treated with intramedullary nailing. The functional end results were somewhat better in the non-operative group and these authors recommend conservative management as the treatment of choice [11,12].

Balfour et al. (1982) reported 42 patients with a humeral shaft fracture treated with a functional brace. Forty-one fractures (97%) united. The time to union averaged 54 days. Varusdeformity averaged 9°. Deformity in the antero-posterior plane averaged 6.2°.Thirty-eight patients (90%) had full motion of the shoulder and elbow 4 months after fracture[13].The outcome of the study of 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. We are of the view that based on proper indications; functional bracing applied after regression of edema may be the treatment of choice in humeral shaft fractures.

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 goal of treatment is to make the patient return to his or her pre-fracture functional state. Conservative treatment for fracture shaft humerus is treatment of choice, with its advantages like bearing no surgical risks, ease of application, causing no work power loss, being economically advantageous and healing with high union rate and excellent functional outcome. So it is recommended to operate for fractures only in the presence of strict indications. Close reduction and conservative management of fracture shaft of humerus remains the best treatmentmodality.

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