

Evaluation of Different Methods for Management of Humeral Diaphyseal Fracture

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ABSTRACT:

BACKGROUND:

Fractures of the humeral shaft account 3% of all fractures.

OBJECTIVE:

purpose of the present study is to study in a consecutive series of humeral shaft fractures; union rate, time of union, rate of nonunion, evidence of malunion, shoulder and elbow joints function and symptoms after each method, to confirm previously published results, and to study the effect of postoperative fracture distraction in fracture union.

METHODS:

By using conservative and operative methods, we treated 54 patients who had a fracture of the humeral shaft. 48 patients were available for follow-up, which ranged from 5 to 40 weeks.

RESULT:

The average age of patients was 31.39 yrs (ranges from 5 to 65 Yrs), 26 males and 22 females. From these patients (42 were of close and 6 were of open fractures), the average time of union was 10.5 weeks for conservative method and 8.4 weeks for operative method.

In non operative method approximately 41.66% of the patients (ten patients) had an excellent functional result and an essentially full range of motion of the shoulder and elbow. 33.33% (eight patients) had a good functional result but lacked 15 degrees of forward flexion of the shoulder, or less, or 5 to 15 degrees of extension of the elbow. 8.3% (two patients) had a fair functional result but lacked more than 20 degrees of motion in both shoulder and elbow joints (specially in elbow extension) with mild pain. 16.6% (four patients) had a poor initial resulted secondary to instability that was due to nonunion of the fracture.

CONCLUSION:

Because of the low morbidity and high rate of success in conservative method and because statistically there was no significant difference between the two methods (P value more than 0.05), we concluded that the treatment of choice for diaphyseal fractures of the humerus is better to be by non operative method unless there's a clear indication for surgery.

KEYWORDS: fracture humerus, hanging arm cast, U shape cast, operative treatment.

INTRODUCTION:

Appropriate non operative and operative treatment of patients with humeral shaft fractures, however, requires an understanding of humeral anatomy, the fracture pattern and the patient's activity level and expectations⁽¹⁾.

Two factors responsible for a final outcome in operative & non operative are the blood supply to the distal fragment of the shaft is sometimes impaired by damage to the nutrient artery. On the other hand, distraction of the fragments, early operative intervention with stripping of soft tissues and deprivation of blood supply, together with inadequate internal fixation support leads inexorably to non-union⁽²⁾.

PATIENTS AND METHODS:

From august 2008 till june 2009, we treated about fifty four patients who had a diaphyseal fracture of the humerus nonoperatively, by using hanging arm cast and coaptation splint (U- shaped cast) and operatively. 48 of these patients were available for follow-up. There were 26 male and 22 female patients, and the average age was 31.39 years (ranged from 5 to 65years). The average period length of follow-up was 13 weeks (ranges from 5 to 22 weeks). 30 cases, the fractures were in the right extremity and 18 were in the left. 42 of the fractures were close and 6 were open, The two most common mechanisms of injury were fall (22 patients) and motor-vehicle accidents (20 patients).

12 fractures were in the proximal third of the humeral diaphysis, 27 were in the middle third, and 9 were in the distal Third.

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At the time of injury in about 11 cases the fractures associated with radial nerve palsy. In determining whether to use the nonoperative method as the treatment for the given fracture, there were four contraindications: massive Injury to soft tissue, or loss of bone; a presumed lack of reliability or cooperation on the part of the patient; the impossibility of obtaining or maintaining acceptable alignment and when nonunion occurs.

24 patients were treated nonoperatively (8 patients by hanging cast and 16 patients by U-shaped coaptation splint) and other 24 patients treated operatively (13 patients by plate and screws, three patients by SIGN nail, 4 patients by external fixators, 1 patient by K-nail and 3 patients by Rush- nail),the latter i.e (Rush nails) were used in patients whom ages were less than 10 years .

In our study the inclusion and exclusion criteria are described as below:

Inclusion criteria are patients of both sex , patients of all age groups, All the types of fractures of humeral shaft.

Exclusion criteria are fracture dislocation of the head ,Anatomical and surgical neck fractures, Supracondylar fractures of humerus.

Roentgenograms were taken two or three days after application of the encasement to determine the position of the fragments, and if necessary, adjustments were then made usually under general anesthesia. From then on until union is adequate to allow removal of the encasement, check-up roentgenograms are taken at two-week intervals.

In some cases we used intramedullary nailing, There are small caliber nails (Rush-pins), nonlocking

nails (Küntscher) and locking nails (SIGN nail).

We used the antegrade method of nailing. Small and nonlocking nails were inserted through only a small hole after the side of the fractures had been opened and the fracture was reduced, these types of nails provide enough stability to maintain alignment, but they usually do not provide rotational stability for this reason an external bracing is applied ⁽³⁾. While in locking intramedullary nails which also provide rotational stability, small incision was done with minimum soft tissue distraction at the site of fracture, the fracture was reduced, reaming of the shaft was done and then the nail was inserted through a small hole in the greater tuberosity after that the nail was locked through other small holes proximal and distal to the site of the fracture.

Postoperative X-ray was taken and then the patient was followed up by radiological examination every two weeks until union was achieved.

And in other patient in whom External fixator, was used in open fractures ,for infected nonunited diaphyseal fractures of humerus ⁽⁴⁾. Under general anesthesia wound debridment was done after that the fracture was fixed through multiple pins proximal and distal to the site of fracture

RESULTS:

The study was done on 48 patients; 26 males (54.2%) & 22 females (45.8%); with male:female ratio of 1.18:1 their ages ranged between 5 yrs - 65 Yrs, the mean of age was 31.39 Yrs.

In thirty cases (62%) the fractures was in right side and in eighteen cases (38%) was in left side.

In twelve cases (25%) the fracture site was in proximal third of the humeral shaft, twenty seven cases (56%) in midshaft and nine cases (19%) in distal third of the humeral shaft. The cause of the fractures was fall from high in twenty two cases (45%) and roadtraffic accident in twenty cases (42%) .

50% of the patients were treated nonoperatively and the other 50% operatively. In nonoperative method the union rate was 83.33% (twenty patients), and nonunion rate was about 16.66% (four patients), while in operative method were 79.16% (nineteen patients), 20.83% (five patients) respectively.

The average time of union was 10.5 weeks for the nonoperative Method (range: 8 to 13 weeks) and 8.4 weeks for the operative method (range: 6 to 11 weeks). In nonoperative method, fractures in the distal third of the humeral diaphysis were the slowest to heal (11.4 weeks as compared with 9.2 and 9.4 weeks for the proximal and mid-shaft fractures respectively); no significant difference was noted in operative method.

In nonoperative method the average time of the union by hanging cast was 10.12 weeks and by U-shaped cast was 9.91 weeks; the nonunion rate was 0% in hanging cast method and 25% in U-shaped cast method.

In operative method the time of union by plate and screws was 8.7 weeks, SIGN nail 8 weeks, external fixators 12 weeks, Rush nail 7 weeks and K nail 6 weeks; the nonunion rate was 23.7% in plate and screws method, 33.33% in SIGN nail method and 25% in external fixators.

In nonoperative method, The mean of varus-valgus (coronal plane) angulation at follow-up was 8 Degrees and the mean of posterior angulation was 12 degrees, about 33.33% of the patients had some degrees of varus or valgus angulation, and approximately 8.33% had some degrees of posterior angulation, (Table 1)

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Table 1: Distribution of sample by types of malunion in non operative method.

Angulation.	Frequency	Percentage
No angulation	14	58.33
Varus angulation	5	20.83
Valgus angulation	3	12.51
Posterior angulation	2	8.33
Total	24	100.00

Varus deformity was significantly more common than any other angulatory deformity ($p < 0.0005$ by the chi-square test); Proximal third fractures had significantly less residual angulation in all planes than did fractures at any other level of the humerus ($p < 0.03$ by the chi-square test). No malunion is noted in operative method. No clinically significant rotational deformities were detected in both nonoperative and operative methods. Shortening, as evaluated radiographically, had a mean of 8 millimeters (range: 5 to 11 millimeters) in nonoperative method and 6.5 millimeters (range: 5 to 8 millimeters) in operative method. Distraction of a

few millimeters in abundant periosteal callus was very difficult to be measured radiographically. Thus, minor Amounts of distraction were recorded as no shortening.

In nonoperative method about 58.33% of the patients (fourteen cases) had joint stiffness near by the site of fractures .(shoulder joint stiffness 41.88%, ten patients) and (elbow joint stiffness 16.66%, four patients).

And in operative method 41.8% of patients (ten cases) developed stiffness in nearby joints . (shoulder joint stiffness 25%, 6 patients)and (elbow joint stiffness 16.66 % , 4 patients). (Table 2, 3)

Table 2: Distribution of sample according to shoulder stiffness

Shoulder stiffness	Frequency	Percent
Valid NO	32	66.67
Yes	16	33.33
Total	48	100.00

Table 3: Distribution of sample according to elbow stiffness

Elbow stiffness	Frequency	Percent
Valid NO	40	83.34
Yes	8	16.66
Total	48	100.00

The average rate of the infection was 0% in nonoperative method and 25% in operative method (mainly in open wound fractures)

Function was evaluated with respect to the range of motion of the shoulder and elbow after union of fracture and to the function of the extremity in the activities of daily living, And evidence of radiological deformities, so our classification of results was as follows ⁽⁵⁾ ,Excellent: No pain or impairment of the function and no roentgenographic evidence of deformity. Good: No pain and no impairment of the function for ordinary purposes, but with limitation of motion in the elbow or shoulder of 20 percent. or less, and with solid bony union and angulation of not more

than 10 degrees. ,Fair: Solid bony union with occasional mild pain, angulation of more than 10 degrees, or limitation of motion in adjacent joints of more than 20 per cent., but with satisfactory function for light duties. Poor: Persistent pain, limitation of motion in an adjacent joint of 40 per cent., and with non-union or malposition and impairment of function.

In non operative method approximately 41.66% of the patients (ten patients) had an excellent functional result and an essentially full range of motion of the shoulder and elbow. 33.33% (eight patients) had a good functional result but lacked 15 degrees of forward flexion of the shoulder, or less, or 5 to 15 degrees of extension of the elbow.

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8.3% (two patients) had a fair functional result but lacked more than 20 degrees of motion in both shoulder and elbow joints (specially in elbow extension) with mild pain. 16.6% (four patients) had a poor initial result secondary to instability that was due to nonunion of the fracture resulting in persistent pain with limitation of movement in all directions.

The complications were minimal. In four patients, a nonunion developed; all of these fractures were closed, all four patients subsequently had open reduction and internal fixation with bone-grafting. All healed, and the patients had a good functional result.

Two patients had a re-fracture that was attributed to removal of the cast less than eight weeks after the original injury. The fractures healed after the cast was worn for several more weeks. In operative method eleven patients with approximately (45.83%) had an excellent

functional result and an essentially full range of motion of the shoulder and elbow. five patients (20.83%) had a good functional result but lacked less than 20 degrees of forward flexion of the shoulder, or less than 20 degrees of extension of the elbow. three patients (12.5%) had a fair functional result but lacked more than 20 degrees of motion in both shoulder and elbow joints (also specially in elbow extension) with mild pain. five patients (20.83%) had a poor initial result secondary to instability that was due to nonunion of the fracture resulting in persistent pain with limitation of movement in all directions.

The complications were occurred, in five patients a nonunion developed, in three of these nonunions the fractures were open. All five patients subsequently had been re-opened and re-fixed with bone-grafting and the patients are still in follow up, one of the patients developed radial nerve palsy postoperatively.

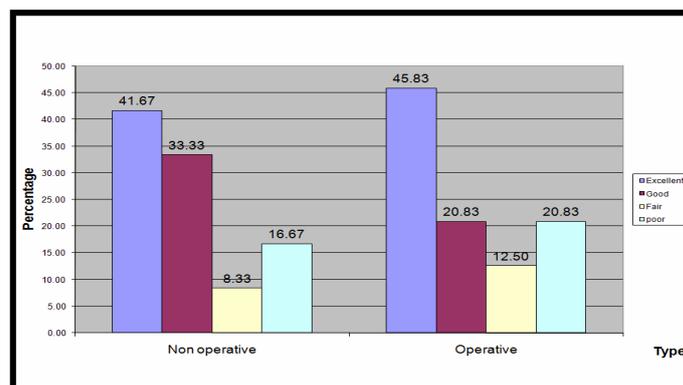


Figure 1: Results by type of management

Radial-nerve palsy at the time of the injury was initially seen in eleven patients, the palsy was not associated with any specific type of fracture, as described by (6,7) but rather, with the fracture of the middle or distal third of the humerus. All eleven palsies (except two) resolved spontaneously in six week to six months without surgical intervention.

DISCUSSION:

As regard to situation of fracture & to relation to sex in our study they are near to other studies of (8).

As regard to Type and cause of the fracture, most of the patients had close type fractures (87.5%), and (12.5%) had open type fractures, the two most common mechanisms of injury were falls (45.8%) and motor vehicle accidents (41.7%), and these ratios have agreement also with studies of (8,9).

Radial nerve injury was present in eleven patients (24.44%) at the time of injury and these ratios

have agreement also with studies of (10,11,12,13). In nine cases the palsies were resolved spontaneously in six week to six months without surgical intervention and these ratios have agreement also with studies of (14). The average time of union was 10.5 weeks for the nonoperative method (range: 8 to 13 weeks) which is similar to other studies (8,15,16). And in operative methods 8.4 weeks (range; 6 to 11 weeks), and these ratios have agreement also with studies of (17,18).

In nonoperative method approximately 75% of the patients (eighteen cases) had a good to excellent functional results and essentially near full range of motion (limitation of motion less than 20 degrees) of the shoulder and elbow joints with no impairment of function for ordinary purposes, and 8.3% (two patients) had a fair result, with occasional mild pain, limitation of motion in adjacent joints of more than 20 degrees, but with

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satisfactory function for light duties. Four patients (16.6%) had a poor initial result which was secondary to instability that was due to nonunion of the fracture resulting in persistent pain with limitation of movement in all directions, and these ratios are near to other studies like ^(8,12).

In operative method approximately 66.66% of the patients (sixteen cases) had a good to excellent functional results and essentially near full range of motion (limitation of motion less than 20 degrees) of the shoulder and elbow joints with no impairment of function for ordinary purposes.

12.5% (three patients) had a fair result, with occasional mild pain, limitation of motion in adjacent joints of more than 20 degrees, but, with satisfactory function for light duties. While five patients (20.83%) had a poor initial results which are secondary to instability that was due to nonunion of the Fracture resulting in persistent pain with limitation of movement in all directions, and these ratios have agreement also with the study of ⁽⁹⁾. Ten patients (41.66%) had shoulder joint stiffness and four patients (16.66%) had elbow joint stiffness after they had been treated nonoperatively by hanging arm cast and U-shaped cast and these ratios have agreement also with studies of Mehmet Fatih Korkmas et al. 2008.⁽²⁰⁾. Six patients (25%) had shoulder joint stiffness and four patients (16.66%) had elbow joint stiffness after they had been treated operatively by different methods of internal fixation. ^(21,22). Patients (41.66%) had malunion in non operative method, eight patients had varus-valgus angulation of average 8 degrees and two patients had posterior angulation of average 12 degrees and this ratios have agreement with the studies of ^(8,17).

Shortening as evaluated radiographically, was a mean of 8 millimeters (range: 5 to 11 millimeters) in nonoperative method which is near to the study of ⁽⁸⁾ and 6.5 millimeters (range: 5 to 8 millimeters) in operative method, unfortunately we couldn't find any previous study to compare these data with it, Four patients (16.66%) had nonunion in conservative method and this ratio has agreement with the study of ⁽⁹⁾, Five patients (20.83%) had nonunion in operative method and this ratio is similar to the ratio found in other studies ^(22,23), Six patients (25%) had infection in operative type which is near to study of ^(23,24).

CONCLUSION:

1. In operative methods fixation by external fixators had the longer period of union as compared with the other types of operative fixations.

2. In non operative methods both angulation in coronal plane (varus-valgus angulation) and sagittal plane (anterior-posterior angulation) are more common than in operative methods, but it dose not affect the function and the appearance of the extremities.
3. Shortening in healed humeral diaphyseal fracture dose not affect the function of the extremities.
4. Stiffness of the joints near to the site of fractures is slightly common in non operative method.
5. The rate of nonunion is higher in operative methods than that in non operative methods.
6. Infection more common in operative methods & the complication of anesthesia, surgery & the need of second operation of removal of hardware.

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