A comparison of the use of coaptation U-splintage and a Polypropylene brace for humeral shaft fractures

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Eighty-eight patients with humeral shaft fractures seen at Mulago hospital, Kampala, were randomly distributed into two groups. In Group A, 58 patients were treated conservatively using a coaptation U-splint of plaster of Paris while 30 patients in Group B were treated with a humeral brace. There were more males than females (M:F;1.75:1). Most patients (68%) were aged 18 years or over. Road traffic accidents accounted for 64% of the fractures. Four patients had associated radial nerve damage.

There was a statistically significant difference in fracture healing times between closed and open fractures but no statistically significant difference in healing was noted in those patients treated with coaptation U-splints and those with a humeral brace. Full recovery of flexion and extension of the elbow was shorter in patients treated with the humeral brace (Group B) than in U-splints (Group A) and the difference was statistically significant (p value < 0.001). The functional humeral brace was found to be superior to the coaptation U-splint as regards functional results and is therefore recommended for those patients who can afford its use.

Introduction

Humeral shaft fractures are fairly common injuries in Mulago hospital as elsewhere. De Souza[1] noted that fractures of the humerus were the fourth commonest fractures of the upper limb. Klenerman[2] observed that among fractures of the humerus, shaft fractures were the least common and Holmes[3] (1970) reported that out of 175 humeral fractures, only 45 (25.7%) involved the shaft. Apart from road traffic accidents, other causes include indirect trauma such as falls on the outstretched hand, falls on the elbow and violent muscular contractions. Open fractures may be produced by projectiles and high velocity missiles are associated with extensive soft tissue damage. Fractures of the humeral shaft have also been reported to occur when javelins, baseballs or grenades are thrown violently. Typically, such fractures occur at the junction of the distal and middle thirds.

There is no unanimity about the best way to treat fractures of the humeral shaft. Klenerman[2] found the U-splint satisfactory in 85% of his cases. Sarmiento et al[4] used functional bracing and found that the healing time was rapid (range 5 to 8 weeks; mean 7 weeks), that there was full joint mobility before complete fracture healing and that morbidity was minimal.

This paper compares the results of treatment of humeral shaft fractures using either a coaptation U-splint or humeral brace.

Patients and methods

A prospective study was undertaken at Mulago Hospital, Kampala on 88 patients seen with fractures of the humeral shaft. Patients with

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supracondylar and anatomical neck fractures or pathological fractures were excluded from the study.

Patients were randomly distributed between two groups. Group A patients were treated with coaptation U-splints of plaster of Paris applied without anaesthesia. The limbs were held in 90 degree elbow flexion using a collar and cuff arm sling. Isometric and isotonic exercises were encouraged within the limits of pain.

Group B patients were treated in a humeral brace, also applied without anaesthesia. The braces used were pre-fabricated using polypropylene fitted with a firm sponge and either with velcro straps or leather straps with buckles. A stockinette was put on to the arm before the brace was applied. During application, gentle correction of alignment was made. Tightening of the brace was done as the oedema subsided. An arm sling or collar and cuff was applied to hold the elbow at 90 degrees. Patients were encouraged to carry out passive and active exercises.

The fractures in the two groups were immobilised until there was evidence of clinical and radiological union. A weekly follow up was done for functional results in the outpatients clinic by one of us (KAP). Assessment of outcome was continued weekly after the removal of the cast or brace. Factors looked for included radiological, functional and cosmetic results as well as complications.

Radiological results were considered satisfactory when apposition was at least one-third of the diameter of the fractured ends and maximum angulation was less than 20 degrees regardless of whether it was varus, valgus, anterior or posterior angulation. Functional results were based on the elapsed period before the patient could extend and flex the elbow within the normal range. Cosmesis was judged on whether any deformity was obvious. Complications looked for included delayed union which was regarded as absence of clinical union by 10 weeks from the time of fracture.

Results

The 88 patients in this study were randomly distributed to the two groups as follows :
Group A (U-splint group) had 58 patients while Group B (humeral brace) had 30 patients. There were 56 males (64%); the sex ratio being M:F;1.75:1. Eleven patients (13%) were aged under nine years, 17 (18%) were between 9 and 17 years old while the remainder (68%) were aged 18 years and above.

Road traffic accidents accounted for 64% of the fractures (Table I). The youngest patients were two neonates who sustained mid-shaft transverse fractures during breech delivery. Forty patients (43%) had associated injuries. Of these, 24 had soft tissue injuries, while eight had other fractures (seven clavicle fractures and one femoral fracture). Six patients had closed and two had open head injuries.

Transverse fractures accounted for 48% of cases (Table II). Most patients (63%) had fractures involving the middle third of the shaft of humerus three of whom had associated radial nerve palsy (Table III).

There was no statistically significant difference in the mean duration that various patterns of fractures took to heal both in the under 18 years group and among patients aged 18 years and above (Table IV).

There was a statistically significant difference in union time between the three age groups (Table V) and a statistically significant difference ($p = 0.05$) in the duration to union in closed and open fractures. Closed fractures healed at a mean time of 7.35 weeks, while open healed at a mean of 8.88 weeks.

A comparison of mean union duration for those aged under 18 years was 4.1 weeks and 4.4 weeks for patients treated with the U-splints and braces respectively while among patients aged 18 years and above the respective corresponding mean durations were 7.6 and 7.1 weeks. The differences were not statistically significant (p value > 0.05).

There was a statistically significant difference (p value < 0.001) between the average time taken to flex and extend the elbow joint to normal range in the brace and U-splint groups (Table VI) both in the under 18 years and in the 18 years and above age groups.

Overall, 78 patients (89%) had satisfactory results while in 10 cases (11%) the results were

unsatisfactory. Complications included delayed union (1), infection (1), stiffness of elbow (1) and stiffness of shoulder (1). No case of non-union was seen. Fortunately, all four cases of radial nerve palsy recovered fully.

TABLE I *Causes of humeral shaft fractures*

CAUSE	FREQUENCY	(%)
Road traffic accidents	56	(64)
Fall while outside	9	(10)
Fall from a tree	7	(8)
Fall while playing at home	5	(6)
Sports	4	(5)
Others	7	(8)
TOTAL	88	

TABLE II *Radiological type of fractures*

TYPE OF FRACTURE	FREQUENCY	(%)
Transverse	42	(48)
Sprial	18	(20)
Oblique	13	(15)
Comminuted	13	(15)
Greenstick	2	(2)
TOTAL	88	

TABLE III *Site of fractures and radial nerve palsy*

SITE	FREQUENCY	(%)	RADIAL NERVE PALSY
Upper third	17	(19)	0
Middle third	55	(63)	3
Lower third	16	(18)	1
TOTAL	88		

TABLE IV *Fracture pattern and union time*

	UNDER 18 YEARS			18 YEARS AND ABOVE		
	Mean (Weeks)	Frequency	S. D.	Mean (Weeks)	Frequency	S. D.
Transverse	3.97	17	1.389	7.339	25	1.313
Spiral	4.33	6	1.604	7.692	12	1.627
Oblique	5.50	2	1.414	7.227	11	1.009
Comminuted	6.50	1	0.000	7.692	13	1.627
Greenstick	4.50	2	0.000	-	-	-
p - value		p > 0.05				p > 0.05

TABLE V *Comparison of union time in different age groups*

AGE (YEARS)	FREQUENCY	MEAN IN WEEKS	S. D.
<9	11	3.502	1.442
9-17	17	5.020	1.431
18 and above	60	7.462	1.384
p - value		p = 0.05	

TABLE VI *Duration of recovery of normal flexion and extension of elbow*

TREATMENT	UNDER 18 YEARS			18 YEARS AND ABOVE		
	Frequency	Mean (Weeks)	S. D.	Frequency	Mean (Weeks)	S. D.
U-Splint	18	1.676	0.498	40	3.805	1.360
Brace	10	0.800	0.587	20	1.875	0.841
p - value		p < 0.001				p < 0.001

Discussion

The humeral shaft is capable of a wide range of responses when fractured and the surgeon of today has therefore a wide range of therapeutic options to choose from. The objective of this study was to analyze the results of current treatment methods and to compare U-splint treatment with functional bracing.

Most of the patients were aged 18 years and above and road traffic accidents were the cause in 64% of cases. De Souza[1] in Mulago Hospital had similar findings.

The association between humeral fractures and radial nerve damage is well known. Carrol[5] and Whitson[6] noted that the critical fracture zone is the junction between the middle third and lower third where the radial nerve is fixed and is in direct contact with the bone as it penetrates the lateral intermuscular septum. Here too is where the main nutrient artery enters the shaft medially near the insertion of the coracobrachialis tendon.

In this study four patients sustained radial nerve damage. Holstein and Lewis[7] described a specific situation which exists when paralysis of the radial nerve complicates fractures of the humerus, namely a fracture of the distal third of the humerus, spiral in type, the distal bone fragment being displaced proximally with its proximal end deviated radially. The radial nerve is caught at the fracture site and, if there is a comminuted fragment, it is the oblique surface of the distal end of the proximal fragment that damages the nerve. In the present study, one of the cases had such a fracture.

Pollock et al[8] followed 24 patients with humeral shaft fractures associated with radial nerve injuries. Only two of them required exploration of the nerves and all did well after delayed repair. Their recommendation was that cases of radial nerve damage should be observed for return of nerve function. If at three to four months after injury, there is still no clinical evidence of recovery, exploration should be done.

In the present study, recovery of the radial nerves occurred within two months.

The statistically significant difference in the union time between the age groups in this study was not surprising since it is well known that age affects the rate of healing. Children have a higher healing rate because of the higher levels of growth hormone in their bodies as compared to adults. The statistically significant difference in the mean union time between males and females under the age of eight years could be attributed to the fact that both the neonates with humeral shaft fractures were female.

The present study demonstrated no difference in union time between fractures treated with the U-splints and those managed with the brace. The statistically significant difference in functionalresults between those patients managed with the brace and those using the U-splint should be a factor in deciding as to which method to use in management of humeral shaft fractures, particularly in elderly patients or those who have to return to work and require early use of their affected limb.

The brace was noted to be a more expensive method of treatment though it was associated with a shorter rehabilitation period. Each brace costs Uganda Sh 13000/- which is equivalent to US dollars 13.

The advantage of a brace is that it is re-usable. For those patients who can afford it, use of a humeral brace is a worthwhile method for treating fractures of the shaft of the humerus.

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