Diaphyseal Fractures of the Humerus Treated by Open Reduction and Internal Fixation

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ABSTRACT

This paper presents our experience with 57 patients of diaphyseal fractures of the humerus, treated by open reduction and fixation with dynamic compression plate.

The indications for surgical treatment included delayed union in 29 patients, soft tissue interposition in 11, multiple injuries in 8, and radial nerve involvement in 9. Seven patients among the 19 who had routine exploration of the radial nerve palsy, took 6 to 12 weeks to recover.

We recommend that fractures which do not show evidence of union in 6-8 weeks are unlikely to unite and should be treated by open reduction and internal fixation. Fractures with a gap between the fragments either in anteroposterior or in lateral radiographs and fractures with distraction of the fragments commonly have soft tissue interposition and should have primary open reduction and internal fixation. Exploration of the radial nerve during primary fixation of the fracture should only be done in patients presenting with radial nerve involvement.

Most diaphyseal fractures of the humerus heal uneventfully, in acceptable position and with satisfactory function, by non-operative treatment[1-4]. However, non-surgical management of some of these fractures is associated with some morbidity and undesirable sequelae which include delayed union and non-union, stiffness of the shoulder from adhesive capsulitis or from a transient inferior subluxation of the shoulder and stiffness of the elbow[5-7]. Early fixation of these fractures can avoid these complications. Fixation of the fracture is indicated with soft tissue interposition, patients with multiple fractures, delayed union, delayed or irrecoverable radial nerve palsy and patients need to stay in bed because of other injuries.

Radial nerve injury constitutes a major problem in the treatment of fractures of the shaft of the humerus[8], the average frequency of which is 11%. These fractures are treated usually by watchful expectance as the principal initial policy of management[9]. Primary exploration of the nerve and internal fixation of the fracture is recommended by Holstein et al[10] in oblique fractures of distal third of humerus presenting with the radial nerve involvement.

The aim of this paper is to present the analysis of 57 patients with the diaphyseal humeral fractures treated by internal fixation with special reference to the indications for primary fixation of the fractures and for the exploration of the radial nerve.

METHODS

During the years 1985-1991, a total of 57 patients with diaphyseal fractures of the humerus were treated by open reduction and internal fixation at King Khalid University Hospital. Fractures with non-union and patho-

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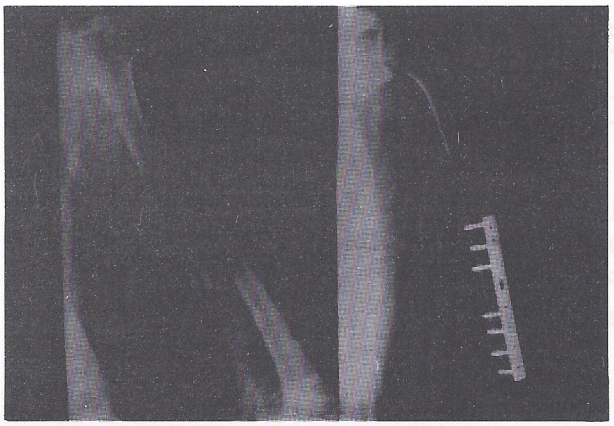

Figure 1: *Anteroposterior radiographs of the left humerus showing a gap between the fragments which has been treated by dynamic compression plate.*

logical fractures were excluded. There were 41 male and 16 female patients. The mean age for male patients was 37 years and for females 48 years.

In the majority of cases (44 patients), the fracture was caused by a road traffic accident; 24 fractures of the right extremity and 33 of the left. Fifty two were closed and 5 open. Four fractures were located in the proximal third, 27 in the middle and 21 in the distal third of the humerus. Five patients had long spiral fractures extending from middle third to distal third of the humerus. Nine patients had radial nerve palsy. Two of these with fracture of the distal third of the humerus and both had oblique fracture and were treated by exploration of the nerve and fixation of the fracture. The nerve in these two patients was found caught at the fracture site (Fig 1). Seven patients with fracture in the middle third had associated radial nerve palsy. Seven patients at 4 to 6 weeks after injury were treated by exploration and neurolysis of the nerve and fixation of the fracture. In two of these patients, the nerve was found adherent to the fracture site. In other 5 patients the nerve was found normal.

Fractures which did not show evidence of healing radiologically at 6 to 8 weeks after injury were considered as delayed union. Fractures with a gap between the fragments which remained mobile at four weeks after injury were considered to have soft tissue interposition. The indications of surgery in 48 patients without radial nerve palsy were delayed union in 29 patients, soft tissue interposition in 11 patients, and multiple injuries in 8 patients.

All patients were operated under general anaesthesia. The standard anterolateral approach was routine in all patients except one who had posterior approach for fixation of the elbow fracture on the contralateral side. Nineteen patients without radial nerve palsy, had routine exploration of the radial nerve at the time of fixation of fracture. The dynamic compression plate was used for fixation of the fracture in all patients. Bone grafting was performed in all cases with delayed union. All 11 patients, showing a gap in anteroposterior or lateral radiograph at the fracture site and patients with distraction of the fragments, were found to have soft tissue interposition.

The mean time for hospital stay among our patients was 12.1 days ranging from 5 to 32 days. Three patients were lost during follow-up. The rest were evaluated for the final results according to the given clinical and radiological criteria (Table 1).

Table 1
Clinical and radiological criteria for assessment of results

Excellent	*Good*	*Poor*
– Full range of joint motion	– Stiffness of one of the nearby joint	Presence of one of the following:
– Normal function	– Overall function satisfactory	* Non-union
– Radiological union of fracture	– Radiological union of fracture	* Irrecoverable nerve injury
		* Uncontrolled infection
		* Joint stiffness with functional impairment

RESULTS

The average time to union in 49 patients was 16.6 weeks ranging from 9 to 28 weeks. In the other 8 patients, 3 cases were lost during follow-up, 1 case developed infection at the site of the non-unified fracture, 4 cases continued to have a non-unified fracture, two of whom refused further surgery and only two of them agreed for further operation. Seven patients among 19 (37%) who had routine exploration of the radial nerve at the time of fixation of the fractures developed radial nerve palsy which took up to 3 months to recover.

After exclusion of the three cases lost during follow-up, the result of 54 patients are: 6 poor, 8 good, and 40 excellent.

The causes of poor results were infection in one case, elbow and shoulder stiffness in another and non-union in 4 cases. All cases with good results showed complete union of the fracture but complained of elbow or shoulder stiffness. The mean time to get full range of motion of both elbow and shoulder in the group of excellent results is 12.3 weeks ranging between 8 to 24 weeks.

Figure 2: *Anteroposterior and lateral radiographs of the humerus showing distraction of the fragments.*

DISCUSSION

Diaphyseal fractures of the humerus account for 6.8% of the total fractures in the body[11]. We observed that fracture of the humerus is more common in males than females and is commonly caused by a road traffic accident. 47.3% of the fractures are located in the middle third, 36.8% in the distal third and 7% in the proximal third. Fifteen percent of the humeral shaft fractures are associated with the radial nerve injury.

In our patients, fractures presenting with a gap between the fragments in either anteroposterior or lateral radiographs (Fig 1) and fractures with distraction of fragments (Fig 2) did not show evidence of union by conventional conservative methods at six weeks after injury. Open reduction of these fractures demonstrated soft tissue interposition. Therefore, fractures showing a gap between the fragments either in anteroposterior or lateral radiographs (Fig 1) and fractures with distraction of the fragments (Fig 2) should be treated by primary open reduction and internal fixation.

Fractures which failed to show evidence of healing in 6 to 8 weeks are unlikely to unite, therefore the line of treatment in these fractures should be changed to open reduction and internal fixation[12]. The majority of these fractures in our series showed soft tissue interposition.

Fractures involving the distal third of the humerus (Fig 3) with involvement of the radial nerve should preferably be treated by primary open reduction and internal fixation along with exploration of the radial nerve, because in such fractures the nerve is often caught at the fracture site[10], while fractures without radial nerve involvement are treated by non-operative methods.

Patients with fracture in the middle third of the humerus plus radial nerve injury should be treated by watchful expectance, as the principal initial policy of management. Exploration of the radial nerve is done in patients which do not show evidence of recovery after 6 weeks of observation.

Henry's anterolateral approach[13] in our opinion is best for open reduction and dynamic compression plating. In this series seven patients out of 19 (37%) developed neuropraxia following the routine exploration

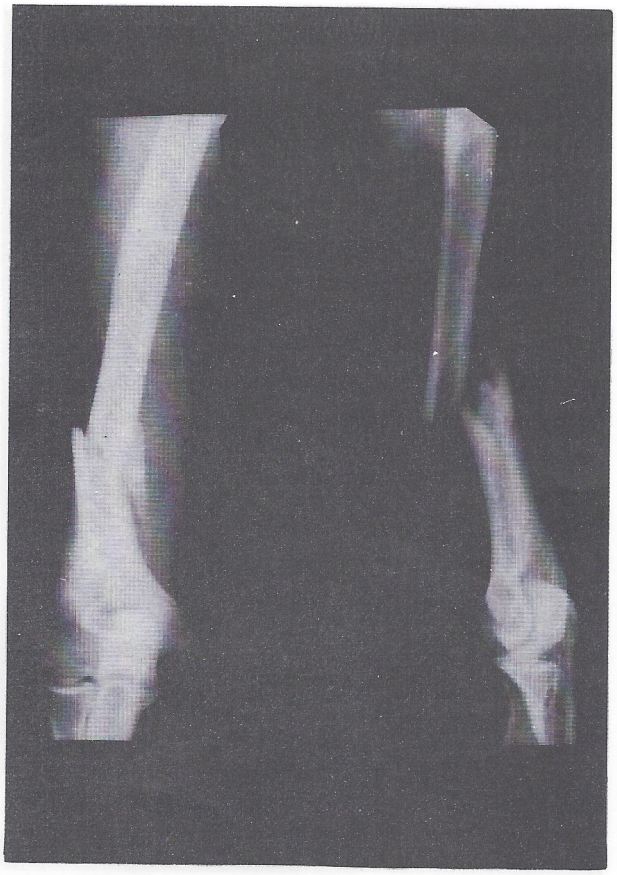

Figure 3: *Anteroposterior and lateral radiographs of the humerus showing comminuted oblique fracture in the distal third of the humerus which was complicated by radial nerve injury.*

of the radial nerve. Considering this high number the radial nerve should only be explored in patients presenting with radial nerve injury. One patient was operated using the posterior approach also developed radial nerve palsy which took almost three months to recover. The neuropraxia developed after exploration of the nerve, recovered in all the patients in 4-12 weeks.

CONCLUSION

Most diaphyseal fractures of the humerus heal in acceptable position by non-operative treatment. The surgeon should not delay the surgical treatment in patients presenting with a gap between the fragments due to soft tissue interposition, distraction of fragments, fracture in distal third of humerus with radial nerve involvement and in patients when there is no evidence of healing in 6 to 8 weeks by non-operative methods.

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