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*Original Article*

# Clinicoradiological and Functional Outcome of Humeral Shaft Fractures Treated by Functional Cast and Brace: A Hospital Based Study

**M R Chandrashekaran**
Associate Professor, Department of Orthopaedics,
Dr. B. R. Ambedkar Medical College, Bengaluru, Karnataka, India.

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***Correspondence to:**
Dr. M R Chandrashekaran
Associate Professor, Department of Orthopaedics,
Dr. B. R. Ambedkar Medical College,
Bengaluru, India.

## ABSTRACT

**Background:** Functional brace application for isolated humeral shaft fracture persistently yields good functional outcome. In the present study, modified technique of functional cast and brace was used, and the clinical results were assessed using an objective scoring system.

**Materials & Methods:** This is a prospective study done on 50 patients with presented fracture of shaft in humerus in Department of Orthopaedics, Dr. B. R. Ambedkar Medical College, Bengaluru, Karnataka, India. Open injury with higher grade and fractures with radial nerve palsy, poor skin condition, bilateral fractures and associated multiple fractures were excluded. Ethical clearance was obtained from a competent authority.

**Results:** Mean follow-up period was 40.5 months (range 15–62 months). At the removal of the cast brace, average union time of 50 patients was 10.1 weeks (range 6–16 weeks). Average varus angulations were 9.1° (range 0–30°). Average rotation was 3° (range 0–15°). Average shortening was 0.51 cm (range 0–2 cm). The final results at 6 months were excellent in 44% ($n$ = 22), good in 42% ($n$ = 21), fair in 8% ($n$ = 4), poor in 6% ($n$ = 3).

**Conclusion:** We concluded that functional brace treatment commenced immediately after injury is a viable alternative in the treatment of middle and lower third diaphyseal fractures of the humerus regardless of fracture configuration.

**KEYWORDS:** Fracture, Shaft of Humerus, Objective Scoring System, Functional Outcome.

## INTRODUCTION

Functional brace application for isolated humeral shaft fracture persistently yields good results. Nonunion though uncommon involves usually the proximal third shaft fractures. It is the general view that humeral shaft fractures can be treated non-operatively.[1,2]

However, not all humeral shaft fractures are eligible for conservative treatment. Conservative treatment was only treatment continued for 5000 years. In last 100 years, various operative techniques developed and successfully used to manage difficult fractures. Initial classifications described are based mainly on the location and to some extent on morphology of the fractures.[3]

Subsequently AO classification combined them adequately but, while treating them, biological environments were paid less importance.[4] The causes of diaphyseal fractures are simple fall, fall from height, sports injuries, road traffic accidents (RTAs) and direct blow.[5]

However, later, it was suggested that functional bracing should start immediately after injury. However, later, it was suggested that functional bracing should start immediately after injury.[6] Nonoperative treatment as the definitive method do not interfere the biological environment at the fracture site and provide more chance of union with fewer complications. As the required procedure can be performed in an outpatient department, hospitalization can be avoided. Different nonoperative procedures such as hanging cast, U cast and few other methods are successfully employed. But the technique described by Sarmiento is widely practiced all over the globe.[7] Nonunion with this method of treatment is rare; but when it occurs it involves usually the proximal third shaft humeral fractures.[8] In the present study, modified technique of functional cast and brace was used, and the clinical results were assessed using an objective scoring system.

## MATERIALS & METHODS

This is a prospective study done on 50 patients with presented fracture of shaft in humerus in Department of Orthopaedics, Dr. B. R. Ambedkar Medical College, Bengaluru, Karnataka, India. Open injury with higher grade and fractures with radial nerve palsy, poor skin condition, bilateral fractures and associated multiple fractures were excluded. Ethical clearance was obtained from a competent authority.

**Procedure**

All cases with an open fracture, the wounds were debrided. Reduction was done in sitting posture without anesthesia. U slabs were extended from the root of the neck to the axilla., Well-padded molded slab was applied to prevent lateral angulations. Rotation was maintained with 30° to coronal body plane. 5 days parental antibiotic (Cefuroxim axtle) was administered to patients with open injuries. Forearm was included in a separate slab, in elbow 90° and forearm pronated, in those cases where the fractures were at more distal level. Arm is then wrapped with single layer compressed cotton which extends around the chest wall in the fashion of spica. First, medial and lateral strips are placed after soaking in water and gently squeezing them and cotton bandage was wrapped over it.

With radiological evidence of union, cast brace was removed and rehabilitation program, consisting of active exercises of the hand, wrist, elbow and shoulder along with shoulder mobilizing exercises at least for ½ h and 2 times daily, were started. They were instructed to use CC sling intermittently for another 2 weeks for protection and after which activities were permitted as per tolerance. Subsequent follow-ups were after 1 month, 3 months and 6 months.

## RESULTS

Fractures involved proximal shaft in 10 (male = 6, female = 4), mid shaft in 30 (male = 20, female = 10) and distal shaft in 10 (male = 7, female = 3) patients. Transverse, oblique, comminuted and spiral orientations were in 24, 18, 5 and 3 respectively.

Mechanism of injuries was RTA 54% (*n* = 27), fall 40% (*n* = 20), fall from height (*n* = 1), direct blow (*n* = 1) and fall of collapsing wall on body (*n* = 1) (table 1).

Mean follow-up period was 40.5 months (range 15–62 months). At the removal of the cast brace, average union time of 50 patients was 10.1 weeks (range 6–16 weeks). Average varus angulations were 9.1° (range 0–30°). Average rotation was 3° (range 0–15°). Average shortening was 0.51 cm (range 0–2 cm). Available painless elbow and shoulder abduction motion was 116.2° (range 70–140°) and 153.4° (range 135–175°) respectively. In subsequent follow-up at 6 weeks shoulder abduction was improved to 162.2° (range 140–180°). However, other findings were similar as it were during removal of the cast. In subsequent followups, these features remained unchanged (Table 2).

As per objective scoring system described here the final results at 6 months were excellent in 44% (*n* = 22), good in 42% (*n* = 21), fair in 8% (*n* = 4), poor in 6% (*n* = 3) (table 3).

**Table 1: Clinical details of patients**

| SHAFT OF HUMERUS | No. | % |
|---|---|---|
| Proximal shaft | 10 | 20% |
| Mid shaft | 30 | 60% |
| Distal shaft | 10 | 20% |
| **TYPE OF FRACTURE** | | |
| Transverse | 24 | 48% |
| Oblique | 18 | 36% |
| Comminuted | 5 | 10% |
| Spiral orientation | 3 | 6% |
| **MECHANISM OF INJURIES** | | |
| RTA | 27 | 54% |
| Fall | 20 | 40% |
| Fall from height | 1 | 2% |
| Direct blow | 1 | 2% |
| Fall of collapsing wall on body | 1 | 2% |

**Table 2: Results at 6 months followup**

| | Mean | Range |
|---|---|---|
| **Follow-up period** | 40.5 month | 15-62 months |
| **Union time** | 10.1 weeks | 6-16 weeks |
| **Average varus angulations** | 9.1° | 0–30° |
| **Average rotation** | 3° | 0–15° |
| **Average shortening** | 0.51 cm | 0–2 cm |
| **Painless elbow abduction** | 116.2° | 70–140° |
| **shoulder abduction** | 153.4° | 135–175° |

**Table 3: Objective scoring system at 6 months**

| | Number | % |
|---|---|---|
| **Excellent** | 22 | 44% |
| **Good** | 21 | 42% |
| **Fair** | 4 | 8% |
| **Poor** | 3 | 6% |

## DISCUSSION

There is nowadays general agreement that total immobilisation of an injured extremity is harmful for fracture healing[9] and for the whole limb[10]. Latta and coworkers[11] and Sarmiento and co-workers[9] noted that controlled movement at the fracture site is conductive for osteogenesis. In recent years, important studies have been published comparing plating and intramedullary nailing of the humeral shaft[12] but the role and justification of conservative treatment has not been called into question[13]. According to our results, functional treatment of a humeral shaft fracture with brace offers an appropriate environment for fracture healing in the middle and distal third of the shaft.

Papasoulis et al. in their review article analyzed outcome of 16 case series of functional cast brace treatment of humeral shaft fracture and two comparative studies.[8] They concluded that average healing time is 10.7 weeks, the union rate 94.5%, proximal shaft fractures have higher nonunion rate. Full shoulder and elbow motion was obtained in 80% and 85% respectively. Subjective parameters were also not satisfactory. In the present study union time is 10.1 weeks, union rate is 98.5%, and obtained full elbow motion in 80% and full shoulder motioned in 82%. One fracture which did not unite is not of the proximal third of the shaft. During the operation, it was found that soft tissue interposition was the reason for nonunion

In general, patient co-operation is a cornerstone in fracture treatment. Functional brace treatment is particularly demanding and non-compliant patients are at marked risk of failure. Although logistic regression analysis in this series showed the only predictive factor in respect of fracture consolidation to be the anatomical location of the fracture, it seemed that the ideal patient for functional brace treatment is an otherwise healthy and co-operative person aged less than 60 years. Pehlivan[14] drew a similar conclusion in his series. The functional treatment of humeral shaft fractures is also demanding for the health care personnel. Doctors and staff in emergency and outpatient clinics must be familiar with the principles of functional treatment. The importance of appropriate physiotherapy must be emphasized. When compared to treatment with a plaster cast, functional brace treatment carries many advantages. Firstly, the patient can remove the brace for personal hygiene. Secondly, elbow movements are not restricted and joint stiffness therefore unlikely to develop. It is reasonable to assume that stiffness of the elbow joint may cause excessive movements between the fracture fragments and thus hinder the consolidation process. Thirdly, the brace is of limited weight and causes no distraction over the fracture site.

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