# Functional Outcome of Closed Humeral Shaft Fractures Treated with Functional Brace.

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**Authorship and contribution Declaration:**
Each author of this article fulfilled ALL 4 Criteria of Authorship:
1. Conception and design or acquisition of data, or analysis & interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.
4. All authors agree to be responsible for all aspects of their research work

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## ABSTRACT

**Objective**: To determine the functional outcome of closed humeral shaft fractures treated with functional brace.

**Methods:** This descriptive study was conducted in Orthopedic Department District Headquarter hospital Teaching Hospital Kohat Development Authority(KDA) Kohat and Khyber Teaching Hospital Peshawar from 23rd February 2018 to 23rd February 2020.All patients with humeral shaft fractures meeting the inclusion criteria were treated with functional brace. Functional assessment was done at 6 months follow up according to Stewart and Hundley criteria and graded as good, fair and poor.

**Results:** The total number of patients in this study were 22. The mean age was 36.23±9.05 years. Males patients were 14 (63.64%) and females were 8 (36.36%). According to Stewart and Hundley criteria, functional outcome in our patients was good in 17(77.27%) patients, fair in 3(13.64%) and poor in 2(9.09%)patients. We achieved union in 20 (90.91%) patients. However, non-union was seen in 2 (9.09%) patients.

**Conclusion:** Closed humeral shaft fractures treated with functional brace had satisfactory union rates and good functional outcome in majority of our patients.

**Keywords**: Functional brace, Functional outcome, Humerus shaft fracture, Union.

**This article may be cited as:** Khattak SD, Khan A, Khan JU, Khan MS. Functional Outcome of Closed Humeral Shaft Fractures Treated with Functional Brace. J Pak Orthop Assoc 2021;33(4): 167-171.

## INTRODUCTION

Fractures of the shaft of the humerus account for 1 to 3% of all fractures and approximately 20% of all fractures involving the humerus.[1,2] About 60% of these fractures occurs in the middle one third, 30% in the proximal one third and 10% in the distal third of the shaft. There is a bimodal age distribution with first peak in third decade in men with high energy trauma and second peak in seventh decade in women after simple fall.[3,4] Both operative and non-operative treatments are used in the management of humeral shaft fractures.[1,2] Non-operative treatment for fractures of the humeral shaft has a long and well-established history of success, with many authors reporting high rates of union with hanging casts, U-slab and functional brace.[5-7] Operative treatment includes plating, intramedullary nailing and external fixation depending on the fracture pattern and associated injuries.[8,9] Indications for operative treatment of humeral shaft fractures include fractures with neurovascula injury, multiple fractures, bilateral humeral shaft fractures, pathological fractures, comminuted segmental fractures, open fractures, fractures with poor patient compliance like mental retardation and in those with neurological disorders like parkinsonism or epilepsy.[10-14]

Currently functional bracing has essentially replaced all other conservative methods and has become the "gold standard" for non-operative treatment because of its ease of application, adjustability, allowance of shoulder and elbow motion, relatively low cost and reproducible results.[15,16]

The objective of our study was to assess the functional outcome of humeral shaft fractures treated with functional humeral brace.

## METHODS

We conducted this descriptive study in Orthopedic Department District Headquarter hospital Teaching

Hospital Kohat Development Authority(KDA) Kohat and Khyber Teaching Hospital Peshawar from 23rd February 2018 to 23rd February 2020.All patients of both genders and age more than 20 years with closed humeral shaft fractures of less than 07 days duration were included in this study. Those patients having open fractures, concomitant vascular and nerve injuries, bilateral humeral fractures, floating elbow injuries, intra-articular fractures, morbidly obese patient, polytrauma patients, pathological fractures and patients not willing for humeral brace were excluded.

Approval of the study was taken from the Ethical Committees of both hospitals. All the patients were informed about all aspects of the procedure and study and written informed consent was taken. Patients received through OPD or Accident and Emergency Department of the hospitals and meeting the inclusion was recruited in the study. Thorough history, complete physical examination and antero-posterior/lateral radiographs of the affected arm were taken. Patients were initially treated with closed reduction and Plaster of Paris (POP) U-slab and kept in a sling for two weeks. After two weeks when pain and swelling decreased, U-slab was replaced with a functional brace. Functional brace was applied according to the technique described by Sarmiento[17] by taking measurements from opposite arm and sling was applied again for further one month. The immediate post reduction radiographs were used to assess the accuracy of the fracture reduction. Patients were advised to remove sling four times a day for shoulder and elbow range of motion exercises as tolerated but avoided active abduction and elevation. Brace was used continuously during the treatment. Follow-up was done of fortnightly for the 1st month and then monthly for 6 months. Functional and radiological assessment was done at every follow up visits. Brace was continued until fracture got clinically and radiologically united. If no union was achieved at 6 months follow up, surgery was offered. Functional assessment was done according to Stewart and Hundley Criteria[18] and graded as good fair and poor(Table I)

The data was entered and analyzed using SPSS version 17. Qualitative variables were analyzed as percentages and quantitative variables were analyzed as mean and standard deviation.

## RESULTS

We treated 22 patients of closed humerus fracture with functional brace. Males were 14 (63.64%) and females 8 (36.36%). The mean age was 36.23±9.05 years. In 15 (68.18%) patients, right humerus was involved while in 7 (31.82%) of patients left humerus was fractured. Etiology of humerus fracture was road traffic accident in 10 (45.45%) patients, fall in 9 (40.91%) patients and sports injury in 3 (13.64%) patients. Middle one third humerus was fractured in 11 (50%) patients, proximal one third in 6 (27.27%) and distal one third in 5 (22.72%) patients. Transverse fracture was present in 8 (36.36%) patients, spiral fracture in 7 (31.82%) patients, oblique in 5 (22.73%) and comminuted fracture in 2 (9.09%) patients. The mean duration of both clinical and radiological union in our patients was 13.41±2.10 weeks (range 10 to 19 weeks). We achieved union in 20 (90.91%) patients. However, non-union was seen in 2 (9.09%) patients (both being transverse fractures) at the end of 6 months which were subsequently treated with plating and bone grafting. The mean varus-valgus angulation was $6.54^0$±4.76 and mean antero-posterior angulation was $7.75^0$±5.09 in patients treated with functional brace. Shortening of 1.5cm and 2cm was seen in 2(9.09%) patients. Pressure sores were observed in 2(9.09%) patients which healed uneventfully with daily dressing without discontinuing the brace. According to Stewart and Hundley criteria, functional outcome in our patients was good in 17( 77.27%) patients, fair in 3(13.64%) patients and poor in 2(9.09%) patients. Shoulder joint stiffness was seen in 3 (13.64%) patients (>$20^0$ loss of abduction and >$10^0$ loss of external rotation), 2 of them also had greater than $10^0$ loss of elbow joint extension.

**Table I:** Stewart and Hundley Criteria of functional outcome.[18]

| Functional Outcome | Pain | Limitation of elbow or shoulder mobility | Angulation |
|---|---|---|---|
| **Good** | No | Less than $20^0$ | Less than $10^0$ |
| **Fair** | After efforts or work | $20^0$-$40^0$ | Greater than $10^0$ |
| **Poor** | Permanent | Greater than $40^0$ | Radiographic Non-union |

## DISCUSSION

Currently functional bracing has essentially replaced all other conservative methods and has become the "gold standard" for non-operative management of humeral shaft fractures.[15,16] In the current study, mean duration of both clinical and radiological union was 13.41±2.10 weeks (range 10 to 19 weeks). In a study done in India in 2018, mean union time of 12±2.6 weeks (range 8 to 18 weeks) had been reported[19]. Sarmiento[3] reported mean union time of 11.5 weeks (range 5 to 22 weeks), while other authors reported mean union time of 10.7 weeks (6.5 – 22 weeks).[18,20-23] We achieved union in 20 (90.91%) patients. Zagorski[24] obtained union rate of 97.6% while a study[25] done at Jinnah Hospital Lahore showed union in 89% of patients. Similarly, other authors[10,23] have documented healing rates of 95.5% and 92% respectively.

Non-union rate of 2 to 20% has been documented for humeral shaft fractures in various studies.[26] In one study published in International Orthopaedics in 2017, non-union was observed in 23.2% of patients treated with functional brace.[27] In our study, it was observed in 2 (9.09%) of cases (both fractures being transverse). Various causes of non union like smoking, obesity, cardiovascular diseases, metabolic bone diseases, transverse/short oblique fractures, open fractures and proximal third of humeral shaft fracture have been reported.[28]

The mean varus-valgus angulation was $6.54^0$±4.76 and mean antero-posterior angulation was $7.75^0$±5.09 in our patients treated with functional brace. Shortening of 1.5cm and 2cm was seen in 2 patients. In studies by Naver L[29] and Zagorski [24] mean varus-valgus angulation was $3.3^0$ and $5^0$ respectively. Koch[30] reported mean antero-posterior angulation of $3.7^0$. Similarly various studies have reported mean shortening of 1.8mm, 1.9mm and 4mm respectively.[3,31,24] Various authors have stated that varus angulation up to $30^0$ and antero-posterior angulation of up to $20^0$ do not cause significant functional problem.[12,31]

In our study functional outcome as per Stewart and Hundley criteria was good in 77.27% (17) patients, fair in 13.64% (3) patients and poor in 9.09% (2) patients. In one study done in CMH Rawalpindi[32], functional outcome was very good in 68.9%, good in 22.2%, fair in 6.7% and poor in 2.2% of patients using modified Stewart and Hundley criteria while another study[33] showed excellent results in 20% and good results in 80% of patients using Hunter's criteria.

In our study shoulder joint stiffness was seen in 3 (13.64%) patients (>$20^0$ loss of abduction and >$10^0$ loss of external rotation), 2 of them also had greater than $10^0$ loss of elbow joint extension. In their review of clinical studies on functional bracing for humeral shaft fractures Papasoulis[7] reported loss of >$10^0$ abduction in 5.9% and external rotation in 12.7% of patients. Similarly >$10^0$ loss of elbow flexion and extension in 1.8% and 0.8% of patients respectively have been observed. Pressure sores were observed in two patients which healed uneventfully with daily dressing without discontinuing the brace. Skin maceration with functional brace were also reported by other authors.[34,24]

The design of our study was descriptive. Our sample size was small. We recommend further studies to address these limitations and confirmed our results.

## CONCLUSION

Closed humeral shaft fractures treated with functional brace had satisfactory union rates and good functional outcome in majority of our patients.

**Conflict of Interest:** None

**Grants/Funding:** None

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