

A Prospective Analysis of Functional Outcome of Humeral Diaphyseal Fractures Treated with Dynamic Compression Plate

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ABSTRACT

Introduction: Humerus fractures constitutes about 3 to 5% of all fractures of which majority can be managed by conservative care but some will need surgery. The objective of this study is to assess the functional and radiological outcome of humerus shaft fractures in adults adults treated by open reduction and internal fixation with Dynamic Compression Plate.

Material and Methods: This study was done as a prospective study among patients admitted for fracture shaft of humerus in southern railway headquarters hospital, Chennai between October 2007 to July 2010 after applying the inclusion and exclusion criteria. The study participants were enrolled for the study after getting the written informed consent and the data were entered in MS office excel sheet and analysis was carried out using the SPSS software 17.

Results: Out of 35 cases, 4(11%) were proximal third, 28(80%) were middle third and 3 (9%) were distal third. The fractures united in 33 (94%) patients whereas 2 (6%) cases developed non union due to deep seated infection and one (3%) showed delayed union. Full range of mobility of shoulder and elbow joints was present in 32 (91%) patients and 3 (9%) patients had stiffness of shoulder and elbow joint.

Conclusion: Open reduction and Internal fixation of the humerus with DCP achieves higher union rates as compared to other modes of treatment.

Keywords: Humeral shaft; fractures; dynamic compression plate; transverse; short oblique; non-union; delayed union.

headquarters hospital, Chennai between October 2007 to July 2010 after applying the inclusion and exclusion criteria. The patients were selected randomly in the hospital who got admitted for fracture humerus shaft after getting informed consent. Those who have not given the informed consent were not included in the study. The data pertaining to the socio-demographic profile, surgical technique adapted, follow up details (X ray and clinical examination findings) were recorded during the hospital stay and follow up visits. The study participants were enrolled for the study after getting the written informed consent and Institutional ethical clearance was obtained for executing the study. Patient outcome were assessed based on the ASES score and range of movements and the complications.

Procedure of the study

A careful history was elicited from the patients and/or attendants to reveal the mechanism of injury and the severity of trauma. The patients were then assessed clinically and care was taken to detect shock and any associated injuries. Local examination of the injured arm, revealed the attitude of the limb to be flexed at the elbow, adducted at the shoulder and supported with the other hand at the elbow. Swelling, deformity, loss of function and nerve injury were looked for and noted. Palpation revealed tenderness, abnormal mobility, crepitus and shortening of the affected arm. Distal vascularity was assessed by radial artery pulsations, capillary filling, pallor, paraesthesia at fingertips. Radial nerve was tested by active wrist and metacarpophalangeal joint dorsiflexion. Sensation in the autonomous zone of 1st web space was checked for any abnormality. Standard radiographs of the humerus, i.e., anteroposterior and lateral views were obtained. The shoulder and elbow joints were included in each view. The limb was immobilized in a U-slab with sling. Injectable analgesics were given. The operative procedure and its advantages were explained in detail to each patient and an informed consent was obtained. The patients posted for surgery were subjected to routine investigations and were referred to the physician for fitness for surgery. The investigations are as follows. Hb%, FBS, Blood Urea, Serum Creatinine, HIV, HBsAg, ECG, and Urine forsugar. Anterolateral approach with lateral plating was

INTRODUCTION

Fracture of shaft of humerus represents 3 to 5% of all fractures^{1,2} and majority heal with conservative management whereas the remaining require surgery to achieve a good outcome.^{3,4} The outcomes of the surgery may vary with good range of mobility of shoulder and elbow, minor degrees of shortening and very low functional deficit with radiographic malunion.⁵ Current research studies published focuses on assessing the resources to treat this injury, indications of surgical intervention, reducing the failure rates by introducing newer implants and techniques and decreasing the post operative disability.^{6,7} The successful treatment of a humeral shaft fracture may not end with bony union: as "holistic" approach to patient care and a knowledge of anatomy, surgical indications, techniques and implants, and patient functions and expectations.⁸ With this background, this study was done to determine the efficacy of Dynamic Compression Plate in the treatment of humeral shaft fractures.

Objectives of study were to assess the functional outcome of treating humeral shaft fractures with Dynamic Compression Plate and to study the time duration for union and complications following Dynamic Compression Plating.

MATERIAL AND METHODS

This study was done as a prospective study among 35 patients admitted for fracture shaft of humerus in southern railway

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the most preferred surgical approach. Posterior approach was used in two cases due to the fracture being in the distal third. A broad 4.5 mm DCP⁹ made of 316L stainless steel was used and a minimum of six cortices were engaged with screw fixation in each fragment.

Anterolateral Approach (Thompson, Henry)^{10,11} - The anterolateral approach to the humerus was most commonly used mostly for proximal and mid 3rd shaft of humerus.

Position of the patient: patient was placed in supine position with arm abducted to 60° on an arm board.

Posterior Approach to the Humerus

The midline posterior approach to the humerus is classically extensile, providing excellent access to the lower three fourths of the posterior aspect of the humerus.

Fracture Fixation

DCP, 4.5mm system, Applied as Self-compression Plate

Lag Screw Through the Plate

In oblique fractures one should enhance the axial compression by placing a lag screw across the fracture. This can be done either separately before the plate is applied or, when suitable, through the plate.

Prerequisites

- The plate must be placed on the tension side of the bone.
- Prebending of the plate.

After treatment: The wound was inspected on the 2nd postoperative day. Sutures/staples were removed on 10th postoperative day and check x-ray in antero-posterior and lateral views were obtained. Patients were discharged after suture removal with the arm in an arm pouch and advised to perform shoulder, elbow, wrist and finger movements. They were prohibited from lifting weight or putting additional stresses on the affected limb.

Follow-up: All the patients were followed up at monthly intervals for the first 3 months, later at 2 monthly intervals till fracture union and once in 6 months till the completion of study. They were examined in detail clinically and special stress was laid on shoulder and elbow range of movements and subjective complaints. x-rays were obtained in anteroposterior and lateral views and signs of union like disappearance of fracture line and bridging callus were looked for. Clinical healing of the fracture was defined by the absence of functional pain and local tenderness at the previous fracture site.

Assessment of outcome of the study (Romen et al series grading)¹²

This scoring system was adapted in this study

Excellent:

- Solid union - anatomic reconstitution
- Less than 10% loss of range of motion
- No significant subjective complaints

Good:

- Solid union - anatomic reconstitution
- 10-30%, loss of range of motion
- Minimal subjective complaints

Poor

- Non-anatomic results or non-union
- Greater than 30° loss of range of motion

- Moderate subjective complaints

STATISTICAL ANALYSIS

The data were entered in MS office excel sheet and analysis was carried out using the SPSS software 17 and the data were expressed in percentages.

RESULTS

The present study consists of 35 cases of humeral shaft fractures treated surgically by open reduction and internal fixation using DCP between October 2007 to July 2010. All the patients were available for follow-up.

Age Distribution: Age of this patient ranged from 18 to 65 years with 12 (34%) patients in the 2nd and 3rd decade. The average age was 42.5 years (Table-1)

Sex Distribution: Majority of the patients, 31 (89%), were males and only 4 (11%) were females.

Side affected: The left side was affected more commonly, in 19 patients (54%), whereas rightside was affected in 16 (46%) patients.

Mode of injury: 26(74%) cases were due to RTA, 6 (17%) cases were due to fall, 2 (6%) cases were due to accident at work place and 1(3%) case was due to assault.

Associated injuries: Out of 35 patients 11 had associated injuries which comprised of 11% of the sample. The details of the injuries were 2 closed head injuries and one each of the following injuries such as abdominal injury, fracture olecranon (ipsilateral), head injury with radial nerve injury (ipsilateral), fracture shaft femur (contralateral) with crush injury foot(ipsilateral), colles fracture, ribs fracture and 3rd, 4th metatarsal shaft fracture(ipsilateral), chest wall injury, fracture neck of scapula (contralateral), clavicle fracture (ipsilateral), medial malleolar fracture (ipsilateral), L1 compression fracture.

Fracture characteristics

1. Clinical

29 fractures were closed and 6 were open fractures (1 Type I, 4 Type II, 1. Type III B)

2. Level of fracture

Majority of the fractures were in the middle third (28 in number i.e.80%) (Table-2).

3. Type of fracture

Majority of fractures were transverse or short oblique i.e. 18 (51%). There were 13 (37%) comminuted fractures, 4 (12%) long oblique fractures and no segmental fractures (Table-3). 32 (91%) patients had sound union in less than six months, 1(3%) patient had delayed union and 2(6%) patients developed non-union-one due to deep infection and in other it may be due to early weight bearing by the patient, (Table-4).

Age in years	Total No. of patients in a study	Percentage (%)
11 – 20	3	9
21 – 30	12	34
31 – 40	11	32
41 – 50	4	11
> 50	5	14

Table-1: Age distribution

The following clinical pictures shows the patient has acquired full range of movements of shoulder and elbow with fracture union in less than 4 months (Figure-1).

Range of Mobility of the Shoulder and Elbow Joints:

28 (80%) patients recovered full range of motion of shoulder and elbow joint while 4 (11%) patients recovered good range of motion (within 10- 15% of full range). 3 (9%) patients had poor range of movements. Of these, 1 (3%) patient had a head injury with wrist drop, 1 (3%) patient had a deep infection causing non- union, the reason for stiffness in 1 (4%) patient was not clear.

Complications

Intra-Operative: There were no intra-operative complications.

Post-Operative Complications

1. Radial Nerve Palsy: There were two (6%) cases of radial nerve palsy. One had radial nerve palsy pre-operatively. The nerve was explored during surgery and found to be intact. Radial nerve palsy recovered in this case after 3 months. Other case developed postoperatively, it may be due to excessive retraction of soft tissues with the nerve, it also recovered after 3 months.

2. Stiffness: Two patients developed stiffness of the shoulder and elbow joints. One patient had an associated head injury and radial nerve palsy. The other patient had a delayed union.

3. Infection: There were no cases of superficial infection. There was one case of deep infection which went for non union and required implant removal.

4. Delayed union: There was one case of delayed union. This patient also had stiffness.

5. Non union: There were two cases of non-union, one case of non union was due to deep infection. And in other case the exact cause was not known. 28 (80%) patients had excellent results, 4(11%) patients had good results. 3 (9%) patients had poor result.

ASES Score: The maximum points for American Shoulder and Elbow Surgeons (ASES) shoulder 52 points. In this study the average ASES score obtained was 48.

DISCUSSION

This study was done to assess the efficacy of DCP in the management of fractures of the shaft of humerus. A total of 35 cases of fracture of shaft of humerus were treated with open reduction and internal fixation using DCP. The study results were compared with many other studies which is shown below.

Age and Sex Distribution

The average age in our series was 42.5years with the maximum number of patients in 2nd and 3rd decades which was similar to the observation of Rodriguez-Merchan EC¹³, McCormack RG et al¹⁴, Gongol T and Mracek D¹⁵ At the same time it also showed male preponderance of 31 patients which is comparable to other studies like Tingstad EM et al¹⁶, Wilairatana v Prasongchin P¹⁷

Level of Fracture: Majority of the fractures in our study were in the middle third i.e. 28 (80%) patients which is in accordance with other studies except for Bell M.M et al and Klenerman et al¹⁸

Type of fracture: Most of the fractures in our series were

Level of Fracture	Total No. of patients in a study	Percentage (%)
Proximal Third	4	11
Middle Third	28	80
Distal Third	3	9
Total	35	100

Table-2: Level of fracture among the study participants

Type of Fracture	Total No. of patients in a study	Percentage (%)
Transverse or short oblique	18	51
Comminuted	13	37
Long oblique	04	12
Segmental	00	00

Table-3: Type of fracture

Time to Union	Total No. of patients in a study	Percentage (%)
< 4 months	21	60
4 – 6 months	11	31
> 6 months	1	3
Non – Union	2	6
Total	35	100

Table-4: Time to fracture union among study participants



Figure-1: Showing the post operative X ray and ROM at elbow and shoulder

transverse or short oblique, 18 (51%) patients. This results is in accordance with more recent studies, but not with older studies like Klenerman L.¹⁸

Fracture Union: 33 (94%) of our 35 fractures united with 2 (6%) fracture going for non-union. Of these 33, there was only 1 (3%) case of delayed union. The results in our series are comparable to those obtained by various other authors and even better than Mulier et al¹⁹ and Koch PP et al²⁰ whom had 75% and 87% respective union rate.

Range of Mobility of the Elbow and shoulder: Out of 35 patients in our series, three patients (9%) had poor mobility of elbow and shoulder joints which gives 91% good mobility overall. Our results in this aspect i.e. mobility of shoulder and elbow joints are comparable with those of Griend RV, Tomasin J and Ward EF and Heim D et al.

ASES Score: The average ASES score obtained was 48 in our study which is similar to the ASES score of 48 obtained by McCormack RG et al when treating humeral shaft fractures

with DCP and a score of 47 when treating with interlocking intramedullary nail fixation.

Overall Results: We had 32 (91%) patients with excellent or good results out of 35 patients in our series which is in par with Rodriguez-Mechan EC and Bell MJ et al at the same time better than Mulier et al and Heim D et al²¹.

CONCLUSION

This study has supported that the early post-operative mobilization following rigid fixation of the fracture of humerus, with DCP lowers the incidence of stiffness and Sudecks dystrophy. Conservative management has provided good union rates but has been plagued with the complications of stiffness and Sudecks dystrophy. Prolonged immobilization goes against the principle of obtaining early, active, pain free mobilization. Internal fixation of the humerus with DCP avoids these complications and achieves higher union rates as compared to conservative management. Dynamic compression plating of the humerus produces comparable better results than ante grade interlocking intra-medullary nailing.

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