



International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2019; 5(3): 97-99
© 2019 IJOS
www.orthopaper.com
Received: 17-05-2019
Accepted: 21-06-2019

Dr. Vishal M Dindod
Assistant Professor, Government
Medical College AMD SSG
Hospital, Baroda, Vadodara,
Gujarat, India

Dr. Gaurang Patel
Associate Professor, Government
Medical College AMD SSG
Hospital, Baroda, Vadodara,
Gujarat, India

A study of functional outcome of humeral diaphyseal fractures treated with dynamic compression plate

Dr. Vishal M Dindod and Dr. Gaurang Patel

DOI: <https://doi.org/10.22271/ortho.2019.v5.i3b.1768>

Abstract

Fractures of the humerus comprise approximately 5% to 8% of all extremity fractures, and shaft fractures account for approximately 3% of all long-bone fractures. Majority of humerus shaft fracture can be treated with conservative management but nowadays surgical indications in humerus fracture are increasingly being adopted. In this study 20 patients of humerus shaft fractures has been treated with 4.5 dynamic compression plate with posterior approach in SSG Hospital Baroda. After one year follow up 19 patients out of 20 having good functional result.

Keywords: Humeral fractures, 4.5 dynamic compression plate, union rate

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} 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 20 patients admitted for fracture shaft of humerus in SSG Hospital and Medical College, Vadodara between September 2018 to September 2019 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. The data pertaining to the surgical technique adapted, follow up details (X ray and clinical examination findings) were recorded during the hospital stay and follow up visits. Patient outcome were assessed based on the functional and radiological outcomes and the complications.

Procedure of the study

A careful history was elicited from the patients to reveal the mechanism of injury and the severity of trauma. The patients were then assessed clinically and care was taken to detect 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. Radial nerve was tested by active wrist and metacarpophalangeal joint dorsiflexion. Standard radiographs of the

Correspondence

Dr. Gaurang Patel
Associate Professor, Government
Medical College AMD SSG
Hospital, Baroda, Vadodara,
Gujarat, India

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 for sugar. Posterior approach was used in all cases. A broad 4.5 mm DCP9 was used and a minimum of six cortices were engaged with screw fixation in each fragment.

Prerequisites

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

Prebending of the plate

After treatment: The wound dressing was done on 2nd postoperative day. Sutures/staples were removed on 12th 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. 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

Results

The present study consists of 20 cases of humeral shaft fractures treated surgically by open reduction and internal fixation using DCP between September 2018 to September 2019. All the patients were available for follow-up.

Age distribution: Age of this patient ranged from 20 to 65 years. The average age was 39 years

Sex distribution: Majority of the patients, 16 (80%), were males and only 4 (20%) were females.

Side affected: The left side was affected more commonly, in 12 patients (60%), whereas right side was affected in 8 (40%) patients.

Mode of injury: 15(75%) cases were due to RTA, 5 (25%) cases were due to fall.

Level of fracture

Majority of the fractures were in the middle third (17 in number i.e. 85%) (Table-1).

Type of fracture

Majority of fractures were transverse or short oblique i.e. 11(55%). There were 6(30%) comminuted fractures, 3(15%) long oblique fractures and no segmental fractures. 17(85%) patients had sound union in less than six months, 2(10%) patient had delayed union and 1(5%) patients developed non-union-one due to deep infection (Table-2).

Complications

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

Post-operative complications

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.

Stiffness: one patient developed stiffness of the shoulder and elbow joints. This patient had a delayed union.

Infection: There was one case of deep infection which went for non-union and required implant removal.

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

Non-union: There were one cases of non-union, one case of non-union was due to deep infection. 16(80%) patients had excellent results, 3(15%) patients had good results. 1(5%) patient had poor result.

Discussion

This study was done to assess the efficacy of DCP in the management of fractures of the shaft of humerus. A total of 25 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 39years which was similar to the observation of Rodriguez-Merchan EC13, McCormack RG *et al.* [14], Gongol T and Mracek D15 At the same time it also showed male preponderance of 16 patients which is comparable to other studies like Tingstad EM *et al.* [16], Wilairatana v Prasongchin P [17].

Level of Fracture: Majority of the fractures in our study were in the middle third i.e. 17 (85%) patients which is in accordance with other studies except for Bell MM *et al.* and Klenerman *et al.* [18].

Table 1: Level of fracture among the study participants

Level of fracture	Total No. of patients in a study	Percentage (%)
Middle Third	17	85
Distal Third	3	15
Total	20	100

Table 2: Time to fracture union among study participants

Time to union	Total No. of patients in a study	Percentage (%)
< 4 months	12	60
4 – 6 months	5	25
> 6 months	2	10
Non – Union	1	5
Total	20	100

Fracture union: 19(95%) of our 20 fractures united with 1(5%) fracture going for non-union. Of these 19, there was only 1(5%) case of delayed union. The results in our series are comparable to those obtained by various other authors and even better than Mulier *et al.* [19] and Koch PP *et al.* [20] whom had 75% and 87% respective union rate.

Range of Mobility of the Elbow and shoulder: Out of 20 patients in our series, 1 patients (5%) had poor mobility of elbow and shoulder joints which gives 95% good mobility overall. Our results in this aspect i.e. mobility of shoulder and elbow joints are comparable with those of Griend RV, Tomasini J and Ward EF and Heim D *et al.*

Overall Results: We had 19(95%) patients with excellent or good results out of 20 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 al.* [21].

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. Conservative management has provided good union rates but has been plagued with the complications of stiffness. 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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