

A PROSPECTIVE STUDY ON FUNCTIONAL OUTCOME OF HUMERUS SHAFT FRACTURES TREATED WITH OPEN REDUCTION AND INTERNAL FIXATION WITH DYNAMIC COMPRESSION PLATE AND SCREWS

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ABSTRACT

BACKGROUND

Fracture of the humerus shaft accounts to 3% to 5% of all fractures. Majority of the fractures are unstable due to distraction force of the gravity in the upper limb and strong muscle contraction leading to displacement. Internal fixation and early mobilisation is more stressed on than splinting and prolonged immobilisation to allow earlier mobilisation and rapid return to work.

The aim of the study was to study the union rates and the functional outcome and complications associated with shaft humerus fractures in KIMS Hospital.

MATERIALS AND METHODS

A prospective study which was carried out from October 2015 to September 2017 in Karnataka Institute of Medical Sciences, Hubballi, Karnataka State, India. In this study period, 25 cases of fracture shaft of the humerus were treated by open reduction and internal fixation using DCP. Skeletally mature patients with fresh humerus diaphysis fractures were included in the study. Pathological fractures and Tschern grade 2 and above, Gustilo Anderson type 2 and above were excluded from the study.

RESULTS

In our series of 25 cases, there were 21 men and 4 women with average age of 42.5 years. Sixteen (64%) cases were due to RTA and with predominance of right side. Transverse fractures were most common that is 15 (60%) patients. Eleven (31%) cases were having associated injuries. 92% of the fractures united with good to excellent outcome. There were 2 (8%) cases of non-union due to infection and comminution.

CONCLUSION

Open reduction and internal fixation with dynamic compression plate is still the standard treatment of choice for fracture shaft of humerus achieving excellent to good functional outcome.

KEYWORDS

Dynamic Compression Plate, Delayed Union, Fractures, Humeral Shaft, Nonunion, Transverse.

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BACKGROUND

Fracture of the humerus shaft accounts to 3% to 5% of all fractures.^{1,2} They have a very good results with nonoperative methods, although some number will need surgery for optimal result. Majority of the fractures are unstable due to distraction force of the gravity in the upper limb and strong muscle contraction leading to displacement. A wide range of radiographic malunion can be accepted with

little functional deficit due to extensive range of motion of the shoulder and elbow. Internal fixation and early mobilisation is more stressed on than splinting and prolonged immobilisation to allow earlier mobilisation and rapid return to work.

Internal fixation techniques were tried in all types of diaphysis fractures, especially in fracture shaft of humerus after the development of formation of the AO group in 1958. The treatment of a humeral shaft fracture may not always end in bony union. The efficacy of the treatment of a humeral shaft fracture demands a knowledge of anatomy, surgical indications, techniques and implants, patient functions and expectations.

Two ways of internal fixation in fracture shaft of humerus are plate osteosynthesis and intramedullary nailing. Plate and screw fixation has traditionally been the preferred method and remains the gold standard for surgical

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management.⁵ Open reduction with plate fixation provides direct visualisation of fracture site, appropriate anatomic reduction and rigid fracture fixation (using dynamic compression plates) and thus allows early upper extremity weightbearing and produces minimal shoulder or elbow morbidity, whereas humerus nailing has certain specific indications and associated with complication like shoulder pain, impingement to cuff, neurovascular injury and a higher nonunion rate compared to plating group.

With this background, current study focuses on defining the incidence and the indications for surgical intervention with open reduction and internal fixation with dynamic compression plate, decreasing the surgical failure rate and minimising the duration and magnitude of disability post injury.

MATERIALS AND METHODS

Current study is a prospective study, which was carried out from October 2015 to September 2017 in Karnataka Institute of Medical Sciences, Hubballi, Karnataka State, India. In this study period, 25 cases of fracture shaft of the humerus were treated by open reduction and internal fixation using dynamic compression plate.

Skeletally mature, closed and humerus diaphysis fracture with type 1 open Gustilo Anderson and Tschern grade 1 fracture were included in the study. Exclusion criteria were grade II and III open fractures, nonunion, delayed union, patients aged 17 years or below and pathological fractures.

Preoperative evaluation was done as history, examination, 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 immobilised in U-slab with sling. Analgesics were given. Routine investigations were done and informed consent and physician reference for fitness were obtained.

Procedure

Anterolateral approach is the most preferred surgical approach. It was used in 23 cases. Posterior approach is used in cases with radial nerve palsy, which was used in 2 cases with mid distal diaphyseal humerus fracture. A narrow 4.5 mm DCP made of stainless steel was used and at least of 8 cortices were fixed with screw fixation on either side of the fracture.

Followup

The arm is supported in a sling and early range of motion exercises for shoulder and elbow were initiated usually on 4th or 5th postoperative day. Range of motion exercise was emphasised to avoid shoulder and elbow stiffness. Other patients with no other complaints were discharged on 4th or 5th postoperative day and advised physiotherapy in the form of passive and active range of motion exercises and asked to follow up on 12th postoperative day for suture removal. Later, followup was at monthly intervals for initial 3 months, 2 monthly intervals until fracture union and once in 6 months till the completion of the study. Range of motion at the follow

up was assessed using ASES score. Functional outcome of the study at the end done with Rodriguez-Merchan criteria.

RESULTS

A total of 25 patients were included in the study. Mean age of patients was 42.5 years (range- 21-65 years). Twenty-one patients were men and 4 were women. Right side was affected in 18 patients (72%) and left side was affected in 7 patients (28%). Most common mode of injury was road traffic accidents in 16 patients (64%), fall in 5 patients (20%), accident at work place in 3 patients (12%) and assault in 1 patient (4 %). Of the 25 patients, 8 (32%) patients have associated injuries. Majority of the fractures were in the middle third (21 in number, i.e. 84%).

Fracture Pattern- Transverse in 15 patients (60%), comminuted in 7 patients (28%), long oblique in 3 patients (12%) and no spiral or segmental fractures. General anaesthesia was given for all the cases. The anterolateral approach of Henry was used in all cases except in 2 cases in which the posterior approach was used due to the fracture being in the mid distal one third with radial nerve palsy. The followup ranged from 6 months to 14 months.

Duration of Fracture Union

Sound union in 22 (88%) patients in less than 6 months, delayed union in 1 (4%) patient, which was managed with secondary iliac crest bone grafting. Nonunion seen in 2 (8%) patients. In one patient, the cause for nonunion was a type 1 open fracture with outside in type of injury leading to deep infection later and was managed with implant removal and debridement and LRS application. In the other case, the cause for nonunion could not be found maybe attributed to rigidity of fixation as there were only 6 cortical purchase on each side and due to fracture comminution.

Range of Motion of the Shoulder and Elbow Joints-

Eighteen (72%) patients recovered full Range of Mobility (ROM) of shoulder and elbow joint. Five (20%) patients recovered good ROM (within 10-15% of full range). Two (8%) patients had poor ROM at shoulder, and of these, 1 (4%) patient had a deep infection resulting in nonunion. The functional results at the end of 1 year were assessed using the American Shoulder and Elbow Surgeons (ASES) score for 13 activities of daily living requiring the shoulder and elbow movement with each activity carrying a maximum of 4 points. The maximum possible score is 52 points. Rodriguez-Merchan criteria were used to assess the final results.⁶ This criterion includes the assessment of shoulder and elbow range of movement, pain and disability.

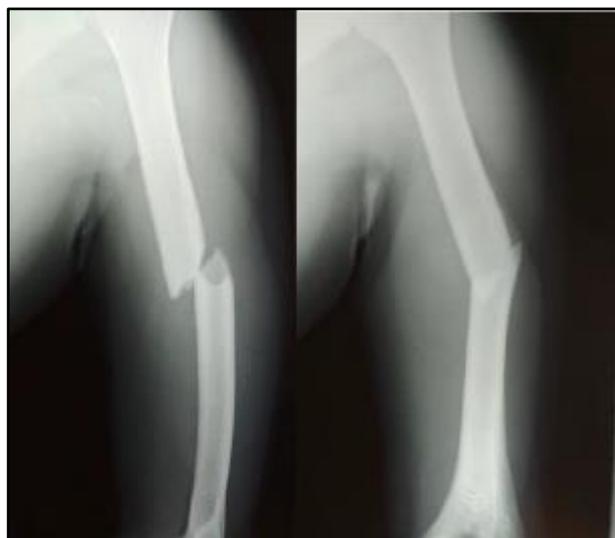


Figure 1. Preoperative Radiograph AP and Lateral View



Figure 2. Postoperative Followup X-Ray at 4 Months AP and Lateral

Rating	Elbow Movement	Shoulder Range	Pain	Disability
Excellent	Extension 5°, flexion 130°	Full range of movement	None	None
Good	Extension 15°, flexion 120°	<10% loss of total range of movement	Occasional	Minimum
Fair	Extension 30°, flexion 110°	10-30% loss of total range of movement	With activity	Moderate
Poor	Extension 40°, flexion 90°	>30% loss of total range of movement	Variable	Severe

Table 1. Criteria for Evaluating Functional Results (Rodriguez-Merchan)

Complications	Number	Percentage
Radial nerve palsy	1	4% recovered fully at 3 months
Delayed union with stiffness of shoulder and elbow joints (treated with bone grafting)	1	4%
Infected nonunion (deep infection)	1	4%
Nonunion	1	4%

Table 2. Postoperative Complications in Our Study



Figure 3. Functional Range of Motion at Final Followup

Radiological union was defined as the presence of bridging callus in 3 cortices, 2 planes (AP and lateral). Union was defined as fracture healing within 4 months, delayed union as no signs of union 4-6 months of injury and nonunion⁷ as no signs of union even after 6 months.

DISCUSSION

The management of the humeral shaft fractures is always a perplexing problem to orthopaedic surgeon as they are commonly associated with multiple injuries and complications like delayed union and nonunion, shortening, malunion, infection, etc. The intent of treatment in these fractures is to maintain length and alignment and produce favourable environment for bone and soft tissue healing and allow early mobilisation and return to work. Previously used mode of treatment of humeral shaft fractures has been the use of U-plaster cast and functional bracing, which leads to residual angulation, malrotation and limb length inequality. Operative treatment may be considered to avoid complications such as malunion, delayed union, rotational deformity, shoulder and elbow stiffness, limb length discrepancy, psychological problems and long hospital stay. This study was done to determine the efficacy of dynamic compression plate in the treatment of fractures of the shaft of humerus. Twenty five cases of fracture shaft of humerus were treated with open reduction and internal fixation using dynamic compression plate. Among 2 cases of nonunions, one was due to deep-seated infection. The other case of

nonunion was due to less rigid fixation and severe fracture comminution and excessive soft tissue stripping needed for achieving reduction.

The higher rate of excellent and good results with the plating group patients seen in our series was also cited in many other reports.⁸

Study	Transverse Fracture Incidence	Approach		Average Union Rate	Iatrogenic Radial Nerve Palsy	Full Range of Movements	Nonunion Rate
		A/I	P				
Bell M J study ⁹	-	100%	-	19 weeks	-	97%	2.6%
R. Vander Grind, et al	55.6%	90%	10%	15.6 weeks	2.9%	85.4%	2.7%
McCormeck RJ, et al ¹⁰	-	-	-	-	-	100%	2.3%
Our study	60%	92%	8%	18.4 weeks	4%	92%	8%

Table 3. Comparison with Similar Studies

The incidence of transverse fractures (60%) in our study is comparable to R. Vander Grind et al and the surgical approach to ORIF is similar to that of Bell M J study and R. Vander Grind et al.

Average union rate in our study was about 18.4 weeks, which is slightly higher than the other studies and iatrogenic radial nerve palsy is about 4% as compared to that of 2.9% of R. Vander Grind et al and the full range of movements achieved in our study is about 92% is comparable with other studies.

CONCLUSION

Open reduction and internal fixation with dynamic compression plate is still the standard treatment of choice for fracture shaft of humerus, achieving a higher union rates and excellent functional outcome provided the fixation principles were according to AO.¹¹ Fixation with intramedullary nailing has special indications like segmental fractures and pathological fractures.¹²

In conclusion, nevertheless open reduction and internal fixation of humerus shaft fracture with DCP is the standard, still achieving good functional outcome and union rate depends on the surgical technique and how well the fracture fixation principles have been followed.

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