International Journal of Research in Orthopaedics
Kubsad S et al. Int J Res Orthop. 2018 May;4(3):436-441
http://www.ijoro.org

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20181795

Functional outcome of middle third humeral shaft fractures treated with anteromedial plate osteosynthesis through an anterolateral approach

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Received: 22 March 2018
Revised: 19 April 2018
Accepted: 21 April 2018

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ABSTRACT

Background: The main aim of treatment of the humeral shaft fractures is to establish union with an acceptable humeral alignment and to restore the patient to pre-injury level of function. Plate osteosynthesis remains the standard of surgical treatment displaced middle third humeral fractures. The most commonly used approaches for treating these fractures are posterior and anterolateral, but these approaches can have iatrogenic radial nerve injury. Our aim is to study the incidence of radial nerve palsy and functional outcome of anterolateral approach with anteromedial plating.
Methods: A total of 26 patients in the age group of 21 to 62 years were included in this prospective study, who were treated by anteromedial plating through anterolateral approach for humerus shaft. Functional assessment was done using Rodriguez-Merchan criteria.
Results: 26 patients with shaft humerus fracture were included in the study with 19 (73%) patients were less than 40 years age. Most common type of fracture pattern is A3 type and the mean duration of surgical time was 60±10 min for anteromedial plating. The time taken for the fracture union was less than 4 months in the most patients (88%). There was no evidence of iatrogenic radial nerve injury. Functional assessment done using Rodriguez-Merchan criteria showed 84.6% of the patients had good to excellent functional outcome.
Conclusions: For treatment of displaced middle third humeral fractures open reduction with anteromedial plating through anterolateral approach is surgically safer and gives better functional outcome.

Keywords: Middle third humeral fractures, Anterolateral approach, Anteromedial plating, Plate osteosynthesis, Iatrogenic radial nerve injury

INTRODUCTION

The humeral shaft fracture is one of the common types of orthopaedic trauma, which account for approximately 1.2–3.0% of all fractures and result in significant burden to society from lost productivity and wages.[1]

Anatomy of humerus shaft is cylindrical in shape with anteromedial, anterolateral and posterior surfaces. Humeral shaft extends from insertion of pectoralis major proximally to supracondylar ridge distally. The humerus shaft serves as insertion and origin site for several major muscles of the upper extremity. These play an important role in the biomechanical consequences of different fracture patterns. [2]

The main aim of treatment of the humeral shaft fractures is to establish union with an acceptable humeral alignment and to restore the patient to pre-injury level of function.[3] Most of the humeral shaft fractures have been

managed conservatively in past with acceptable healing in more than 90% of these injuries. But operative fixation of fracture is needed in open fractures, vascular or nerve injury which needs exploration, polytrauma patients and in cases where patient's tolerance to functional bracing is poor.[4]

Operative treatment can be performed via external fixation, intramedullary nails or plate and screw constructs, with each method resulting in predictably high union rates. Despite the numerous surgical techniques, plate fixation remains standard fixation method for shaft humerus fracture. Plate fixation results in rigid fixation with high union rates but requires extensive dissection and soft tissue stripping.[5,6]

The most commonly used approaches described in literature for treating these fractures are posterior or anterolateral plating on respective surface.[3]

Anterolateral surface of humerus is curved and irregular, many times placing plate on that surface does not fit well especially proximally and which needs pre-bending of plate and may results in medial opening of fracture fragment. Occasionally butterfly fragment located on lateral surface makes reduction difficult and takes long surgical hours for fixation.[7]

Iatrogenic radial nerve injury was noted with an incidence rate of 5.1-17.6%, as radial nerve traverses posterior to lateral aspect around distal humerus. Many times distally fixed plate may be held on the radial nerve causing injury if proper dissection or isolation of nerve not done.[8,9]

In posterior approach with posterior surface plating has an an incidence of 11%. The proximity and danger of injury to the radial nerve as plate extension past to midshaft of the bone must be done under the nerve, resulting in the awkward situation of having the nerve lying directly on the plate with more chances of radial nerve getting irritated or damaged.[10,11]

Aims and objectives

We study fracture shaft humerus treated with anterolateral approach with anteromedial plating in our hospital with objectives

- Functional outcome of this approach
- Incidence of non-union and radial nerve palsy through this approach of plating.

METHODS

This was prospective study done at Subbaiah Institute of Medical Sciences, Shivamogga from October 2013 to October 2016. Data was collected regarding demographics, mechanism of injury, type of fracture, duration of surgery, time taken for the union and complications. Written consent was obtained from every patient. Ethical clearance was obtained from the institutional ethics committee. A total of 26 patients were included in the study who were treated by anteromedial plating through anterolateral approach for humerus shaft.

All data was entered in an MS excel sheet and analyzed by SPSS version 2.0. The qualitative variables are expressed as frequencies/percentages.

Inclusion criteria

Acute middle third humerus shaft fractures treated with anteromedial plating with anterolateral approach

Exclusion criteria

Patients less than 18 years of age, pathological fractures, preoperative radial nerve palsy, ipsilateral upper limb fractures and those lost to follow up.

Operative technique

Patient was anaesthetised and positioned supine on operating table with arm in abduction with arm board support. Standard Henry's approach made by palpating lateral border of biceps and incision made (Figure 1). The biceps was retracted medially and the brachialis muscle visualized (Figure 2) and musculocutenous nerve identified and brachialis muscle was split longitudinally lateral to nerve to expose the humerus. The arm was externally rotated to expose and ease the visualization of the anteromedial surface of the humerus (Figure 3). Fractures were reduced and fixed with 4.5 mm narrow LCP or narrow DCP was fixed with adequate screws by the AO principle (Figure 4). There was no significant blood loss during surgery. Wound closed in layers, with antiseptic dressing. Immediate post trauma and postoperative radiograph was taken (Figure 5 and 6). Initially, till suture removal above elbow slab was given. Then arm pouch used for 3-4 weeks and advised elbow and shoulder movements an hour in a day. Patients were followed up successively at the end of 6 weeks, 3rd month (Figure 7) and 6th month then yearly for 2 years. During the each visit patients were evaluated and functional outcome recorded using Rodriguez-Merchan criteria (Table 1).

Figure 1: Standard Henry's approach.

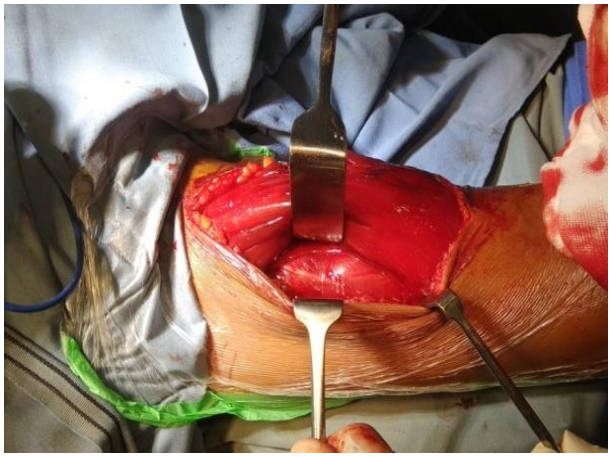

Figure 2: The biceps was retracted medially and the brachialis muscle visualized.

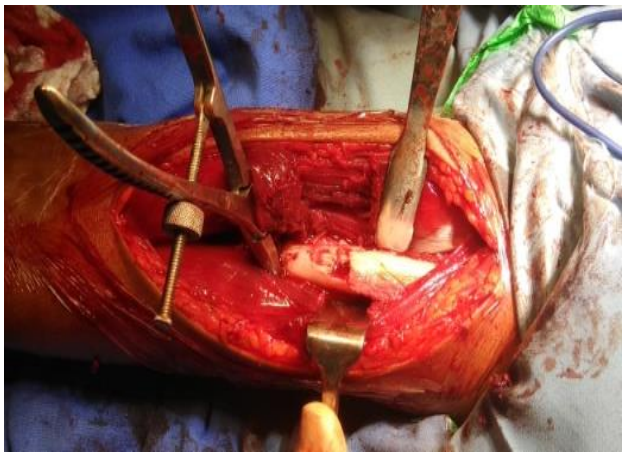

Figure 3: Visualization of the anteromedial surface of the humerus.

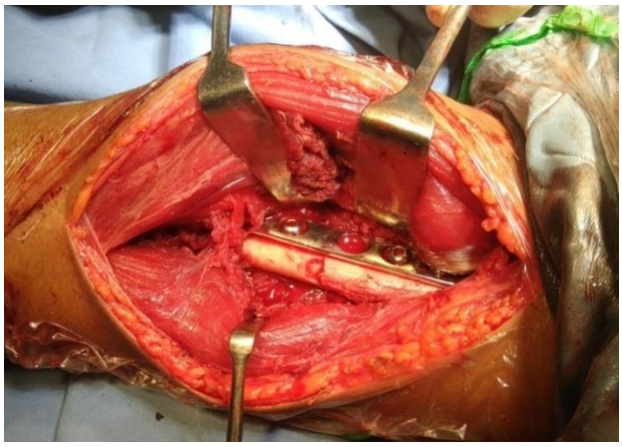

Figure 4: Fractures were reduced and fixed with 4.5 mm DCP

We compared the radiological and anatomical contouring of plates over anterolateral and anteromedial aspect of humerus. We found plate was well opposed on the anteromedial aspect of humerus with no need of pre-bending/contouring (Figure 8A and B). Whereas the anterolateral aspect of humerus plate was protruding out proximally, so there is need for pre-bending the plate (Figure 9 A and B).

Figure 5: Immediate post trauma radiograph.

Figure 6: Postoperative radiograph.

Figure 7: Radiograph of 3rd month follow up.

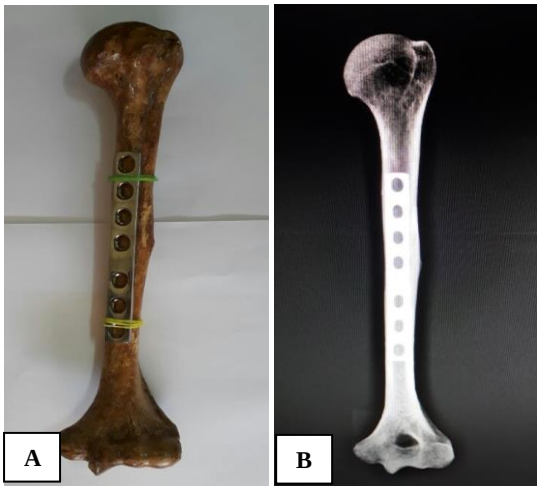

Figure 8: (A) Anatomical placement of plate on anteromedial aspect; (B) Radiological confirmation on anteromedial aspect.

Figure 9: (A) Anatomical placement of plate on anterolateral aspect; (B) Radiological confirmation on anterolateral aspect.

Table 1: Criteria for evaluating functional results using Rodriguez-Merchan criteria.

Rating	Elbow range of movement	Shoulder range of movement	P value	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

RESULTS

26 patients with shaft humerus fracture were included in the study, among them 18 (69%) were males. The age group ranged from 21 to 62 years, 19 (73%) patients were less than 40 years age (Table 2). Mode of injury road traffic accident 18 (69%) patients, fall from height in about 6 (23%) patients, throwing injuries 1 (3%) patient and assault 1 (3%) patient.

Table 2: Age wise distribution of patients.

Age group of patients (in years)	No. of patients	Percentage (%)
21-30	7	27
31-40	12	46
41-50	5	19
51-60	2	8

The most common fracture pattern identified in this study was A3 type in 11 patients, which accounts for 44% followed by A2 type 7 (26%), B2 type 4 (15%) and A1 type 4 (15%) which was least, according to AO classification.

Table 3: Time taken for union.

Time taken for union	No of patients	Percentage (%)
<4 months	23	88.5
>4 months	03	11.5

The mean duration of surgical time was 60±10 min for anteromedial plating. The time taken for the fracture union was less than 4 months in the most patients i.e. in 23 patients (88%) (Table 3). Presence of good amount of callus and cortical union taken as evidence of radiological union. There was no evidence of iatrogenic radial nerve injury.

Functional assessment done at the final follow up using Rodriguez Merchan criteria which showed that 18 (69%) of the patients had good functional outcome and 5 (19%) had excellent outcome (Table 4).

Table 4: Criteria for evaluating functional results.

Result	Number of patients	Percentage (%)
Excellent	5	19
Good	18	69
Fair	2	08
Poor	1	04

DISCUSSION

In recent times surgical intervention is increasing for all fractures. For humerus shaft fracture open reduction and plate and screw fixation has become standard method in need for early mobilization and patient compliance.

Standard surgical approach anterolateral approach with lateral plating and posterior approach with posterior plating are well accepted.

Yin-Feng Zheng et al studied 24 saw bones with distal third humerus fractures randomly divided into 3 groups anteromedial, anterolateral and posterior plating, subjected to biomechanical fatigue tests horizontal torsional fatigue tests, horizontal torsional and axial compressive fatigue tests and four point bending fatigue tests using Instron E10000 system and found anteromedial plating as good fatigue tolerability. They suggested that anteromedial plating is a clinically safe and effective way for humerus shaft fractures.[10]

Judet et al treated many patients with complex fractures and non-union by medial plating. Placing the plate on medial surface of humerus is easy and fracture reduction can be achieved well.[11]

Lateral fixation of plate results in medial opening/ distraction of fracture causing delayed union, so plate needs accurate pre-bending of plate.[12] Locking plate can't be bent properly and may lose fixation strength. The lateral surface of humerus is curved and keeps changing the shape from deltoid insertion to distal humerus.

Ivan Kirin et al did anterolateral and anteromedial plating through anterolateral approach and noted no radial nerve palsy and mean operative time was less in anteromedial plating compared to anterolateral plate fixation. In our study there was no radial nerve injury and mean surgery time was 60±10 min which is comparable to Ivan Kirin et al study.[3]

The medial surface of humerus is straight and placing the plate on it is easy, well opposed and no need for plate bending. This signifies that anteromedial humeral plating consumes less time compared to other surgical approaches for humerus shaft plating.

In our study of 26 patients treated with anteromedial plating through anterolateral approach, there was no non-union, no nerve palsy, less operative time and early union. This is coperable to Senthil et al and Mattan et al studies.[13,14]

Kumar BS et al did similar study; the time taken for the fracture to unite was less than 16 weeks in the majority patients (92.59%). There was no incidence of iatrogenic radial nerve palsy. Rodriguez-Merchan criteria showed that 37 (68.51%) of the patients had good and 12 (22.22%) had excellent functional outcome.[15]

CONCLUSION

Recent trend of surgical fixation for most humerus shaft fracture, open reduction and internal fixation still remain the standard treatment. Among the approaches for middle third shaft humerus anterolateral approach with anteromedial surface plating has less operative time, no need for pre-bending; it is easy, has nil nerve related complications, good union rates and produce excellent function outcome.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Kubsad S, Suresh B, Bharath SG, Reddy M, Pai HS. Functional outcome of middle third humeral shaft fractures treated with anteromedial plate osteosynthesis through an anterolateral approach. Int J Res Orthop 2018;4:436-41.