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ORIGINAL ARTICLE

Application of Plate on Anteromedial Surface of Humerus Through Anterolateral Approach: A Safe and Reliable Approach for Midshaft Humerus Fractures With Good Functional Outcomes

Kapil Mani KC[1], Raju GC[1]
[1]Mercy City Hospital, Rupandehi, Nepal

ABSTRACT

BACKGROUND

Both anterolateral and posterior plating require isolation of radial nerve while anteromedial plating does not require stripping of muscles as well as isolation of radial nerve. Moreover, anteromedial surface is smooth and flat that makes easy to apply plate even without pre-bending. The aim of our study is to assess the functional outcomes and complications after anteromedial plating through anterolateral approach for mid shaft humerus fractures.

METHODS

This was a descriptive analytical study conducted between 15 February 2021 to 15 May 2023. All patients of midshaft humerus fractures with age more than 18 were included in the study. Functional outcomes were assessed based on Rodriguez Merchan criteria at the time of union of fracture. Study variables included demographic profiles, mechanism of injury, type of fractures, time to unite the fracture, shoulder motion, elbow motion.

RESULTS

Total time required to complete the surgical procedure was 86.91±11.30 minutes (70-115 minutes). Total time required for radiological union of fracture was found to be 6.85±1.06 months (5-9 months). Forty-one (85.4%) patients had excellent functional outcomes, while 7 (14.6%) had good functional outcomes based on Rodriguez Merchan criteria at three months. All patients had excellent functional outcomes at the time of final union of fractures.

CONCLUSION

Anteromedial plating of mid shaft humerus fracture through anterolateral approach is technically easy, reliable, safe and free from the risk of radial nerve injury at the time of application as well as removal of plate. In addition, it does not require the release of deltoid muscle insertion which has vital role for postoperative rehabilitation.

KEYWORDS

Anterolateral approach; Anteromedial Plating; Functional Outcomes; Midshaft Humerus Fractures

INTRODUCTION

Different approaches are used for the surgical fixation of midshaft humerus fracture, out of which anterolateral and posterior approaches are widely used while anteromedial approach is infrequently used.[1,2] Posterior plating requires splitting of large triceps muscle as well as isolation of radial nerve while anteromedial approach needs to separate brachial artery, median nerve, and other vital structures.[3]

CORRESPONDENCE

Dr Kapil Mani KC,
Mercy City Hospital, Butwal, Rupendehi,
Tel: +9779851114502,
Email: drkapil2007.kmkc@gmail.com

Anterolateral plating also requires identification as well as isolation of radial nerve. In this approach plate has to be placed underneath the radial nerve after reduction of fractured bone which inadvertently increases the risk of radial nerve injury.[4,5,6,7] In addition, callus formation during fracture healing may encroach the radial nerve that further increases the radial nerve injury during plate removal. Antero-medial plating through anterolateral approach does not have any of the complications mentioned above for other approaches.[8] More importantly, anteromedial surface is smooth and flat that makes easy to apply the plate even without pre-bending with optimal functional outcomes.[9,10]

The aim of this study is use of the anteromedial plating through anterolateral approach which has been used less frequently and assess the functional outcomes and complications after the surgery.

METHODS

This was a descriptive analytical study performed in Mercy City Hospital, Butwal from 15 February 2021 to 15 May 2023. Written consent was taken from all the patients before enrolling them into the study. All patients of midshaft humerus fractures with age more than 18 years presenting to emergency department of hospital were included in the study. Pathological fractures, segmental fractures, fractures in proximal and distal third, fractures with radial nerve palsy, fractures associated with polytrauma injury were excluded from the study. During that time interval we operated altogether 50 patients, however we were able to follow up 47 patients only. Therefore, functional outcomes were assessed in 47 patients with midshaft humerus fractures. All patients were thoroughly counselled by either of two authors regarding the need of surgical fixation of fractures, surgical procedures, and possible complications after the surgery.

Surgical technique

Patient was positioned supine on OT table with arm rest towards the injured side. Primary scrubbing with 10 percent Betadine, Savlon was done thoroughly from shoulder joint to hand before doing painting and draping. Incision was given at anterolateral surface of arm starting from deltopectoral groove and continued distally through lateral border of biceps depending on the level of fracture. Incision was further deepened in between the Pectoralis major and anterior fibers of deltoid proximally while distally muscle plane was followed between the lateral border of biceps and triceps muscles. Periosteum was stripped proximally to expose the fractured site while distally brachialis muscle was released from medial to lateral side to expose the bone. Since our study was related towards the application of plate on smooth anteromedial surface of humerus, periosteum was exposed specially from the anteromedial surface of humerus. Fractured ends of bone were cleaned before reduction of fracture with bone holding forceps and application of at least 8-hole Narrow DCP (Dynamic compression plate) or locking compression plate. Interestingly, it is not needed to prebend the plate to apply on the medial surface of humerus, however there is difficulty to insert the most distal screws on plate. Therefore, either deep retraction is needed, or elbow is flexed to relax the muscle while applying the distal screws on anteromedial side. After plate has been applied, compression at the fractured site was achieved by applying the two non-locking screws eccentrically at plate hole proximal and distal to fractured end. Usually, fracture was stabilized by two non-locking and two locking screws on either side from fractured site. Drain was put at the deep wound site before doing closure of wound. Intraoperatively blood loss was measured by calculating the number of wet gauze pieces or gauze pads while postoperatively it was measured by amount of blood in drain. Dressing was performed with elbow at 90 degrees positioned, however plaster was not applied after surgery.

Post-operative protocol

Operated arm was rested in arm pouch sling after surgery. Patient was encouraged to do finger mobilization, elbow mobilization as well as assisted shoulder mobilization exercises next day after surgery. Intravenous antibiotic was continued for three days after surgery. First dressing was done two days after surgery. Drain was removed when amount of blood in drain was not more than 50 ml for 24 hours. Patients were discharged from the hospital after completion of intravenous antibiotics for three days. Oral antibiotics was continued for further five days. Suture were removed two weeks after surgery. Patients were followed up in OPD at seven days, 2 weeks, 6 weeks and then every two months till fracture union was completed. Patients were followed up at least for 18 months after surgery. Patients were encouraged to do physiotherapy at every visit. Functional outcomes were assessed based on Rodriguez Merchan criteria at three months and at the time of union of fracture (table 1).

Statistical Analysis

All relevant data were first filled in Microsoft Excel and then transferred to SPPSS (Version 20). Qualitative data were expressed in Percentage while quantitative data were demonstrated by Mean± standard deviation.

RESULTS

Average age of the patients in our study was 32.94±8.94 years (range 19 to 56 years). There were 30 (63.8%) male patients and 17 (36.2%) female patients. Twenty-six (55.3%) patients had fracture in left side while 21 (44.7%) had fracture in the right side. Regarding mechanism of injury, fifteen (31.9%) patients sustained fracture because of motor bike accident, 11 (23.4%) patients had fractures due to fall from height, 10 (21.3%) had injury due to motor vehicle accident, 6 (12.8%) sustained fracture because of sports injury, 3 (6.4%) patients had fracture because of fall on the ground while walking and only 2 (4.2%) patients sustained injury due to direct injury on the arm. There were 22 (46.8%) transverse fractures, 22 (46.8%) short oblique fractures and 3 (6.4%) comminuted fractures. Total time required to complete the surgical procedure was 86.91±11.30 minutes (70-115 minutes). It was estimated that 498.83±80.69 ml (390-700 ml) blood was lost during whole surgery while 85.64±14.94 ml (50-125 ml) of blood was lost in drain during 48 hours after surgery. Total time required for radiological union of fracture was found to be 6.85±1.06 months (5-9 months). Regarding elbow motion, 43 (91.5%) patients had normal elbow motion at three months after surgery while 4 (8.5%) had 5degree extension lag at same time period. Thirty-seven (78.7%) patients had normal shoulder motion at three months after surgery, 4 (8.5%) patients had 10degree motion lag, 5 (10.6%) had 15degree motion lag while 1 ((2.1%) had 20degree motion lag as compared to normal side. Forty-one (85.4%) had excellent functional outcomes, while 7 (14.6%) had good functional outcomes based on Rodriguez Merchan criteria at three months. All patients had excellent functional outcomes at the time of final union of fractures. All fractures had united without a single nerve injury; however one patient was found to have superficial wound infection which had heeled with oral antibiotic.

DISCUSSION

Fracture shaft of humerus is one of the common orthopedic fractures which approximately accounts for 1.2 to 3 % of all fractures.[11,12,13,14] Currently these fractures have been treated primarily by surgery [15]. Open reduction and internal fixation with plating is

gold standard treatment for humerus shaft fractures.[16,17,18,19]

For distal third humerus fractures, plating has been done primarily through posterior approach. Open reduction and fixation through medial approach was first described by Judet.[20] Later Jupiter mentioned that medial approach is not the ideal approach for plating because it encounters brachial vessels, median nerve and ulnar nerve during dissection.[21]

Lu et al[22] has mentioned that biggest challenge of medial approach is inability to extend the fracture both proximally as well as distally. It is difficult to expose as well as manipulate the fractured ends in case the fracture has been located either proximally or distally. Therefore, they mentioned that medial approach is only suitable for midshaft humerus fracture taking special precautions to prevent the neurovascular injuries.

Senthil et al[23] has pointed that medial plating was performed through anterolateral approach with elevation and retraction of brachialis muscle from medial to lateral side. The main advantages of medial surface plating as compared to posterior plating is supine position of patient, which is both comfortable for surgeon as well as for anesthetist, requires less soft tissue dissection and is associated with lower risk of radial nerve injury. Radial nerve has been found to be injured in 11.12% of cases in posterior plating of humerus fractures.[5]

Ivan Kirin et al[24] performed the comparative study between the anterolateral and anteromedial plating. They noticed that incidence of radial nerve palsy in anterolateral plating is 5.4% while there have been no cases of radial nerve palsy in anteromedial plating. Contouring of plate and partial erasing of deltoid muscle insertion are frequently required in case of anterolateral plating.

Rai et al[8] mentioned that there are many advantages of anteromedial plating versus anterolateral plating which are a) easier to apply the plate b) less chance of hypertrophic nonunion and implant failure as surface area for placement of plate is large c) surgical dissection is safe d) less stripping of muscles and hence less bleeding e) less surgical time f) no requirement of plate contouring g) comparable outcomes with anterolateral plating h) less incidence of radial nerve palsy during plate application and removal.

In our study forty-one (85.4%) patients had excellent functional outcomes, while 7 (14.6%) patients had good functional outcomes based on Rodriguez Merchan criteria at three months after surgery. All patients had excellent functional outcomes at the time of union of fractures. There was not a single case of radial nerve injury at the time of plate application as well as removal. Based on the functional results from our study, we can say that anteromedial plating of humerus fracture through anterolateral approach is relatively safe, technically easy and free from radial nerve injury during application as well as removal of plate.

Plate should be placed principally on the posterior and anterolateral surfaces of humerus which are the tensile surfaces. Unlike tibia and femur where plates are applied in tensile surfaces to counteract the weight bearing bending force, plate can be placed on compressible side of humerus without implant failure. Since there is no weight bearing force in humerus, only force, which is significant enough is rotational force. Rotational force does not overcome the strength created by compressible plating in humerus. Hence it is safe to apply the plate on anteromedial surface of humerus [3,22,25]

Limitation of study

Our study included the relatively small sample size. In addition, it is not a comparative study. For the definitive conclusion, high grade large multicentric randomized study will be required.

CONCLUSION

Anteromedial plating of mid shaft humerus fracture through anterolateral approach is technically easy, reliable, safe and free from the risk of radial nerve injury at the time of application as well as removal of plate. In addition, it does not require stripping of muscles including the insertion of deltoid muscle which could have been released in anterolateral plating.

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CONFLICT OF INTEREST

None

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