

Original Research Article

A prospective study on clinical outcome of humerus shaft fracture and nonunion treated with antero medial plating

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ABSTRACT

Background: Humeral shaft fractures have an incidence of 13 per 100000 per year and account for 3% of total fractures. The following study is carried out with intention for determining and verifying facts around plate osteosynthesis on anteromedial surface of humerus through anterior approach.

Methods: This is a prospective study of 38 patients presenting with humerus shaft fracture and non-union to the Balaji Institute of Surgery Research and Rehabilitation for the Disabled (BIRRD) from April 2015 to March 2016. Inclusion criteria were age > 18 years, acute humerus shaft fractures and nonunion of humerus shaft. Exclusion criteria were undisplaced fractures, fractures associated with neurovascular injury, compound and pathological fractures, infected non unions. The functional outcome was graded based on the QuickDASH score. Fisher's exact test was used to find the association between categorical data.

Results: Clinical union was noted in 87% of the patients and radiological union in 74% at the end of three months. The average time period required to achieve union was 13.57 weeks. Based on Quick DASH score, 66% of them had excellent outcome, 24% had good outcome, 10% had fair outcome, and none had poor outcome.

Conclusions: It may be concluded that, anteromedial plating through anterior approach for the treatment of humerus shaft fractures and non union leads to a satisfactory functional outcome in most of the patients. Most of the fractures were united by 3 months with good range of motion of shoulder and elbow.

Keywords: Humerus shaft fracture, Anteromedial plating, Plate osteosynthesis

INTRODUCTION

Humeral shaft fractures are relatively common fractures presenting to trauma services, with an incidence of 13 per 100000 per year and account for 3% of total fractures.¹ The incidence shows bimodal distribution with peak incidence for males between 20 to 30 years of age and a second peak for older females aged between 60 and 70 years.^{2,3} The rate of non-union reported following open reduction and internal fixation or closed IM nailing is up to 13%. Operative options include plate osteosynthesis and intra medullary nailing. Both methods of fixation are

having their own pros and cons. Common benefit being early mobilization, which may lead to earlier functional recovery and reduced pain.^{4,5} With benefits like early mobilisation, rigid fixation, reduced complications and opportunity to address problems like primary radial nerve injuries there is a growing interest in treating humeral shaft fractures by plate osteosynthesis.^{6,7} Further the debate on best approach for plate osteosynthesis shows benefit and limitations of various approaches like posterior, anterolateral, anterior and medial. By placing the plate on the medial surface, excessive soft tissue dissection for visualization and preservation of the radial

nerve is not required. Anteromedial surface being relatively flatter, plate contouring is less frequently required. The following study is carried out with intention for determining and verifying facts around plate osteosynthesis of anteromedial surface of humerus through anterior approach.

METHODS

This study was conducted in Balaji Institute of Surgery, Research And Rehabilitation For Disabled, Tirupati, Andhra Pradesh (BIRRD) during the period from April 2015 to March 2016.

Study design: The study design was a one year prospective study.

Sample size: A total of 38 cases were enrolled in the study.

Inclusion criteria

Patients with age >18 years, with acute humerus shaft fractures, those with nonunion of humerus shaft and patients who are medically fit for surgery.

Exclusion criteria

Patients with undisplaced fractures, those who have fractures associated with neurovascular injury, compound and pathological fractures and those who have infected non unions

Examination and evaluation

A careful history was elicited from the patients and/or attendants about age, sex, details of injury, history of previous treatment and duration. Patients were evaluated for associated medical problems and associated injuries. These findings were recorded on predesigned and pretested proforma. The local examination of the injured arm was done to look for the attitude, swelling, deformity and loss of function. Any nerve injury was also carefully looked for and noted. Fracture was stabilized temporarily by POP U- slab and arm sling in case of acute cases.

Investigations

Routine blood examination for hemoglobin %, total and differential counts, ESR, blood grouping and Rh typing, blood urea, serum creatinine, random blood sugar and coagulation profile. Routine urine examination. HIV- I & II, HBsAg, ECG, Echocardiography. X-ray- Humerus Anteroposterior And Lateral Views.

Anaesthesia

Brachial block or general anaesthesia was used in the patients according to their medical condition.

Patient position and draping

Patients placed in supine position on operating table with extended arm board. Limb is draped from shoulder to elbow joint.

Surgical procedure

Surgical approach performed was anterior approach. The incision should begin 5 to 7 cm distal to the coracoid process, which is palpated in deepest point in the concavity of the clavicle distally towards acromioclavicular joint. A 10 to 15 cm incision was taken in the middle of arm. Fascia over the biceps muscle was split open and muscle was retracted medially. The underlying brachialis muscle was elevated from its medial margin, lifting along with the musculocutaneous nerve. The radial nerve can be located either at the lateral edge of the brachialis muscle or inside the lateral part of the muscle.

Instruments and implants used

Locking compression plates/ dynamic compression plate of varying length, Drill bit and sleeve for 4.5 mm system, Power drill, Tap for 4.5 mm cortical screws and 4.5 mm depth gauge, Hexagonal screw driver for 4.5 mm cortical screws and locking screw driver, General instruments like retractors, periosteal elevators, reduction clamps, bone levers etc.

Procedure

All patients received a prophylactic dose of 1gm ceftriaxone intravenously preoperatively. The surgery was done in supine position, under brachial block or general anaesthesia. Through anterior approach, the fracture site was exposed and reduced with minimal soft tissue dissection. Anatomical reduction of fracture ends is attained. In cases of non union, the medullary cavity of both the ends was opened with rigid reamers till fresh medullary bleed was noticed. In cases of hypertrophic non union, the exuberant callus from medial surface was excised in order to make the plate to sit in congruence with medial surface. The excised callus is placed at the fracture site after plate fixation. In case of atrophic non union, the ends were freshened till the bleeding was noted from the cut ends. Decision to harvest bone graft from iliac crest was then made according to the intra operative findings. The cancellous bone graft was placed at fracture site and once the acceptable reduction was obtained, the plate was placed on the medial surface of shaft and fixed with screws. Wound was closed in layers over drain under negative suction, which was removed after 48 hours.

Postoperative management

Postoperatively the arm was immobilised in arm sling. After weaning off of anaesthesia, signs for radial nerve injury were looked for. Appropriate antibiotics and

analgesics were used. Immediate postoperative radiographs were taken to check the fracture reduction. Sutures were removed by the 12th day.

Rehabilitation

Depending upon the pain, shoulder pendulum and elbow range of motion exercises were begun as soon as possible. At first week passive range of motion was started. Active range of motion was started at 3-4 weeks postoperatively, depending on stability of osteosynthesis. At fourth to sixth week immobilization is discontinued. At sixth to eighth week-full range of movements with active exercises were started. Follow-up of patients was done at six weeks, three months and six months following the surgery

Assessment

For all subjects, radiographs were performed at the end of six weeks, three months and six months of follow-up. Patients were evaluated for clinical union, pain at fracture site, complications, radiological union, range of motion of the shoulder and elbow at the time of discharge and during all three follow-ups.

Final outcome: QUICK DASH evaluation questionnaire

The QuickDASH⁸ consists of 11 items to measure physical function and symptoms in people with any or multiple musculoskeletal disorders of the upper limb. From the item scores, a summative score is calculated. The final score ranges between 0 (no disability) and 100 (the greatest possible disability). Only one missing item can be tolerated and if two or more items are missing, the score cannot be calculated. Based on the QuickDASH score the functional outcome among patients was graded as excellent outcome 0 to 25, good outcome 25.1 to 50, fair outcome 50.1 to 75.0 and poor outcome score ≥ 75 .

Statistical analysis

Data obtained was coded and entered into Microsoft Excel spreadsheet. The categorical data was expressed as rate, ratio and percentage. The continuous data was expressed as mean \pm S.D. Fisher's exact test was used to find the association between categorical data. A 'p' value of less than or equal to 0.05 was considered as statistically significant.

RESULTS

This prospective study was conducted at Balaji Institute of Surgery, Research and Rehabilitation for Disabled (BIRRD), Tirupati, Andhra Pradesh for a period of one year from April 2015 to March 2016. A total of 38 patients sustained with humerus shaft fractures and non-union were studied. Data obtained was analyzed and the final results and observations were interpreted.

Table 1: Demographic characteristics (n=38).

Age (years)	Distribution	
	Number	%
18-30	7	18.40
31-40	8	21.10
41-50	10	26.30
51-60	6	15.80
>60	7	18.40
Total	38	100

Table 2: Follow up at 6 weeks (n=38).

Variables	Findings	Distribution	
		Number	%
Clinical union	Yes	0	0
	No	38	100
Pain at fracture site	Yes	38	100
	No	0	0
Complications	Yes	1	3
	No	37	97
Radiological union	Yes	6	16
	No	32	84

Table 3: Follow up at 3 months (n=38).

Variables	Findings	Distribution	
		Number	%
Clinical union	Yes	33	87
	No	5	13
Pain at fracture site	Yes	8	21
	No	30	79
Complications	No	38	100
	Yes	0	0
Radiological union	Yes	28	74
	No	10	26

Table 4: Follow up at 6 months (n=38).

Variables	Findings	Distribution	
		Number	%
Clinical union	Yes	38	100
	No	0	0
Pain at fracture site	Yes	0	0
	No	38	100
Complications	Yes	0	0
	No	38	100
Radiological union	Yes	38	100
	No	0	0

In the present study 53% of the patients were males and 47% were females. Age distribution is evenly distributed and most of the patients presented with age between 41 to 50 years. The mean age was 45.23 years. 61% of the patients presented with road traffic accident and 39% with history of fall as nature of trauma. 71% of the patients presented with fresh fractures and 29% with non-

union. Out of total 27 cases of fresh fractures, 67% of the patients presented with Type-A fracture, 22% with Type-B fracture and 11% with Type-C fracture of the humerus shaft according to AO classification. Out of 11 non-union cases, 73% were of hypertrophic type and 27% were of atrophic type.

In the present study at first follow up at six weeks, pain at fracture site was noted in all the patients (100%), radiological union in 6 (16%) patients and one patient (3%) had wrist drop. Physiotherapy for wrist drop patient was started immediately and patient was given dynamic cock up splint. During second follow up at three months, clinical union was noted in 87% of the patients and radiological union in 74%. Pain at fracture site was reported by 21% of the patients and no complications were observed. The patient who had wrist drop, recovered completely during the second follow up. Compared to first follow up, 33 patients attained clinical union, 30 patients were relieved of pain at fracture site and 22 more patients attained radiological union. The

average time period required to achieve union was 13.57 weeks.

Based on Quick DASH score, 66% of them had excellent outcome, 24% had good outcome, 10% had fair outcome, and none had poor outcome. Total 90% of patients had excellent and good outcome. For statistical analysis excellent and good results are taken as acceptable and fair and poor results are taken as non-acceptable.

Table 5: Final outcome based on QUICK DASH score (n=38).

Outcome	Score	Distribution	
		Number	%
Excellent	<25	25	65.78
Good	26-50	9	23.68
Fair	51-75	4	10.52
Poor	>75	0	00.00



Figure 1: (a) Skin incision, (b) deep dissection, (c) exposure of nonunion site, (d) opening of medullary canal and (e) fracture reduced and fixed with LCP.



Figure 2: (a) Pre-op radiograph and (b) post-op radiograph.

DISCUSSION

In humerus shaft fractures and non-unions, ORIF with anteromedial plate offers good functional outcome with context to the early joint mobilization and rigid fixation of the fracture. The present study was undertaken to assess the efficacy and the functional outcome following internal fixation with anterior approach and anteromedial plate for humerus shaft fractures and non-unions. The posterior and anterolateral plating of humerus are more commonly practiced. Biomechanically, the plate should be placed on the tension side of the injury. The plate should therefore be placed on either the posterior or the anterolateral aspects of the humerus. Unlike the long bones of lower limb, whose primary stresses are weights bearing; the major stresses on the humerus are rotational forces. The plate can therefore be placed on the medial aspect of the humerus.

In this study, 27 patients of fresh fractures were enrolled. Type A, type B and C type of fractures were classified based on AO classification. Accordingly, the type A fractures were noted in most of the cases (66.67%) followed by type B (22.22%) and type C (11.11%). Wali et al used AO classification for fracture classification. Their study had 64% of type A, 24% of type B and 12% of type C fractures. In the present study, out of total 11 non-union cases, 72.73% of patients were of hypertrophic type and 27.27% of cases were of atrophic type. Anthony et al classified non unions in their study as hypertrophic and atrophic.⁹ Their study too had most of hypertrophic non unions (81.8%).

In the anterolateral plating, soft tissue dissection may demand partial or complete erasing of deltoid insertion. The reported incidence of radial nerve palsy is 5.4% in anterolateral plating. In posterior plating, the incidence of radial nerve palsy is 11.4%. Anteromedial plating avoids radial nerve visualization and dissection, protecting the neurovascular structures. In the present study, we used anterior approach and placed the plate on anteromedial surface. The studies in which plate was positioned on medial surface, by Kirin et al, Senthil et al, Dayez et al concluded that, there was no requirement for blood transfusion for any of the patients, radial nerve palsy was not observed in any of the case immediately after surgery.¹⁰⁻¹² Evidence of union was seen between six to twelve weeks. Our experience was same regarding the need of blood transfusion, time period of healing, simplicity of procedure, safety and time duration of surgery. Outcome of our study which was not consistent with others is, post-operative wrist drop. No study where anteromedial plating was performed, showed incidence of secondary radial nerve palsy. In present study, one patient (2.63%) had wrist drop immediately after surgery and recovered completely with physical therapy by 3 months post-surgery. Other studies by Kirin et al and

Senthil et al in which plate was placed on medial surface did not show wrist drop.^{10,11}

Majority of the patients had clinical (87%) and radiological union (74%) during second follow up at three months. The range of motion at first, second and third follow ups showed gradual increase in mean flexion, abduction, external rotation and internal rotation. These findings suggest that internal fixation with anteromedial plate for humerus shaft fractures and non-union result in overall good results that is nearly 90% of the patients had excellent and good results. These findings are consistent with study done by Kirin et al and Senthil et al.^{10,11}

CONCLUSION

It may be concluded that, anteromedial plating through anterior approach for the treatment of humerus shaft fractures and non-union lead to a satisfactory functional outcome in most of the patients. With this approach, soft tissue dissection was minimized and the flat medial surface of the shaft of humerus offered an ideal surface for plate positioning by decreasing the need of plate contouring and making the procedure easier. The average time period required to achieve union was 13.57 weeks. But most of the fractures were united by 3 months with good range of motion of shoulder and elbow. The incidence of secondary radial nerve palsy was 2.63%. Though secondary radial nerve palsy is quite rare as per reported literature, one should be watchful while applying traction for reduction, while placing bone clamps and retractors, as we encountered a case of secondary radial nerve palsy which recovered completely with physiotherapy. Anteromedial plating is an ideal construct to use for fractures of the shaft of humerus in AO type-A, type-B and type-C. Satisfactory results were noted in both hypertrophic and atrophic nonunions.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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