



Original Research Article

Effectiveness of low profile pre contoured clavicular plate in mid shaft clavicular fractures in young patients

Ankur Mittal¹, Ramprasad R^{2*}, Biju R³, Siva Prasad Y⁴, Ganesh Kumar Reddy M²

¹Senior Resident, ²Assistant professor, ³Professor, ⁴Professor and Head, Department of Orthopedics, Narayana Medical College and Hospital, Nellore, Andhra Pradesh, India

*Corresponding author email: research.nmch@rediffmail.com

How to cite this article: Ankur Mittal, Ramprasad R, Biju R, Siva Prasad Y, Ganesh Kumar Reddy M. Effectiveness of low profile pre contoured clavicular plate in mid shaft clavicular fractures in young patients. IAIM, 2015; 2(5): 140-146.

Available online at www.iaimjournal.com

Received on: 02-05-2015

Accepted on: 12-05-2015

Abstract

Introduction: Risk of Nonunion, residual shoulder disability and symptomatic malunion are higher in conservative treatment of displaced midshaft clavicle fractures which are reportedly decreased by operative method but plating these fractures, however, have hardware-related problems. Low-profile anatomically precontoured plates may reduce the rates of plate prominence and hardware removal.

Objective: To assess the rate of plate prominence, rate of hardware removal, rate of complications, radiological and functional outcome of a pre-contoured congruent clavicle plate in the treatment of acute, displaced, mid-shaft clavicle fractures.

Materials and methods: This study presented the results of 50 patients treated with an anatomical congruent clavicle plate for acute displaced, mid-shaft fractures of the clavicle from October 2011 to December 2013 admitted in Narayana General Hospital.

Results: The fracture united in all cases with minimal complications and high patient satisfaction on the Disability of the Arm and Shoulder (DASH) score, American Shoulder and Elbow Surgeons score (ASES) and Pain Visual analogue score (VAS). The results compare favorably with other published studies

Conclusion: A congruent clavicle plate prove to be a better option for mid shaft clavicle fracture in terms of patient compliance, hardware complication, radiological and functional outcome.

Key words

Clavicle fracture, Union, Pre-counterated plate fixation.

Introduction

Fractures of the clavicle are common, accounting for 5 to 10% of all fractures and up to 44% of all injuries to the shoulder girdle [1, 2]. Among 44% of these injuries two-thirds occur at the diaphysis of the clavicle, and as compared to medial- and lateral third fractures these injuries are more likely to be displaced. Traditionally, nonsurgical management has been favored as the initial treatment modality for most clavicle fractures because of the high nonunion rates reported after operative treatment [1]. According to recent evidence specific subsets of patients may be at high risk for nonunion, shoulder dysfunction, or residual pain after nonsurgical management [3].

In this subset of patients, acute surgical intervention may minimize suboptimal outcomes. Therefore, specific treatment of clavicle fractures should not be broadly applied but rather should be individualized based on fracture characteristics, cosmetic purposes and patient expectations.

Controversy exists on the types of fixation to be used of middle third clavicle fractures [1, 4]. The treatment options include intra medullary fixation [5, 6] and internal fixation with plates [7, 8, 9, 10]. Fixation with wires carries the risk of wire migration which may cause damage to vital structures [11, 12]. There is also controversy about which type of plate to use: On one hand Low Contact Dynamic Compression Plates (LC-DCP) are strong plates but difficult to contour to the anatomy of the clavicle due to its bulkiness and often cause soft tissue irritation whereas 3.5 mm reconstruction plates are easier to contour, but offer less mechanical strength [13]. Anatomic pre-contoured implants have the

potential advantages of having a lower profile causing fewer soft tissue problems and requiring no further bending whilst retaining the mechanical strength of the stronger plates. The purpose of this study is to assess the clinical and radiological outcome of the precontoured Congruent Clavicle Plate in the treatment of acute, displaced, mid-shaft clavicle fractures. It comes in right and left sides and different shaped curves and these are low profile plates.

Material and methods

A prospective case series of fifty patients with acute, displaced, mid-shaft fractures of the clavicle treated with an anatomical congruent clavicle plate. Plate used was of Matrix Company. All patients gave informed verbal consent to be included into the study. All fractures were Type 1 fractures according to the Allmann classification system [14]. Fifty four patients with the above fracture were identified and recruited over a two year period but four patients were lost to follow up.

Patients were assessed clinically and radiological looking for union, plate loosening and implant failure Healing was defined as pain free use of the arm/shoulder without evidence of delayed fracture union on the radiograph. Final outcome assessment was performed after 6 months post operatively. We used the Disabilities of the Arm Shoulder and hand questionnaire (DASH) scoring system on all 50 patients [15].

Inclusion criteria

- Fractures with greater than 1.5 cm of clavicle shortening with substantially displaced fracture fragments lacking cortical apposition.

- Impending skin compromise secondary to displaced fracture fragments.
- Comminuted fractures.

Exclusion criteria

- Closed fractures with less than 1.5 cm of shortening with apposing fracture fragments.
- Open fractures.
- Children below 15 years

All the patients were followed-up for a period of 6 months.

Operative technique

Under Interscalene block the patients were placed in the supine beach-chair position. An infra clavicular approach was utilised with careful periosteal stripping. The fracture was anatomically reduced and the plate applied to the superior surface of the clavicle. Contouring of the plate was not required. Interfragmentary screw, Vicryl and S.S. wire has been used where ever it is necessary depending on fracture pattern (**Figure – 1a, 1b**). Sub cuticular stiches were applied.

Postoperative protocol

- 1st post operative day (POD): Started elbow range of motion, Abduction till 90 degree
- Immobilized in a Shoulder Arm Immobilizer for 2 weeks.
- During this time, it was removed at least four times a day for active ROM of the elbow and pendulum exercises of the shoulder.
- At 2 weeks patients got full range of motion
- Patient evaluated for wound healing, radiograph and range of motion at 2 week 6 week and 6 month.

Results

Age distribution

Most of the patients present in the range of 16 - 59 years. The average age was 41.5 years. Out of 50 patients operated 15 were women and remaining 35 were men.

Affected side

Right side clavicle fracture was seen in thirty patients and twenty patients had left side involvement.

Mechanism of injury

Out of 50 patients, 15 fractures occurred while playing sport, 25 were as a result of road traffic accidents (RTA), 9 due to falls and 1 due to an assault with a metal bar.

Time from injury to surgical intervention

Time period from injury to surgical intervention ranges between 2 to 5 days.

Status of associated lesions at the time of surgery and their management

One patient had an associated ipsilateral dislocated shoulder which required closed reduction under anesthesia and five patients had additional both side multiple rib fracture and ipsilateral scapula fracture which were treated conservatively.

At follow up of 6 months the mean DASH score was 13.4 (0.0-77.2) and the mean ASES score was 82.1 (28.3-100). The mean VAS score was 1.7 (0-8). Full range of motion was regained in all patients. At a mean of 6 weeks there was a 100% healing rate. Post operative movements were recorded (**Figure – 2, Figure – 3**).

Complications

- In one case of a 16 year old (BMI 19.1) the plate was felt to be prominent under

the skin and was removed 13 months post-surgery.

- Mild hypersensitivity of the scar occurred in four patients but this did not limit function.
- Ten patients had paresthesias over the surgery scar but it had not affected the final functional outcome.

It was not necessary to further contour the plate in any of the cases.

Discussion

Mid shaft clavicle fractures are common injuries. The reported results for the non-operative treatment of fractures of the clavicle have been variable. Neer reported a non-union rate of 0.1% for conservatively treated fractures [1], and non-union rate of 4.6% for fractures treated operatively. However the operatively treated fractures were of higher energy and it was accepted that poor surgical technique and fixation devices may have contributed to the non-unions [16-20].

Conservative treatment of fractures with shortening is associated with high risk of non-union and unsatisfactory shoulder function [5, 6].

Shortening of the clavicle results in altered anatomical relationships and abnormal biomechanical stress on the shoulder [21]. Shortening of 1 cm was shown to decrease shoulder function in 50% of cases and with shortening greater than 2 cm the deterioration was considerable.

Mal-union of the clavicle may also alter the position of the Glenoid fossa which may affect glenohumeral mobility and scapular rotation, leading to unsatisfactory results especially in young and active patients [6].

Controversy exists regarding the techniques used for fixation of displaced middle third clavicle fractures and the type of fixation device used [1, 4]. Operative treatment is not without its risks, and a complication rate as high as 27.3% has been quoted [13].

Dynamic compression plating has a problem of soft tissue irritation due to plate prominence and plate removal being a common reason for re-operation [13].

In this series it was found that routine plate removal is not necessary as the implant is low profile and causes minimal irritation.

The Canadian Orthopedic Trauma Society compared the outcome of conservative and operative management in displaced mid shaft clavicle fractures and showed significantly better function, a lower rate of non-union, and a lower incidence of symptomatic mal-union in the operative group. It was found that removal of the plate was the most common reason for re-intervention. However, towards the end of the study the researchers changed to using the congruent plate and preliminary results indicated a markedly reduced prevalence of soft tissue irritation, which could lead to a decrease in the need for plate removal [20]. It should be pointed out, however, that there were only 4 patients in the latter group. Implants contouring takes time, and experience is needed for contouring the plates accurately to match the patient's anatomy. Repeated bending of implants can lead to structural failure. Huang et al compared the anatomy of the clavicle with the shape of the congruent plate via digital mapping. They found that the plate fitted the S-shaped contour of the superior surface of the majority of male clavicles but not for white female clavicles. However the mapping study did conclude that the plate was adequately shaped for fixation of fractures in the medial three-fifths



of clavicles [21]. This paper describes a series of 50 patients with acute, displaced, mid-shaft fractures. The study is limited in the fact there is no control group and therefore it provides no basis for firm conclusions, or statistical analysis. However the study does demonstrate that the congruent plate appears to be an effective and reliable means of fixing mid shaft clavicle fractures and due to its low profile nature, routine plate removal is not required.

Conclusion

A congruent clavicle plate prove to be a better option for mid shaft clavicle fracture in terms of patient compliance, hardware complication, radiological and functional outcome.

References

1. Neer CS. Nonunion of the clavicle. *JAMA*, 1960; 172: 1006-11.
2. Post M. Current concepts in the treatment of fractures of the clavicle. *ClinOrthop*, 1989; 245: 89-101.
3. Zlowodzki M, Zelle BA, Cole PA, Jeray K, McKee MD. Treatment of acute midshaft clavicle fractures: Systematic review of 2144 fractures. *J Orthop Trauma*, 2005; 19: 504-7.
4. Herbsthofer B, Schuz W, Mockwitz J. Indications for the surgical treatment of clavicular fractures. *AktuelleTraumatol*, 1994; 24: 263-8.
5. Jubel A, Andemahr J, Bergmann H, et al. Elastic stable intramedullary nailing of midclavicular fractures in athletes. *Br J Sports Med*, 2003; 37: 480-484.
6. Ngarmukos C, Parkpain V, Patradul A. Fixation of fractures of the midshaft of the clavicle with Kirschner wires. Results in 108 patients. *J Bone Joint Surg[Br]*, 1998; 80: 106-8.
7. Poigenfurst J, RappoldG, Fischer W. Plating of fresh clavicular fractures: Results of 122 operations. *Injury*, 1992; 23(4): 237-41.
8. Ali Khan MA, Lucas HK. Plating of fractures of the middle third of the clavicle. *Injury*, 1978; 9: 263-267.
9. Mullaji AB, Jupiter JB. Low contact dynamic compression plating of the clavicle. *Injury*, 1994; 25: 41-45.
10. Schwarz N, Hocker K. Osteosynthesis of irreducible fractures of the clavicle with 2.7 mm ASIF plates. *J Trauma*, 1992; 33: 179-183.
11. Lyons FA, Rockwood CA. Migration of pins used in operations on the shoulder. *J Bone Joint Surg [Am]*, 1990; 72-A: 1262-7.
12. Norell H, Llewellyn RC. Migration of threaded Steinmann pin from an acromioclavicular joint into the spinal canal: A case report. *J Bone Joint Surg [Am]*, 1965; 47-A: 1024-6.
13. Iannotti MR, Crosby LA, Stafford P, et al. Effects of plate location and selection on the stability of midshaft clavicle osteotomies: A biomechanical study. *J shoulder Elbow Surgery*, 2002; 11: 457-62.
14. Allmann FL. Fractures and Ligamentous Injuries of the Clavicle and Its Articulation. *J Bone Joint Surg [Am]*, 1967; 49: 774-784.
15. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: DASH (Disabilities of the Arm Shoulder and hand). The Upper Extremity Collaborative Group (UECG). *Am J Ind Med*, 1996; 29: 602-8.
16. Hill JM, McGuire MH, Crosby LA. Closed treatment of displaced middle third clavicular fractures of the clavicle gives poor results. *J Bone Joint Surg [Br]*, 1997; 79-B(4): 537-9.
17. McKee MD, Pedersen EM, Jones C, Stephen DJG, et al. Deficits following

- nonoperative treatment of displaced midshaft clavicular fractures. J Bone Joint Surg [Am], 2006; 88-A(1): 35-40.
18. Chan KY, Jupiter JB, Leffert RD, Marti R. Clavicle malunion. J Shoulder Elbow Surg, 1999; 8: 287-90.
19. Rowe CR. An atlas of anatomy and the treatment of midclavicular fracture. ClinOrthop, 1968; 58: 29-42.
20. Canadian Orthopaedic Trauma Society.
- Nonoperative treatment compared with plate fixation of displaced midshaftclavicular fractures. A multicenter randomised clinical trial. J Bone Joint Surg [Am], 2007; 89: 1-10.
21. Huang JI, Toogood P, Chen MR, et al. Clavicular Anatomy and the Applicability of Precontoured Plates. J Bone Joint Surg[Am], 2007; 89(10): 2260.

Source of support: Nil

Conflict of interest: None declared.

Figure – 1: Post-operative assessment done with an AP radiograph.

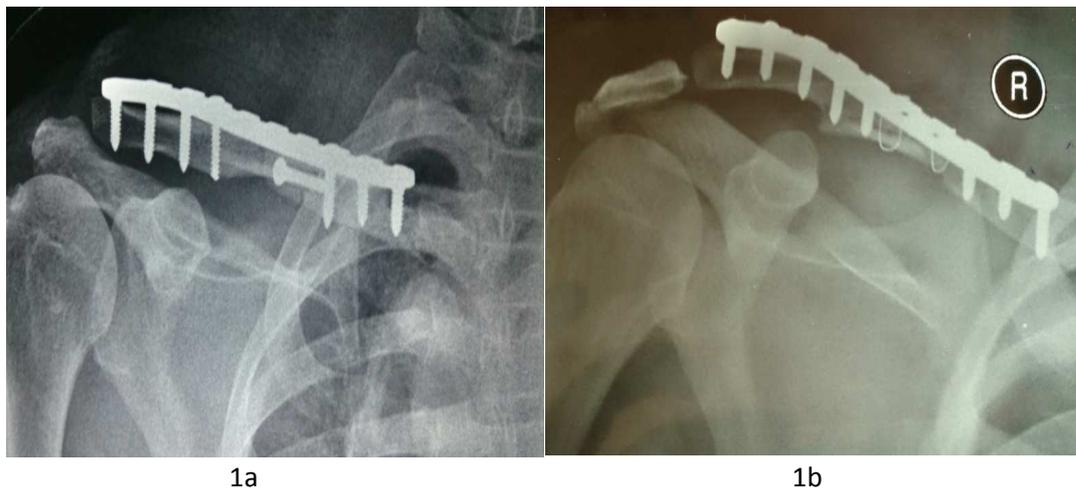
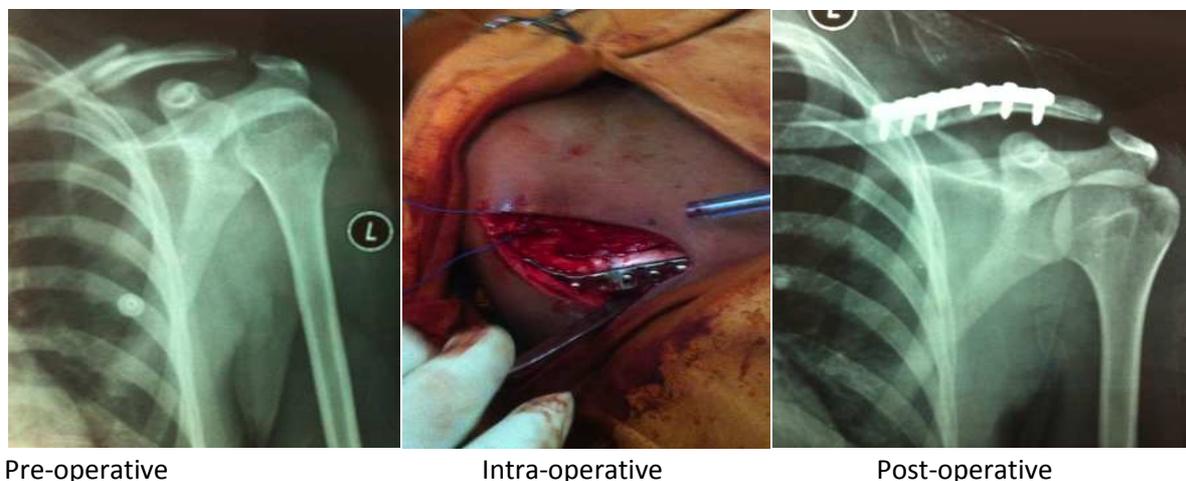


Figure – 2: X-ray during pre-operative, intra-operative and post-operative periods.



Pre-operative

Intra-operative

Post-operative



X-ray at 6 week

ROM at 6 week

Figure – 3: X-ray during pre-operative, intra-operative and post-operative periods.



Pre-operative X-ray

Intra-operative

Post-operative X-ray



X-ray at 6 week

ROM at 6 week