

## Original Research Article

# A clinical study of displaced clavicle fractures treated with precontoured locking compression plate

E. Dilip Kumar Naidu\*, A. V. Anand

Department of Orthopaedics, SRM Medical College, Hospital and Research Centre, Chennai, Tamil Nadu, India

**Received:** 12 August 2017

**Revised:** 28 August 2017

**Accepted:** 29 August 2017

### \*Correspondence:

Dr. E. Dilip Kumar Naidu,

E-mail: [kendilip@rediffmail.com](mailto:kendilip@rediffmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** Fractures which involve the clavicle are very common and account for almost 5-10% of all the fractures and up to around 45% of those which involve the shoulder girdle. Most of these fractures occur due to a direct blow to the anterior chest wall or by falling on the outstretched hand. Traditionally, clavicular fractures have been treated with conservative methods, but the outcome was poor, leading to patient dissatisfaction. An option is the precontoured locking plates which provide immediate relief, stabilization and early mobilization, more so because they do not require further bending.

**Methods:** 50 patients, above 18 years of age, with closed displaced clavicular fractures were included in the study. Clinical evaluation was done for all the patients using the Constant-Murley score. Precontoured locking compression plate was inserted surgically for the treatment of the fracture and follow-up was done for 6 months postoperatively.

**Results:** Out of the 50 patients studied, 42 were males (84%) and 8 (16%) were females. Most of the patients belonged to 21-50 years of the age group. Road traffic accidents were the most common cause (98%) for this type of fractures. Most of the fractures were united by 11-12 weeks of duration (42%), closely followed by a time period of 9-10 weeks (40%). Most of the patients showed full range of movement (84%), while 6% showed movements which were restricted by 20° and 10% showed 30° restrictions. In 32% of the cases, the outcome was excellent while only 6% of the patients showed a fair outcome.

**Conclusions:** Displaced mid-shaft clavicle fractures treated with precontoured locking compression plates gave good functional outcome and patient satisfaction with excellent reunion rates.

**Keywords:** Mid-shaft clavicle fractures, Precontoured locking compression plates, Reunion

## INTRODUCTION

Clavicle is the horizontally placed collar bone that connects the upper limb to the trunk and plays a very important role in mobility and anatomical stability of upper limb. Its subcutaneous position makes it vulnerable to traumatic injuries.<sup>1</sup> Fractures which involve the clavicle are very common and account for almost 5-10% of all the fractures and up to around 45% of those which

involve the shoulder girdle. Fractures of the mid shaft of the clavicle account for about 80% of all the clavicular fractures. 2-5% of all the fractures in the adults and 10-15% in children are estimated to be due to fractures of the clavicle.<sup>2</sup>

Most of these fractures occur due to a direct blow to the anterior chest wall or by falling on the outstretched hand. The most common site of clavicle fracture is said to be

the mid shaft, which is followed by the lateral ends.<sup>3,4</sup> Some of these fractures are usually unstable due to the displacing forces which act on the fractures, an inferior force acting on the lateral fracture and an anterosuperior force acting on the medial clavicle fragment.<sup>5</sup>

Traditionally, clavicular fractures have been treated with conservative methods, but the outcome was poor, leading to patient dissatisfaction.<sup>5,6</sup> Nonunion rate has been reported to be as high as 22-44%.<sup>7-9</sup> This may lead to persistent pain, restricted movement and loss of strength and endurance of the shoulder.<sup>5,10</sup>

This has led to the expansion of surgical management of these fractures. There have been many studies which have reported poorer outcomes of the nonoperative measures in comparison to the surgical ones.<sup>11-15</sup>

Three types of surgical treatments are available, intramedullary devices such as K-wires, Steinman pins, Knowles pins cannulated screws; plates such as dynamic compression plate, reconstruction plates or locking compression plates and external fixators. Plate fixation has been advocated to be one of the options for treatment.<sup>16,17</sup> Low contact dynamic compression plates are strong but difficult to contour, thereby causing irritation of the soft tissue. Reconstructed plates have the capacity to contour easily but they are not mechanically strong. A better option is the precontoured locking plates which provide immediate relief, stabilization and early mobilization, more so because they do not require further bending. They are also known to cause fewer soft tissue problems.

Hence, this study was taken up to assess the various aspects of clavicle fractures treated with open reduction internal fixation with pre contoured locking compression plates, its functional and radiological outcome as well as to evaluate complications associated with the same.

## METHODS

This prospective study was performed in the Department of Orthopedics at SRM Medical college, Hospital and research centre from April-2015 to September-2016. 50 patients, above 18 years of age, with closed displaced clavicular fractures and not known contraindications to general anesthesia were included into the study. The fractures were classified as 2B1 and 2B2 by Robinson's classification only were included into the study. Patients below 18 years of age, having open or pathological fractures, fractures in the proximal or the distal third of the clavicle, or those which were associated with head injury were excluded from the study. Patients with a neurovascular injury, established non-union from previous fracture or with acromioclavicular joint dislocation were also excluded from the study.

All the patients were subjected to complete clinical and radiological evaluation which included chest PA view,

chest with both shoulders AP view and X-ray of the clavicle AP view, 30° cephalo-caudal view on the admission into the casualty ward of our hospital. After confirming the patient to be in the inclusion criteria, the mode of action was properly explained to the patient and the relatives and an informed consent was taken from all of them. Blood was collected for investigations such as hemoglobin, Tc/DC, ESR, blood grouping and typing, HIV, HBsAg, RBS, Blood urea, and creatinine. ECG was also done for all patients.

Clinical evaluation was done for all the patients using the Constant-Murley score. This scoring system consists of four variables that are used to assess the function of the shoulder. The subjective variables are pain and ADL (sleep, work, recreation/sport) which give a total of 35 points.

The objective variables are range of motion and strength which give a total of 65 points, giving a total of 100 points. The radiological evaluation was done as per the DASH score, where in the immediate post-operative period was compared with the latest follow-up. Followup was done for a period of 6 months at regular intervals.

All patients underwent surgery under general/regional anesthesia. The patient was placed in supine position with a sand bag positioned in the interscapular region. A Transverse incision centering the fracture site of clavicle was made approximately measuring about 5-7 cm in length depending on the fracture. The underlying soft tissue was dissected through the subcutaneous layer and the platysma sub-periosteally.

Care was taken to avoid the supraclavicular nerve, if identified in the plane it was tagged with vessel loop. The overlying fascia and periosteum was dissected to identify the fracture ends which were then cleared from all surrounding soft tissue attachment. The fracture edges were then reduced and held in position with bone clamps or towel clips. If necessary a lag screw fixation was carried out using a 3.5 mm cortical screw.

If significant comminution was encountered then careful initial re approximation of the smaller fragments was performed with one or two 3.5 mm interfragmentary screws if possible if not was fixed to the plate using anatomically contoured plate. The plate was placed superiorly and the fracture was fixed with at least three 3.5 mm cortical screws on either side.

Great care was taken to avoid "plunging" through the inferior cortex and potentially damaging the underlying neurovascular structures and the pleura. The periosteum was preserved as much as possible with minimal stripping done to preserve the vascularity of the bone. The c- arm was used on occasions to confirm the reduction and the screw length at the end of the procedure prior to skin closure with either 3.0 Ethylon or skin staples.

Post operatively, analgesics and tranquilizers were given as per the requirements of the patient and check X-ray was taken to check for the alignment and fixation. The patient was discharged the next day with an arm pouch

At 4 to six weeks active range of movements were started as tolerated by the patient with a limited abduction of 90 degrees. After 8 weeks active full range of movements were encouraged in all planes. Patients were followed up regularly every 4 weeks for three months and one after 6 months. Microsoft excel was used to calculate averages and percentage and plot bar charts and graphs.

**RESULTS**

Out of the 50 patients studied, 42 were males (84%) and 8 (16%) were females. Most of the patients belonged to 21-50 years of the age group. Very few patients were less than 20 (10%) and above 60 years of age (6%). The predominant age group was 21-30 years and 41-50 years. Road traffic accidents were the most common cause (98%) for this type of fractures, while only 1 case (2%) was found to be due to slip and fall. Left side fractures were slightly more common than the right side though this was not fun to be significant (Table 1).

**Table 1: General characteristics.**

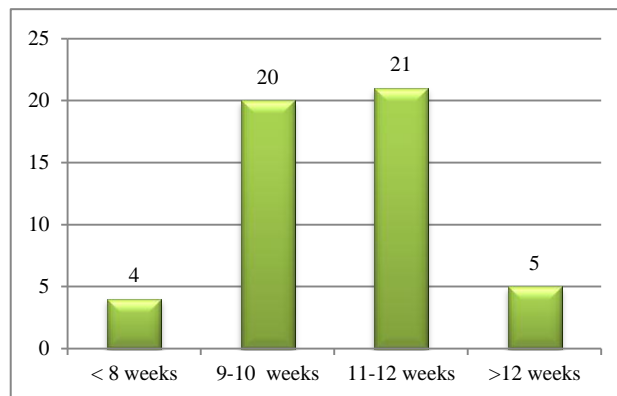
Characteristics	No. of patients (%)
<b>Age (in years)</b>	
≤20	5 (10)
21-30	12 (24)
31-40	8 (16)
41-50	12 (24)
51-60	10 (20)
≥61	3 (6)
<b>Gender</b>	
Males	42 (84)
Females	8 (16)
<b>Nature of trauma</b>	
Road traffic accidents	49 (98)
Slip and fall	1 (2)
<b>Side involved</b>	
Right	22 (44)
Left	28 (56)

Most of the fractures were united by 11-12 weeks of duration (42%), closely followed by a time period of 9-10 weeks (40%). Around 8% of the cases, the duration for the union to occur was <8 weeks and in 10% of the cases it was >12 weeks (Figure 1).

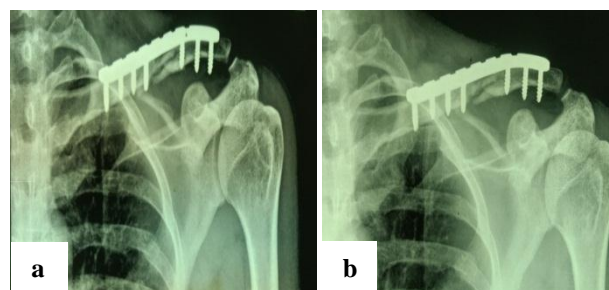
Most of the patients showed full range of movement (84%), while 6% showed movements which were restricted by 20° and 10% showed 30° restrictions (Figure 3).

In 32% of the cases, the outcome was excellent while only 6% of the patients showed a fair outcome. None of

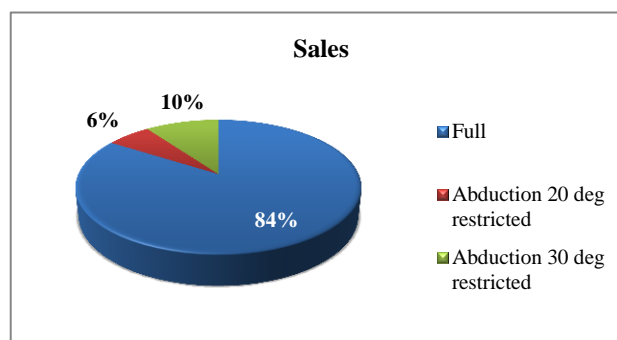
the patients showed a poor outcome of the surgery (Figure 5).



**Figure 1: Duration of union.**



**Figure 2: (a) Post-operative picture of the fractured clavicle, (b) follow up picture of the affected clavicle.**



**Figure 3: Range of movements.**



**Figure 4: (a) Range of movement on follow-up, (b) Range of movement on follow-up.**



**Figure 5: Outcome.**

## DISCUSSION

Clavicle fracture is one of the most commonly encountered fractures in present day scenario of trauma care. As the lifestyle of a citizen changes, his requirements, needs, and understanding towards a medical condition completely changes with time. With the era where a person immobilised for a long duration would face utter economical distress, the conservative means of treating most of the fractures including clavicle fractures has become obsolete. Moreover, there have been a few studies which have reported a poor outcome and higher rates of non-union of the fractures by the conservative methods.<sup>11-13</sup> Patients seek for faster and better functional outcome and are ready for the risk of surgery. With the advent of better surgical techniques, sterile maintenance, better post op protocols the results of surgical management are far superior compared to conservative means.

Management of clavicular fractures may be of different types such as intramedullary, plates and external fixators. Like K wire, Steimman pin, recon plate, new generation pre-contoured anatomical plates. The main purpose of these surgical treatments is the anatomical reduction and reconstruction of the clavicular length and alignment of the shoulder girdle. In order to prevent stress to the implant, it is necessary that it is strong in comparison to the bone strength. Therefore precontoured plates are preferred as they involve locking between the screw and the plate. As there is minimal contact between the plate and the cortical bone, there is no hindrance to the blood supply as well as minimizing the risk of injury to the subclavicular artery or brachial plexus, more so because tip of the screw does not reach the opposite bone cortex. Periosteal stripping is minimized to promote rapid union.<sup>18</sup>

In our study we have prospectively analysed the outcome of clavicle fractures treated with precontoured locking compression plates in 50 patients. We have taken into account statistically the age distribution, gender, nature of trauma, side involved, duration of union, range of movements attained at the end of study and results according to scoring systems.

Majority of our cases were in the age group of 21-30 and 41-50 years which were 12 a piece, least being over 60 years and 3 in number, signifying that young active adults are most commonly involved in traumatic incidences. Mean age was calculated to be 40 years. This was in accordance with study by Zlowodzki et al, who also reported a higher rate of clavicular fractures in males rather than in females, and that too among the younger age group.<sup>19</sup>

A male predominance was observed in our study with 25 cases that is about 84% of our study group being male patients and rest female. 98% of the cause was due to road traffic accidents. This inclines our thought towards males being involved in vehicular accidents more than females. The duration of union was found to be less than 8 weeks in 4 patients, 9-10 weeks in 20, 11-12 weeks in 21, greater than 12 weeks in 5 patients respectively. Mean duration was found to be 10.33 weeks. The range of movement attained at the end of the follow up in the patients was calculated to be full and free in 42 patients. 3 patients had 20 degree and 5 patients had 30 degree restriction respectively.

All the patients were further assessed with Constant Murley score and DASH score for final outcome and performance in daily and occupational activities. Results were fair in 6, good in 15, very good, in 13, excellent in 16 patients respectively. We found no patient with poor result. Very good results were observed in another study performed on Korea by Lee et al, where most of the patients returned to their work within 6 months of their surgery.<sup>20</sup>

Georghiu et al conducted a study on 29 patients and found LCP to be more effective and reliable due to their low profile nature.<sup>21</sup> Bhundekar et al, in their study reported that fractures treated with LCPs showed early return to function, better cosmesis and less hardware removal.<sup>22</sup>

Canadian Orthopedic Trauma Society, in their randomized study found DASH score was significantly better at all-time points in the study group.<sup>23</sup> In yet another study by Zlowodzki et al, it was observed that there was a 57% relative risk reduction for non-union using a plate in comparison to 86% of the non-union for patients treated conservatively.<sup>19</sup> Locking plates was also found to have stiffer constructs compared to other different techniques.<sup>24</sup>

## CONCLUSION

Displaced mid-shaft clavicle fractures treated with precontoured locking compression plates gave good functional outcome and patient satisfaction. They also had low complication rates and excellent reunion rates, retaining the normal 'S' shape of the clavicle. The surgical procedure was also easy and less time consuming, with very less intraoperative bleeding. Hence



this type of procedure can be considered to be one of the best modalities.

*Funding: No funding sources*

*Conflict of interest: None declared*

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

## REFERENCES

1. Samy M, Khanfour A. Extra-articular fixation of displaced fracture lateral end clavicle. *Eur J Orthop Surg Traumatol.* 2011;21(8):557-61.
2. Robinson CM. Fractures of the clavicle in the adult. Epidemiology and Classification. *J Bone Joint Surg Br.* 1998;80:476-84.
3. Robinson CM, Cairns DA. Primary non-operative treatment of displaced lateral fractures of the clavicle. *J Bone Jt Surg Am.* 2004;86:778-82.
4. Khan LA, Bradnock TJ, Scott C, Robinson CM. Fractures of the clavicle. *J Bone Jt Surg Am.* 2009;91:447-60.
5. Neer II CS. Fractures of the distal third of the clavicle. *Clin Orthop Relat Res.* 1968;58:43-50.
6. van der Meijden OA, Gaskill TR, Millet PJ. Treatment of Clavicle fractures: Current concepts review. *J Shoulder Elbow Surg.* 2012;21(3):423-9.
7. Nordqvist A, Petersson C, Redlund-Johnell I. The natural course of lateral clavicle fracture. 15 (11-21) years follow-up of 110 cases. *Acta Orthop Scand.* 1993;64(1):87-91.
8. Edwards DJ, Kavanagh TG, Flannery MC. Fractures of the distal clavicle: a case for fixation. *Injury.* 1992;23(1):44-6.
9. Rokito AS, Zuckerman JD, Shaari JM, Eisenberg DP, Cuomo F, Gallaher MA. A comparison of nonoperative and operative treatment of type II distal clavicle fractures. *Bull Hosp Jt Dis.* 2003;61(1-2):32-9.
10. Jupiter JB, Leffert RD. Non-union of the clavicle. Associated complications and surgical management. *J Bone Joint Surg Am.* 1987;69(5):753-60.
11. Hill JM, McGuire MH, Crosby LA. Closed treatment of displaced middle-third fractures of the clavicle gives poor results. *J Bone Joint Surg Br.* 1997;79(4):537-9.
12. Robinson CM, Court-Brown CM, McQueen MM, Wakefield AE. Estimating the risk of nonunion following nonoperative treatment of a clavicular fracture. *J Bone Joint Surg.* 2004;86:1359-65.
13. Wild LM, Potter J. Deficits following nonoperative treatment of displaced midshaft clavicular fractures. *J Bone Joint Surg.* 2006;88:35-40.
14. Ali KM, Lucas HK. Plating of fractures of the middle third of the clavicle. *Injury.* 1978;9(4):263-7.
15. Jeray K. Acute midshaft clavicular fracture. *J Am Acad Orthop Surg.* 2007;15:239-48.
16. Mullaji AB, Jupiter JB. Low-contact dynamic compression plating of the clavicle. *Injury.* 1994;25:41.
17. Ring D, Jupiter JB, Miller ME, Ada JR. Injuries to the shoulder girdle: part II. Fractures of the clavicle. In: Browner BD, Jupiter JB, Levine AM, Trafton PG, (eds). *Skeletal trauma. Volume 2.* Philadelphia: WB Saunders; 1998: 1670.
18. Hathiwale MI, Sasnur PA, Tapadar MJI. A prospective study on operative management of displaced fracture of midshaft of clavicle. *Int J Res Orthop.* 2017;3:619-22.
19. Zlowodzki M1, Zelle BA, Cole PA, Jeray K, McKee MD; Evidence-Based Orthopaedic Trauma Working Group. Treatment of acute midshaft clavicle fractures: systematic review of 2144 fractures: on behalf of the Evidence-Based Orthopaedic Trauma Working Group. *J Orthop Trauma.* 2005;19(7):504-7.
20. Lee SK, Lee JW, Song DG, SikChoy W. Precontoured Locking Plate Fixation for Displaced Lateral Clavicle Fractures. *Orthopedics.* 2013;36(6):801-7.
21. Gheorghiu D, Sinopidis C, Brown DJ. Treatment of Acute Clavicle fractures with an Anatomical Congruent Plate. *J Surg.* 2013;1(2):8-10.
22. Hundekar BB. Internal Fixation of displaced middle third fractures of clavicle with precontoured locking plate. *J Orthop.* 2013;10:79-85.
23. Canadian Orthopaedic Trauma Society. Non Operative treatment compared with plate fixation of displaced midshaft clavicular fractures: A multicenter, randomised, clinical trial. *J Bone Joint Surg Am.* 2007;89:1-10.
24. Drosdowech DS. Biomechanical Analysis of Fixation of Middle Third Fractures of Clavicle. *J Orthop Trauma.* 2011;25(1):39-43.

**Cite this article as:** Naidu EDK, Anand AV. A clinical study of displaced clavicle fractures treated with precontoured locking compression plate. *Int J Res Orthop* 2017;3:1122-6.