

Study of Displaced Midshaft Clavicle Fractures Treated with Plate Osteosynthesis

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Abstract:

Background: Clavicle fractures are on the rise in recent years. Studies suggest high rate of malunion and non-union associated with these fractures. Operative treatment leads to improved short-term functional outcomes, increased patient satisfaction, an earlier return to sports and lower rates of non-union compared with conservative treatment.

Methods: This is a prospective study conducted at a tertiary trauma care center. The inclusion criteria included age between 16 and 60 with acute isolated closed displaced mid-shaft clavicle fracture which were treated by open reduction and internal fixation with anatomical locking compression plate.

Results: In this study, the mean age group of patients was 35.70 years of life with others ranging from 16 to 60 years. Out of 34 patients, 28 (82%) patients were male and 6 (18%) were female. Right side clavicle was affected in 11 patients and left was affected in 23 patients. The mean time of union in operative group was 12.4 weeks. The constant shoulder score was 86.5 in the study. Fracture union was noted in all cases by 12 weeks.

Conclusion: In this prospective cohort study, plate fixation of middle third clavicle fractures showed excellent osteosynthesis. The patients experienced better functional outcome, immediate pain relief, early return to activities of daily living while avoiding complications.

Keywords: Clavicle fractures, Locking compression plate, Constant-Murley score.

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Introduction

The clavicle is one of the most commonly fractured bones in the human body representing 2.6% to 4% of all adult fractures. [1] Nearly 80% of the clavicle fractures occur in the midshaft of the bone. This is due to the typical compressive forces applied to the shoulder and the narrow cross section of the bone. It plays a critical role in the formation of the shoulder girdle and superior shoulder suspensory complex.

A direct blow on the point of the shoulder is the commonest reported mechanism of injury that produces a midshaft fracture of the clavicle. The management of clavicle fractures has been traditionally done by non-operative method. However, recent studies have reported malunion rates of 14-36% and non-union rates of 4-29%. Hill et al. [2] examined 66 consecutive patients with displaced midshaft clavicle fractures and they found an unsatisfactory outcome in 31%, as well as a non-union rate of 15%. Zlowodzki et al. [3] found that the non-union rate for nonoperatively treated

displaced midshaft clavicle fractures was 15.1%. The recent trend has been towards surgical fixation of displaced clavicle fractures. Primary fixation has shown good results with a high union rate and a low complication rate.

After considering patient comorbidities and functional goals, midshaft clavicle fractures featuring >2 cm of shortening or ≥100% of displacement should be considered for open reduction and internal fixation. [4] The options for plate fixation include low contact dynamic compression plates, which are strong but difficult to contour and cause soft tissue irritation. And reconstruction plates are easier to contour but lack sufficient mechanical strength. [5]

The purpose of this study is to assess the clinical and radiological outcome of a pre-contoured congruent clavicle plate in the treatment of acute, displaced, mid-shaft clavicle fractures.

Aim and Objectives

- To study the functional and radiological outcome following the use of precontoured clavicular locking plates.
- To study the advantages and disadvantages associated with precontoured clavicular locking plates.
- To study complications associated with anatomical Locking plate and screws

Materials and Methods

This is a cross sectional study conducted a tertiary care center in Bangalore between June 2019 to December 2021.

Inclusion Criteria:

1. Age 16 - 60 years.
2. Males and females.
3. Robinson 2B1 & 2B2 clavicle fractures
4. Fracture with >2 cm of shortening
5. Fracture with Displacement >2 cm
6. Open fractures Type1 and 2 according to Gustilo Anderson classification

Exclusion Criteria:

1. Patient who refused to participate in the study
2. Age <16 years or >60 years
3. Fractures of medial and lateral end clavicle
4. Open fractures Type 3 according to Gustilo Anderson classification
5. Fracture associated with neurovascular injury

Statistical analysis:

The patients were evaluated for pain, functional assessment, strength measures and range of motion based on VAS score and Constant shoulder score. The data collected and computed by simple average statistics and standard deviations.

Methods:

Data was collected from patients admitted in a tertiary care center. All patients included in the study were assessed clinically and confirmed radiologically for a mid-shaft clavicle fracture. Patient who met the inclusion and exclusion criteria after surgical management by plate and screws were included in the study. The patients were followed up regularly at 6,12, 24 weeks and 1 year. In This Study Fractures were classified as 2B1 & 2B2 by Robinsons Classification only were included in the study. The Fracture was considered united when there was no Tenderness clinically and Radiologically Fracture line was not visible.

Operative Technique

Under general anesthesia or regional block, the patients were placed in the supine position with a sandbag given between the scapulae. An anterosuperior approach was used. The skin, subcutaneous tissue and platysma were retracted and careful periosteal stripping was done. The fracture was anatomically reduced and held with bone clamps and anatomical plate applied to the superior surface of the clavicle as a neutralization plate held with 3.5mm screws. An interfragmentary lag screw was used in cases with oblique fractures. Contouring of the plate was not required. Care was taken during drill not to injure the neurovascular structures. Post-operatively, patients were given sling or arm pouch for comfort up to 2 weeks. Wound was inspected on 2nd day and staples or sutures were removed by 12th post-operative day. The patients were started on physiotherapy exercises as tolerated as early as 3 weeks and encouraged to do full range of motion by 6 weeks.

Post-operative protocol

Arm pouch was used to immobilize the operated limb. Physiotherapy of the operated arm was started at the end of 3 days. The patients were started on pendulum exercises at the shoulder in the arm pouch as tolerated. After 6 weeks postoperatively, active range of motion of the shoulder was allowed in all planes. Regular follow-up for all the patients was done at 6,12,18,24 weeks and 1 year. The outcome was measured using the constant Murley Score. [6]

Results

Out of 34 patients in our study, the mean age group of patients was 35.7 years ranging from 16 to 60 years as shown in table 1. Out of 34 patients, 28 (82%) patients were male and 6 (18%) were female. In our study, 25 patients had a history of road traffic accidents, while 9 had a history of fall on outstretched hand.

Right side clavicle was affected in 11 patients and left was affected in 23 patients (table 2). The mean time of union in operative group was 12.4 weeks described in table 5. The mean constant shoulder score was 86.5 in the study. Plate prominence was noted in one patient in the study. Two patients in the postoperative period had stiffness of the shoulder and one patient had a Hypertrophic scar as seen in figures 4 and 5. There was no case with superficial infection/deep infection/numbness at surgical site/medial sternoclavicular pain in our study.

Table 1: Age distribution of patients

Age (years)	20	21-29	30-39	40-49	50-59	60
No. of cases	02	11	10	06	03	02
Percentage	5.8%	32.35%	29.41%	17.64%	8.8%	5.8%

Table 2: Demographic analysis of the study

Sex	
Male	28
Female	6
Mechanism of Injury	
RTA	25
Fall	09
Side of Injury	
Right	11
Left	23

Table 3: Length of the plate used

Length	No. of Cases	Percentage
5 Holed	03	8.57
6 Holed	07	20
7 Holed	20	57.15
8 Holed	05	14.28

Table 4: Complications

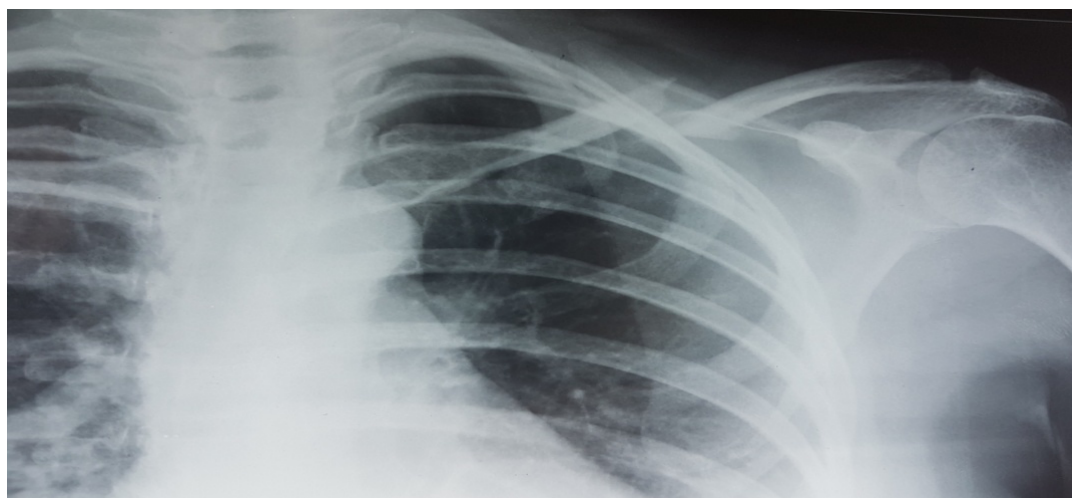
Complication	Number Of Cases
Malunion with cosmetic deformity	0
Non-union	0
Plate prominence	1
Scar problems	1
Restriction of ROM	2

Table 5: Time of Union

Time for Union	No. of Cases	Percentage
10-12 Weeks	02	5.88 %
12-14 Weeks	26	76.47 %
14-16 Weeks	05	14.70 %
16-18 Weeks	01	2.94 %

Table 6: Outcome according to Constant Murley Score

Outcome	No of Patients	Percentage
Excellent	24	70.58
Good	8	23.52
Fair	2	5.88
Poor	0	0

**Figure 1: Fracture of mid-shaft of right clavicle**

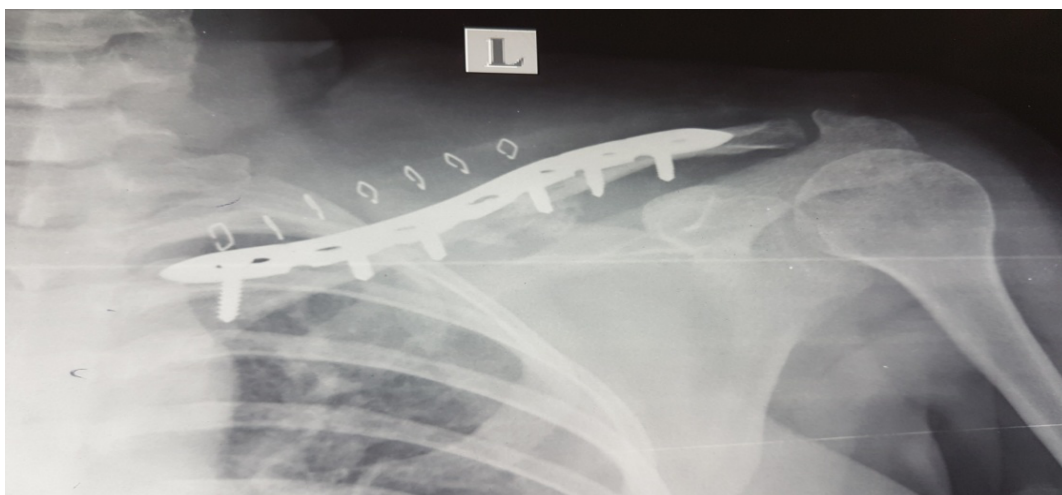


Figure 2: Post-operative fixation with locking compression plate

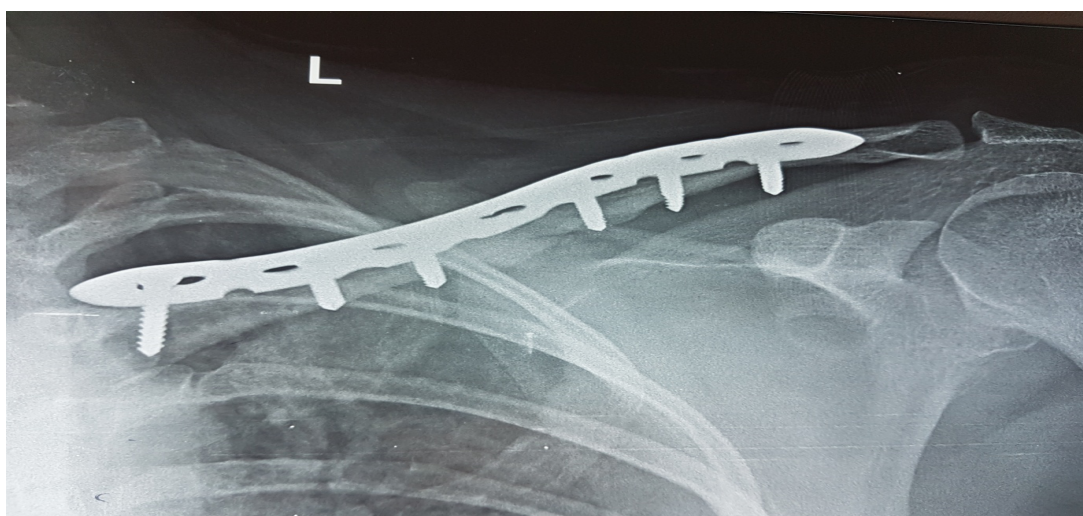


Figure 3: X-ray at 12 weeks



Figure 4: Plate Prominence



Figure 5: Hypertrophic Scar

Discussion

Clavicle fractures since ancient times are being treated by conservative methods such as clavicle brace and arm sling support. These nonoperative methods of treatment of all clavicle fractures produced better results in the general population but not in people like manual laborers who require overhead abduction of limb regularly. Neer [7] published a series in 1960 of over 2,000 clavicle fractures treated non-operatively and found only a 0.13% non-union rate. [8] More recent literature has found this number to be much higher, reaching up to 15% in some studies. A meta-analysis by McKee RC, have shown an incidence of nonunion as high as 30% with conservative treatment. Other complications such as persistent pain, decreased shoulder function have been seen in patients treated nonoperatively. [9]

Operative management with open reduction has the advantage of direct visualization and being less technically demanding. The advantage of this is the restoration and preservation of the natural anatomy and length of the fractured clavicle. With the advent of locking plate, a stable internal fixation can now be achieved; especially in patients with poor bone quality and comminution [10] the risk of complications should not be ignored. Operative management is associated with neuropathy of the supraclavicular nerve, infection, pneumothorax, implant failure and the need for hardware removal due to hardware-related complaints. [11] There are reports of lower non-union rates of approximately 2%. Woltz et al. reported a relative risk of nonunion to be 0.14. An improved patient satisfaction and earlier return to work compared with conservative treatment is also reported. [12] Karibasappa et al. [13] in 2014 studied 50 patients of acute displaced mid-shaft clavicular fractures treated either by surgical management with plate osteosynthesis as Group I ($n = 25$) or by conservative management Group II ($n = 25$).

Follow-up was done at 3, 6, 12 weeks, 6 months, and 1 year and Constant shoulder score were used to assess fracture union time, complications, and functional outcome. They reported union in all cases of Group I with two cases of symptomless malunion (8%) and one case of delayed union (4%). In Group II, they observed 4 cases of nonunion (16%), 6 cases of symptomless malunion (24%), and delayed union in 2 cases (8%) was observed. Functional outcome was significantly good in surgically managed group at follow-ups with less time for fracture union than in the group treated conservatively.

Plate osteosynthesis of midshaft clavicle fractures can provide immediate fixation of the fracture facilitating early mobilization. However, complications such as infection, hardware failure and hypertrophic scarring have been reported. Bostman et al. [14] reported that complication and reoperation rate to be as high as 43% and 14% respectively, considering the need for hardware removal. The introduction of anatomically contoured clavicle plates may reduce the need for hardware removal. In a study by Georghiu et al. [4] on 29 patients with midshaft clavicle fractures found LCP to be more effective and reliable due to their low profile nature. Bhundekar et al. [15] reported that fractures treated with LCPs showed early return to function, better cosmesis and less hardware removal.

In this study we studied 34 cases of middle third clavicle fracture treated with precontoured locking compression plate. The results were compared with studies conducted by Kulshrestha et al. [16], Virtanen et al. [17], and Smekal et al. [18] as shown in table 7. The patients were analyzed statistically by the age distribution, gender, mode of injury, time taken for union, range of movements achieved at the end of study. The functional outcome was assessed with Constant Murley score. [6]

Table 7: Comparative data analysis

Age	
Vikas Kulshreshta [16]	32
Virtanen [17]	41
Smekal [18]	35.5
Present Study	35.7
Time Of Union	
Vikas Kulshreshta [16]	12
Virtanen [17]	10
Smekal [18]	14
Present Study	12.4
Constant Murley Score (1 Year)	
Vikas Kulshreshta [16]	89.3
Virtanen [17]	86.5
Smekal [18]	97.9
Present Study	86.5

Conclusion:

The small sample size remains the limitations of the present study. Fractures of the middle third clavicle treated by plate fixation using a precontoured locking compression plate showed excellent osteosynthesis. The patients experienced better functional outcome, immediate pain relief, and early return to activities of daily living and less complications. To conclude meticulous soft tissue handling, minimum periosteal stripping & proper selection of Anatomical contoured locking plate & regular follow-up help in good to excellent results.

Consent and Competing Interests

The patient has given their informed consent. The author(s) declare that they have no competing interests.

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