

## Original Research Article

# Comparative study of plating versus conservative treatment in mid shaft fractures of clavicle

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## ABSTRACT

**Background:** Clavicle fractures represent up to 4% and 1% of all fractures, respectively. Historically, both fracture types have been treated conservatively with acceptable outcomes. The surgical correction of these fractures is currently being investigated as a viable alternative to conservative management.

**Methods:** A systematic search of PubMed was performed to identify articles comparing open reduction and internal fixation (ORIF) with conservative treatment for clavicular fractures. Specific outcomes of interest were shoulder function, pain, strength, range of motion, and risk of non-union.

**Results:** ORIF of midshaft clavicular fractures results in increased shoulder function within 6 weeks following treatment and a decreased risk of non-union. After 1 year, there was no longer a difference in shoulder function between groups. There was no difference in pain between treatment groups. Both ORIF and conservative treatment of extraarticular scapular fractures yield comparable results in shoulder function, range of motion, and strength following treatment.

**Conclusions:** This study, early primary plate fixation of comminuted mid shaft clavicular fractures results in improved patient-oriented outcomes, improved surgeon-oriented outcomes, earlier return to function and decreased rates of non-union and malunion.

**Keywords:** Clavicle, Conservative, Fracture, Mid shaft, Plate

## INTRODUCTION

Clavicle fracture account for approximately 2.6% of all fractures and for 44% to 66% fractures about the shoulder. Middle third fractures account for 80% of all clavicle fractures whereas fractures of lateral and medial third of the clavicle account for 15% and 5% respectively. Most minimally displaced clavicle fractures can be successfully treated non-operatively with some forms of immobilization.<sup>1-25</sup>

The clavicle is an S-shaped bone that acts as a strut between the sternum and the gleno-humeral joint. It also has a suspensory function to the shoulder girdle. The shoulder hangs from the clavicle by the coraco-clavicular ligament.

The most commonly used system of classification of clavicular fractures is that of Allman. It is divided into 3 groups: group I: Middle-third fractures, group II: Lateral-third fractures and group III: Medial-third fractures.

Mid-clavicular fracture is one of the common injuries of the skeleton, representing 3% to 5% of all fractures and 45% of shoulder injuries. The annual incidence of mid clavicular fracture is 64 per 100000 population. Open clavicular fracture is an absolute rarity, found in only 0.1% to 1% of cases. The rate of mid clavicular fractures is more than twice as high in men as in women. The peak incidence occurs in the third decade of life.<sup>26-43</sup>

The incidence of non-union of mid clavicular fractures is usually quoted as being from 0.1 to 0.8%, and traditionally

treatment has been given non-operative. Surgical treatment of acute middle one third clavicle fractures was not favored due to relatively frequent and serious complications. These data, however, are based on studies in which clavicle fractures were not adequately classified regarding patient age and fractured is placement. More, recent data, based on detailed classification of fractures, suggest that the incidence of non-union in displaced comminuted mid shaft clavicular fractures in adults is between 10 and 15%.<sup>37</sup>

The prevalence of non-union normal-union in dislocated mid shaft clavicular fractures after conservative treatment is higher than previously presumed and fixation methods have evolved. The patients treated conservatively has varying amount of pain and disability during the first three to six weeks and this factor has been underrated. Pressure from a displaced fragment on the retro-clavicular part of the brachial plexus can cause symptoms after conservative treatment. Also, persistent wide separation of fragments with inter position of soft tissue may lead to failure of closed reduction. There is 15% non union rate in widely displaced fractures of middle-third of the clavicle treated without surgery, and all fractures with initial shortening of more than 2 cm resulted in nonunion.<sup>26</sup>

In a large number of complex clavicles fractures a satisfactory out-come is possible with a low complication rate using a locking compression plate.<sup>46</sup> Primary internal fixation of displaced comminuted mid-shaft clavicular fractures leads to predictable and early return to function.<sup>38</sup>

But treating fracture clavicle by surgical methods are not complication free, there can be scar hypertrophy, superficial and deep infection, non-union, delayed union, implant loosening and breakage, iatrogenic brachial plexus injury or great vessel damage.

Majority of clavicle fractures are benign, but it can be associated life-threatening intra-thoracic injuries based on the location of fracture. Fracture of the clavicle is associated with delayed union or non-union, brachial plexus injury, compression or laceration of the great vessels, trachea, or esophagus, injuries to the neurovascular bundle and the pleura or apex of lung, poor cosmetic appearance, pneumothorax and intra-thoracic injury.

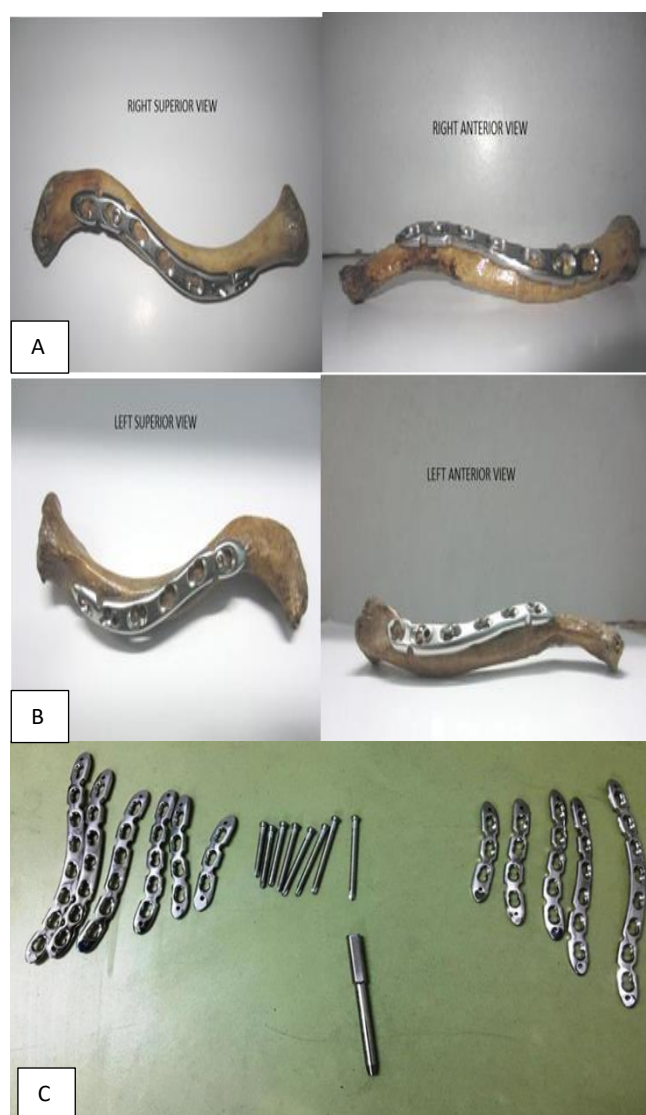
There are various methods for surgically treating clavicle mid-shaft fractures, such as intra-medullary K-wires or Steinmann pins fixation and plate fixation. Plates when used for fixation can attain firm anatomical reduction in severe displaced or comminuted fracture. There are various plates including Sherman plates, dynamic compression plates, locking clavicle plates and semi tubular plates. Among all these, clavicle locking compression plate (LCP), which is pre contoured to an S-shaped as per the curvature of the clavicle, are the most preferred. In the conservative stream, various braces are introduced to immobilize the mid third clavicle especially Parham support, Bohlers brace, Taylor's support, Velpeau

wrap, Billington yoke and commercial figure of eight brace. Among the conservative braces, the commercial figure of eight brace is the most commonly used one. This study aims to obtain a deeper understanding of results and problems associated with both conservative and surgical procedure (ORIF with Clavicular LCP) in treating fracture mid-third clavicle and, to evaluate the functional outcome after each treatment.

**Aim and objectives**

The aim of the study is to analyze and compare the functional out come between surgical and conservative management of middle third clavicle fractures at the department of orthopaedics, R. N. T. medical college, Udaipur, Rajasthan between February 2019 and September 2020.

**Plate placement illustration of anatomical pre contoured locking compression plate**



**Figure 1 (A-C): Both right and left plates, locking screws, cortical screws, drill bit and drill sleeve.**

## METHODS

This comparative study was conducted in the department of orthopedic surgery, govt. Maharana Bhupal hospital and R. N. T. Medical College from February 2019 to September 2020. Ethical committee approval was obtained. Patients with mid shaft clavicle fractures were randomly selected and divided into two groups, one group who were treated with locking plates using anatomical pre-contoured locking compression plate and the other group treated conservatively. We chose to compare between these two modalities of treatment as one was the latest advancement in orthopedics and the other one being the most followed and preferred treatment by many orthopedic surgeons until recently and historically.

### *Inclusion criteria*

Patients in the age group of above 18 years, Robinson type 2B fractures, closed fractures, and fractures reported within 9 days of injury were included in the study.

### *Exclusion criteria*

Other simultaneous upper limb fractures, former surgery of the shoulder, former chronic illness of the shoulder, associated nerve or vessel damage of the affected arm, compound fractures were excluded from the study.

### *Surgical technique for fixing mid shaft clavicle fractures using anatomical pre contoured LCP*

#### *Pre operative planning*

The preoperative radiographs were taken in all cases to determine the length of the plate and the position of the screw.

#### *Position and preparation*

Patient was kept in supine position on a radio lucent operating table with enough are a provided for the movement of c-arm at 45° in both directions to view the clavicle in two planes.

Operative site including the arm was prepared and draped so that it can be mobilized intra-operatively and could be used as are duction aid.

Preoperative antibiotics were usually given within one-hour before surgery after a test dose.

#### *Surgical approach*

Skin incision-a gentle curvi linear incision was made parallel to the skin cleavage lines.

The supra clavicular nerve branches were identified during the subcutaneous dissection and protected, which is usually difficult.

The platysma was divided to expose the clavicle periosteum at the delto-trapezial fascia.

The periosteum was then minimally dissected to expose the fracture site.

### *Post operative care and rehabilitation*

The arm was maintained in as ling on a full-time basis for two weeks. Pendulum movements of shoulder was started within two days with limb rested in arms ling. Suture removal was done on the 12<sup>th</sup> post operative day. After two weeks, the wound status was assessed and use of the sling was discontinued and active assisted range-of-motion exercises of the shoulder in the scapular plane were started. After four weeks, full active motion was initiated. When there were clinical and radiographic signs of union noted (usually at six to eight weeks), strengthening and resistive exercises of the rotator cuff, deltoid and trapezius were started. After clinical and radiological union, most patients were allowed to participate in sports activities usually by three to four months. All the patients were reviewed on 2<sup>nd</sup> week, 4<sup>th</sup> week, 6<sup>th</sup> week, 8<sup>th</sup> week and then every month for the next three months and thereafter once in 7 three months. In our study, the follow up period ranged from 6 to 18 months with average of 10 months. At three months and 6 months follow up, patients functional outcome were assessed using DASH questionnaire. Radiological evaluation of the union was done by taking serial x-rays. Radiological union was assumed to be achieved when there were bridging trabeculations across the fracture site on three of four cortices at the fracture line. Any changes in the alignment, screw pull out or implant failure were also noted. Functional outcome was based on the constant and Murley scoring system which includes both subjective and objective variables and DASH score.<sup>14</sup>

### *Conservative management*

Patients not willing for surgery were in variably included in this group. All patients were applied with figure of 8 bandage. It was continued for 4 weeks with reinforcing of bandage at 2 weeks. At the end of 4 weeks bandage was removed and was started on with pendulum exercises. When radiological signs of union was noted, strengthening and resistive exercises of the rotator cuff, deltoid and trapezius were started. Union was assessed radiologically at every follow up at 2 weeks, 4 weeks, 6 weeks, eight weeks. Then at one month interval for next three months and every three months from there on. We had follow up period range of 6 to 18 months with average of eight months.

## RESULTS

In our study of 36 patients, surgical group had an average age of 34.3 ranging from 21-50 years and conservative group had an average of 41.3 ranging from 20-66 years. Maximum number of patients in surgical group belonged

to 30 to 39 years whereas in conservative group it was between 40 to 49 years.

Total number of males in surgical group were 13 and conservative group were 11. Total number of females in surgical group were 5 and conservative group were 7.

Maximum number of cases in both groups were due to road traffic accidents. The 50% in surgical group and 40% in conservative group.

In surgical group we had 11 (61%), patients with right side injury and in conservative group it was 12 (66%) patients with injured right side. In total maximum number of cases in our study had right sided injury. All patients in the study are right hand dominant.

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in our study had right sided injury. All patients in the study are right hand dominant.

Complications were encountered in 4 patients in surgical group. Two patients had hardware irritation, 1 patients developed superficial infection which settled with intravenous anti biotics within 7 days, 1 patient developed numbness over the clavicular region, which resolved spontaneously after 11 weeks.

In conservative group we observed 3 malunions and 3 non-unions. Patients with non-unions proceeded with further appropriate treatment.

Post operative pain was recorded on a scale of 0-5 points. At six months followup 17 (95%) patients had no pain and 1 (5%) patients had mild pain in surgical group and in conservative group, 12 (66.6%) patients had no pain, 3 (16.7%) patients had mild pain and 3 patients (16.7%) had no pain after unusual activities.

**Table 1: Age distribution.**

Age (years)	No. of patients		Percentage (%)		Males		Females	
	Surgical	Conservative	Surgical	Conservative	Surgical	Conservative	Surgical	Conservative
20-29	5	5	28	28	3	4	2	1
30-39	8	2	45	11	7	2	1	0
40-49	4	6	22	34	2	1	2	5
50-59	1	2	5	11	1	2	0	0
60-69	0	3	0	16	0	2	0	1

**Table 2: Sex distribution.**

Sex	No. of patients		Percentage (%)	
	Surgical	Conservative	Surgical	Conservative
Male	13	11	72	61
Female	5	7	28	39

**Table 3: Grouping of patients.**

Sex		Groups		Total
		Surgical fixation with locking	Conservative treatment	
Male	Count	13	11	24
	% within sex	54.1	45.9	100
	% within group	72.2	61.1	66.6
Female	Count	5	7	12
	% within sex	41.6	58.4	100
	% within group	27.8	38.9	33.4
Total	Count	18	18	36
	% within sex	50	50	100
	% within group	100	100	100

**Table 4: Mode of injury.**

Mode of injury	No. of patients		Percentage (%)	
	Surgical	Conservative	Surgical	Conservative
Road traffic accidents	9	7	50	40
Self-fall	6	4	33	22
Assault	3	7	17	38

**Table 5: Involved side.**

Sides	No. of patients		Percentage (%)	
	Surgical	Conservative	Surgical	Conservative
Right	11	12	61	66
Left	7	6	39	34

**Table 6: Complications.**

Complications	No. of patients
<b>Surgical</b>	
Hardware irritation	2 (11)
Superficial infection	1 (5)
Numbness	1 (5)
<b>Conservative</b>	
Malunion	3
Non-union	3

**Table 7: Evaluation of pain.**

Pain scale	Points	No. of patients			
		At 3 months (%)		At 6 months (%)	
		Surgical	Conservative	Surgical	Conservative
No pain	5	14 (77.8)	9 (50)	17 (95)	12 (66.6)
Mild pain	4	3 (16.7)	5 (27.8)	1 (5)	3 (16.7)
Pain after unusual activities	3	1 (5.5)	4 (22.2)	-	3 (16.7)
Pain at rest	2	-	-	-	-
Marked pain	1	-	-	-	-
Complete disability	0	-	-	-	-

**Table 8: Range of movements.**

Shoulder movements	Average	
	Surgical	Conservative
Flexion	172.5	151.3
Abduction	172.2	150.5
External rotation	78.0	64.7
Internal rotation	77.2	65.8

**Table 9: Fracture union.**

Fracture type	Average time for union (weeks)	
	Surgical	Conservative
Type 2B1	6.45	7.81
Type 2B2	6.57	7.0
Combined	6.44	7.06

**Table 10: Functional evaluation using constant score.**

Result	Constant score	No. of patients		Percentage (%)	
		Surgical	Conservative	Surgical	Conservative
Excellent	86-100	15	4	83	23
Good	71-85	3	10	17	55
Fair	56-70	0	2	0	11
Poor	1-55	0	2	0	11

**Table 11: Functional outcome using DASH's core.**

Variables	Groups	N	Mean	Std. deviation	Std. error mean	P value
<b>DASH score-3 months</b>	Surgical fixation with locking	18	29.27	3.322	0.783	0.001
	Conservative treatment	18	34.22	4.857	1.144	
<b>DASH score-6 months</b>	Surgical fixation with locking	18	10.77	3.040	0.716	0.000
	Conservative treatment	18	23.66	4.862	1.146	
<b>DASH score-difference</b>	Surgical fixation with locking	18	18.50	4.853	1.144	0.000
	Conservative treatment	18	10.56	3.203	0.755	

The range of motion with flexion, abduction, external and internal rotation were measured in both groups after 6 months of followup using goniometer and was recorded. The average range of motion in the surgical group was found to be better than the conservative group.

Average time for union in surgical group was 6.45 and 6.57 weeks for type 2B1 and 2B2 fractures respectively whereas, in conservative group it was 7.81 and 7 weeks for type 2B1 and 2B2 fractures after excluding the three non-unions which were observed. Overall average radiological union time in surgical group was 6.44 weeks, range being 6-8 weeks and in conservative group it was 7.06 weeks ranging from 6-10 weeks.

We evaluated functional outcome using constant score in both groups. Surgical group showed 83% excellent and 17% good outcome whereas conservative showed 23% and 55% of excellent and good outcome along with 11% fair and 11% of poor outcome. All were evaluated at the end of 6 months of follow up.

In this study we treated 36 patients of mid shaft clavicle fractures using two different modalities of treatment and divided it into two groups accordingly. One group was treated surgically using anatomically pre-contoured LCP and the other group treated conservatively using figure of 8 bandage. We included 18 patients in each group for the study.

We evaluated the functional outcome of the patients using constant-Murley shoulder score at 6 months follow up and DASH score twice at 3 months and 6 months follow up period.

We did the statistical comparison between the outcomes of surgical fixation and conservative management and level of significance is determined by  $p < 0.05$ . Value was determined using Pearson chi square and independent sample t test. Constant score done at the end of 6 months showed a  $p = 0.000$  which is considered significant. The surgical group had significantly superior (lower) DASH score at both 3 months and 6 months follow up. The  $p < 0.001$  which is considered significant.

## DISCUSSION

In our comparative study we have compared the functional outcome of mid shaft clavicle fractures treated surgically using anatomical pre-contoured LCP and conservative management. We divided the patients in to two groups randomly and some those who were not willing for surgical treatment were included directly into conservative group and analyzed the result.

Most of the orthopedic surgeons prefer too pt for non-operative treatment for non-displaced middle-third fractures of the clavicle, using a sling or a figure 8 support. Still the ideal treatment modality for acute displaced middle-third fractures of the clavicle remains controversial.<sup>29</sup>

Although most of the middle-third clavicle fractures treated conservatively seems to unite uneventfully, studies now show to have higher rates of non-union and patient dissatisfaction to be associated with it in the final result.<sup>15</sup>

A prospective randomized controlled trial by the Canadian orthopaedic trauma society compared plate and screw fixation with non-operative treatment for displaced middle-third clavicle fractures.<sup>36</sup> The functional outcome was assessed using constant shoulders cores and DASH scores, which were significantly improved the operative fixation group at all time-points ( $p = 0.001$  and  $p < 0.01$ , respectively). Similar to COTS study, our study also revealed a significant p value when the functional outcome was measured using constant and DASH scores favouring surgical fixation.

## Limitations

Our study had some of the limitations-We had limited number of cases in the stipulated period of time, minimum follow up of the patients, included only Robinson type 2B fractures also to for the patterns of clavicle fractures being left out, did only plating in surgical group as intramedullary fixations are also available, hence, we recommend a multicenter randomized study comparing various modalities of surgical fixation for mid shaft

clavicle fractures with long term followup and adequate number of patients.

## CONCLUSION

In this study, we observed better functional out come in surgically treated patients compared to conservatively managed patients.

We achieved excellent functional outcome and did not encounter either delayed union or non-union in surgical group.

While we stress that our findings such as improved DASH score, better constant score, early return to work, no nonunion, no malunion, decreased pain in surgical fixation with significant  $p=0.000$  in constant score and  $<0.001$  in DASH score are applicable to certain sub set (Robinson type 2B) of clavicle injuries but our data supports surgical fixation using anatomical pre-contoured locking compression plate in displaced mid shaft clavicle fractures for better functional outcome, early return to work, saving man-hour, decreased non-union and decreased mal union.

Hence, we conclude that primary surgical fixation of mid shaft clavicle fractures using anatomical pre contoured locking compression plate inactive adults gives better functional outcome, early return to work, decreased rates of non-union.

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

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