

# Plating Versus Conservative Treatment in Mid Shaft Fracture of Clavicle

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## ABSTRACT

**Background:** A Clavicle fracture is a common traumatic injury as it positions directly under the skin. Both conservative and operative methods are used for the treatment of this fracture. But there is no uniform agreement on the best choice of treatment. So, this study aims to assess the outcome of the conservative treatment and operative treatment by using plate and screw of midshaft fracture of clavicle and comparing the two treatment methods. **Patients and methods:** This study was done at the Department of Orthopedic Surgery of Zagazig University Hospital from April 2020 to December 2020 on 18 patients are involved then these patients were subdivided into two groups, Group A (9 patients) for conservative treatment and Group B (9 patients) for operative treatment by using a plate and screw fixation. **Assessment of the outcome using the constant shoulder score. Results:** The time of union was  $5.33 \pm 0.70$  months in the conservative group and  $4.66 \pm 0.86$  months in the operative group. Constant shoulder score was in Conservative group 4 patients had excellent score (44.4%), 2 patients had good score (22.2%), 3 patients had poor score (33.3%) While in Operative group 6 patients had excellent score (66.6%), 1 patient had good score (11.1%), 2 patients had poor score (22.2%). **Conclusion:** The non-surgical methods still the best treatment of simple nondisplaced mid-shaft clavicular fractures. The operative methods donate a good result in active athlete's patient with displaced or comminuted fracture.

**Keywords:** Clavicle, Fracture, Mid-shaft, Plating

## INTRODUCTION

The collarbone (clavicle) is a long bone that serves as a strut between the shoulder blade and the sternum or breastbone [1].

Clavicle fractures are commonly classified according to the Allman classification and/or the Robinson classification. The location and type of fracture are important in the decision-making as it influences management strategies [2].

Treatment of clavicular fractures in adults can be done either by conservative or surgical methods. Many different methods of clavicle immobilization have been described and can be summarized as a sling, strapping, or a combination of both. Although non-surgical management may be optimal for many clavicular fractures, good outcomes of non-surgically treated fractures are not universal [3].

Undisplaced fractures of the clavicle have a high rate of union, and the functional outcomes are good after non-operative treatment. Non-operative treatment of displaced fractures may be associated with a higher rate of mal-union and functional deficits. However, it remains difficult to predict which patients will have these complications [4].

A variety of complications can be associated with clavicle fractures, regardless of the form of treatment. Displaced clavicle fractures can be associated with skin necrosis, neurovascular injury, pneumothorax, nonunion, mal-union, posttraumatic arthritis, and refractor. Complications associated with surgical intervention can include infection, scarring, prominent hardware, and additional surgical complication. Careful patient assessment and individual treatment plans can help minimize the complications associated with the management of clavicle fractures [5].

**The current work aims** to assess the outcome of the conservative treatment and operative treatment by using plate and screw of midshaft fracture of clavicle and compare between the two methods of treatment.

## **PATIENTS AND METHODS**

This study was done at the Department of Orthopedic Surgery of Zagazig University Hospital from April 2020 to December 2020. 18 patients are involved then these patients were subdivided into two groups, **Group A** (9 patients) for conservative treatment and **Group B** (9 patients) for operative treatment by using plate and screw fixation. Follow-up was done for a period of eight months by clinical examination and radiographic x-rays assessing the outcome and possible complication. Functional outcome was assessed using the Constant Shoulder Score [6, 7].

Written informed consent was obtained from all participants and the study was approved by the research ethics committee of the Faculty of Medicine, Zagazig University. The work has been carried out by The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans

### **Inclusion Criteria:**

**Conservative (Group A):** None displaced mid-shaft clavicular fractures, displaced mid-shaft clavicular fractures with less than 2cm shortening.

**Operative (Group B):** Displaced mid-shaft clavicular fractures with more than 2cm shortening, Open midshaft clavicular fractures, clavicular fracture with skin tenting, clavicular fracture with ipsilateral upper limb injury, clavicular fracture with neurovascular injuries, Floating shoulder (clavicle and scapula neck fracture), clavicular fracture in the multi-trauma patient.

**Exclusion criteria:**

**Conservative (Group A):** Displaced mid-shaft clavicular fractures with more than 2cm shortening, Open midshaft clavicular fractures, clavicular fracture with skin tenting, clavicular fracture with ipsilateral upper limb injury, clavicular fracture with neurovascular injuries, Floating shoulder (clavicle and scapula neck fracture), clavicular fracture in the multi-trauma patient.

**Operative (Group B):** None displaced mid-shaft clavicular fractures. Displaced mid-shaft clavicular fractures with less than 2cm shortening. Lateral third fractures clavicle. Medial third fractures clavicle.

**All patients were subjected to the following:**

**History Taking** (Name, age, sex, address, phone number, and occupation).

**General Examination:** The patient was fully examined systematically for any other associated injuries and co-morbidities.

**Local examination:** Complete assessment was done for the injured area giving attention to open wounds. Documentation of sensory affection by pinprick test and vascularity by capillary refill test was performed for the affected limb.

**Radiographic evaluation:** Standard AP x-ray view will be taken for evaluation of the fractures. CT scan if needed for associated injury.

**Laboratory Investigations:** In the form of routine labs; complete blood picture, renal function tests, liver function tests, and Coagulation profile.

**Conservative treatment:**

**Broad arm sling:** The upper limb of the affected side is immobilized in internal rotation for 3-4 weeks. Self-mobilization of the elbow out of the sling is required several times a day to avoid stiffening of the elbow (fig 1).

**Figure-of-eight brace:** The patient sits on a stool the operator standing behind with his knee between the patient shoulder blades overlay pads of cotton in each axilla. Demotte bandage 15cm wide are bound in front of the shoulder and cross between the shoulder blades in such a way that both shoulders are braced back. The limb is supported by a triangular sling under the elbow and forearm (fig 2).

**Surgical Technique:** (fig. 3-6)

The patient is positioned in the beach chair position. A transverse incision (7-9cms) along the anterior superior aspect of the clavicle (from the sternal notch to the anterior edge of the acromion) is made. The overlying fascia and periosteum are next divided, in line with the clavicle. This step is performed sharply and down to the bone, leaving thick flaps for later closure. The division is started medial and lateral to the fracture site and then proceeds to the fracture site. The osseous ends are freed from surrounding tissues. Soft tissue is circumferentially removed only from the osseous ends.

The periosteum is then elevated from the superior aspect of the clavicle. At the junction of the medial and middle thirds of the clavicle, the inferior surface is exposed so that a protective instrument can be inserted during drilling. The remaining soft tissue sleeve is left intact. A 3.5-mm reconstruction plate is centered accurately over the fracture site so that at least three screws (3.5-mm cortical) can be placed in each of

the proximal and distal fragments. A lag screw can be placed either through the plate or directly into the bone at roughly a 90-degree angle to the fracture line.

Following wound irrigation, meticulous closure is performed in two layers. The myofascial layer is closed with absorbable sutures in an interrupted fashion. Then the subcutaneous tissues are closed with absorbable sutures, and the skin is closed with a subcuticular stitch or staples. The incision is infiltrated with local anesthesia 0.5% bupivacaine for post-operation pain, and the arm is placed in a standard sling. An anteroposterior radiograph of the clavicle is made postoperatively.

#### **Patient's assessment:**

The functional outcome of the conservative group (A) and operative group (B) was done using the Constant Shoulder Score.

#### **Statistical Analysis:**

Data collected throughout history, basic clinical examination, laboratory investigations, and outcome measures coded, entered, and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represented by mean  $\pm$  SD, the following tests were used to test differences for significance; Difference and association of qualitative variable by Chi-square test ( $\chi^2$ ). Differences between quantitative independent groups by t-test, independent predictors by logistic regression. P-value was set at  $<0.05$  for significant results &  $<0.001$  for high significant result.

## **RESULTS**

Table (1) show demographic ,side, associated injuries, and fracture classification distribution between the group A (Conservative) and group B (Operative) , where in Conservative group mean age was  $39.55 \pm 11.11$ , 5 patients had left side injury (55.6%) and 4 patients had right side injury (44.4%), no patients had associated injury, mode of trauma was Direct fall on the shoulder in 4 patients (44.4%), Direct impact to clavicle in 3 patients (33.3%), Fall on outstretched hand 2 patients (22.2%), classification according to Robinson classification was 2A2 in 2 patients (22.2%), 2B1 in 4 patients (44.4%) and 2B2 in 3 patients (33.3%), while in Operative group mean age was  $36.11 \pm 9.96$ , 6 patients had left side injury (66.7%) and 3 patients had right side injury (33.3%), 1 patient had associated injury (fracture left scapula) (11.1%) and 8 patient had no associated injury (88.9%), mode of trauma was Direct fall on the shoulder in 6 patients (66.7%), Direct impact to clavicle in 1 patients (11.1%), Fall on outstretched hand in 2 patients (22.2%). classification according to Robinson classification was 2A2 in 1 patients (11.1%), 2B1 in 4 patients (44.4%) and 2B2 in 4 patients (44.4%). Table (2) the union time was less among operative cases. Wherein Conservative group 4 Patients had a union at 5 months (44.4%), 4 patients had a union at 6 months (44.4%) and one patient had a union at 4 months (11.1%) with a mean union time of  $5.33 \pm 0.70$  months.

While in the Operative group 5 patients had a union at 4 months (55.5%), 2 patients had a union at 5 months (22.2%) and 2 patients had a union at 6 months (22.2%) with a mean union time of  $4.66 \pm 0.86$  months. Also, there was no significant difference between the studied groups regarding follow-up duration, where it was  $5.44 \pm 0.72$  in the Conservative group and  $5.88 \pm 0.33$  in the Operative group. Table (3) show Result of Constant shoulder score, wherein Conservative group 4 patients had excellent score (44.4%), 2 patients had good score (22.2%), 3 patients had poor score (33.3%) and Three patients had poor score due to mal-union with decreased length of clavicle leading to change the position of glenoid and decrease muscles strength of the shoulder. While in the Operative group 6 patients had excellent score (66.6%), 1 patient had a good score (11.1%), 2 patients had poor score (22.2%) and two patients had poor score one due to associated ipsilateral fracture scapula which treated conservatively and the other was due to plate failure. table (4) showed that There was no significant association or difference regard overall complication but mal-union was significantly associated with the Conservative group, wherein Conservative group 5 patients had no complication (55.6%) and 4 patients had mal-union (44.4%). While in the Operative group 7 patients had no complication (77.8%), 1 patient had an infection (11.1%) and 1 patient had plate failure (11.1%).

**Table (1):** Demographic data distribution between studied groups

			<b>Group 1</b>	<b>Group 2</b>	<b>t/X<sup>2</sup></b>	<b>P</b>
			<b>Conservative</b>	<b>operative</b>		
	<b>Age</b>		39.55±11.11	36.11±9.96	0.692	0.499
<b>Sex</b>	<b>Male</b>	<b>N</b>	6	5	0.23	0.62
		<b>%</b>	66.7%	55.6%		
	<b>Female</b>	<b>N</b>	3	4		
<b>Side of Injuries</b>	<b>Left</b>	<b>%</b>	33.3%	44.4%	0.23	0.62
		<b>N</b>	5	6		
	<b>Right</b>	<b>N</b>	4	3		
<b>Associated injury</b>	<b>fracture Lt. scapula</b>	<b>%</b>	44.4%	33.3%	1.05	0.303
		<b>N</b>	0	1		
	<b>No</b>	<b>N</b>	9	8		
<b>Mode of trauma</b>	<b>Direct fall on shoulder</b>	<b>%</b>	100.0%	88.9%	1.40	0.497
		<b>N</b>	4	6		
	<b>Direct impact</b>	<b>N</b>	3	1		
<b>Robinson classification</b>	<b>Fall on out-stretched hand</b>	<b>%</b>	33.3%	11.1%	0.47	0.78
		<b>N</b>	2	2		
	<b>2A2</b>	<b>N</b>	2	1		
	<b>2B1</b>	<b>N</b>	4	4		

		%	44.4%	44.4%
	<b>2B2</b>	N	3	4
		%	33.3%	44.4%
<b>Total</b>	N	9	9	
	%	100.0%	100.0%	

**Table (2):** Time of union and follow up duration distribution between studied groups

	Conservative (N=9)	Operative (N=9)	t	P
<b>Time of union</b>	5.33±0.70	4.66±0.86	1.789	0.093
<b>Follow up</b>	5.44±0.72	5.88±0.33	1.668	0.115

**Table (3) Constant Shoulder Score** distribution between studied groups

		Conservative (N=9)	Operative (N=9)	t/ X <sup>2</sup>	P
<b>Excellent</b>	N	4	6	0.93	0.62
	%	44.4%	66.7%		
<b>Good</b>	N	2	1		
	%	22.2%	11.1%		
<b>Poor</b>	N	3	2		
	%	33.3%	22.2%		
<b>Total</b>	N	9	9		
	%	100.0%	100.0%		

**Table (4):** Complication distribution between studied groups

		Group		P	X <sup>2</sup>	P	
		Conservative	Operative				
<b>Complication</b>	<b>No</b>	N	5	7	0.061	6.33	0.096
		%	55.6%	77.8%			
	<b>Infection</b>	N	0	1	0.052		
		%	0.0%	11.1%			
	<b>Mal-union</b>	N	4	0	0.00*		
		%	44.4%	0.0%			
	<b>Plate failure</b>	N	0	1	0.052		
		%	0.0%	11.1%			
	<b>Total</b>	N	9	9			
		%	100.0%	100.0%			

## DISCUSSION

In general almost midshaft clavicular fracture unites with surgical or nonsurgical treatment. So, non-surgical treatment was the traditional and established method of treatment. This is approved by low nonunion rates shown by previous studies. However, modern studies show substandard results with high malunion rates in

displaced fractures if treated conservatively. Surgical treatment with the realignment of fractured clavicle and restoration of its normal length can prevent this complication of nonsurgical treatment. Surgical methods provide excellent results with a high rate of union and lower rates of complication in the treatment of displaced clavicular fracture [8].

The current study showed that the age of patients in the conservative group ranged from 21 - 54 years with a mean of  $39.55 \pm 11.11$ , while in the Operative group age ranged from 26 – 58 years with a mean age of  $36.11 \pm 9.96$  with no significant difference regarding age distribution. Regarding sex distribution; in the Conservative group, there were 6 males (66.7%) and 3 females (33.3%), while in the Operative group there were 5 males (55.6%) and 4 females (44.4%) with no significant difference regarding sex distribution. Which is in agreement with the study of **Haque et al., [9]** who found that the mean age was  $31.61 \pm 8.32$  in the Operative Group and  $30.58 \pm 9.56$  in a conservative group with no significant difference between both groups, Inoperative group (n=30) all patients were male whereas in the conservative group male patients were 25 and female patients were 5 with no significant difference between both groups.

Also, **Naveen et al., [8]** reported that there was no statistically significant difference between group A (non-operative) and group B (Operative) concerning age (35.20) for the conservative group and 32.43 for operative,  $p = 0.219$ ) and sex of patients (27 males and 3 females in conservative group and 26 males and 4 females for operative,  $p = 0.999$ ) (118).

The current study showed that in Conservative group (A) 5 patients had left side injury (55.6%) and 4 patients had right side injury (44.4%) while in Operative group (B) 6 patients had left side injury (66.7%) and 3 patients had right side injury (33.3%). The left side was the majority in both groups with no significant difference between both groups. This is in agreement with the study of **Mishra et al., [10]** found that 12 (33.3%) patients acquire clavicular fracture on the left side and 24 (66.7%) patients acquire right side clavicular fractures with no significant difference between studied groups. Also, **Dhakad et al., [11]** reported a total of 28 patients (56%) who acquire left-sided fracture and 22 patients (44%) acquire right-sided fracture with no significant difference between studied groups.

The current study showed that in the Conservative group no patients had associated injury, in Operative group 1 patient had associated injury (fractured left scapula) (11.1%) and 8 patients had no associated injury (88.9%) with no significant difference between studied groups.

**Kale et al., [12]** reported that there were associated injuries in few patients with clavicle fracture who suffered road traffic accidents. The associated injuries were scapulae fracture (2), mandible fracture (1), proximal tibia fracture (1), skull fracture (1), and superior and inferior pubic rami fracture (1). A total of 5 patients (10%) acquire associated injuries; among them, 2 patients (4%) acquire scapular body fracture, 1 patient (2%) acquire a femur fracture and another 2 patients (4%) acquire glenoid fossa and acromion process fracture.

The current study showed that in the Conservative group, the model of trauma was Direct fall on the shoulder 4 patients (44.4%), Direct impact to clavicle 3 patients (33.3%), and Fall on outstretched hand 2 patients (22.2%), while in Operative group (A) mode of trauma was Direct fall on the shoulder 6 patients (66.7%), Direct impact to clavicle 1 patients (11.1%) and Fall on outstretched hand 2 patients (22.2%). Direct fall was the major mode of injury and there was no significant difference between studied groups regarding the mode of injuries.

Which in agreement with the study of **Dhakad et al. [11]** who reported that direct injury occurred in 48 patients (96%); among them, 14 patients (28%) were due to fall on the shoulder from a two-wheeler, 32 patients (64%) were due to road traffic accident and in 2 patients (4%), it was due to assault. The indirect injury occurred in 2 patients (4%) due to a fall on an outstretched hand with no significant difference between the studied groups.

The current study showed that patient injury classification according to Robinson classification in Conservative group; 2A2 2 patients (22.2%), 2B1 4 patients (44.4%) and 2B2 3 patients (33.3%), while in Operative group 2A2 1 patients (11.1%), 2B1 4 patients (44.4%) and 2B2 4 patients (44.4%). Regard Robinson classification 2B1 & 2B2 were the major classes with no significant difference between studied groups. Which in agreement with the study of **Woltz et al., [15]** who reported that in the operative group there were 50 patients (60%) 2B1 and 34 patients (40%) 2B1, while in the Conservative group 37 patients (53%) 2B1 and 33 patients (47%) 2B1 with no significant difference between studied groups.

Also, **Jha et al., [13]** reported that Group A (conservative) included five patients with 2B1 (50%) and five patients with type 2B2 (50%). Group B (operative) had three patients with type 2B1 (30%), and seven patients with type 2B2 (70%), with no statistically significant difference; p-value > 0.05.

The current study showed that in Conservative group (A) 4 Patients had a union at 5 months (44.4%), 4 patients had a union at 6 months (44.4%) and 1 patient had a union at 4 months (11.1%) with  $5.33 \pm 0.70$  months mean time of union. But Operative group (B) 5 patients had a union at 4 months (55.5%), 2 patients had a union at 5 months (22.2%) and 2 patients had a union at 6 months (22.2%) with  $4.66 \pm 0.86$  months mean time of union. The time of union was shorter among operative cases with no significant difference between studied groups ( $P = 0.093$ ). which in agreement with the study of **Kale et al., [12]** the 16 patients who were operated upon had an average union time of 7.8 weeks; 1 patient had delayed fracture union by 12 wks. 16 patients in the conservative group had a normal union of fractures with 1 patient going into non-union. The average union time in the conservative group was 9.4 weeks, which was more than the 7.8 weeks seen in the group treated operatively with a significant difference between both groups ( $P < 0.05$ ).

Also, **Haque et al., [9]** reported that the average time for the union was  $10.18 \pm 0.84$  weeks in the operative group whereas it was  $18.37 \pm 2.17$  weeks in the non-operative group with a significant difference between both groups. **Jha et al., [13]** found that Patients in the conservative group achieved union in 5.8 months; range

from 4 to 8 months. Inoperative group union occurred in 5.3 months; range 4 to 12 months. The difference was statistically insignificant with a p-value >0.05.

According to Pain assessment distribution, The current study showed that in Conservative group (A): No pain 2 Patients (22.2%), Mild pain 2 patients (22.2%), and Moderate pain 5 patients (55.5%). While in Operative group (B) No pain 6 Patients (66.7%), Mild pain 2 patients (22.2%) and Moderate pain 1 patient (11.1%). There was no significant difference between groups however the surgical group was better and less regard pain.

**Herzog et al. [14]** Reported the incidence of chronic pain in a pediatric patient population (n = 20). There wasn't a statistically significant (p = 1.00) difference in chronic pain at a median follow-up of 2.6 years (range = 1.4-5.2 years) between pediatric patients treated operatively or conservatively. 20 only one patient from the conservative group reported chronic pain. No patients from the operative group reported chronic pain. Therefore, conservative and surgical treatment alike yields similar results. Neither one is more effective than the other in reducing the amount of pain felt by patients.

According to the Constant shoulder score, the current study showed that in the Conservative group (A) 4 patients had excellent scores (44.4%), 2 patients had good scores (22.2%) and 3 patients had poor scores (33.3%). Three patients had poor scores due to malunion with decreased length of clavicle leading to change the position of glenoid and decrease muscles strength of the shoulder. While in Operative group (B) 6 patients had excellent scores (66.6%), 1 patient had a good score (11.1%) and 2 patients had poor scores (22.2%). Two patients had poor score one due to associated ipsilateral fracture scapula which treated conservatively and the other was due to plate failure with no significant difference between studied groups (p = 0.93), which in agreement with the study of **Dhakad et al., [11]** who reported that in the operative group, 19 patients (76%) had excellent functional outcome, 4 patients (16%) had good functional outcome and 2 patients (8%) had a fair functional outcome. In the non-operative group, 7 patients (28%) had excellent functional outcomes, 8 patients (32%) had good functional outcomes and 10 patients (40%) had fair functional outcomes with no significant difference between the studied groups.

According to Complication, the current study showed that in the Conservative group (A) 5 patients had no complication (55.6%) and 4 patients had malunion (44.4%), while in the Operative group (B) 7 patients had no complication (77.8%), 1 patient had an infection (11.1%) and 1 patient had plate failure (11.1%). There was no significant association or difference regard overall complication but Mal-union was significantly associated with the Conservative group.

**Haque et al., [9]** reported that the complication in the nonsurgical group was 13 patients acquire mal-union (43.33%), 8 patients get muscle wasting (26.66%), shortening present in 5 patients (16.66%), droop shoulder and complex regional pain syndrome each present in 2 patients (6.66%). The complications in the surgical group were 1 case complaining of mild pain due to implant irritation and prominence the

implant was removed on the 9th month after that the patient gets asymptomatic and no other complication in the surgical group.

**Naveen et al., [8]** found that 9 patients (30%) in the nonsurgical group acquire different complications like mal-union, nonunion, and restriction of shoulder movements, in comparison to 6 patients (20%) in the surgical group who had scar and hardware problem. In the general the rate of complication higher in a nonsurgical group especially the rate of nonunion and malunion. While in the surgical group the complication is usually related to surgical procedures, hardware problems, and infection.

**Conclusion:** The non-surgical methods still the best treatment of simple nondisplaced mid-shaft clavicular fractures. The operative methods donate a good result in active athlete's patient with displaced or comminuted fracture.

**Recommendation:** We recommend that conservative treatment is the first choice of simple undisplaced fracture midshaft clavicle and operative treatment is indicated in special cases associated with neurovascular injury, Open fractures, skin tenting, and floating shoulder and in the multi-trauma patient. Also doing further multicentric prospective studies with a large number of patients and a long period of follow-up to confirm our findings.

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