

## Original Research Article

# Radiological and functional outcome of conservatively managed middle one third clavicle fractures

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### ABSTRACT

**Background:** We aim to assess radiological and functional outcome of conservatively managed middle one third clavicle fractures in Indian population. Clavicle fractures represent 2% to 10% of all fractures. In middle third clavicle fractures, conservative management is the commonest approach. In uncomplicated non displaced midshaft fractures, patients treated non operatively with these conservative measures have fewer complications and a timely recovery as those treated operatively. Conservative management is a simpler yet effective mode of management in middle one third clavicle fractures.

**Methods:** Patients managed conservatively for clavicle fractures were assessed on OPD basis with follow up chest X-ray with bilateral shoulder AP view for radiological signs of union and assessing percent shortening and two questionnaires. Constant shoulder score which assess pain, degree of function, range of motion and muscular force and, simple shoulder test, self administered questionnaire defining one or more affirmative answers to find the satisfaction after treatment modality which were tabulated in Microsoft excel sheets.

**Results:** Out of the 55 patients enrolled in the study 52 showed signs of union at 6 months follow up with mean fracture union time of 13.9 weeks. At 6 months follow up Mean Constant Shoulder score was 87.1 with excellent outcome in 67.67 percent patients and using Simple Shoulder Test satisfaction rate was found to be 78.18 percent.

**Conclusions:** Solid evidence in favour of non-operative treatment for fractures with remaining contact of the bone fragments. Non-surgical management of middle third clavicle fractures yield excellent results. Clear indications for conservative treatment versus surgical fixation of displaced midshaft fractures have not finally been established yet. We recommend conservative management for uncomplicated middle one third clavicle fractures.

**Keywords:** Clavicle fractures, Constant shoulder score, Simple shoulder test

### INTRODUCTION

Clavicle fractures constitute 5 to 10 percent of all fractures.<sup>1</sup> The anatomic site of the fracture is usually described using the Allman classification, which divides the clavicle into thirds. Group I (midshaft) fractures occur on the mid third of the clavicle, group II fractures on the lateral (distal) third, and group III fractures on the medial (proximal) third.<sup>3</sup> Midshaft fractures account for roughly 75 to 80 percent of all clavicle fractures and typically occur

in younger persons. Distal third fractures represent about 15 to 25 percent of clavicle fractures. Medial third fractures are least common, accounting for fewer than 5 percent of clavicle fractures.<sup>1,4</sup> The clavicle is an S-shaped bone and is that the sole osseous link between the upper extremity and the trunk.<sup>2</sup> The usual mechanism of a clavicle fracture may be a fall directly on the shoulder with the arm at the side. Rarely, clavicle fractures can occur from an immediate blow or from a fall on an outstretched hand.

Patients who have sustained clavicle fractures typically hold the affected arm adducted on the brink of the body, often supporting the affected side with the other hand. Physical examination may reveal ecchymosis, swelling, focal tenderness, and crepitation on palpation over the clavicle. The defect within the bone could also be seen by visual inspection or localized by palpation. Diagnosis of midshaft clavicle fractures by history, examination, and radiography is relatively straightforward. The medial segment is pulled superiorly by the sternocleidomastoid. The weight of the arm pulls the lateral segment inferiorly through the coracoclavicular ligaments, but is opposed by the trapezius. In addition, the pectoralis major and latissimus dorsi pull the lateral segment inferomedially with resultant shortening. The goals of treatment are to restore normal anatomy, limit pain, and promote a quick return to activity or play. In middle third clavicle fractures, conservative nonoperative management is that the commonest approach. Treatment of those fractures consists of supportive or reductive measures. Supportive treatment involves the location of a sling or sling and swathe, while reductive treatment includes the utilization of a figure-of-eight bandage or clavicle brace. Recently

various operative interventions like open reduction internal fixation with anatomical plates, intramedullary nailing has evolved for the management of clavicle fractures. In uncomplicated nondisplaced midshaft fractures, patients treated nonoperatively with these conservative measures have fewer complications and a faster recovery than those treated operatively.<sup>5</sup> In view of the recent advances in management techniques of these fractures our study was undertaken for assessing the radiological and functional outcome of middle third clavicle fractures in adults treated non surgically.

**METHODS**

*Study design, location and duration*

This is a type of cross sectional study of patients with middle third clavicle fracture presenting to orthopaedic out patient department and emergency services of a tertiary care hospital which were non surgically managed for an average of 6 months after injury was undertaken.

OUT-PATIENT CLINIC	SHOULDER UNIT				
<b>CONSTANT SCORE</b>					
Patient's Details	<b>Operation/Diagnosis:</b> _____ <b>Date:</b> _____ <b>Examination:</b> Pre-op _____ <b>Side: R L</b> 3 months      6months 1 year        2 years        ____ years				
<b>A.- Pain (/15): Average (1 + 2) <input type="text" value="4"/> A</b> 1. Do you have pain in your shoulder (normal activities)? No = 15 pts,      Mild pain = 10 pts,      Moderate = 5 pts,      Severe or permanent = 0. _____ 2. Linear scale: If "0" means no pain and "15" is the maximum pain you can experience, please circle where is the level of pain of your shoulder. (Points given are inverse to the scale. E.g. level 5 in the scale means 10 points) Level of pain: <input style="width: 100%; border: none; border-bottom: 1px solid black;" type="text"/> Points: <input style="width: 100%; border: none; border-bottom: 1px solid black;" type="text"/>					
<b>B.- Activities of daily living (/20) Total (1 + 2 + 3 + 4) <input type="text" value="11"/> B</b> 1. Is your occupation or daily living limited by your shoulder? No = 4,      Moderate limitation = 2,      Severe limitation = 0 _____ 2. Are your leisure and recreational activities limited by your shoulder? No = 4,      Moderate limitation = 2,      Severe limitation = 0 _____ 3. Is your night sleep disturbed by your shoulder? No = 2,      Sometimes = 1,      Yes = 0 _____ 4. State to what level you can use your arm for painless, reasonably activities. Waist = 2,      Xiphoid (sternum) = 4,      Neck = 6,      Head = 8,      Above head = 10 _____					
<b>C.- Range of movement (leave this for the doctor or physiotherapist) (/40): Total (1 + 2 + 3 + 4) <input type="text" value="30"/> C</b> <table style="width:100%; border: none;"> <tr> <td style="width:50%; border: none;"> <b>1.- FWD Flexion:</b> 0- 30      0 pts                      _____ 31-60      2 pts                      _____ 61- 90      4 pts                      _____ 91- 120      6 pts                      _____ 121- 150      8 pts                      _____ &gt; 150      10 pts                 </td> <td style="width:50%; border: none;"> <b>2.- Abduction:</b> 0- 30                      _____ 31- 60                      _____ 61- 90                      _____ 91- 120                      _____ 121 - 150                      _____ &gt; 150                 </td> </tr> <tr> <td style="border: none;"> <b>3.- External Rotation:</b> _____                      Hand behind head &amp; elbow forward 2                      Hand behind head &amp; elbow back 4                      Hand above head &amp; elbow forward 6                      Hand above head &amp; elbow back 8                      Full elevation of arm 10                 </td> <td style="border: none;"> <b>4.- Internal Rotation: (Dorsum hand to)</b> _____                      Thigh 0                      Buttock 2                      SI joint 4                      Waist 6                      T12 8                      Between shoulder blades 10                 </td> </tr> </table>		<b>1.- FWD Flexion:</b> 0- 30      0 pts _____ 31-60      2 pts _____ 61- 90      4 pts _____ 91- 120      6 pts _____ 121- 150      8 pts _____ > 150      10 pts	<b>2.- Abduction:</b> 0- 30 _____ 31- 60 _____ 61- 90 _____ 91- 120 _____ 121 - 150 _____ > 150	<b>3.- External Rotation:</b> _____ Hand behind head & elbow forward 2 Hand behind head & elbow back 4 Hand above head & elbow forward 6 Hand above head & elbow back 8 Full elevation of arm 10	<b>4.- Internal Rotation: (Dorsum hand to)</b> _____ Thigh 0 Buttock 2 SI joint 4 Waist 6 T12 8 Between shoulder blades 10
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<b>D.- Power (/25): Points: average (kg) x 2 = <input type="text" value="10"/> D</b> First pull:      Second pull:      Third pull:      Fourth pull:      Fifth pull: Average pulls:					
<b>TOTAL (/100): A + B + C+ D <input type="text" value="51"/></b>					

**Figure 1: Constant shoulder score.**

**Table 1: Interpretation constant shoulder score.**

Score	Interpretation
90-100	Excellent
81-89	Good
71-80	Fair
<70	Poor

The fractures were managed by an arm sling or figure of 8 bandage or clavicle brace with no attempt made to reduce displaced fractures and patients to be allowed immediate free shoulder mobilization as tolerated. They will be prospectively evaluated radiologically and functionally. This study was undertaken for a period of 3 years at KEM Hospital, Mumbai from December 2019 to December 2022.

Simple Shoulder Test			
Dominant Hand (fill in only one oval):	Right <input type="radio"/>	Left <input type="radio"/>	Ambidextrous <input type="radio"/>
Shoulder Evaluated (fill in only one oval):	Right <input type="radio"/>	Left <input type="radio"/>	
		Yes	No
1. Is your shoulder comfortable with your arm at rest by your side?		<input type="radio"/>	<input type="radio"/>
2. Does your shoulder allow you to sleep comfortably?		<input type="radio"/>	<input type="radio"/>
3. Can you reach the small of your back to tuck in your shirt with your hand?		<input type="radio"/>	<input type="radio"/>
4. Can you place your hand behind your head with the elbow straight out to the side?		<input type="radio"/>	<input type="radio"/>
5. Can you place a coin on a shelf at the level of your shoulder without bending your elbow?		<input type="radio"/>	<input type="radio"/>
6. Can you lift one pound (a full pint container) to the level of your shoulder without bending your elbow?		<input type="radio"/>	<input type="radio"/>
7. Can you lift eight pounds (a full gallon container) to the level of your shoulder without bending your elbow?		<input type="radio"/>	<input type="radio"/>
8. Can you carry twenty pounds at your side with the affected extremity?		<input type="radio"/>	<input type="radio"/>
9. Do you think you can toss a softball under-hand twenty yards with the affected extremity?		<input type="radio"/>	<input type="radio"/>
10. Do you think you can toss a softball over-hand twenty yards with the affected extremity?		<input type="radio"/>	<input type="radio"/>
11. Can you wash the back of your opposite shoulder with the affected extremity?		<input type="radio"/>	<input type="radio"/>
12. Would your shoulder allow you to work full-time at your regular job?		<input type="radio"/>	<input type="radio"/>

**Figure 2: Simple shoulder test.**

The study was conducted as per National and International standards for conducting research in human subjects. The privacy and confidentiality of the patients is maintained in the study and not revealed except in the court of law.

#### Inclusion criteria

Male and female of Indian origin more than 25 years with complete ossification of all ossification centers of clavicle with unilateral uncomplicated middle one third clavicle fracture with no fracture or abnormality on the opposite shoulder were included.

#### Exclusion criteria

Exclusion criteria in current study were; age <25 years, lateral and medial third clavicle fractures, any grade of

Open fractures, associated acromioclavicular or sternoclavicular dislocation or neurovascular injuries, associated ipsilateral shoulder abnormalities like congenital anomalies, inflammatory changes or rotator cuff tear, previous clavicle fracture or pseudo arthrosis.

#### Procedure

Patients managed conservatively with various methods like a sling, figure of 8 bandage, clavicle brace were followed up on OPD basis on timely interval upto 6 months and evaluated using the following methods like AP chest x-ray, Constant Shoulder score, Simple shoulder test. AP chest X-ray with a specific clavicle projection that is obtained by cephalic angling of the tube at 45 degree to avoid superimposition of clavicle and ribs at a 1:1 scale. Successful consolidation of the fracture determined by formation of callus and presence of Trabecular Bridge over the fracture gap at periosteal and endosteal level after period of 6 months. After calculating the length of the healthy and affected segment by drawing a straight line through the medial end of sternal and acromial borders, the difference expressed in mm and percentage of shortening can be quantified. Constant shoulder score (Figure 1, Table 1) which assess pain, degree of function, range of motion and muscular force. It is used to measure the functional outcome of shoulder after the treatment modality.<sup>12</sup>

Simple shoulder test (Figure 2) a self-administered questionnaire defining one or more affirmative answers to find the satisfaction after treatment modality. >7 affirmative answers are considered to be satisfied.

#### Sample Size

Sample size will be calculated based on following formula;

$$n = z^2 \times \frac{p(1-p)}{e^2} \div 1 + \{z^2 \times p(1-p)/e^2 N\}$$

Where, N=Population size, e=Margin of error, z=z score, SD=standard deviation of constant shoulder score. By considering values given by Naveen et al where, Sample size was calculated to be 60 and considering 10% lost to follow up sample size will be 55. The study was conducted as per National and International standards for conducting research in human subjects.

#### Statistical analysis

Data will be entered in Ms-excel and then imported to SPSS for analysis. Data will be analysed using SPSS version 23.0. Qualitative variables will be presented in terms of mean and standard deviations whereas qualitative variables will be expressed in terms of proportions or percentages. Mann-Whitney U test or Wilcoxon sign rank test will be applied to compare means based on normality of distribution. The value of 'p' less than 0.05 will be considered as statistically significant.

## RESULTS

The present study was undertaken for assessing the radiological and functional outcome of conservatively managed middle one third clavicle fractures. A total of 55 patients were enrolled. 60 percent of the patients belonged to the age group of 25 to 40 years. 27.27 percent of the patients belonged to the age group of 41 to 50 years. Mean age of the patients was 35.8 years.

**Table 2: Age groups.**

Age group (years)	N	%
25 to 40	33	60
41 to 50	15	27.27
51 to 60	5	9.09
More than 60	2	3.63

**Table 3: Mean constant shoulder score on follow-up.**

Time interval (follow-up)	Mean constant shoulder score	SD
Six weeks	61.4	6.55
Three months	71.3	6.58
Six months	87.1	9.45
P value	0.00	

**Table 4: Constant shoulder score.**

Outcome	N	%
Excellent	37	67.27
Good	11	20
Fair	5	9.09
Poor	2	3.64
Total	55	100

**Table 5: Patient satisfaction as per simple shoulder test.**

Patient satisfaction	N	%
Satisfied	43	78.18
Unsatisfied	12	21.82
Total	55	100

In 56.36 percent of the patients, right side was involved while in the remaining 43.64 percent, left side involvement occurred. Mean fracture union time of the 55 patients was found to be 13.9 weeks. Mean constant shoulder score at six weeks follow-up, three months follow-up and six months follow-up was 61.4, 71.3 and 87.1 respectively. Significant results were obtained while comparing the mean constant shoulder score at different time intervals. Excellent results were seen in 67.27 percent of the patients while good results were seen in 20 percent of the patients. 9.09 percent of the patients showed fair results while poor results were seen in 3.64 percent of the patients. As per simple shoulder test, 78.18 percent of the patients were satisfied while the remaining 21.82 percent of the patients were unsatisfied. Shortening of clavicle was 10 to 15 mm

in 74.54 percent of the patients. Mean percentage shortening of clavicle was 8.57 percent. Non-union occurred in 3.64 percent of the patients while delayed union occurred in 1.82 percent of the patients. Malunion occurred in 31.82 percent of the patients.

**Table 6: Degree of shortening.**

Shortening of clavicle	N	%
10 to 15 mm	41	74.54
16 to 20 mm	12	21.82
More than 20 mm	2	3.64
Total	55	100
Mean percentage shortening	8.57%	

**Table 7: Complications.**

Complications	N	%
Non-union	2	3.64
Delayed union	1	1.82
Malunion	12	21.82

## DISCUSSION

Clavicle fractures are considered one of the most common skeletal injuries around 2-5% of all adult fractures with an incidence of 29 to 64 cases per 100000.<sup>7</sup> Mode of injury being due to moderate to high-energy mechanisms like road traffic accidents or sports activities. By far in the past non operative treatment of midshaft clavicular fractures has been considered to be the gold standard of treatment for these fractures. This recommendation is based on the analysis of 2000 patients with a very low non-union rate of 0.13%, reported by Neer et al in 1960 and Rowe et al in 1968 with an observed nonunion rate of 0.8% in 566 midshaft clavicular fractures.<sup>8,9</sup> However, there has been no uniform conservative treatment modality yet and different conservative interventions are commonly applied. The present study was undertaken for assessing the radiological and functional outcome of conservatively managed middle one third clavicle fractures. A total of 55 patients were enrolled. In the present study, 60 percent of the patients belonged to the age group of 25 to 40 years. 27.27 percent of the patients belonged to the age group of 41 to 50 years. Mean age of the patients was 35.8 years. Mean fracture union was found to be 13.9 weeks. In a study conducted by Gyanendra et al, mean fracture union time among patients with fracture of middle one third of the clavicle undergoing nonsurgical treatment was 16.04 weeks.<sup>11</sup> Naveen et al mean fracture union time among patients with fracture of middle one third of the clavicle undergoing nonsurgical treatment was 11.29 weeks.<sup>6</sup>

Mean constant shoulder score at six weeks follow-up, three months follow-up and six months follow-up was 61.4, 71.3 and 87.1 respectively. Significant results were obtained while comparing the mean constant shoulder score at different time intervals. Our results were in concordance with the results obtained by previous authors who also reported similar findings in their respective

studies. In a study conducted by Naveen et al mean constant shoulder score at six weeks follow-up, three months follow-up and six months follow-up was 63.87, 75.77 and 89.6 respectively. In another study conducted by Gyanendra et al mean constant shoulder score at 6 months follow-up was found to be 94.5 among patients treated non-surgically. Robinson et al in their study, reported that mean score at final follow-up was 87.8.<sup>5,11</sup> In this study Excellent results were seen in 67.27 percent of the patients while good results were seen in 20 percent of the patients. 9.09 percent of the patients showed fair results while poor results were seen in 3.64 percent of the patients. Our results were in concordance with the results obtained by previous authors who also reported similar findings in their respective studies. In a study conducted by Gyanendra et al excellent results were seen in 80 percent of the patients while good results were seen in 13.33 percent of the patients. In their study, fair and poor results on follow-up were seen in 3.3 percent of the patients each. As per simple shoulder test, 78.18 percent of the patients were satisfied while the remaining 21.82 percent of the patients were unsatisfied. Our results were in concordance with the results obtained by previous authors who also reported similar findings in their respective studies. In a study conducted by Gyanendra et al 70 percent of the patients with fracture of middle third of clavicle undergoing nonsurgical treatment were satisfied while the remaining were unsatisfied. Naveen BM et al in their study, reported that 73.33 percent of the patients were fully satisfied.<sup>6</sup>

In our study it was noted that radiological shortening of 10 to 15 mm in 74.54 percent patients as compared to >20 mm in 3.64 percent with higher satisfaction rate in the former group and increased dissatisfaction in patients with >20 mm shortening. These findings were in concordance to study by Giorgi et al who observed highly significant association of dissatisfaction with shortening in 20 dissatisfied patients with more than 15mm shortening.<sup>10</sup>

Considering the sample size of 55 which provides limitation, as this study was undertaken in covid times, there had been limitation in the number of patients presenting to OPD for regular follow ups. Hence further studies with large sample size are recommended. Under the light of above obtained results, following conclusion can be drawn as solid evidence in favour of non-operative treatment for fractures with remaining contact of the bone fragments. Clear indications for conservative treatment versus surgical fixation of displaced midshaft fractures have not finally been established yet, Non-surgical management of middle third clavicle fractures yield excellent results.

## CONCLUSION

Solid evidence in favour of non-operative treatment for fractures with remaining contact of the bone fragments. Non-surgical management of middle third clavicle

fractures yield excellent results. Clear indications for conservative treatment versus surgical fixation of displaced midshaft fractures have not finally been established yet. We recommend conservative management for uncomplicated middle one third clavicle fractures.

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