



International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2019; 5(2): 808-815
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www.orthopaper.com
Received: 11-02-2019
Accepted: 15-03-2019

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Clinico-radiological outcome of fracture middle 3rd clavicle treated non-operatively and with plate osteosynthesis: A comparative study

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DOI: <https://doi.org/10.22271/ortho.2019.v5.i2l.95>

Abstract

Background: Clavicle fractures are common injuries, accounting for 2.8% of all fractures. Fractures of the middle third account for approximately 80% of all clavicular fractures. Displaced middle 3rd clavicle fractures are typical and are generally treated non-operatively. Non-operative treatment of these fractures with axial shortening is correlated with a non union rate of 13 – 18% and a delayed union rate of 25%. Intractable pain, neurological complications and loss of shoulder function have been noted. Prompt fixation of these clavicle fractures charter increased patient comfort, and early shoulder mobility. We have taken up this study to analyse the results of plate fixation and non-operative treatment for middle third clavicle fractures in terms of time to union, functional improvement and complications.

Objectives: To compare results of plate fixation of middle third clavicle fractures with those managed nonoperatively in terms of radiological union and functional outcome.

Materials and Methods: This is a prospective comparative study. The duration of study period is 2 years. Cases satisfying the inclusion criteria and who had received treatment either nonoperatively or in the form of plate fixation at Chettinad Hospital and Research Institute based on the patient's informed decision during the period of Jun 2013 to Feb 2015 were included in the study. Patients were then followed up for a period of up to 9 months (3, 6 & 9 months) and evaluated clinically with Constant and Murley scoring system and with radiographs.

Results: There was significant improvement in the rate of fracture union and functional scores in the operated group compared to the nonoperative treatment group.

Conclusions: In this prospective study, plate fixation of middle third clavicular fractures resulted in earlier functional recovery and lower complication compared with nonoperative treatment.

Keywords: clavicle, fracture, middle third, plate fixation, nonoperative

Introduction

The clavicle plays an important role in providing stability and improving the movement of the shoulder joint. Therefore, clavicle fracture has an adverse effect on shoulder function. Being the most common fracture in adult and children ranging from 2.6% to 4% of all fractures, and middle third fracture accounting for more than 80% of cases there is a wide array of treatment options available for clavicle fracture in the middle third. Selecting the most appropriate method of treatment depends on fracture personality, types, associated injuries and patient expectations.

A prospective cohort study of seventy three patients with middle third clavicle fracture who were provided either plate fixation or non-operative treatment based on their decisions showed that union rate and functional score were significantly higher in the operated cases with fewer malunion compared to patients who had received non-operative treatment. A recent RCT published a similar result with a better cosmetic result, ability to return to pre-injury lifestyle and shoulder function in patients who received plate fixation but residual pain, stiffness and shoulder weakness were comparable in both groups.

Although the above studies showed a superior union rate, anatomical restoration and improved functional outcome following plate fixation compared to non-operative treatment, these result were short to medium term. A recent meta-analysis showed that shoulder function and need for

further surgery following plate fixation were similar to those managed non-operatively on long term follow up. A Cochrane review found that surgical treatment gave no additional benefit over non-operative treatment but the former results in lesser secondary procedures.

The objective of this study was to analyse the results of plate fixation and non-operative treatment for middle third clavicle fractures in terms of time to union, functional improvement and complications in the light of existing studies.

Materials and Methods

The study was conducted at a tertiary care hospital between June 2013 to February 2015 on forty consecutive patients who fulfilled the criteria for inclusion into the study. All patients above 18 years of age with close, displaced, middle third clavicle fracture, and willing to take part in the study were included. Institutional ethical committee approval was obtained prior to the study. Patients with pathological fracture, open fracture, ipsilateral limb fracture in other bones, clavicle fracture in skeletally immature bones, and polytrauma were excluded from the study. The decision to undergo plate fixation or managed non-operatively was left to the discretion of the patient after thorough counseling about the merits and demerits of either modes of treatment.

Non-operative treatment

Patients who preferred non-operative treatment were given figure-of-eight clavicle brace for 6 to 8 weeks. Instructions were given to patient to prevent pressure sores of skin over the axilla and for any distal nerve as well as circulatory function deficit due to excessive pressure. The patients were advised to perform gentle pendulum exercises which gradually increase to complete range of movement exercise

usually by the end of 6 weeks. Return to full pre-injury activity were permitted after 3 to 4 months.



Fig 1: Photographs showing clavicle brace for fracture clavicle.

Surgical techniques

Under a general anaesthesia, the patient in supine position the involved extremity was prepared and draped so that the arm was allowed unrestricted movement during surgery, and an oblique incision was made over superior surface of clavicle centering the fracture. The fracture was identified, and the fracture was reduced and fixed with a 3.5 mm precontoured plate. Plate is applied to the superior surface of the bone, with the goal being to put a minimum of three screws in the main proximal and distal fragments in most cases. Comminuted fragments were secured with lag screws if possible, with care being taken to preserve soft-tissue attachments. The deltotrachezial fascia was closed with interrupted absorbable sutures as a distinct layer, followed by skin closure. Drains were not used.

A simple arm sling was given to all operated patients for 2 to 3 weeks. Active range of movement exercise were started from second week followed by isometric strengthening exercises from 6 to 8 weeks onward. Contact sports were permitted after radiological union.



Fig 2: Intra-operative photographs showing various steps of clavicle plate fixation.

Follow-up Assessment

Patients were seen at three, six & nine months. Assessment included standardized clinical evaluation and completion of the Constant shoulder score. Both an anteroposterior and a 20° cephalad radiographs were made for each patient.



Fig 3: Pre- and post-operative radiographs of plate fixation

Results

The following observations were made from this comparative study of Fracture Middle 3rd Clavicle treated Non-operatively and with plate osteosynthesis in 40 cases, 20 cases conservatively & 20 cases ORIF with plate osteosynthesis in

the Department of Orthopaedics, Chettinad Hospital and Research Institute, between June 2013 and Feb 2015.

In our series, majority of the cases i.e., 13(32.5%) were seen in the age group 26-30 years.

- Mean age in years of patients treated conservatively: 33.10
- Mean age in years of patients treated with plate osteosynthesis: 34.15

Out of 20 patients in conservative group, 80.0% were males and 20.0% were females. Whereas in Plate osteo-synthesis group, 75.0% were males and 25.0% were females. This difference is not statistically significant.

- In the Conservative group, RTA is the most common mode of injury i.e., 15(75.0%) Patients and in the Plate osteo-synthesis i.e., 18(90.0%).
- In both the groups Fall out-stretched hand was found to be the least common mode of injury, Conservative i.e., 5(25%) and in plate osteo-synthesis i.e., 2(10%).

Out of forty patients, 20 patients in conservative group (Mean

age-33.10), 20 patients in plate osteo-synthesis (Mean age-34.15) between the year June 2013 to February 2015. Among 20 patients in conservative group, 1 patient had non-union for whom plate osteo-synthesis with bone grafting was done. The

average union rate was 10.75wks and mean constant shoulder score was 87.30. 20 patients in plate osteo-synthesis the average union was 11.53 wks and mean constant shoulder score was about 94.65.

Table: Table showing comparison of various variables in both treatment groups

Group Statistics					
	Definition of outcome	N	Mean	Std. Deviation	p value
Age in years	Non-operative	20	33.10	7.261	.638
	Operated	20	34.15	6.738	
Gender	Non-operative	20	1.80	.410	.714
	Operated	20	1.75	.444	
Injured side	Non-operative	20	1.80	.410	1.000
	Operated	20	1.80	.410	
Mechanism of injury	Non-operative	20	1.25	.444	.080
	Operated	20	1.05	.224	
Duration of follow-up in months	Non-operative	20	8.45	1.538	.154
	Operated	19	9.37	2.338	
Time to radiological union in weeks	Non-operative	20	18.55	2.012	.000
	Operated	19	11.53	1.645	
Method of treatment	Non-operative	20	1.00	.000 ^a	
	Operated	20	2.00	.000 ^a	
Flexion	Non-operative	20	160.75	7.482	.002
	Operated	20	169.75	9.386	
Extension	Non-operative	20	49.25	3.354	.001
	Operated	20	53.00	2.991	
Abduction	Non-operative	20	159.25	7.993	.002
	Operated	20	168.50	9.881	
Adduction	Non-operative	20	42.50	2.565	.002
	Operated	20	45.25	2.552	
Internal rotation	Non-operative	20	56.25	5.350	.001
	Operated	20	63.25	6.544	
External rotation	Non-operative	20	81.50	5.405	.000
	Operated	20	91.50	6.304	
Complications	Non-operative	20	1.05	.224	.304
	Operated	20	1.15	.366	
Final Constant & Murley Score	Non-operative	20	87.30	2.080	.000
	Operated	20	94.65	3.468	

Discussion

This study shows significant outcome of operative treatment of middle 3rd clavicle fractures. The patients treated early, rigid internal fixation of their clavicle fractures given a good postoperative constant score, early pain relief, quick to daily activity and excellent patient satisfaction rate.

In a prospective surveillance Cohort study. Robinson *et al.* interpret a consecutive series of 868 patients with clavicular fractures, 581 of whom had a mid-shaft diaphyseal fracture [44]. They found a higher non-union rate (21%) for the displaced, comminuted midshaft fractures ($p < 0.05$).

Similarly, in a study of fifty-two displaced midshaft clavicular fractures, Hill *et al.* [9]. Recorded that eight patients had a nonunion and sixteen patients had an regrettable outcome on the basis of patient-oriented measures [9]. They concluded that displacement of the fracture fragments by >2 cm was identify with an unsatisfactory result.

A meta-analysis of recent studies admit that the rate of nonunion for displaced midshaft clavicular fractures was 2.2% (ten of 460 patients) after plate fixation in comparison with 15.1% (twenty-four of 159 patients) after nonoperative care, a proportionate risk reduction for nonunion of 86% [14]. That meta-analysis also exhibit that primary plate fixation was, contrary to prevailing opinion, a safe and reliable procedure [14].

The current studies on primary plate fixation of acute midshaft clavicular fractures have represent high rates of

successful results with rates of union ranging from 94% to 100% and low rates of infection and surgical complications: a recent meta-analysis of plate fixation for 460 displaced fractures confess a nonunion rate of only 2.2% [14, 45, 46]. With improved implants, prophylactic antibiotics, and superior soft-tissue handling, plate fixation has been a stable and reproducible technique.

Late neurovascular concession upto 6% was seen in patients treated conservatively due to non union and excessive callus formation [47]. In our study there was no transient neurological abnormalities.

The range of motion was excellent and the mean constant score was above 90 in our study. On analysis the literature we initiated patients treated conservatively had substantial residual disability of the affected shoulder with minimal loss of muscle strength [9, 12, 32, 48].

The preference of internal fixation of clavicle fractures, which have early pain resolution, early return of shoulder function and potentially early return to work makes it an good option for the treatment of displaced fractures in active individuals.

Many various methods of operative fixation of mid-shaft clavicle fractures have been explained. Intramedullary pinning techniques have been combined with a high number of complications, such as pin migration and rotational instability and fixation with interfragmentary screws or wire sutures displayed insufficient immobilization⁴⁸. As a result, we select rigid fixation with a plate osteosynthesis which gives

superior fracture stability and outstanding clinical results in the treatment of acute fractures.

Taking these percentages into account, we consider that operative treatment of acute middle-third clavicle fractures should be composed for persons who choice to return early to

activity and who obtained the risk for potential complications. Specifically wound disorders and infection may give arise to disasters and the patient should be properly told before deciding to have the operation.

Case Illustration

Case - I

Name	Mr. Baskar
No.	090846418
Age	39
Sex	M
Mode of injury	RTA
Date of admission	05.11.13
Date of surgery	07.11.13
Diagnosis	Allman Type I
Procedure	ORIF with Plating
Complications	Nil
Secondary procedure	Nil
Follow up period	13 Months
Time of Union	6wks

Time for Union		
Movements at the shoulder	Flexion (0-180°)	170
	Extension (0-60°)	55
	Abduction (0-180°)	170
	Adduction (0-50°)	50
	Internal Rotation at 90° abduction (0-70°)	65
	External rotation at 90° abduction (0-100°)	95
Pain in the shoulder		Nil
Constant Score		98

Functional out come



Case - II

Name	Mr. Padmini
No.	090017307
Age	28
Sex	F
Mode of injury	RTA
Date of admission	10.03.14
Date of surgery	11.03.14

Diagnosis	Allman Type I
Procedure	ORIF with Plating
Complications	Nil
Secondary procedure	Nil
Follow up period	10 Months
Time of Union	5 wks

Functional out come

Time for Union		
Movements at the shoulder	Flexion (0-180°)	180
	Extension (0-60°)	55
	Abduction (0-180°)	175
	Adduction (0-50°)	45
	Internal Rotation at 90° abduction (0-70°)	60
	External rotation at 90° abduction (0-100°)	95
Pain in the shoulder		Nil
Constant Score		98

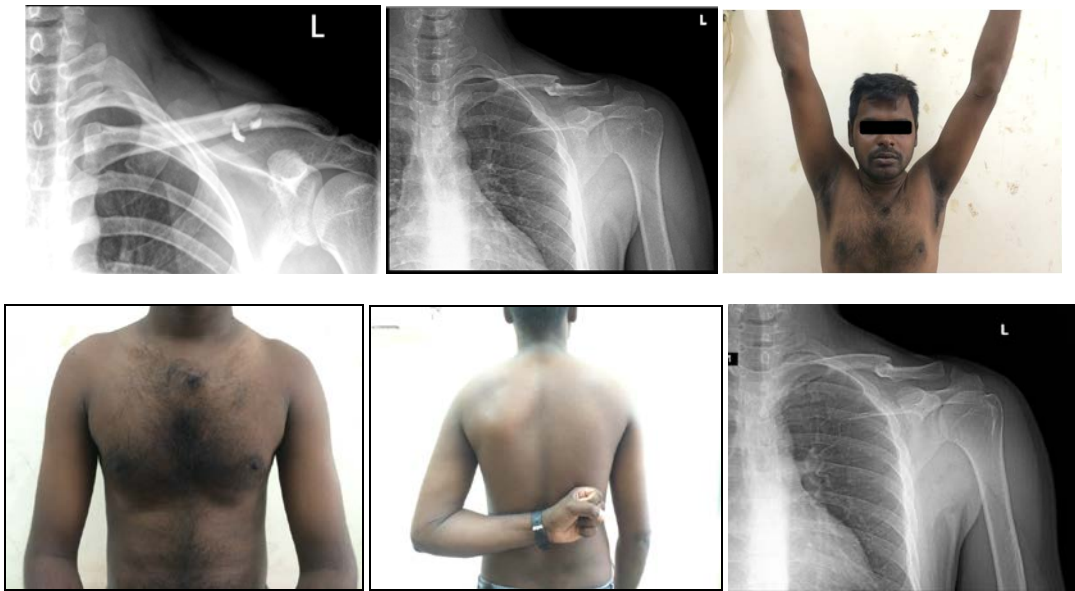


CASE - III

Name	Mr. Jaganathan
No.	090954222
Age	27
Sex	M
Mode of injury	RTA
Date of injury	14.11.13
Side	Left
Diagnosis	Allman Type I
Procedure	Conservative management with clavicle brace
Complications	Malunion
Secondary procedure	Nil
Follow up period	8 Months
Time of Union	9wk

Functional out come

Time for Union		
Movements at the shoulder	Flexion (0-180°)	160
	Extension (0-60°)	50
	Abduction (0-180°)	150
	Adduction (0-50°)	30
	Internal Rotation at 90° abduction (0-70°)	45
	External rotation at 90° abduction (0-100°)	80
Pain in the shoulder		Nil
Constant Score		88

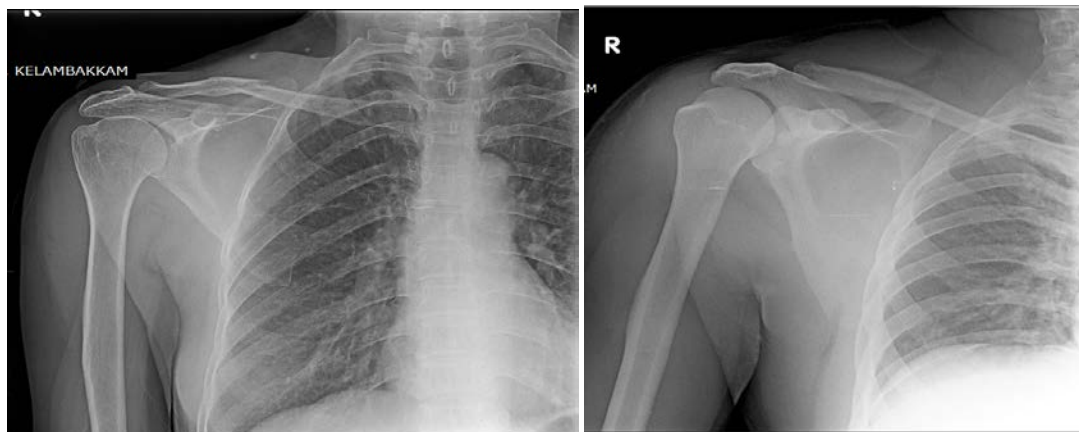


Case – IV

Name	Mrs. Thersa
No.	090017067
Age	45
Sex	F
Mode of injury	Fall on shoulder
Date of injury	05.05.14
Side	Right
Diagnosis	Allman Type I
Procedure	Conservative management with clavicle brace
Complications	Nil
Secondary procedure	Nil
Follow up period	8 Months
Time of Union	9wk

Functional out come

Time for Union		
Movements at the shoulder	Flexion (0-180°)	160
	Extension (0-60°)	50
	Abduction (0-180°)	160
	Adduction (0-50°)	45
	Internal Rotation at 90° abduction (0-70°)	55
	External rotation at 90° abduction (0-100°)	90
Pain in the shoulder		Nil
Constant Score		90



Conclusion

The acute treatment of displaced middle third clavicle fractures persists a subject of controversy. Recent studies have described a higher rate of non-union, late neurovascular compromise and specific deficits of shoulder function in subgroups of patients with these injuries who are managed by conservative means. Internal fixation by plate osteosynthesis has the influence of early pain resolution, early return of shoulder function and potentially early return to work. Clavicle fractures should therefore be viewed as a spectrum of injuries with diverse functional outcomes, each requiring careful assessment and individualized treatment, and plate osteosynthesis should be preferred for the treatment of indicated middle-third clavicle fractures in active individuals.

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