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

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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

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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 skeletal 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.

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.

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 osteo-synthesis: 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 osteosynthesis (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 osteosynthesis with bone grafting was done. The
average union rate was 10.75wks and mean constant shoulder
core was 87.30. 20 patients in plate osteosynthesis the
average union was 11.53 wks and mean constant shoulder
core was about 94.65.

| 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*          |         |
|                  | Operated              | 20 | 2.00 | .000*          |         |
| Flexion          | Non-operative         | 20 | 160.75| 7.482          | .002    |
|                  | Operated              | 20 | 169.75| 9.386          |         |
| Extension        | Non-operative         | 20 | 49.25| 3.554          | .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 prospective 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 unsatisfactory outcome on
the basis of patient-oriented measures [9]. They concluded that
placement 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
core 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 immobilization [48]. 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 choose 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 outcome**

**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 outcome

| Time for Union   | 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 outcome

| Time for Union     | 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 outcome

| Time for Union          | Flexion (0-180°) | 160 |
|-------------------------|------------------|-----|
| Movements at the shoulder| 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 manage 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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