



SURGICAL AND FUNCTIONAL OUTCOME MANAGEMENT OF MID CLAVICULAR SIMPLE DISPLACED FRACTURE BY CLAVICLE PLATE OSTEOSYNTHESIS SYSTEM A PROSPECTIVE STUDY

Orthopaedics

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ABSTRACT

Background: Fracture of the clavicle is common, accounting for 5 to 12% of all fractures. About 80 to 85% of these fractures are in the middle third of the bone. Fracture of clavicle are commonly seen by a fall on an outstretched hand or by direct injury. Clavicle fractures are common injuries in young active individuals especially those who participate in activities and sports where high speed falls or violent collisions are frequent and account for 2.6% of all fractures. The majority of clavicular fractures 80-85% occur in midshaft of the bone, where the typical compressive forces applied to the shoulder and the narrow cross section of the bone combine and result in bony failure¹. Displaced mid shaft clavicle fractures are common and are generally treated non-operatively. Non-operative treatment of these fractures with axial shortening is associated with non-union, delayed union, and mal-union & Other complications are severe pain, neurological complications, loss of shoulder function and protuberant callus forming swelling and stretching of skin which is cosmetically unacceptable¹. **Materials And Method:** This study of 30 patients with mid-shaft clavicle fractures was conducted over a period of between 2 years June 2022 to June 24 in the Department of Orthopaedics, Navodaya Medical College Hospital and Research Centre, Raichur and treated with clavicular plate system. In this study 30 patients (23 male, 7 females) with displaced mid clavicular simple fracture treated with open reduction internal fixation by clavicle plate. Functional outcome was assessed as per constant & murley and cologne clavicle score. **Results:** A total of thirty patients were evaluated in our study of which there were 23 males and 7 females. Out of all 30 patients, majority 23 cases (76.6%) had an excellent outcome, 6 cases (20%) Good outcome and only 1 patients (3.3%) is Fair outcome. Not a single patient had poor outcome according to constant & murley and cologne clavicle score. **Conclusion:** Displaced mid clavicular fracture treated with Clavicle plate is an effective mode of treatment to restore the function in adult patients, consistently providing excellent results with minimal complications and is a safe option in treating clavicle fracture with good recovery despite, patients having several associated injuries.

KEYWORDS

Midshaft clavicle fracture, clavicle fracture fixation, with open reduction internal fixation by clavicular plate osteosynthesis system. identical terms.

INTRODUCTION

Clavicular fractures are common injuries, accounting for 5 to 12% of all fractures¹. Fractures of the middle third (or midshaft) account for approximately 85% of all clavicular fractures^{1,2}.

The traditional view that the vast majority of clavicular fractures heal with good functional outcomes following non-operative treatment is no longer valid.

Recent studies have identified a higher rate of non-union and specific deficits of shoulder function in subgroups of patients with this injuries^{3,4,5,6,7}.

These fractures should therefore be viewed in the spectrum of injuries with diverse functional outcomes, each requiring careful assessment and individualized treatment and when indicated these fractures should be treated by primary operative fixation.

MATERIALS AND METHOD

This study of 30 patients with mid-shaft clavicle fractures was conducted during the period between June 2022 to June 2024 in the Department of Orthopaedics, Navodaya Medical College Hospital and Research Centre, Raichur and were treated with titanium elastic nailing system.

Inclusion Criteria

- Patients within age of 16-60 years, displaced middle third clavicle fractures (>2cm displacement).
- Fractures within the last 4 weeks with no cortical bone contact.
- A communicated middle one third fracture of the clavicle with inferior cortical defect.
- Painful non-union.
- Floating shoulder.

Exclusion Criteria

- Patients of age less than 16 years and below 60 years.
- Fractures with marked comminution.
- Fractures older than 4 weeks.
- Pathological fractures.

- Open fractures.
- Congenital anomaly or bone disease.
- High anaesthetic risk.
- Any medical contraindication for surgery.

Indications For Open Reduction And Internal Fixation Of Displaced Midshaft Fractures

ABSOLUTE

- Shortening of >20 mm
- Open injury
- Impending skin disruption and irreducible fracture
- Vascular compromise
- Progressive neurologic loss
- Displaced pathologic fracture with associated trapezial paralysis
- Scapulothoracic dissociation
- Painful non-unions

RELATIVE

- Displacement of >20 mm
- Comminution >3 fragments
- Neurologic disorder
- Parkinson's
- Seizures
- Head injury
- Poly-trauma
- Expected prolonged recumbency
- Floating shoulder
- Intolerance to immobilization
- Bilateral fractures
- Ipsilateral upper extremity fracture
- Cosmetic
- Various modalities of treatment

Options For Treatment Of Displaced Clavicle Fractures

- For non-operative treatment, a **simple sling** is preferred. A figure-of-8 bandage can lead to brachial plexopathy if not applied appropriately, and has little influence on fracture outcome.
- Plate fixation:** This technique provides immediate rigid stabilization and pain relief and facilitates early mobilization^{8,9,10,11}. Most commonly,

the plate is implanted on the superior aspect of the clavicle, and biomechanical studies have shown this to be advantageous, especially in the presence of inferior cortical comminution^{11,12}.

• **Intramedullary fixation:** A variety of devices, including Knowles pins, Hagie pins, Rockwood pins, and minimally invasive titanium nails, have been used. Two methods of implant insertion have been described: antegrade, through an anteromedial entry point in the medial fragment, and retrograde, through a posterolateral entry portal in the lateral fragment. There is biomechanical evidence to suggest that plate fixation provides a stronger construct than intramedullary fixation¹³.

• **External fixators** have been used to treat clavicular fractures, although this technique is most commonly recommended only for open fractures or septic nonunions¹⁴.

COMPLICATION OF CLAVICULAR FRACTURE

- a) Pain non union
- b) Symptomatic malunion
- c) Shoulder strength
- d) Shoulder stiffness
- e) Neurological & Vascular
- f) Refracture

OPERATIVE TREATMENT

Under a general or anaesthesia, the patient positioned in supine position with sand bag beneath the ipsilateral scapula. The involved shoulder prepared and draped, and an oblique incision made over superior surface of clavicle centring the fracture site. The fracture site identified, and the fracture reduced and fixed with a 3.5 mm reconstruction plate after contouring. Plate is applied to the superior surface of the bone, with the goal being 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. Bone grafting performed in the case with non-union. The delto-trapezial fascia was closed with interrupted number-1 absorbable sutures as a distinct layer, followed by skin closure. No drains were used. A sling was used for comfort for seven to ten days, and then active range-of motion exercises were allowed. When fracture union (defined as radiographic union with no pain or motion with manual stressing of the fracture) was evident, typically at six weeks, overhead abduction and strengthening were allowed, with a return to full activities at three months.

Case 1 Esappa A/H/O fall from bike and sustained

Injury to left shoulder



PRE-OPERATIVE X-RAY



FRACTURE EXPOSED



WOUND CLOSURE



POST OPERATIVE X-RAY



POST OPERATIVE X-RAY



Radiography after 18 months post-surgery, it is showing complete bony union and plate removal

FUNCTION OUTCOME AT END OF STUDY PERIOD

1. Flexion and abduction,

2. Adduction,
3. Internal rotation & adduction

POST SURGERY

Collar-cuff sling or a shoulder immobilizer Overhead activity was restricted for 3 weeks. After 6 weeks when radiological union was seen, strengthening exercises were started.

RESULTS

Majority Of the patients most of them aged below 40 years studied between June 2022 and June 2024, all had primary plate fixation except the one with painful non-union for whom plate osteosynthesis with bone grafting was done. All 29 patients had fracture union in a mean of 16 weeks. Most of the patients (82%) had constant shoulder score above 90 with an excellent grade except for one patients. These, two of them had wound infection and function improved after implant removal; and one patient was a 60 year old lady who developed shoulder stiffness due to improper follow-up and physiotherapy.

Table 1: According Time Interval Between Trauma & Surgery

TIME INTERVAL TRAUMA & SURGERY	NUMBER OF CASES	PRESENT
<4 Days	16	53.3
4-7 Days	14	46.6
Total	30	100

Table 2: According To Mode Of Injury

MODE OF INJURY	NUMBER OF CASES	PERCENT
RTA	18	60
Accidental fall	12	40
Total	30	100

Table 4: Distribution Of Cases According To Affected Side

SIDE AFFECTED	NUMBER OF CASES	PERCENT
Closed	16	53.3
Open	14	46.6
Total	30	100

Table 5: Functional Outcome According To Constant & Murley Score And Cologne Clavicle Score

FUNCTIONAL OUTCOME	NUMBER OF PATIENTS	PERCENT
Poor	0	0
Fair	1	3.3
Good	6	2
Excellent	23	76.6
Total	30	100

DISCUSSION

There is a general consensus that clavicular fractures are best treated nonoperatively. In the 1960s, Neer and Rowe reported on the nonoperative.

treatment of clavicular fractures^{3,4}. However, more recent studies have shown that the union rate for displaced midshaft fractures of the clavicle may not be as favourable as once thought.

There were no non-union in our study. In a prospective, observational cohort study, Robinson et al. described a consecutive series of 868 patients with clavicular fractures, 581 of whom had a midshaft diaphyseal fracture¹⁶. They found a significantly 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. reported that eight patients had a non-union and sixteen patients had an unsatisfactory outcome on the basis of patient-oriented measures⁶. They concluded that displacement of the fracture fragments by >2 cm was associated with an unsatisfactory result.

A meta-analysis of recent studies revealed that the rate of non-union for displaced midshaft clavicular fractures was 2.2% (ten of 460 patients) after plate fixation compared with 15.1% (twenty-four of 159 patients) after nonoperative care, a relative risk reduction for non-union of 86%⁶². That meta-analysis also showed that primary plate fixation was, contrary to prevailing opinion, a safe and reliable procedure.

Modern studies on primary plate fixation of acute midshaft clavicular

fractures have described 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 revealed a non-union rate of only 2.2%. With improved implants, prophylactic antibiotics, and better soft-tissue handling, plate fixation has been a reliable and reproducible technique. Late neurovascular compromise upto 6% was seen in patients treated conservatively due to non-union and excessive callus formation⁶⁵. In our study we had no transient neurological abnormalities.

The range of motion was good and the mean constant score was above 90 in our study. On reviewing the literature we found patients treated conservatively had substantial residual disability of the affected shoulder with minimal loss of muscle strength.

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

Many different methods of operative fixation of mid-shaft clavicle fractures have been described. Intramedullary pinning techniques have been associated with a high number of complications, such as pin migration and rotational instability and fixation with interfragmentary screws or wire sutures show insufficient immobilization. As a result, we prefer rigid fixation with a plate osteosynthesis which provides superior fracture stability and excellent clinical results in the treatment of acute fractures and non-unions.

In our study, the majority of complications were post-operative wound disorder (10%). Literature review shows infection rate upto 10% for plate fixation of displaced mid shaft fracture. The other major complication of our study was hardware irritation and prominence in 5% of patients. All cases were followed up regularly we have no refractures till date.

Taking these percentages into account, we believe that operative treatment of acute middle-third clavicle fractures should be reserved for persons who wishes to return early to activity and who accept the risk for potential complications. Especially wound disorders and infection may lead to disasters and the patient should be duly informed before deciding to have the operation.

MECHANISM OF INJURY

In our study, majority cases 18 (60%) injury occurred due to road traffic accidents, 6cases (20%) as a result of fall on an outstretched hand, 3 cases (10.0%) due to fall and 3 cases (10%) due to direct trauma, whereas in Meier et al study showed direct injury to the shoulder in 13 patients, 1 patient fell on his extended arm, 10 fractures were caused by road traffic accidents and 4 by sports injuries⁴⁰ In Mueller et al study, 19 patients sustained their fractures in high energy impact traffic injuries such as car and motorcycle injuries. 8 patients performed sports, 1 patient attributed his injury to the direct impact of rolling trunks, and 2 patients fell after a vasovagal syncope.⁴¹ Radwan et al had 32 cases due to RTA, 8 cases were due to work related causes, 3 during sport activity and 3 by other causes⁷ From the above observations it can be concluded that indirect injury caused by road traffic accidents is the most common cause for clavicular fractures

AGE INCIDENCE

The average age in our study group is 27 years in that 3 cases (10%) were between 18- 20years, 17 cases (56.6%) between 21-30 years, 5 cases (16.6%) between 31-40 years, 3 cases (10%) between 41-50 years and 2cases (6.6%) between 51-60 years. In Radwan et al study patients, the average age at the time of operation was 36±11 years for group I versus 39±9 years for group II.⁴² In Mueller et al mean age was 40 years (range, 19–66, group 1:40.2 years, group 2:39.9 years, group 3:39.1 years). Whereas Meier et al had mean age of 28 years (range: 16 to 40).

TIME INTERVAL FOR SURGERY

In 16 cases (53.3%), the time interval before surgery was less than 3 days after trauma, 14(46.6%) cases surgery took place between 3-7 days. In Mueller et al study surgery was performed on average 14.5 days after trauma. Meier et al conducted surgery on 6th day post trauma⁴ Radwan et al had a mean time interval of 4.5 days after trauma. Thus, on comparing the results of all the four studies, it was

observed that majority of cases were intervened at similar time interval after trauma.

FUNCTIONAL OUTCOME

The functional outcome according to Constant and Murley shoulder score in this study of 30 patients presented with midshaft clavicle fracture treated with open reduction internal fixation LCP 3.5 system Clavicle plate showed excellent outcome in 24 cases (80%), good outcome in 5 cases (16.6%) and fair outcome in 1 patient (3.3%). No case had poor outcome. Meier et al showed that in his study Constant shoulder score averaged 81 (range: 37 to 96) after 7 days and was 96 (range: 85 to 100) after 6 weeks. After 6 months and after hardware removal, all 13 patients presented with basically normal shoulder function (mean: 98, range: 93 to 100).⁴⁰ Mueller et al had Constant Score in group 1 as 91.6 points, in group 2 as 99.0 and in group 3 as 88.6 points whereas Radwan et al at final follow-up, the median Constant score was 92.^{5,6} Our present study had simple displaced and mild to moderately comminuted clavicle fractures like other studies and the results of functional outcome give promising evidence that Plating can be used as a surgical option. Thus clavicle plate osteosynthesis 3.5 system is a reliable and effective option in management of middle third clavicle fractures.

CONCLUSION

The traditional view that the vast majority of clavicular fractures heal with good functional outcomes following nonoperative treatment is no longer valid. Recent studies have identified a higher rate of non-union, late neurovascular compromise and specific deficits of shoulder function in subgroups of patients with these injuries who are treated by conservative means. Internal fixation by plate osteosynthesis has the advantage of early pain resolution, early return of shoulder function and potentially early return to work. The encountered complications in our study were similar to other recent studies. 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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