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# Plate Osteosynthesis versus conservative treatment in middle third shaft fractures of clavicle: A comparative study

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**Abstract**
**Objectives:** Mid shaft clavicle fractures have traditionally been treated by conservative means with good outcome. ORIF with plating is an upcoming option to improve outcome further. Aim of this study is to compare the outcome of open reduction and internal fixation with conservative treatment.
**Methods:** The study was done at the tertiary care trauma centre of Krishna institute of medical sciences, karad, Maharashtra between January 2018 to January 2019. The study was conducted over a period of one year, with 40 closed mid shaft clavicle fractures included. Half of the patients were operated using AO pre-contoured plate. The functional outcome was evaluated by the Constant and Murley score at the end of 3 months from injury. The fracture union time and associated problems were also compared.
**Results:** In the operative group, 20 patients (76%) had excellent functional outcome. In the operated group, 2 patients (8%) had hypertrophic skin scar and in 2 patients (8%) plate prominence occurred. 1 patient (4%), plate loosening occurred. In 2 patients (8%), delayed union occurred which went for malunion and in 1 patient (4%), plate breakage occurred.
In the non-operative group, 3 patients (15%) had good functional outcome, 7 patients (35%) had fair functional outcome and 10 patients (50%) had poor functional outcome.
**Conclusion:** In this study, early primary plate fixation of mid shaft clavicular fractures results in improved patient-oriented outcomes, improved surgeon-oriented outcomes, earlier return to function and decreased rates of non-union and malunion.

**Keywords:** Clavicle, mid shaft, fracture, conservative, plate

## 1. Introduction
Clavicle fracture is a common traumatic injury around shoulder girdle due to their subcutaneous position. It acts as a bridge connecting the upper limb to the thoracic cage, which helps to stabilise the shoulder girdle, while allowing the arm to perform a full range of movement. In addition, it functions as an attachment for muscles, provides protection to vital neurovascular structures, supports respiratory function and has a significant aesthetic role in a person's physical appearance. These functions can be damaged by fracture of the clavicle (Kotelnicki 2006; Lazarus 2001) [5]. About 70–80% of these fractures are in the middle third of the bone and less often in the lateral third (12–15%) and medial third (5–8%) [1]. Fractures of the clavicle have been traditionally treated non-operatively. Although many methods of closed reduction have been described, It frequently results in short-term disability and pain, eventually causing longer-term deformity and disability. Conservative treatment of displaced fracture midshaft of clavicle has produced mixed result from malunion to non-union as end result [2, 3] An informed decision about the best treatment can be put forth only after available evidence is systematically reviewed to determine whether surgical or conservative interventions are preferred to treat some or all middle third clavicle fractures. The present study was conducted to analyse the outcome of managements of clavicle fractures.

## 2. Materials and Methods
The study was done at the tertiary care trauma centre of Krishna institute of medical sciences, Karad, Maharashtra between January 2018 to January 2019. There were 20 patients in each group. All the patients with isolated closed displaced traumatic midclavicular fractures without

neurovascular involvement between age group 16-60 years were included in the study. In this study majority of the patients were with mid shaft clavicle fracture, i.e. 21 patients (42%) were in the age group of 18–28 years. The youngest patient was 18 years and oldest patient was 56 years. The average patient age was 33 years. Patients were enrolled from the emergency department and every alternate patient were enrolled between the two groups. Group A underwent conservative management and Group B underwent open reduction and internal fixation with a plate.

Exclusion criteria were fracture medial third shaft and fracture lateral end of clavicle, compound fractures with or without loss of bony segments. Inclusion criterion were patients with closed displaced fracture midshaft clavicle with or without associated head injury, abdominal injury or polytrauma. Each patient was thoroughly evaluated clinically and radiologically using plain radiograph of affected shoulder anteroposterior view to determine the site and nature of fracture.

### 2.1 Conservative Management

The patient will be managed conservatively using clavicle brace and a sling in which limb is immobilised for six weeks. After six weeks Range of motion will be started.

### 2.2 Surgical Management

Instruments used for plate fixation: 3.5 mm LCP anterosuperior plate (S shaped) was used. At about 7–9 cms, incision was made in the anterior aspect centring of clavicle over the fracture site. The skin subcutaneous tissue and platysma were divided without undermining the edges. The overlying fascia and periosteum were next divided. The osseous ends were freed from surrounding tissue. Minimal soft tissue and periosteum dissection was done.

**Fig 1:** surgical procedure for plate fixation

**Fig 2:** AP and PA view of surgically operated patient immediately post operative

Fracture fragments were reduced and plate was applied over the superior aspect of the clavicle. The plate was fixed to the medial and lateral fragment with 3.5 mm cortical screw and at least three screws in medial and lateral fragment were applied. The postoperative patient were given iv antibiotics for a period of 3 days and then discharged. The patient were given arm sling for two weeks. After two weeks suture removal was done, and range of motion was started. The patients were followed up at two weeks, six weeks, twelve weeks. Cases were assessed clinically at subsequent follow-up visits and results were designated as Excellent, Good, Fair and Poor based on Constant and Murley scoring at the end of 6 months.

## 3. Results and Observations

All the patients were available for follow-up. Regular follow up was done at 4 weeks interval for first 4 months by clinical examination and radiologically, then at 3 months interval till 1 year of fixation. In each follow up, progress of fracture union and range of movements at shoulder joint achieved was assessed. The functional outcome were assessed by constant and Murley score [7]. Based on total score obtained by subjective and objective evaluations, functional outcome in each patient was graded as the following:

- Excellent: 91- 100
- Good 81-89
- Satisfactory 71-80
- Adequate 61-70
- Poor 0-60.

This study was carried out on 40 patients of fresh fracture of the clavicle, out of which 20 were treated conservatively and 20 operatively at our hospital. All patients sustained clavicle fractures due to road traffic accidents. Mean age of the patients in the study was 33 years. Out of the 40 patients participated in this study, 8 (20%) were females while 32 (80%) were males. All patients were regularly followed up and were evaluated clinically in form of tenderness over fracture site and radiographic union and range of movement achieved. The associated injuries were scapulae fracture (5), acromion fracture (1), coracoid fracture (7), and ribs fracture (14). In this study, 12 (30%) patients had clavicle fracture on left side and 28 (70%) patients had right side clavicle fractures. Functional outcome of each patient was noted at each 1 month interval. All of 20 operative patients, (100%) had excellent or good functional outcome at 4 weeks 11, 14.

13 of the 20 patients who were managed conservatively had satisfactory scores and 7 had poor scores. The functional outcome results were assessed by the Constant and Murley Score. It was found that the difference between the number of excellent outcomes between the two groups was highly significant.

**Table 1:** Activity related pain

| Pain | Activities |
|---|---|
| Severe | Unaffected sleep yes/no |
| Moderate | Full recreation/sport yes/no |
| Mild | Full work yes/no |

**Table 2:** Abduction of arm

| Arms positioning | Strength of abduction (pounds) | |
|---|---|---|
| Up to waist | 0 | 13-15 |
| Up to xiphoid | 1-3 | 16-18 |
| Up to neck | 4-6 | 19-21 |
| Up to top of head | 7-9 | 22-24 |
| Above head | 10-12 | >24 |

**Table 3:** Range of movement

| Forward flexion | Abduction | External rotation | Internal rotation |
|---|---|---|---|
| 31-60 degrees | 31-60 degrees | Hand behind head, elbow forward | Up to lateral thigh, |
| 61-90 degrees | 61-90 degrees | Hand behind head, elbow back | Up to buttock, |
| 91-120 degrees | 91-120 degrees | Hand to top of head, elbow forward | Up to lumbosacral junction, |
| 121-150 degrees | 121-150 degrees | Hand to top of head, elbow back | Up to waist (L3 vertebra), |
| 151-180 degrees | 151-180 degrees | Full elevation | Up to T12 vertebra, Up to interscapular, region (T7) |

There was no statistically significant difference between two groups with respect to flexion, extension, abduction, internal rotation and external rotation movements. Patients in the operative group had better range of shoulder adduction movement than nonoperative group ($P = 0.015$).

## 4. Complications

Complications including non-union and malunion were more common in a conservative group whereas complications in the operative group were prominently related to hardware (implant failure, loosening of screw, infection). A complication requiring inpatient treatment and resulting in an additional morbidity of 2 months or more was regarded as a major complication.

In the operated group, surgical complications are more common. 2 patients (10%) had hypertrophic skin scar and in 2 patients (10%) plate prominence occurred. In 1 patient (5%), plate loosening occurred. In 2 patients (10%), delayed union occurred which went for malunion and in 1 patient (5%) plate breakage occurred.

In 20 patients treated with figure of 8 brace and sling, 4 patients (25%) had delayed union, 4 patients (20%) had malunion, 6 patients (25%) had non-union (figure 3) and 2 patients (10%) had restricted shoulder motion and pain.

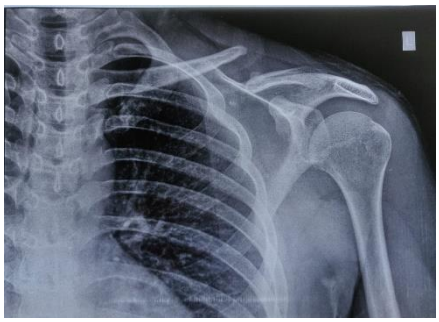

**Fig 3:** Non-union in conservatively treated patient.

**Table 4:** Outcomes of the two groups.

| Outcome Results | Group | | | |
|---|---|---|---|---|
| | Conservative | | Operative | |
| | No. | % | No. | % |
| **According to constant and Murley score** | | | | |
| Excellent/good | 3 | 15.0 | 20 | 100.0 |
| Satisfactory | 10 | 50.0 | 0 | 0.0 |
| Poor | 7 | 35.0 | 0 | 0.0 |
| Total | 20 | 100.0 | 20 | 100.0 |
| **According to final union status** | | | | |
| Union | 0 | 0.0 | 19 | 100.0 |
| Mal-union | 14 | 52.9 | 0 | 0.0 |
| Non-union | 6 | 23.5 | 0 | 0.0 |
| Total | 20 | 100.0 | 19 | 100.0 |

## 5. Discussion

Clavicle fractures are mostly treated by conservative methods like clavicle brace and arm sling support. These conservative methods of treatment of all types of clavicle fractures produced good results in general population who don't need much overhead abduction of shoulder in their daily life. However, this doesn't produced good result in subgroup of manual laborers who need good overhead abduction of shoulder joint.

Conservative management of displaced fracture shaft clavicle needed longer duration for union and some went into non-union, thereby increasing the morbidity and stiffness of shoulder joint with poor functional outcome and need for operative treatment to achieve union [2]. This increased financial burden in manual laborers life with delayed return to work and loss of working days.

To decrease the duration of treatment and to achieve early union of displaced fracture clavicle and early mobilisation of shoulder and good functional outcome, operative treatment was used and found to be having good to excellent result with early return to work.

In operative treatment, with proper technique and using safety measures, open reduction and internal fixation using reconstruction plate or AO pre contoured plate has been found to produce excellent results with some surgical complication.

The mean time for fracture healing (radiological union) was shorter in the operative group (15.73 weeks) than nonoperative group (27.46 weeks). McKee *et al*. [3] described the mean time for fracture healing were 14-16 weeks for operated patients and 24-28 weeks for nonoperated patients.

The complications were more in the nonoperative group like symptomatic malunion 7 cases (46.66%), shortening 3 cases (20%), muscle wasting 4 cases (26.66%), pressure necrosis 1 case (6.66%) and complex regional pain syndrome 1 cases (6.66%). The complications noted in the operative group 2 patients (10%) had hypertrophic skin scar and in 2 patients (10%) plate prominence occurred. In 1 patient (5%), plate loosening occurred. In 2 patients (10%), delayed union occurred which went for malunion and in 1 patient (5%) plate breakage occurred.

Iatrogenic neurovascular vascular injury is an imminent complication if proper operative techniques are not followed. Because major neurovascular structures like subclavian vein, subclavian artery and brachial plexus are near to the surgical field. However, in this study, none of our operated patients developed any neurovascular injury. None of the patients in this study had pulmonary injury either following primary injury or iatrogenic ally.

According to various studies, conservative therapy of displaced middle third clavicle fracture has been associated with poor outcomes.

## 6. Conclusion

In this study, early primary plate fixation of mid shaft clavicular fractures results in improved patient-oriented outcomes, improved surgeon-oriented outcomes, earlier return to function and decreased rates of non-union and malunion.

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