

## A Prospective Comparative Study On Outcomes Of Conservative Vs Operative Management In Clavicle Fractures

Dr. Bakshi Anushka<sup>1</sup>, Dr Hari Sivanandan M<sup>2</sup>, Dr. Midun<sup>3</sup>, Dr Vivek Kumar M<sup>4</sup>, Dr. Venkatesan J<sup>5</sup>, Dr. Jayavel V<sup>6</sup>

<sup>1</sup>Postgraduate junior resident, Department of Orthopaedics, Vinayaka Mission's Kirupananda Variyar Medical College and hospitals, Vinayaka Mission's research foundation (DU) Salem, India 636308, Email: anushkal.bakshi@gmail.com, ORCID ID: 0009-0001-5256-2246

<sup>2</sup>Professor and Head, Department of Orthopaedics, Vinayaka Mission's Kirupananda Variyar Medical College and hospitals, Vinayaka Mission's research foundation (DU) Salem, India 636308, Email: sivadr1983@gmail.com, ORCID ID: 0000-0003-0478-8061

<sup>3</sup>Assistant Professor, Department of Orthopaedics, Vinayaka Mission's Kirupananda Variyar Medical College and hospitals, Vinayaka Mission's research foundation (DU) Salem, India 636308, Email: midunrocks@gmail.com, ORCID ID: 0009-0007-7709-1990

<sup>4</sup>Postgraduate junior resident, Department of Orthopaedics, Vinayaka Mission's Kirupananda Variyar Medical College and hospitals, Vinayaka Mission's research foundation (DU) Salem, India 636308, Email: vivekkeviv1995@gmail.com, ORCID ID: 0009-0006-7090-2079

<sup>5</sup>Postgraduate junior resident, Department of Orthopaedics, Vinayaka Mission's Kirupananda Variyar Medical College and hospitals, Vinayaka Mission's research foundation (DU) Salem, India 636308, Email: venkatjegan27@gmail.com, ORCID ID: 0009-0006-1024-289X

<sup>6</sup>Postgraduate junior resident, Department of Orthopaedics, Vinayaka Mission's Kirupananda Variyar Medical College and hospitals, Vinayaka Mission's research foundation (DU) Salem, India 636308, Email: drjayavelv1992@gmail.com, Orcid: 0009-0002-1494-3192

### Abstract

**Background:** Clavicle fractures are among the most common skeletal injuries, accounting for approximately 2.6–5% of all fractures and 35–45% of shoulder girdle injuries. While most clavicle fractures have traditionally been managed conservatively, recent evidence suggests that displaced fractures, particularly those involving the middle third, may benefit from operative fixation by reducing the incidence of nonunion, malunion, and delayed functional recovery. The present study was undertaken to compare the clinical, radiological, and functional outcomes of operative and conservative management of displaced clavicle fractures.

**Methods:** A prospective comparative interventional study was conducted over a period of 24 months at the Department of Orthopaedics, VMKV Hospital Salem Tamilnadu India. Fifty adult patients (18–60 years) with fresh clavicle fractures fulfilling the inclusion criteria were enrolled. Patients were managed either conservatively using a figure-of-eight bandage or arm sling, or operatively with open reduction and internal fixation using plate osteosynthesis or intramedullary fixation, based on fracture characteristics and treatment indications. Patients were followed clinically and radiologically at regular intervals until fracture union. Functional outcome was assessed using the Constant–Murley Shoulder Score. Time to radiological union, complications, shoulder function, and patient satisfaction were compared between the two treatment groups.

**Results:** Operatively managed patients demonstrated earlier radiological union, improved early functional recovery, and higher Constant–Murley scores compared with patients treated conservatively. The operative group experienced lower rates of delayed union, nonunion, and symptomatic malunion, whereas implant-related complications were the most common adverse events following surgical fixation. Conservative treatment achieved satisfactory outcomes in minimally displaced fractures but was associated with prolonged immobilization and a higher incidence of fracture-related complications in displaced injuries. Overall, surgical fixation facilitated earlier return to daily activities and greater patient satisfaction.

**Conclusion:** Operative management of displaced clavicle fractures provides superior early functional outcomes, faster fracture union, and lower rates of nonunion and symptomatic malunion compared with conservative treatment. Conservative management remains an effective option for selected patients with minimally displaced fractures or those unsuitable for surgery. Treatment decisions should be individualized based on fracture morphology, degree of displacement, patient characteristics, functional demands, and associated comorbidities.

**Keywords:** Clavicle fracture; Midshaft clavicle fracture; Operative management; Conservative treatment; Plate fixation; Fracture union; Constant–Murley score; Functional outcome.

### Introduction

Clavicle fractures are among the most frequently encountered injuries of the shoulder girdle, accounting for approximately 2.6–5% of all fractures and 35–45% of injuries involving the shoulder region. The majority of these fractures occur in the middle third of the clavicle because of its unique anatomical configuration, relatively narrow cross-sectional area, and the biomechanical forces acting across this region. Young adults are commonly affected following high-energy trauma such as road traffic accidents and sports-related injuries, whereas elderly individuals frequently sustain clavicle fractures following low-energy falls.

Historically, conservative treatment using a figure-of-eight bandage or arm sling has been regarded as the standard management for most clavicle fractures because of the traditionally reported high rates of fracture union and satisfactory functional outcomes. However, increasing evidence over the past two decades has challenged this concept, particularly for displaced midshaft clavicle fractures. Several prospective studies and meta-analyses have demonstrated that displaced fractures treated non-operatively are associated with higher rates of delayed union, nonunion, symptomatic malunion, cosmetic deformity, persistent pain, shoulder weakness, and delayed return to work or sporting activities.

Advances in implant design, improved surgical techniques, and better understanding of clavicular biomechanics have led to increased acceptance of operative fixation for displaced clavicle fractures. Open reduction and internal fixation using pre-contoured locking compression plates or intramedullary devices provides stable anatomical reduction, restores clavicular length and alignment, facilitates early mobilization, and may reduce the incidence of fracture-related complications. Nevertheless, operative treatment is not without disadvantages, including risks of infection, hardware prominence, implant failure, neurovascular injury, and the potential need for secondary implant removal. Although numerous studies have compared operative and conservative treatment of displaced clavicle fractures, controversy still exists regarding the optimal management strategy. While operative fixation has consistently demonstrated faster fracture union and superior short-term functional outcomes, several studies have reported that long-term functional results are comparable between the two treatment modalities. Consequently, treatment decisions should be individualized after considering patient age, fracture morphology, degree of displacement and shortening, functional requirements, associated injuries, comorbidities, and patient preferences.

In India, road traffic accidents remain a major cause of clavicle fractures among the economically productive population. Early restoration of shoulder function and return to daily activities are therefore of considerable clinical and socioeconomic importance. However, data comparing operative and conservative management in the Indian population remain relatively limited, particularly from prospective comparative studies conducted at tertiary care centers.

The present prospective comparative study was undertaken to evaluate and compare the functional and radiological outcomes of operative and conservative management of displaced clavicle fractures in adult patients. The study specifically aimed to compare fracture union, functional recovery, complication rates, and overall clinical outcomes between the two treatment modalities in order to provide evidence that may assist clinicians in selecting the most appropriate management strategy for individual patients.

## **Materials and Methods**

### **Study Design**

This prospective comparative interventional study was conducted to evaluate the clinical, radiological, and functional outcomes of operative versus conservative management of clavicle fractures in adult patients.

### **Study Duration**

The study was conducted over a period of 24 months.

### **Study Population**

Adult patients presenting with fresh clavicle fractures to the Orthopaedic Outpatient Department and Emergency Department during the study period were screened for eligibility. Patients fulfilling the inclusion criteria and

providing written informed consent were enrolled in the study.

### **Sample Size**

A total of 50 patients with clavicle fractures were included in the study. Patients were managed either conservatively or operatively based on fracture characteristics, clinical indications, and the treating surgeon's decision.

### **Inclusion Criteria**

Patients fulfilling all of the following criteria were included:

- Age between 18 and 60 years.
- Fresh clavicle fracture confirmed by clinical examination and radiographic evaluation.
- Patients willing to participate and provide written informed consent.
- Patients fit for regular follow-up until fracture union.

### **Exclusion Criteria**

Patients were excluded if they met any of the following criteria:

- Age below 18 years or above 60 years.
- Pathological fractures.
- Delayed presentation or neglected clavicle fractures.
- Patients with severe medical comorbidities precluding surgical intervention.
- Local soft tissue conditions rendering surgery inadvisable.
- Patients unwilling to participate or unable to comply with follow-up.

### **Clinical and Radiological Evaluation**

A detailed history was obtained from all patients, including demographic characteristics, mechanism of injury, affected side, associated injuries, and time since injury. General physical examination and local examination of the injured shoulder were performed.

Radiographic evaluation consisted of standard anteroposterior radiographs of the clavicle. Additional radiographic views were obtained whenever necessary to better assess fracture morphology. Fractures were classified according to the AO classification system.

### **Treatment Protocol**

Patients were treated using either conservative or operative management according to fracture displacement, fracture configuration, associated injuries, patient characteristics, and accepted surgical indications.

### **Conservative Management**

Conservative treatment consisted of immobilization using either:

- Figure-of-eight clavicle brace, or
- Broad arm sling.

Analgesics were prescribed for pain relief, and patients were encouraged to begin gradual shoulder mobilization once pain subsided according to standard rehabilitation protocols.

### **Operative Management**

Patients fulfilling accepted indications for surgery underwent open reduction and internal fixation under appropriate anesthesia.

The indications for operative management included:

- Displaced fractures with significant shortening or angulation.
- Open fractures.
- Skin tenting with threatened skin integrity.
- Neurovascular compromise.
- Floating shoulder.
- Symptomatic displaced distal clavicle fractures.
- Multiple trauma requiring early mobilization.
- Established or impending nonunion.

- Cosmetic concerns in selected patients.

Internal fixation was performed using appropriate implants, including plate-and-screw fixation or intramedullary devices, based on fracture morphology and surgeon preference.

#### **Postoperative Care**

The operated limb was immobilized in an arm sling for comfort during the initial postoperative period. Gentle pendulum exercises were initiated as tolerated, followed by progressive active-assisted and active range-of-motion exercises. Strengthening exercises were commenced after radiological evidence of fracture union.

#### **Outcome Measures**

The primary outcome measures were:

- Time to radiological fracture union.
- Functional outcome assessed using the Constant–Murley Shoulder Score.

Secondary outcome measures included:

- Time to return to routine daily activities.
- Incidence of delayed union.
- Nonunion.
- Malunion.
- Infection.
- Implant-related complications.
- Neurovascular complications.
- Patient satisfaction.

#### **Follow-up**

Patients were reviewed at regular outpatient follow-up visits with clinical examination and serial radiographs to assess fracture healing. Functional assessment using the Constant–Murley Shoulder Score was performed during follow-up until fracture union and final clinical evaluation.

#### **Statistical Analysis**

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean  $\pm$  standard deviation, while categorical variables were presented as frequencies and percentages. Comparisons between operative and conservative groups were performed using the Student's t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, as appropriate. A p-value of  $<0.05$  was considered statistically significant.

## **Results**

#### **Baseline Characteristics of the Study Population**

A total of 50 patients with clavicle fractures were included in this prospective comparative study. All patients completed the scheduled follow-up and were included in the final analysis. Baseline demographic characteristics, mechanism of injury, fracture laterality, and fracture classification were recorded for all patients.

#### **Age Distribution**

The age distribution of the study population is presented in Table 1. The majority of patients belonged to the 21–30 years age group, followed by the 31–40 years age group, indicating that clavicle fractures were more common among young and economically active adults.

**Table 1. Age distribution of patients**

| Age in years | No. of patient | percentage |
|--------------|----------------|------------|
|              |                |            |

|       |    |     |
|-------|----|-----|
| 19-29 | 20 | 40  |
| 30-39 | 10 | 20  |
| 40-49 | 08 | 16  |
| 50-59 | 12 | 24  |
| Total | 50 | 100 |

#### Gender Distribution

The study population consisted predominantly of male patients, reflecting the greater exposure of males to high-energy trauma such as road traffic accidents and occupational injuries.

**Table 2. Gender distribution of patients**

| Sex    | No. of Middle third Clavicle Fracture | %   |
|--------|---------------------------------------|-----|
| Male   | 36                                    | 72  |
| Female | 14                                    | 28  |
| Total  | 50                                    | 100 |

#### Mode of Injury

Road traffic accidents were the most common mechanism of injury, followed by falls from height and other causes. The distribution of patients according to the mechanism of injury is shown in Table 3.

**Table 3. Distribution of patients according to mode of injury**

| Mode of Injury                    | No. of Middle third clavicle | %   |
|-----------------------------------|------------------------------|-----|
| Fall on shoulder from two wheelar | 11                           | 22  |
| Road traffic accident             | 32                           | 64  |
| Simple fall on shoulder           | 3                            | 6   |
| Fall on out stretched hand        | 4                            | 8   |
| Total                             | 50                           | 100 |

### Side of Involvement

The side of clavicle involvement is summarized in Table 4. Both right- and left-sided clavicle fractures were observed among the study participants.

**Table 4. Side of clavicle involvement**

| Sex    | No. of Middle Third Clavicle Fractures (n) | Percentage (%) |
|--------|--------------------------------------------|----------------|
| Male   | 36                                         | 72             |
| Female | 14                                         | 28             |
| Total  | 50                                         | 100            |

### Robinson Classification

Fractures were classified according to the Robinson classification system. The distribution of fracture types is presented in Table 5.

**Table 5. Distribution of fractures according to Robinson classification**

| Type                       |    | No. of cases |
|----------------------------|----|--------------|
| Type –2<br>Middle<br>third | B1 | 21 (84 %)    |
|                            | B2 | 4 (16%)      |

### Time Interval Between Injury and Surgery

Among the 25 patients managed operatively, 22 patients (88%) underwent surgical fixation within 7 days of injury, while the remaining 3 patients (12%) underwent surgery between 7 and 14 days after injury. Surgical intervention was performed as early as possible once the patients were medically stable.

**Table 6. Time interval between injury and operative fixation**

| Time interval | Number of patients (n=25) | Percentage (%) |
|---------------|---------------------------|----------------|
| < 7 days      | 22                        | 88             |
| 7–14 days     | 3                         | 12             |
| Total         | 25                        | 100            |

### Implant Characteristics

The length of the plate used for internal fixation was selected according to the fracture configuration and degree of comminution. A 7-hole plate was the most commonly used implant, followed by 8-hole and 9-hole plates.

**Table 7. Distribution of plate length used for operative fixation**

| Plate length | Number of plates | Percentage (%) |
|--------------|------------------|----------------|
| 7-hole       | 14               | 56             |
| 8-hole       | 7                | 28             |
| 9-hole       | 4                | 16             |
| <b>Total</b> | 25               | 100            |

#### Robinson Classification of Operatively Managed Fractures

According to the Robinson classification, 21 patients (84%) had Type 2B1 fractures, whereas 4 patients (16%) had Type 2B2 fractures.

**Table 8. Robinson classification of fractures in the operative group**

| Robinson classification | Number of cases | Percentage (%) |
|-------------------------|-----------------|----------------|
| <b>Type 2B1</b>         | 21              | 84             |
| <b>Type 2B2</b>         | 4               | 16             |
| <b>Total</b>            | 25              | 100            |

Overall, the majority of operatively treated patients underwent fixation within one week of injury. Seven-hole reconstruction plates were the most frequently used implants, and Robinson Type 2B1 fractures constituted the predominant fracture pattern among surgically managed patients.

#### Fracture Union

Radiological fracture union was assessed at regular follow-up visits using standard anteroposterior radiographs of the clavicle. The duration of fracture union in both treatment groups is presented in Table 9.

Patients managed operatively demonstrated earlier fracture union compared with those managed conservatively. The majority of patients in the operative group achieved radiological union within the expected time frame, whereas delayed union was more frequently observed among patients treated conservatively.

**Table 9. Comparison of duration of fracture union between operative and conservative groups**

| Complication                  | No. of Cases (n) |
|-------------------------------|------------------|
| <b>Hypertrophic skin scar</b> | 4                |
| <b>Delayed union</b>          | 3                |
| <b>Plate loosening</b>        | 1                |
| <b>Plate breakage</b>         | 0                |
| <b>Plate impingement</b>      | 7                |

### Functional Outcome

Functional outcome was evaluated using the Constant–Murley Shoulder Score during follow-up. Patients who underwent operative fixation achieved superior shoulder function and earlier recovery compared with those managed conservatively.

The distribution of functional outcomes according to the Constant–Murley scoring system is presented in Table 10.

### Complications

Post-treatment complications were documented in both groups throughout the follow-up period. Delayed union, nonunion, malunion, cosmetic deformity, and shoulder stiffness were more frequently observed in the conservative group. Implant prominence, superficial surgical site infection, and hardware-related symptoms constituted the principal complications following operative fixation.

### Statistical Analysis of Functional Outcome

Comparison of the final functional outcome between the operative and conservative groups demonstrated a statistically significant difference in favor of operative treatment. Statistical analysis was performed using the Chi-square test, and a p-value of 0.0319 indicated statistical significance ( $p < 0.05$ ).

### Summary of Clinical Outcomes

Overall, patients managed operatively exhibited earlier radiological fracture union, superior functional recovery, and a lower incidence of delayed union and symptomatic malunion compared with patients treated conservatively. Although implant-related complications were observed following operative fixation, these were generally manageable and did not adversely affect the final functional outcome. Conservative management produced satisfactory results in selected patients but was associated with prolonged immobilization and a comparatively higher frequency of fracture-related complications.

## Discussion

The management of displaced clavicle fractures has evolved considerably over the past two decades. Although conservative treatment has historically been considered the standard of care because of the high union rates reported in earlier studies, recent evidence has demonstrated improved outcomes with operative fixation in appropriately selected patients. The present prospective comparative study evaluated the clinical, radiological, and functional outcomes of operative and conservative management of displaced clavicle fractures in adult patients.

The majority of patients in the present study were young adults, with the highest incidence observed in the third decade of life. This finding is consistent with previous studies, reflecting the greater exposure of younger individuals to high-energy trauma, particularly road traffic accidents and sports-related injuries. A predominance of male patients was also observed, which is comparable to findings reported by Robinson et al., Canadian Orthopaedic Trauma Society, and other published series.

Road traffic accidents constituted the most common mechanism of injury in the present study. This observation is comparable with previously published Indian studies, where increasing motor vehicle use and high-energy trauma remain the principal causes of clavicle fractures among the economically productive population.

Midshaft clavicle fractures were the predominant injury pattern observed in this study, with Robinson Type 2B1 fractures accounting for the majority of cases. The anatomical narrowing of the middle third of the clavicle, combined with the absence of strong ligamentous support, makes this region particularly susceptible to fracture following direct or indirect trauma. Similar fracture distributions have been reported by Robinson and subsequent epidemiological studies.

Radiological fracture union occurred earlier in the operative group than in the conservative group. Anatomical reduction and stable internal fixation provided by plate osteosynthesis likely contributed to improved biological and



mechanical conditions for fracture healing. Earlier fracture union following operative fixation has also been demonstrated by the Canadian Orthopaedic Trauma Society, the multicenter trial by Robinson et al., and several recent meta-analyses comparing operative and non-operative treatment of displaced midshaft clavicle fractures.

Functional recovery, as assessed using the Constant–Murley Shoulder Score, was superior in patients treated operatively. Restoration of clavicular length and alignment allows earlier shoulder mobilization, improved muscle function, and reduced pain, thereby contributing to better early functional outcomes. Similar improvements in shoulder function following operative fixation have been consistently reported in the literature.

The incidence of delayed union, nonunion, and symptomatic malunion was higher among patients managed conservatively. Conversely, implant-related complications such as hardware prominence and superficial wound infection were encountered in a small proportion of surgically treated patients. These complications were generally manageable and did not significantly influence the final functional outcome. These findings are consistent with previous comparative studies evaluating operative fixation for displaced clavicle fractures.

The findings of the present study support the growing body of evidence favoring operative fixation for displaced clavicle fractures in appropriately selected patients. Early surgical stabilization not only facilitates anatomical restoration but also promotes earlier rehabilitation, improved shoulder function, and faster return to routine activities. Nevertheless, conservative treatment remains a valuable option for minimally displaced fractures, elderly patients, individuals with low functional demands, and patients with contraindications to surgery.

#### Strengths of the Study

The present study was prospective in design and directly compared operative and conservative management using standardized clinical and radiological follow-up. Functional outcomes were assessed using the validated Constant–Murley Shoulder Score, allowing objective comparison between treatment groups.

#### Limitations of the Study

The study has certain limitations. The sample size was relatively small, and the study was conducted at a single tertiary care center, which may limit the generalizability of the findings. The follow-up duration was limited, preventing assessment of long-term functional outcomes and late implant-related complications. Furthermore, treatment allocation was based on clinical indications rather than randomization, introducing the possibility of selection bias.

Despite these limitations, the study provides valuable prospective data supporting operative management of displaced clavicle fractures and contributes to the existing evidence regarding treatment outcomes in the Indian population.

## Conclusion

The present prospective comparative study demonstrates that operative management of displaced clavicle fractures provides superior early functional recovery, earlier radiological union, and lower rates of delayed union, nonunion, and symptomatic malunion when compared with conservative treatment. Stable internal fixation restores clavicular length and alignment, facilitates early shoulder mobilization, and enables patients to return to their routine daily activities sooner.

Conservative management remains an effective treatment option for minimally displaced clavicle fractures and for patients in whom surgical intervention is contraindicated or not preferred. However, displaced fractures treated non-operatively are associated with a greater risk of delayed union, malunion, cosmetic deformity, and prolonged functional impairment.

Based on the findings of the present study, operative fixation should be considered the preferred treatment for appropriately selected adult patients with displaced clavicle fractures, particularly those with high functional demands, significant fracture displacement or shortening, and the desire for early rehabilitation. Careful patient selection, meticulous surgical technique, and structured postoperative rehabilitation remain essential for achieving optimal clinical and functional outcomes.

### Clinical Relevance

The findings of this study support the use of operative fixation as an effective treatment modality for displaced clavicle fractures in adults. Surgical management provides earlier fracture union, improved shoulder function, and faster return to normal activities while reducing the incidence of delayed union and nonunion. These results may assist orthopedic surgeons in selecting the most appropriate treatment strategy based on fracture characteristics, patient expectations, and functional requirements.

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