Section: Orthopedics

Original Research Article

COMPARATIVE STUDY BETWEEN OPERATIVE AND CONSERVATIVE MANAGEMENT OF CLAVICLE FRACTURES IN ADULTS AT TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Clavicle fractures are among the most common skeletal injuries, frequently affecting young, active adults. While conservative management has been the traditional approach, recent advances in fixation techniques have renewed interest in surgical management. The objective is to evaluate and compare radiological union, functional outcomes, pain levels, and complications in adult patients with midshaft clavicle fractures managed either operatively or conservatively.

Materials and Methods: A prospective comparative study was conducted on 60 adult patients with midshaft clavicle fractures in a tertiary care teaching hospital. Thirty patients underwent open reduction and internal fixation with plates and screws, while thirty were managed conservatively with an arm sling and figure-of-eight bandage. Patients were followed up for six months. Radiological union time, Constant-Murley score, DASH score, and Visual Analogue Scale (VAS) for pain were assessed and statistically analysed.

Results: The mean time to union was significantly shorter in the operative group (9.8 weeks) compared to the conservative group (14.2 weeks) ($p < 0.001$). Operative patients demonstrated higher mean Constant-Murley scores (90.6 vs. 82.3) and lower DASH scores (9.4 vs. 18.2). Pain reduction occurred earlier, and cosmetic satisfaction was greater in the surgical group. Non-union and malunion were more frequent in the conservative group, while minor implant-related irritation occurred in some operative cases.

Conclusion: Operative management of displaced midshaft clavicle fractures provides faster union, improved early function, and better cosmetic outcomes compared to conservative treatment. Non-operative care remains suitable for undisplaced fractures.

Keywords: Operative Management, Conservative Management, Clavicle Fractures, Adults.

INTRODUCTION

Clavicle fractures are among the most common injuries encountered in orthopedic practice, accounting for approximately 2.6–5% of all adult fractures and nearly 35–45% of shoulder girdle injuries.[1] The clavicle, being a subcutaneous S-shaped bone that serves as the strut connecting the upper limb to the axial skeleton, is vulnerable to direct and indirect trauma, particularly due to its superficial position and exposure to external forces. The majority of clavicular fractures occur in the middle third (midshaft) segment, which represents the thinnest portion of the bone and lacks muscular or ligamentous reinforcement.[2]

Traditionally, non-operative (conservative) management has been considered the standard of care for most clavicle fractures, particularly those that are undisplaced or minimally displaced. The conservative approach—often involving the use of a

figure-of-eight bandage or simple arm sling—was widely accepted based on early studies suggesting satisfactory functional outcomes and a low risk of complications.[2,3] However, over the past two decades, this paradigm has been increasingly challenged. Recent evidence has demonstrated that displaced midshaft clavicle fractures treated non-operatively are associated with higher rates of malunion, non-union, shoulder weakness, and cosmetic deformity compared to surgically treated counterparts.[4,5]

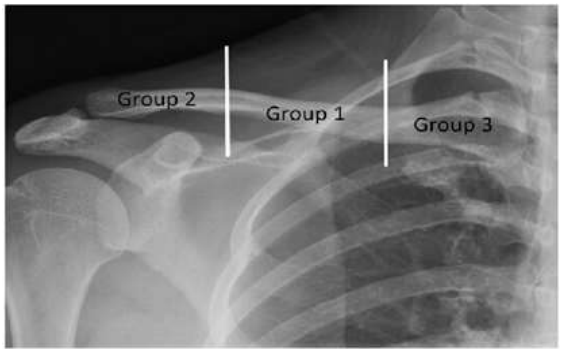

Figure 1: Radiograph showing clavicular fractures based on their location: 1-Middle third; 2-Lateral third; 3-Medial third.

The shift in treatment philosophy has been fueled by the advent of improved surgical techniques and implants, such as pre-contoured locking plates and intramedullary fixation devices, which provide stable fixation with minimal soft tissue disruption.[6] Operative fixation aims to restore anatomical alignment, facilitate early mobilization, and improve functional outcomes. Several randomized controlled trials and meta-analyses have suggested that surgical intervention in selected cases of displaced midshaft clavicle fractures leads to earlier union, reduced rates of non-union, and better patient satisfaction compared to conservative methods.[7,8]

Despite these advancements, controversy persists regarding the optimal management strategy. While surgery may provide superior anatomical and functional outcomes, it is not without risks. Complications such as infection, hardware irritation, implant failure, and neurovascular injury have been reported.[9] On the other hand, conservative management avoids surgical risks but may lead to prolonged immobilization, shoulder stiffness, and cosmetic dissatisfaction in patients with displaced fractures. Thus, the decision between operative and non-operative treatment must balance the benefits of early recovery and alignment against potential surgical morbidity and cost implications.

The functional outcome of clavicle fracture management is multifactorial, depending on the site of fracture, displacement, comminution, patient age, activity level, and compliance with rehabilitation. The Constant-Murley score and Disabilities of the Arm, Shoulder, and Hand (DASH) score are commonly used standardized tools for assessing postoperative function and quality of life. While some studies have reported superior Constant and DASH scores with operative treatment at early follow-up intervals, differences tend to narrow over long-term follow-up, indicating that both modalities can yield acceptable outcomes when properly indicated.[1,10]

This study aims to compare the functional, radiological, and complication outcomes of operative versus conservative management in adult clavicle fractures. The specific objectives were to evaluate the time to fracture union, shoulder range of motion, pain relief, patient satisfaction, and incidence of complications such as non-union or malunion in both groups.

MATERIALS AND METHODS

Study Settings: A prospective comparative clinical study was conducted in the Department of Orthopaedics, at a tertiary care teaching hospital in North India, over a period of 18 months from January 2024 to June 2025. The study compares the functional and radiological outcomes of operative versus conservative management of clavicle fractures in adult patients. All adult patients presenting with acute clavicle fractures to the emergency or outpatient department during the study period were assessed for eligibility. The diagnosis was established based on clinical examination and confirmed with standard anteroposterior radiographs of the clavicle and shoulder girdle.

Sample Size: A total of 60 patients were included in the study which were divided equally into two groups:

- Group A (Operative group) – 30 patients managed surgically.
- Group B (Conservative group) – 30 patients managed non-operatively.

The sample size was determined based on previous literature showing a significant difference in functional outcome scores between the two modalities (Canadian Orthopaedic Trauma Society, 2007), with a power of 80% and a significance level of 0.05.[8]

Inclusion & Exclusion Criteria

Adult patients aged 18 years and above presenting with acute clavicle fractures (<2 weeks old) of midshaft (middle-third) fractures of the clavicle (Robinson type 2) and willing to participate were included in the study. However patients with open fractures of the clavicle or pathological fractures, associated neurovascular injury or polytrauma or fractures involving the lateral or medial third of the clavicle were excluded from the study.

Treatment Protocol

Group A – Operative Management

- Patients in this group underwent open reduction and internal fixation (ORIF) with either pre-contoured locking compression plate (LCP) or reconstruction plate under general or regional anesthesia.

- The surgical approach used was a superior incision along the clavicle.
- Fracture fragments were reduced anatomically and fixed with plate and screws ensuring at least six cortical purchases on either side of the fracture.
- Postoperatively, the arm was supported in a sling for 2 weeks, and pendulum exercises were started from day 3 to 5.
- Progressive mobilization and physiotherapy were initiated after suture removal, depending on radiological healing.

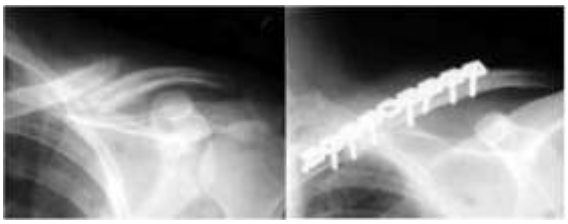

Figure 2: Radiograph showing a) a midshaft fracture (Pre-OP) b) After surgical management (Post-OP)

Figure 3: Radiograph showing surgically managed by pre-contoured locking compression plate (LCP)

Group B – Conservative Management

- Patients were treated with figure-of-eight bandage or arm sling immobilization for 3–4 weeks, depending on pain and clinical assessment.
- Analgesics and anti-inflammatory medications were prescribed as required.
- Gentle shoulder mobilization exercises were started after 3–4 weeks, followed by progressive range of motion and strengthening exercises.
- Patients were advised to avoid lifting heavy weights for at least 6 weeks.

Follow-up and Evaluation

All patients were followed up at 2 weeks, 6 weeks, 3 months, and 6 months after treatment.

At each visit, the following parameters were recorded:

1. Pain Assessment – using the Visual Analogue Scale (VAS).
2. Functional Outcome – evaluated by Constant-Murley Shoulder Score and Disabilities of the Arm, Shoulder and Hand (DASH) score.
3. Radiological Assessment – standard AP and 15° cephalad tilt radiographs were taken to assess fracture alignment, callus formation, and union.
   - Union was defined as bridging callus in at least three cortices on radiographs and absence of tenderness at the fracture site.
   - Non-union was defined as absence of clinical or radiological healing at 6 months.
4. Time to Union – calculated from the date of injury to radiological confirmation of union.
5. Complications – recorded in both groups, including infection, implant failure, non-union, malunion, shoulder stiffness, and hardware irritation.

Figure 4: Radiograph showing evidence of secondary healing with callus formation in conservatively

Outcome Measures

The primary outcome measure was the functional recovery of the shoulder as assessed by the Constant-Murley Score at 6 months.

The secondary outcome measures included:

- Time to clinical and radiological union
- Pain scores (VAS)
- Incidence of complications
- Cosmetic satisfaction (subjective patient evaluation)

Statistical Analysis: All collected data were entered into Microsoft Excel and analyzed using SPSS software version 23.0. Continuous variables were expressed as mean ± standard deviation (SD) and compared using the Student's t-test. Categorical variables were analyzed using the Chi-square test or Fisher's exact test as appropriate. A p-value of <0.05 was considered statistically significant.

RESULTS

1. Demographic Profile

A total of 60 adult patients with midshaft clavicle fractures were included in the study, with 30 patients in each group:

- Group A (Operative management) – treated with plate fixation
- Group B (Conservative management) – treated with figure-of-eight bandage or arm sling.

Table 1: Demographic characteristics of study subjects

Parameter	Group A (Operative)	Group B (Conservative)	p-value
Number of Patients	30	30	—
Mean Age (years)	35.9 ± 10.6	37.7 ± 12.1	0.56
Gender (Male:Female)	24:6	23:7	0.77
Side (Right: Left)	19:11	17:13	0.61
Mode of Injury (RTA:Fall)	22:8	21:9	0.78

The mean age of the study population was 36.8 ± 11.4 years, ranging from 18 to 62 years. The majority of patients were male (78.3%), reflecting the higher incidence of road traffic accidents and occupational injuries in men. No significant difference was found between groups in terms of age, gender, or side of fracture ($p > 0.05$), indicating comparability between groups.

2. Type and Classification of Fractures

Most fractures were of the midshaft (Robinson Type 2B1 and 2B2) variety.

- Comminuted and displaced fractures (Type 2B2) were more frequent in the operative group (66.7%), while simple displaced fractures (Type 2B1) predominated in the conservative group (63.3%).
- The difference was not statistically significant ($p = 0.12$).

Table 2: Mean time to fracture union

Parameter	Group A (Operative)	Group B (Conservative)	p-value
Mean Time to Union (weeks)	9.8 ± 2.1	14.2 ± 3.4	<0.001*
Non-union	1 (3.3%)	4 (13.3%)	0.17
Malunion	0 (0%)	3 (10%)	0.04*

*p value significant

The mean time to fracture union was significantly shorter in the operative group compared to the conservative group Radiological union was achieved earlier and more consistently in the operative group, with fewer cases of malunion.

Functional recovery was assessed using the Constant-Murley Shoulder Score and DASH (Disabilities of the Arm, Shoulder and Hand) Score at the end of 6 months.

Table 3: Functional Outcome among study groups

Functional Outcome	Group A (Operative)	Group B (Conservative)	p-value
Constant-Murley Score (Mean ± SD)	90.6 ± 6.1	82.3 ± 8.7	<0.001*
DASH Score (Mean ± SD)	9.4 ± 5.8	18.2 ± 7.6	<0.001*

*p value significant

Patients managed operatively achieved better shoulder function and less disability, with statistically significant improvement in both functional scores.

Pain was assessed using the Visual Analogue Scale (VAS) at each follow-up.

Table 4: Pain Assessment among study groups

Follow-up Interval	Group A (Operative)	Group B (Conservative)	p-value
2 weeks	6.1 ± 1.2	6.3 ± 1.1	0.42
6 weeks	3.8 ± 1.0	4.6 ± 1.2	0.02*
3 months	1.9 ± 0.7	2.8 ± 0.9	<0.001*
6 months	0.8 ± 0.5	1.3 ± 0.6	0.01*

Patients in the operative group experienced earlier pain relief and quicker return to normal activities.

Complications were noted in both groups, as summarized below in table 5.

Table 5: Complications among study groups

Complications	Group A (Operative)	Group B (Conservative)
Superficial Infection	2 (6.7%)	0 (0%)
Implant Irritation	3 (10%)	—
Non-union	1 (3.3%)	4 (13.3%)
Malunion / Cosmetic Deformity	0 (0%)	3 (10%)
Shoulder Stiffness	2 (6.7%)	3 (10%)
Total Complication Rate	26.7%	33.3%

While the overall complication rate was comparable, cosmetic deformity and non-union were more frequent in the conservative group, whereas minor implant-related issues were observed in the operative group.

Subjective patient satisfaction (graded as Excellent, Good, Fair, Poor) was higher in the operative group.

Table 6: Cosmetic and Patient Satisfaction among study groups

Satisfaction Level	Group A (Operative)	Group B (Conservative)
Excellent	18 (60%)	9 (30%)
Good	9 (30%)	12 (40%)
Fair	3 (10%)	6 (20%)
Poor	0 (0%)	3 (10%)

The difference in overall satisfaction was statistically significant ($p < 0.05$), indicating a clear preference for operative results due to faster recovery and better shoulder contour.

DISCUSSION

Our findings align with global literature indicating that operative fixation offers earlier union and superior short-term functional outcomes compared to conservative treatment, especially in displaced or comminuted fractures.

In our study, the mean age of patients was 36.8 years, with a marked male predominance (78.3%). This demographic pattern is consistent with studies by Hill et al. (1997) and McKee et al. (2006), who reported similar male predominance due to greater involvement in outdoor and high-energy activities.[4,5] The midshaft region (Robinson type 2B) was the most common site of fracture, reaffirming the well-established vulnerability of this segment to biomechanical stress and lack of soft tissue reinforcement (Craig, 1991; Neer, 1960).[2]

The mean time to union in our study was 9.8 weeks in the operative group and 14.2 weeks in the conservative group, demonstrating a statistically significant difference ($p < 0.001$). This finding correlates with the results of the Canadian Orthopaedic Trauma Society (2007),[8] which reported a mean union time of 16.4 weeks in the non-operative group versus 10.8 weeks in the operative group. Faster union in the surgical group can be attributed to rigid fixation and early mobilization, whereas the conservative approach depends on natural callus formation, which may be delayed in displaced fractures. Similarly, Smekal et al,[11] (2009) observed a union time of 8.7 weeks with intramedullary fixation compared to 13.3 weeks with non-operative care, reinforcing that surgical stabilization accelerates bone healing.

The Constant-Murley and DASH scores in our study were significantly better in the operative group (90.6 and 9.4, respectively) than in the conservative group (82.3 and 18.2) at 6 months ($p < 0.001$). This indicates that surgically treated patients regained shoulder function earlier, with better strength and range of motion. These findings are consistent with those of Robinson et al,[12] (2013) and Woltz et al,[10] (2017) who concluded that operative fixation provided superior early functional recovery, although long-term results may eventually converge between groups. A meta-analysis by Zlowodzki et al,[7] (2005) involving 2144 fractures also confirmed that operative treatment results in better functional outcomes and lower rates of non-union. The improvement in functional scores in surgically managed patients can be explained by early mobilization, anatomical reduction, and prevention of shortening or malalignment.

Pain assessment using the Visual Analogue Scale (VAS) showed significantly lower scores in the operative group after 6 weeks, 3 months, and 6 months, suggesting faster pain relief and return to activities. Early fixation allows earlier physiotherapy and reduced immobilization-related stiffness, which supports findings by Virtanen et al,[9] (2012) and Ferran et al. (2010).[6] In contrast, conservative treatment often requires prolonged immobilization, predisposing patients to shoulder stiffness and muscle weakness.

The complication profile differed between groups. Operative patients experienced minor issues such as superficial infection (6.7%) and implant irritation (10%), while the conservative group showed higher incidences of non-union (13.3%), malunion (10%), and cosmetic deformity. These observations parallel the findings of Hill et al. (1997),[4] who reported that non-operatively treated displaced midshaft fractures had non-union rates up to 15% and symptomatic malunion in nearly 20% of patients. Our study's non-union rate was lower than older reports due to improved fixation techniques, pre-contoured plates, and early mobilization.

However, implant irritation remains a concern, sometimes necessitating secondary implant removal. Virtanen et al,[9] (2012) similarly reported hardware-related discomfort in 10–15% of surgically treated cases.

Patient satisfaction was notably higher in the operative group (60% excellent, 30% good), owing to faster recovery and better shoulder contour. Cosmetic outcomes are a significant factor, especially in young adults. These findings correspond with those of McKee et al. (2006),[5] who highlighted cosmetic dissatisfaction and residual deformity as major drawbacks of non-operative management.

Table 7: Comparison with Previous Studies on Management of Clavicle Fractures

Author & Year	Study Design / Methodology	Key Findings	Comparison with Present Study
Canadian Orthopaedic Trauma Society (2007)	Randomized controlled trial comparing operative vs. non-operative treatment of displaced midshaft clavicle fractures	Operative fixation showed shorter union time (10.8 vs. 16.4 weeks), fewer non-unions (2% vs. 15%), and higher Constant scores	Consistent with our findings—operative fixation resulted in faster union, fewer complications, and better functional scores
Robinson et al. (2013)	Prospective comparative study of operative vs. conservative management	Surgical fixation improved early function and patient satisfaction, but long-term results were comparable after 1 year	Our study also observed superior early outcomes with surgery; long-term outcomes expected to converge
Woltz et al. (2017)	Meta-analysis of randomized controlled trials	Demonstrated significantly fewer non-unions, better early function, and reduced re-intervention rates with surgery	Supports our observation that operative management provides early functional benefits and fewer complications

Smekal et al. (2009)	Prospective randomized study comparing intramedullary fixation and non-operative care	Found faster union (8.7 vs. 13.3 weeks) and less early pain in the operative group	Our results agree that surgical stabilization accelerates healing and reduces pain during recovery

Recommendations

1. Operative fixation should be preferred for displaced, comminuted, or shortened midshaft clavicle fractures in adults, as it ensures faster union and superior functional recovery.
2. Conservative management remains appropriate for undisplaced or minimally displaced fractures, elderly patients, or those with medical contraindications to surgery.
3. Standardized surgical techniques using pre-contoured locking plates and early, structured physiotherapy programs should be adopted to enhance postoperative outcomes.
4. Routine radiological follow-up is essential to monitor healing and detect complications such as implant irritation or delayed union.

Limitations

1. The sample size was relatively small and limited to a single tertiary care center, which may affect the generalizability of results.
2. The follow-up duration of six months was insufficient to evaluate long-term outcomes such as implant failure, hardware removal, or late functional convergence between groups.
3. Selection bias could not be completely excluded, as treatment choice depended partly on patient preference and surgeon judgment.
4. Rehabilitation compliance and pain tolerance varied among participants, possibly influencing functional scores.

CONCLUSION

The present study concludes that operative management of displaced midshaft clavicle fractures in adults results in faster radiological union, superior early functional outcomes, reduced pain, and better cosmetic satisfaction compared to conservative management. Although non-operative treatment remains effective in minimally displaced fractures, surgical fixation provides significant advantages for active individuals and those with displaced or comminuted fractures. Early anatomical reduction and stable fixation promote rapid rehabilitation and return to function.

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