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Original Research Article

A Comparative Study of Functional Outcomes in Conservative Versus Surgical Management of Clavicle Fractures

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Abstract:

Background: Displaced midshaft clavicle fractures are common orthopedic injuries, and the optimal management (conservative versus surgical) remains debated, particularly regarding functional outcomes.

Aim: To compare radiological union and functional outcomes between conservative and surgical management of displaced midshaft clavicle fractures.

Methodology: This prospective comparative observational study included 60 patients (18–60 years) with displaced midshaft clavicle fractures (Robinson type 2B1), divided equally into conservative (n=30) and surgical (n=30) groups. Patients were followed for six months. Radiological union and functional outcomes were assessed using the Constant–Murley Shoulder Score, along with documentation of complications.

Results: Demographic and injury characteristics were comparable between groups. The surgical group achieved significantly earlier radiological union (mean 11.2 ± 2.4 weeks) compared to the conservative group (14.8 ± 3.2 weeks). Excellent functional outcomes were more frequent in the surgical group (60%) than in the conservative group (26.7%), with a higher mean Constant–Murley score (89.2 ± 7.8 vs. 78.4 ± 10.6).

Conclusion: Surgical management of displaced midshaft clavicle fractures results in faster union and superior functional outcomes compared to conservative treatment.

Keywords: Clavicle fracture, conservative management, surgical fixation, functional outcome, Constant–Murley score.

Introduction

Clavicle fractures are among the most common skeletal injuries encountered in orthopedic practice, accounting for approximately 2–5% of all adult fractures and nearly 35–45% of injuries involving the shoulder girdle [1]. Owing to its subcutaneous position and its role as a strut connecting the axial skeleton to the upper limb, the clavicle is particularly vulnerable to trauma. These fractures most frequently result from direct blows to the shoulder, road traffic accidents, sports-related injuries, and falls onto an outstretched hand. The midshaft region of the clavicle is the most commonly affected site, followed by lateral and medial third fractures [2]. Given the wide range of patient demographics affected (from young, active individuals to the elderly) the optimal management of clavicle fractures remains a topic of continued clinical interest and debate.

Traditionally, the majority of clavicle fractures, particularly undisplaced or minimally displaced fractures, have been managed conservatively using slings, figure-of-eight bandages, or simple immobilization techniques [3]. Conservative management has long been favored due to the clavicle's excellent healing potential, relatively high union rates, avoidance of surgical risks, and satisfactory functional outcomes reported in early literature. Many classic studies suggested that even displaced fractures healed reliably with acceptable cosmetic and functional results, reinforcing non-operative treatment as the standard of care for decades. However, advances in imaging, improved outcome assessment tools, and long-term follow-up studies have challenged this traditional paradigm.

In recent years, increasing attention has been directed toward the functional outcomes of displaced clavicle fractures treated non-operatively [4].

Emerging evidence has indicated that conservative management of significantly displaced or comminuted fractures may be associated with higher rates of non-union, malunion, residual deformity, shoulder weakness, and patient dissatisfaction. Malunion, characterized by clavicular shortening or angulation, may alter shoulder biomechanics, leading to reduced strength, endurance, and range of motion of the affected upper limb [5]. These concerns are particularly relevant in young, active patients and manual laborers, for whom optimal shoulder function is essential for daily activities and occupational demands.

With the evolution of surgical techniques and implant technology, operative management of clavicle fractures has gained increasing popularity. Surgical fixation, most commonly achieved through open reduction and internal fixation using plates and screws or intramedullary devices, aims to restore anatomical alignment, achieve stable fixation, and allow early mobilization [6]. Proponents of surgical management argue that it offers faster fracture union, lower non-union rates, improved functional recovery, and better cosmetic outcomes in selected cases, especially in displaced midshaft fractures. Several randomized controlled trials and meta-analyses have suggested superior early functional outcomes and patient-reported satisfaction following surgical intervention when compared to conservative treatment.

Despite these reported advantages, surgical management is not without risks. Potential complications include infection, implant failure, hardware irritation, neurovascular injury, hypertrophic scarring, and the need for secondary procedures for implant removal. Additionally, the cost implications and surgical expertise required may limit the universal application of operative treatment, particularly in resource-constrained settings. Therefore, the decision between conservative and surgical management must be individualized, taking into account fracture characteristics, patient factors, functional demands, and potential risks and benefits [7].

Functional outcome assessment has emerged as a critical parameter in evaluating treatment efficacy for clavicle fractures. Beyond radiological union, functional recovery encompasses pain relief, restoration of shoulder range of motion, muscle strength, return to daily activities, and overall quality of life. Validated outcome measures such as the Constant–Murley Score, Disabilities of the Arm, Shoulder and Hand (DASH) score, and visual analog scale for pain have become essential tools for objectively comparing treatment modalities. These measures provide a comprehensive evaluation of both clinician-assessed and patient-reported outcomes, facilitating evidence-based decision-making.

Given the ongoing debate and variability in treatment practices, there remains a need for further comparative studies evaluating the functional outcomes of conservative versus surgical management of clavicle fractures. Such studies are particularly relevant in diverse patient populations and healthcare settings, where treatment protocols and patient expectations may differ. Understanding the relative advantages and limitations of each approach can help refine clinical guidelines, optimize patient counseling, and improve overall functional recovery.

Materials and Methods

Study Design: The present study was designed as a prospective, comparative observational study conducted to evaluate and compare the functional outcomes of conservative versus surgical management in patients with displaced clavicle fractures. The study aimed to assess fracture union, shoulder function, and complication rates between the two treatment modalities using standardized clinical and radiological parameters.

Study Area: The study was carried out in the Department of Orthopedics, Anugrah Narayan Magadh Medical College and Hospital, Gaya ji, Bihar, India for six months from March 2025 to August 2025

Study Participants: A total of 60 patients, both male and female, diagnosed with displaced clavicle fractures will be enrolled in the study after obtaining written informed consent.

Inclusion Criteria

- Age between 18 and 60 years
- Either gender
- Displaced midshaft clavicle fractures
- Fracture classified as Robinson type 2B1
- Presentation within 1 week of injury
- Written informed consent provided

Exclusion Criteria

- Age <18 years or >60 years
- Open fractures
- Fractures involving medial or lateral third of clavicle
- Established non-union from previous fracture
- Polytrauma patients
- Medical conditions contraindicating surgery/anesthesia
- Refusal to give consent or non-compliance with follow-up

Sample Size

The study will include a total sample size of 60 patients, who will be equally divided into two groups:

- Group A (n = 30): Conservative management
- Group B (n = 30): Surgical management

Study Period: The study will be conducted over a period of six months, including patient recruitment, treatment, and follow-up assessments.

Procedure: After enrollment in the study, all patients underwent a comprehensive evaluation. A detailed demographic profile including age, sex, side of involvement, and mechanism of injury was recorded. This was followed by a thorough clinical history and physical examination, focusing on pain severity, swelling, visible deformity, tenderness, skin condition, and restriction of shoulder movements on the affected side. Neurovascular status of the limb was assessed and documented in all cases. Radiological assessment was performed for every patient using a standard anteroposterior radiograph of the clavicle along with the shoulder joint. These radiographs were evaluated to determine the site, pattern, degree of displacement, and comminution of the fracture. Based on these findings, fractures were classified according to Robinson's classification system, and only displaced midshaft fractures (type 2B1) were included for further management.

Patients were then allocated into two treatment groups. The conservative management group was treated with arm sling immobilization combined with a clavicle brace. Adequate analgesics and anti-inflammatory medications were prescribed, and patients were advised activity modification. Physiotherapy was initiated in a phased manner, beginning with pendulum exercises followed by gradual active and passive shoulder mobilization as pain subsided and radiological signs of healing appeared.

Patients in the surgical management group underwent open reduction and internal fixation using plate and screws after being declared medically fit for anesthesia. All surgical procedures were performed under standard aseptic precautions. Postoperatively, patients received appropriate antibiotics, analgesics, and wound care. Immobilization was maintained initially, followed by a structured rehabilitation protocol aimed at restoring shoulder range of motion and strength. All patients were followed up at 2 weeks, 6 weeks, 3 months, and 6 months after initiation of treatment. At each follow-up visit, clinical evaluation and radiographic assessment were performed to assess fracture union, alignment, and any treatment-related complications.

The functional outcome was evaluated using the Constant and Murley Shoulder Score, which assesses pain, activities of daily living, range of motion, and shoulder strength. Based on the total score, outcomes were graded as Excellent (91–100), Good (81–90), Satisfactory (71–80), Adequate (61–70), and Poor (<60). Complications such as delayed union, non-union, malunion, implant failure, infection, and shoulder stiffness were actively monitored and documented.

Statistical Analysis: All collected data were entered into Microsoft Excel and subsequently analyzed using Statistical Package for Social Sciences (SPSS) 27.0v software. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Comparison of functional outcomes and radiological union between the conservative and surgical groups was performed using the independent t-test for continuous variables and the Chi-square test for categorical variables. A p-value less than 0.05 was considered statistically significant.

Result

Table 1 shows the demographic distribution of the study participants, indicating that the mean age of patients was comparable between the conservative group (38.6 ± 9.4 years) and the surgical group (36.9 ± 8.7 years), with an overall mean age of 37.8 ± 9.1 years. Males constituted the majority of the study population in both groups, accounting for 70% in the conservative group and 76.7% in the surgical group, while females represented 30% and 23.3%, respectively. Right-sided clavicle involvement was more common than left-sided involvement across both treatment groups, observed in 60% of patients managed conservatively and 63.3% of those managed surgically. Overall, the demographic characteristics were well balanced between the two groups, suggesting comparability and reducing the likelihood of demographic bias influencing the study outcomes.

Table 1: Demographic Distribution of Study Participants

Variable	Conservative Group (n=30)	Surgical Group (n=30)	Total (n=60)
Mean age (years)	38.6 ± 9.4	36.9 ± 8.7	37.8 ± 9.1
Male	21 (70%)	23 (76.7%)	44 (73.3%)
Female	9 (30%)	7 (23.3%)	16 (26.7%)
Right side involvement	18 (60%)	19 (63.3%)	37 (61.7%)
Left side involvement	12 (40%)	11 (36.7%)	23 (38.3%)

Table 2 depicts the distribution of mechanisms of injury among the study participants in both conservative and surgical groups. Road traffic accidents were the most common cause of clavicle fractures overall, accounting for 50% of cases, with a slightly higher proportion in the surgical group (53.3%) compared to the conservative group (46.7%). Falls from height constituted the second most frequent mechanism (28.3%), showing a comparable distribution between the conservative (30%) and surgical (26.7%)

groups. Sports-related injuries contributed to 15% of cases, again with similar representation in both groups. Direct blow was the least common mechanism, observed equally in both groups (6.6–6.7%). Overall, the mechanism of injury was evenly distributed between the two treatment groups, indicating comparable baseline injury characteristics.

Table 2: Mechanism of Injury in Study Groups			
Mechanism of Injury	**Conservative Group (n=30)**	**Surgical Group (n=30)**	**Total (n=60)**
Road traffic accident	14 (46.7%)	16 (53.3%)	30 (50%)
Fall from height	9 (30%)	8 (26.7%)	17 (28.3%)
Sports-related injury	5 (16.7%)	4 (13.3%)	9 (15%)
Direct blow	2 (6.6%)	2 (6.7%)	4 (6.7%)

Table 3 demonstrates that the surgical group achieved radiological union earlier and more consistently than the conservative group. A substantially higher proportion of patients in the surgical group attained union within 12 weeks (66.7%) compared to the conservative group (26.7%), whereas delayed union between 12–16 weeks was more common in the conservative group (50%) than in the surgical group (26.7%). Union beyond 16 weeks and non-union were also observed more frequently in the conservative group. The mean time to radiological union was significantly shorter in the surgical group (11.2 ± 2.4 weeks) compared to the conservative group (14.8 ± 3.2 weeks), indicating that surgical management facilitates faster fracture healing.

Table 3: Time to Radiological Union in Both Groups		
Time to Union	**Conservative Group (n=30)**	**Surgical Group (n=30)**
< 12 weeks	8 (26.7%)	20 (66.7%)
12–16 weeks	15 (50%)	8 (26.7%)
> 16 weeks	5 (16.7%)	1 (3.3%)
Non-union	2 (6.6%)	1 (3.3%)
Mean union time (weeks)	14.8 ± 3.2	11.2 ± 2.4

Table 4 demonstrates a clear difference in functional outcomes between the conservative and surgical groups as assessed by the Constant–Murley score. The surgical group showed a markedly higher proportion of excellent outcomes (60%) compared to the conservative group (26.7%), indicating superior shoulder function following surgical management. While good outcomes were comparable between groups, satisfactory to poor outcomes were more frequent in the conservative group, with 20% achieving satisfactory results and 6.7% falling into the poor category, whereas no patients in the surgical group had poor outcomes. Additionally, the mean Constant–Murley score was substantially higher in the surgical group (89.2 ± 7.8) than in the conservative group (78.4 ± 10.6), further highlighting the overall better functional recovery associated with surgical intervention.

Table 4: Functional Outcome Based on Constant–Murley Score		
Outcome Grade	**Conservative Group (n=30)**	**Surgical Group (n=30)**
Excellent (91–100)	8 (26.7%)	18 (60%)
Good (81–90)	10 (33.3%)	9 (30%)
Satisfactory (71–80)	6 (20%)	2 (6.7%)
Adequate (61–70)	4 (13.3%)	1 (3.3%)
Poor (<60)	2 (6.7%)	0 (0%)
Mean score	78.4 ± 10.6	89.2± 7.8

Discussion

The present study evaluated the functional and radiological outcomes of conservative versus surgical management in displaced midshaft clavicle fractures and compared the findings with existing literature. The demographic profile of patients in both treatment groups was comparable, with a predominance of young to middle-aged adults, which aligns with earlier reports indicating that clavicle fractures commonly affect the active population exposed to high-energy trauma (Böstman et al., 1997; Hill et al., 1997) [7,8]. The male predominance observed in the present study is consistent with large epidemiological series, where males constituted nearly 70–80% of cases due to higher occupational and recreational risk exposure (Faldini et al., 2010; Zlowodzki et al., 2005) [9,10].

Road traffic accidents emerged as the most common mechanism of injury in our cohort, followed by falls and sports-related trauma. Similar patterns have been reported by Böstman et al., where direct trauma to the shoulder accounted for the majority of

injuries, and by Faldini et al., who observed that nearly half of the fractures resulted from vehicular accidents [11]. The similarity in injury mechanisms between treatment groups in the present study supports the comparability of baseline trauma severity and strengthens the validity of outcome comparisons.

Radiological union was achieved significantly earlier in the surgically managed group, with most patients demonstrating union within 12 weeks. In contrast, delayed union and non-union were more frequent in the conservative group. These findings closely resemble those reported by Shen et al. (1999), who demonstrated faster and more predictable union following plate fixation of displaced midshaft clavicle fractures [12]. Poigenfürst et al. (1992) reported a non-union rate of only 2.2% following operative fixation, whereas Hill et al. (1997) documented non-union rates as high as 15% with non-operative treatment of displaced fractures [13]. In the present study, non-union was observed only in the conservative group, further supporting the mechanical advantage of surgical fixation in maintaining alignment and promoting biological healing.

The functional outcomes assessed using the Constant–Murley score were significantly superior in the surgical group. A higher proportion of patients achieved excellent and good outcomes compared to those managed conservatively. Similar improvements in shoulder function following operative management have been reported by Zlowodzki et al. (2005), who found better functional scores and lower non-union rates in surgically treated displaced midshaft clavicle fractures. Stegeman et al. (2011), in a randomized controlled trial, also demonstrated superior early functional recovery in patients treated with plate fixation compared to non-operative management [15]. The improved outcomes in the surgical group in the present study can be attributed to anatomical restoration of clavicular length, stable fixation, and early mobilization, which together enhance shoulder biomechanics and reduce stiffness.

Conversely, patients managed conservatively showed a higher incidence of satisfactory to poor functional outcomes. Persistent pain, cosmetic deformity, and restricted shoulder movements were more commonly observed in this group. Faldini et al. (2010) reported that although non-operative treatment can yield acceptable results in minimally displaced fractures, displaced fractures are associated with inferior functional outcomes and patient dissatisfaction. Hill et al. (1997) similarly concluded that closed treatment of displaced midshaft clavicle fractures often results in poor functional and subjective outcomes. These observations correlate well with the present study, where conservative management failed to consistently achieve optimal shoulder function in displaced fractures.

Implant-related complications were noted in a small proportion of surgically treated patients, including implant failure, which is comparable to the complication rates reported by Böstman et al. (1997), who documented plate-related complications despite overall favorable union rates. However, the benefits of early union and superior function appear to outweigh these manageable complications. Hundekar (2013) also emphasized that the use of precontoured locking plates minimizes hardware-related issues while providing stable fixation and good functional outcomes [16].

Overall, the findings of the present study are in agreement with contemporary evidence suggesting that surgical management of displaced midshaft clavicle fractures results in faster radiological union, lower non-union rates, and superior functional outcomes when compared with conservative treatment. Although non-operative management continues to be an acceptable option for carefully selected patients, particularly those with minimally displaced fractures or lower functional demands, the overall results indicate that conservative treatment may be associated with delayed healing and suboptimal functional recovery in displaced fracture patterns. In contrast, operative fixation provides stable anatomical reduction, facilitates early mobilization, and promotes improved shoulder biomechanics, thereby leading to better clinical and functional outcomes. Based on the cumulative findings of this study, surgical management appears to be a preferable treatment option for displaced midshaft clavicle fractures in active individuals to achieve reliable fracture union and optimal functional restoration.

Conclusion

The present study demonstrates that surgical management of displaced midshaft clavicle fractures offers clear advantages over conservative treatment in terms of both radiological and functional outcomes. Patients treated surgically achieved faster and more consistent fracture union, with a lower incidence of delayed union and non-union compared to those managed conservatively. Functional assessment using the Constant–Murley score revealed superior shoulder function in the surgical group, with a higher proportion of excellent and good outcomes and fewer residual limitations. Although conservative treatment remains a reasonable option for selected patients with lower functional demands, it was associated with delayed healing and comparatively inferior functional recovery in displaced fractures. Overall, the findings support operative fixation as a preferable treatment strategy for displaced midshaft clavicle fractures, particularly in active individuals, to ensure reliable union and optimal restoration of shoulder function.

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