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Original Article

Comparative outcomes of surgical fixation versus conservative management in clavicle fractures: A prospective cohort study.

Dr Anup Kumar Padamwar[1*], Dr Keyur Jain[2]
[1]Assistant Professor, Department of Orthopaedics, Late Smt. Indira Gandhi Memorial Government Medical College and Hospital, Kanker, Chattisgarh, India
[2]Junior Resident, Department of Orthopaedics, Late Smt. Indira Gandhi Memorial Government Medical College and Hospital, Kanker, Chattisgarh, India

Abstract

Background
This study aimed to compare the clinical outcomes of conservative versus surgical intervention in patients with clavicle fractures.

Methods
A prospective study was conducted on 50 patients with clavicle fractures, allocated into two groups: 25 patients managed conservatively (arm sling) and 25 undergoing surgical fixation (open reduction and internal fixation with plates). Baseline characteristics, fracture union time, functional outcomes (Constant-Murley Shoulder Score), pain levels (Visual Analog Scale), complications, and return to work/activity time were recorded. Statistical analyses included chi-square tests for categorical variables and t-tests for continuous variables, with $p < 0.05$ considered significant.

Results
Baseline demographics were comparable between groups ($p > 0.05$). The surgical group achieved significantly faster fracture union (9.2 ± 1.5 weeks) compared to the conservative group (13.5 ± 2.1 weeks, $p < 0.001$). Functional outcomes favored the surgical group (88.6 ± 6.2) over the conservative group (79.3 ± 7.8, $p = 0.002$). Nonunion and malunion were more frequent in the conservative group ($p = 0.04$ and $p = 0.03$, respectively), while superficial wound infections occurred in 8% of surgical cases. Pain scores were significantly lower in the surgical group (1.3 ± 0.9) versus the conservative group (2.8 ± 1.2, $p = 0.001$). Return to work was earlier in the surgical group (10.5 ± 2.3 weeks) than in the conservative group (15.7 ± 3.1 weeks, $p < 0.001$).

Conclusion
Surgical intervention in clavicle fractures provides superior union time, functional outcomes, lower pain scores, and quicker return to activity compared to conservative management, with an acceptable complication profile.

Recommendations
Surgical fixation should be preferred for displaced midshaft clavicle fractures in active individuals to ensure faster recovery and better function. Conservative treatment remains suitable for minimally displaced fractures or patients with lower functional demands. Larger studies with longer follow-up are encouraged.

Keywords: *Clavicle fracture, Surgical fixation, Conservative management, Fracture union, Shoulder function*
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Corresponding author: *Dr. Anup Kumar Padamwar**
Email ID*: **anups125@yahoo.com***
Department of Orthopaedics, Late Smt. Indira Gandhi Memorial Government Medical College and Hospital, Kanker, Chattisgarh, India

Introduction

Clavicle fractures are among the most common skeletal injuries involving the shoulder girdle, comprising approximately 2.6% to 5% of all adult fractures and nearly 44% of shoulder fractures [1]. These injuries frequently occur due to falls, direct shoulder impact, or road traffic accidents, particularly affecting active young adults [2]. The midshaft segment is the most frequently involved site, attributed to its unique anatomy and vulnerability to biomechanical forces [3]. Management strategies for

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clavicle fractures are influenced by fracture location, displacement, fragmentation, and individual patient characteristics.

Traditionally, non-operative treatment using an arm sling or figure-of-eight bandage has been the mainstay for non-displaced or minimally displaced fractures, relying on the bone's natural capacity to heal [4]. Nonetheless, recent evidence indicates that conservative approaches in displaced midshaft fractures may be associated with increased incidences of nonunion, malunion, suboptimal shoulder function, and dissatisfaction with cosmetic outcomes [5]. These challenges have prompted a growing preference for operative intervention, especially in cases involving significant displacement or comminution [6].

Open reduction and internal fixation (ORIF) using plating techniques offers anatomical realignment and stable fixation, facilitating early mobilization and potentially enhancing both radiological and functional recovery [7]. However, surgical management is not without risks, including potential for infection, neurovascular injury, implant-related issues, and the possibility of reoperation [3]. Recent meta-analyses have yielded mixed conclusions regarding the superiority of one approach over the other, emphasizing the need for further comparative studies to support clinical decision-making [7].

In this context, the present study aims to evaluate and compare the clinical outcomes of surgical versus conservative treatment of midshaft clavicle fractures. The comparison focuses on fracture healing time, shoulder function, pain intensity, complication rates, and return to work, thereby contributing to evidence-based orthopedic practice.

Methodology

Study design and setting

This was a prospective cohort study conducted at the Department of Orthopaedics, Late Smt. Indira Gandhi Memorial Government Medical College and Hospital, Kanker, Chhattisgarh, India, over 12 months from January 2023 to December 2023. The study compared clinical outcomes between two cohorts: patients undergoing surgical fixation and those receiving conservative treatment for midshaft clavicle fractures.

Study population

A total of 50 patients diagnosed with midshaft clavicle fractures were enrolled. Patients were allocated into two groups:

Conservative Group (n = 25): Managed with arm sling immobilization.

Surgical Group (n = 25): Underwent open reduction and internal fixation (ORIF) using locking compression plates.

Inclusion criteria

- Patients aged 18 to 60 years.
- Diagnosed with midshaft clavicle fractures confirmed radiographically.
- Fractures are classified as displaced or minimally displaced (Robinson classification).
- Patients are willing to provide informed consent and comply with follow-up.

Exclusion criteria

- Open fractures or pathological fractures.
- Associated neurovascular injuries.
- Patients with fractures involving the lateral or medial third of the clavicle.
- Polytrauma patients.
- Previous history of clavicle fracture on the same side.
- Unwilling or unable to attend follow-up visits.

Bias minimization

To minimize selection bias, patients were enrolled consecutively as they presented to the hospital and were allocated to treatment groups based on standardized clinical criteria and patient preference after counseling. Assessment bias was reduced by using validated outcome measures (Constant-Murley Shoulder Score, VAS), and radiographic evaluations were performed independently by two orthopedic consultants blinded to the treatment groups. Attrition bias was addressed through diligent follow-up, with all patients completing the 6-month follow-up period.

Sample size justification

A total sample size of 50 patients (25 in each group) was determined based on feasibility, institutional patient volume, and available resources during the 12-month study period. Previous studies reporting differences in functional outcomes (Constant-Murley Score) between surgical and conservative groups were reviewed to estimate a meaningful effect size. Given a significance level of 0.05 and power of 80%, a minimum of 22 patients per group was estimated. To account for potential loss to follow-up, 25 patients were included in each group.

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Procedure

Baseline demographics, clinical examination findings, and radiographs were documented.
Conservative management involved immobilization with an arm sling for 4-6 weeks, followed by physiotherapy.
Surgical fixation was performed under general anesthesia using ORIF with locking compression plates, followed by postoperative immobilization and structured physiotherapy.

Outcome measures

Fracture union time (weeks), determined radiologically and clinically.
Functional outcomes were assessed using the Constant-Murley Shoulder Score at 6 months.
Pain levels were assessed using the Visual Analog Scale (VAS) at 6 months.
Complication rates (nonunion, malunion, infection).
Return to work/activity time (weeks).

Statistical analysis

Data were analyzed using **SPSS version 25.0**. Continuous variables were expressed as **mean ± standard deviation (SD)** and compared using the **independent t-test**. Categorical variables were analyzed using the **chi-square test**. A **p-value < 0.05** was considered statistically significant.

Ethical considerations

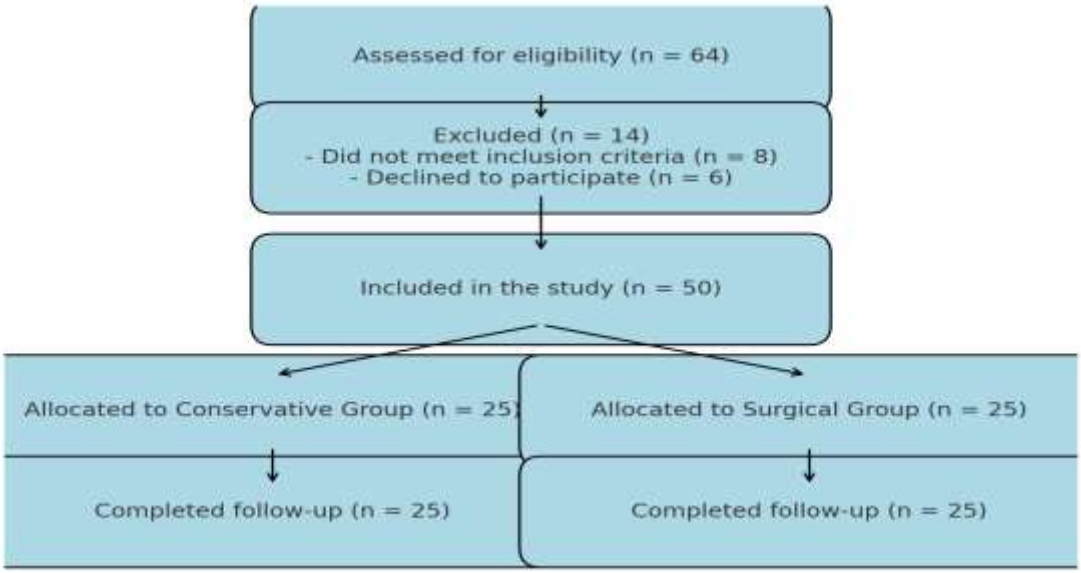
The study received approval from the Institutional Ethics Committee of Late Smt. Indira Gandhi Memorial Government Medical College and Hospital, Kanker, Chattisgarh, India. Written informed consent was obtained from all participants. Patient confidentiality was maintained throughout the study, and all procedures adhered to the Declaration of Helsinki guidelines.

Results

Participant flow

During the study period, a total of 64 patients with clavicle fractures were assessed for eligibility. Of these, 56 patients met the inclusion criteria and were invited to participate. 6 patients declined participation due to personal reasons or preference for treatment outside the study protocol. Ultimately, 50 patients were enrolled and included in the study.
25 patients were allocated to the conservative management group.
25 patients were allocated to the surgical fixation group.
All enrolled patients completed the 6-month follow-up, and there were no losses to follow-up or exclusions after enrollment.

Figure 1: Flow diagram of participant recruitment and follow-up



Baseline characteristics

The baseline demographic characteristics, including mean age and gender distribution, were comparable between the two groups, with no statistically significant differences ($p > 0.05$). The mean age was

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32.4 ± 8.5 years in the conservative group and 33.1 ± 9.2 years in the surgical group. Males accounted for 76% in the conservative group and 72% in the surgical group (Table 1).

Table 1: Baseline characteristics

Variable	Conservative Group	Surgical Group	p-value
Mean Age (years)	32.4 ± 8.5	33.1 ± 9.2	> 0.05
Male (%)	76%	72%	> 0.05

Fracture Union Time

The mean fracture union time was significantly shorter in the surgical group (9.2 ± 1.5 weeks) compared to the conservative group (13.5 ± 2.1 weeks), and this difference was statistically significant ($p < 0.001$) (Table 2).

Table 2: Fracture union time

Group	Mean Union Time (weeks)	p-value
Conservative	13.5 ± 2.1	< 0.001
Surgical	9.2 ± 1.5	< 0.001

Functional outcomes

Functional outcomes were evaluated at the final follow-up (6 months) using the Constant-Murley Shoulder Score. The surgical group demonstrated significantly better shoulder function (88.6 ± 6.2) compared to the conservative group (79.3 ± 7.8) ($p = 0.002$) (Table 3).

Table 3: Functional outcomes (Constant-murley shoulder score)

Group	Constant-Murley Score	p-value
Conservative	79.3 ± 7.8	0.002
Surgical	88.6 ± 6.2	0.002

Complications

The incidence of complications varied between the two groups. Nonunion was observed in 2 patients (8%) in the conservative group, with no cases in the surgical group ($p = 0.04$). Similarly, malunion was more prevalent in the conservative group (4 patients; 16%) compared to the surgical group (1 patient; 4%) ($p = 0.03$). However, superficial wound infection occurred in 2 patients (8%) in the surgical group and none in the conservative group. All infections resolved with antibiotic therapy (Table 4).

Table 4: Complications

Complication	Conservative Group	Surgical Group	p-value
Nonunion	2 (8%)	0 (0%)	0.04
Malunion	4 (16%)	1 (4%)	0.03
Superficial Wound Infection	0 (0%)	2 (8%)	NA

Pain levels

Pain was assessed at 6 months post-treatment using the Visual Analog Scale (VAS). Patients in the surgical group reported significantly lower pain scores (1.3 ± 0.9) compared to those in the conservative group (2.8 ± 1.2) ($p = 0.001$) (Table 5).

Table 5: Pain levels (VAS score at 6 months)

Group	VAS Score	p-value
Conservative	2.8 ± 1.2	0.001
Surgical	1.3 ± 0.9	0.001

Return to work/activity

The mean time to return to work or routine activities was significantly shorter in the surgical group (10.5 ± 2.3 weeks) as compared to the conservative group (15.7 ± 3.1 weeks), with a highly significant difference ($p < 0.001$) (Table 6).

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Table 6: Return to work/activity

Group	Mean Time to Return (weeks)	p-value
Conservative	15.7 ± 3.1	< 0.001
Surgical	10.5 ± 2.3	< 0.001

Discussion

This prospective study evaluated the comparative effectiveness of surgical fixation and conservative management for midshaft clavicle fractures by analyzing fracture healing time, functional recovery, pain levels, complications, and return to activity. The results indicated that surgical management led to more favorable clinical outcomes overall.

Patients treated surgically experienced a significantly shorter time to fracture union (9.2 ± 1.5 weeks) than those managed conservatively (13.5 ± 2.1 weeks), corroborating previous findings that attributed accelerated healing to precise anatomical reduction and enhanced mechanical stability provided by internal fixation [8]. Institutional protocols have also underscored the benefits of surgical management in active individuals with acute displaced midshaft clavicle fractures (ADMCFs) [9].

Functional outcomes, assessed using the Constant-Murley Shoulder Score, were also superior in the surgical group (88.6 ± 6.2) compared to the conservative group (79.3 ± 7.8). These results are consistent with studies reporting better long-term function and significant improvements in range of motion and shoulder strength following operative intervention [10,11].

Pain scores measured via the Visual Analog Scale (VAS) at six months were notably lower in patients who underwent surgery (1.3 ± 0.9) than in those treated non-operatively (2.8 ± 1.2). This reduction in pain likely facilitated the earlier return to work observed in the surgical group (10.5 ± 2.3 weeks versus 15.7 ± 3.1 weeks). These findings align with prior research highlighting superior pain control and faster reintegration into daily activities with surgical treatment [12].

Despite the advantages, surgical intervention was associated with certain risks, including superficial wound infections in 8% of cases, a figure comparable to those reported in existing literature [8,12]. These infections responded well to antibiotic therapy and had no long-term sequelae. Conversely, conservative treatment was linked to higher incidences of nonunion (8%) and malunion (16%), supporting studies that found non-operative approaches in displaced fractures to be associated with increased complication rates [13]. Other investigations have also emphasized the functional gains and acceptable safety profile of open reduction and internal fixation (ORIF) in clavicle fracture management [14].

Overall, this study adds to the existing body of evidence favoring surgical fixation for displaced midshaft clavicle fractures, highlighting benefits in fracture union time, functional recovery, pain relief, and earlier return to work. Nevertheless, surgical risks such as infection, though minimal, remain important considerations in treatment planning.

Generalizability

The findings of this study are generally applicable to adult patients with displaced midshaft clavicle fractures treated in tertiary care settings, particularly in similar demographic and clinical environments. The prospective cohort design and use of validated outcome measures enhance the internal validity of the results. However, as the study was conducted at a single center in a rural Indian hospital with a relatively small sample size (n = 50), caution should be exercised in extrapolating the results to other populations, such as elderly individuals, pediatric patients, or those managed in high-volume urban trauma centers. Moreover, socioeconomic and occupational factors unique to the study population may influence recovery timelines and patient preferences. Therefore, while the results support the superiority of surgical fixation in active adults, multicentric trials with larger and more diverse samples are needed to strengthen external validity.

Conclusion

This prospective study demonstrates that surgical fixation of midshaft clavicle fractures offers significant advantages over conservative management in terms of faster fracture union, improved functional outcomes, reduced pain levels, and earlier return to work. Although surgical intervention carries a minor risk of complications, such as superficial wound infections, these are manageable and outweighed by the overall clinical benefits. In contrast, conservative treatment showed higher rates of nonunion and malunion, which can negatively impact long-term function. Based on these findings, surgical fixation should be considered the preferred treatment for displaced midshaft clavicle fractures, especially in active individuals requiring early functional recovery.

Limitations

This study was limited by its small sample size (n = 50) and single-center design, which limited the generalizability of the findings. Long-term outcomes beyond 6 months were not assessed, which restricts conclusions about sustained functional recovery and

complications. These limitations underscore the need for future multicenter studies with larger cohorts and extended follow-up durations to validate the results and improve external validity.

Recommendations

Based on the findings of this study, surgical fixation is recommended for patients with displaced midshaft clavicle fractures, particularly in young, active individuals and those requiring early return to work or sports. Conservative management may be considered for minimally displaced fractures or in patients with low functional demands. Preoperative counseling should address potential surgical risks, including infection and hardware-related complications. Further multicenter studies with larger sample sizes and long-term follow-up are recommended to validate these findings and assess long-term functional outcomes and patient satisfaction across diverse populations and varying fracture patterns.

List of abbreviations

ORIF – Open Reduction and Internal Fixation
VAS – Visual Analog Scale
ADMCFs – Acute Displaced Midshaft Clavicle Fractures

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The study had no funding.

Conflict of interest

The authors declare no conflict of interest.

Author's contribution

AKP- Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.**KJ review** of the literature and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.

Data availability

Data is available on request.

Author biography

Dr Anup Kumar Padamwar is working as an Assistant Professor in the department of Orthopaedics at Government Medical College, Kanker. He has done his MBBS and M S in Orthopaedics from Government Medical College, Nagpur.
Dr. Keyur Jain is working as a Junior Resident in the department of Orthopaedics, Late Smt. Indira Gandhi Memorial Government Medical College, Kanker. He has done his MBBS from the Government Medical College, Rajnandgaon.

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