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" *Plate Fixation Versus Conservative Treatment for Displaced Midshaft Clavicle in Adults* "

Authors

Mohamed Abdelaziz Fayed [1], Abdullah Tawfeek Mohammed [2], Mohamed El-Tabey El-Gritly [3], Ahmed El Deriny [1]

[1] Lecturer of Orthopedics at Orthopedic Surgery Department, Faculty of Medicine, Port Said University

[2] orthopedic surgery at Sharm Elsheikh ,Egypt

[3] Professor of Orthopedic Surgery Department, Faculty of Medicine, Port Said University, Port Said, Egypt.

ABSTRACT:

Introduction: Midshaft fractures of the clavicle are highly prevalent, representing 80% of all clavicle fractures, particularly among young adults. While traditionally managed non-operatively, recent evidence for completely displaced midshaft fractures reveals considerably higher nonunion rates (15-20%). The aim of this study was to evaluate the functional outcomes and union rates of non-operative treatment in comparison to operative plate fixation for these specific fracture patterns.

Methods: A randomized controlled trial was carried out from October 2024 to April 2025, involving 26 patients aged 18-60 with isolated, completely displaced middle third clavicular fractures sustained less than two weeks prior. Patients were randomly divided into two groups: 13 for operative plate fixation and 13 for conservative management. Outcomes were assessed using the Quick DASH score at three and six months and radiographic union.

Results: The study found a statistically significant difference in time to union ($p<0.001$), with the operative group achieving full union in 12.7 weeks compared to 20 weeks in the conservative group. Quick DASH scores were statistically superior in the operative group at 3 months (28.2 vs. 37.8, $p=0.028$), indicating better early functional outcomes. Complication profiles differed, with malunion affecting five patients (71.4%) in the non-operative group, while the operative group mainly experienced hardware-related issues like painful shoulder (50%) and lateral screws loosening (33.3%).

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https://muj.journals.ekb.egdean@med.psu.edu.eg

vice_dean_postgraduate@med.psu.edu.eg

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Conclusion: This study demonstrates that operative plate fixation provides improved functional outcomes, a lower malunion rate, and a lower nonunion rate for completely displaced midshaft clavicular fractures compared to non-operative treatment.

Keywords: Clavicle fracture, displaced fracture, functional outcomes, operative management

Introduction:

In the human body, the clavicle is the most frequently fractured bone, accounting for approximately 5% to 10% of all fractures presenting to hospital emergency departments (Burnham et al., 2016). This high incidence is attributed to several factors, including its anatomical position, structural characteristics, and articulations. Positioned superficially beneath the skin and the thin platysma muscle, the clavicle is minimally protected by surrounding soft tissues such as muscle or fat, rendering it particularly vulnerable to injury (Preston & Egol, 2009).

The clavicle is also a relatively thin bone. Its midshaft is particularly fragile and prone to fractures due to its slight curvature in the middle third (Bachoura et al., 2013).

These injuries occur most frequently in younger individuals and are commonly linked to direct trauma to the clavicle, such as that sustained during contact sports or motor vehicle collisions. Males are more frequently affected than females, and the incidence gradually decreases with age; however, traumatic falls in older adults contribute to a secondary peak in the age distribution (Postacchini et al., 2002).

The location of the fracture is traditionally delineated by dividing the clavicle into thirds. The most common type of clavicle fractures is the midshaft fracture, which affects the middle third and accounts for up to 80% of all fractures. The fracture's location, degree of displacement, and involvement of adjacent structures are critical factors in determining the appropriate treatment approach (Duan et al., 2011).

Various methods are available for the management of midshaft clavicle fractures, which can generally be classified into operative and nonoperative (Burnham et al., 2016).

Initial nonoperative management typically involves immobilization of the affected shoulder using either a figure-of-eight brace or a sling to support fracture alignment during the healing period. However, the figure-of-eight brace has become less favored due to associated discomfort and pain. Comparative studies have

demonstrated that, while patients using the figure-of-eight brace report higher pain scores, there is no significant difference in union rate or time to reunion compared to those treated with a standard sling (Burnham et al., 2016).

Operative Management of midshaft clavicular fractures primarily includes three techniques: intramedullary fixation, plate and screw fixation, and external fixation. Fixation with plate and screw, also referred to as open reduction and internal fixation (ORIF), is widely regarded as the gold standard. One of its key advantages is that it is technically less complex compared to intramedullary fixation (Song & Kim, 2021).

Previous studies comparing nonoperative treatment with open reduction and plate fixation have shown that operative treatment is associated with lower rates of nonunion, shorter time to union, and improved functional outcomes (Robinson et al., 2013).

This study compared non-operative management to plate fixation in managing displaced mid-shaft clavicle fractures regarding union and the functional outcome.

Patients and Methods:

The study employed a randomized clinical trial conducted at Sharm El Sheikh International Hospital for six months, from October 2024 to April 2025. It included 26 patients who presented with acute midclavicular shaft fractures. Patients who were aged 18 to 60 years, had isolated, completely displaced middle third clavicular fractures, and the fracture had occurred less than two weeks prior, were included in the study. Fractures were classified using the Robinson classification, specifically Type 2B1 and 2B2. Exclusion criteria included open or pathological fractures, associated neurovascular injury, or fractures older than two weeks. The 26 eligible patients were randomly divided into two treatment groups: 13 cases for operative management and 13 for conservative management.

Conservative Management (Group 1): This approach involved immobilizing the affected shoulder with a broad arm sling for 4 to 6 weeks, or until clinical or radiological union, with advice not to lift weights. Patients were advised to refrain from active shoulder movements during the initial phase, allowing only passive range of motion (ROM) limited to forward flexion below 90˚ and slight hand or elbow movements without any load. Clinical assessments were conducted at 14 days to evaluate arm sling tolerability and position, with surgery discussed if significant worsening of displacement or the presence of skin tenting. After sling removal and

radiographic control, patients initiated Codman exercises and progressive strengthening to gradually restore active shoulder movement, aiming to achieve full range of motion within 3 to 4 weeks. Once clinical and radiological evidence of fracture healing was confirmed, patients were allowed to resume contact sports, weightlifting, and heavy physical activity.

Operative Management (Group 2): This involved one-stage ORIF using a 3.5 mm reconstruction plate and screws. The plates were typically placed on the superior clavicle surface and secured with bicortical screws. Post-operative rehabilitation began at the end of week 1 with gentle shoulder pendulum exercises and elbow/wrist mobilization. Gentle active assisted ROM, with abduction limited to 80˚, was allowed after two to three weeks. Active ROM in all planes commenced after six weeks, contingent upon the degree of union at the fracture site.

Follow-up Protocol and Outcome Measures:

Clinical assessment: This included evaluating pain, tenderness, mobility, and shoulder range of motion (external rotation, internal rotation, forward elevation, lateral elevation). Functional outcomes were measured using the Quick DASH score at 3 and 6 months of the study. It assesses the patient's symptoms and ability to perform daily activities related to arm, shoulder, and hand function. Scores range from 0 to 100, where 0 represents no disability and 100 indicates the most severe disability. A lower Quick DASH score indicates better function.

Radiographic assessment: Plain anteroposterior (AP) X-rays, often with a 20-degree cephalic angulation, were used to evaluate fracture reduction and alignment, implant position, and osseous healing. Osseous healing was defined by the presence of at least three of four cortices with bridging callus formation. Malunion was identified by specific three-dimensional deformities, including shortening more than 14 – 20 mm, medial and inferior displacement, anterior rotation, or a change in angulation (horizontal or vertical plane) greater than 20 degrees, often accompanied by symptoms like muscular impairment, periscapular pain, limb united at 6 months, based on clinical findings (absence of tenderness at the fracture site, good functional ROM), and radiological evidence of bridging callus.

Statistical Analysis: IBM SPSS Software (version 26 for Windows) was employed to code and analyze the data. For categorical variables, descriptive statistics comprised frequencies and percentages, while numerical variables were represented by

the mean and standard deviation (SD) or median (minimum–maximum), depending on normality tested by Shapiro-Wilk. For inferential statistics, the Chi-square test was used for qualitative variables, replaced by Fisher's exact test or the Monte-Carlo test if expected cell counts were less than 5. The independent t-test was analyzed for normally distributed continuous data, while the Mann-Whitney U test was employed for non-normally distributed continuous data. A p-value <0.05 was considered statistically significant.

Ethical Considerations: The Ethical Committee approved the study protocol at the Faculty of Medicine, Port Said University. Consent was obtained from the hospital managers where the study was conducted. Informed consent was secured from each participant. Confidentiality and personal privacy were maintained, and collected data were not used for any other purposes. Participants were free to withdraw from the study at any time without affecting their medical care or treatment plan.

Results:

A total of 26 patients were included, with a mean age of 29.8 years in Group 1 and 31.6 years in Group 2. As shown in **Table 1**, males were predominant in both groups, and left-sided fractures were more common in Group 1 (76.9%), while right-sided fractures were more frequent in Group 2 (53.8%). Regarding age, sex, fracture site, or mode of injury, no statistically significant differences were observed between Group 1 and Group 2 (p > 0.05).

Table 1: Demographic data of the studied participants

		Group 1 (n = 13)	**Group 2 (n = 13)**	**p-value**
Age	Mean (SD)	29.8 (12.5)	31.6 (11.5)	0.876
Sex	Male	10 (76.9)	8 (61.5)	0.432
	Female	3 (23.1)	5 (38.5)	
Fracture site	Left	10 (76.9)	6 (46.2)	0.655
	Right	3 (23.1)	7 (53.8)	
Mode of injury	Fall from height	0 (0)	1 (7.6)	0.782

	Fall to the ground	11 (84.6)	10 (76.9)	
	Motor bicycle accident	1 (7.6)	1 (7.6)	
	Road traffic accident	1 (7.6)	1 (7.6)	

Figure 1 illustrates that the average time to full union was 20 weeks in Group 1 and 12.7 weeks in Group B. The two groups had a statistically significant difference regarding time to union ($p<0.001$).

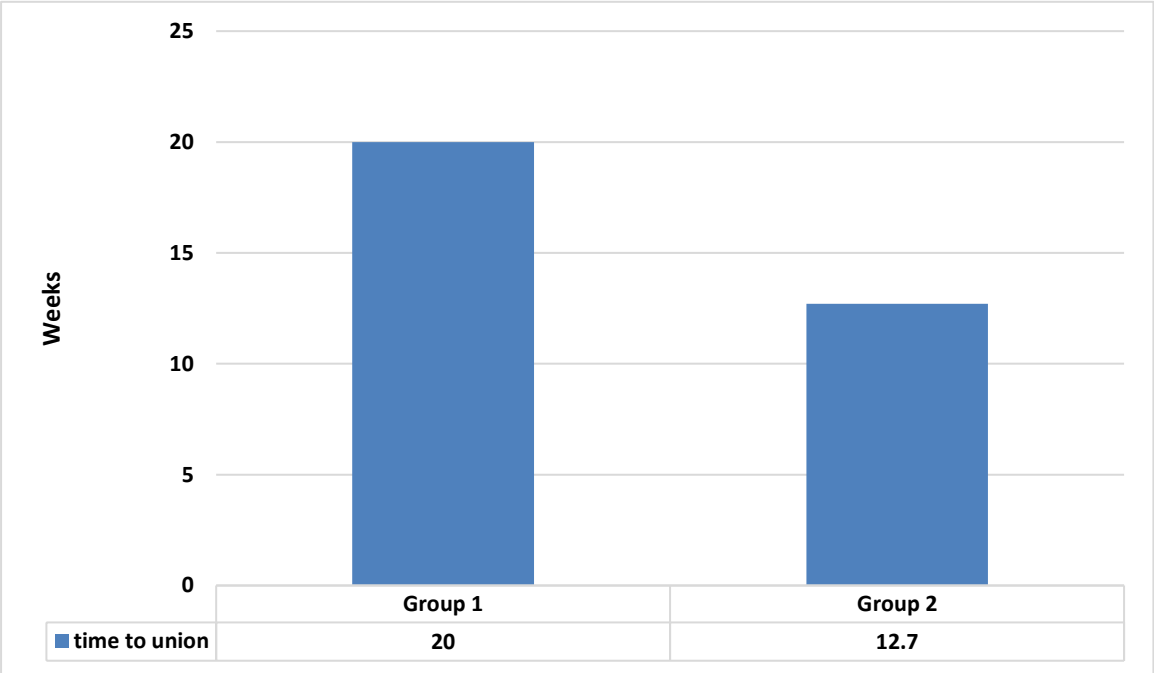


Figure 1: Time to full union in both groups

Table 2 shows a statistically significant difference in Quick DASH scores between the two groups at 3 months ($p = 0.028$), with Group 2 demonstrating better functional outcomes. However, by 6 months, the difference between groups was no longer significant ($p = 0.252$).

Table 2: Functional outcomes at 3 and 6 months using the Quick DASH tool

		Group 1 Mean (SD)	**Group 2** Mean (SD)	**p-value**
Quick DASH	At 3 months	37.8 (10)	28.2 (13.3)	**0.028***
	A 6 months	22.3 (11.9)	16.4 (10.3)	0.252

*Statistically significant

Regarding clinical assessment, 84.6% of cases in Group 1 had full range of motion at the end of the study compared to 92.3% of cases in Group 2. However, no significant difference between the groups was identified as demonstrated in **Table 3**.

Table 3: Clinical assessment outcomes in the studied groups

		Group 1 N (%)	**Group 2** N (%)	**p-value**
Clinical assessment	Full ROM	11 (84.6)	12 (92.3)	1.000
	Limited	2 (15.4)	1 (7.7)	

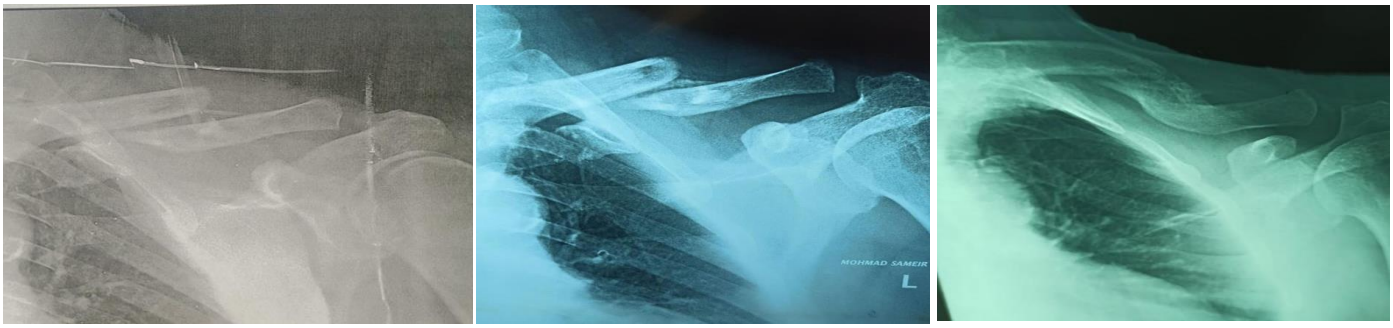
Table 4 presents the incidence and types of complications between the two groups. While the overall complication rates were similar (Group 1: 53.8%, Group 2: 46.2%, p = 0.715), the types of complications differed significantly. Group 1 had higher rates of malunion (71.4%) and nonunion (28.6%), whereas Group 2 exhibited issues like lateral screws loosening (33.3%) and painful shoulder (50%) (p = 0.005).

Table 4: Incidence of complications among the study participants

		Group 1 N (%)	Group 2 N (%)	p-value
Complications	Yes	7 (53.8)	6 (46.2)	0.715
	No	6 (46.2)	7 (53.8)	
Type of complications	Infection	0 (0)	1 (16.7)	**0.005***
	Lateral screws loosening and backing out	0 (0)	2 (33.3)	
	Malunion	5 (71.4)	0 (0)	
	Nonunion	2 (28.6)	0 (0)	
	Painful shoulder	0 (0)	3 (50)	

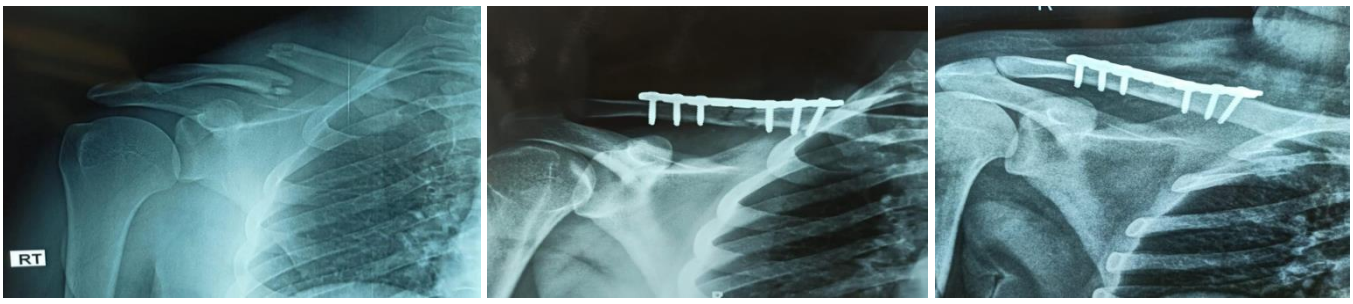
*Statistically significant

Case 1:



A 50-year-old male patient presented with a left midshaft clavicular fracture, and at 3 and 6-month follow-up.

Case 2:



A 21-year-old male patient presented with a right midshaft clavicular fracture, postoperative, and at 6-month follow-up.

Discussion:

Midshaft clavicular fracture accounts for approximately 2.6% – 4% of all adult fractures. They are particularly prevalent among young adults, with more than one-third occurring in adolescent males and about one-fifth in adolescent females (Yan et al., 2022). For this reason, the present study was carried out to assess the functional outcomes of conservative and operative treatment of acute midclavicular fractures at Sharm Elsheikh International Hospital.

In the present study, falls to the ground were the predominant mechanism of injury, accounting for 84.6% of cases in the conservative group and 76.9% in the operative groups. These findings are partially consistent with the results reported by Adham et al., who observed that 40% resulted from falls onto the shoulder, while 50% were due to road traffic accidents (Adham et al., 2021).

This study found that the average time to union was significantly shorter in the operative group (approximately 13 weeks) compared to the conservative group (20 weeks). The findings of this align with the results reported by Kale et al., who observed a mean union time of 7.8 weeks in surgically treated patients versus 9.4 weeks in the conservative group (Kale et al., 2016). Similarly, Haque et al. reported a comparable trend, with union times of 10.18 weeks in the operative group and 18.37 weeks in the non-operative group, further reinforcing the advantage of surgical intervention in accelerating fracture healing (Haque et al., 2017). While our study demonstrated a longer overall union time in both groups compared to these earlier reports, the consistent trend across studies supports the role of operative fixation in reducing time to union.

This study demonstrated a significant difference in functional recovery, measured by the Quick DASH score, between the conservative (37.8) and the operative (28.2) groups at 3 months. However, this difference was no longer significant by 6 months. These findings are partially supported by Sabir et al., who reported mean DASH scores of 7.9 (conservative) and 10.8 (operative) at 1-year follow-up, suggesting a trend toward slightly better outcomes in nonoperatively managed patients in the long term. Conversely, Micheloni et al. found no significant difference between surgical (4.63) and conservative (3.86) groups in DASH scores (Micheloni et al., 2019; Sabir et al., 2023).

The complication profiles differed notably between treatment groups in the current study, with malunion predominating in the conservative group (71.4%) and painful shoulder being most frequent in the operative group (50%). Similarly, Sabir et al. reported a 40.3% complication rate in conservative management, primarily malunion (19.2%) and nonunion (8.3%). In comparison, Wolf et al. noted that 20% - 30% of operatively treated patients required hardware removal due to implant-related issues (Sabir et al., 2023; Wolf et al., 2022).

Conclusion:

This study reaffirms that operative plate fixation offers superior outcomes for displaced midshaft clavicle fractures compared to nonoperative (conservative) management. It provides faster healing, improved early functional recovery, and lower malunion and nonunion rates than conservative management.

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