

Article

# Comparative Study of Conservative and Surgical Management of Clavicle Fractures in Iraqi Adults: A Prospective Cohort Study at a Al-Hilla General Teaching Hospital

Kaisser Kareem Jassim Al-Janabi<sup>1</sup>, Montadher Najem Oubaid Fanharawy<sup>2</sup>, Ali Dheyaa Abed Alkadhim<sup>3</sup>

<sup>1,2,3</sup>Babil health directorate, Al-Hilla General Teaching Hospital

**Citation:** Al-Janabi, K. K. J., Fanharawy, M. N. O., & Alkadhim, A. D. A. Comparative Study of Conservative and Surgical Management of Clavicle Fractures in Iraqi Adults: A Prospective Cohort Study at a Al-Hilla General Teaching Hospital. American Journal of Biomedicine and Pharmacy 2026, 3(6), 22-33

Received: 10<sup>th</sup> Mar 2026

Revised: 21<sup>th</sup> Apr 2026

Accepted: 08<sup>th</sup> May 2026

Published: 02<sup>th</sup> June 2026



**Copyright:** © 2026 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>)

**Abstract:** Background: Clavicle fractures represent one of the most frequently encountered skeletal injuries in orthopaedic practice, accounting for approximately 2.6–5% of all fractures in adults. Despite their high prevalence, the optimal management strategy—conservative or surgical—remains a subject of ongoing clinical debate, particularly within the Iraqi healthcare context where epidemiological and functional outcome data are sparse.

**Objectives:** To compare functional outcomes, radiological union rates, complication profiles, and patient satisfaction between conservative and surgical management of displaced clavicle fractures in Iraqi adults treated at a Al-Hilla General Teaching Hospital.

**Methods:** A prospective cohort study was conducted between January 2021 and December 2023. A total of 130 adult patients with acute displaced midshaft or lateral third clavicle fractures were enrolled and allocated to either conservative management (sling immobilisation, n=68) or surgical intervention (open reduction and internal fixation using plate and screws, n=62) based on standardised clinical criteria. Primary outcomes included the Disabilities of the Arm, Shoulder and Hand (DASH) score and Visual Analogue Scale (VAS) for pain at serial follow-up intervals (6 weeks, 3, 6, and 12 months). Secondary outcomes included time to radiological union, return to work, complication rates, and patient-reported satisfaction.

**Results:** The surgical group demonstrated significantly superior DASH scores at all follow-up intervals compared to the conservative group (p<0.001). Mean time to radiological union was 11.4 ± 2.6 weeks in the surgical cohort versus 14.8 ± 3.2 weeks in the conservative cohort (p<0.001). Non-union occurred in 11.8% of conservatively managed patients compared to 3.2% in the surgical group (p=0.048). Return to occupational activity was significantly earlier in the surgical group (7.6 ± 2.9 weeks vs. 11.3 ± 3.8 weeks; p<0.001). While the surgical group exhibited specific complications including wound infection (6.5%) and implant-related issues (8.1%), the overall complication burden was significantly lower compared to the conservative group (32.3% vs. 66.2%; p<0.001).

**Conclusion:** Surgical management of displaced clavicle fractures in Iraqi adults yields significantly better functional recovery, earlier return to work,

and lower overall complication rates compared to conservative management. These findings support the selective use of operative fixation—particularly open reduction and internal fixation with plate and screws—as the preferred approach for significantly displaced midshaft and lateral third clavicle fractures in the Iraqi adult population, subject to appropriate patient selection.

**Keywords:** clavicle fracture; conservative management; surgical fixation; ORIF; DASH score; Iraq; Baghdad; fracture outcomes; non-union; orthopaedic surgery

## Introduction

Clavicle fractures are among the most common injuries encountered in orthopaedic and emergency medicine practice, accounting for approximately 2.6% to 5% of all fractures in the adult population and up to 35% of all shoulder girdle injuries [1,2]. The clavicle, the only long bone oriented horizontally in the human body, serves as the primary bony link between the upper extremity and the axial skeleton, playing an indispensable role in shoulder biomechanics, thoracic stability, and upper limb function [3]. Given the high-energy mechanisms frequently responsible for these injuries—including road traffic accidents, falls from height, and direct impact—clavicle fractures carry substantial functional implications, particularly in the context of low- and middle-income countries like Iraq, where occupational dependence on physical labour remains considerable [4].

The epidemiology of clavicle fractures in Iraq reflects both global patterns and region-specific determinants. Road traffic accidents remain the predominant mechanism of injury in Baghdad and other Iraqi cities, with a disproportionately high incidence among young adult males aged 18 to 45 years [5]. The rapidly urbanising environment of Baghdad, combined with the high volume of two-wheeled vehicle use and inconsistent enforcement of road safety legislation, contributes substantially to the burden of musculoskeletal trauma in the Iraqi capital [6]. Despite the clinical significance of this injury pattern, peer-reviewed evidence from Iraqi institutions regarding optimal management strategies for clavicle fractures is conspicuously limited, creating a reliance on international guidelines that may not adequately account for local healthcare infrastructure, patient demographics, and socioeconomic realities [7].

Anatomically, clavicle fractures are classified by location into midshaft (Group I), lateral third (Group II), and medial third (Group III) injuries, with midshaft fractures accounting for approximately 69–82% of all cases [8]. Neer's classification and the more comprehensive Edinburgh classification system are widely applied to further stratify fracture morphology, degree of displacement, and comminution—factors that are critically relevant to management decision-making [9]. The biomechanical consequences of fracture displacement and shortening are particularly important, as clavicular shortening greater than 1.5–2.0 cm has been consistently associated with impaired shoulder girdle function, subacromial impingement, and diminished long-term functional outcomes in multiple prospective studies [10,11].

Historically, the vast majority of clavicle fractures—including those with significant displacement—were managed non-operatively using immobilisation devices such as a broad arm sling or figure-of-eight bandage [12]. This conservative approach was largely predicated on early descriptive series suggesting acceptable healing rates and functional recovery in the majority of patients. However, this traditional paradigm has been substantially challenged over the past two decades by a growing body of high-quality evidence demonstrating that displaced midshaft clavicle fractures managed conservatively are associated with non-union rates of 5–15%, symptomatic malunion in up to 30% of patients, and persistent functional deficits that may be prolonged or permanent [1,13,14].

The landmark Canadian Orthopaedic Trauma Society (COTS) randomised controlled trial published in 2007 represented a pivotal shift in clinical thinking, demonstrating that surgical fixation with plate and screws yielded significantly superior functional outcomes and lower non-union rates compared to non-operative management for completely displaced midshaft clavicle fractures [15].

Subsequent meta-analyses and systematic reviews have largely corroborated these findings, supporting the selective use of operative fixation in appropriately indicated cases [16,17]. Open reduction and internal fixation (ORIF) using pre-contoured locking compression plates has emerged as the most widely utilised surgical modality, though intramedullary nailing and other fixation techniques are also reported in the literature with comparable outcomes in selected fracture patterns [18,19].

Despite this accumulation of international evidence, the implementation of surgical management protocols for clavicle fractures in Iraq faces several contextual challenges. These include variable availability of specialised implant systems across public and private healthcare institutions, constraints on postoperative rehabilitation services, the economic burden of surgical intervention for patients without comprehensive health insurance coverage, and a relative paucity of trained orthopaedic subspecialists in some governorates [7,20]. Furthermore, the absence of locally validated outcome instruments and the limited availability of prospective Iraqi-specific data make it difficult for orthopaedic surgeons practicing in Baghdad to contextualise international evidence within the local clinical milieu.

Patient-reported outcome measures (PROMs) have become essential tools in the evaluation of musculoskeletal interventions. Among these, the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire is internationally recognised as a reliable, valid, and responsive measure of upper extremity function, widely applied in clavicle fracture research [21]. The Visual Analogue Scale (VAS) for pain assessment and patient satisfaction surveys complement the DASH score in providing a comprehensive functional outcome profile. These instruments have been validated in Arabic-speaking populations, making them applicable in the Iraqi context [22].

From a surgical technique perspective, the choice between superior plating and anteroinferior plating for midshaft clavicle fractures has been a subject of ongoing research. Biomechanical studies suggest that superior plating provides superior resistance to bending forces, while anteroinferior plating may reduce the risk of implant-related symptoms and secondary hardware removal procedures [23,24]. Intramedullary fixation using elastic nails or titanium elastic nails (TENs) offers the theoretical advantages of minimally invasive technique, smaller scars, and possibly lower infection rates, but at the potential cost of rotational instability and a higher rate of implant migration [19,25]. In the current study, the primary surgical modality employed was ORIF with pre-contoured locking plates, consistent with the predominant practice at the study institution.

Complications associated with both management strategies deserve careful consideration. Conservative management carries inherent risks of non-union—defined as radiologically confirmed failure of fracture consolidation at six months—symptomatic malunion with cosmetic and functional sequelae, shoulder stiffness, and suprascapular nerve traction injury [26,27]. Surgical management introduces the additional risks of wound infection, iatrogenic neurovascular injury, hardware prominence, plate failure, and the possibility of requiring secondary implant removal surgery [28]. The comparative risk-benefit analysis of these complication profiles is central to evidence-based patient counselling and management planning.

At the institutional level, the Private Hospital in Baghdad serves a predominantly working-age adult patient population, many of whom sustain clavicle fractures through road traffic accidents and occupational injuries. The socioeconomic importance of a timely return to work and upper limb function makes the selection of the most effective management strategy particularly consequential for this patient cohort. Given the lacuna in locally generated evidence and the imperative to align orthopaedic practice in Iraq with contemporary global standards, this prospective comparative study was designed to rigorously evaluate and compare the functional outcomes, complication profiles, radiological results, and patient satisfaction associated with conservative versus surgical management of displaced clavicle fractures in the Iraqi adult population treated at a private hospital in Baghdad.

It is anticipated that the findings of this study will contribute meaningfully to the evidence base informing clinical decision-making for Iraqi orthopaedic surgeons, support the development of locally adapted clinical guidelines, and potentially lay the groundwork for future multicentre collaborative research across Iraqi academic and clinical institutions. The results will also serve to contextualise international evidence within the specific epidemiological, socioeconomic, and clinical characteristics of the Iraqi adult patient population.

## Materials and Methods

### Study Design and Setting

A prospective cohort study was conducted at the Department of Orthopaedic Surgery, a Al-Hilla General Teaching Hospital, Iraq, over a 36-month period from January 2021 to December 2023, with all patients followed for a minimum of 12 months post-intervention. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrolment.

### Study Population and Eligibility Criteria

The study population comprised adult patients (aged  $\geq 18$  years) presenting with acute displaced clavicle fractures to the orthopaedic outpatient clinic or emergency department of the Private Hospital. Inclusion criteria were: (1) radiologically confirmed displaced midshaft (Group I) or lateral third (Group II) clavicle fracture; (2) fracture displacement  $\geq 100\%$  cortical width or shortening  $\geq 1.5$  cm on standard anteroposterior radiographs; (3) acute injury within 72 hours of presentation; (4) age between 18 and 65 years; and (5) willingness to attend all scheduled follow-up appointments. Exclusion criteria included: (1) pathological fractures; (2) open fractures with significant soft tissue compromise; (3) medial third fractures; (4) associated ipsilateral upper limb fractures; (5) pre-existing ipsilateral shoulder pathology including rotator cuff disease or glenohumeral arthritis; (6) severe polytrauma with an Injury Severity Score (ISS)  $>16$ ; (7) neurovascular compromise at presentation; (8) pregnancy; and (9) inability to provide informed consent due to cognitive impairment.

### Patient Allocation

Following screening for eligibility, patients were allocated to either the conservative management group or the surgical management group based on a standardised clinical decision algorithm agreed upon by the treating orthopaedic team, incorporating degree of displacement, fracture shortening, patient age, occupational demands, patient preference after informed counselling, and overall fitness for general anaesthesia. This allocation methodology was selected in preference to randomisation given the ethical imperative to individualise management and the pragmatic constraints of the private hospital setting; however, allocation was pre-specified and documented prospectively. Both patient cohorts were followed using identical assessment protocols.

### Interventions

Patients in the conservative management group were treated with a broad arm sling for six weeks, with commencement of progressive pendulum exercises at two weeks and active-assisted range of motion exercises at four weeks under physiotherapy supervision. Analgesic therapy with oral non-steroidal anti-inflammatory drugs (NSAIDs) and paracetamol was standardised across both groups during the acute phase. Radiological review was conducted at two, six, and twelve weeks, and then monthly until confirmed union. Patients in the surgical group underwent ORIF under general anaesthesia, performed by two senior orthopaedic consultants using pre-contoured superior locking compression plates (3.5 mm LC-DCP, Synthes® system) through a direct superior approach. All surgeries were performed within five days of presentation. Postoperatively, a sling was used for comfort for two weeks, with early-passive shoulder mobilisation commenced at 48 hours and active mobilisation at three weeks under standardised physiotherapy protocols.

### Outcome Measures

The primary outcome measure was the DASH questionnaire score, administered at baseline (pre-operatively or at initial presentation), 6 weeks, 3 months, 6 months, and 12 months. The DASH score ranges from 0 (no disability) to 100 (maximum disability), with a minimum clinically important difference (MCID) established at 10.2 points [29]. The secondary outcome measures included: (1) VAS pain score (0–10 scale) at each follow-up interval; (2) time to radiological union in weeks, defined as bridging callus across three or more cortices on orthogonal radiographic views; (3) time to return to usual occupation in weeks; (4) rate of non-union, defined as absence of radiological union at 24 weeks; (5) rate of malunion, defined as clavicular shortening  $>2.0$  cm or angular deformity  $>30^\circ$  at the time of union; and (6) overall patient satisfaction assessed using a four-point Likert scale (Excellent, Good, Fair, Poor) at 12 months.

## Data Collection and Follow-up

A dedicated research coordinator administered all questionnaires and clinical assessments at standardised follow-up appointments. Radiographic measurements were independently assessed by a consultant radiologist (N.A. Al-Janabi) blinded to the clinical outcome data. Follow-up rate at 12 months was 94.6% (123 of 130 patients); the seven patients lost to follow-up (four in the conservative group and three in the surgical group) were excluded from final analyses using complete case methodology, having been verified as non-differential.

## Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean  $\pm$  standard deviation (SD), and categorical variables as frequencies and percentages. Normality of distribution was assessed using the Shapiro-Wilk test. Between-group comparisons of continuous variables were performed using the independent samples t-test for normally distributed data and the Mann-Whitney U test for non-normal distributions. Categorical variables were compared using the Chi-square test or Fisher's exact test as appropriate. Longitudinal within-group changes in DASH and VAS scores were assessed using repeated-measures ANOVA with Greenhouse-Geisser correction for sphericity violations. A p-value of  $<0.05$  was considered statistically significant. No imputation was performed for missing data. Multivariate logistic regression was employed to identify independent predictors of non-union within the conservative group, adjusting for age, BMI, degree of displacement, and fracture shortening.

## Results and Discussion

### Results

#### Patient Characteristics

A total of 130 patients met the eligibility criteria and were enrolled over the study period. Of these, 68 were allocated to the conservative management group and 62 to the surgical management group. The two cohorts were well-matched at baseline, with no statistically significant differences in age, sex, BMI, mechanism of injury, or fracture location (Table 1). The mean age was  $34.6 \pm 11.2$  years in the conservative group and  $32.1 \pm 10.8$  years in the surgical group ( $p=0.184$ ). Male patients predominated in both groups (75.0% and 75.8%, respectively). Road traffic accidents accounted for the largest proportion of injuries in both cohorts (~56%). As expected by design, the surgical group had significantly greater mean fracture displacement ( $2.1 \pm 0.7$  cm vs.  $1.4 \pm 0.6$  cm;  $p<0.001$ ) and shortening ( $1.7 \pm 0.5$  cm vs.  $0.8 \pm 0.4$  cm;  $p<0.001$ ), reflecting the clinical decision algorithm applied to allocation.

*Table 1. Baseline demographic and clinical characteristics of study participants*

Variable	Conservative Group (n=68)	Surgical Group (n=62)	P-value
Age (years), Mean $\pm$ SD	$34.6 \pm 11.2$	$32.1 \pm 10.8$	0.184
Male, n (%)	51 (75.0%)	47 (75.8%)	0.912
Female, n (%)	17 (25.0%)	15 (24.2%)	0.912
BMI (kg/m <sup>2</sup> ), Mean $\pm$ SD	$26.3 \pm 3.8$	$25.9 \pm 4.1$	0.541
Road traffic accident, n (%)	38 (55.9%)	35 (56.5%)	0.946
Fall from height, n (%)	18 (26.5%)	17 (27.4%)	0.893
Direct blow, n (%)	12 (17.6%)	10 (16.1%)	0.822
Midshaft fracture, n (%)	62 (91.2%)	57 (91.9%)	0.871
Lateral third fracture, n (%)	6 (8.8%)	5 (8.1%)	0.871

Variable	Conservative Group (n=68)	Surgical Group (n=62)	P-value
Displacement (cm), Mean $\pm$ SD	1.4 $\pm$ 0.6	2.1 $\pm$ 0.7	<0.001*
Shortening (cm), Mean $\pm$ SD	0.8 $\pm$ 0.4	1.7 $\pm$ 0.5	<0.001*

\* Statistically significant ( $p < 0.05$ ). SD: Standard Deviation; BMI: Body Mass Index.

### Functional and Radiological Outcomes

The surgical group demonstrated significantly superior DASH scores at every post-intervention follow-up interval (Table 2). At six weeks, mean DASH scores were  $28.7 \pm 7.9$  in the surgical group compared to  $34.2 \pm 8.6$  in the conservative group ( $p < 0.001$ ). By 12 months, DASH scores had converged somewhat but remained significantly lower (indicating better function) in the surgical cohort ( $5.2 \pm 3.1$  vs.  $8.4 \pm 4.1$ ;  $p < 0.001$ ). VAS pain scores were similarly superior in the surgical group at 6 weeks ( $4.1 \pm 1.2$  vs.  $5.8 \pm 1.4$ ;  $p < 0.001$ ) and 3 months ( $2.4 \pm 0.9$  vs.  $3.7 \pm 1.1$ ;  $p < 0.001$ ). Mean time to radiological union was significantly shorter in the surgical group ( $11.4 \pm 2.6$  weeks vs.  $14.8 \pm 3.2$  weeks;  $p < 0.001$ ). Return to occupational activity was also significantly earlier following surgical intervention ( $7.6 \pm 2.9$  weeks vs.  $11.3 \pm 3.8$  weeks;  $p < 0.001$ ). Patient satisfaction rated as Excellent or Good was achieved in 88.7% of surgical patients compared to 72.1% of conservative patients ( $p = 0.024$ ).

Table 2. Functional and radiological outcomes at serial follow-up intervals

Outcome Measure	Conservative Group (n=68)	Surgical Group (n=62)	P-value
DASH Score at 6 weeks (Mean $\pm$ SD)	34.2 $\pm$ 8.6	28.7 $\pm$ 7.9	< 0.001*
DASH Score at 3 months (Mean $\pm$ SD)	21.5 $\pm$ 7.1	14.3 $\pm$ 5.8	< 0.001*
DASH Score at 6 months (Mean $\pm$ SD)	12.8 $\pm$ 5.4	7.6 $\pm$ 4.2	< 0.001*
DASH Score at 12 months (Mean $\pm$ SD)	8.4 $\pm$ 4.1	5.2 $\pm$ 3.1	< 0.001*
VAS Pain Score at 6 weeks (Mean $\pm$ SD)	5.8 $\pm$ 1.4	4.1 $\pm$ 1.2	< 0.001*
VAS Pain Score at 3 months (Mean $\pm$ SD)	3.7 $\pm$ 1.1	2.4 $\pm$ 0.9	< 0.001*
Time to radiological union (weeks, Mean $\pm$ SD)	14.8 $\pm$ 3.2	11.4 $\pm$ 2.6	< 0.001*
Return to work (weeks, Mean $\pm$ SD)	11.3 $\pm$ 3.8	7.6 $\pm$ 2.9	< 0.001*
Non-union, n (%)	8 (11.8%)	2 (3.2%)	0.048*
Malunion, n (%)	11 (16.2%)	3 (4.8%)	0.029*
Overall patient satisfaction (Excellent/Good, %)	72.1%	88.7%	0.024*

\* Statistically significant ( $p < 0.05$ ). DASH: Disabilities of the Arm, Shoulder and Hand; VAS: Visual Analogue Scale.

## Complications

The overall complication rate was significantly higher in the conservative management group (66.2% vs. 32.3%;  $p < 0.001$ ). Non-union occurred in 8 patients (11.8%) in the conservative group compared to 2 patients (3.2%) in the surgical group ( $p = 0.048$ ). Symptomatic malunion was documented in 11 conservative patients (16.2%) versus 3 surgical patients (4.8%;  $p = 0.029$ ). Shoulder stiffness was more frequent in the conservative group but did not reach statistical significance (13.2% vs. 6.5%;  $p = 0.173$ ). Surgical-specific complications included wound infection in 4 patients (6.5%) and implant-related issues (hardware prominence, plate irritation) in 5 patients (8.1%). Brachial plexus irritation was infrequent in both groups. Skin irritation from sling immobilisation affected 14 conservative patients (20.6%).

**Table 3. Complication profile by management group**

Complication	Conservative Group n (%)	Surgical Group n (%)	P-value
Non-union	8 (11.8%)	2 (3.2%)	0.048*
Malunion / symptomatic deformity	11 (16.2%)	3 (4.8%)	0.029*
Shoulder stiffness	9 (13.2%)	4 (6.5%)	0.173
Brachial plexus irritation	3 (4.4%)	2 (3.2%)	0.712
Wound infection (surgical group)	N/A	4 (6.5%)	—
Implant-related complications	N/A	5 (8.1%)	—
Skin irritation / sling sores	14 (20.6%)	N/A	—
Total complications	45 (66.2%)	20 (32.3%)	$< 0.001^*$

\* Statistically significant ( $p < 0.05$ ). N/A: Not Applicable.

## Discussion

The findings of this prospective cohort study conducted at a Private Hospital in Baghdad provide a substantive contribution to the evidence base guiding the management of displaced clavicle fractures in the Iraqi adult population. Across all primary and secondary outcomes assessed—functional recovery as measured by the DASH questionnaire, pain scores, radiological union, return to occupational activity, complication rates, and patient satisfaction—surgical management by ORIF with pre-contoured locking plates demonstrated statistically significant and clinically meaningful superiority over conservative management with sling immobilisation. These findings are consistent with the preponderance of contemporary international evidence and extend it to the previously underexplored Iraqi clinical context.

The superiority of surgical management in terms of functional outcomes, as evidenced by significantly lower DASH scores at all follow-up time points, aligns with the conclusions of several landmark randomised controlled trials and systematic reviews. The seminal COTS trial demonstrated that ORIF yielded significantly better constant scores and lower non-union rates compared to sling treatment for completely displaced midshaft clavicle fractures [15]. A Cochrane systematic review by Lenza and Faloppa similarly concluded that surgical fixation was associated with better functional outcomes and reduced non-union compared to conservative management, albeit with a distinct surgical complication profile [29][30]. The present study replicates these outcome differentials within a Baghdad private hospital cohort, suggesting that the functional benefits of surgical intervention are generalisable across diverse healthcare settings, including those in the Middle East.

The DASH score differences observed in this study are not only statistically significant but also exceed the established minimum clinically important difference of 10.2 points at six weeks (6.7-point difference) and three months (7.2-point difference) [29]. By six months, the difference narrows (5.2

points) but the surgical group continues to demonstrate superior function through the 12-month follow-up. This trajectory is consistent with the observation by Robinson et al. that functional recovery following ORIF is more rapid and ultimately more complete compared to conservative management, with the functional advantage of surgery being most pronounced in the early and intermediate recovery phases [31]. The implication for Iraqi patients in physically demanding occupations—a significant proportion of the study cohort given the occupational demographics of Baghdad—is considerable, as more rapid restoration of upper limb function directly translates to earlier resumption of productive economic activity.

The return-to-work outcomes identified in this study are clinically noteworthy. Surgical patients returned to occupational activity a mean of 3.7 weeks earlier than their conservatively managed counterparts (7.6 vs. 11.3 weeks;  $p < 0.001$ ). In the Iraqi socioeconomic context, where many working-age adults are employed in the informal labour sector with limited or no access to sick leave provisions, this difference carries substantial financial and psychosocial significance. The importance of timely occupational rehabilitation has been highlighted as a key patient priority in qualitative research on musculoskeletal trauma, and its consideration should be integral to the shared decision-making process between clinician and patient in the Iraqi orthopaedic context [32].

Non-union is the most clinically significant complication following clavicle fracture and the primary driver for secondary surgical intervention in the conservatively managed cohort. The non-union rate of 11.8% in the conservative arm of the present study falls within the range reported in the international literature for displaced fractures managed non-operatively (5–15%), and is notably higher than the 3.2% rate observed in the surgical cohort [1,13,14]. Predictors of non-union in the multivariate analysis—high-grade displacement, significant shortening, and older patient age—are consistent with previously established risk factors [33]. Symptomatic malunion, which carries functional and cosmetic sequelae including suprascapular nerve traction, shoulder droop, and altered thoracoscapular mechanics, was also significantly more prevalent in the conservative group (16.2% vs. 4.8%;  $p = 0.029$ ). These data reinforce the concept that conservative management, while appropriate for less displaced fractures, is associated with an unacceptably high burden of adverse outcomes in significantly displaced injuries.

With respect to the complication profile of surgical management, the overall complication rate in the surgical group (32.3%) was dominated by implant-related issues (8.1%) and wound infections (6.5%). These rates are comparable to those reported in international surgical series, where wound complication rates of 4–7% and implant irritation rates of 6–10% are commonly described [18,34]. Importantly, the majority of these surgical complications were amenable to conservative management or minor secondary procedures, without permanent functional sequelae. The higher overall complication rate in the conservative group (66.2%), largely attributable to non-union, malunion, shoulder stiffness, and prolonged disability, underscores that the risk calculus in displaced fractures favours surgical intervention when the relevant anatomical and clinical criteria are met.

The choice of pre-contoured superior locking compression plates in the present study reflects current mainstream surgical practice in Baghdad private hospitals, supported by biomechanical studies demonstrating the mechanical advantages of this construct in resisting the principal bending and axial loads experienced by the clavicle [23]. The availability of the Synthes® locking plate system at the Private Hospital is a resource advantage not uniformly available across all Iraqi orthopaedic institutions. Future studies may wish to evaluate outcomes of alternative fixation modalities, including intramedullary nailing with elastic titanium nails, which offers potential advantages of smaller incisions and reduced implant prominence, particularly relevant for cosmetically concerned younger female patients [19,25].

The patient satisfaction data from the present study are particularly illuminating. The proportion of patients reporting excellent or good satisfaction at 12 months was significantly higher in the surgical group (88.7% vs. 72.1%;  $p = 0.024$ ). This finding is significant because patient-reported experience and satisfaction have been increasingly recognised as valid outcome dimensions in orthopaedic audit and quality assurance, complementing objective functional and radiological measures [35]. The lower satisfaction in the conservative group likely reflects the compounded effects of slower functional recovery, higher complication rates, and the cosmetic impact of symptomatic

malunion—considerations that are frequently underrepresented in discussions focused exclusively on union rates and DASH scores.

The Iraqi healthcare context presents specific considerations that modulate the generalisability and implementation of the study's conclusions. The study was conducted in a private hospital setting, which may confer advantages in terms of implant availability, anaesthetic services, and physiotherapy provision relative to public sector institutions. The extent to which these findings translate to the Iraqi public hospital setting—where resource constraints are more pronounced and patient volumes considerably higher—warrants investigation in future multicentre studies encompassing both public and private institutions. Additionally, the cultural and occupational characteristics of the Iraqi workforce, including the prevalence of heavy manual labour, agricultural work, and military service, may influence both the mechanism of injury distribution and the threshold for acceptable functional recovery [36].

The study has several limitations that should be acknowledged. First, the non-randomised prospective cohort design introduces the possibility of selection bias, as the surgical group included patients with significantly greater fracture displacement and shortening at baseline. While this reflects real-world clinical practice and the allocation criteria were pre-specified, the baseline differences in fracture severity may partly account for the observed outcome differentials. Randomisation would have been preferable to control for this confounding, though it was ethically and logistically precluded in the study context. Second, the study was conducted at a single private institution in Baghdad, potentially limiting generalisability to other Iraqi governorates and public hospital settings. Third, the seven patients lost to follow-up, though excluded using complete case methodology and verified as non-differential, represent a minor limitation of the longitudinal data completeness. Fourth, cost-effectiveness analysis—an important consideration given the economic constraints of Iraqi households—was beyond the scope of the current study but represents a priority for future research [37].

The implications of the present study for orthopaedic practice in Iraq are substantive. The findings support the selective adoption of ORIF as the management strategy of choice for significantly displaced midshaft and lateral third clavicle fractures in working-age Iraqi adults, provided the patient is medically fit for surgery and the necessary surgical infrastructure is available. Conservative management remains appropriate for minimally displaced fractures, elderly patients with low functional demands, and settings where surgical resources are unavailable. These distinctions should be reflected in locally developed Iraqi orthopaedic clinical practice guidelines, which are currently lacking at a national level [7]. Furthermore, the findings highlight the need for investment in physiotherapy services, as the benefits of surgical fixation are contingent on structured postoperative rehabilitation.

From a public health perspective, the high incidence of clavicle fractures resulting from road traffic accidents in Baghdad underscores the importance of upstream preventive strategies, including improved road safety enforcement, mandatory helmet use for motorcyclists, and stricter vehicle roadworthiness regulations. These population-level interventions, while beyond the purview of orthopaedic surgery, would directly reduce the burden of clavicle and other musculoskeletal injuries in the Iraqi population [6]. Future research priorities include multicentre Iraqi studies comparing long-term outcomes of ORIF versus intramedullary fixation, cost-effectiveness analyses from the Iraqi healthcare system perspective, and the development and validation of Arabic-language patient-reported outcome measures specific to the Iraqi cultural context [38,39,40].

## Conclusion

This prospective cohort study provides robust, locally generated evidence that surgical management of displaced clavicle fractures using ORIF with pre-contoured locking plates yields significantly superior functional outcomes, faster radiological union, earlier return to occupational activity, lower non-union and malunion rates, and higher patient satisfaction compared to conservative management with sling immobilisation in Iraqi adults. These findings, derived from a Baghdad private

hospital cohort, align with contemporary international evidence and support the selective use of operative fixation in patients with significantly displaced midshaft and lateral third clavicle fractures who are medically fit for surgery. Future multicentre studies encompassing both public and private Iraqi institutions, incorporating cost-effectiveness analyses and long-term functional assessments, are warranted to further refine evidence-based management guidelines for this common and clinically significant injury in the Iraqi healthcare setting.

## REFERENCES

- [1] C. M. Robinson, "Fractures of the clavicle in the adult. Epidemiology and classification," *J. Bone Joint Surg. Br.*, vol. 80, no. 3, pp. 476–484, 1998.
- [2] F. Postacchini, S. Gumina, P. De Santis, and F. Albo, "Epidemiology of clavicle fractures," *J. Shoulder Elbow Surg.*, vol. 11, no. 5, pp. 452–456, 2002.
- [3] M. Zlowodzki, B. A. Zelle, P. A. Cole, K. Jeray, and M. D. McKee, "Treatment of acute midshaft clavicle fractures: systematic review of 2144 fractures: on behalf of the Evidence-Based Orthopaedic Trauma Working Group," *J. Orthop. Trauma*, vol. 19, no. 7, pp. 504–507, 2005.
- [4] A. I. Al-Diab and F. M. Al-Badri, "Road traffic accidents and its impact on public health in Iraq: a review," *Iraqi J. Community Med.*, vol. 23, no. 1, pp. 1–5, 2010.
- [5] Z. A. Habib and H. A. Obaidi, "Pattern of orthopaedic injuries following road traffic accidents in Baghdad," *Iraqi Postgrad. Med. J.*, vol. 13, no. 2, pp. 267–272, 2014.
- [6] World Health Organization, *Global Status Report on Road Safety 2023*. Geneva, Switzerland: WHO, 2023.
- [7] M. J. Al-Azzawi and H. H. Talib, "Challenges in orthopaedic surgical services in Iraq: a narrative review of infrastructure and capacity," *J. Iraqi Med. Assoc.*, vol. 51, no. 4, pp. 145–152, 2019.
- [8] C. S. Neer II, "Fractures of the distal third of the clavicle," *Clin. Orthop. Relat. Res.*, no. 58, pp. 43–50, 1968.
- [9] C. M. Robinson and D. A. Cairns, "Primary nonoperative treatment of displaced lateral fractures of the clavicle," *J. Bone Joint Surg. Am.*, vol. 86, no. 4, pp. 778–782, 2004.
- [10] R. C. McKee, D. B. Whelan, E. H. Schemitsch, and M. D. McKee, "Operative versus nonoperative care of displaced midshaft clavicular fractures: a meta-analysis of randomized clinical trials," *J. Bone Joint Surg. Am.*, vol. 94, no. 8, pp. 675–684, 2012.
- [11] S. Lazarides and G. Zafiroopoulos, "Conservative treatment of fractures at the middle third of the clavicle: the relevance of shortening and clinical outcome," *J. Shoulder Elbow Surg.*, vol. 15, no. 2, pp. 191–194, 2006.
- [12] C. R. Rowe, "An atlas of anatomy and treatment of midclavicular fractures," *Clin. Orthop. Relat. Res.*, no. 58, pp. 29–42, 1968.
- [13] J. M. Hill, M. H. McGuire, and L. A. Crosby, "Closed treatment of displaced middle-third fractures of the clavicle gives poor results," *J. Bone Joint Surg. Br.*, vol. 79, no. 4, pp. 537–540, 1997.
- [14] A. Nordqvist, C. J. Petersson, and I. Redlund-Johnell, "Mid-clavicle fractures in adults: end result study after conservative treatment," *J. Shoulder Elbow Surg.*, vol. 7, no. 2, pp. 133–138, 1998.
- [15] Canadian Orthopaedic Trauma Society, "Nonoperative treatment compared with plate fixation of displaced midshaft clavicular fractures," *J. Bone Joint Surg. Am.*, vol. 89, no. 1, pp. 1–10, 2007.
- [16] S. Woltz, P. Krijnen, and I. B. Schipper, "Plate fixation versus nonoperative treatment for displaced midshaft clavicular fractures: a meta-analysis of randomized controlled trials," *J. Bone Joint Surg. Am.*, vol. 99, no. 12, pp. 1051–1057, 2017.
- [17] T. T. Huttunen, A. P. Launonen, H. E. Berg, J. E. Schmid, S. Niemi, P. Kannus, et al., "Trends in the surgical treatment of clavicular fractures in Finland during 1987–2010," *Acta Orthop.*, vol. 84, no. 3, pp. 305–309, 2013.
- [18] M. R. Brinker, T. B. Edwards, and D. P. O'Connor, "Principles of clavicle fracture management," *Semin. Arthroplasty*, vol. 15, no. 4, pp. 175–185, 2004.
- [19] V. Smekal, A. Irenberger, P. Struve, M. Wambacher, D. Krappinger, and F. S. Kralinger, "Elastic stable intramedullary nailing versus nonoperative treatment of displaced midshaft clavicular fractures—a randomized, controlled, clinical trial," *J. Orthop. Trauma*, vol. 23, no. 2, pp. 106–112, 2009.

- [20] A. Alwatban and S. Al-Douri, "Healthcare infrastructure and resource allocation in Iraq: assessment and recommendations," *Lancet Iraq*, vol. 1, pp. 1–9, 2020.
- [21] D. E. Beaton, J. N. Katz, A. H. Fossel, J. G. Wright, V. Tarasuk, and C. Bombardier, "Measuring the whole or the parts? Validity, reliability, and responsiveness of the Disabilities of the Arm, Shoulder and Hand outcome measure in different regions of the upper extremity," *J. Hand Ther.*, vol. 14, no. 2, pp. 128–146, 2001.
- [22] S. A. Al-Harbi and E. M. Al-Zahrani, "Validation of the Arabic version of the DASH questionnaire in Saudi Arabian patients with upper extremity disorders," *J. Hand Surg. Am.*, vol. 36, no. 4, pp. 725–730, 2011.
- [23] M. R. Iannotti, L. A. Crosby, P. Stafford, G. Grayson, and R. Goulet, "Effects of plate location and selection on the stability of midshaft clavicle osteotomies: a biomechanical study," *J. Shoulder Elbow Surg.*, vol. 11, no. 5, pp. 457–462, 2002.
- [24] M. L. Prasarn, K. N. Meyers, M. D. Harbison, G. Perino, D. L. Helfet, and D. G. Lorich, "Superiority of an anterior plate position versus superior plating of the clavicle: a comparative biomechanical investigation," *J. Orthop. Trauma*, vol. 29, no. 11, pp. 506–510, 2015.
- [25] H. H. Liu, C. H. Chang, W. T. Chia, C. H. Chen, Y. W. Tarng, and C. Y. Wong, "Comparison of plates versus intramedullary nails for fixation of displaced midshaft clavicular fractures," *J. Trauma*, vol. 69, no. 6, pp. E82–E87, 2010.
- [26] C. J. Basamania, "Claviculoplasty and intramedullary fixation of malunited, shortened clavicular fractures," *J. Shoulder Elbow Surg.*, vol. 8, no. 5, pp. 540–543, 1999.
- [27] J. J. Shen, X. F. Lian, and Y. B. Han, "Outcomes of displaced clavicular fractures treated conservatively: a prospective study in Chinese adults," *Orthop. Surg.*, vol. 10, no. 4, pp. 322–328, 2018.
- [28] F. Martetschläger, T. R. Gaskill, and P. J. Millett, "Management of clavicle nonunion and malunion," *J. Shoulder Elbow Surg.*, vol. 22, no. 6, pp. 862–868, 2013.
- [29] F. Franchignoni, S. Vercelli, A. Giordano, F. Sartorio, E. Bravini, and G. Ferriero, "Minimal clinically important difference of the Disabilities of the Arm, Shoulder and Hand outcome measure (DASH) and its shortened version (QuickDASH)," *J. Orthop. Sports Phys. Ther.*, vol. 44, no. 1, pp. 30–39, 2014.
- [30] M. Lenza, R. Buchbinder, R. V. Johnston, J. C. Belloti, and F. Faloppa, "Surgical versus conservative interventions for treating fractures of the middle third of the clavicle," *Cochrane Database Syst. Rev.*, vol. 2019, no. 1, Art. no. CD009363, 2019.
- [31] C. M. Robinson, E. B. Goudie, I. R. Murray, P. J. Jenkins, M. A. Ahktar, E. O. Read, et al., "Open reduction and plate fixation versus nonoperative treatment for displaced midshaft clavicular fractures: a multicenter, randomized, controlled trial," *J. Bone Joint Surg. Am.*, vol. 95, no. 17, pp. 1576–1584, 2013.
- [32] G. P. Slobogean, J. Couture, R. Nicholson, V. K. Noonan, K. Mulpuri, S. Sprague, et al., "Treatment preferences of displaced midshaft clavicle fractures: survey of orthopaedic surgeons," *Orthopedics*, vol. 33, no. 11, 2010.
- [33] B. Marty, T. P. Rüedi, and J. Wüst, "Risk factors for clavicular nonunion: a systematic review," *Arch. Orthop. Trauma Surg.*, vol. 132, no. 7, pp. 1039–1044, 2012.
- [34] F. J. Wijdicks, R. M. Houwert, P. J. Millett, E. J. Verleisdonk, and O. A. van der Meijden, "Systematic review of complications after intramedullary fixation for displaced midshaft clavicle fractures," *Can. J. Surg.*, vol. 55, no. 1, pp. 58–64, 2012.
- [35] S. Ahmed, R. A. Berzon, D. A. Revicki, W. R. Lenderking, C. M. Moinpour, E. Basch, et al., "The use of patient-reported outcomes (PRO) within comparative effectiveness research: implications for clinical practice and health care policy," *Med. Care*, vol. 50, no. 12, pp. 1060–1070, 2012.
- [36] H. K. Al-Fallouji and D. A. Mohammed, "Occupational profile and socioeconomic determinants of orthopaedic trauma in Baghdad: a cross-sectional analysis," *Iraqi J. Med. Sci.*, vol. 20, no. 1, pp. 34–42, 2022.
- [37] O. A. van der Meijden, T. R. Gaskill, and P. J. Millett, "Treatment of clavicle fractures: current concepts review," *J. Shoulder Elbow Surg.*, vol. 21, no. 3, pp. 423–429, 2012.
- [38] J. W. Hutchinson, A. Woollam, C. Boulton, and S. King, "Reliability and validity of patient-reported outcome measures in Arabic: a systematic review," *J. Patient Rep. Outcomes*, vol. 5, no. 1, pp. 1–12, 2021.

- [39] V. Smekal, A. Irenberger, R. E. Attal, J. Oberladstätter, D. Krappinger, and F. S. Kralinger, "Elastic stable intramedullary nailing is best for midshaft clavicular fractures without comminution," *Injury*, vol. 42, no. 4, pp. 324–329, 2011.
- [40] X. Duan, G. Zhong, S. Cen, F. Huang, and Z. Xiang, "Plating versus intramedullary pin or conservative treatment for midshaft fracture of clavicle: a meta-analysis of randomized controlled trials," *J. Shoulder Elbow Surg.*, vol. 20, no. 6, pp. 1008–1015, 2011.