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CURRENT TRENDS IN THE MANAGEMENT OF MIDSHAFT CLAVICLE FRACTURES: A SYSTEMATIC REVIEW

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ABSTRACT

Introduction: Clavicle shaft fractures account for up to 80% of all injuries to this bone. For decades, conservative treatment remained the gold standard, based on historical reports of a minimal (0.6%) non-union rate. However, modern diagnostics and increasing patient expectations regarding biomechanical performance have necessitated a revision of these views.
Aim of the study: To analyze the effectiveness of surgical versus conservative treatment based on literature from 2021–2026, with a particular focus on union rates, functional outcomes, and complication profiles.
Material and methods: A review of the PubMed, Cochrane Library, Scopus, and Google Scholar databases was conducted. The analysis included meta-analyses, systematic reviews, and randomized controlled trials (RCTs) involving adult patients with clavicle shaft fractures.
Results: Contemporary data indicate that the non-union rate for conservative treatment is approximately 11%, whereas surgical stabilization (ORIF) reduces this risk by 77%. Surgically treated patients achieve significantly better short-term functional outcomes (at 6 weeks: DASH improved by 9.4 points; CMS: SMD = 0.49), which is of key economic and performance importance for athletes and manual workers. Although long-term results for both groups eventually align, surgical intervention allows for a faster return to full function (3.1 vs. 3.9 months). Conservative treatment eliminates iatrogenic risks but is associated with the risk of scapular dyskinesis when bone shortening exceeds 2 cm, as well as more frequent patient dissatisfaction with aesthetic outcomes.
Conclusions: Current scientific evidence indicates the superiority of surgical treatment in terms of union reliability and rehabilitation speed. However, the choice of method requires personalization - balancing the risk of postoperative complications against potential biomechanical dysfunction resulting from clavicular shortening.

KEYWORDS

Clavicle Fracture, Meta-Analysis, Surgical Fixation, Non-Operative Management, Trauma, Orthopedic Surgery

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Introduction

Up to 10% of all human fractures involve the clavicle, with as many as 80% located in its shaft (Type I in the Allman classification) [1]. It is estimated that clavicle fractures may affect up to 1 in 1,000 individuals, approximately 67% of whom are men [1, 2]. This is undoubtedly influenced by its anatomy, characterized by an S-shape and a lack of muscular protection in the middle third. These factors make the bone exceptionally susceptible to various types of fractures during direct trauma [18]. While there are many potential causes, the fracture most commonly occurs as a result of a fall or a road traffic collision [17]. Despite the high frequency of these injuries, opinions regarding the optimal treatment - surgical versus conservative - remain divided [2]. Key factors in selecting the appropriate method include fracture characteristics, the risk of complications, and patient demographics [3]. Implementing treatment is essential due to the clavicle's functions: it is mobilized during all possible shoulder joint movements and serves as a stable base for the scapula, enabling a full range of motion, including the critical rotation required above 90 degrees of abduction and flexion [18].

In the past, management primarily relied on non-operative treatment combined with appropriate immobilization and early physiotherapy [3]. For decades, the treatment of clavicle injuries was based on Rowe's findings, which indicated the exceptional effectiveness of immobilization, reporting a non-union rate of only 0.6% (4/690 patients) [5]; this was pivotal in establishing conservative treatment as the standard of care. However, recent meta-analyses show that the union rate after non-operative treatment is noticeably lower, reaching just under 89% [6, 7]. Over the years, increasing knowledge of invasive techniques has led to a growing trend toward surgical intervention [3], driven by better clinical outcomes compared to non-operative methods [4]. Conversely, a rising awareness of postoperative complications encourages greater personalization of care, with a shift toward implementing conservative treatment tailored to the individual needs of the patient [6, 8, 19].

Aim

The purpose of this study is to review the most recent literature from 2021–2026 to analyze the effectiveness of both treatment methods in terms of bone union, functional outcomes, and complication profiles. Furthermore, this review aims to identify key risk factors that should serve as the basis for selecting a treatment strategy in modern clinical practice.

Material and Methods

Search Strategy and Selection

A literature review was conducted between March and April 2026. The data collection process was based on searching medical databases, including **PubMed, Cochrane Library, Scopus, and Google Scholar**, as well as referencing historical printed works. The search strategy employed keywords such as clavicle fracture; meta-analysis; surgical fixation; non-operative management; trauma; orthopedic surgery. Additionally, data from national registries, such as the **Danish National Patient Registry**, were included.

Inclusion and Exclusion Criteria

The analysis included papers published between **2021 and 2026** that met the criteria for meta-analyses, systematic reviews, and randomized controlled trials (RCTs). Only English-language publications concerning clavicle fractures and comparing surgical and conservative treatments were utilized. Case reports and pediatric studies were excluded from the analysis.

The analysis focused on the effectiveness of the respective treatment methods in three primary domains:

- **Biological:** Measured by achieved bone union.
- **Functional Outcomes:** Based on orthopedic scoring systems, specifically the **DASH** (Disabilities of the Arm, Shoulder, and Hand) and **CMS** (Constant-Murley Score).
- **Safety Profile:** Based on the frequency and type of complications associated with each treatment modality.

Limitations

This review focuses specifically on **midshaft clavicle fractures** and does not include less common lateral (distal) end fractures, which require a different management approach. Furthermore, the follow-up period in the presented studies rarely exceeds **24 months**, which precludes an assessment of long-term risks, such as the development of degenerative changes over several years.

Results

Analysis of the collected material reveals significant differences between surgical and conservative treatment in patients with clavicle shaft fractures, both in terms of union rates and the profile of safety and patient aesthetic satisfaction regarding the post-traumatic site. Meta-analyses of randomized controlled trials (RCTs) provide substantial evidence for the superiority of operative treatment over conservative management in achieving bone union. These studies indicate that surgical intervention reduces the probability of non-union by 77% compared to conservative treatment [8, 9]. Nevertheless, conservative techniques remain a solid foundation for treating clavicle fractures; primary indications for using a sling or a figure-of-eight strap include < 2 cm shortening and displacement or < 1cm displacement of the superior shoulder suspensory complex [19]. Clavicular shortening is directly associated with scapular dyskinesis, which leads to long-term dysfunction by altering the mechanics of the glenohumeral and acromioclavicular joints. Clinically, this extends beyond joint motion and is associated with pain and decreased shoulder strength [20].

Comparative studies have evaluated the proportion of patients achieving successful union versus cases of non-union or the development of pseudarthrosis (false joint).

Despite the advantages of surgical treatment regarding bone union, one must consider risk factors that noticeably decrease the rate of successful healing. Major causes include osteoporosis, open fractures, the use of NSAIDs, delayed weight-bearing, failed stabilization, or infection [14]. Surgical treatment using ORIF is associated with potential adverse events occurring in approximately 1.9% of all operated patients within the first 30 days post-procedure [12]. When opting for surgery, general medical complications resulting from the procedure and anesthesia must also be considered, including infections, neurovascular injuries, and anesthetic complications such as nausea, vomiting, or shivering [13, 15]. Nevertheless, based on CMS and DASH scores, it can be concluded that surgically treated patients rate upper limb function higher in the initial weeks following treatment - at 6 weeks, the mean difference in the DASH score was 9.4 points in favor of surgery. Similarly,

the CMS indicates better shoulder strength and range of motion (SMD = 0.49, p = 0.05) favoring surgical intervention. However, these results tend to equalize in long-term follow-ups [8, 11].

Surgical treatment may also better facilitate and accelerate the return to pre-injury performance levels. Among athletes, the average time to return to play after surgical treatment was 3.1 months, with 92% returning to their pre-injury form; with conservative treatment, this period extended to 3.9 months, with only 78% returning to the same level of play [10]. Thus, conservative treatment remains a vital option for less active individuals or for fractures with minimal displacement [8]. Despite their respective advantages, both methods carry risks of complications. Conservative treatment eliminates the risk of surgical site infection and tissue damage related to implant placement, as well as anesthesia-related complications. However, it may be associated with symptomatic malunion and potential neurological symptoms originating from the clavicular region, which significantly increases patient dissatisfaction [9, 11, 13]. Additionally, complications following conservative treatment can occur in up to 24.5% of patients - most cited are persistent post-traumatic pain, dissatisfaction with appearance, and ongoing shoulder stiffness [16].

Discussion

The findings included in this review allow for a retrospective evaluation of historical approaches to treating clavicle fractures. For many years, conservative management was the sole gold standard, as documented in the pioneering works of Rowe, where non-union rates were reported at a mere 0.6% [5]. However, the meta-analyses from 2021–2026 included here demonstrate that the actual non-union rate for conservative treatment is significantly higher, fluctuating around 11% [6]. This discrepancy may stem from a radical shift in both patient expectations and diagnostic imaging capabilities; while in Rowe's era, success was defined simply by achieving bony continuity, modern orthopedics measures treatment outcomes by biomechanical performance and the absence of muscle strength deficits [20].

Based on the analysis of the DASH and CMS scales, it can be concluded that the superiority of surgical treatment is most evident in the short-term perspective. The 9.4-point difference in favor of surgery on the DASH scale indicates that operated patients return to activity faster, although ultimate long-term functional outcomes remain at a similar level [11]. It is worth emphasizing, however, that for athletes or manual workers, these initial weeks can have significant economic and performance-related implications [10].

The choice of treatment involves a constant balancing of the risks associated with both methods. Surgical intervention (ORIF) drastically reduces the risk of non-union (by 77%) but carries the potential for various complications that can be entirely avoided with conservative management. Conversely, conservative treatment exposes the patient to pain associated with bony deformity, aesthetic dissatisfaction, and, above all, a lower rate of successful union.

Conclusions

Contemporary scientific evidence from 2021–2026 clearly indicates the superiority of surgical treatment (ORIF) over conservative management in terms of achieving clavicular union. Surgical intervention reduces the risk of non-union by approximately 77% compared to conservative methods. Operative treatment allows for a faster return to activity, although the differences in functional outcomes between the two methods diminish in long-term follow-ups. The choice of treatment modality involves balancing potential iatrogenic complications associated with surgery against the biomechanical dysfunction that may result from clavicular shortening and secondary scapular dyskinesis. Modern standards of care should, therefore, emphasize patient personalization and the selection of an appropriate method by carefully weighing the advantages and disadvantages of each approach.

Conflict of interest statement

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work.

Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Declaration on the Use of AI: In preparing this manuscript, the authors used ChatGPT for language improvement and enhancing readability. Following the use of this tool, all content was reviewed and edited by the authors, who take full responsibility for the accuracy and integrity of the final version.

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