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Lateral clavicle fractures in children: Functional and cosmetic outcomes following different treatment approaches

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Abstract

Lateral clavicle fractures are rare injuries in the pediatric population, comprising only 10–20% of all clavicle fractures. There is limited evidence in the literature regarding long-term outcomes and indications for surgical treatment in this group. To retrospectively analyze the clinical and radiological outcomes of pediatric patients with lateral clavicle fractures treated in our clinic. Patients aged 16 years or younger who were treated for lateral clavicle fractures were included. Clinical outcomes were assessed using Quick-DASH (Disabilities of the Arm, Shoulder, and Hand) and Peds-QL (Pediatric Quality of Life) questionnaires, as well as a satisfaction survey focusing on shoulder function and cosmetic appearance. Radiological evaluations were performed using PACS to measure displacement and shortening. Sixteen patients were analyzed, including 12 boys and 4 girls. Their mean age was 9.9 years, and the mean follow-up period was 8.6 weeks. Surgical intervention was applied in 50% of cases, with the rest managed non-operatively. The average Quick-DASH score was 3.5, while the average Peds-QL score reached 99.1. There were no statistically significant differences between the surgical and conservative groups in terms of functional outcomes or overall satisfaction. However, cosmetic satisfaction was significantly higher in the conservatively treated group ($p < 0.05$). No patients experienced motion limitation, and all fractures healed without complications. Lateral clavicle fractures in children can be effectively managed conservatively, with excellent functional and radiological outcomes. Surgical intervention may be reserved for select cases with marked displacement or soft tissue concerns but does not appear to offer additional benefit in terms of quality of life or function.

Keywords: Lateral clavicle fracture, pediatric, quick disability of the arm shoulder and hand, pediatric quality of life, cosmetic satisfaction

Introduction

Clavicle fractures are common injuries in the pediatric population and account for nearly 10% of all extremity fractures. In contrast, distal clavicle fractures are relatively rare, representing only 10–20% of all clavicle fractures [1,2]. Despite this, they constitute an important subgroup because the unique anatomy of the distal clavicular physis and its late ossification may lead to specific injury patterns that differ from those observed in adults.

The current literature on distal clavicle fractures in children is limited, and most available studies include small patient groups

with heterogeneous treatment approaches [3,4]. As a result, there is no clear consensus regarding optimal management, particularly in displaced fractures. Decisions regarding surgical intervention are often influenced by concepts derived from adult acromioclavicular and coracoclavicular ligament injuries, although their applicability to skeletally immature patients is uncertain.

Given the scarcity of long-term pediatric data and the ongoing debate regarding indications for surgery, further clinical evidence is needed. The aim of this study was to perform a retrospective evaluation of clinical and radiological outcomes in children treated for distal clavicle fractures in our clinic.

CITATION

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Based on our clinical experience and the existing, yet limited, pediatric literature, we hypothesized that distal clavicle fractures in children can achieve favorable functional and radiological outcomes when managed according to treatment principles commonly applied in adults. We further assumed that, despite anatomical and biological differences, adopting similar decision-making strategies—particularly regarding the assessment of displacement and stability—would result in successful healing without significant complications.

Material and Methods

This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Institutional Ethics Committee Ümraniye Training and Research Hospital (No: B.10.1.TKH.4.34.H.GP.0.01/187, Date: 19 June 2025).

Study Design and Participants

All lateral clavicle fractures in patients aged 16 years or younger treated in our clinic between January 2012 and December 2022 were identified retrospectively through ICD diagnostic codes and included in the study. Patients were eligible if they had a fracture located in the lateral one-third of the clavicle, received treatment in our clinic, and completed follow-up until radiological union. Patients with insufficient follow-up data, bilateral clavicle fractures, segmental fractures, or concomitant ipsilateral upper-extremity fractures were excluded from the study.

Surgical Indications

In our institution, the decision between conservative and operative management of pediatric lateral clavicle fractures is primarily based on clinical presentation and surgeon experience. Although most fractures in this age group can be managed non-operatively, surgery is considered when stability of the acromioclavicular or coracoclavicular ligaments is compromised, as surgeons often rely on principles derived from adult injury patterns. Additional indications for operative treatment include open fractures, significant skin compromise or imminent skin perforation, displaced intra-articular extension, and associated neurovascular injuries requiring surgical intervention. The degree of fracture displacement also plays a key role in selecting the appropriate treatment modality.

After identifying the patients, Quick-DASH (Disabilities of the Arm, Shoulder, and Hand), Peds-QL (Pediatric Quality of Life), and satisfaction questionnaires were administered during follow-up visits. For patients unable to attend in person, assessments were conducted via telephone. Patients who discontinued follow-up or could not be reached were excluded from the study.

Radiological data were evaluated using the PACS (Picture Archiving and Communication System), measuring total

clavicle length in comparison with the healthy side, displacement, and shortening. Inconsistencies were reviewed and resolved by two senior authors. The classification system described by Nenopoulos et al. [5] was used to categorize the fractures.

The Quick-DASH questionnaire was used to assess functional outcomes, and its validated Turkish version was applied [6]. Since no validated Turkish version of the PedsQL scale exists, a carefully translated Turkish form was used to ensure that patients and families clearly understood each item before scoring.

A satisfaction questionnaire was used to assess patients' satisfaction with their shoulder, asking: "How satisfied are you with your injured shoulder?" with the options: "very satisfied," "somewhat satisfied," "somewhat dissatisfied," and "very dissatisfied." Cosmetic satisfaction was assessed with the question: "How satisfied are you with the cosmetic appearance of your injured shoulder?" and the responses were categorized as: "not at all satisfied," "a little satisfied," "moderately satisfied," "quite satisfied," and "very satisfied."

Demographic data, treatment method (surgical vs. conservative), and whether the fracture occurred on the dominant side were also recorded.

Statistical Analysis

Data were analyzed using SPSS software (ver. 22.0; IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Shapiro–Wilk test. As the data did not follow a normal distribution, quantitative variables are presented as median, minimum, and maximum values. Categorical variables are expressed as frequencies and percentages.

Between-group comparisons were performed using the Mann–Whitney U test for continuous variables and the Chi-square or Fisher's exact test for categorical variables, as appropriate. A p-value of <0.05 was considered statistically significant.

Results

The study cohort consisted of 16 patients, including 12 boys and 4 girls. Fractures were located on the right side in 7 cases and on the left in 9 cases. The average age of the patients was 9.9 years (range: 3–16; med: 9.5), and the mean follow-up duration was 8.6 weeks (range: 2–20; med: 7.5). The overall follow-up period ranged from 2 to 20 weeks (mean: 8.8 weeks).

In operative group, the follow-up ranged from 7 to 20 weeks (mean: 11.8 weeks; med: 12 weeks), while in conservative group, it ranged from 2 to 11 weeks (mean: 4.5 weeks; med: 3.5 weeks) (Table 1). The mean Quick-DASH score was calculated as 3.5, while the mean Peds-QL score was 99.1. The mean displacement was 4.6 mm (range: 0–12 mm; med: 3.5), and the mean shortening was 3.8 mm (range: 0–9 mm; med: 2.5)

(Table 2). Half of the patients underwent surgical treatment, while the other half were managed conservatively with a simple arm sling (Figure 1). Surgical fixation involved reduction and K-wire application. Plate fixation was applied to a patient aged 14 years. While 58.3% of male patients received surgical treatment, only one female (25%) was operated on, with no significant difference between sexes ($p>0.05$). The average age was 12.1 years in the surgical group and 7.7 years in the non-

surgical group, which was likewise not statistically significant ($p=0.23$). The youngest surgical patient was 8 years old, with 12 mm displacement and 9 mm shortening. This patient also had the lowest cosmetic satisfaction score. The mean displacement in the surgical group was 6.75 mm, compared to 2.5 mm in the non-surgical group ($p>0.05$). The mean shortening was 5.1 mm in the surgical group and 2.5 mm in the conservative group ($p>0.05$).

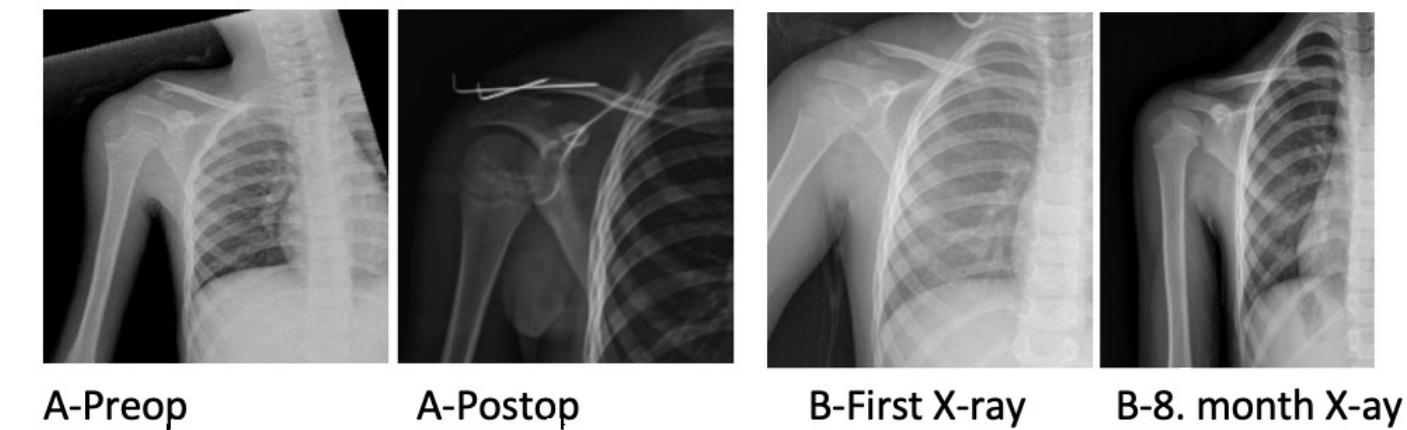


Figure 1. Representative radiographs of pediatric lateral clavicle fractures. (A) Surgically treated case demonstrating fixation method and postoperative alignment. (B) Conservatively treated case showing typical fracture appearance and follow-up healing

Table 1. Demographic characteristics of the patients	
Continuous variables	Mean, (min-max, med)
Age (years)	9.9 (3-16, 9.5)
Follow up period (week)	8.6 (2-20)
Operative group	11.8 (7-20, 12)
Conservative group	4.5 (2-12, 3.5)
Categorical variables	N (%)
Gender (patients)	
Female	4(25)
Male	12(75)
Side	
Right	7 (43)
Left	9 (57)
Treatment	
Surgery	8 (50)
Nonsurgery	8 (50)
Min: minimum, max: maximum, med: median	

Table 2. Mean Quick-DASH, Peds-QL scores, and radiological measurements	
Variable	Mean (Min-Max, Med)
Quick DASH	3.5
Peds-QL	99.1
Displacement (mm)	4.6 (0-12, 3.5)
Shortening (mm)	3.8 (0-9, 2.5)
Min: minimum, max: maximum, Med: Median, Quick-DASH: Disabilities of the Arm, Shoulder, and Hand, Peds-QL: Pediatric Quality of Life	

Although long-term functional and cosmetic outcomes of pediatric lateral clavicle fractures have not been well established in the literature, our study provides short-term clinical and radiographic data regarding early healing and early recovery.

In the satisfaction questionnaire, nine patients responded "very satisfied," while seven responded "somewhat satisfied." No patient reported dissatisfaction. In terms of cosmetic appearance, nine patients reported being "satisfied," six were "a little satisfied," and one reported being "moderately satisfied" due to a noticeable protrusion. No significant differences were found between the surgical and conservative groups with respect to Quick-DASH, Peds-QL, or overall satisfaction scores ($p>0.05$).

In contrast, cosmetic satisfaction was significantly greater among patients managed conservatively ($p<0.05$) (Table 3). No restriction in range of motion was observed in any patient. Full shoulder mobility was maintained. Half of the fractures occurred on the dominant side. According to the Nenopoulos classification system, six patients had type 2A fractures, six had type 2B, one had type 3A, and three had type 3B.

Table 3. Comparison of demographic, radiological, and functional outcomes between surgical and conservative groups

Variable	Surgical group	Conservative group	p-value
Sex (male)	58.3%	41.7%	> 0.05
Sex (female)	25%	75%	> 0.05
Age (years, mean)	12.1	7.7	0.23
Displacement (mm, mean)	6.75	2.5	> 0.05
Shortening (mm, mean)	5.1	2.5	> 0.05
Quick-DASH score (mean)	3.75	3.43	> 0.05
Peds-QL score (mean)	99.2	99.1	> 0.05
Overall satisfaction	-	-	> 0.05
Cosmetic satisfaction	-	-	< 0.05

Quick-DASH: Disabilities of the Arm, Shoulder, and Hand, Peds-QL: Pediatric Quality of Life

Discussion

Studies evaluating lateral clavicle fractures in pediatric patients are limited in the literature. Although few, these studies do not clearly specify the age group or indications for surgical treatment [7-9]. Despite the small sample size, our study is one of the rare reports assessing both clinical and radiological outcomes as well as patient satisfaction in surgically and conservatively treated cases.

In our study, the rate of surgical intervention was higher than reported in the literature, likely due to loss to follow-up in conservatively managed patients. As reported in previous studies, surgical cases typically involved greater displacement and potential skin tension [9,10]. Consistent with the literature, surgical decision-making in our clinic also places emphasis on the degree of displacement and the presence of skin compromise. We believe that in this patient group, when treated conservatively, there is a potential risk of skin-related complications due to pressure from the displaced fragment.

Although there is no consensus on age threshold, the youngest surgical patient in our cohort was eight years old [5]. In our cohort, the mean age was higher in the surgical group (12.1 years) compared with the conservative group (7.7 years). Although surgical decision-making is primarily guided by displacement severity, soft-tissue status, and stability of the acromioclavicular and coracoclavicular ligaments, age may indirectly influence management. Older children often sustain higher-energy injuries, resulting in more displaced fracture

patterns that more readily fit established surgical indications. Consequently, the tendency toward operative management increases with age, which may explain the distribution observed in our study.

Male patients were in the majority and had a higher rate of surgical intervention compared to female patients, although this was not statistically significant. This may suggest that male sex could be a risk factor for both fracture occurrence and surgery. Displacement and shortening were higher in surgically treated patients, although not significantly. Although clear surgical indications have not been established for lateral clavicle fractures in the pediatric population, a greater degree of displacement and shortening tends to increase the likelihood of choosing operative management, similar to the approach used in adult patients. The experience gained from adult cases has therefore served as a guiding reference in the surgical decision-making process for these injuries.

Functional outcomes, as measured by quality of life scores, were similar between groups once healing was complete. All patients regained full range of motion. This also suggests that treatment decisions informed by experience from adult patients can lead to successful outcomes in the pediatric age group as well.

Nenopoulos et al. [5], who proposed a classification system for distal clavicle fractures, also reported excellent functional outcomes regardless of the treatment method. However, there is limited literature evaluating patient-reported clinical outcomes

in this population. The only study we identified that specifically assessed distal clavicle fractures using such measures was conducted by Liebs et al. [11], who reported excellent Quick-DASH and Peds-QL scores in their cohort, in which all but one patient were treated conservatively.

Our study provides valuable information as it includes a relatively high proportion of surgically treated patients and evaluates both radiological and functional outcomes. Furthermore, it is one of the few studies in which the number of surgical cases is higher, and patient-reported functional and satisfaction outcomes are assessed.

While not statistically significant, overall satisfaction was higher in the non-surgical group. Additionally, cosmetic satisfaction was significantly greater in the conservative treatment group ($p < 0.05$). Younger patients who underwent surgery tended to report lower cosmetic satisfaction. The lower cosmetic satisfaction observed in the surgical group may be attributed to the fact that these patients were generally older, leading to reduced remodeling capacity and more noticeable residual asymmetry, which likely contributed to decreased satisfaction. However, when considering the functional and radiological improvements achieved with surgery, it is advisable to inform appropriate candidates about these potential cosmetic drawbacks during the decision-making process.

We did not encounter any true acromioclavicular dislocations, a subtype reported in the Nenopoulos classification. This aligns with other studies that report such injuries as rare in the pediatric population [12,13].

We acknowledge several limitations. The study was single-center, retrospective, and involved a relatively small sample size. However, our institution serves a large population, and since treatment was completed before clinical assessments were performed, the risk of bias is minimal. Radiographs used for measurement were taken at presentation and during follow-up. Measurements were performed prior to clinical evaluation, minimizing observer bias.

The most important limitation of this study is the short follow-up duration. With a mean of 8.6 weeks, our data primarily reflect early clinical and radiographic outcomes, and do not allow for a robust assessment of long-term functional or cosmetic results. Given the remodeling potential of pediatric clavicle fractures, longer observation would be necessary to fully determine late deformity, cosmetic appearance, and shoulder function.

Another important limitation of this study is the small sample size ($n=16$), which reduces the statistical power and may limit the ability to detect subtle differences between treatment groups. This constraint reflects the rarity of displaced lateral clavicle fractures in the pediatric population but nonetheless restricts the generalizability of the results. Future research with larger cohorts, ideally through multicenter collaborations, is

necessary to validate and expand upon the findings presented in this study.

The cosmetic satisfaction survey used in this study represents a subjective patient-reported measure and may not fully reflect objective cosmetic outcomes. This subjectivity may introduce response bias and limit the precision of cosmetic evaluation. Future studies would benefit from incorporating objective assessment methods—such as standardized photographic scoring systems, validated cosmetic scales, or evaluations performed by independent observers—to provide a more comprehensive and reproducible assessment of cosmetic results.

Conclusion

In conclusion, lateral clavicle fractures are a rare type of pediatric fracture. Excellent outcomes can be achieved with conservative treatment, and surgical treatment in appropriately selected cases can also yield similarly favorable results.

Ethical Approval

Approved by the Institutional Ethics Committee Ümraniye Training and Research Hospital (No: B.10.1.TKH.4.34.H.GP.0.01/187, Date: 19 June 2025).

Patient Consent

Informed consent was waived due to the retrospective design.

Conflict of Interest

The authors declare no conflict of interest.

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