

Evaluation of Screw Fixation for Lateral Condyle Fracture of the Humerus in Children

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Abstract

Original Research Article

Background: Lateral condyle fractures of the distal humerus are among the most common pediatric elbow injuries and require precise management to prevent long-term complications. Although Kirschner wire fixation is widely used, cannulated screw fixation provides interfragmentary compression, which may enhance fracture stability and promote early union. This study aimed to evaluate the clinical and radiological outcomes of screw fixation in displaced lateral condyle fractures in children. **Methods:** This prospective quasi-experimental study included 59 pediatric patients with displaced Milch type II lateral condyle fractures treated between January 2016 and December 2023 at a tertiary care center. All patients underwent open reduction and internal fixation using a 4.0 mm partially threaded cannulated cancellous screw. Patients were followed up for a minimum of 48 weeks. Outcomes were assessed clinically and radiologically, and functional results were evaluated using Hardacre criteria. Data were analyzed using descriptive statistics with 95% confidence intervals. **Results:** All fractures achieved union (100%), with a mean time to consolidation of 8.11 ± 1.08 weeks. The overall complication rate was 11.29%. The mean loss of elbow extension was $2.89^\circ \pm 3.4^\circ$, and flexion loss was $2.67^\circ \pm 1.9^\circ$. Satisfactory functional outcomes (excellent and good) were observed in 94.91% of cases. **Conclusion:** Screw fixation represents a promising treatment modality for displaced lateral condyle fractures of the humerus in children, demonstrating satisfactory fracture union, maintenance of reduction, and good functional recovery. The method provides adequate interfragmentary compression and allows early mobilization with an acceptable complication profile. Nevertheless, further prospective comparative studies are warranted to clarify its advantages over other established fixation techniques.

Keywords: Lateral condyle fracture, Distal humerus fracture, Screw fixation, Open reduction and internal fixation, Pediatric elbow fracture.

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INTRODUCTION

Lateral condyle fractures of the distal humerus represent the second most common elbow fracture in children and involve the articular surface, making accurate reduction essential [1]. These injuries involve the capitellum, the lateral portion of the trochlea, and the distal humeral metaphysis, including the physal plate [2]. These fractures commonly result from a fall onto an outstretched hand and, if inadequately treated, may lead to complications including nonunion, malunion, avascular necrosis, and residual deformity. Restoration

of anatomical alignment, secure fracture fixation, and initiation of early joint mobilization are considered the cornerstone principles for achieving satisfactory clinical and functional outcomes [3].

Various classification systems, including Milch and Jakob classifications, are used to guide treatment decisions. In Milch type I fractures, the fracture line passes through the capitello-trochlear groove, while in type II it extends through the trochlea. According to the Jakob classification, type I fractures are nondisplaced,

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type II fractures are displaced without rotation, and type III fractures are displaced with rotational deformity [4,5,6]. Management is guided by the extent of fracture displacement. Undisplaced and minimally displaced fractures are typically managed non-operatively with immobilization and careful radiographic follow-up, especially within the initial two weeks when the risk of secondary displacement is highest. Conversely, fractures demonstrating more than 2 mm of displacement usually warrant surgical fixation. Kirschner wire fixation has traditionally been the preferred method due to its technical simplicity; however, it carries potential drawbacks, including pin tract infection, loss of reduction, and the need for extended immobilization. In comparison, cannulated screw fixation provides interfragmentary compression, resulting in enhanced stability and facilitating earlier fracture union and mobilization [7,8,9,10]. Delayed presentation or neglected injuries especially those managed beyond two weeks after the initial trauma are frequently linked to inferior clinical outcomes. This is largely attributable to progressive fragment displacement, early physeal arrest, compromised vascularity, and the development of fibrosis and callus, all of which contribute to joint stiffness and functional limitation [11].

Despite these theoretical advantages, there remains limited prospective data evaluating its effectiveness in comparison to conventional methods.

This study was conducted to assess the clinical and radiological outcomes of open reduction and screw fixation in displaced Milch type II lateral condyle fractures in children.

MATERIALS AND METHODS

Study Design and Setting

This prospective quasi-experimental study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, from January 2016 to December 2023. Ethical approval was obtained from the institutional review board (IRB No: NITOR/ACADEMY/IRB/2016/04), and the study adhered to ethical standards.

Patient Selection

A total of 59 pediatric patients aged 3–13 years with closed, displaced Milch type II lateral condyle fractures presenting within two weeks of injury were included.

Inclusion criteria:

- Age 3–13 years
- Displaced Milch type II fractures
- Presentation within 14 days

Exclusion criteria:

- Open fractures
- Pathological fractures
- Infected injuries
- Delayed presentation (>14 days)

Surgical Technique

All patients underwent open reduction through a standard lateral approach. Anatomical reduction was achieved, followed by fixation using a 4.0 mm partially threaded cannulated cancellous screw placed perpendicular to the fracture plane to achieve compression.

Follow-Up and Outcome Measures

Patients were followed up at 1, 2, 4, 8, 12, 24, 36, and 48 weeks postoperatively.

Outcomes assessed included:

- Time to fracture union
- Range of motion
- Carrying angle
- Complications
- Functional outcome using Hardacre criteria

Radiological assessment included fracture union and Baumann's angle measurement.

Statistical Analysis

Data were analyzed using descriptive statistics. Continuous variables such as age (years), duration of fracture union(weeks), range of motion (degrees) were expressed as mean \pm standard deviation, and categorical variables as sex (male/female), functional outcome (excellent/good/fair/poor) and presence of complications were presented as percentages. Functional outcomes were reported with 95% confidence intervals.

RESULTS

A total of 59 patients completed follow-up. The mean age was 7.11 ± 2.34 years, with a male predominance (66.11%). Left-sided injuries were more common (64.40%).

Table 1 showing demographic data.

Table 1: Demographic Data

Variable	Value
Total Patient	59
Mean age	7.11 \pm 2.34
Male	64.40%
Female	35.59%
Left side	64.40%
Right side	35.60%

Mechanism of Injury

The most common mechanism was fall during play (33.89%), followed by fall from height (28.11%),

bicycle-related falls (23.72%), and falls from bed (13.55%).

Surgical Timing

The mean interval from injury to surgery was 9.23 ± 1.71 days.

Fracture Union

All fractures united (100%), with a mean time to union of 8.11 ± 1.08 weeks.

Functional Outcomes

- Excellent: 59.32%
- Good: 35.59%
- Poor: 5.08%

Overall satisfactory outcomes: **94.91%**.
Table- 2 showing functional outcome.

Table- 2: Functional outcome

Outcome	Value
Union rate	100%
Mean union time	8.11weeks
Excellent	59.32%
Good	35.59%
Poor	5.08%

Range of Motion

- Mean extension loss: $2.89^\circ \pm 3.4^\circ$
- Mean flexion loss: $2.67^\circ \pm 1.9^\circ$

Carrying Angle

- No change: 35 patients
- Mild (inconspicuous): 21 patients
- Significant deformity: 3 patients

Complications

- Lateral prominence: 38.98%
- Elbow stiffness: 5.08%
- Myositis ossificans: 1.69%

Figures 1-3 are case illustrations showing a preoperative AP/lateral X-ray, Immediate postoperative fixation image and Union at follow-up.



Fig- 1: preoperative AP/lateral X-ray of fracture lateral condyle

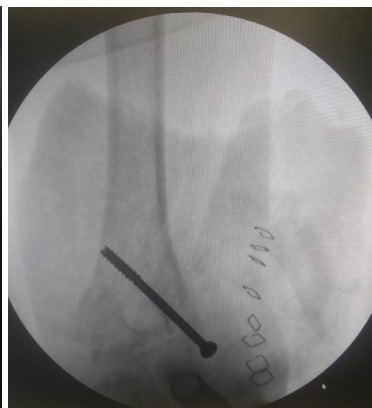


Fig- 2: postoperative fixation image



Fig- 3: Union of fracture at follow-up

Figure 4-6 showing Clinical range of motion at final follow up.



Fig- 4: Extension



Fig- 5: Flexion



Fig- 6: Extension

DISCUSSION

The management of displaced lateral condyle fractures in children remains a topic of ongoing discussion, particularly regarding the optimal fixation method. In this study, screw fixation demonstrated excellent union rates and favorable functional outcomes.

The findings demonstrated a higher incidence among boys and within the first decade of life, which is consistent with previously reported literature. The predominance of injury in this age group may be attributed to increased physical activity and relative skeletal immaturity [12,13]. Left-sided injuries were observed more frequently, possibly reflecting the natural tendency for individuals to protect or preferentially use the dominant upper limb during activities, thereby exposing the non-dominant extremity to a higher risk of trauma. Similar observations have been documented in previous studies [14,15]. Most fractures occurred during play and sports-related activities, with a noticeable rise in incidence during the summer vacation period when children are typically more physically active. This seasonal and activity-related pattern is consistent with findings reported in previous series [16]. The average time from injury to surgery in this study was within an acceptable range, and early intervention likely contributed to favorable outcomes. Previous studies have emphasized that delayed surgical management beyond two to three weeks is associated with poorer results due to soft tissue changes and difficulty in achieving anatomical reduction [17-19]. The achievement of fracture union in all patients in the present series is in agreement with previously published studies and underscores the reliability of screw fixation in providing stable interfragmentary compression at the fracture site. The average union time of 8.11 weeks was also comparable to that reported in earlier literature, indicating that this method promotes effective and timely bone healing.

Functional recovery was promising in the majority of patients, with more than 94% demonstrating excellent to good outcomes. Preservation of elbow range of motion along with the low incidence of angular

deformity further emphasizes the efficacy of screw fixation in restoring both anatomical alignment and satisfactory elbow function [13,15,20]. Lateral prominence was the most common complication but did not significantly affect functional outcomes. The low incidence of stiffness and other complications suggests that this method is relatively safe when performed appropriately [21].

Compared to Kirschner wire fixation, screw fixation may provide biomechanical advantages, including improved stability and reduced risk of loss of reduction. However, the absence of a comparative group in this study limits definitive conclusions regarding superiority.

LIMITATIONS

This study has several limitations. It was conducted at a single center with a relatively small sample size, which may limit generalizability. The absence of a control group prevents direct comparison with other fixation methods. Additionally, the follow-up period, although adequate for short-term outcomes, may not capture long-term complications such as growth disturbances or late deformities. Observer bias in functional assessment may also be present.

CONCLUSIONS

Open reduction and internal fixation using a partially threaded cannulated cancellous screw is an effective treatment for displaced lateral condyle fractures of the humerus in children. It provides stable fixation, promotes early union, and results in excellent functional outcomes. While these findings support its clinical use, further comparative studies are necessary to determine its superiority over traditional fixation methods.

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