RESEARCH PAPER

Functional Outcomes Following Lateral Closing Wedge Osteotomy for Cubitus Varus Deformity: A Case Series

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ABSTRACT

Background: Cubitus varus deformity is the most common late complication of supracondylar humeral fractures in children, often associated with cosmetic and functional impairment. Corrective osteotomy remains the gold standard, with lateral closing wedge osteotomy widely practised for its simplicity and stability.

Aim: To evaluate the functional outcomes, radiological correction, and union time following lateral closing wedge osteotomy for cubitus varus deformity in children.

Methods: This prospective case series included 10 paediatric patients (mean age 10 years) who underwent lateral closing wedge osteotomy with fixation using cortical screws, tension band wiring, and supplementary K-wires and plates. Outcomes were assessed radiologically and functionally using Morrey's criteria over a mean follow-up of 2.5 years.

Results: The mean preoperative varus carrying angle of 20.3° was corrected to 11.0° valgus immediately postoperatively and maintained at 12 weeks without loss of correction. Radiological union was achieved at a mean of 6.7 weeks, with return to normal activity between 9–12 weeks. Functionally, 70% of patients achieved excellent outcomes and 30% good outcomes, with no fair or poor results.

Conclusion: Lateral closing wedge osteotomy provides predictable correction, rapid union, and excellent functional recovery in paediatric cubitus varus deformity. Despite advances in 3D-assisted techniques, conventional osteotomy remains highly effective and relevant, particularly in resource-limited settings.

Keywords: Cubitus varus deformity, Lateral closing wedge osteotomy, Pediatric elbow deformity, Corrective osteotomy outcomes, Morrey's criteria, Radiological union

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INTRODUCTION

Cubitus varus deformity, often referred to as the "gunstock deformity," is the most common late complication following supracondylar fractures of the humerus in children.[1] It typically arises due to malunion, growth disturbances, or rotational malalignment of the distal humerus. The deformity is characterised by varus angulation in the coronal plane, hyperextension in the sagittal plane, and internal rotation in the axial plane.[2] Although traditionally considered a cosmetic problem, cubitus varus has important functional implications. Patients may develop lateral condyle fractures, posterolateral rotatory instability, tardy ulnar nerve palsy, and long-term degenerative changes in the elbow joint.[3]

Corrective osteotomy remains the gold standard for management. Several techniques have been described, including medial opening wedge, dome, step-cut, and lateral closing wedge osteotomies.[4] Among these, the lateral closing wedge osteotomy is widely accepted because of its simplicity, reproducibility, and ability to provide stable fixation. However, the procedure's success depends not only on osteotomy design but also on fixation stability, which helps maintain correction and promotes early union.

Recent advances in surgical planning have introduced three-dimensional (3D) simulation and patient-specific instruments (PSI). These innovations allow surgeons to visualise deformities in multiple planes and perform precise intraoperative corrections. Studies show that 3D-guided osteotomies achieve superior accuracy in restoring the carrying angle and rotational alignment compared with conventional methods.[5,6] Furthermore, patient-specific 3D-printed osteotomy guides have been reported to reduce operative time, minimise intraoperative errors, and improve cosmetic outcomes.[7] Despite these advances, conventional lateral closing wedge osteotomy continues to be widely practised, especially in resource-limited settings, and has consistently demonstrated reliable correction and excellent functional outcomes.[8]

This case series evaluates the functional outcomes of lateral closing wedge osteotomy in paediatric patients with cubitus varus deformity. Emphasis is placed on radiological correction, union time, and functional recovery assessed using Morrey's criteria. By comparing our findings with recent literature, we aim to evaluate the functional outcomes, radiological correction, and union time following lateral closing wedge osteotomy for cubitus varus deformity in children.

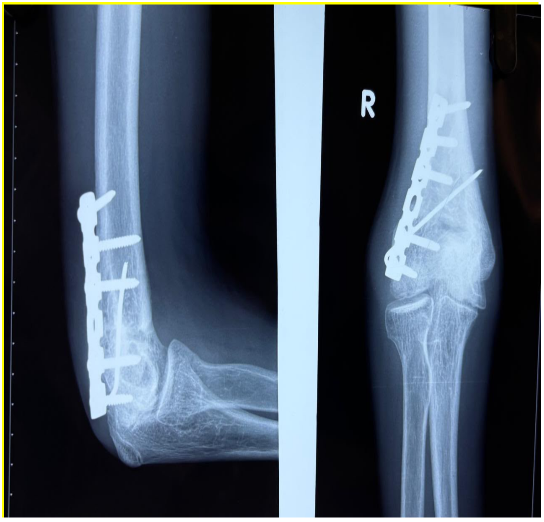
MATERIALS AND METHODS

Study Design and Patients

This prospective study included patients presenting with cubitus varus deformity following supracondylar fracture of the humerus. A total of 10 cases were operated on between February 2024 and June 2026. Of these, 6 were male, and 4 were female. The mean age at corrective surgery was 10.00 ± 1.62 years (range: 8.0 –12.0 years). Patients were selected for surgery if they had a varus carrying angle greater than 10° on radiographs, associated cosmetic concerns, or functional limitations. Younger children were observed for at least six months to confirm that the deformity was static before surgical correction was undertaken.

(a)

(b)



(C)

Figure 1: Anteroposterior radiograph — (a) Preoperative image demonstrating cubitus varus deformity. (b) Immediate postoperative image showing maintained correction with restoration of normal valgus alignment (c) Three months postoperative image showing maintained correction with restoration of normal valgus alignment.

Figure 2: Clinical image demonstrating
Figure 3: Photograph showing satisfactory
successful correction of the right elbow
postoperative elbow mobility
deformity

Preoperative Assessment

Clinical evaluation included measurement of the carrying angle of both elbows, range of motion, and comparison with the contralateral side. Standard anteroposterior and lateral radiographs were obtained for templating and calculation of the wedge size required for correction. The Humerus-Elbow-Wrist Angle (HEWA) was used to quantify deformity. Preoperative templating determined the wedge length and the osteotomy angle.

Operative Technique

Under general anaesthesia, patients were positioned laterally with the elbow supported on an armrest table. A posterolateral incision was made, and the lateral third to half of the triceps was reflected from its insertion. The preoperative template was used to mark the osteotomy site. The desired correction was calculated by adding the difference in HEWA between the affected and normal elbows to the normal valgus angle.

Two Kirschner wires were inserted parallel to the proposed osteotomy site, one proximally and one distally, to guide alignment. After wedge removal, cortical screws were placed proximally and distally, parallel to the K-wires. Fixation was secured with a figure-of-eight tension band wire looped around the screws or internal plate, as done in some cases. To enhance stability, two additional K-wires were passed from the lateral condyle across the osteotomy site into the proximal medial cortex. The wound was closed, and an above-elbow plaster slab was applied. Stitches were removed after 10–12 days.

Postoperative Care and Follow-up

Radiographs were obtained at 1, 3, 6, and 12 months to assess maintenance of correction and union. Functional outcomes were evaluated using Morrey's criteria, which assess pain, stability, motion, and strength. Cases were followed from February 2024 to June 2026.

RESULTS

In this case series, the baseline demographic and deformity profile highlights a typical Pediatric population affected by cubitus varus. We included 10 patients, with a slight male predominance (60% male, 40% female) and a mean age of 10 years at the time of corrective surgery (8-12 years). The preoperative deformity was substantial, with the affected elbow showing a mean carrying angle of 20.3° in varus compared to 13.5° of valgus on the normal side. This discrepancy resulted in a total angular deformity averaging 33.8°, underscoring the severity of malalignment and the need for surgical correction (Table 1).

Table 1: Demographic and baseline characteristics

Variable	n (%)	Mean ± SD	Range
Sample			
Total patients	10 (100%)	—	—
Male	6 (60%)	—	—
Female	4 (40%)	—	—
Age (years)			
Age at corrective surgery	—	10.00 ± 1.62	8.0 – 12.0
Preoperative deformity			
Carrying angle — affected side (°)	—	20.30 ± 2.11	18 – 24
Carrying angle — normal side (°)	—	13.50 ± 1.35	12 – 16

Variable	n (%)	Mean ± SD	Range
Total angular deformity (°)	—	33.80 ± 2.49	30 – 38

Table 2 shows that, in this series, radiological outcomes demonstrated that corrective osteotomy achieved stable, lasting correction of the deformity. The mean preoperative carrying angle was 20.3° in varus, which improved immediately postoperatively to 11.0° in valgus and remained at 14.5° at 12 weeks, indicating no loss of correction over time ($p < 0.001$). The normal side valgus averaged 13.5°, and at 12 weeks the operated side differed by only +1.0° (±1.89), a variation that was not statistically significant ($p = 0.10$), indicating near-symmetry with the contralateral elbow. Importantly, there was no measurable loss of correction between the immediate and 12-week postoperative assessments (0.00°, $p = 1.00$). Total correction was substantial, averaging 34.8° (±1.55) and highly significant ($p < 0.001$).

Table 2: Radiological outcomes and angular correction

Measurement	Preoperative	Immediate postop	12-week postop	p-value
Carrying angle, mean ± SD (°)	20.30 ± 2.11 (varus)	14.41 ± 1.65 (valgus)	14.50 ± 1.65 (valgus)	<0.001*
Normal-side valgus, mean ± SD (°)	13.50 ± 1.35			—
Difference from normal side at 12 weeks (°)	—	—	+1.00 ± 1.89	0.10
Loss of correction (immediate → 12 wk)	—	—	0.00 °	1.00
Total correction achieved (°)	—	—	34.80 ± 1.55	<0.001*

Functional outcomes assessed using Morrey's criteria showed consistently positive results throughout the series. Of the 10 patients, 7 (70%) achieved an excellent outcome, while the remaining 3 (30%) achieved a good outcome. Importantly, no patient fell into the fair or poor categories, indicating that all children benefited meaningfully from corrective osteotomy. The confidence intervals (35–93% for excellent and 7–65% for good) reflect the small sample size but still demonstrate a strong trend toward favourable recovery. When excellent and good outcomes were combined, the success rate reached 100%, underscoring that the procedure reliably restored elbow function and provided satisfactory cosmetic correction in every case (Table 3).

Table 3: Functional outcomes by Morrey criteria

Outcome	n	%	95% CI
Excellent	7	70%	35% – 93%
Good	3	30%	7% – 65%
Fair	0	0%	—
Poor	0	0%	—
Excellent + Good (combined)	10	100%	—

Time-to-event outcomes in this series highlight the efficiency of healing and recovery following corrective osteotomy. Radiological union was achieved rapidly, with a mean of 6.7 weeks (±0.86), a median of 6.5 weeks, and a range of 5.5 to 8 weeks, indicating consistent and predictable bone healing across patients. Return to normal activity was observed between 9 and 12 weeks, reflecting functional restoration following radiological union (Table 4).

Table 4: Time-to-event outcomes

Outcome	Mean ± SD	Median	Range
Radiological union (weeks)	6.70 ± 0.86	6.5	5.5 – 8.0
Return to normal activity (weeks)	9–12*	—	—

Estimated calculation

Table 5 provides detailed case-by-case clinical outcomes, illustrating the consistency and reliability of corrective osteotomy in this series. The patients ranged in age from 8 to 12 years, with a balanced distribution of both sexes. Preoperative varus deformities varied between 18° and 24°, while the normal contralateral carrying angles ranged from 12° to 15°. Immediate postoperative correction successfully restored the carrying angle to a valgus alignment (12°–16°), which was maintained at 12 weeks without loss of correction. Flexion improved in most cases, with postoperative ranges of 140–150°, indicating restoration of functional mobility. Radiological union was achieved within 5.5 to 8 weeks, demonstrating predictable healing across the cohort. At the time of union, carrying angles closely matched the normal side, confirming durable correction. Functionally, 7 patients achieved excellent outcomes, and 3 were graded as good, with no fair or poor results.

Table 5: The clinical details of patients

Case	Age (year)	Sex	Carrying angle (degree)		Carrying angle (degree)		Flexion (degree)		Duration of union (wks)	Carrying angle at the time of union	Results
			Preop clinical varus angle	Preop carrying angle of the normal elbow	Immediate postop (degree)	At 12 weeks (follow-up)	Preop	Postop (12 weeks)			
1	8	M	19	15	16	16	5–140	0–140	6	16	Excellent
2	9	F	24	14	14	14	0–120	0–130	8	14	Excellent
3	12	M	21	12	13	13	0–121	0–129	6	13	Excellent
4	8.5	F	20	12	13	13	0–119	0–132	6.5	13	Excellent
5	8.5	F	23	14	12	12	0–118	0–131	6	12	Excellent

Case	Age (year)	Sex	Carrying angle (degree)		Carrying angle (degree)		Flexion (degree)		Duration of union (wks)	Carrying angle at the time of union	Results
			Preop clinical varus angle	Preop carrying angle of the normal elbow	Immediate postop (degree)	At 12 weeks (follow-up)	Preop	Postop (12 weeks)			
6	9	M	18	13	16	16	0–135	0–138	7	16	Good
7	12	M	18	16	16	16	0–134	0–140	5.5	16	Good
8	10	M	21	14	13	13	5–120	0–140	7	13	Excellent
9	12	F	18	12	16	16	0–125	0–140	7	16	Good
10	11	M	21	13	16	16	0–145	0–150	8	16	Excellent

DISCUSSION

This case series highlights the effectiveness of lateral closing wedge osteotomy in correcting cubitus varus deformity among paediatric patients. All children achieved either excellent or good outcomes, with no cases of poor or fair recovery. The 100% success rate underscores the technique's reproducibility and its ability to restore both cosmetic alignment and functional mobility. Prior literature reports comparable findings, with corrective osteotomy consistently producing satisfactory outcomes and minimal complications.[9]

Radiological correction in our cohort was both substantial and durable. The mean preoperative varus carrying angle of 20.3° was corrected to a valgus alignment of 11.0°, which was maintained at 12 weeks without measurable loss of correction. Secure fixation with cortical screws, tension band wiring, supplementary K-wires, and a lateral plate contributed to this stability. Similar fixation strategies have been shown to prevent deformity recurrence and promote early union.[10] In our series, union was achieved within a mean of 6.7 weeks, aligning with reports of predictable healing times following osteotomy.[11]

Functional recovery was equally encouraging. Using Morrey's criteria, 70% of patients achieved excellent outcomes and 30% good outcomes, with flexion restored to 129–150° at 12 weeks. These results align with studies showing that corrective osteotomy reliably restores elbow function and allows return to normal activity within three months.[12] Importantly, no complications such as nonunion, nerve palsy, or loss of correction were observed, reinforcing the safety of this approach.

Recent innovations in surgical planning, particularly three-dimensional (3D) simulation and patient-specific instruments, have demonstrated superior accuracy in restoring carrying angles and rotational alignment.[5,6,] Meta-analyses confirm that 3D-printed guides improve precision and reduce operative time.[13] However, their availability remains limited in resource-constrained settings. In contrast, conventional lateral closing wedge osteotomy requires minimal instrumentation, is technically straightforward, and continues to deliver excellent outcomes, as evidenced by this series. Thus, while 3D-guided osteotomies may represent the future of deformity correction, conventional methods remain highly relevant and practical in routine practice.

The strengths of this study include a prospective design, a uniform surgical technique, and consistent follow-up. Limitations include the small sample size and relatively short follow-up period, which restrict generalisability and preclude assessment of late complications, such as degenerative changes. Future multicentre studies comparing conventional osteotomy with 3D-assisted techniques could provide valuable insights into the relative merits of each approach.

Limitations

- **Sample size:** The study included only 10 patients, limiting generalisability.
- **Follow-up duration:** The mean follow-up of 2.5 years may not capture late complications such as degenerative changes or tardy ulnar nerve palsy.
- **Single technique:** Only lateral closing wedge osteotomy was evaluated; comparative outcomes with dome or 3D-assisted osteotomies were not assessed.
- **Resource setting:** Findings reflect outcomes in a conventional surgical setting and may differ in centres using advanced 3D simulation or patient-specific instruments.

CONCLUSION

This case series demonstrates that lateral closing wedge osteotomy is a reliable and reproducible technique for correcting cubitus varus deformity in children. The procedure achieved durable radiological correction, rapid union within 6–8 weeks, and excellent functional recovery in all cases. While modern 3D-assisted approaches offer enhanced precision, conventional osteotomy continues to provide excellent outcomes and remains the gold standard in many clinical environments. Larger multicentre studies comparing conventional and 3D-guided techniques are warranted to further refine surgical strategies.

REFERENCES

1. Ghoti SD, Shetty RS, Das J, Jawale SA, Shisode DP, Rathod AS. Oblique Lateral Closing-Wedge Osteotomy for Cubitus Varus in Skeletally Immature Children: A Case Series. J Orthop Case Rep. 2026;16(5):502-8.
2. Bhowmik D. Correction of cubitus varus deformity in an adolescent using lateral closing wedge osteotomy with reconstruction plate fixation: a case report. Int J Multidiscip Res. 2025;8(2):1-3.
3. Garg S, Meena N, Rathore KS. Effectiveness of lateral closing wedge osteotomy fixed with a reconstruction plate as a Treatment Approach for Cubitus Varus. Int J Pharm Clin Res. 2023;15(10):943-7.
4. Srivastava AK, Srivastava D, Gaur S. Lateral closed wedge osteotomy for cubitus varus deformity. Indian J Orthop. 2008;42(4):466-70.
5. Oka K, Miyamura S, Shiode R, Kazui A, Iwahashi T, Tanaka H, et al. Three-dimensional corrective osteotomy for cubitus varus deformity using patient-matched instruments. JSES Int. 2024;8(3):646-53.
6. Zhang MR, Zeng X, Guo JL, Zhao K, Hu JH, Guan JH. Three-dimensional correction of cubitus varus deformity using patient-specific 3D-printed osteotomy guides. Front Surg. 2026;13:1804208.
7. Yang Y, Kao H. 3D-printed patient-specific instruments for corrective osteotomy in paediatric cubitus varus deformity. Orthop Procs. 2025;107-B(SUPP_7):51-51.
8. Liu J, He Y, Shi Q, Wang Y. Locking plate versus K-wires and cast fixation in lateral closing-wedge osteotomy for cubitus varus deformity. Front Pediatr. 2024;12:1344283.
9. Mulders MA, d'Ailly PN, Cleffken BI, Schep NW. Corrective osteotomy is an effective method of treating distal radius malunions with good long-term functional results. Injury. 2017;48(3):731-7.
10. Bowers KM, Anderson DE. Delayed Union and Nonunion: Current Concepts, Prevention, and Correction: A Review. Bioengineering (Basel). 2024;11(6):525.
11. Khan MZH, Das KP, Islam MA, Sarker MHR, Sidny NZ. Management of cubitus varus deformity by three-dimensional osteotomy: analysis of outcome. Int J Res Orthop. 2024;10(6):1126-30.
12. Gong HS, Chung MS, Oh JH, Cho HE, Baek GH. Oblique closing wedge osteotomy and lateral plating for cubitus varus in adults. Clin Orthop Relat Res. 2008;466(4):899-906.
13. Salkhori O, Bagheri N, Khabiri SS, Arabzadeh A, Kalantar SH, Poorghasem E, et al. Efficacy of 3D-printed surgical guides in the correction of pediatric cubitus varus deformity: a systematic review and meta-analysis. JSES Int. 2025;10(2):101604.