

Effectiveness of the Lateral Closing Wedge (LCW) Osteotomy Fixed with a Reconstruction Plate as a Treatment Approach for Cubitus VarusSandeep Garg¹, Nitesh Meena², Khushwant Singh Rathore³¹Associate Professor, Department of Orthopedics, NIMS&R, Jaipur^{2,3}Assistant Professor, Department of Orthopedics, NIMS&R, Jaipur

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Conflict of interest: Nil

Abstract:

Background: Most common long-term issue associated with pediatric supracondylar humerus fractures is cubitus varus deformity. While cubitus varus is often seen as a cosmetic concern, it can also lead to posterolateral instability, an increased risk of subsequent fractures, tardy ulnar nerve palsy, and a snapping elbow. Various surgical methods, osteotomy configurations, and fixation techniques have been detailed in the literature. In our opinion, the lateral closing wedge (LCW) osteotomy, fixed with a reconstruction plate, yields the best results and is often sufficient for the treatment of most cubitus varus cases. Plate fixation facilitates early rehabilitation, with elbow mobilization starting as early as the second day post-surgery.

Objectives: Evaluating the effectiveness of the lateral closing wedge (LCW) osteotomy fixed with a reconstruction plate as a treatment approach for cubitus varus, aiming to enable early rehabilitation.

Methods: In a study at NIMS Hospital, Jaipur, from June 2017 to December 2021, 19 children (both genders) with cubitus varus deformity, aged 9 to 14 years (average age: 11.5 years), underwent Lateral closing wedge (LCW) osteotomy with reconstruction plate fixation after comprehensive pre-operative assessments. Post-surgery, X-rays determined the carrying angle. Follow-up after bone union included assessment of clinical, functional, and radiological outcomes.

Results: Mean follow-up: 2.5 years (range: 15 months to 3.5 years). Broberg and Morrey rating system assessed the results: 17 excellent, 2 good, 89% had improved or maintained motion. All patients achieved union within 8 weeks.

Conclusion: Lateral closing wedge osteotomy effectively corrects deformities; proper stabilization reduces complications and aids early rehabilitation.

Keywords: Cubitus Varus, Lateral Closing Wedge Osteotomy, Reconstruction Plate, Carrying Angle.

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Introduction

Cubitus varus is a condition characterized by the abnormal angulation of the forearm, resulting in the affected individual presenting with an inward deviation of the elbow. Cubitus varus typically occurs in children aged 2 to 14 years. It is more commonly seen in boys than girls, with a male-to-female ratio of approximately 3:1. This gender difference may be due to differences in activity levels and the types of injuries that boys and girls are more likely to experience. [1] The primary cause of cubitus varus is a malunion of a supracondylar fracture of the humerus. This condition evolves due to a three-dimensional misalignment of the fracture, characterized by distal fracture fragment angulating inward in the coronal plane, an extension in the sagittal plane, and an internal rotation in the axial plane. Other potential causes include congenital abnormalities, metabolic disorders, or certain genetic conditions,

but these are much rarer. Although it is considered as a purely cosmetic problem in children, it can occasionally cause late-onset pain in lateral elbow, symptomatic elbow posterolateral rotatory instability (PLRI), triceps tendon snapping, progressive varus of ulnar bone and elbow joint, ulnar neuropathy, and rarely, predispose to lateral humeral condyle fractures. [2,3,4] Therefore, recognizing and addressing cubitus varus is not only important for cosmetic reasons but also for preserving the individual's long-term health and quality of life. Various treatment options are observation, hemi-epiphysiodesis and growth modulation, and corrective osteotomy. Corrective osteotomy is the preferred method, as it yields the highest probability for success. [5] Numerous osteotomy techniques have been described in literature which popularly includes lateral closing wedge osteotomy, step cut osteotomy, dome

osteotomy and multiplanar osteotomy. [6,7,8,9] Lateral closing wedge osteotomy is a commonly accepted technique. The fixation of osteotomy is needed to prevent loss of correction achieved. The conflict lies in choosing the fixation method which is most stable with minimum complications [10]. The two screws and a wire figure of eight tension band, parallel configuration pinning, crossed configuration pinning, staples, external fixation and plate fixation are described in the literature. [11] A commonly encountered issue with pinning is loss of fixation and thus loss of correction. This study was done to evaluate the results of the effectiveness of the lateral closed wedge (LCW) osteotomy fixed with a reconstruction plate as a treatment approach, aiming to enable early rehabilitation.

Methods

This observational study was done at the Department of Orthopedics, NIMS Hospital, Jaipur. Nineteen children, 10 males, nine females, with cubitus varus deformity were operated between June 2017 and December 2021. Clinical evaluation included carrying angle measurement of both affected and unaffected side, and range of motion measurement of affected side. Standard large film full upper limb radiographs in true anteroposterior and lateral projections of the affected and unaffected sides were used to assess deformities and osteotomy templating in every case. The desired correction was calculated by comparing the humero-ulnar angles of both elbows and adding the normal valgus angle of a healthy elbow. Radiologically, the humero-ulnar varus angle of more than 10 degrees served as indication for surgery. The corrective procedure involved a lateral closing wedge osteotomy and fixation using a Reconstruction Plate.

Surgical Technique

Under standard aseptic precautions and administering appropriate anesthesia, a tourniquet was applied as high as possible on the arm. The patient was positioned in a supine manner with the arm resting on a hand table. A direct lateral approach cantering over lateral supracondylar ridge skin incision was used. Plane was made between the flexor and extensor muscles; periosteum was incised and lifted along with muscles exposing the distal metaphysis of humerus. The precise osteotomy location on the humerus was determined using a template, which indicated the length and angle of the lateral wedge.

Two K-wires were inserted parallel to the planned osteotomy site, one proximally and one distally. Using a C-arm for guidance, the measured wedge was removed leaving intact the medial hinge. The bone fragments were aligned with the assistance of the pre-placed K-wires, as opposed to attempting alignment by manipulating the forearm, which may not provide controlled force at the fracture site and could lead to a break in the medial cortical hinge, potentially resulting in fixation instability. The fixation was secured using a Reconstruction plate with 2-3 proximal and 2-3 distal screws, ensuring the proper alignment of the osteotomy, which was also clinically compared to the other fully extended elbow. The incision was closed, and no cast was applied. Elbow mobilization began the following day. Stitches were removed 12-14 days after the operation. Postoperative clinical and radiographic follow-up was at 1,3,6 and 12 months post-surgery to determine the maintenance of the correction and clinical improvement.

Broberg and Morrey rating system was used to evaluate the functional results.

Variable	No. of points
Motion (total for each plane) (degrees)	
Flexion (0.2 × arc)	27
Pronation (0.1 × arc)	6
Supination (0.1 × arc)	7
Strength	
Normal	20
Mild loss (appreciable but not limiting; strength 80% that of contralateral side)	13
Moderate loss (limits some activity; strength 50% that of contralateral side)	5
Severe loss (limits everyday tasks, disabling)	0
Stability	
Normal	5
Mild loss (perceived by patient, no limitation)	4
Moderate loss (limits some activity)	2
Severe loss (limits everyday tasks)	0
Pain	
None	35
Mild (with activity, no medication)	28
Moderate (with or after activity)	15
Severe (at rest, constant medication, disabling)	0

Figure 1: Broberg & Moorey rating system

Results

The average age at the time of injury was 9 years, ranging 7 to 11 years, while the average age at the time of corrective surgery was 11.5 years, ranging 9 to 14 years.

Patients pre-operatively presented with an average loss of flexion of 11 degrees, ranging from 0 to 20 degrees, and two patients exhibited hyperextension deformities of 14 and 16 degrees, respectively.

Carrying angle on the normal side was more in females (average 11.50) than in males (average 10.10). Degree of deformity, calculated by subtracting the carrying angle on affected side from the carrying angle on normal side, was found to be 110 to 200 in 16% of the patients, 210 to 300 in 36% of patients, more than 300 in 48% of patients,

while no patient had 00 to 100 of deformity. Time of union ranged from four to eight weeks with an average of 6.2 weeks. While 13 cases (68.42%) showed union time from four to six weeks, rest four cases (21%) showed union within eight weeks. The radiological valgus achieved on the operated side was near equal to valgus of normal side with a mean variation of ± 1.91 degrees. Cosmetically all were satisfied with the outcome. There had been no neurovascular complication, unsightly scar or any residual deformity. Stable fixation had led our most of the cases to achieve >170 degree of supination-pronation, $<5-10$ degrees of restriction of flexion extension.

Most of our patients were able to regain their pre-injury functional status in the ninth week postoperatively with excellent cosmetic correction.

Table 1: Results of our study according to Broberg and Morrey rating system

Resultant outcome	Number of patients	Percentage values
Excellent	17	89.47%
Good	02	10.53%
Poor	00	00
Total	19	100%

Discussion

The treatment of cubitus varus, a deformity of the elbow that often affects paediatric patients, remains a significant focus for orthopaedic surgeons. This study delved into lateral closing wedge osteotomy fixed with a Reconstruction plate as a surgical approach for correcting this deformity. Let's discuss the advantages and disadvantages of this technique and compare it with alternative treatment methods.

Three fundamental categories of osteotomies have been outlined: a medial opening wedge osteotomy with bone graft, an oblique osteotomy with derotation, and a lateral closing wedge osteotomy. Uchida et al. introduced a three-dimensional osteotomy for cubitus varus correction, enabling the adjustment of medial and posterior tilt as well as rotation of the distal fragment when required. [13]

In our experience, a lateral closing wedge osteotomy stands out as the most straightforward, secure, and inherently stable type of osteotomy. Variations among lateral closing wedge osteotomies mainly lie in the fixation methods, which encompass the use of two screws with a connecting wire, plate fixation, compression fixation, crossed Kirschner wires, and staples. The choice of fixation method can be tailored to suit the child's age and the severity of the deformity. For younger patients, a combination of screws and Kirschner wires may be necessary, whereas adolescents are better suited for plate-and-screw fixation. DeRosa and Graziano achieved favourable

outcomes using a step-cut osteotomy technique secured by a single cortical screw. [14] They observed no occurrences of ulnar or radial nerve injuries, infections, non-unions, or hypertrophic scars, and all patients retained their preoperative range of motion. Their conclusion emphasized that the single-screw fixation osteotomy is a safe procedure capable of correcting deformities across multiple planes. They underscored the significance of thorough preoperative planning and meticulous attention to surgical details.

In cases necessitating more extensive osteotomies, Kim et al. recommended the utilization of a straightforward step-cut translation osteotomy, fixed with a Y-shaped humeral plate to provide robust fixation while enabling early joint movement. [15] This method proved successful in treating cubitus varus or valgus resulting from supracondylar or lateral condylar fractures in older children and young adults. It yielded positive clinical outcomes.

Lateral closing wedge osteotomy offers precise and controlled correction of cubitus varus, allowing surgeons to tailor the procedure to meet the unique needs of each patient, both cosmetically and functionally. The immediate stability achieved through fixation with a Reconstruction plate and proximal and distal screw placement is vital for long-term success, reducing the risk of postoperative complications and facilitating early mobilization.

Early postoperative mobilization is a crucial aspect of the rehabilitation process, enabling quicker

recovery and diminishing the chances of complications such as stiffness and muscle atrophy.

However, it's essential to acknowledge the surgical complexity of this procedure, which demands a high level of surgical skill and precision. The intricacy of the surgery may limit its accessibility in some healthcare settings, underscoring the necessity for experienced orthopaedic surgeons to perform the procedure. While the short-term results are encouraging, there is a notable need for long-term follow-up data to assess the maintenance of correction and the emergence of potential complications over time. Further research in this area is required. Additionally, patient selection criteria play a crucial role in determining the appropriateness of lateral closing wedge osteotomy for specific cases, considering factors such as age, the severity of the deformity, and overall health.

Comparatively, when assessing lateral closing wedge osteotomy against alternative methods, conservative approaches like physiotherapy and bracing may be appropriate for some cases of cubitus varus but may lack the precision and immediacy of correction offered by the surgical approach. Other surgical techniques, such as lateral column shortening or dome osteotomy, are available, each with its own set of advantages and disadvantages. Lateral closing wedge osteotomy's precision and avoidance of extensive bone removal or reconstruction can be advantageous in reducing the risk of complications, but the choice of surgical technique should be individualized to meet each patient's specific requirements. To establish the superiority of lateral closing wedge osteotomy, comparative studies with other surgical methods are essential, taking into account factors like the extent of deformity, patient age, and the surgeon's expertise. In conclusion, lateral closing wedge osteotomy fixed with a Reconstruction plate offers several advantages, including precise and controlled correction, immediate stability, and early mobilization. Nonetheless, its complexity and the need for long-term data should be considered. The choice of method should be based on individual patient characteristics and the specific needs of the case. Further research and comparative studies are necessary to determine the optimal approach for cubitus varus correction. This study contributes to the existing body of knowledge on this condition and underscores the potential benefits of lateral closing wedge osteotomy.

Conclusion

In conclusion, the results of lateral closing wedge osteotomy fixed with a Reconstruction plate in the treatment of cubitus varus have shown promising outcomes. This surgical approach effectively corrected the deformity in our patient cohort. The correction achieved was not only radiologically

evident but also demonstrated clinical improvements.

The surgical technique, involving precise osteotomy placement and fixation, allowed for controlled correction of the cubitus varus deformity. This method addressed issues of flexion loss and hyperextension while ensuring the stability of the fixation. The early mobilization of the elbow joint post-surgery contributed to a quicker recovery for our patients.

Our results highlight the importance of preoperative planning, careful surgical technique, and postoperative follow-up. The use of the Reconstruction plate, with proximal and distal screw fixation, provided stable support for the corrected bone alignment.

While our study showed favourable outcomes, it is essential to recognize that individual patient characteristics, such as age and the severity of the deformity, may influence treatment decisions. Additionally, further long-term follow-up studies are warranted to assess the maintenance of correction and any potential complications that may arise.

In summary, lateral closing wedge osteotomy fixed with a Reconstruction plate is a valuable surgical intervention for addressing cubitus varus deformities, offering both radiological and clinical improvements. This approach provides a promising option for patients seeking corrective treatment for this condition, with an emphasis on proper planning and surgical precision for optimal results.

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