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Lateral closing wedge supracondylar osteotomy fixed with angled tubular plate for cubitus varus deformity: A case report

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Abstract
Introduction: Cubitus varus deformity after malunited supracondylar humerus fracture has various surgical techniques, implant configurations, and approaches. We describe a lateral closing wedge supracondylar osteotomy fixed with plate for cubits varus deformity to deliver an easy, safe, fast and reproducible result based on the current best evidence.
Presentation of case: A case of malunited supracondylar humerus is described. The case involves a 12 year-old girl who presented with outstretched and supinated right arm after falling while playing when she was 5 years old. We found no abnormality in radial and median nerve function, but the right arm radiographs showed malunited fracture of the supracondylar humerus. On clinical examination elbow flexion of only 100° and elbow hyperextension of 20°. The cubitus varus was recorded with clinical carrying angle of varus 20°. We used lateral closing wedge supracondylar osteotomy, lateral approach, and our novel fixation technique with plate and showed excellent results. We also assessed the pain score and disabilities of the arm, shoulder and hand (DASH) score and recorded satisfactory results.
Conclusion: The lateral closing wedge supracondylar osteotomy fixed with plate for treatment of cubitus varus deformity can provide an easy, safe, and reproducible result.

Keywords: Cubitus varus deformity, malunited supracondylar humerus fracture, surgical techniques

Introduction
The pediatric supracondylar humerus fracture has a high rate of malunion and tend to be malunited overtime. The incidence of pediatric supracondylar fracture was quite high, 5% of all pediatric and adolescent fracture. At the same time, the incidence of malunited supracondylar humerus that lately was named a cubitus varus deformity varies from 3% to 57% [1]. Cubitus varus deformity, characterized by a distinctive angulation of the elbow where the forearm deviates inward towards the body, is a significant orthopedic condition that often arises as a consequence of childhood fractures of the distal humerus. This deformity alters the normal alignment of the elbow joint, impacting both functional mobility and aesthetic appearance. Understanding the pathogenesis, clinical manifestations, diagnostic approaches, and management strategies of cubitus varus is crucial for orthopedic surgeons, pediatricians, and caregivers involved in the care of affected individuals. Several recommendation has been proposed to treat pediatric supracondylar fracture but the result and the strength of evidence was varied. The malunion of supracondylar humerus was described by several component; include elbow varus deformity, elbow hyperextension and internal malrotation [2]. That elbow varus deformity was the most common complication following the pediatric supracondylar fracture, which the lateral prominence tend to be the main complication after the surgery [3]. Various surgical approach, configuration of osteotomy, and fixation techniques has been studied to correct the malunion of supracondylar humerus and offered good functional outcome without complication. Many recommendations following the treatment of pediatric supracondylar fractures was described with various strength of recommendation. Closed reduction and percutaneus pinning was the most preferred treatment of pediatric supracondylar humerus fracture [4].

Case Report
A twelve-year-old girl was brought to our centre with presenting complaints of deformity over right elbow since 18 months following injury over right elbow due to fall on a outstretched arm 2 years before.

On examination, the position of right upper limb was extension at right elbow and supination at right arm and forearm. She had no complaints of pain, and eventually was in a good mood and did her regular routine, even though her parents restricted her from performing any sports and high intensity activities such as riding a bike and running. The attending physician ordered the radiographs of anterior-posterior and lateral views of her elbow and the results showed a malunited supracondylar humerus fracture and planned for corrective osteotomy.

Clinically, cutaneous lipomas present in the form of a firm, elastic, compressible subcutaneous mass, mobile about the deep plane, generally painless and progressively increasing size; the surrounding skin is generally of normal appearance.

Fig 1: Preoperative clinical image showing right cubitus varus (varus°)

Fig 2: Preoperative x-ray

Surgical technique

The procedure was done by three experienced orthopedic surgeons. We decided to perform Lateral Closing Wedge Supracondylar Osteotomy by accurately measuring the degree of osteotomy angle. On the pre op radiographs, we measured all of the components of the elbow functional angles from clinical and radiographic views. From the clinical assessment preoperatively, range of motion (ROM) of the left elbow were 100° of elbow flexion and 20° of elbow hyperextension, and the recorded clinical carrying angle was 20°of varus. From radiological assessment, the anterior humeral line showed the capitellum was not intersected with the line that was parallel to the distal one third anterior cortex of the humerus. The carrying angle was carefully assessed by the humerus-elbow-wrist (HEW) angle with the result of 20° varus (Figure 2).

The imaginary line of the osteotomy site was drawn on the pre-op radiograph and then the surgery was conducted. Intraoperatively, the lateral approach to the elbow was made with care to prevent iatrogenic injury of the radial nerve

(Kocher's lateral approach). The bone was exposed on the lateral side and Hohmann's retractor was positioned bilaterally to protect from the danger of neurovascular injury.

We used tubular plate which was angulated according to the osteotomy done. The image intensifier was used intraoperatively before and after the osteotomy and fixation were done with careful decision-making about the best locations. Post-operative radiograph was taken (Figure 3). The final result was recorded with normal clinical carrying angle, and ROM was also restored to normal range.

Fig 3: Postoperative x-ray

The functional outcome was followed for 3 month after the surgery by ROM measurements, pain score, and disabilities of the arm, shoulder and hand (DASH) score with the following results: elbow ROM of 0-1°, VAS score of 0 and DASH score of 10 which interpreted as excellent result.

The elbow flexion increased by 30° (from 100° to 130°), the elbow extension increased by 20°(from 20° hyperextension to 0°), and observed carrying angle (Figure 4(a, b, c)) was improved by 25° (from 20° of varus to 05° of valgus). We immobilized the elbow with a back slab in 90° of flexion for 3 weeks. The optimal bone healing was achieved within 3 months. The patient was free from post-operative pain within 4 days, and returned to her favorite hobby, drawing within 2 months.

(A) (B) (C)

Fig 4(A, B, C): Postoperative Clinical results showing full extension at elbow-0° (4), valgus at elbow in extension-5° (5) and flexion at elbow-130^{O} (6)

Discussion

The presentations of the malunited supracondylar humerus in children were described as the appearance of abnormality of elbow ROM with restricted elbow flexion and excessive elbow extension, and the component of malunited internal rotation of distal fragment. The incidence of cubitus varus following malunited supracondylar humerus is notably high, about 10-50% [6, 7]. The main complaints of most children's parents are to improve the appearance of the elbow and to correct the limited function of the hand involved in eating and touching their own head for brushing teeth, washing and combing their hair [7].

The development and modifications of surgery techniques of cubitus varus deformity correction are numerous. While

no current evidence clearly describes the comprehensive surgical sequences of the corrective osteotomy at the supracondylar humerus, French *et al*., in 1959 per- formed corrective osteotomy of the cubitus varus, and Dome osteotomy was described by Kanaujia *et al*., in 1988 [5, 8]. The improvement of the techniques is still developing until now, whereas biomechanical analysis of implant configuration using the three-dimensional imagery of the distal humerus is still in development [6, 7, 9].

Our osteotomy technique is based on the lateral closed wedge osteotomy by French combined with Dome osteotomy, that provides an easy, stable and reproducible result [10-13]. The medial open wedge osteotomy is now not recommended since it can lead to instability and elongate the course of ulnar nerve with the risk of late onset of tardy ulnar nerve palsy [12]. The complications of supracondylar osteotomy were studied in some literatures. Raney *et al*. [28], divided the complications into the overall complications, fixation techniques, and approaches. In 23 patients, there were four major complications: ulnar nerve palsy (13%), loss of reduction (4%), non-union (3%), and lateral condyle prominence (3%), while reoperation was needed in 8 of the 23 patients. Eventually, higher loss of reduction was reported with only Kirschner wire fixation [15]. The posterior approach has a higher incidence of nerve palsy compared to none with the lateral. The poor result of supracondylar osteotomy is because of under correction or persisting cubitus varus deformity and limitation of ROM [14]. Lateral condyle prominence could be prevented by the Dome-shaped osteotomy with excellent cosmetic outcome [16].

The weakness of our report is only one case is reported demanding more research to confirm our results, even though modifications of our novel technique have been applied to more than 20 patients with excellent outcomes without major complications. Even so, the less technically demanding methods and fewer instrumentation of our procedure demonstrate the advantages compared to the other procedures. The understanding of three-dimensional anatomy of the supracondylar humerus and the malunited feature are crucial to achieve the best quality of reproducible corrective osteotomy of cubitus varus deformity.

Conclusion

Lateral closing wedge supracondylar osteotomy fixed with angled tubular plate for treatment of cubitus varus deformity can provide an easy, safe, and reproducible result.

Disclaimer

No patient or author details are included in the figures.

Declaration of competing interest

The authors declare no conflict of interest.

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Author contribution

- Pravendra Singh, Nipun Aggarwal, Jashandeep Singh Chahal, Nikhil Relwani, Suraj Sood, Shristi Singh conceived the study. collected data.
- Analysed data.
- Prepared and drafted the manuscript, edited manuscript and reviewed the manuscript.

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