Publisher
MEDRESEARCH
www.medresearch.in

Surgical Review: International Journal of Surgery Trauma and Orthopedics

2021 Volume 7 Number 3 May-June

E-ISSN:2455-5436
P-ISSN:2456-9518
RNI:MPENG/2017/70870

Research Article

Osteotomy

Corrective Osteotomy in cubitus varus deformity in children: A prospective study

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DOI: https://doi.org/10.17511/ijoso.2021.i03.06

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Background and Aim: Cubitus varus deformity is the most common late complication after supracondylar fracture of the distal humerus in children, incidence varying from 4% to 58%. The present study was done to evaluate the results of dome osteotomy. **Material and Methods:** This prospective study was conducted in a tertiary care hospital over 16 months. In all patients humerus-elbow wrist angle was measured on both sides and the correction needed was calculated. The lateral condyle prominence index (LCPI) was calculated by anteroposterior view radiographs of the deformed and the normal elbow in full extension by (AB-BC)/AC. Dome osteotomy with para triceps approach was used. Pre and post-operative carrying angle of elbow, range of motion and lateral prominence indices were compared. **Results:** The age of patients ranged from 3 to 15 years with a mean age of 8.47±3.14 years. Preoperative carrying angle of normal side ranged from 80 to 140 and that of effected side ranged from -23 to -13 and the difference was statistically significant ($p<0.05$). LCPI ranged from -8.4 to 5.9%. The majority of cases had LCPI >2.7%. As compared to, an improvement in carrying angle at defect side was observed to be 28.41±2.15 which was significant ($p<0.05$). At baseline mean LCPI was 0.39±3.87% which changed to -0.86±3.47%, the mean change of this was significant ($p=0.01$). baseline **Conclusion:** Dome osteotomy is a relatively technically demanding technique for correction of cubitus varus deformity but with a better functional outcome without being associated with lateral condyle prominence.

Keywords: Baseline, Cubitus varus, Dome osteotomy, Lateral condyle

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How to Cite this Article

Kotak A, Rudani S. Corrective Osteotomy in cubitus varus deformity in children: A prospective study. Surgical Rev Int J Surg Trauma Orthoped. 2021;7(3):73-77.
Available From
https://surgical.medresearch.in/index.php/ijoso/article/view/241

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Manuscript Received	Review Round 1	Review Round 2	Review Round 3	Accepted
2019-05-30	2019-05-10	2019-05-20	2019-05-30	2019-07-18

Conflict of Interest	Funding	Ethical Approval	Plagiarism X-checker	Note
No	Nil	Yes	7%	

Introduction

Cubitus varus or "gunstock" deformity, a common long term complication of a supracondylar fracture [1]. Cubitus vams deformity is not a functional problem, but it may become so disfiguring that correction is indicated. Cubitus varus deformity is the most common late complication after supracondylar fracture of the distal humerus in children, incidence varying from 4% to 58% [2,3]. The metaphyseal area of the distal humerus is the weakest region around the elbow, so supracondylar fractures are the most common elbow injuries.

Also, the frequent falls in small children while playing, cycling or fall inside the house from bed, the sofa has added to the increase in incidence. The non-dominant side and boys have a more predilection to such injuries than the dominant side and girls. Associated vascular injuries in 1% of the cases and nerve injuries involving median and radial nerve in at least 7% of the cases add to the concern [4,5]. It occurs in only the extension type of supracondylar fracture of the humerus, causing a reduction or loss of the carrying angle. Components of cubitus varus deformity are: a) medial angulation, b)

Medial rotation, c) extension of distal fragment with or without d) medial epicondyle epiphyseal injury leading to delayed growth of medial condyle and cubitus varus deformity [6]. Many surgical techniques to correct cubitus varus deformity are described in the literature [7-9]. These include opening wedge, closing wedge and three-dimensional osteotomies and reverse 'V' osteotomy [10-16]. Closed wedge osteotomy is easy to perform but it leads to lateral condyle prominence, inadequate removal of wedge and shortening. Medial opening wedge osteotomy is associated with stretching of ulnar nerve and instability and needs for bone graft and difficulty in fixation.

Three dimensional osteotomy is difficult to perform but among all the surgical treatments available, dome osteotomy can realign the distal fragment in horizontal and coronal plane both. The residual prominence of the lateral condyle and loss of elbow rotation is avoided [17]. Although, dome osteotomy has been described by Tachdjianin 1972, however, there is not enough clinical evidence available. This was followed by Higaki T and Ikuta Y who reported this procedure [18]. considering the advantages of dome osteotomy, we did a study and evaluated the results of dome osteotomy.

Materials and Methods

This prospective study was conducted in a tertiary care hospital over 16 months. Informed written consent was taken from the parent/guardian(s) of all the patients. A total of 17 children with cubitus varus deformity of the elbow were included in this study.

The inclusion criteria were; the age of the patient less than 15 years, varus deformity due to malunited supracondylar fracture of the humerus and the parent's concern for the cosmetic appearance of the elbow. The exclusion criteria included parent's/patient's refusal for surgery and age of patient more than 15 years.

Following parameters measured pre and post-operatively:
01. Carrying angle of deformed side,

02. LCPI,

III. Range of motion and
01. Mayo Elbow score (MES).

Preoperative Planning: Anteroposterior view and lateral view radiographs of both the elbows were taken. In all patients humerus-elbow wrist angle was measured on both sides and the correction needed was calculated. The lateral condyle prominence index (LCPI) was calculated by anteroposterior view radiographs of the deformed and the normal elbow in full extension by (AB-BC)/AC. The humerus-elbow wrist angle of both sides was compared on a radiograph and the angle of correction was measured. Onanteroposterior radiograph of affected side the mid-humeral axis of the affected side was drawn. A point 'O' was marked where this axis cut the Olecranon fossa. Another point 'A' was marked at the junction of the lateral condylar epiphysis with the distal humerus. The point 'O' and point 'A' were joined. Then the angle of correction uses the 'OA' line as the base was drawn. Another point 'B' was drawn where this angle cut the distal humerus. Now 'O' becomes the centre of the dome and 'OB', the radius of the dome. With this radius an arc was drawn making point 'O' as the centre. The arc of the dome was the proposed site of the osteotomy.

Surgical Procedure: All surgeries were done under general anesthesia. The patients were placed in a lateral position with arm supported and forearm hanging with 90° elbow flexion. A pneumatic tourniquet was used in all cases.

A midline posterior incision was given andParatriceps approach was used. The ulnar nerve was identified, exposed proximally and protected with wet gauze during the operation. Pericondrium and the periosteum junction and was identified in the distal humerus. A thick portion of the periosteum was detached carefully to avoid trauma topericondriumand physis. A preoperatively drawn template was placed over the posterior aspect of the humerus to match the OA line with the periosteum-perichondrium junction of the distal humerus of the lateral side. Point 'A', point 'B' and the dome of the osteotomy were then marked. During the osteotomy the neurovascular bundles in the anterior cubital fossa were protected carefully. Multiple drill holes were made along with the marked osteotomy arc by drilling through the anterior and posterior cortices of the humerus and osteotomy was completed with an arrow osteotome.

The distal fragment was then rotated along the arc till point 'A' and point 'B' are overlapping. The elbow gets realigned as planned. Percutaneous cross 'K' wire fixation for the osteotomy was done. The 'K' wires were bent and kept protruding through the skin for easy removal later. The wound was closed in layers and the padded dressing was given. Plaster of Paris back slab was applied. Intravenous antibiotics were given, 6 hours before surgery and for the next two days in the post-operative period and further 5 days oral antibiotics were given. Postoperatively, active exercises of the fingers and wrist were encouraged from the first postoperative day.

Stitches were removed after 2 weeks. The plaster of the Paris back slab was removed after 3 weeks and the 'K' wires were removed after 5 weeks. Gentle active movements of the elbow were encouraged.

Radiographs were obtained in anteroposterior and lateral view every 4 weeks for the three months and then every three months till the last follow up. The data collected were analyzed using SPSS (Statistical Package for Social Sciences) Version 15.0statistical Analysis Software.

Results

A total of 17 children with cubitus varus deformity were enrolled for the study. The age of patients ranged from 3 to 15 years with a mean age of 8.47±3.14 years. The left side was involved in 11 children and the right side was involved in 6 children. The mean time between injury and surgery was 15.74±3.92 months. 140 and that of the affected side ranged from -23 to -13 and the difference was statistically significant ($p<0.05$). LCPI ranged from -8.4 to 5.9%. The majority of cases had LCPI >2.7% (Table 1).

The postoperative evaluation revealed statistically no significant difference in carrying angle of normal and involved side($p>0.05$). As compared to baseline, an improvement in carrying angle at defect side was observed to be 28.41±2.15 which was significant ($p<0.05$). At baseline mean LCPI was 0.39±3.87% which changed to -0.86±3.47%, the mean change of this was significant ($p=0.01$). At baseline extension angle was 2.05±3.15 which was reduced to reach 1.29±3.01 postoperatively but this change was not significant ($p=0.1$). A total of 13 patients had a score of 100, thus indicating full functional recovery, Mayo Elbow score of the rest 4cases was 95. Mean MES was 98.14±1.98. No major complications took place. Pin tract infection was seen in 4 cases and skin infections in 3 cases.

Table 1: Clinical detail of patients

Number of cases	Carrying angle Mean ±SD			LCPI (%) Mean ±SD		Flexion Mean ±SD		Extension Mean ±SD	
	Normal side	Affected side	Post -operative	Pre- operative	Post- operative	Pre- operative	Post- operative	Pre- operative	Post- operative
17	10.54±2.01	-19.01±3.02	9.47±2.10	0.39±3.87	-0.86±3.47	117.1± 10.1	127.32±11.23	2.05±3.15	1.29±3.01
P value	P=0.01*			P=0.005*		P=0.04*		P=0.1	

*** indicates statistical significance at p≤0.05**

Discussion

Cubitus varus is one of the most common complications of supracondylar fracture of humerus in children treated with non-operative management without reduction and fixation, the incidence of which varies from 4% to 58%.

Most surgeons consider the deformity to result from an inadequate reduction that leaves a residual rotatory deformity that can collapse into medial tilt and result in a varus deformity.

In India, such injuries are still commonly handled by local bone setters rather than a certified orthopaedician.

Most of the patients in this series were mainly the result of this practice. All the cases were treated conservatively with no history of any associated injuries. The majority of cases in the present study were males though some studies have suggested an equal incidence between males and females. Yet studies from the Indian subcontinent generally have a higher prevalence of males as compared to females in both childhood and adult cases. It has been reported that the incidence of cubitus varus is high in fractures that are treated conservatively. In the present study, the left side was more commonly involved as compared to the right side. This is following the reported classical feature of the supracondylar fractures which mostly occurs in the non-dominant limb. In the present study, preoperative lateral condylar prominence index (LCPI) values ranged from -8.4 to 5.9%.

Preoperative LCPI has been reported to vary from -67% to +20.8% in the literature [19-21]. The high variability in the average value of LCPI is because it is noted with the sign, and on averaging sometimes values with opposite signs change to provide a poor idea of the actual magnitude of the problem. Thus we find that the average LCPI does not provide a good idea of the extent of the problem when depicted through an average value, hence, it is time now to build a consensus and evolve a strategy to compensate for this problem. We suggest a method to average the square root of squared LCPI values of individual patients and report the LCPI in ± terms. This is a suggestion made through this work on which consensus needs to be built. Prospective multi-centre studies are needed to further evaluate the safety and efficacy of this treatment alternative.

Conclusion

Dome osteotomy is a relatively technically demanding technique for correction of cubitus varus deformity but with a better functional outcome without being associated with lateral condyle prominence.

Addition of the study to existing knowledge

Excellent results in the present research attributed to thorough preoperative planning and meticulous intraoperative procedure along with percutaneous technique and mini external fixator used which gave stable fixation for early rehabilitation.

Contribution from authors

- **Dr. Abhinav Kotak** formulated the aims & objectives with study design and helped in data collection from the medical record department.
- **Dr. Suresh Rudani** contributed to the preparation of the manuscript and data analysis.

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