

# Clinical outcome of dome osteotomy in cubitus varus

## Abstract

**Introduction:** Cubitus varus (Gunstock deformity), is the most common long term complication of childhood supracondylar fracture of the humerus. For correction of cubitus varus deformity many types of osteotomies and fixations methods have been described. The most commonly used is the Lateral closing wedge osteotomy, which provides good results but results in two fragments of unequal width for bony union and the lateral condyle becomes prominent leading to Lateral condyle prominence, another cosmetic deformity. To overcome this problem, Dome osteotomy was done.

**Material and methods:** This prospective study included 15 cases of cubitus varus deformity of elbow over a period of 18 months. Mean age of the cases was  $9.07 \pm 3.07$  years. Dome osteotomy with paraticeps approach was used. Pre and post-operative carrying angle of elbow, range of motion and lateral prominence indices were compared.

**Results:** The mean follow-up period was  $13.33 \pm 1.84$  months. Mean time between injury and surgery was  $16.53 \pm 4.10$  months. There was significant improvement in carrying angle and lateral condylar prominence indices. Two of the cases developed transient ulnar nerve neuropraxia and one patient had superficial skin infection.

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

**Keywords:** Cubitus varus, Dome osteotomy, Lateral Condyle Prominence Index, LCPI

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## Introduction

Cubitus varus or "gunstock" deformity, a common long-term complication of a supracondylar fracture.<sup>1</sup> 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.<sup>2</sup> It is generally believed that functional impairment is none and it causes only cosmetic deformity of the elbow. Many surgical techniques to correct a cubitus varus deformity are described in literature.<sup>3-5</sup> These include opening wedge, closing wedge and three-dimensional osteotomies and reverse 'V' osteotomy.<sup>6-12</sup> 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 need for bone graft and difficulty in fixation.<sup>13</sup> Three dimensional osteotomy is difficult to perform but among all the surgical treatments available, dome osteotomy has the ability to realign the distal fragment in horizontal and coronal plane both. The residual prominence of the lateral condyle and loss of elbow rotation is avoided.<sup>8,14,15</sup> Although, dome osteotomy has been described by Tachdjian in 1972, however, there is not enough clinical evidence available. 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 in North India over a period of 18 months. The study was cleared by the institutional ethical committee and research cell. Informed written consent was taken from the parent/guardian(s) of all the patients. Total 15 children with cubitus varus deformity of elbow were included in

this study.

The inclusion criteria were:

- a) Children above 5 years of age and
- b) Deformity of more than 6 months.

Exclusion criteria were:

- i. Children below 5 years of age,
- ii. Deformity of less than 6 months duration,
- iii. Congenital deformity and
- iv. Surgically intervened elbow.

Following parameter measured pre and post operatively:

- I. Carrying angle of deformed side,
- II. LCPI,
- III. Range of motion and
- IV. Mayo Elbow score (MES).<sup>16</sup>

## 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 the sides and the correction needed was calculated. The lateral condyle prominence index (LCPI) was calculated by antero-posterior view radiographs of the deformed and the normal elbow in full extension by  $(AB-BC)/AC$  (Figure 1). The humerus-elbow-wrist angle of both sides was compared on radiograph and the angle of correction was measured. On anteroposterior 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 lateral condylar epiphysis with distal humerus. The point 'O' and point 'A' were joined. Then the angle of correction uses 'OA' line as 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 osteotomy (Figure 2).



Figure 1 Showing points to calculate lateral prominence index.



Figure 2 Showing pre-operative planning of Dome 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 and Paratriceps 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. Thick portion of periosteum always was detached carefully to avoid trauma to pericondrium and physis. Preoperatively drawn template was placed over the posterior aspect of the humerus to match OA line with the periosteum-pericondrium junction of the distal humerus of 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 the marked osteotomy arc by drilling through the anterior and posterior cortices of the humerus and osteotomy was completed with an arrow osteotome. 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 padded dressing was given. A plaster of Paris back slab was applied. Intravenous antibiotics were given, 6 hours before surgery and for next two days in post-operative period and further 5 days oral antibiotics were given. Postoperatively, active exercises of the fingers and wrist were encouraged from first postoperative day. Stitches were removed after 2 weeks. Plaster of 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 last follow up. The data collected was analyzed using SPSS (Statistical Package for Social Sciences) Version 15.0 statistical Analysis Software.

## Results

A total of 15 (M 9, F 6) children with cubitus varus deformity were enrolled for the study. Age of patients ranged from 5 to 15 years with a mean age of 9.07±3.07 years. Left side was involved in 10 (66.7%) children and right side was involved in 5 (33.3%) children. Mean time between injury and surgery was 16.53±4.10 months (range 11 to 26 months). Preoperative carrying angle of normal side ranged from 80 to 140 (mean: 10.40±1.72) and that of affected side ranged from -24 to -14 (mean: -18.07±3.10) and the difference was significant ( $p < 0.001$ ). LCPI ranged from -8.2 to 5.8% (mean 0.45±4.20%). Majority of cases had LCPI >2.5% ( $n=8$ ; 53.3%). Cases were followed up till 18 months (mean: 13.33±1.84 months) (Table 1).

Post-operative evaluation revealed statistically no significant difference in carrying angle of normal and involved side ( $p=0.212$ ). As compared to baseline, an improvement in carrying angle at defect side was observed to be 27.67±3.27° which was significant ( $p < 0.001$ ). At baseline mean LCPI was 0.45±4.20% which changed to -0.88±4.17%, thus showing a mean change of -1.29±1.68% and this change was significant ( $p=0.010$ ). At baseline extension angle was 2.00±4.14 which reduced to reach at 1.33±3.52° postoperatively but this change was not significant ( $p=0.334$ ) (Figure 3–5). MES ranged from 95% to 100%. A total of 12 (80%) patients had a score of 100, thus indicating full functional recovery, Mayo Elbow score of rest 3 (20.0%) cases were 95. Mean MES was 99.00±2.073 (Table 2 & 3).

**Table 1** Clinical detail of patients

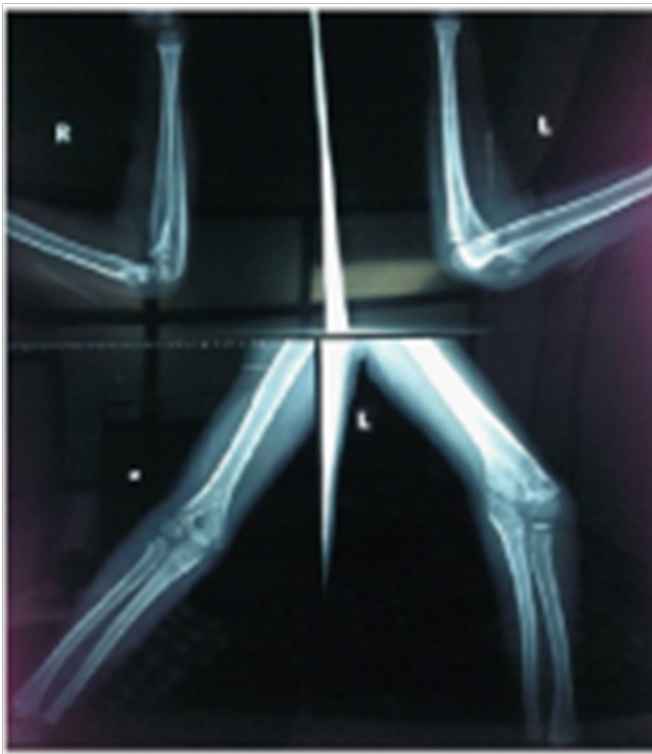
Case	Carrying Angle (Preoperative)		Carrying Angle	LCPI (%)		Flexion		Extension	
	Normal side	Affected side	Post op.	Preop.	Post op.	Preop.	Post op.	Preop.	Post op.
1	10	-24	6	-3.2	-4.1	120	120	10	10
2	10	-15	10	4.2	3	130	130	0	0
3	10	-20	10	-2.5	-3.7	120	120	0	0
4	12	-16	8	3.9	2.7	110	120	0	0
5	8	-18	10	-4.0	-5.2	120	120	0	0
6	12	-14	8	-8.2	-9.4	120	120	0	0
7	10	-20	10	5.8	4.7	110	130	0	0
8	8	-22	10	4.5	3.4	110	120	0	0
9	10	-16	12	-2.2	-3.2	110	120	10	10
10	8	-15	10	3.0	2.1	130	130	0	0
11	10	-20	8	-3.5	-2.1	120	130	10	0
12	12	-15	12	2.6	-4.3	120	120	0	0
13	10	-18	10	-1.2	-2.1	120	130	0	0
14	14	-22	12	3.5	2.7	110	120	0	0
15	12	-16	8	4.1	3	120	130	0	0
Mean	10.40	-18.07	9.60	0.45	-0.83	116.7	126.0	2.00	1.33
SD	1.72	3.10	1.72	4.20	4.17	8.17	5.07	4.14	3.52

**Table 2** Quantitative evaluation of change in different parameters as compared to baseline

S. No	Variables	Carrying Angle		LCPI (%)		Flexion		Extension	
		Pre op.	Post op.	Pre op.	Post op.	Pre op.	Post op.	Pre op.	Post op.
1	Mean	-18±3.11	9,60±1.72	0.45±4.20	-0.88±4.17	116.7±8.17	126.0±5.07	2.00±4.14	1.33±3.52
2	Difference	27.67±3.27		-1.29±1.68		9.33±4.96		-0.67±2.58	
3	Significance	t=32.81; p<0.001		t=2.96; p=0.010		t=8.234; p<0.001		t=1.000; p=0.334	

**Table 3** Comparison of results in present study and different case series using Dome osteotomy

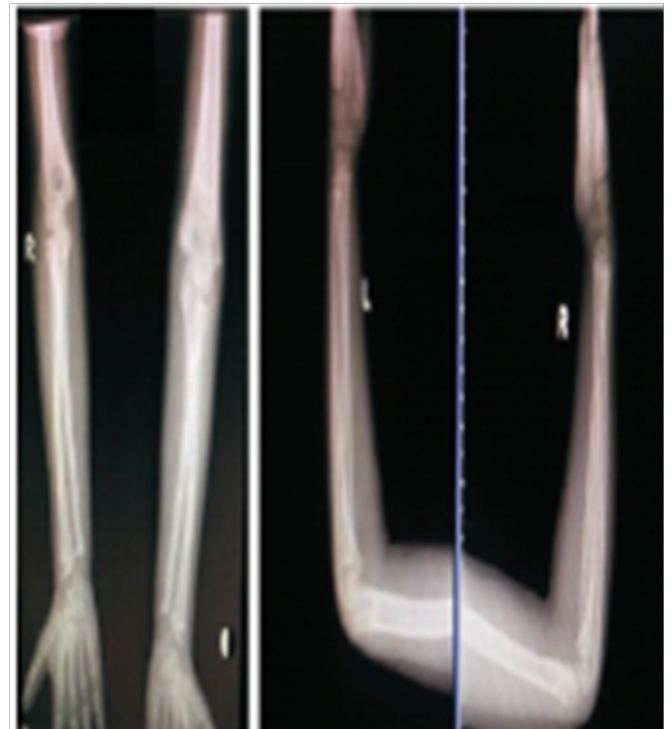
S. No.	Author (Year)	Sample size	Follow up period	Change in		
				Carrying angle	LCPI	ROM
1	Kanaujia et al. <sup>8</sup>	11	60.18 months	34.5°		5.45°
2	Tien et al. <sup>11</sup>	15	28 months	37.9°	-30.1%	
3	Pankaj et al. (2006)	12	27 months	-	-	-
4	Hahn et al. (2009)	19 Adults	41 months	24°	-	-
5	Singh (2012)	11	24 months	32.5°	20.8%	
6	Banerjee et al. <sup>15</sup>	24	27.6 months	28.8°	5.60%	5.3°
7	Eamsobhana & Kaewpornasawan (2013)	18	50.3 months	-	-	-
8	Present study (2014)	15	13.33 months	27.67°	1.29%	7.33°



**Figure 3** Preoperative X- ray.



**Figure 4** Three weeks post-op.



**Figure 5** 1 year follow-up.

No major complication took place. Only 1 case had ulnar neuropraxia in the early post-operative period which recovered fully within two weeks. Pin tract infection was seen in 3(20%) cases and skin infections in 2 (13.3%) cases. All these cases were given oral antibiotics for a week and infection was cleared. No case of failure was reported. None of the cases with good outcome had achieved one year of follow up. An esthetic and functional improvement is expected at the completion of follow up of one year duration.

### Discussion

The axis of correction should pass through the CORA (Centre of rotation of angulation) for re-alignment of distal and proximal mechanical axis after the osteotomy.<sup>17</sup> Geometrically unsound correction leading to lazy-S deformity would result if this precaution is not taken during deformity correction. Cubitus varus is a common delayed complication of supracondylar fracture of humerus in childhood. Untreated cubitus varus has a no effect on the function of elbow hence it is usually ignored. However, it has a definitive impact on cosmetic appearance.

Majority of cases in present study were males though some studies have suggested an equal incidence between males and females. Yet studies from Indian subcontinent generally have a higher prevalence of males as compared to females in both childhood and adult cases (Figure 6). It maybe just because of more outdoor activity in male counterpart. In present study majority (60%) of the cases were from rural areas. No study till date has shown a rural-urban difference in incidence of cubitus varus, however, the higher proportion of rural patients in present study could be attributed to proximity of our center to the rural areas. Another reason for higher prevalence of rural patients could be owing to their inability to pay for surgery and forced to go for non-operative treatment which has high incidence of cubitus varus deformity. It has been reported that incidence of cubitus varus is high in fractures which are treated conservatively.





**Figure 6** Clinical photographs showing. A: Cubitus varus deformity. B & C: Range of movement front and from side.

In present study, left side was more commonly involved as compared to right side. This is in accordance with the reported classical feature of the supracondylar fractures which mostly occurs non dominant limb. In present study, preoperative lateral condylar prominence index (LCPI) values ranged from -8.2 to 5.8 (mean:  $0.45 \pm 4.20$ ). Preoperative LCPI has been reported to vary from -67% to +20.8% in literature.<sup>8,14</sup> The high variability in average value of LCPI is owing to the fact that it is noted with sign, and on averaging sometimes values with opposite signs change provide a poor idea of actual magnitude of problem. Thus we find that average LCPI does not provide a good idea of the extent of problem when depicted through an average value, hence, it is time now to build a consensus and evolve a strategy to compensate 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 build. Using this approach in present study we can report the pre-operative LCPI as  $\pm 3.76\%$ .

## Conclusion

The domeosteotomy is a procedure which can achieve correction of the deformity in all three planes. It is effective in minimizing the lateral condylar prominence as compared to that in lateral closing wedge osteotomy.

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