ORIGINAL ARTICLE

Focal dome osteotomy for correction of varus deformity at elbow in children

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Abstract

Background: Cubitus varus is the most common complication of un-treated or mal-treated supracondylar fracture of humerus at elbow. Various osteotomies have been described to correct this deformity but each is associated with its own complications. In this study, focal dome osteotomy for correction of cubitus varus was performed to determine its functional and radiological outcome.

Materials and Method: In this study, 35 children with cubitus varus deformity were admitted from Jan 2009- Jan 2013. Clinical assessment was done before the procedure by measuring the carrying angle at elbow joint. Radiographic assessment of deformity was done by anteroposterior (AP) radiographs of the elbow by measuring the humeral-ulnar angle (HUA) and metaphyseal-diaphyseal angle (MDA). Through anterolateral approach, supracondylar region of humerus was exposed and focal dome osteotomy was done at the center of rotation of angulation (CORA). Final assessment was done clinically for carrying angle and radiologically for HUA and MDA at 8 weeks to evaluate the functional and radiological outcome as good or poor.

Results: The mean age of 35 children at the time of surgery was (mean ± SD 8.03 ± 2.35) with range from 5 - 12 years, Male to female ratio was 1.50:1. The mean duration of injury was (170.26 ± 41.78) days. The functional outcome for carrying angle improved from 1.49 ± 5.95 to 14.46 ±1.44 with p value <0.05. Radiological outcome for humeral-ulnar and metaphyseal-diaphyseal angle improved from 27.71 ± 4.31 to 17.77 ± 1.23 and 103.66 ± 4.76 to 90.49 ± 1.96 with p value <0.05 respectively. The final Functional and Radiological outcome was good in 32 patients (91%) and poor in 3 patients (9%).

Conclusion: Focal dome osteotomy is safe and stable method of correction of cubitus varus which avoids prominence of lateral condyle and is cosmetically acceptable.

Keywords: Cubitus Varus, Focal dome Osteotomy, Correction of Elbow Deformity, Mal-united Supracondylar Fracture Humerus in Children, Center of Rotation of Angulation (CORA). (JPMA 65: S-115 (Suppl. 3); 2015)

Introduction

Supracondylar fracture of distal humerus is the commonest fracture in children between the ages of 5-10 years[1] and this may result in elbow deformity like cubitus varus if untreated or under treated.[2] The incidence of pain, functional impairment and cosmetic problems due to varus deformity is reported in 5-7% cases and usually requires surgical correction.[1]

Cubitus varus is a triplanner deformity and manifest clinically as varus, hyperextension and limitation of pronation at elbow.[3] Malreduction and malposition is the primary factor in the varus deformity.

Different types of osteotomies have been proposed to correct the elbow deformity like lateral closing wedge osteotomy,[4] arc osteotomy,[5] reverse V osteotomy,[6] French cut osteotomy[7] and supracondylar humeral osteotomies using the small AO external fixator[8] but these remain deficient on certain aspects i.e. deformity is not corrected in three planes. Focal dome osteotomy to correct the tibial deformity in children is widely practiced and success rate is about 96%.[9]

The aim of this study is to evaluate the functional and radiological outcome of focal dome osteotomy to correct cubitus varus as it will address the correction in three planes.

Material and Methods

During Jan 2009 - Jan 2013, 35 children were selected from the outpatient clinic of Orthopaedics Department of Services Hospital, Lahore with mal-united supracondylar fracture of humerus.

The informed consent was taken from their parents. For each patient detailed history including demographic information (age, sex, and address) was taken and recorded. Clinical assessment was done by measuring the carrying angle at elbow joint. Radiographic assessment of deformity was done on anteroposterior (AP) radiographs of the elbow. Humeral-ulnar angle (HUA), metaphyseal-diaphyseal angle (MDA) and CORA[10,11] were measured on anteroposterior radiographs of the elbow. The fractures of less than three week duration and children with neurovascular compromise were excluded from the study.

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All the operations were carried out with the patients in supine position and the affected arm on a hand table. Pneumatic tourniquet was used. After anaesthetizing, draping of upper limb was done. With anterolateral approach, the supracondylar region of humerus was exposed. The focal dome osteotomy was marked and predrilled. It was completed in the reverse direction by using small osteotome at CORA at supracondylar region of the humerus by applying the principles of deformity correction described by Paley.[11] The deformity was corrected and osteotomy was fixed with two cross k-wires. It was protected with above elbow back slab.

Stitches were removed at 2 weeks. Wires and plaster slab were removed at 4 weeks after the surgery and rehabilitation was started. Final assessment of carrying angle (13°-18°) and HUA (15°-20°) and MDA (87°-93°) were done at 8 weeks. The functional and radiological outcome was considered good if the angles were within normal range and poor if the correction was not achieved.

Data

Data was entered in computer and analyzed by using Statistical Package of Social Sciences (SPSS) version 13. Quantitative data including age and duration of injury was analyzed by using mean ± standard deviation. Frequency and percentages were calculated for improvement in carrying angle (Yes/ No), HUA (Yes/No) and MDA in (Yes/No). Data was stratified for duration of injury to address effect modifier.

Results

The sample study consisted of 35 patients. The age of the children were from 5-12 years (mean ± SD 8.03 ± 2.35). Out of thirty five patients, 21 (60%) patients were male and 14 (40%) patients were female with male to female ratio 1.50:1. The patients presented with cubitus varus 19 (54%) had right side cubitus varus and 16 (46%) had left side cubitus varus (Table-1). The mean duration of injury was 170 days (mean ± SD 170.26 ± 41.78 days), with maximum of 240 days (Table-1).

Figure-1: Pre Operative Radiographs of Elbow Joint.

Figure-2: Post Operative Radiographs of Elbow Joint.

Before operation, the mean carrying angle was (-27.71 ± 4.31). After focal dome osteotomy the carrying angle was improved (17.77 ± 1.23) in 32 (91%) patients and poor in 3 (9%) with p <0.05) at 8 weeks follow up (Table 2 &3). The

Table-1: Distribution of frequency and percentages.

Variables	Frequency	Percentage
Age (year)		
5 - 7	13	37
8 - 10	17	49
> 10	5	14
Gender		
Male	21	60
Female	14	40
Effected Side		
Right	19	54
Left	16	46
Duration of Injury (days)		
95 - 150	10	29
151 - 205	18	51
206 - 240	7	20

Table-2: Functional and Radiological outcome.

Variables	Details	Before Operation (Mean±SD)	8th weeks follow up (Mean±SD)	P value
Radiological Outcome	Humeral- Ulnar Angle (15°-20°)	-27.71 ± 4.31	17.77±1.23	<0.05
	Metaphyseal-Diaphyseal Angle (87°-93°)	103.66 ± 4.76	90.49±1.96	<0.05
Functional Outcome	Carrying angle (13°-18°)	1.49 ± 5.95	14.46±1.44	<0.05

(-) indicates varus deformity.

Table-3: Final Outcome (Post-operative 8th week).

	Frequency	Percentage	Result	Outcome
Carrying Angle				
13°-18°	32	91	Yes	Good
<13°	3	9	No	Poor
Humeral-ulnar angle (15°-20°)				
15°-20°	32	91	Yes	Good
>20°	3	9	No	Poor
Metaphyseal Diaphyseal Angle (87°-93°)				
87°-93°	32	91	Yes	Good
>93°	3	9	No	Poor

mean ± SD of humeral-ulnar angle before operation was (-27.71 ± 4.31) and after focal dome osteotomy improved to good in 32 (91%) patients and poor in 3 (9%) patients at 8th week with mean (17.77 ± 1.23)and p value <0.05) (Table-2 & 3). The metaphyseal-diaphyseal angle before surgery was 103.66 ± 4.76 and after focal dome osteotomy improved to 90.49 ± 1.96 with (p <0.05) at 8th week of follow up. Results were good in 32 (91%) patients, and poor in 3 (9%) patients (Table-2 & 3).

Out of 35 patients in 33 patients, the functional and radiological outcome for carrying angle, HAU and MDA improved within normal ranges showing good results (Table-3). Five patients had superficial pin track infection which was treated with first generation cephalosporin and sterile dressings with pyodine solution. Two patients had loss of fixation and correction which improved after revision surgery and result was satisfactory. There was no lateral prominence. The range of elbow joint movement in three patients was restricted which required physiotherapy. Cosmetically all patients were satisfied with the outcome. Ulnar nerve palsy was noted in three patients which improved after three weeks.

Discussion

Varus deformity is common in children due to mal-treated or un-treated supracondylar fracture of humerus. In our study the age of the children were from 5-12years and common problem was varus deformity of elbow and the carrying angle (13°-18°) was reduced to varus (-27.71±4.31). This deformity was treated with focal dome osteotomy at supracondylar region of humerus at CORA because union of bone in metaphyseal region is rapid and remodeling is prompt.

Focal dome osteotomy has its own merits. It avoids damage to the apophysis and physis of distal Humerus. It corrects tri-planner deformity. In this study no injury was noted to growth plate with good apposition of bones at osteotomy side.

Uchida et al reported that, supracondylar osteotomy for the correction of cubitus varus deformity has been associated with a high failure rate and significant complications.[12] This is because the supracondylar area is thin and fixation is difficult to maintain. But we have not faced such problem because focal dome osteotomy has greater contact area and was easy to maintain.

Medial approach is used for correction of cubitus varus to avoid cosmetic problem.[13] But during medial approach ulnar nerves identification is required and there is a chance of ulnar nerve injury. In our study we have used lateral approach and risk of ulnar nerve injury is less but we noticed ulnar nerve neuropyrexia in three patients which recovered after three weeks of surgery.

In the present series soft tissue dissection was done carefully. The humerus was pre-drilled at CORA and then osteotomy was completed with an osteotome to ensure no neurovascular complication. This procedure was performed without radiological control.

In our study after osteotomy and desired correction, osteotomy was fixed with cross K-wires. We found that it was

more stable and safe as compared to Kim et al who did step cut osteotomy in 19 patients to reduce residual protrusion of the lateral or medial condyle.[10] He did rigid fixation with Y-shape plate by using, posterior approach and found that it provides firm fixation that allows early movement of the joint. We used anterolateral approach to avoid triceps tongue or splitting to avoid fibrosis and limitation of joint movements. Decreased movements were noted in only three patients which were improved after physiotherapy.

We have fixed osteotomy internally and no further distraction osteogenesis is required as Song et al had described the use of the Ilizarov external fixator in the treatment of 15 adult patients with cubitus varus or valgus. In some cases they had to shorten the humerus and trim proximal fragment to improve bone contact.[14] Similarly Karatosun et al reported seven children with post traumatic cubitus varus deformities who were treated by distraction osteogenesis with Ilizarov method. They reported excellent results clinically and radiogically.[15]

In our study the carrying angle was improved from varus to valgus clinically and radiologically both HUA and MDA were corrected and they were within normal range and p value <0.05 which was significant (Table-1 & 2).

There were complications like keloid formation and pin track infections as in Levine et al study when patients were treated with external fixation for treatment of cubitus.[16] Duration of external fixation was 8.9 weeks. In our study the wires were removed at fourth week and there was no keloid formation or radial nerve injury.

Prominence of the lateral condyle is troublesome. It can occur in different osteotomies[5-9] and in Ilizarov distraction osteogenesis method[17] because the correction of deformity is done only in coronal plane. However, there was no lateral condyle prominence in our study because focal dome osteotomy corrects deformity in three planes. In focal dome osteotomy results were good and comparable with different osteotomies fixed with internal or external devices which are already published and cosmetically all patients are satisfied with the outcome.

Conclusion

In conclusion, the focal dome osteotomy is more stable, for maintaining the obtained correction of cubitus varus deformity. It is safe, avoids lateral condyle becoming prominent, cosmetically acceptable and allowing early movement. Its functional and radiological outcomes were good.

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