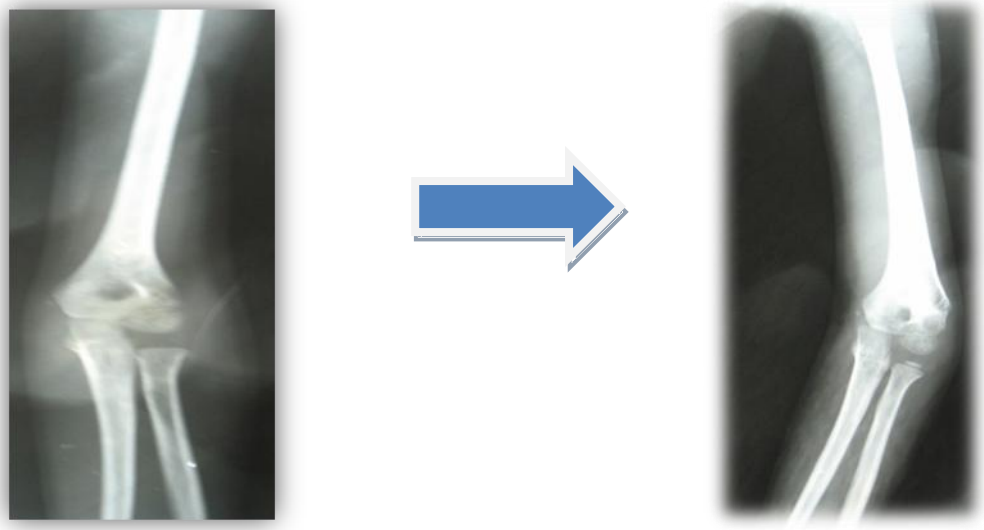
EVALUATION OF RESULTS OF SUPRACONDYLAR DOME OSTEOTOMY IN CUBITUS VARUS DEFORMITY



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AWARD OF

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BY

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CONTENTS

INTRODUCTION

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Cubitus varus (gunstock deformity) is the most common long term complication of childhood supracondylar fracture of the humerus, irrespective of the method of treatment. Cubitus varus deformity following supracondylar fracture of the humerus in children consist of varus, hyperextension and internal rotation of the distal bone fragment of the humerus. The usual presenting complaint is deformity not functional disability. As the deformity is unsightly, the child's parents often request for an operation to improve the appearance of the elbow ; although the function is not greatly impaired. Because cubitus varus deformity persists and has no spontaneous remolding, so the only method to correct the deformity is surgery.

Various corrective osteotomy procedures have been proposed for treatment of cubitus varus . The goals of osteotomy are correction of the coronal, sagittal and rotational deformity. Prevention of elbow stiffness, through firm fixation of the osteotomy site and early use of the joint, is also desirable. The lateral closing wedge osteotomy is the most widely used method to correct this deformity, but the clinical results have been disappointing. The closing wedge osteotomy, although deceptively simple ,has a significant complication rate .In the study of Oppenheim et al , with an average follow up of 21/2years ,24% of patients had complications of neurapraxia, sepsis or cosmetically unacceptable scarring. In the study of Ippolito et al with an average of 23 years, all but two of the 19 patients in whom the carrying angle had been measured preoperatively lost correction that had been obtained during surgery. If the distal humeral physis is not affected and the distal end of the distal humerus grows uniformly, the deformity can be corrected permanently. When direct physeal injury has occurred, the possibility of late recurrence of the deformity after the corrective osteotomy always should be considered. Although the lateral closing wedge osteotomy is the simplest method of correction, it has many technical pitfalls, and its tendency to produce a prominent lateral condyle after the angulations is corrected often compromises the cosmetic outcome.

In 1972, a dome osteotomy was initially mentioned by Tachdjian without giving details to overcome several reported complications of lateral closing-wedge osteotomy. Then Higaki and Ikuta (1982) reported the same kind of osteotomy in Japanese. After that several authors have reported the usefulness of dome osteotomy for cubitus varus deformity.

Traditionally many surgeons believed that the lateral closing wedge osteotomy is the best treatment for correction of cubitus varus deformity. There have been a number of studies in the west in recent times which highlight the advantages of dome osteotomy for correction of cubitus varus deformity.

AIMS

AND

OBJECTIVES

AIMS & OBJECTIVES

The aim of our study was to evaluate the results of dome osteotomy in respect of pre and post-operative carrying angle, range of motion and lateral condylar prominence index to avoid cosmetic complication and achieve a better functional outcome.

The main objectives were:

1. To study the anatomical deformity before and after the operation.
2. To study the cosmetic deformity before and after the operation.
3. To study any association between the different variable like carrying angle, lateral condylar prominence index before and after the dome osteotomy.

MATERIALS AND METHODS

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The study was conducted in the department of Orthopaedics, Medical College and Hospital, Kolkata on a prospective basis from March 2009 to April 2010. We selected 12 patients who fitted our criteria for the study. A written consent was obtained from all the patients.

Study Place: Department of Orthopedics ,Calcutta Medical College, Kolkata.

Study period: March 2009 to April 2010

12 patients of cubitus varus deformity were selected for dome osteotomy. There were some inclusion and exclusion criteria.

Inclusion criteria:

1. Age of patient 5 to 15 years.
2. Appearance of deformity more than 12 months.

Exclusion criteria:

1. Patient younger than 5 and older than 15 years.
2. Occurrence of deformity less than 12 months.
3. Anesthetically unfit patient.
4. Associated with other serious injuries or co-morbid medical illness.

PREOPERATIVE ASSESSMENT

Anteroposterior (elbow in full extension and forearm in full supination) and lateral radiographs of both elbows were taken. The humerus-elbow-wrist angle was measured on both sides in all patients using the Oppenhiem method and the angle of correction was estimated (Fig 1). The lateral condylar prominence index (LPI) was calculated on the affected side as described by H.K.Wong (Fig2). Range of motion of the affected elbow was noted, along with complaints of cosmesis, pain and loss of motor power.

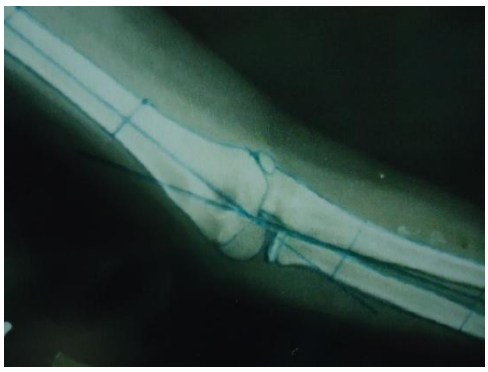

Fig 1

Fig2

Fig.1: Estimation of angular correction using the method of Oppnheim.

Fig.2: The lateral condylar prominence index (LCPI)=(AC-BC) x 100/AB. There is usually a slight medial prominence, making the LCPI predominantly negative.

PREOPERATIVE PLAN FOR OSTEOTOMY

First the humerus-elbow-wrist angle of both sides were measured. Then angle of correction was calculated. The mid humeral axis of the affected side was then drawn over the anteroposterior radiograph of the affected side. A point (point O) was marked where this axis cut the olecranon fossa, another point (point A) was marked at the junction of lateral condylar epiphysis with distal humerus. Then point O and point A were joined. Then the angle of correction making OA as base was drawn. Another point was drawn were this angle cut the distal humerus (point B). Now O became the center of the dome and OB the radius of the dome. With this radius a dome was drawn making point O as the center(Fig 3).The arc of the dome was the proposed site of osteotomy.

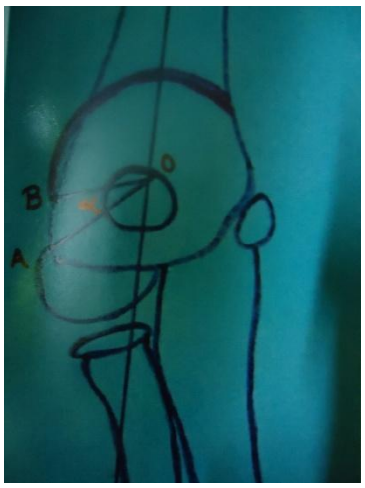

Fig 3:Dome supracondylar osteotomy.The intersection of the midhumeral axis and the upper border of the olecranon fossa were designated as the center of the dome (point O).The junction of lateral condylar epiphysis with distal humerus marks another point A. With the segment of OA as the base a second line, OB, was drawn according to the planned angle of correction (α). Point B acted as the starting point of the osteotomy and a dome was drawn with OB as the radius of the arc.

Fig 3

INDICATIONS OF SURGERY

The indication for surgery in all these cases was the unacceptable appearance of the elbow.

SURGICAL TECHNIQUE

All operations were done under general anesthesia.

Fig 1:- General Anesthesia is given

The patients were placed in a lateral position and a tourniquet was applied. The affected arm was placed on a support allowing at least 90° of elbow flexion.

Fig 2: Position of Patient during Operation.

A midline posterior incision was performed, curving laterally around the olecranon. It was continued about 3 cm distal to the olecranon tip.

Fig 3: Posterior Midline Longitudinal skin Incision.

The fascia overlying the triceps brachii was identified, split in the midline, and elevated with the dermis and subcutaneous tissue, creating two fasciocutaneous flaps. Dissection was continued to the lateral and medial triceps borders at their respective interfaces with the posterior aspects of the intermuscular septae. In this way, the triceps muscle was separated from the posterior surface of the intermuscular septae. The posterolateral humeral shaft was approached by elevating the triceps muscle from the posterior periosteum and by retracting it medially.

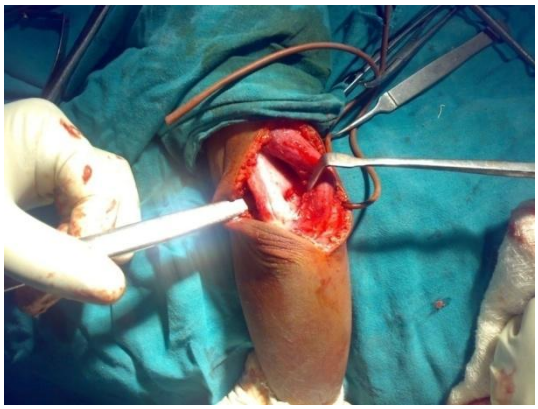

Fig.4: Triceps muscle elevated from postero-lateral surface of the humerus

Medially, the ulnar nerve was identified and exposed proximally in the posterior compartment. In order to avoid injury to the ulnar nerve, it was protected with a penrose drain during the operation.

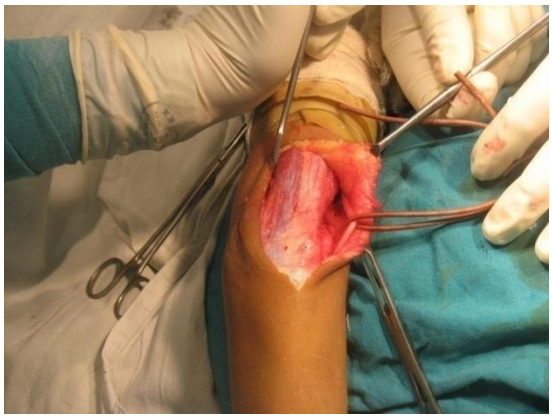

Fig.5: Dissection of ulnar nerve and protected with penrose drain

Medial paratricipital dissection along the posterior border of the intermuscular septum exposed the posteromedial aspect of the distal humerus.

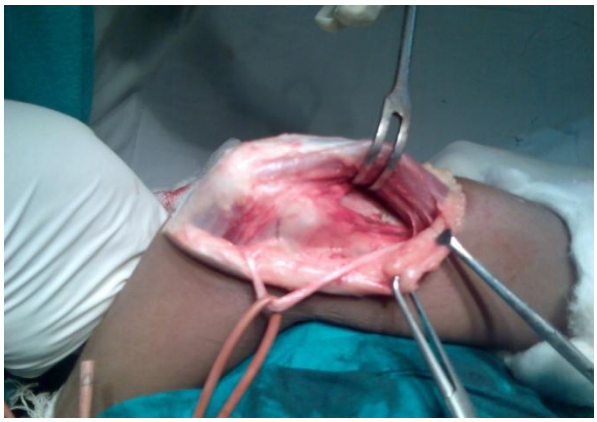

Fig 6: Medial paratricipital dissection and exposure of postero-medial aspect of distal humerus

Connection of the medial and lateral dissections by mobilization and elevation of the triceps muscle from the posterior humeral periosteum allowed visualization of the entire posterior distal humerus.

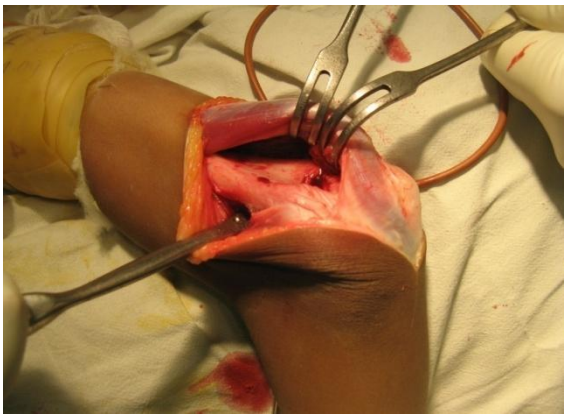

Fig 7: Exposure of entire posterior aspect of distal humerus

In the distal humerus identify the periosteum and pericondrium junction. Thick portion of periosteum always had to be detached very carefully so that the perichondrium and physis would not be traumatized. Now the template which drawn preoperatively placed over the posterior aspect of the humerus. OA line matched with the periosteum and perichondrium junction of the distal humerus of lateral side .Now, point A, Point B and dome of the osteotomy was marked.

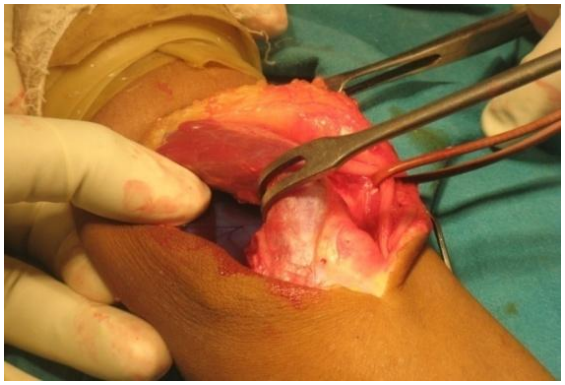

Fig 8: Positioning of template for marking of osteotomy site

During the osteotomy retractors were placed along the anterior cortex to protect the neurovascular bundles in the anterior cubital fossa. Interrupted holes were made along the presumed osteotomy arc by 1.8 mm k- wire drilling through the anterior and posterior cortices of the humerus

Fig 9: Marking of osteotomy site

The osteotomy was completed with a ¼ inch osteotome.

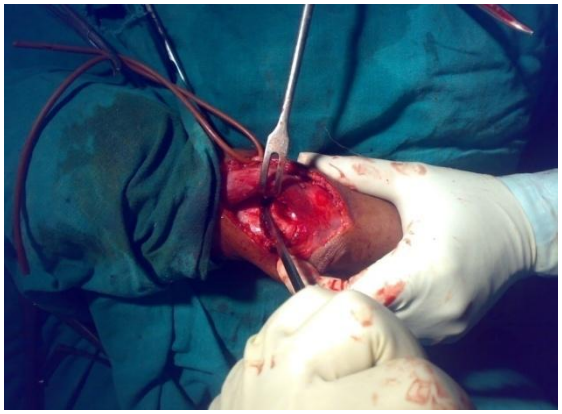

Fig 11: Osteotomy done by osteotome

After the osteotomy was completed, the proximal fragment had to be pulled outwards by a bone hook to facilitate complete division of the thick anterior periosteum and to smooth the spikes over the edge of the anterior cortex on the proximal and distal fragments.

Fig 12: Smoothening the spikes over the edge of proximal fragment

The AB segment of the lateral cortex was curved to fit the arc of the dome shaped osteotomy. Then the distal fragment could be rotated along the arc until *point A* on the distal fragment and *point B* on the proximal fragment overlapped .Thus the elbow was realigned as planned.

Fig 13: Planning of fixation of osteotomy site

Percutaneous cross k-wire (1.8mm) fixation for the osteotomy was done.

Fig 14: Fixation of osteotomy site with crossed k-wire

The Kirshner wires were bent and kept proud to facilitate easy removal later. The wound was closed in layers and no drain was given in routine cases.

Postoperatively, patient was asked to do pendulum movements of the shoulder and active exercises of the fingers and wrist started immediately. Stitches removed 14 days postop. Back slab was removed after four weeks and the K wires removed after fifth week. Gentle active movements of the elbow was encouraged. Radiographs were obtained in anteroposterior and lateral projections every month for the first three months and then every three months till final follow up.

FOLLOW-UP ASSESSMENTS

Follow up of the patients ranged from 5 months to 12 months. All patients and their parents responded to a questionnaire similar to that used by Barrette al to measure consumer satisfaction with the cosmetic outcome. The questions were as follows:

1. Does your child's arm look crooked?
2. Do you or your child notice a bump?
3. Does the bump bother you or your child?
4. Do you or your child notice the operation scar?
5. Does the scar bother you or your child?
6. Are you and your child pleased with the result?
7. Would you repeat the operation if given the same circumstances?

Clinical assessment included the subjective evaluation of the lateral condylar prominence, cosmesis and scar. The range of motion complications were also noted. Radiograpic assessment included the measurment of the carrying angle and LCPI as said before. Postoperative change of the lateral condylar prominence had a cosmetic significance. The operative time, blood loss, neurological complications, wound healing and pin tract condition were all recorded. Carrying angle, ROM and change of lateral condylar prominence index were used as strict criteria to categorize the results. The results of the osteotomy were categorized as excellent, good and poor as in Table I.

Table I: Showing Gradation Of Results

CRITERIA	EXCELLENT	GOOD	POOR
Carrying angle	Difference in the angle from the unaffected side was 5* or less	Difference in the angle from the unaffected side was 6* to 10*	Difference in the angle from the unaffected side was more than 10*
Range of motion	Loss of flexion & extension was 10* or less	Loss of flexion & extension was 20* or less	Loss of flexion & extension was more than 20*
Lateral condylar prominence index	No increase in the lateral condylar index	Increase in the lateral condylar index was 2.5% or less	Increase in the lateral condylar index was more than 2.5%

RESULTS AND ANALYSIS

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All twelve patients were reviewed clinically and radiographically. Follow up ranged from 5 to 12 months. Seven patients had an excellent result, four had good and one had poor (Table II).

FLEXION

Before operation, the range of motion was normal in seven patients and five had hyperextension (10 degrees in two 5 degrees in three). The average range of motion was 127.9 degrees before surgery and 123.3 degrees after surgery.

COSMETIC OUTCOME

In terms of appearance of elbow only one patient reported an unsightly scar. None of the patients had a prominent lateral condyle and there was no complaint of medial fullness of elbow.

COMPLICATION (Table II)

This include superficial skin infection and ulnar neuropraxia in one patient each. Ulnar nerve neuropraxia manifested in the form of tingling and numbness in the ulnar distribution without any motor weakness and resolved spontaneously. Superficial skin infection was treated with oral antibiotics and dressing but left sequel of ugly scar. No patient reported pain, motor weakness or atrophy of the arm musculature. There was no fixation failure or loss of correction during healing stage and no revision surgery was needed.

RADIOGRAPHIC ASSESSMENT (Vide Table II)

The pre-operative humerus elbow wrist angle was average -16.8 degrees (range -2 to -30 degrees). The post operative angle was 12.4 degrees valgus (range 4 to25 degrees valgus). In seven patients the carrying angle was within 5 degrees of the contralateral unaffected side. The pre-operative LCPI varied from -45.95 to 15.56. The post operative LCPI varied from -40.54 to 26.08. Compared with the preoperative values, the LCPI actually decreased after the surgery.

Table II : Detail informations of 12 patients before and after surgery

Pre Operative:

SL. NO.	PATIENT NAME	AGE IN YRS.	SEX	AFFECTED SIDE	INITIAL INJURY	INJURY-SURGERY INTERVAL (MONTHS)	PRE-OP CARRYING ANGLE (DEGREES)	CARRYING ANGLE NORMAL (DEGREES)	FLEXION PREOP (DEGREES)	EXTEN-SION PREOP (DEGREES)
1	M T	7	M	Right	S/C#	7	-19	12	90	-5
2	S S	10	M	Left	S/C#	6	-20	10	130	0
3	S K	6	F	Left	S/C#	10	-8	12	125	-10
4	D H	5	M	Left	S/C#	22	-2	11	135	0
5	A P	7	M	Left	S/C#	12	-14	12	135	-10
6	S D	8	F	Right	S/C#	84	-28	10	130	0
7	S B	9	F	Left	S/C#	72	-24	12	135	-5
8	S R	15	F	Left	S/C#	18	-20	16	125	-5
9	A P	9	F	Left	S/C#	6	-13	13	135	0
10	R R	5	M	Left	S/C#	11	-15	15	130	0
11	R K	6	M	Right	S/C#	7	-30	7	130	0
12	F N	8	M	Left	S/C#	16	-9	19	135	0

Post Operative:

SL. NO.	FOLLOW –UP (MONTH)	FLEXION POST-OP	EXTENSION POST-OP	ROM POST-OP	PRE-OP LCPI(%)	POST-OP LCPI(%)	POST-OP CARRYING ANGLE	COMPLI CATION	RESULT
1	12	130*	0*	130*	-10.64	11.11	10*	None	Excellent
2	10	120*	0*	130*	-17.95	-12.82	14*	Ulnar nv. neuropraxia	Excellent
3	11.5	100*	0*	100*	-45.95	-9.09	8*	None	Excellect
4	11	130*	0*	130*	-3.34	-1.65	18*	None	Good
5	5	125*	0*	135*	-7.69	-12.93	15*	None	Excellent
6	7	1108	0*	110*	15.56	26.08	12*	Superficial infection	Poor
7	9	135*	0*	135*	-8.11	0	4*	None	Good
8	10	120*	0*	120*	-28.89	0	8*	None	Good
9	9	135*	0*	135*	-36.82	-4.76	14*	None	Excellent
10	8.5	130*	0*	130*	-40.00	-40.54	12*	None	Excellent
11	8	110*	0*	110*	-13.64	-4.00	9*	None	Excellent
12	7	135*	0*	135*	2.44	-8.33	25*	None	Good

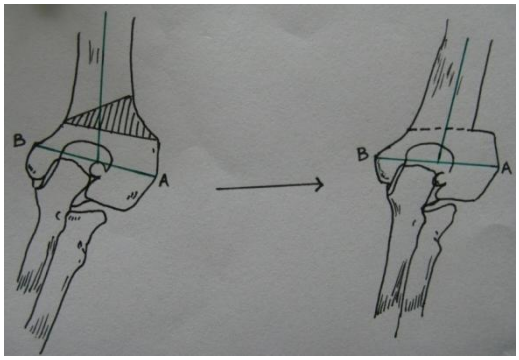
DISCUSSION

DISCUSSION

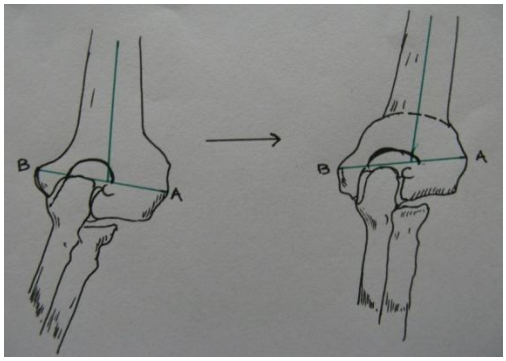
Cubitus varus is one of the most common complications of supracondylar fractures of the humerus in children treated with nonoperative management without reduction and fixation. It's reported incidence varies from 4% to 58%. It may result from inadequate reduction, from loss of reduction with consequent malunion or from disturbance of growth at the lower end of the humerus. Most authors consider the deformity to result from inadequate reduction that leaves a residual rotatory deformity that can collapse into medial tilt and therefore results in a varus deformity. In my series, all 12 patient had previous history of supracondylar fracture of humerus and all these fractures were treated conservatively .There was no history of any other associated injury.

Although cubitus varus has recently been reported to be associated with ulnar neuropathy, snapping of the medial portion of the triceps,secondary distal humeral or lateral condylar fracture, avascular necrosis of the distal humeral epiphysis, and tardy postero lateral rotatory instability of the elbow, in most of the patients the usual presenting complain is an unsightly deformity rather than a functional disability. In my study , the indication for surgery in all 12 patients was an unsightly deformity .All of the patients have normal elbow function .

Various corrective procedures for cubitus varus deformity have been described. These include medial opening wedge osteotomy, lateral closing wedge osteotomy, lateral closing wedge osteotomy with simultaneous derotation arc osteotomy, pentalateral osteotomy and dome osteotomy . The lateral closing wedge osteotomy is the most commonly used procedure to correct the deformity. However, in osteotomies that do not allow translation of the distal humerus, the appearance of the joint after surgery is different from that of the unaffected side, as if the varus deformity still exists, although the carrying angle of the affected elbow is corrected to match the angle of the unaffected side. Thus, it was said that this residual cosmetic appearance might be due to a radial shift in the distal fragment of the humerus, relative to the proximal humeral shaft, causing a protrusion of the lateral humeral condyle.Wong et al reported an incidence of 64% of this complication in a series of 22 patients. The cause of this prominence of the lateral condyle is inherent in the design of the lateral closing wedge osteotomy. Excision of the wedge leaves two fragments of unequal width and hinging on the medial cortex, whereas closing the osteotomy effectively shifts the distal fragment laterally, thus making the lateral condyle more prominent and compromising the cosmetic out come.



Lateral closing-wedge osteotomy results in two fragments of unequal widths and the lateral condyle becomes prominent



In contrast, no such lateral condylar prominence occurs after dome osteotomy

Tachdjian, who did not report any results, first describe the dome osteotomy for correction of cubitus varus. Good results with out complications were reported by Kanaujia et al [19] and Tien et al. In my series, except one none of the other patients had lateral condylar prominence after correction of the deformity be the technique of dome osteotomy. The lateral condylar prominence index improved in 11 out of 12 patient. Dome osteotomy uses the midline of the humerus as the centre of rotation, therefore, the lateral condyle dose not shift with reference to the midline and the lateral condyle is thus prevented from becoming prominent.

Apart from the tendency to produce lateral condylar prominence, lateral closing wedge-osteotomy has another pitfall. The center of rotation of the distal humeral fragment is located at the medial cortex, making a large rotation arc necessary for the distal fragment to be mobilized during correction of the deformity. This result in the further tightening of the already contracted medial structures and a large varus moment acting on the osteotomy site .In this situation, the osteotomy is mechanically unstable, and loss of correction would occur easily if the fixation were inadequate. On the , other hand ,in dome osteotomy ,because the centre of rotation of the distal fragment is at the midline of the humerus ,the varus moment acting at the osteotomy site is much less ,making the osteotomy mechanically more stable.

Ippolito et al 21 reported approximately 60% of the patient reported an unattractive postoperative scar. In my study, one patients reported an unattractive scar because of superficial skin infection. None of my patient had any history of pin tract infection, pin loosening, and elbow stiffness. I used a posterior longitudinal incision to approach the lower end of the humerus. Scar is cosmetically more acceptable after dome osteotomy. The location of the scar is posterior when the arm is hanging down at rest and down when the pronated

forearm is resting on a desk, making the scar more less obvious. The standard lateral longitudinal incision used for the lateral closing wedge osteotomy directly crosses the Langer's lines in that area, leading to a tendency towards hypertrophic scar.

The results of the dome osteotomy for the correction of cubitus varus deformity in my series were comparable to dome osteotomy by various authors in terms of the correction of carrying angle, overall results and the incidence of complications (infection, neurapraxia, loss of correction) .

CONCLUSION

CONCLUSION

Twelve patients between 5-15 years of age were selected with cubitus varus deformity all of whom presented after 12 months of appearance of the deformity. Seven of the patients were males and the rest were females. The entire patient had previous history of supracondylar fracture.

Pre-operatively carrying angle, lateral condylar prominent index, range of motion were recorded.

The patients were treated with dome osteotomy.A posterior longitudinal midline incision was used for the osteotomy. After osteotomy, fixation of the osteotomy site was done by giving cross K- wires.

There were no intraoperative complications.

Post–operatively, one patient developed superficial skin infection. Other complications in our study were one patient had ulnar nerve neurapraxia; one patient had cosmetically unacceptable scar. But no elbow stiffness, pin tract infection, nonunion of osteotomy site was there.

Active range of motion exercises of the elbow were started 5 weeks after the operation .The cases were followed up on a weekly basis till the removal of the k- wire. Then it was fortnightly basis till acceptable uncomplicated range of motion was regained and monthly thereafter.

The results were graded according to the pre-operative and post- operative carrying angle, movement of flexion and extension, lateral condylar prominence index and they were statistically evaluated.

Pre-operative and post-operative extension, carrying angle and lateral condylar prominence index has got statistical significance.

I conclude that dome osteotomy for the correction of the cubitus varus deformity is associated with an excellent cosmetic outcome and low complication rates. Dome osteotomy was found to have the following advantages for correction of cubitus varus deformity: the osteotomy site is more stable than a lateral closing wedge osteotomy for maintaining the correction, it avoids the lateral condyle becoming prominent and the posterior scar is more cosmetically acceptable than the lateral scar in the lateral closing wedge osteotomy. Dome osteotomy is a simple, safe and technically sound procedure that prevents the lateral condyle from becoming prominent and yields a near-normal cosmetic outcome.

CLINICAL PHOTOGRAPHS

CLINICAL PHOTOGRAPHS



Pre Operative photograph of Mithun Talukdar ,7yrs old boy.

Pre-operative AP View of affected side

Pre-operative Lat View of affected side

Immediate post-operative radiograph AP View

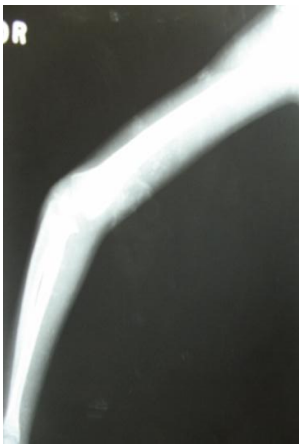
Immediate post-operative radiograph Lateral view

Follow-up after 12 months

Follow-up after 12 months showing extension

Follow –up 12 months showing flexion

Post-operative follow-up after 12 months AP View



Pot-operative follow-up after 12 months Lateral View

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