



International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2015; 2(1): 01-05
© 2015 IJOS
www.orthopaper.com
Received: 07-10-2015
Accepted: 09-11-2015

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Observations on the correction of cubitus varus post supracondylar fracture of humerus by lateral closed wedge osteotomy and plating in adolescents and adults: A case study of 12 patients

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Abstract

Objective: To study the results of lateral closed wedge osteotomy and plating for correction of cubitus varus in adolescents and adults.

Materials and methods: This prospective study was conducted in post-graduate department of orthopaedics, Government Medical Srinagar, J&K “between” May 2012 to June 2015. A total of 12 patients with cubitus varus secondary to malunited supracondylar fracture in the age group of 15-25 years were treated by lateral closed wedge osteotomy and fixed with a plate. Patients were properly assessed preoperatively and postoperatively.

Results: A total of 12 cases with 7 males and 5 females with a mean age of 19.41 years. Most cases were right handed forming 8 of the 12 cases (66.66%). Mean carrying angle on the normal side was 9.16 degrees while mean varus deformity of the affected side was 17.16 degrees. Follow-up period ranged from 6 to 24 months. Postoperative valgus achieved was with a mean of 8.66 degrees which is close to the mean of carrying angle on normal side. Mean range of motion preoperatively was 134.16 degrees while postoperatively it was 132.5 degrees. There was a hyperextension of 10 degrees in one patient who continued to have the same in the postoperatively. One patient had loss of terminal 5-10 degrees of extension. Mean time for clinical union was 11.75 weeks. Lateral condylar prominence index improved from a mean of 5.23(ranging from 2.5-7.8) to -10.95(ranging from -5 to -18.4). Good to excellent results were observed in all patients.

Conclusion: Lateral closed wedge osteotomy with plating is a safe and effective method of correction of cubitus varus in adolescents and adults.

Keywords: Supracondylar humeral fractures, cubitus varus, corrective osteotomy.

1. Introduction

Supracondylar fractures of humerus form 50-70% of pediatric elbow fractures. [1, 2] Cubitus varus is the most common angular deformity of the supracondylar fracture in children and adults, which most commonly results from entrance and rotation of distal fracture fragment and the poor union of this fracture. Growth cessation is another factor for progressive cubitus varus deformity for which in addition to above factors, osteonecrosis and overgrowth of lateral condyle is also responsible. [2, 3, 4] Cubitus varus is more common after conservative management (upto 58%). [5, 6] Presently closed reduction and percutaneous pinning under c-arm is the recommended treatment for displaced supracondylar fractures which has significantly reduced the cubitus varus deformity following these fractures. [7-11] although it rarely poses a functional problem but most patients are concerned with it cosmetically. Correction of cubitus varus deformity can be done by various types of osteotomies (lateral closed wedge, medial open wedge, step-cut, oblique and rotational osteotomies, etc) which use different methods of implants for fixation like k-wires, external fixator (monolateral as well as illizarov ring fixator), screws with s-s wire, plates, etc with their respective immediate and delayed complications (nerve injuries, pin infections, stiffness, delayed union and non-union, etc). [12-22] Surgical treatment of cubitus varus in adults is more challenging in view of poor remodeling due to growth cessation, osteotomy union problems, infections, stiffness, neurovascular complications, etc. [23] So keeping in view above complications, we used lateral closed wedge osteotomy with plating to correct our adult cubitus varus deformities.

2. Materials and methods

This prospective study was conducted in post-graduate department of orthopaedics, Government Medical Srinagar, J&K 'between' May 2012 to June 2015. A total of 12 patients were taken in our study with 7 males and 5 females in the age group of 15-25 years. Patients were assessed properly preoperatively for range of motion, neurovascular status and any other deformity in the affected limb. Patients having problems in these parameters were excluded. Contralateral limb was also examined and was normal in all patients. Radiologically patients were also examined and compared to normal side. Pre-operative carrying angle and lateral condylar prominence index were also were calculated and fitness for anaesthesia was sought.

Surgical procedure

Under general anaesthesia with patient in prone position and using tourniquet with triceps retracting approach, distal humerus was subperiosteally exposed. Osteotomy site was marked and osteotomy was done using a power saw with proper cutting of the wedge as per pre-operative parameters. Now the two ends were approximated and correction was checked. After the required correction was achieved, osteotomy was fixed with 3-7 hole reconstruction or locking plate with the required number of screws. Wound was closed. Tourniquet was removed. Radial pulse checked and long arm splint in the form of crammer wire or long arm slab was given in 90 degree flexion.

Patients were kept admitted and check x-ray was done on 1st postoperative day and distal neurovascular status was checked. Wound examination and dressing was done on 2nd postoperative day and patients were usually discharged by 3rd or 4th day. Stitches were removed at 2 weeks and splint was removed and gentle range of motion was started. Repeat x-rays were done at 2, 6, 12, 24 weeks. At final follow-up, range of motion, carrying angle, union, lateral condyle prominence index were assessed.

3. Results

(Table 1): In our series, we had total of 12 cases with 7 males and 5 females. Patients were ranging from 15 -25 years of age with a mean age of 19.41 years. Most cases were right handed forming 8 of the 12 cases (66.66%). Carrying angle on the normal side ranged from 5-12 degrees with a mean of 9.16 degrees while varus deformity of the affected side ranged from 12-28 degrees with mean of 17.16 degrees. Follow-up period ranged from 6 to 24 months. Post-operatively valgus ranging from 6-12 degrees with a mean of 8.66 degrees was achieved which is close to the mean of carrying angle on normal side. Range of motion preoperatively was from 130-140 degrees of flexion with a mean of 134.16 degrees while postoperatively range of motion was 125-140 degrees of flexion with a mean of 132.5 degrees. There was a hyperextension of 10 degrees in one patient who continued to have the same postoperatively. One patient had loss of terminal 5-10 degrees of extension. Mean time for clinical union was 11.75 weeks, ranging from 8-24 weeks. Lateral condylar prominence index improved from a mean of 5.23(ranging from 2.5-7.8) to -10.95(ranging from -5 to -18.4). Complications in the form of mild stiffness was present in most patients in the early follow-up period but it was restored to near normal in almost all patients with physiotherapy(Fig1a-1d showing radiographs of one of the patient, pre-op to final follow-up). One male patient (fig 2a-2d) who was pre-operatively fixed with locking plate developed delayed union as per history and examination along with

radiographs who was re-operated at 12 weeks via olecranon osteotomy approach where ends were freshened, approximated, bone graft was added and was fixed with two plates (locking & reconstruction plate) to ensure stable fixation, as of which early range of motion was started. Osteotomy finally united at a period of 24 weeks with loss of terminal extension of 5-10 degrees. No other complications were seen. Final results were assessed by means of Bellmore criteria [22] which included range of motion (<10,10-20,>20 degrees difference),carrying angle(5-6,6-10,>10) and lateral condylar index(no increase,<25% increase,>25% increase) with good to excellent results in all patients. All patients were satisfied. We had no poor results.



Fig 1a: Preoperative X-Ray with cubitus varus



Fig 1b: 1st day postoperative X-Ray



Fig 1c: X-Ray at 6 weeks



Fig 1d: X-Ray at 12 weeks



Fig 2b: 1st day postoperative X-Ray after reoperation of delayed union



Fig 2a: showing delayed union of osteotomy



Fig 2c: final X-Ray showing united osteotomy



Fig2d: Final range of motion of the same patient

Table 1: (showing results of all patients) as below

S. No.	Age	Sex	Ca (Normal)	Varus	Ca (Post)	Rom (Pre)	Rom (Post)	Union Time (Weeks)	Lcpi (Pre)	Lcpi (Post)
1.	15	M	8	12	10	140	140	8	2.5	-7.5
2.	19	M	10	15	7	135	135	12	4.5	-12.5
3.	18	M	10	20	8	135	135	12	5	-8
4.	18	F	12	12	10	130	130	10	7.5	-5
5.	16	M	8	15	8	140	140	9	3	-8
6.	20	M	12	25	10	135	125	24	7	-14
7.	18	F	12	15	10	135	130	10	5.5	-10.5
8.	19	F	10	28	8	130	130	12	8	-10
9.	25	F	8	12	7	130	130	12	6.5	-18.4
10.	23	M	5	14	8	130	130	11	3	-11.5
11.	22	F	8	18	6	135	135	11	7.8	-14.6
12.	20	M	7	20	12	135	130	10	2.5	-11.5

Ca=Carrying Angle, Pre=Preoperative, Post=Postoperative, Rom=Range of Motion, Lcpi=Lateral Condyle Prominence Index.

4. Discussion

Cubitus varus is one of the commonest deformity in paediatrics following supracondylar fracture. In developing countries where due to poor awareness and lack of easy access to health facilities, these patients are usually managed either by local bone setters or by simple closed reduction and slab application without pinning (with incidence as high as 58% by conservative methods) ^[5, 6, 23] as a result of which they develop this deformity. In our series, most patients were by slab only without any pinning and few were treated by bone setters. Corrective osteotomy for cubitus varus is usually done in children. Although there are available studies about correction of cubitus varus in adolescents and adults, but detailed literature is lacking.

S. Pandey ^[23] *et al.* corrected cubitus varus in young adults in a series of 7 patients where he used lateral closed wedge osteotomy and fixed with k-wire, S-S wire and screw. He found excellent results in all patients except one who had lateral condylar prominence. In our study most of the results are comparable to the study of S. Pandey *et al.* except a case of delayed union which we re-operated as mentioned earlier.

Min Yu ^[24] *et al.* treated 12 patients of cubitus varus deformity post-supracondylar fracture in children and adolescents and found that lateral close wedge osteotomy is the safest and most effective method for correction of cubitus varus irrespective of plate positioning whether placed laterally or posterolaterally. They achieved good to excellent results in all cases without any loss of motion and achieved valgus correction in all cases (both groups) with resemblance to normal contralateral elbow. Muhammad Ayaz Khan ^[25] *et al.*, in a case series of 30 patients used modified lateral closed wedge osteotomy in children and adolescents in the age group of 7-14 years where they fixed the osteotomy with two screws and figure of eight tension band wire supplemented with two k-wires. They achieved valgus correction in all patients with near normal range of motion and improved Lateral prominence index .28(93%) patients achieved good to excellent results. They concluded this as simple, reliable, acceptable and effective method of correction.

Hyun Sik Gong ^[26] *et al.* used oblique closed wedge osteotomy with lateral plating in 12 adult patients with mean age of 39 years (31-48) who had cubitus varus post-supracondylar fracture. The delay between trauma and osteotomy was mean of 33 years. They found excellent results in all cases with maintained range of motion, improved humero-elbow-wrist angles and negative lateral prominence index (except one patient whose lateral prominence index increased by 10%). They believed lateral oblique closed wedge osteotomy provides larger contact area with effective fixation by a plate and a lag screw which ensures early motion and stable fixation.

Hahn SB ^[27] *et al.* used dome osteotomy in 16 adult patients of cubitus varus deformity with a mean age of 31.1 years with mean postoperative carrying angle of 6.1 degrees and good to excellent results in all cases.

Issa Sawaqed ^[28] corrected cubitus varus in 12 cases in 7-14 years age group by lateral closed wedge osteotomy and found good to excellent results in 92% of cases.

Other studies on cubitus varus correction in adults are there like Matsushita T ^[29] *et al.* which used arc osteotomy in 3 postpubertal patients with a mean age of 20 years, fixed with pinning and cast immobilization for 6-8 weeks and found decrease arc of motion in 2 out of the 3 patients, by 40 and 10 degrees. Pentalateral osteotomy by Laupattarakasem W ^[30] *et al.* in 108 patients was done with a mean age of 14 years with

satisfactory results but information about patients older than 15 years was not available. Tinen ^[31] *et al.* did dome osteotomy via olecranon osteotomy approach in two postpubertal patients to apply plate posteriorly, both lost motion of 20 and 30 degrees. Chung MS ^[32] *et al.* performed three dimensional osteotomy in 23 adult patients with one case of myositis ossificans and one nerve palsy. Kim HT ^[12] *et al.* used step-cut osteotomy in patients with average age of 26 years where triceps muscle was divided to apply Y-plate but reported deficit in triceps torque by 3-6% at 3.5 years. We had comparable or better results than above studies which can be explained by the fact that we had younger population than these adult cubitus varus corrective osteotomy studies.

Advantages with this lateral closed wedge osteotomy than other osteotomies is being inherently stable ensuring early range of motion, safe, less chances of non-union, less chances of requirement of bone graft, also it avoids olecranon osteotomy and triceps division but problems with this osteotomy is shortening of limb and lateral condylar prominence which is more evident in adults due to problems of remodeling in adults as reported by Wong ^[33] *et al.* and Voss ^[4] *et al.* Problems with unsightly lateral scar due to crossing of Langer's lines as reported by Ippolito ^[34] *et al.* and with correction of rotation which although is less evident due to compensation by shoulder ^[29].

5. Conclusion

We conclude that lateral closed wedge osteotomy is safe, effective and easy procedure for the correction of cubitus varus even in adults, although problems with our study was small sample size and lack of control group.

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