

Original Research Article

Evaluation of management of malunited supracondylar fracture of humerus by lateral closing wedge osteotomy

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ABSTRACT

Background: Various osteotomies have been in use for correction of varus deformity at elbow secondary to malunited supracondylar humerus fracture in children. The objectives of the study were to determine the efficacy & outcome of lateral closing wedge osteotomy in children as a treatment of malunited supracondylar fracture of humerus with cubitus varus and to evaluate various technical problems, morbidity, complications of Lateral closing wedge osteotomy and to suggest ways to overcome them.

Methods: This prospective study was conducted among 50 cases of malunited supracondylar fracture of humerus who visited in OPD during 1st September 2008 to 31st August 2010. After pre-operative assessment, lateral closing wedge osteotomy was done and fixed with two 3.5 mm screws, figure of eight tension band stainless steel wire and a supplemental lateral k-wire. Post operatively x-ray of patient was taken and carrying angle and range of movement were calculated. Patients were re-assessed at complete union.

Results: Maximum patients were from the age group of 8 to 10 years- 22 cases, mean age 13.08 years, 80% male. Left (non-dominant) side was involved in 30 (60%) cases. Around 18% cases developed complications. 25 (50%) patients had no loss of range of movement and 2 (4%) had 16 to 20 degrees loss of range of movement. Almost 36 (72%) cases had excellent outcome, 11 (22%) cases had good outcome, 3 (6%) cases had poor outcome due to loss of fixation, 47 (94%) patients/parents were satisfied with the final outcome.

Conclusions: Lateral closing wedge osteotomy with a lateral K-wire is a sound, cost-effective, technically less demanding modality of treatment for varus deformity due to malunited supracondylar fracture of humerus in children with minimum complications.

Keywords: Children, Deformity correction, Malunion, Osteotomy, Supracondylar fracture of humerus

INTRODUCTION

Most common late complication after supracondylar fracture of distal humerus in children is cubitus varus deformity, incidence varying from 4% to 58%.^{1,2} Between 5-10 years of age, elbow injuries are most commonly observed in skeletally immature children.^{3,4} Supracondylar fractures are the most common elbow injuries as metaphyseal area of the distal humerus is the weakest region around the elbow. Also, the frequent falls

in small children while playing, cycling or fall inside the house from bed, sofa has added to the increase in incidence.^{5,6}

Vascular compromise, compartment syndrome, neurological deficit, elbow stiffness, pin track infections, myositis ossificans, nonunion, osteonecrosis, loss of reduction, hyperextension, and cubitus varus are the most common complications of a supracondylar fracture and its treatment.⁷ Cubitus varus, along with malunion, is

observed in type 3 supracondylar humerus fractures, which is when complete displacement occurs with no cortical contact according to the Gartland classification.⁸ New recent advance research done in methods of repairing supracondylar fractures have significantly decrease the events of cubitus varus malunion.⁹ Dome osteotomy successfully provides highest stability of maintaining the correction, avoids lateral condyle becoming more prominent and less scar, but it needs special instruments and expertise to perform.¹⁰ The present study was carried out with the objectives to determine the efficacy and outcome of Lateral closing wedge osteotomy in children as a treatment of malunited supracondylar fracture of humerus with cubitus varus and to evaluate various technical problems, morbidity, complications and to suggest ways to overcome them.

METHODS

This prospective study was conducted among 50 cases of malunited supracondylar fracture of humerus who visited in O.P.D. of Shree Annasaheb Shinde Mhaishalkar Charitable Trust's Post Graduate Institute of Orthopaedics, Mhaishalkar Shinde Orthopaedic Research Centre and Accident Hospital, Sangli, Maharashtra during 1st September 2008 to 31st August 2010. Study included all the patients who visited OPD during study period, Age was more than 5 years and less than 16 years, and who had cubitus varus secondary to malunion of supracondylar fracture of humerus. We excluded patients whose age was more than 16 years, patients with cubitus varus deformity secondary to other fractures around elbow (intercondylar or physeal injury) and patients having malunited supracondylar fracture of humerus with neurological complications as additional anterior transposition of ulnar nerve is needed in such cases. Study participants were thoroughly evaluated for the deformity and any other associated complaints like pain, whether the deformity was varus or valgus. Three bony point relationship was checked in both elbows to know the cause of the varus deformity i.e. supracondylar fracture humerus or physeal injury. Lengths of both arms and forearms were measured to rule out physeal injury. Clinical carrying angle was determined by drawing the long axis of the arm and forearm of both hands. Presence of any complications of varus deformity in the patient like limitation of movements, ulnar neuropathy, snapping of the medial head of the triceps, secondary distal humeral or lateral condylar fracture, osteonecrosis of the distal humeral epiphysis, joint ganglia, osteoarthritis etc. was checked and noted. Pre-operative routine investigations: Hb, CBC, ESR, Serology, chest x-ray, pediatric and anaesthesia fitness, written and informed consent for surgery, both upper limb Antero-posterior and lateral radiographs were done. Radiographic measurements included angle measurements on the Antero-posterior and lateral views.

After all the aforementioned investigations were done patient was taken for surgery. On the operative upper

limb a tourniquet was applied to the proximal arm and was inflated to appropriate pressure. Lateral closing wedge osteotomy was performed and the wedge as calculated on x-rays was removed. The osteotomy was fixed by two screws and figure of eight tension band wire. The fixation was supplemented with one lateral K-wire. Post operatively the limb was immobilized in above elbow cast at 100 degree flexion with forearm in full supination. Strict limb elevation was given for first 5 days. First check dressing was done on post operative day 2 by making a window at incision site. On post operative day 14 suture removal was done, the window closed and cast continued for 6 weeks. After 6 weeks the cast was removed and check x-rays taken and the correction of deformity achieved was measured clinically and radiologically. Mobilization was started when radiological evidence of callus was evident. Post operatively the patients were evaluated according to Oppenheim's criteria. Parent and patient satisfaction with the final appearance and function of the limb was also taken into consideration.

Operative technique

Anesthesia was given by infraclavicular/supraclavicular Block OR General Anesthesia. Patient was given supine position with his affected limb resting on the radiolucent arm board. Image intensifying television (C Arm) was arranged near the foot end of the operating table. Appropriate size tourniquet was applied to proximal humerus and attached to the tourniquet machine after anesthesia. The arm was prepped and draped up to just below the tourniquet after scrubbing by Betadine scrub, cleaning with spirit and painting with betadine solution. Thereafter the image intensifier was draped into the surgical field. Tourniquet was inflated to appropriate pressure and lateral closing wedge osteotomy was performed in stepwise manner as below:

Postero lateral skin incision was made along the lower arm. The lateral third to half of the triceps muscle was reflected from its insertion. The desired correction was calculated pre operatively on antero posterior view by adding the differences of humero-ulnar angle of both elbows and adding normal valgus angle of normal elbow. 2 K-wires were inserted at the proposed osteotomy site. One proximally which was passed perpendicular to the shaft of humerus under IITV guidance and one distally which was passed parallel to the elbow joint line under IITV guidance so that they converge at the medial cortex of the humerus. After checking the placement of K-wires under the C-arm, two cortical screws were inserted. Proximal screw was proximal to the K-wire and directed postero anteriorly while the distal screw is distal to the distal K-wire and directed antero posteriorly. After removing measured wedge, the fragments were aligned with the help of pre-placed K-wires. Rotation deformity was corrected by rotating the distal fragment until the distal screw was directly distal to the proximal screw. The fixation was then secured with the help of figure of

eight tension band wiring loop around the screws heads after achievement of reduction of osteotomy. This fixation was supplemented by one K-wire inserted from the lateral condyle passing through the osteotomy site and engaging the opposite proximal medial cortex. The wound was closed in layers using Vicryl 2-0 and Ethilon 3-0. Dressing done. Above elbow plaster of Paris slab was then applied in 100 degree flexion and full supination.

RESULTS

Table 1: Clinico-demographic characteristics of study participants (n=50).

Sr. No.	Variable	N (%)
1	Age (in years)	
	5-7	7 (14)
	8-10	22 (44)
	11-13	15 (30)
	14-16	6 (12)
	Mean Age (mean ± SD)	13.08 ± 4.6
2	Gender	
	Male	40 (80)
	Female	10 (20)
3	Side of the Extremity Involved	
	Right/Dominant	20 (40)
	Left/non-dominant	30 (60)
4	Pre-operative Varus Angle	
	(-11)-(-15)	11 (22)
	(-16)-(-20)	24 (48)
	(-21)-(-25)	14 (28)
	(-26)+	1 (2)
5	Time Interval from Injury to The Elbow and Surgery (in years)	
	2 – 4	39 (78)
	4 – 6	10 (20)
	>6	1 (2)
6	Age at which primary trauma occurred (in years)	
	4-5	10 (20)
	6-7	20 (40)
	8-9	16 (32)
	10-11	4 (8)

Table 1 shows that the average age being 13.08 years with 4.6 SD, the youngest patient in our study was 6 years old, and the oldest being 15 years of age. Maximum number of patients (44%) were from age group of 8 to 10 years. Number of male patients is 40 (80%) while number of female patients is 10 (20%), who represented to the O.P.D. with complaint of deformity of elbow, within the specified duration and were eligible according to the inclusion criteria. Amongst the cases included, the Left (non-dominant) side was involved more frequently i.e. in 30 cases constituting 60 % of total, as compared to the Right (dominant) side which suffered injury in 20 cases

(40%). Pre- operatively amongst 50 patients 24 patients (48% of total) had varus angle of (-16) to (-20) degrees, 14(28%) had varus angle of (-21)-(-25) degrees, 11 (22%) had varus angle of (-11)-(-15) and 1 (2%) had a varus angle more than (-26) degrees. Out of 50 cases most of the cases were seen 2 years after the initial injury (38/50) while 28, 18, 12, 2, and 2 cases were seen after 3, 5, 4, 6 and 7 years of initial injury respectively. Out of 50 patients studied, 20 patients (40%) were 6-7 years old, when they suffered from primary injury in the form of supracondylar fracture humerus while, 16 patients (32%) were 8-9 years old, 10 patients (20%) were 4-5 years old and only 4 patients (8%) were 10-11 years old.

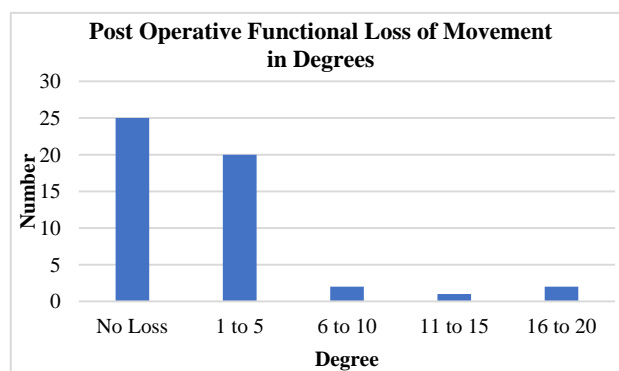


Figure 1: Functional loss in terms of loss of motion post operatively (n=50).

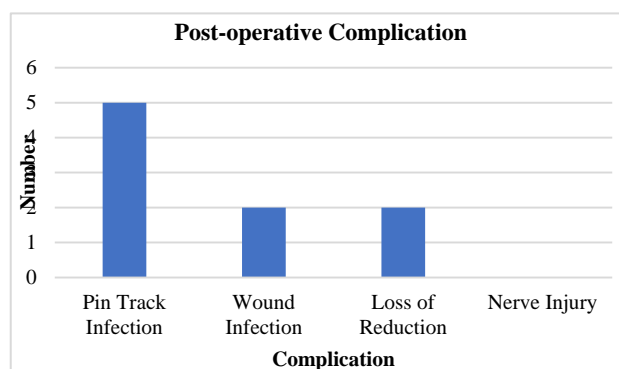


Figure 2: Post-operative complications among study participants (n=50).

Figure 1 shows that Amongst the 50 patients studied, 25 patients (50%) had no loss of movement, 20 patients (40%) had loss of 1 to 5 degrees of terminal flexion, 2 patients had loss of 6 to 10 degrees of terminal flexion while another 1 patient (2%) had loss of terminal 11 to 15 degrees of flexion and 2 patients (4%) had loss of terminal 15 to 20 degrees of terminal flexion compared to the normal opposite limb.

Figure 2 shows that pin loosening/ pin track infection of superficial type was detected in 5 patients (10%), wound infection in 2 patients (4%), loss of reduction in 2 patients (4%). Post-operative nerve injury was not observed.

DISCUSSION

Present study included 50 cases of Cubitus varus secondary to malunion of supracondylar fracture of humerus visited at the O.P.D. of Shree Annasaheb Shinde Mhaishalkar Charitable Trust's Post Graduate Institute of Orthopaedics, Mhaishalkar Shinde Orthopaedic Research Centre and Accident Hospital, Sangli, Maharashtra during 1st September 2008 to 31st August 2010 and treated by lateral closed wedge osteotomy fixed by two screws and figure of eight tension band wire. The fixation was supplemented with one lateral K-wire.

In our study, highest number of participants belonged to 8 to 10 years age group. This findings are correlate with the similar study done by Farnsworth et al, Hanlon et al and Cheng et al.¹¹⁻¹³ Male: female ration in our study was 4:1 and this finding is comparable with similar study Wilkins et al, Sath et al, Farr et al and Verka et al and not correlate with the similar study done by Farnsworth et al, David et al and Hanlon et al.^{11,12,14-17} Higher incidence of cases in boys in this series may be due to social factor. Girls are less active than boys so less exposed to risk of injury while playing. Among the 50 patients left (non-dominant) side was involved in 30 (60%) cases while remaining i.e. 20 (40%) patients right (dominant) side was involved. Similar study done by Cheng JC, Farnsworth, Houshian, Topping and Verka et al also found the non-dominant side (left) to be more frequently affected than the dominant side.^{10,11,13,18} Pre- operatively amongst 50 patients 24 patients (48% of total) had varus angle of (-16) to (-20) degrees. This finding doesnot correlate with the similar study done by Verka et al.¹⁰

Out of 50 patients 9 (18%) patients developed minor complications, of which 5 (10%) had lateral K-wire loosening or minor pin track infection, 2 (4%) had wound infection and 2 (4%) had loss of reduction. Similar complications were also observed in other study done by Sath et al, Farr et al, Verka et al and Tien et al.^{10,15,16,19} Among 50 patients 25 (50%) patients had no loss of range of movement while 20 (40%) had 1 to 5 degrees of loss of range of movement, 2 had 6 to 10 degrees loss of range of movement, 1 had 15 degrees loss of movement and remaining 2 had 16 to 20 degrees loss of range of movement. Passive flexion and extension was started immediately after the supplemental K-wire was removed and signs of callus formation were noted radiographically. This finding correlates with the similar study done by Verka et al, Tien et al, Wong et al and Skaggs et al.^{10,19,21}

CONCLUSION

The best method of correcting a varus deformity secondary to malunited supracondylar humerus fracture is by appropriate osteotomy. Of the various osteotomies lateral closing wedge osteotomy is a very simple, easy and cost-effective method. It is inherently very stable osteotomy with minimal complications. Addition of a

lateral K-wire adds to its stability. When done correctly excellent to good results can be easily obtained. Neurological complications are too rare. Lateral closing wedge osteotomy with a lateral K-wire is a sound, cost-effective, technically less demanding modality of treatment for varus deformity due to malunited supracondylar fracture of humerus in children with minimum complications which has proved true in our study.

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Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Hayer A. Treatment of supracondylar fracture of the humerus by skeletal traction in abduction splint. *J Bone Joint Surg Am.* 1952;54:623-37.
2. Piggot J, Graham MK, McCoy GF. Supracondylar fracture of the humerus in children: Treatment by straight lateral contraction. *J Bone Joint Surg.* 1986;68:577-83.
3. Henrikson B. Supracondylar fracture of the humerus in children. A late review of end-results with special reference to the cause of deformity, disability and complications. *Acta Chir Scand Suppl.* 1966;369:1-72.
4. Wilson PD. Fractures and dislocation in the region of the elbow. *Surg Gynaecol Obstet.* 1933;56:335-59.
5. Cramer KE, Green NE, Devito DP. Incidence of anterior interosseous nerve palsy in supracondylar humerus fractures in children. *J Pediatr Orthop.* 1993;13(4):502-5.
6. Spinner M, Schreiber SN. Anterior interosseous-nerve paralysis as a complication of supracondylar fracture of the humerus in children. *J Bone Joint Surg Am.* 1969;51(8):1584-90.
7. Beaty JH, Kasser JR (eds) *Rockwood and Wilkins' fractures in children*, 7th edn. Lippincott Williams and Wilkins, Philadelphia; 2010: 488-532.
8. Gartland JJ. Management of supracondylar fractures of the humerus in children. *Surg Gynecol Obstet.* 1959;109:145-54.
9. Tellisi N, Abusetta G, Day M. Management of Gartland's type III supracondylar fractures of the humerus in children: the role audit and practice guidelines. *Injury.* 2004;35:1167-71.
10. Verka PS, Kejriwal U, Singh B. Management of Cubitus Varus Deformity in Children by Closed Dome Osteotomy. *J Clin Diagn Res.* 2017;11(3):8-12.
11. Farnsworth CL, Silva PD, Mubarak SJ. Etiology of supracondylar humerus fractures. *J Pediatr Orthop.* 1998;18(1):38-42.
12. Hanlon CR, Estes WL. Fractures in childhood: A statistical analysis. *Am J Surg.* 1954;87:312-23.

13. Cheng JC, Lam TP, Shen WY. Closed reduction and percutaneous pinning for type III displaced supracondylar fractures of the humerus in children. *J Orthop Trauma.* 1995;9(6):511-5.
14. Wilkins KE: Residuals of elbow trauma in children. *Orthop Clin North Am.* 1990;21:291.
15. Sath S, Shah NA, Peerzada MS. 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. *Int J Orthop Sci.* 2016;2(1):1-5.
16. Farr S, Ganger R, Girsch W. Distal humeral flexion osteotomy for the treatment of supracondylar extension-type malunions in children. *J Pediatr Orthop.* 2017;26(3):195-6.
17. David L, David G, Weiss JM, Kay RM. A new surgical technique for the treatment of supracondylar humerus fracture malunions in children. *J Child Orthop.* 2011;5:305-12.
18. Houshian S, Mehdi B, Larsen MS. The epidemiology of elbow fracture in children: analysis of 355 fractures, with special reference to supracondylar humerus fractures. *J Orthop Sci.* 2001;6:312-5.
19. Tien YC, Chin HW, Lin GT. Dome corrective osteotomy for cubitus varus deformity. *Clin Orthop Rel Res.* 2000;380:158-66.
20. Wong HK, Lee EH, Balasubramaniam P. The lateral condylar prominence. A complication of supracondylar osteotomy for cubitus varus. *J Bone Joint Surg Br.* 1990;72(5):859-61.
21. Skaggs DL, Hale JM, Bassett J, Kaminsky C, Kay RM, Tolo VT. Operative treatment of supracondylar fractures of the humerus in children. The consequences of pin placement. *J Bone Joint Surg Am.* 2001;83(5):735-40.

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