

Original Research Article

Evaluation of the results of cubitus varus deformity by stepcut osteotomy

Ratan K. Paul^{1*}, Mohammad S. Saleheen², Mohammad. Z. Raihan³, Sanjoy Sinha⁴,
Ali Haider⁵, Mohammad R. R. Miah⁶, Mohammad R. Hasan⁷

¹Department of Orthopedic Surgery, Kushtia Medical College, Kushtia, Bangladesh

²Department of Orthopedic Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh

³Department of Neuro Surgery, Kushtia Medical College, Kushtia, Bangladesh

⁴Department of Sports Medicine and Arthroscopy, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh

⁵Daulatpur Upazila Health Complex, Kushtia, Bangladesh

⁶Department of Radiology and Imaging, Kushtia Medical College, Kushtia, Bangladesh

⁷Department of Orthopedic Surgery, 250 beded General Hospital, Kushtia, Bangladesh

Received: 29 June 2024

Revised: 02 August 2024

Accepted: 03 August 2024

*Correspondence:

Dr. Ratan K. Paul,

E-mail: dratankumpaul48@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: A gunstock deformity or varus elbow is the commonest late deformity in supracondylar fractures of the humerus. The elbow is bowed outward making a bow elbow or cubitus varus deformity. The aim of this study was to evaluate the effectiveness of the step cut osteotomy technique for correcting cubitus varus deformity following supracondylar fractures of the humerus

Methods: This prospective observational study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka and 250 beded General Hospital, Kushtia, Bangladesh from July 2010 to June 2018.

Results: The majority 36 patients (75% of total) were aged between 11 to 20 years, 8 patients (16.67% of total) were aged 10 years or younger and 4 patients (8.33% of total) were aged between 21 to 30 years respectively with female male ration 1:5. Majority 44 patients (91.67% of total) were students and 4 patients (8.33% of total) were workers respectively. Left side involvement was in 32 (66.67%) and right side in 16 (33.33%) cases. In our study 20 (42%) cases result was excellent, good in 16 (33%) cases and poor in 12 (25%) cases respectively.

Conclusions: This study demonstrates that the corrective osteotomy of cubitus varus deformity using the stepcut technique is a satisfactory method of treatment.

Keywords: Cubitus varus deformity, Cosmetic outcomes, Elbow alignment, Stepcut osteotomy, Supracondylar fracture

INTRODUCTION

A gunstock deformity or varus elbow is the commonest late deformity in supracondylar fractures of the humerus.¹

The elbow is bowed outward making a bow elbow or cubitus varus deformity.² The incidence of cubitus varus has been reported by various authors to range from 9 to 57 percent. Cubitus varus following supracondylar fracture of

the humerus in children consists of varus, hyperextension and internal rotation deformities of the distal fragment of the humerus.³ The parents are often worried and request the orthopaedic surgeon for correction of deformity. There is little published support for growth disturbance as a cause of deformity after supracondylar fracture. No progression of deformity has been reported in the growing children. It is accepted that the fracture involving the growth plate and epiphysis cause growth disturbance. But by definition, the supracondylar fracture does not involve the epiphysal plate or distal epiphysis. So, true supracondylar fracture does not demonstrate the growth disturbance.⁴ Carrying angle appears early in intrauterine life and is completely developed in the newborn. Under normal condition it is unchanged throughout life and is not altered by secondary sexual development.⁵ A change in the carrying angle after treatment of supracondylar fracture may result from inadequate reduction, from loss of reduction with consequent malunion, or from disturbance of growth at the lower end of the humerus. The acceptance of inadequate reduction is partly due to the great difficulty of assessing the clinical carrying angle in the flexed elbow. It is difficult to obtain adequate anteroposterior and radiographs when the elbow is in this position. The ugliness of the elbow after supracondylar fracture is most apparent when the full elbow movement has returned. This deformity does not affect mobility of the elbow but may limit apparent rotation.^{6,7} Sometime patient of supracondylar fracture remains either untreated or maltreated in our country. The limbs are so swollen during emergency treatment of supracondylar fracture that the patient may have vascular problem, in that case limb salvaging technique are applied, whatever the position of fracture fragments are ultimately supracondylar fracture of humerus unites with the deformity.⁸ Most common deformity is cubitus varus deformity. Most of the parents attend the orthopaedic surgeons when it is ugly looking. There are several fixation techniques of corrective osteotomies of the distal humerus. The dispute lies in the type of fixations which are most stable with minimum complications. The two screws and a figure of eight tension band wire attached between them, plate fixation, crossed Kirschner's wires, staples, external fixation and even no fixations which are most described in the literature. In present series we used to do posterolateral approach for the exposure of the distal humerus. This approach is convenient to see and estimate the carrying angle preoperatively after corrective osteotomy in lateral position with the elbow extended. We have corrected both varus and internal rotation, maintenance of reduction by French Technique and two 'K'wire. The objectives were to evaluate the result of corrective osteotomy of cubitus varus deformity by step cut in 08 to 25 years age group. To identify the functional outcome of the procedure. To identify the advantage of the procedure. To identify the complications of the procedure.

METHODS

This prospective observational study was conducted at the National Institute of Traumatology and Orthopaedic

Rehabilitation (NITOR), Dhaka and 250 bedded General Hospital, Kushtia, Bangladesh from July 2010 to June 2018. Purposive sampling was employed to select 48 patients presenting with cubitus varus deformity, chosen from both outpatient and inpatient departments. Inclusion criteria specified patients aged between 8 to 25 years with unsightly cubitus varus deformity exhibiting varus angulation of 20 degrees or more, following radiologically united and remodeled supracondylar fractures. Exclusion criteria excluded patients with septic foci, elbow joint instability, non-union, or comorbid diseases. Ethical considerations were addressed through obtaining informed written consent from all patients or their guardians, approved by the local ethical committee (NITOR). Data collection utilized a structured questionnaire covering relevant variables, and statistical analysis was performed using SPSS version 16.0, employing descriptive statistics to present findings through tables and charts with appropriate interpretations.

Surgical procedure

The surgical procedure for correcting cubitus varus deformity by stepcut osteotomy involved meticulous preoperative preparation and intraoperative techniques. Patients underwent thorough counseling and pre-anesthetic evaluation, followed by administration of prophylactic antibiotics. Under general anesthesia or regional block, with a lateral patient positioning and pneumatic tourniquet application, a standard posterolateral approach was used.

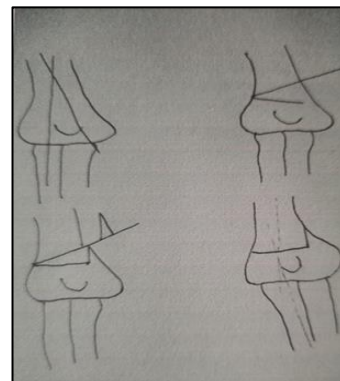


Figure 1: Diagram of stepcut osteotomy.

A template guided the osteotomy placement just superior to the olecranon fossa, with careful drilling and bone removal to avoid neurovascular damage. The distal fragment was translated laterally and posteriorly for correction, secured initially with Kirschner wires and then with screws and wires under C-arm guidance. Careful assessment ensured proper correction in all planes, avoiding joint penetration and epiphyseal damage. Postoperatively, a plaster of Paris splint maintained elbow flexion and supination to stabilize the osteotomy site and facilitate optimal healing and functional outcome. Case records were analysed on the basis of demographic data with special reference to age, sex and incidence. All

patients were examined for their presentation, course of disease, various examination and investigations. These records were also analysed for surgical interventions and outcome.



Figure 2: Operative procedure; (a) skin incision; (b) supracondylar area of humerus (posterior); (c) with template; (d) marking by electrocautery; (e) osteotomy by power saw; (f) resected wedge of bone; (g) after osteotomy; (h) stabilization by k wire (i) preoperative check of correction; (j) fixation by screw and surgical wire; (k) after final fixation;

Postoperative care

Postoperative care included limb elevation and active finger movement, with pain managed by pethidine injections and oral diclofenac. Patients received intravenous ceftriaxone for 3 days followed by oral antibiotics for 10 days, and ranitidine injections followed by oral ranitidine. Routine postoperative X-rays were taken; stitches were removed after 2 weeks with a fresh plaster cast applied for an additional 2-6 weeks. The plaster slab was removed after 4-8 weeks, encouraging active elbow movement. X-rays were taken every 4 weeks to monitor bone union. Follow-ups occurred every 4 weeks, assessing flexion, extension, internal rotation, supination, pronation, deformity correction, scar condition, and functional and cosmetic aspects compared to the healthy limb.

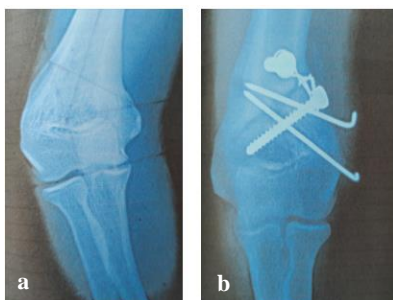


Figure 3 (a and b): Preoperative elbow (A/P view) and post-operative elbow (after union).

RESULTS

This prospective study of the corrective osteotomy of cubitus varus deformity by Step cut osteotomy was carried out in NITOR and 250 bedded General Hospital, Kushtia, Bangladesh during the period from July 2010 to June 2018. Evaluations of the results of the cases in this series were done on the basis of clinical and radiological findings. A total of 48 patients were included in this study. All the patients had been followed up to their complete bony union radiologically. At an average of 9.41 months follow-up, the following findings are presented.

Table 1: Demographic characteristics of our study patients (n=48).

Variables		Number of patients	(%)
Age group (years)	≤10	8	16.67
	11-20	36	75
	21-30	4	8.33
Sex	Male	40	83.33
	Female	8	16.67
Occupation	Student	44	91.67
	Worker	4	8.33

Table 1 summarizes the distribution of patients according to age group, sex, and occupation in the study sample of 48 patients. The majority 36 patients (75% of total) were aged between 11 to 20 years, 8 patients (16.67% of total) were aged 10 years or younger and 4 patients (8.33% of total) were aged between 21 to 30 years respectively with female male ration 1:5. Majority 44 patients (91.67% of total) were students and 4 patients (8.33% of total) were workers respectively. Figure 4 shows cause of injury of our study patients. Out of 48 patients, 28 patients (58.3%) cause of injury was due to fall from tree, 8 patients (16.67%) due to fall from bicycle, 4 patients (8.3%) due to fall from rickshaw and 8 patients (16.67%) due to fall during play. Figure 5 shows side of involvement in our study patients. Left side involvement was in 32 (66.67%) and right side in 16 (33.33%) cases.

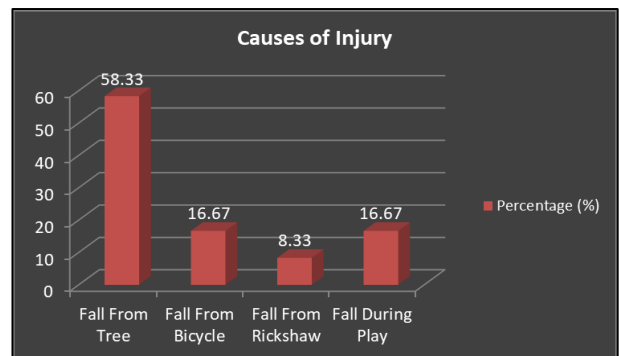


Figure 4: Distribution of our study patients by causes of injury (n=48).

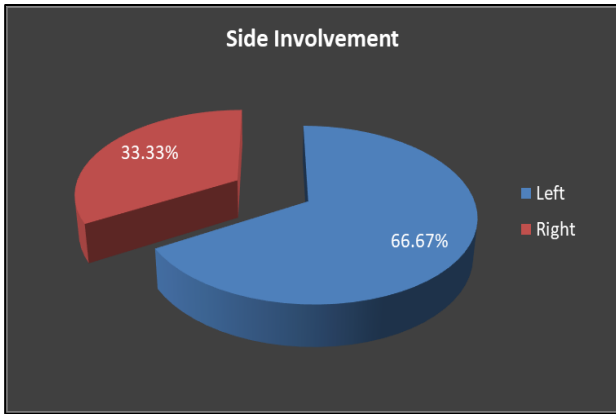


Figure 5: Distribution of our study patients by side involvement (n=48).

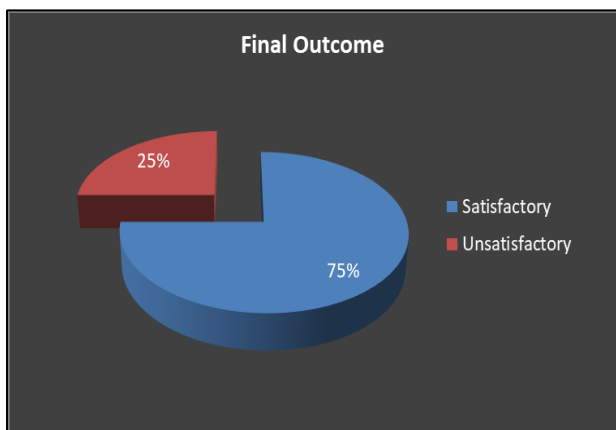


Figure 6: Outcome of our study patients (n=48).

Figure 6 shows outcome of our study patients. Overall satisfactory result (excellent plus good) was achieved in 36 (75%) patients and unsatisfactory result (poor) in 12 (25%) patients respectively.

Table 2: Postoperative complication of our study patients (n=48).

Complications	Number of patients	%
Lateral bulging	12	25.00
Infection	4	8.33
Unsightly scar	4	8.33
Loss of fixation	4	8.33
Delayed union	4	8.33
No Complication	28	58.33

Table 2 shows that 16 (33%) patients had postoperative complications, including lateral bulging (25%), infection (8.33%), unsightly scar (8.33%), loss of fixation (8.33%), and delayed union (8.33%). Four patients developed multiple complications, including infection, loss of fixation, and an unsightly scar. No complications were observed in 28 (58.33%) patients.

Table 3: Distribution of our study patients by final result (n=48).

Result	Number of patients	%
Excellent	20	41.67
Good	16	33.33
Poor	12	25.00
Total	48	100

Table 3 shows that in 20 (42%) cases result was excellent, good in 16 (33%) cases and poor in 12 (25%) cases respectively.

DISCUSSION

Cubitus varus deformity after supracondylar fracture of the humerus is typically the result of a malunion, as opposed to a disturbance in growth which will neither correct nor progress with time. The distal fragment is typically in varus, with variable extension and internal rotation. Numerous methods for correction of cubitus varus have been described, however there is still no consensus on which method yields the best results with the fewest complications. A recent study comparing multiplanar versus uniplanar correction of posttraumatic cubitus varus noted comparable outcome with respect to coronal plane alignment and elbow range of motion. However, the participants undergoing 3-dimensional osteotomy showed significantly greater loss of alignment at final follow-up. It was determined that maintaining alignment during healing was difficult after the multiplanar osteotomy due to the small area of bone contact at the osteotomy site. The normal carrying angle can be restored by lateral closed wedge supracondylar osteotomy. This procedure was performed on 11 patients over 12 years using the stepcut osteotomy technique described by Derosa et al, employing the posterolateral approach with fixation by a single cortical screw.⁹ In this study, the same approach was used to allow accurate clinical assessment of the carrying angle post-surgery. In this study, the highest numbers (75%) of patients were in their second decade, with the lowest in the third decade. The mean age was 13.68 years (range 9 to 23 years). Khalil and Quader observed similar age distributions in their studies.^{10,11}

The deformity was more common in males (83%) than females, with a male-to-female ratio of 5:1. Khalil (1989) found a different distribution, with 43% males and 57% females. This study's higher male prevalence may be due to increased cosmetic concerns among males. Most patients (91.7%) were students, similar to Quader's observation of 95%.¹¹ Left side involvement was more common (66.7%) than right side (33.3%), differing from Khalil and Quader, who reported higher left side involvement.^{10,11} The most common cause of the initial fracture was falling from height (58.3%), followed by road traffic accidents (25%) and sports injuries (16.67%), aligning with findings by Sarwar and Quader.^{11,12} Operative intervention is primarily for cosmetic

correction. However, cubitus varus is associated with other musculoskeletal sequelae, including pain, functional limitations, and neuropathies. Gurkan noted relationships between cubitus varus, ulnar nerve dislocation, and ipsilateral shoulder instability with a Bankart lesion. Reports of tardy ulnar nerve palsy and cubital tunnel syndrome exist. In this study, patients had no complaints other than cosmetic concerns. Preoperative mean varus deformity was 26 degrees (range 21 to 33 degrees), with a postoperative mean valgus deformity of 4 degrees (5 to 10 degrees), indicating a mean correction of 30 degrees, similar to Quader's findings.

The lateral closing wedge osteotomy of the distal humerus is the most popular correction method, initially described by Siris in 1939 and modified by DeRosa and Graziano with a step cut for better stabilization.^{9,13} These methods attempt to preserve the medial cortex and/or periosteum as a hinge for stability. However, they can create a prominent lateral condyle. Voss and Barrett reported that many patients noticed a bump post-surgery.¹⁴ This study observed a 25% incidence of lateral condylar prominence, lower than previous studies but still significant. Preoperative elbow flexion-extension movement averaged 112.5 degrees (range 100-125 degrees), improving to 118 degrees postoperatively (range 90-135 degrees). Internal rotation is an important component of cubitus varus deformity. DeRosa and Graziano's stepcut osteotomy did not correct internal rotation, only varus deformity.⁹ This study corrected both, using a new technique with French technique and additional parallel K-wires. Preoperative internal rotation averaged 34.33 degrees (range 20 to 45 degrees), decreasing to 8.33 degrees postoperatively (range 0 to 20 degrees), similar to Quader's findings.¹¹ Many surgeons prefer the lateral closing wedge osteotomy for its presumed inherent stability provided by medial structures. However, Hernandez and Roach reported a high failure rate due to loss of fixation, possibly due to inadequate postoperative immobilization. In this study, only one patient (8.33%) experienced loss of fixation.¹⁵ Another strategy, involving medial translation of the distal fragment, aims to correct varus deformity without creating a prominent lateral condyle, producing a more anatomically and cosmetically appealing result. This method may also stabilize the subluxation of the medial head of the triceps and the ulnar nerve, preventing late ulnar neuritis and cubital tunnel syndrome. There is no need to wait for cessation of growth before correcting the deformity. The ugliness of the elbow is most apparent when full elbow movement has returned post-fracture union, making this a good time for osteotomy. Excellent results were observed in patients aged 9 to 14 years, similar to Jain et al, who found the best age for correction to be 6-11 years.¹⁶ This may be due to the thick periosteum acting as a hinge, holding the distal humerus fragment in position.

Screw fixation is crucial for retaining the fragment position post-osteotomy; inadequate wedge and loose screws may cause recurrence of varus deformity. The wedge closer to the joint line allows more accurate

deformity correction. The lower wedge margin should pass through the olecranon tip, ascertainable by flexing and extending the elbow.¹⁷ Screws should pass about 1 cm from the wedge margin, piercing both cortices. Before applying the plaster cast, the correction degree can be checked by placing the arm at the body's side with the elbow fully extended and the forearm supinated. Postoperatively, full elbow extension aids in accurate carrying angle measurement, though the distal fragment may tilt backward. At 90 degrees flexion, estimating correction degree is difficult, and carrying angle cannot be maintained. Thus, 40-50 degrees flexion with full forearm supination is preferred for assessment and fragment positioning. Screw fixation and K-wire alone are insufficient for accurate fragment positioning; plaster cast is crucial. The main success lies in correcting cubitus varus deformity and improving the cosmetic appearance, alleviating parents' worries, especially for girls facing social issues. Increasing socioeconomic status makes males equally concerned about cosmetic issues. The evaluations of the result were done according to the criteria of the Bellemore et al.¹⁴ In this study there was 42% excellent result and 33% good result. In another study there was 57.1% excellent result and 14.3 percent good result.¹⁰

The study has several limitations. Due to the short duration of follow-up, fewer patients were included in our study. As this deformity causes less functional problem so patient of low socioeconomic condition is less interested to correct this deformity though there is a chance of late complication like tardy ulnar nerve palsy. Power saw is very important to do fine surgery which is not available always. Correction of rotation makes osteotomy site more unstable and correction of varus become difficult.

CONCLUSION

From this study it is evident that the corrective osteotomy of the cubitus varus deformity by Stepcut technique is a satisfactory method of treatment.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Kumar K, Sharma R, Maffulli N. Correction of cubitus varus by French or dome osteotomy: a comparative study. *J Trauma.* 2001;50:1159-60.
2. Duthie RE, Bently G. *Mechanics of the elbow in mercher's orthopedic surgery.* New York: Arnold, Oxford University Press. 1996;1055-7.
3. McCoy GF, Piggot J. Supracondylar osteotomy for cubitus varus. The value of the straight arm position. *J Bone joint Surg.* 1988;70:283-6.

4. French PR. Varus deformity of elbow following supracondylar fractures of the humerus in children. *Lancet.* 1959;439-41.
5. Labelle H, Bunnell WP, Duhaime M. Cubitus varus deformity following supracondylar fractures of the humerus in children. *J Pediatr Orthop.* 1982;2:539-46.
6. Ambrosia RD. Supracondylar fractures of the humerus: prevention of cubitus varus. *J Bone Surg.* 1972;54:60-6.
7. Carlson CS JR, Rosman MA. Cubitus varus: a new and simple technique for correction'. *J Pediatr orthop.* 1982;2:99-201.
8. Yamamoto, Ishii S, Usui M, Ogino T, Kaneda K. Cubitus varus deformity following supracondylar fracture of the humerus: a method of measuring rotational deformity. *Clin Orthop.* 1985;201:179-85.
9. DeRosa GP, Graziano GP. A new osteotomy for cubitus varus', *Clin Orthop.* 1988;236:160-5.
10. Khalil. Evaluation of the result of corrective osteotomy of cubitus varus deformity following supracondylar fracture of the humerus by French technique. University of Dhaka. 1989.
11. Quader A. Study of the results of the corrective osteotomy of cubitus varus deformity by French technique [M.S thesis]. Dhaka: BSMMU. 2004.
12. Sarwar G. Result of supracondylar fracture of the humerus in children treated by open reduction and internal fixation by K-wire. [M.S. thesis]. University of Dhaka. 2002.
13. Siris IE. Supracondylar fracture of the humerus: analysis of 330 cases. *Surg Gynecol Obstet.* 1939;68:201-12.
14. Bellemore MC, Barrett IR, Middleton RW, Scougall JS, Whiteway DW. Supracondylar osteotomy of the humerus with correction of cubitus varus. *J Bone Joint Surg.* 1984;66:566-72.
15. Hernandez MA, Roach JW. Corrective osteotomy for cubitus varus deformity. *J pediatr orthop.* 1994;14:487-91.
16. Jain AK, Dhammi IK, Arora A, Singh MP, Luthra JS, 'Cubitus varus: problem and solution. *Arch orthop Trauma Surg.* 2000;120:420-5.
17. Koch PP, Exner GU. Supracondylar medial open wedge osteotomy with external fixation of the cubitus varus deformity', *J Pediatr orthop.* 2003;12:116-22.

Cite this article as: Paul RK, Saleheen MS, Raihan MZ, Sinha S, Haider A, Miah MRR, et al. Evaluation of the results of cubitus varus deformity by stepcut osteotomy. *Int J Res Orthop.* 2024;10:896-901.