

A comparative study of management of supracondylar fractures of humerus by open reduction versus closed reduction in a tertiary hospital

Parminder Singh Kular, Sandeep Kaur

¹Department of Orthopedics, Adesh Institute of Medical Sciences and Research, Bathinda, Punjab, India.

²Department of Physiology, Adesh Institute of Medical Sciences and Research, Bathinda, Punjab, India.

Correspondence to: Parminder Singh Kular, E-mail: parminderkular71@yahoo.co.in

Received November 26, 2015. Accepted December 7, 2015

Abstract

Background: Supracondylar fracture of humerus is the commonest injury about the elbow in children. Anatomical reduction is required to prevent complications and improve cosmetic appearance.

Objective: To compare the results of the closed reduction and open reduction of the supracondylar fractures of humerus in children.

Materials and Methods: The study was done in all cases of supracondylar fractures in children of 2–15 years of age who visited orthopedic outpatient department and were confirmed with X-ray. They were divided randomly into two groups. Group I children were treated with open reduction and internal fixation, and group II cases were treated with closed reduction. Both the groups were followed up for 6 months and evaluated with X-rays. The results were expressed in mean and percentage.

Result: All the fractures were found to be united clinically and radiologically when X-rays were taken at 5 weeks in group I and at 6 weeks in group II. Only 4% cases in group I and 44% cases in group II resulted in cubitus varus deformity as measured by the carrying angle. Only 16% cases in group I and 48% cases in group II showed unsatisfactory results.

Conclusion: Open reduction and internal fixation give more stable fixation and better anatomical reduction with negligible complication. Treatment from quacks of supracondylar fracture humerus should be discouraged owing to availability of surgical techniques giving excellent results.


KEY WORDS: Baumann's angle, children, cubitus varus, complication, internal fixation

Introduction

The supracondylar fracture of the humerus is the most frequently seen fracture about the elbow in children. It comprises about 58% of the elbow fractures in children.^[1] The common age group is 5–10 years. At this peak age for the

supracondylar fractures, there is commonly occurring hyper-extension at the elbow, which makes susceptible the distal humerus to this type of fracture.^[2] The increased occurrence of these fractures is due to more frequent falls in children and due to metaphysis being the weakest area around the elbow. This superimposed on the frequency of falls in small children while playing on ground, cycling or falling from household objects such as bed, sofa, etc., which is the factor responsible for the common occurrence of this fracture in children.

Timely and appropriate treatment must be delivered to these injuries to attain the best possible results. The supracondylar fracture of humerus demand great respect in treatment because, if it is not treated properly, it may lead to several complications such as Volkmann's ischemic contracture, neurovascular injury, myositis ossificans, stiffness of elbow, and malunion.^[3] The need for accurate anatomical reduction for

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2016.06122015283	

International Journal of Medical Science and Public Health Online 2016. © 2016 Parminder Singh Kular. This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), allowing third parties to copy and redistribute the material in any medium or format and to remix, transform, and build upon the material for any purpose, even commercially, provided the original work is properly cited and states its license.

achieving good functional and cosmetic results can never be stressed more in any fracture than supracondylar fracture of humerus.

Several modalities of treatment have been suggested for the treatment of displaced supracondylar fractures of the humerus in children, such as closed reduction and plaster of paris (POP) slab application, skin traction, overhead skeletal traction, closed reduction and percutaneous pin fixation, and open reduction with internal fixation (ORIF).^[4] During the initial phase of the century, there was a disinclination to suggest open reduction of supracondylar fracture. But now, several modifications in medical field have happened, chiefly in orthopedic trauma. A better knowledge of biomechanics, quality of implants, principles of internal fixation, soft tissue care, antibiotics, and asepsis have all contributed to the radical changes.

A number of studies have been conducted earlier in the past comparing the results of one form of treatment with the other with varying results. Majority of the studies show best results with operative intervention for these fractures in the form of internal fixation with Kirschner (K-wires).^[5-7] Some studies have also shown excellent results with closed reduction and POP cast.^[8,9] This variation may be owing to individual surgeons skill or owing to differences in surgical facilities. So, this study was done to see the results in our tertiary hospital setting as it is the most common fracture in children, and accurate and appropriate treatment needs to be decided. Moreover, in our area, the tradition of going to quacks for the treatment of these fractures has been observed. The study was done to discourage parents who prefer going to quacks with the sole purpose of avoiding operation so that the children do not experience the complications associated with these fractures.

Materials and Methods

The study was done in Adesh Institution of Medical Sciences and Research, Bathinda, a tertiary institution in Malwa belt of Punjab. Of the total cases of supracondylar fractures who presented in the orthopedic department, twenty-five cases were randomly selected for treatment with primary ORIF with two crossed K-wires and included in group 1, and twenty-five other cases were selected for open reduction treated by the conventional method of closed manipulative reduction and POP splint and included in group II. All children in the age of 2–15 years with extension types II and III supracondylar fracture of distal humerus presenting within 7 days of injury were included in the study. Children of age older than 15 years and medically unfit for surgery were not included in the study. Informed consent was taken for parents to participate in the study, and approval of local institutional ethical committee was taken. As it was a random selection, only children fit for surgery were included in the study. The results of both these methods were compared after a minimum follow-up of 6 months.

Open reduction was performed under general anesthesia; the area was cleaned, and Opsite (sterile transparent drape)

was applied after proper draping proximally and distally. Injection ceftriaxone (500 mg) was given. Bilateral approach was used in all the cases, exposing the distal fragment from the medial and lateral sides. Reduction was judged from the alignment of the supracondylar ridges on the proximal and distal fragments. Now, one K-wire was put from below the lateral epicondyle across the fracture line into proximal fragment obliquely so as to engage the medial cortex of the proximal fragment, and the second K-wire was put from below the medial epicondyle across the fracture into the proximal fragment so as to engage the lateral cortex. The wires were cut so that they remained slightly outside the skin. The wounds were stitched in layers, and a POP back splint was given from the axilla up to the knuckles with the elbow in 90° flexion and the forearm in neutral position.

Two injections of ceftriaxone (500 mg) were given at 6 h interval after the operation. Radiographs injections of ceftriaxone (500 mg) were given at 6 h interval after the operation. Radiographs were taken in anteroposterior and lateral views to see the reduction and calculate the postreduction Baumann's angle. Patients were discharged when the condition was found to be satisfactory.

Patients were called after 3 weeks when the plaster splint was discarded, stitches were removed, and active exercises of the elbow were advised with wires in situ. Patients were called after 2 weeks when X-rays were taken, wires were removed, and physiotherapy was continued. In the patients treated by conservative method, the plaster splint was removed after 6 weeks, and the same instructions were given.

Patients were called after 6 weeks, 3 months, and 6 months interval when the improvement of the elbow movements was noticed, and any complaint by the patient was asked and dealt with.

The Mitchell and Adams criteria was formulated for grading of the results.^[10] Excellent: change in the carrying angle of less than 5 degree, and restriction of movement in any plane is less than 10 degree; good: change in the carrying angle from 5 degree to 15 degree (i.e., not beyond cubitus rectus), and restriction of flexion, extension, or rotation by 10 degree–20 degree; unsatisfactory: when the changes surpass the abovementioned limits.

At the first follow-up after 3 weeks, the things looked were evidence of infection, condition of the wound, any migration of wires, any evidence of the neurovascular deficit, and any other observation. Wires were removed 2 weeks later. Thereafter, at every follow-up, measurements were taken, any other specific observation was recorded, and advice was given accordingly. At last, the results were evaluated, and comparison between the results of the patients treated by closed reduction and those treated by ORIF and statistical significance were determined.

Result

Observation and analysis of results were done in patients who stayed in the hospital. Average stay of the patients of

group I in the hospital was 7 days when compared with 1.5 days for the patients of group II [Table 1].

The range of elbow movements were documented at the last follow-up and recorded. All the fractures were found to be united clinically and radiologically when X-rays were taken at 5 weeks in group I and at 6 weeks in group II. The range of elbow movements was documented at the last follow-up and recorded [Table 2].

19 patients in group I and 23 in group II had full range of flexion or <100 of lag in flexion [Table 3].

One (4%) case in group I and 11 (44%) cases in group II resulted in cubitus varus deformity as measured by the carrying angle [Table 4].

Three (12%) of cases in group I developed complication in the form of treatable infection. No long-term complication, except the cosmetic deformity of cubitus varus was reported — 12 in group II and three in group I.

The final results were graded as per the Mitchell and Adam's criteria. Excellent, good, and poor results were 52%, 32%, and 16%, respectively, in group I, and 36%, 16%, and 48%, respectively, in group II [Figure 1].

Discussion

It is a universally accepted fact that the supracondylar fractures of the humerus account for the majority of the fractures about the elbow. Owing to the high incidence of these fractures, 58% of the 308/100,000 elbow fractures per year,^[1] the concern about the treatment of this fracture has always been a subject of interest among the orthopedic surgeons.

In group I, all the patients were subjected to X-rays after 5 weeks of surgery after removing the K-wires, although the splint was discarded at 3 weeks. There was clinical and radiological union at this stage. In group II, all the cases showed clinical and radiological union at 6 weeks when the X-rays were taken in both the planes after discarding the POP slab.

There was a significant reduction in range of movement (extension lag more than 100 or more than 100 limitation of flexion in eight cases of group I and three cases in group II). In similar studies done in 44 cases treated by open reduction and crossed K-wire fixation, there was restriction in range of motion of elbow in eight cases, which matches closely with that of our series.^[6] Thus, as far as the range of movement is concerned, the results found are comparable in groups I and II as were found in a similar study, which reported that functional results are similar with closed reduction and open reduction.^[11] This may be because the main function of the elbow is flexion and extension, and the functional results are similar in two groups.

Carrying angle in one patient of group I showed clearly demonstrable cubitus varus deformity in the form of negative carrying angle, whereas in group II there were 11 such patients. Our observations were similar to a study, where it was observed that, by ORIF by crossed K-wires, the functional results are similar to those obtained by closed methods but the incidence of cubitus varus is decreased in the former.^[11]

Baumann's angle is considered the best indicator for assessing postreduction alignment. It is measured in the anteroposterior projection and defined as the angle which makes physeal line of the lateral condyle and the longitudinal axis of the humerus—the line that divides the humerus in two equal parts in the longitudinal direction. In a study done on 35 cases of supracondylar fractures, the mean Baumann's angle observed was 6.6 degree Baumann's angle in ORIF and 8.7 degree Baumann's angle in closed reduction.^[12] In this study, Baumann's angle was of 6.1 degree in open reduction in group I and 5.4 degree in group II. The difference in closed reduction may be attributed to the fact that it was done without any radiographic control.

Two cases developed superficial and one case deep wound infection in group I [Table 5]. The superficial wound infection is attributed to our dusty atmosphere and the pins

Table 1: Hospital stay of the patients

Hospital stay (days)	Group I		Group II		Total	
	N	%	N	%	N	%
<1	0	0	2	8	2	4
1–2	1	4	20	80	21	42
3–4	6	24	3	12	9	18
5–10	14	56	0	0	14	28
11–15	3	12	0	0	3	6
>15	1	4	0	0	1	2

Table 2: Extension lag in the elbow movement in both the groups

Extension lag in degrees	Group I		Group II		Total	
	N	%	N	%	N	%
Normal or up to 10	23	92	24	96	47	94
More than 10 up to 20	0	0	1	4	1	2
More than 20	2	8	0	0	2	4

Table 3: Limitation of flexion movement

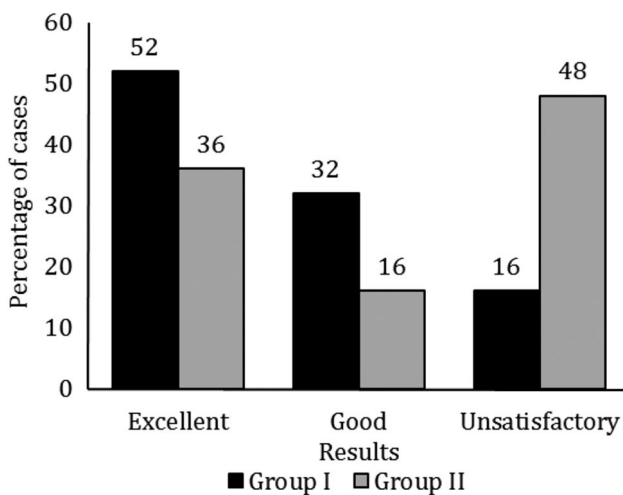
Limitation of flexion (degrees)	Group I		Group II		Total	
	N	%	N	%	N	%
>20	3	12	2	8	5	10
10–20	3	12	0	0	3	6
<10	19	76	23	92	42	84

Table 4: Carrying angle

Carrying angle in degrees	Group I		Group II		Total	
	N	%	N	%	N	%
Negative carrying angle	1	4	11	44	12	24
0	3	12	3	12	6	12
1–10	10	40	8	32	18	36
11–15	6	24	2	8	8	16
>15	2	8	0	0	2	4
Could not be determined	3	12	1	4	4	8

Table 5: Complications of treatment

Type of complication	Group I		Group II		Total	
	N	%	N	%	N	%
Superficial wound infection	2	8	–	–	2	4
Deep wound infection	1	4	–	–	1	2
Myositis ossificans	–	–	–	–	–	–
Total	3	12	0	0	3	6

**Figure 1:** Results of the study.

that are kept outside the skin for easy removal in outpatient department. These superficial infections healed after the pins were removed, and a single oral antibiotic was given after the removal of the pins. The deep infection occurred in case that had degloving injury at the elbow. It healed ultimately without osteomyelitis. Thus, our complication rate was quite low keeping in mind the operations done under proper aseptic

precautions only after the swelling subsided in cases where the presentation was delayed, coverage provided to the pins by the antiseptic dressing, further covered by POP, universal instructions given to all our patients to keep the pins covered by antiseptic dressing and crepe bandage when the splints were discarded, and exercises started with pins in situ. Our results were similar to study done in 115 patients, which reported three pin tract infections among 115 patients treated operatively and were cured by antibiotic therapy.^[13] In the same study, two cases of pin breakage were observed, while there was no case of pin breakage found in our study. However, in one of our cases, one of the two crossed pins was accidentally removed at the time of removing the splint; we continued with the splint for another week, and the fracture was healed without any displacement. No case of migration of pin was reported by us.

Following the Mitchell and Adam's criteria^[10] for grading the results, we obtained excellent results in 48% of group I cases and 36% of group II cases. The results were good in 36% of group I and only in 16% of group II cases. The results were unsatisfactory (poor) in 16% of group I and 48% of group II cases. A similar study also reported higher percentage of poor results (28.6%) and 28% with closed reduction when compared with ORIF (12.8%) poor results.^[14,15] In a study done on 42 displaced supracondylar fractures of humerus, excellent results were reported in 81% of patients with open

reduction and crossed K-wires fixation, which is comparable to our study with 84% excellent/good results.^[16] Although the functional results achieved were good with closed method of treatment, the high incidence of gunstock deformity reported in our series and the ones in literature make this an unpopular mode of treatment. Thus, we have advanced from the conservative approach to ORIF in fractures as an acceptable mode of treatment.

Conclusion

Our experience from this study indicates that primary open reduction and internal fixation of this fracture by two K-wires achieves good functional and cosmetic results. Incidence of cubitus varus is less with this method. This study will be shared with local media and helps to develop faith and confidence in the treatment of surgeon. It will refrain parents from taking to quacks doing malpractices.

References

- 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(4):312–5.
- Wilkins KE. The operative management of supracondylar fractures. *Orthop Clin North Am* 1990;21(2):269–89.
- Weiland AJ, Meyer S, Tolo VT, Mueller J. et al. Surgical treatment of displaced supracondylar fractures of the humerus in children. *J Bone Joint Surg Am* 1978;60(5):657–61.
- Pirone AM, Graham HK, Krajbich JI. Management of displaced extension-type supracondylar fractures of the humerus in children. *J Bone Joint Surg Am* 1988;70(5):641–50.
- Reitman RD, Waters P, Millis M. Open reduction and internal fixation for supracondylar humerus fractures in children. *J Pediatr Orthop* 2001;21(2):157–161.
- Kumar R, Kiran EK, Malhotra R, Bhan S. Surgical management of the severely displaced supracondylar fracture of the humerus in children. *Injury* 2002;33(6):517–22.
- Chaitanya M, Teja BR, Sreenivasulu P, Shivprasad Y. Displaced supracondylar humeral fractures in children: open reduction vs. closed reduction and pinning. *J Evid Based Med Healthc* 2015;2(39):6235–43.
- Hadlow AT, Devane P, Nicol RO. A selective treatment approach to supracondylar fracture of the humerus in children. *J Pediatr Orthop* 1996;16(1):104–6.
- Siris IE. Supracondylar fractures of the humerus. An analysis of 330 cases. *Surg Gynecol Obstet* 1939;68:201–22.
- Mitchell WJ, Adams JP. Supracondylar fractures of the humerus in children. A ten-year review. *J Am Med Assoc* 1961;175(7): 573–77.
- Weiland AJ, Meyer S, Tolo VT, Berg HL, Mueller J. Surgical treatment of displaced supracondylar fractures of the humerus in children. Analysis of fifty-two cases followed for five to fifteen years. *J Bone Joint Surg Am* 1978;60(5):657–61.
- Oh CW, Park BC, Kim PT, Park IH, Kyung HS, Ihn JC. Completely displaced supracondylar humerus fractures in children: results of open reduction versus closed reduction. *J Orthop Sci* 2003; 8(2):137–41.
- Mehlman CT, Crawford AH, McMillion TL, Roy DR. Operative treatment of supracondylar fractures of the humerus in children: the Cincinnati experience. *Acta Orthop Belg* 1996;62 (Suppl 1): S41–50.
- Diri B, Tomak Y, Karaismailoglu TN. [The treatment of displaced supracondylar fractures of the humerus in children (an evaluation of three different treatment methods)]. *Ulus Travma Acil Cerrahi Derg* 2003;9(1):62–9.
- Shoib M, Hussain A, Kamran H, Ali J. Outcome of closed reduction and casting in displaced supracondylar fracture of humerus in children. *J Ayub Med Coll Abbottabad* 2003; 15(4):23–5.
- Srivastava S. The results of open reduction and pin fixation in displaced supracondylar fractures of the humerus in children. *Med J Malaysia* 2000;55 Suppl C:44–8.

How to cite this article: Kular PS, Kaur S. A comparative study of management of supracondylar fractures of humerus by open reduction versus closed reduction in a tertiary hospital. *Int J Med Sci Public Health* 2016;5:794-798

Source of Support: Nil, **Conflict of Interest:** None declared.