

Supracondylar fractures in children—closed reduction vs open reduction

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Back ground: Supracondylar fracture is the most common fracture around the elbow in children of the age group 5-10 yrs. The issue of open reduction in such fractures is always a matter of debate as even closed reduction gives satisfactory results. However the present study of 50 cases aims to highlight the benefits of open reduction over closed reduction in such cases.

Methods: Patients were divided into two groups, 25 cases (group I) were treated by ORIF using K-wires while 25 cases (group II) were treated by closed reduction and P.O.P. splint in pronation. Group I patients were treated under G/A by two mini incisions medial and lateral and fragments fixed with K-wires. Post-operatively P.O.P. back splint was given. In both groups, the back splint was discarded after three weeks and active exercises encouraged.

Results: Minor complications as superficial infections and pin tract infection were observed in group I patients. However variation of carrying angle (cubitus varus) was more in group II. Limitation of movement was more in group II due to mal-rotation and anterior ledge formation, not seen with open reduction group.

Conclusion: We conclude from above series that ORIF of supracondylar fracture is better than closed reduction as incidence of malunion is less and range of motion near normal as compared to closed reduction.

Key-words: Supracondylar fracture, cubitus varus, anterior ledge.

near the distal end of bone, at transformation zone, where shape changes from tubular to flat, and fracture line crosses just proximal to the articular surface. This local anatomy makes it difficult to achieve satisfactory reduction and more so to maintain it. Children are specifically predisposed to this fracture due to various factors, mainly ligamentous laxity and anatomical structure.

The fracture has an impressive pedigree of devastating complications ascribed to it, including arterial occlusion – leading to VIC, nerve injury – median nerve most common, severe deformity, permanent disability, compartment syndrome, myositis ossificans and amputation. It should be considered as a surgical urgency. Various treatment modalities available are close reduction and POP cast, traction, open reduction and internal fixation and close reduction and percutaneous pinning. Each method has its own advantages and disadvantages. As stated by Siris¹ main objectives of treatment for supracondylar fracture in children are prevention of Volkmann's contracture, avoidance of deformities, and restoration of normal function. In past open reduction was generally reserved for complicated cases or performed only after failure of several attempts at closed reduction, as it was believed to produce poor results attributed to the additional surgical insult. The aim of the study was to compare the results of CR & POP cast with primary ORIF in management of supracondylar fractures of humerus.

Introduction

Supracondylar fracture of humerus in children is one of the most common fractures seen in pediatric orthopedic clinic setting worldwide. It accounts for 65.4% of upper extremity fractures in 5-10 year age group in children, fall on outstretched hand being the commonest cause. It is a fracture

Material and methods

Present study consisted of 50 cases of Gartland's type III supracondylar fracture in children admitted to our department from 2001-2004. Patient age ranged from 2 to 12 years with average age of 7.33 years, 82% boys. Thirty one patients attended emergency same day, 11 came next day, 5 within 2 days and rest 3 came in 2-7 days after injury. Patients were divided into two groups, 25 cases (group I) were treated by ORIF using K-wires while 25 cases in group II were treated by closed reduction and P.O.P. splint in pronation. There were three cases of compound fracture in group-I. Five patients in group-I and two in group-II had taken previous

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Fig 1(a). Pre-reduction X-ray showing supracondylar fracture, (b) X-ray after reduction, and (c) post-reduction X-ray showing union.

treatment in the form of massage and splintage from local bone setters. Our only criterion was that any patient with neurovascular compromise must be treated in group-I, except these patients were randomly allotted groups. So in group-I five patients had weak radial pulse and seven had some neurological complication because of fracture, which was partial in nature and recovered in three weeks. Patients were divided into two groups.

Group I cases were operated under G/A and tourniquet control. With medial and lateral mini incisions open reduction was done. The quality of reduction was assessed by inspection of medial and lateral supracondylar ridge alignment. Two crossed K-wires were put from below the epicondyles across the fracture line into proximal fragment obliquely so as to engage the opposite cortex of the proximal fragment. Elbow alignment was checked by comparing with the opposite side in full extension, this step is important in cases with supracondylar ridge comminution. K-wires were left percutaneous and cut and bend just proud of the skin to facilitate subsequent removal without anesthesia. Capillary return was checked. POP splint was applied in 90° flexion and mid prone position.

The child was discharged after 24-48 hours on oral antibiotics. Patients were reviewed after three weeks when stitches were removed and POP splint discarded. Active exercises were started at three weeks. K-wires were removed between 4-6 weeks in group I.

Group II cases were treated by CR and POP splint under general anaesthesia with elbow flexed to more than 90° degree and full pronation of the forearm. After manipulation radial pulse was checked and if absent, the degree of flexion was reduced to recover the pulse. An acceptable reduction of the coronal, sagittal and rotational alignment was attempted. All cases in this group were taken to O.T. with prior consent for surgery if check X-ray done in O.T. showed unsatisfactory reduction. Criteria used for satisfactory reduction was Baumann's angle within 5° – 8° and humero-capitellar angle within 10° of the contra-lateral side. Cases with unsatisfactory

reduction were taken for open reduction and internal fixation immediately. These patients were excluded from study as they did not fit into primary ORIF group. In group II cases child was discharged next day. POP splint was discarded after three weeks and active movements were started.

All patients were reviewed at 3 wks, 6 wks, 9 wks, 3 months, 6 months and 9 months. Assessment at final visits included clinical measurement of carrying angle of both the elbows and range of motion using goniometer. Results were graded as per criteria of Mitchell and Adams (1961) as shown in table I. The results were compared at minimum follow up of six months.

Table I. Criteria of Mitchell and Adams (1961)

Results	Criteria
Excellent	Normal shape & movements apart from 5° changes in carrying angle and 10° limitation of flexion.
Good	Reduction of the carrying angle from 5° – 10° but not beyond cubitus rectus and restriction of flexion by 10° – 20°.
Unsatisfactory	Alteration of carrying angle by more than 10° with obvious varus deformity and restriction of flexion more than 20°

Results

Commonest age group was 5-10 years. Left side was involved in 29 patients. Three fractures in group I and none in group II were open. All the fractures in group I were extension type while two were of flexion type in group II. Average duration of hospital stay in group I was 2.8 days compared to 1.8 days for group II. Commonest complication observed in group I was pin tract infection (10 cases) followed by superficial infection (5), transient ulnar nerve palsy (1) and deep wound infection (1). Pin tract infection resolved with oral antibiotics and did not require premature pin removal. Superficial infection was managed by local antibiotic dressings. Mal-union (Fig. 1) was the commonest complication (Table II) in group II (9 compared with 4 in group-I) followed by myositis ossificans (1). Extent of elbow flexion was near normal in 16 cases of group I and 11 cases in group

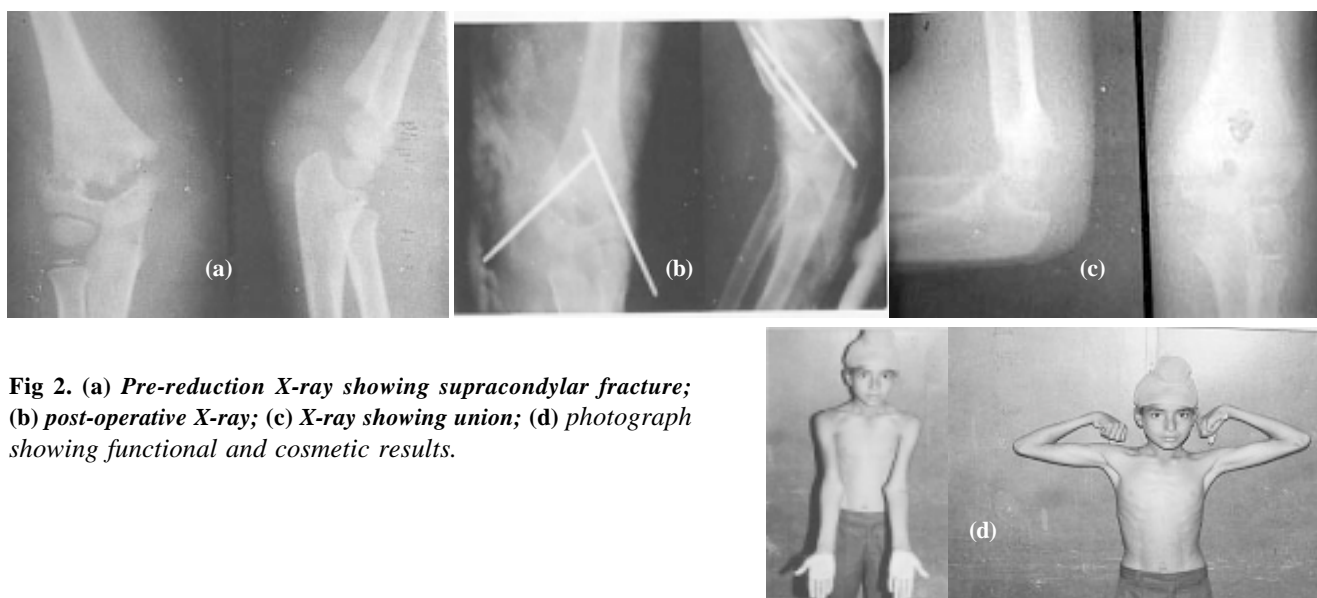


Fig 2. (a) Pre-reduction X-ray showing supracondylar fracture; (b) post-operative X-ray; (c) X-ray showing union; (d) photograph showing functional and cosmetic results.

II. Extension lag was recorded in 5 cases in group-I and 6 cases in group-II. But it was significant only in one case of group-I, where full extension of elbow was not possible and it hindered in carrying angle determination. Results were significantly better in group I (Fig. 2) (Table III).

Table II. Carrying angle in both groups

Carrying angle in degrees	Group I No.	Group II No.
Negative carrying angle	4	9
Zero degrees	3	3
0-10°	9	10
11-15°	8	3
Could not be determined	1	—

Table III. Results as per criteria of Mitchell and Adams (1961)

Grading	Group I	Group II
Excellent	9	9
Good	11	5
Unsatisfactory	5	11

Discussion

Though supracondylar fracture of humerus is the commonest injury around elbow in children, a single, perfect and ideal method of treatment for this fracture is yet to emerge. Treatment modality should be such so as to satisfy both functional as well as cosmetic results.

Closed reduction and casting for type-III fracture is still practiced in developing countries due to limited facilities. Its merits include no need for metal insertion², least costly and less time consuming. Main demerits are high incidence of multiple attempts³, failure in grossly displaced fractures and

loss of reduction after successful closed reduction. The main difficulty of closed reduction & POP splint is the need to hyperflex the elbow beyond 120° to maintain reduction, which is not always possible due to loss of radial pulse on hyperflexion. Failure to do so increases the risk of losing reduction, due to loss of supporting effect of the triceps muscle. Another fallacy in closed reduction is that coronal tilt is not always appreciated on radiograph, and the fact unveils itself only when deformity has already occurred⁴. Loss of reduction was a major concern in our series as we included only perfectly reduced fractures in group-II, any case with unsatisfactory reduction was managed by ORIF and excluded from series.

The main goal of surgical treatment of pediatric supracondylar humerus fracture is to safely create an adequately stable construct to prevent axial rotation and coronal or sagittal tilt to avoid post-operative deformity⁴⁻⁸, which historically has been reported as high as 17%^{9,10}. Internal rotation of the distal fragment is the major predisposing factor to varus deformity and is necessary for coronal varus tilt to occur^{5,8,11}. This is the most critical plane in which to achieve stability with fixation¹². The actual bony surface contact area of the fracture fragment is remarkably small, so even small amounts of rotational motion can lead to clinically significant varus tilt^{5,12}.

Closed reduction and percutaneous pinning has become the standard treatment for reducible supracondylar fractures. However delay in presentation¹² and the non-availability of image intensifier preclude successful closed management, both of which are common in developing countries. After

closed reduction and percutaneous fixation the tilt can be best appreciated only after the elbow is completely extended and if present it will require wire removal, repeat reduction and fixation, this sometimes lead to accepting less than accurate alignment. Achieving anatomical reduction under C-arm is also tough as it is basically closed reduction and it is difficult to judge reduction, specifically coronal tilt radiologically^{4,6}. Moreover the reported incidence of iatrogenic ulnar nerve injury ranges from 2% to 8%^{7,13,14}, with Gosens and Bongers reporting alarming 16.5% incidence of neurological compromise¹⁵ in series of 200 cases. Taking this fact into consideration some authors recommended two lateral pins⁷. Medial and lateral pin insertion provides better stabilization¹¹ and but opinion varies about stability of two lateral pins.

Most pediatric orthopedic surgeons would reserve ORIF for open fractures or for those associated with vascular injury¹¹. But it can give good results with low complication rate as anatomical reduction can be achieved by ORIF. In meta-analysis of 470 supracondylar fractures, Wilkins reported a 1.4% incidence of myositis ossificans and 0% incidence of lasting neurovascular deficit⁸.

Medial and lateral mini-incisions allow excellent view of the fracture anatomy, access to fracture site in case of any buttonholing and most importantly anatomical reduction. Additional advantage of open reduction is decompression of fracture hematoma which reduces the risk of compartment syndrome by decreasing the resistance to venous outflow. Haematoma drainage and elimination of secondary soft tissue injury from repeated attempts at CR reduces the predisposition to excessive callus formation and myositis ossificans, thus better post-op range of motion. Soft tissue injury is most important prognostic factor for recovery of elbow range of motion. Sibly pinned 35 cases in retroversion but still reported predominant extension loss¹⁶, thus concluding that extension loss is mainly due to soft tissue injury.

Rate of pin tract and superficial infection is high in our series which might be due to the fact that we have included all the cases where even angry looking inflammation around the pin tract was noticed without pus formation. Range of motion was significantly better in group-I with 16 cases showing near normal elbow flexion as compared to 11 cases in group-II (P=0.044). In cosmetic results, surgical intervention however does not provide immunity to cubitus varus deformity which still remains the commonest complication¹⁷.

In our series we had 16% incidence of cubitus varus in ORIF group which is better than CR group with 36% incidence. One case with significant extension lag in group-I was mishandled by traditional bone setter and reported in emergency late with huge swelling and gross displacement.

As per Mitchell and Adams criteria excellent to good results were seen in 80% cases in group-I while unsatisfactory results were seen in 20% which rose to 44% in group-II. The results of ORIF are comparable to those of many other authors in recent publications. Philip et al reported 82% excellent or good results, 12% fair and 6% poor results, in open reduction of irreducible supracondylar fractures¹⁸. Kumar et al reported 84% excellent and good results and 16% fair and poor results in primary ORIF using medial incision and crossed pins in type-III supracondylar fractures¹⁹. Closed reduction and casting for type-III fractures has been recently condemned by many authors^{20,21}. The final results of present series when compared using Chi-Square test significantly favor ORIF over CR & POP as the treatment of choice (P=0.005) for management of displaced supracondylar fractures of humerus in children.

From above study we conclude that primary ORIF of type-III supracondylar fracture gives good functional and cosmetic results as compared to closed reduction and POP splint, and surgeons must lower their threshold for open reduction of displaced supracondylar fractures. The fears of infection, significant loss of motion¹⁶ and myositis ossificans are unfounded. The ulnar nerve identification and mobilization in the length of incision makes iatrogenic nerve injury unlikely. The morbid pathology is visualized, and anatomical reduction can be achieved, which minimizes the chance of accepting less than excellent results. Cross pinning provide stable fixation and obviates the need to immobilize elbow in more than 90° flexion. Though percutaneous pinning obviates the need of surgery, however danger of nerve injury can not be ruled out, secondly in some fractures closed reduction may not be possible and open reduction is the only answer, thirdly expensive C-arm is must for percutaneous pinning.

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