

# Analytical study of the management of supracondylar fracture of children in our setup

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## ABSTRACT

We performed a clinical-radiological audit of 142 children with consecutive Supracondylar fractures of the humerus over a period of 5 years (1996-2001). The fractures were classified according to the Gartland system; 58 types I, 44 type II and 40 type III. And 87.0% were extension and 13.0% flexion types. These cases were managed by closed reduction and posterior cast application (n=120) and open reduction with internal fixation (n=22). All the stable fractures irrespective of types were managed by closed method and all the unstable or failed manipulation cases were operated upon. In total 38 required re manipulation in the cast group and twelve (n=12) had a varus deformity (ten from closed group and two from operation group). Failure to follow the treatment according to the guidelines led to an unsatisfactory result in 12 patients. We have devised a protocol for the management of these difficult injuries in our setup for optimal outcome.

## INTRODUCTION

Supracondylar fracture of the humerus is the second most common fracture in children (16.6%) and the most frequent before the age of seven years.<sup>1</sup> In 1959 Gartland<sup>2</sup> commented that "it is interesting to observe the trepidation with which men, otherwise versed in trauma, approach a fresh Supracondylar fracture". The dread of this injury still remains. Treatment is controversial and often technically difficult; complications are common. Cubitus varus is the most frequent problem with a mean incidence of 30.0% in the series reviewed by Smith.<sup>3</sup> This deformity is due to medial tilting of the distal fragment, associated with rotation. It does not remodel with growth,<sup>4-6</sup> is not progressive and is not due to physeal injury.<sup>5</sup> Injury to any of the three major nerves around the elbow occurs in 6.0% to 16.0% of cases. The radial pulse is absent in about 3.0% after reduction of the fracture. Volkmann's ischemic contracture is rare, with an incidence of 1.1 in 1000, but is still seen. Stiffness of the elbow may occur, particularly after repeated manipulation and the use of the posterior approach for open reduction. In most cases, however, there is improvement with time and the functional result is not greatly impaired.<sup>5,6</sup>

A variety of methods of treatment for displaced fractures has been recommended including closed reduction and immobilisation<sup>2,4</sup> traction by various methods<sup>7,8</sup> and closed<sup>9,10</sup> or open reduction stabilised by Kirschner (K-) wires.<sup>11</sup> Although some authors are not in favour of closed reduction and immobilisation, particularly for severe injuries, this treatment remains popular. Others recommend stabilisation by K-wires for all displaced fractures.<sup>12</sup>

The aim of treatment is to gain a functional and cosmetically acceptable upper limb with a normal range of movement.<sup>13</sup> Ideally, this should be achieved by one definitive procedure. A change in treatment because of loss of reduction may be psychologically traumatic to the child, may give rise to parental anxiety and is associated with an increased risk of a poor outcome.<sup>14</sup> However, because of our limitation in terms of availability of anaesthetist, imaging and operative facilities in our general setup, we need to evolve our own protocol of treatment.

We have followed general guidelines as following: 1. All the fractures irrespective of the types were first tried by closed method. The fractures were manipulated only twice. 2. The fractures which could not be reduced and/or maintained reduction were treated by open method.

After the introduction of these guidelines a clinical-radiological audit of 142 consecutive cases of displaced Supracondylar fracture of the humerus was carried out over five years. We now report the results in regard to the protocol of treatment and the provision of resources.

## MATERIAL AND METHODS

Between March 1996 and March 2001, 142 consecutive children with Supracondylar fractures of the humerus were entered into the study. Initial care and outpatient follow-up were analysed using clinical notes, details of the operation, and plain radiographs. This study includes patients from NMC Teaching Hospital, Kathmandu and Orthopaedic and Trauma Clinic, Janakpur during this period.

There were 82 boys and 60 girls with a mean age of six years (1 to 11). The fractures were classified according to the Gartland system. There were 58 type-I, 44 type-II and 40 type-III fractures (Fig.1). There was five (n=5) grade-I open injury occurring in a type-III fracture and three cases of associated ipsilateral fractures of radius and ulna.

The causes of injury were fall from tree (78.0%), bed (2.0%), bicycle (12.0%) or while playing (8.0%). The average duration of injury on presentation was 5 days (2 days to 2 weeks) and the modes of presentation were unsplinted (10.0%), faulty splint (75.0%) and proper splint (15.0%).

In twelve children the radial pulse was absent on presentation, but distal pulses returned after reduction of the fracture in ten. Two children had no pulse but the capillary circulation was satisfactory. There were neurological complications in ten children, in six palsy of the median nerve and in four injury to the radial nerve. All of which resolved within eight weeks. The methods of treatment have been shown in Table-1.

The patients were allocated prospectively into two groups based on the guidelines in the closed group (n=122 patients) and open group (n=22 patients). The two groups were then compared with regard to the rate of remanipulation or reoperation, the range of elbow movement and cosmetic deformity. Only five patients were treated by corrective osteotomy for cubitus varus osteotomy.

Patients were followed up until there was full recovery or the clinical situation was stable. This ranged from three months to one year on the basis that varus angulation occurs as a result of malreduction and not abnormal growth.

## RESULTS

All of the 58 type-I undisplaced fractures were managed non-operatively by a collar and cuff sling or immobilisation in plaster. All 58 children in this group had an excellent outcome with a full range of movement and a normal carrying angle. No further procedure was required after the primary procedure. All the 84 displaced fractures (44 type-II and 40 type-III) were treated first by closed manipulation under ketamine anaesthesia and held reduced with external plaster cast (n=64) and others (n=20) were operated as they could not be held reduced by cast or they could not be reduced in the first instance. In all 22 children with displaced fractures from Grade I and II, fixation was done by K-wires in a crossed configuration through a posterior midline approach. The ulnar nerve was identified in each case before insertion of the medial wire. There were no cases of iatrogenic palsy of the ulnar nerve.

The results were unsatisfactory in 22 of the 84 type-II and type-III fractures. Fourteen remanipulations were required for redisplacement of the fracture. On discharge all the patients had a functional range of movement within 10° of the normal arc.

No patient required reoperation but developed varus deformity of the carrying angle in 10 patients in closed group and 2 in the operated group. Analysis of the 22 unsatisfactory results showed that closed reduction of type-II and type-III fractures without stabilisation by K-wires or plaster led to an unsatisfactory result. They required further manipulation or operations for loss of reduction.

Non-operative or operative treatment of displaced type-II and type-III fractures (n=84) led to cubitus varus in twenty four (n=24) i.e. one out of three children treated by this method. However, only five (n=5) patients were treated by corrective osteotomy for cubitus varus deformity.

There were six complications related to operative treatment. Four patients developed pin-site infection which responded to antibiotics and two had a postoperative neurapraxia of the radial nerve which resolved spontaneously. There were two cases of infection in those fractures which were open type from the beginning. There were ten cases of superficial infection in the closed fractures which presented late with swelling.

## DISCUSSION

The many different methods advocated for supracondylar fractures of the humerus in children suggest that no single technique is suitable for all types of fracture. The displaced supracondylar fracture represents a spectrum of injury from type I with minor swelling of soft tissues to type III with considerable swelling and potential neurovascular complications. A selective approach to treatment is required based on the classification of the fracture and the soft-tissue complications present.

Closed reduction and immobilisation require 120° of elbow flexion to maintain stable reduction.<sup>15</sup> There are two disadvantages to this method, described by McLaughlin<sup>13</sup> as the "supracondylar dilemma". Flexion to 120° in a swollen elbow may compromise the circulation but less flexion predisposes to loss of reduction. This method has a high incidence of poor results when used for all types of fracture.<sup>6,14</sup> Some authors have used manipulation and immobilisation in plaster as their first line of treatment and then remanipulate or change their treatment if there is loss of reduction. Further manipulation, however, predisposes to stiffness and myositis ossificans.<sup>5</sup> Our study also supports this view. Mitchell and Adams<sup>6</sup> reported an incidence of 60.0% of cubitus varus deformity using this method but we had only 33.0% incidence; 19.0% of their patients had three manipulations. Eleven of their patients had less severe injuries, however, equivalent to Gartland-Wilkins type IIA of whom nine had satisfactory results. Pirone *et al*<sup>14</sup> found that only 51.0% of patients had excellent results using manipulation and plaster and concluded that its use was inappropriate for the displaced supracondylar fracture. Their series, however, did not provide individual results for type-IIA and type-IIB fractures. Recently, Hadlow *et al*<sup>16</sup> have recommended manipulation and immobilisation in plaster for all types of fracture, despite 31.0% of children requiring further operative treatment and the development of a

number of varus deformities when loss of position was unrecognised with type-III fractures treated in plaster. In our study, only 24.0% cases required operative treatment for the unstable fractures.

We believe that closed reduction and immobilisation are satisfactory for most of the type-II and some of the type III fractures. The fractures with mild swelling and without vascular complications are suitable for this method in our setup.<sup>2,8</sup> Type-II fractures usually do not have neurovascular complications or major swelling and can be managed in flexion in a collar and cuff or plaster. They may not even require reduction provided that the angle of the distal humeral articular surface measures at least 0° with the shaft. We treated 44 type-II fractures with immobilisation alone and all had satisfactory results. We encountered situations where there was sufficient elbow swelling to compromise the circulation and we waited till the swelling had subsided.

In a report<sup>17</sup> in which 198 patients who had urgent treatment were compared with a cohort of patients who were treated more than eight hours (average, twenty-three hours) after the injury, Mehlman found no substantial differences with respect to conversion from a closed to an open reduction, infection, or iatrogenic nerve injury. There were no compartment syndromes in either group. The hand must be warm, have capillary refill, and be viable in order to permit this delayed approach. Mehlman concluded that operative reduction and percutaneous stabilization may be safely delayed if deemed appropriate by the surgeon.

Closed reduction and percutaneous pinning are now widely recommended for type III fractures. Wilkins<sup>12</sup> has advocated stabilisation by K-wires for all displaced fractures. The inpatient stay is reduced and the elbow can be immobilised in a more extended position reducing concern about limb perfusion in injuries with major swelling of soft tissues. Flynn *et al*<sup>5</sup> found no evidence of physeal injury secondary to insertion of K-wires when smooth wires were used. Pin-track infection occurred in only four pins in our series without sequelae. Iatrogenic injury to the ulnar nerve may occur even when the medial epicondyle is palpable. Lateral K-wires have been recommended to avoid this complication. Biomechanical studies have shown, however, that a crossed medial and lateral K-wire configuration is more stable than lateral pins alone. Redisplacement of the fracture has been reported to be significant after the use of lateral K-wires. A lateral K-wire configuration may not allow full extension of the elbow thus preventing examination of the carrying angle at operation. We would recommend identification of the ulnar nerve and crossed K-wire stabilisation. We had no iatrogenic injuries to the ulnar nerve.

In our study the indications for open reduction and pin fixation included a fracture which is irreducible by closed methods; an open fracture and vascular injury.<sup>11</sup> Open reduction has been advocated as the primary procedure in all type III fractures. Others have condemned this approach because of concerns about infection and loss of movement.<sup>4,6</sup> Those series which demonstrated significant loss of movement, however, were reported by surgeons who resorted to surgery only after repeated closed manipulations.<sup>11,18</sup> Open reduction was required in 22 out of 84 patients with displaced fractures. There were two cases of infection in the open group and ten in the closed group but no functional loss of movement.

Our study has addressed the differences in the closed and operative management of the supracondylar fracture of the humerus in children as well as flaws in the appropriate use of available resources. These points of view have been addressed with the introduction of a formal treatment protocol. The closed treatment in general and open treatment in particular remain the mainstream of treatment protocol in our setup. Repeated manipulations and unnecessary open procedures should be avoided. The high incidence of cubitus varus deformity (33.0%) does not necessarily needs corrective procedure because all of them usually have good functional limb and therefore, only a small number may ask for cosmetic correction specially in girls in our society. However, all attempts should be made to prevent it.<sup>19</sup> On the other hand, serious complications like volkman's contracture, myositis ossificans and gangrene can be avoided by effective primary care and definitive secondary procedures.

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**Table-1:** Methods of treatment

Treatment	Type I	Type II	Type III	Total
Plaster Immobilisation	58	0	0	58
Closed Reduction & immobilisation	0	42	20	62
Open Reduction & K-wire fixation	0	2	20	22
<b>Total</b>	<b>58</b>	<b>44</b>	<b>40</b>	<b>142</b>

**Fig.1: TYPES OF FRACTURES (GARTLAND)<sup>2</sup>**



