A STUDY OF SURGICAL MANAGEMENT OF DISPLACED SUPRACONTLAR FRACTURES OF HUMERUS IN CHILDREN

By

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ABSTRACT

Background

Children usually fall while playing or while riding the bicycle and sustain injury to the supracondylar region of the humerus and complete displacement of the fragments occurs in many of the cases. This is the most common fracture seen in the children and makes up to 60% of all elbow injuries Elbow being important region for the patient as well as the treating surgeons, request early intervention to get an excellent reduction and to avoid complications. Elbow injuries also demand respect because of their vascular and nerve damages. Open reduction and internal fixation is a useful option for the treatment of supracondylar fracture of humerus. The results of displaced supracondylar fracture treated by open reduction and internal fixation with K wire and the complications on 20 children who had come to the Department of Orthopaedics, Metropolitian Hospital, Thrissur with history of supracondylar fracture of humerus was studied.

Method

Twenty children who presented with displaced supracondylar fracture of the humerus to the Department of Orthopaedics, Metropolitian Hospital, Thrissur was treated with open reduction and internal fixation with K wire after thorough pre-operative investigation during the course of the study. Children below the age of 13 were selected irrespective of the sex.

Results

A good result was obtained in 60% of the patients, fair in 30% and poor in 10%. The poor results were due to the open fracture and in one case the patient presented very late to the hospital. Complications such as nerve injuries, vascular injuries, infections were seen in the study which healed following the treatment. Two patients had cubitus varus and six patients had flexion loss on follow-up study.

Conclusion

Open reduction and internal fixation with K wire is an easy, simple, inexpensive method, which gives excellent results and good outcome.

Keywords

Supracondylar Fracture of Humerus in Children; K wire

Scope.

Supracondylar fractures of humerus is the most common elbow injury in children and makes up approximately 60% of all elbow injuries. It becomes progressively more uncommon as the child approaches adolescence the average age group of patients being 7½ years.

Age is a key factor in the incidence of supracondylar fractures. This fracture occurs primarily in the first decade. (Elison EL. Dressing for S.C. fractures of the humerus. JAMA 1934; 82). Fathey has observed that older children have a greater displacement with their supracondylar fracture. (Falhey JJ. Fracture of elbow in children. American Academy of Orthopaedic Surgeons, Inst Course Lect 1960; 17: 13 - 46). This was also referred in Nenrikson's series of over 800- supracondylar fractures. (Henrickson B. S.C. fractures in children. Acta Chir Scand 1966; 369).

Considering the number of patients injured and the severity of the initial injury that occurs, great deligence is required to secure an excellent result and to avoid or minimise the crippling complications, such as Volkmann's ischaemic contracture, mysositis ossification, stiffness, permanent nerve injuries and malunion.

Injuries of elbow demand respect because for their vascular damage and nerve injury they cause than any other injuries in the body. (Hanlon CR., Ester WL. Fractures in Children: A Statistical Analysis. Am J Surg 1954; 87: 312-23).

Poor bone to bone contact because of low cross sectional area makes correct alignment of there fractures difficult to achieve and impossible to maintain by closed methods. The error of rotational malalignment therefore of ten persists despite prolenged and forceful conservative management.

Open reduction of supracondylar fractures, visualisation of the traumatic anatomy, restoration of the pillars and the fossac and maintenance of pillar heights by cross kuire fixation ensure a predictable good cosmetic and a functional result. (Hammond G. The management of S.C. fractures of the humerus in children. Surgical Clinics of N.A. 1952; 32(2): 747). (Lars Dineission, Holger Peterson. Open reduction and pin fixation of severely displaced S.C. fractures of the humerus in children. Acta Orthop Scand 1980; 54: 249).

Material & Methods

In the present series, twenty cases which had completely displaced supracondylar fractures of the humerus were studied. The study was made in children up to the age of thirteen years Metropolitian Hospital, Trissur.

A detailed history of the mode of injury was obtained from the parents as well as patient. Out of the 20 cases, 8 (40%) sustained fracture due to a fall while playing and the remaining 12 patients due to fall from cycle.

All patients presented with pain, welling, "S" shaped deformity of the lower arm and inability to move the affected elbow. On examination all patients had diffuse swelling all around the elbow and puckering of the skin was seen at the site of fracture. All patients had shortening of the arm as compared to the normal side.

The average period from injury to presentation was 10 hours, the mean age being 7.8 years. There were 16 boys and 4 girls. 14 patients presented with involvement of left side and 6 patients on the right side.

6 cases gave history of having received massage from osteopath.

X-ray of the elbow was taken in 2 planes antero-posterior and lateral. Twenty cases of Gartland's Grade III type of supracondylar fractures were included in this series. These were further grouped into fractures with postero medial, postero lateral and posterior displacement.

Out of these twenty cases, six had postero medial, eleven had postero lateral, two had posterior displacement and one case was of flexion type.

Out of twenty cases, five were given one trial and two cases were given two trial's of closed reduction under sedation, taking care to maintain good radial artery pulsation. In four cases the radial artery pulsation had to be restored by open reduction and internal fixation.

Check X-ray of the three patients who under went closed reduction was taken. They proved unsatisfactory and were admitted for open reduction and internal fixation the reasons being.

- There was rotation in the horizontal plane (crescent sign).
- Inability to restore the radial pulse by closed reduction.

Remaining thirteen cases were taken up for primary open reduction and internal fixation, the reasons being.

- Extensive separation of the fracture fragments.
- Open fractures.
- Severe vascular compromises

Operative Procedure

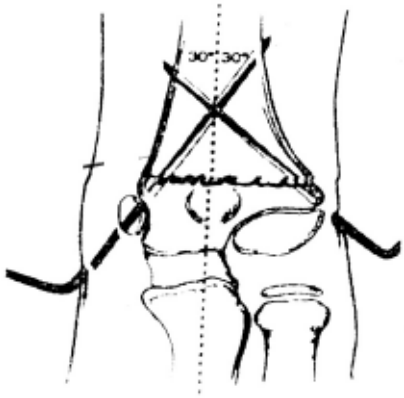
Open reduction and internal fixation with criss-cross or two lateral Kirschner wires.

Anaesthesia - General Anaesthesia

Position - Prone Position

Tourniquet was applied.

- K-wires Placement
  In the coronal plane, the wires travel up each S.C. column, with wide separation at the fracture site



Observation & Outcome

Mitchell and Adam (1961) have proposed the criteria for evaluation of the end results of supracondylar fractures.

Good: Change in the carrying angle less than 5 degrees or limitation of elbow motion less than 10 degrees.

Fair: Change in the carrying angle from 5-15 degrees or limitation of elbow motion 10 to 20 degrees.

Poor: Change in the carrying angle more than 20 degrees or limitation of elbow motion more than 20 degrees.

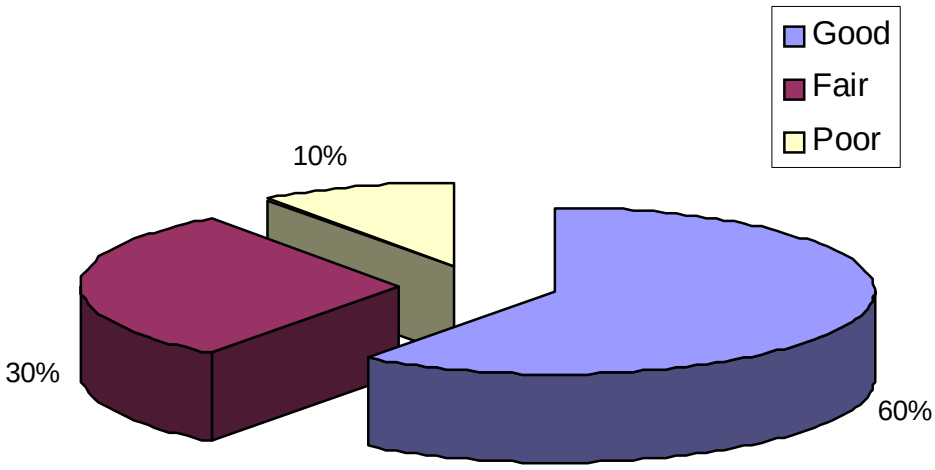
Results: In our series

- 12 cases (60%) exhibited good results
- 6 cases (30%) exhibited fair results
- 2 cases (10%) exhibited poor results

Failures

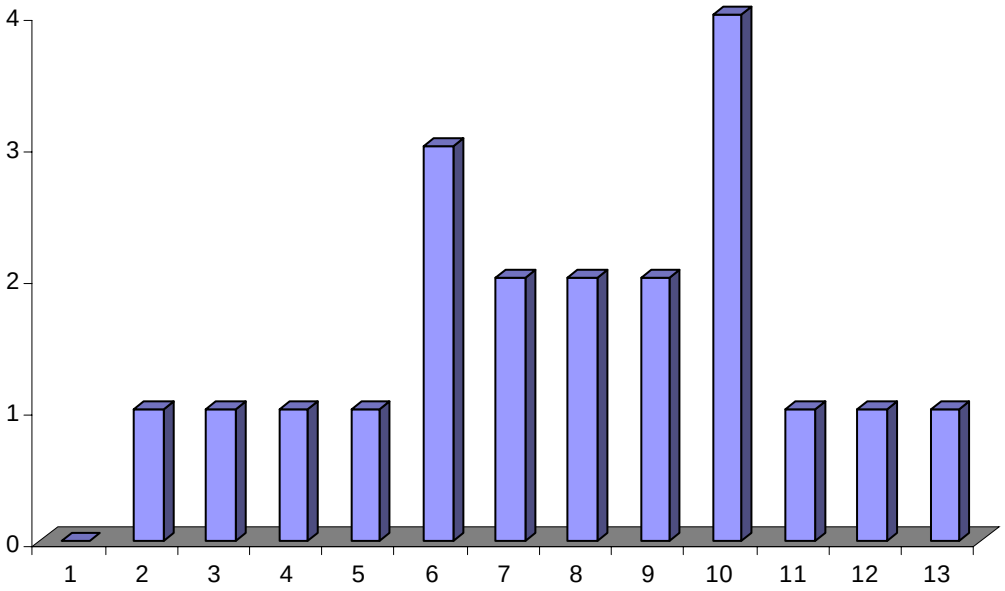
Two cases (6%) had poor results, which are considered as failures. Both cases had a limitation of elbow movement of more than 20 degrees flexion, and cubitus varus of 20 degrees, associated with medial pillar comminution, out of which one was open fracture and one who presented late to the hospital.

Graph 1 : Assessment of Result of Present series

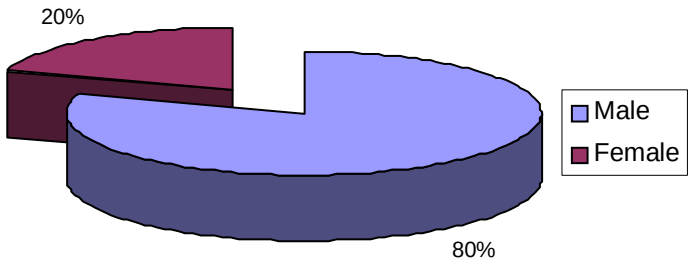


STATISTICAL ANALYSIS

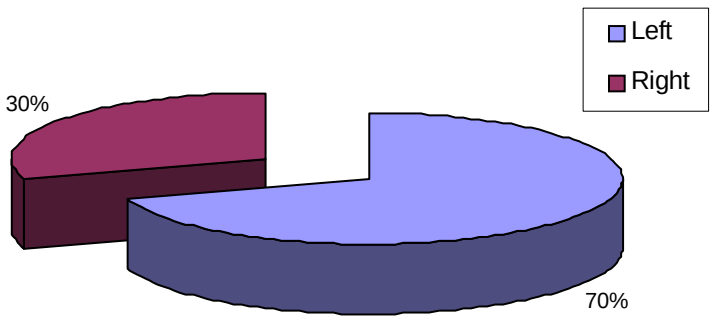
Age Distribution



Sex Distribution



Side Involvement



Age group Comparison with Other series

Authors	Average Age (in years)	Common Age Group (in years)
Andrew J.W.(1978)	6.6	2-13
D.Ambrosia (1972)	7	4-10
Fowles & Kassab (1974)	7.2	5-10
Kurer & Regan (1990)	8.0	5-12
Present Series	7.8	2-13

Sex Incidence as compared with Other Series

Authors	Male (%)	Female (%)
D.Ambrosia (1972)	69	31
Edward (1978)	50	50
Fowles and Kassab (1974)	81	19
Present Series	80	20

Showing Sides Involved

Left elbow	Right elbow	Total
14	6	20

Type of Displaced Fractures

Extension Type	Flexion Type	Total
19	1	20

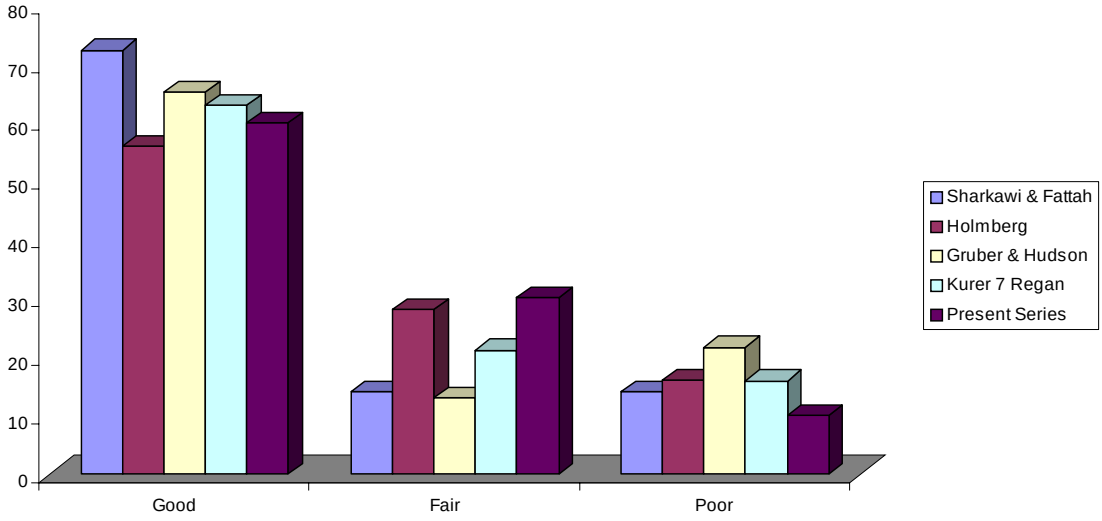
Type of Fracture as compared with Other Series

Authors	Extension Type (%)	Flexion Type(%)
Fowles & Kassab (1974)	90	10
Waston & Jones (1955)	96	04
Gere (1974)	95	05
Present Series	95	05

Comparison of results of present series with other series

Authors	Good (%)	Fair (%)	Poor (%)
Sharkawi & Fattah	72.4	14	14
Holmberg	56	28	16
Gruber & Hudson	65.3	13	21.7
Kurer 7 Regan	62.9	21.2	15.9
Present Series	60	30	10

Comparative Result of open Reduction & Internal Fixation between the Present Study & Other Authors



Analysis & Discussions

Supracondylar fractures of the humerus in children are common injuries and complete displacement of the fragments occurs in many of the cases. Vascular complication is preventable to a great extent. However, cubitus varus deformity seems to be the most common complication with any of the methods of treatment.

In the present series all the patients have been followed up for a period of one year. Six patients were in addition subjected to local massage by an osteopath according to their history, but clinico-radiologically showed no evidence of myositis ossificans. The considerable soft tissue oedema is an expression of the underlying injury and its severity, and it indicates a regional vascular compromise. Immediate exploration in these cases achieves good soft tissue decompression, allows ease of reduction, and as a result of anatomic restoration of the span of soft tissue, the progression of oedema was arrested.

Flexion type of S.C. fractures are much less common than the extension types, remembered that the posterior periosteum is torn, and the anterior periosteum now functions as a tension band by extending the arm. Having the elbow extended is awkward, and it does not control the proximal migration of the fracture. Open reduction and pinning is therefore recommended for displaced flexion type of S.C. fractures.

The one case of flexion type displaced fracture encountered was treated by open reduction and internal fixation with K wires. No. Complications were encountered in this type.

Complications were encountered like;

- Feeble radial pulse in three cases, before reduction. The pulse had returned immediately after open reduction.

- Three cases of median nerve and one case of radial nerve involvement were noted pre-operatively which were transient and recovered spontaneously over the period of ten to twelve weeks.

- Pin tract entry wound irritation was seen in two of the cases, which presented as points of hypergranulation tissue on the skin. This could have been avoided by burying the K wires subcutaneously.

- Two cases had superficial would infections, which subsided immediately after the irrigation of the wounds and appropriate antibiotic cover.

- These minor complications like pin tract entry wound irritation and superficial wound infection had no influence whatsoever on the final functional result.

- There was not a single case of secondary nerve lesion of Volkmann's ischaemia or myositis ossificans.

The Traumatic Anatomy Preoperatively

There was associated disruption of the capsule of the elbow joint which as a rule, in some cases, was partially excised to facilitate reduction. The distal fragment could be delivered out of the wound partly on exposure of

the fracture. Excision of the posterior capsule of the elbow in part has had no effect on the mechanics, vascularity of the regional physis or on the overall function of the elbow.

The single most important factor that decides the overall prognosis in a given patient is the extent of pillar comminution. Pillar comminution was seen in five of the twenty cases on exploration. Perfect anatomic realignment of the pillars then becomes difficult. In such situations we suggest first, the anatomic restoration and stabilization of the pillar that is not comminuted, followed by that of the comminuted pillar.

The restoration of the olecranon fossa anatomy is an index of the anatomy of the overall restoration. The elbow is then passively extended, and one can compare the resultant carrying angle intraoperatively. We retain the implants for six weeks, follow up the patient radiologically, and decide on implant removal when there is evidence of reunion. In 2 cases we have accepted fixation in varus position. This was necessary in order to achieve a stable reduction, which was possible only in varus position, and was attributed to the degree of pillar comminution. All the poor results in this series are associated with medial pillar comminution.

The overall results at the end of one year are as follows;

- Good (60%)
- Fair (30%)
- Poor (10%)

This evaluation thus takes into account strictly the resultant change in the carrying angle, when it comes to classifying the results, despite the good

range of elbow movement at the end of one year. In all cases the distal fragment anatomy was thoroughly defined by a wide exposure, which necessitated exposure of the distal fragment upto the level of the epicondyles on either side. The distal fragment exposure must include complete visualization of the olecranon fossa. The K wires are introduced through the epicondylar region and the wires must lie in the same coronal plane. In Five cases two parallel lateral K wires are passed from the lateral epicondyle obliquely across the fracture site to engage the opposite cortex.

In none of the patients there was a neuro-vascular complication as against the possibility of such a complication in methods employing percutaneous pinning From the economic standpoint, all our patients were discharged from the hospital on an average after four days. The patient turnover is thus rapid unlike in those protocols of treatment where overhead traction or Dunlop traction is advocated. Conservative management of displaced supracondylar fractures requires adequate facilities in the hospital for maintenance of the traction system as well as for the nursing care of the children. This is a luxury that hospitals as well as the patients in developing countries cannot afford.

The results presented by us compare well with the results observed by other authors in literature. These results are better than equivalent results in series describing the closed methods of treatment, both for the change of carrying angle is concerned as well as the motion of the elbow is considered.

Conclusion & Summary

The summary of the following study keeping in mind the aims of the same. There were 16 boys (80%) and 4 girls (20%) with average age of (7.8) patients. 14 patients (70%) presented with involvement of left side and 6 patients (30%) on the right side. 1 case sustained fracture due to a fall on a flexed elbow and remaining 19 cases fell on outstretched hand.

The average period from injury to presentation was 12 hours, the mean age being 7.8 years.

Six cases gave history of having received massage from an osteopath.

Among the 20 cases of displaced fractures, 19 were of extension type and 1 was of flexion type. Of the 19 cases, 6 had postero-medial displacement. 11 had postero lateral, and 2 had only posterior displacement.

Of the 20 cases, 2 had open fracture and 18 had closed fracture. Of the 18, seven were given a trial of closed reduction and thirteen were taken up for primary open reduction. All the cases for which closed reduction was attempted failed and had to be taken up for open reduction and internal fixation with Kirschner wires.

The associated injuries seen were as follows:

- Traumatic median nerve injury (in three cases) and radial nerve palsy (one case) which recovered over the period of 10-12 weeks.

- Vascular injuries (in three cases) which normalized after open reduction and internal fixation.

Two cases had open fracture and had to be taken for primal open reduction and internal fixation.

The closed reduction in the 7 cases failed due to various causes like, rotation in horizontal plane (as visualized in check x-ray), interposition of soft tissues between fragments, insufficiency of radial artery pulsations even after closed reduction.

The remaining 13 cases were taken up for primary open reduction and internal fixation with K wires.

The time taken from injury to surgery on an average was (24-36) hours.

In a nutshell all the 20 cases finally had to under go open reduction and internal fixation with K wires.

Special care was taken while introducing the K wire anteriorly into the medial epicondyle so as to prevent ulnar nerve injury. In five cases two parallel lateral K wires were passed from the lateral epicondyle.

After regular postoperative follow ups, the results were assessed as follows according to Adams and Mitchell criterias.

Twelve cases (60%) exhibited good results, 6 cases (30%) fair and 2 cases (10%) poor results.

Open reduction of displaced supracondylar fractures in children is based on the principles of treatment of intra-articular fractures namely, anatomic restoration, stable internal fixation, and early mobilization.

The major complications of surgical management appear to be a loss of range of motion and residual cubitus varus deformity.

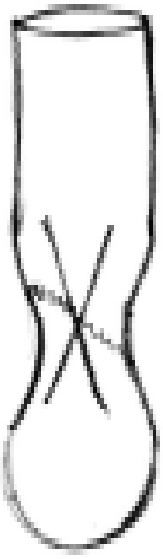
The main reason for decrease in range of motion being the late initiation of active exercises.

Most patients will regain full function of the elbow if the K wires are removed and motion started four weeks after injury. (Early motion is the key).

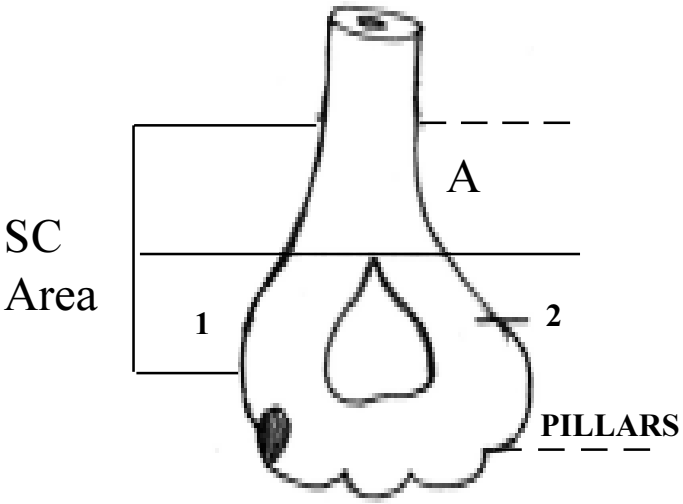
Cubitus varus is mainly due to inadequate reduction as a result of medial pillar comminution. This complication may have been avoided, if the implants were retained for either weeks.

We strongly advocate open reduction and internal fixation with K wires fixation of displaced supracondylar fractures in children for the various reasons discussed above in the study.

MASTER CHART / ILLUSTRATIONS / DIAGRAMS



Antomical Restoratino of pillars with K Wires



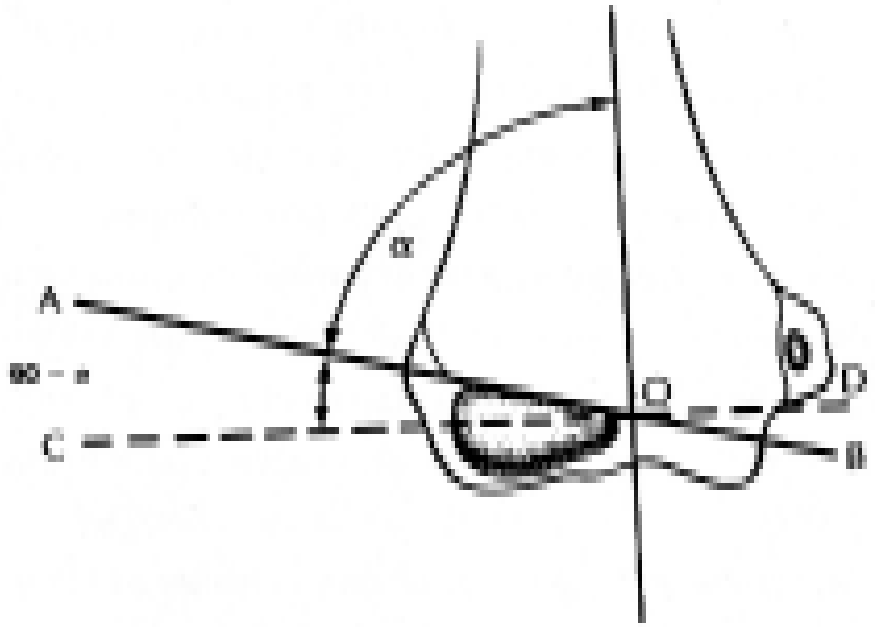
A- Area Above the pillar

B - Area below the pillar

1 - Medical Pillar

2. Lateral pillar

Diagramatic Representation of the Lower end of the Numerus


α
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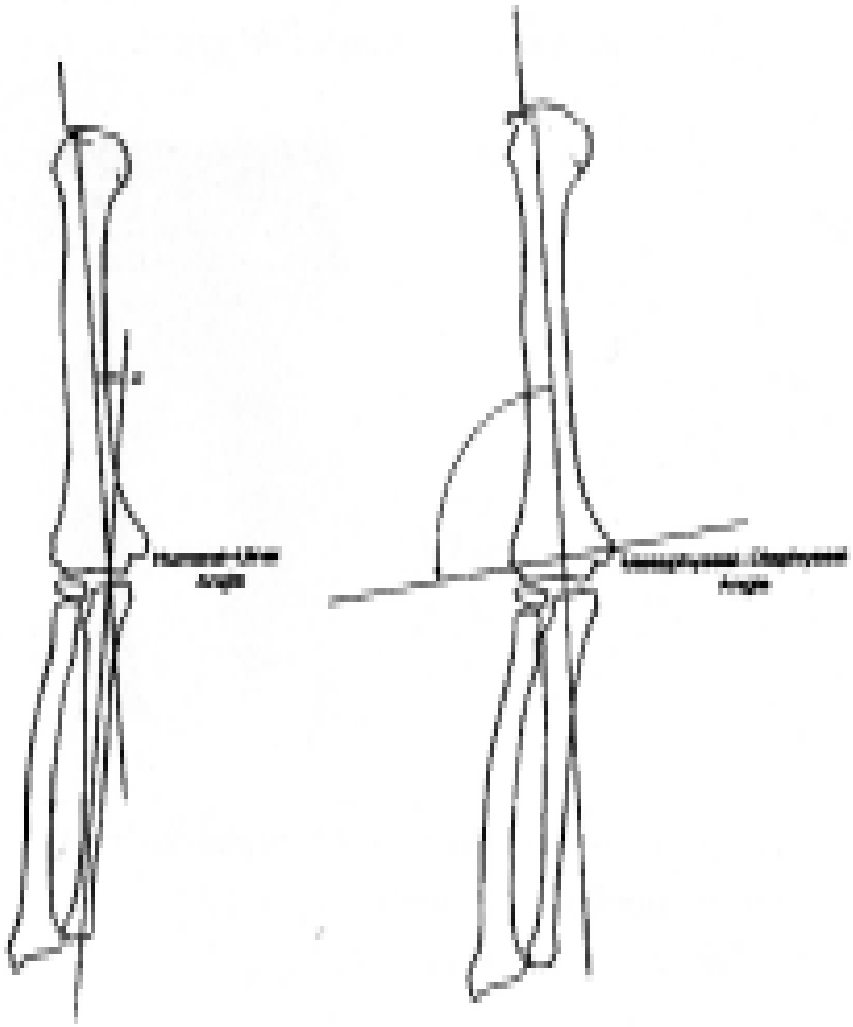
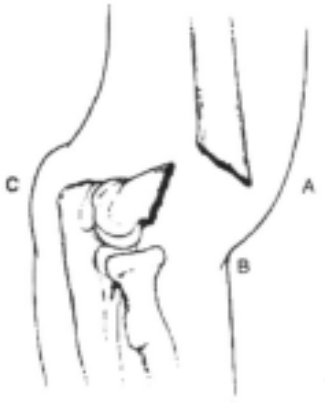


Clinical Appearance



(A) The S-shaped configuration is created by prominence of the spike of the proximal fragment **(B)** Flexion of the distal fragment **(C)** The posterior prominence of the olecranon **(D)** Puckering of the skin in the area where the spike penetrates into the subcutaneous tissue

Classification of Supracondylar Fractures

They may be further broadly classified as ;

- Flexion Type
- Extension type

Flexion Type

Extension Type

Gartland's Classification

Type I : Undisplaced

Type II : Displaced with intact posterior cortex

Type III : Completely displaced Postero medial, Postero lateral

Gartland's Classification

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Annexure

PROFORMA

"Study of operative management of displaced supracondylar fractures of the humerus in children"

Name :

Age: Sex: IP No:

Address :

Complaints :

History :

(1) Fall (2) Accident (3) Previous Treatment (4) Native Treatment

(5) Duration (hours)

Mechanism of Injury:

1) Direct Trauma (2) Indirect Trauma

Time & Date of Injury:

First Aid given:

Time & Date when seen in the Hospital:

On Examination:

(1) Attitude of the Limp:

(2) Open or Closed:

If Open Type:

Radial

(3) Neurological Deficit: Anterior interosseous

Unlar

4. Vascular Deficit: Radial Plus : Good / Feeble

Capillary Filling: Good /Sluggish

5. Passive Stretch Sign:

6. Associated Other Bony Injuries:

6. Associated Diseases:

FINAL DIAGNOSIS

GENERAL PHYSICAL EXAMINATION

(1) C.V.S.: **(2) Respiratory System:** **(3) Abdomen:**

Investigations: Hb%

Blood Group & Typing

Urine (R)

Treatment Given: Prior Closed Reduction Done or Not:

Time of Surgery: **Emergency:** **Anaesthesia -** G.A.

Elective: **Position of Patient: Prone**

Whether Traction given: Yes / No **No.of Days:**

Open Reduction & Internal Fixation with 'K' wires:

Post Operative Complications

Immediate

- Loss of Reduction
- Vascular (Ischaemia)
- Nerve injures
- Wound infection

Delayed

- Pin Tract Infection
- Mal union
- Stiffness
- VIC
- Myositis Ossificans
- Late Nerve Complications - Tardy Ulnar Palsy

X-ray Report: Elbow - A.P. / Lateral

Injury X-ray

Post Traction Injury X-ray

Post-Operative X-ray a) 1st X-ray b) 3rd week c) 6th week
d) 12th week e) 6th month

Removal of 'K' wires: **Mobilization:**

Clinical Follow-Up Assessment

R.O.M.in	Flexion	3 weeks	6 weeks	3-6 months	1 year & Above
Degrees	Extension				
Pain					
Tenderness					
Pin Tract Infection					
Deformity					
Nerve Involvement					

Assessment of Results

Range of Movements

Malunion

Results: 1) Good 2) Fair 3) Poor

Remarks

DECLARATION

I hereby declare that the thesis is original and that no copyrights have been infringed. The study was done at Metropolitian Hospital, Trissur under the guidance of Dr. RAMKUMAR Ms. (Ortho) and under Dr. SUNNY PAZHAYATTIL MS. (Ortho) MCH (Ortho), (LIVERPOOL) during the period from May 2003 May 2005.

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