

**MANAGEMENT OF SUPRACONDYLAR  
FRACTURES OF THE HUMERUS  
BY A CONSERVATIVE METHOD  
IN A DISTRICT HOSPITAL**

***DISSERTATION SUBMITTED AS PARTIAL FULFILLMENT  
FOR THE AWARD OF THE  
MASTER OF MEDICINE [SURGERY] DEGREE  
OF THE UNIVERSITY OF ZAMBIA***

**DR ROY CHAVUMA : MB.BCh.  
(MEDICAL ACADEMY SOFIA)**

**257344**

**SUPERVISOR : MR. JAMES M. CAIRNS FRCS**

**CO-SUPERVISOR : PROF. KRIKOR ERZINGATSIAN FRCSI**

**FEBRUARY, ~~1996~~ 1997**

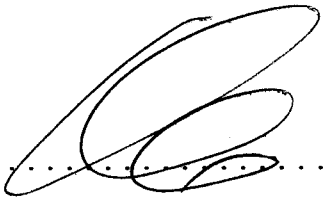
THESIS  
CHA  
1997

DECLARATION.

I THE UNDERSIGNED DECLARE THAT THE WORK IN THIS  
PROJECT HAS NOT BEEN PUBLISHED BEFORE AND I FURTHER  
DECLARE THAT IT HAS NOT BEEN PRESENTED FOR ANY OTHER  
DEGREE.

Signed..........

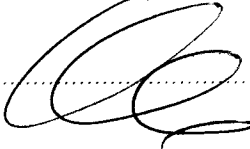
Dr. Roy Chavuma.

Signed..........

Supervisor. ( Prof. Krikor)

APPROVAL PAGE


Approved by ..... Prof. Karika Egingebian

signed.....

Approved by ..... Prof. JOHN E JELMS

signed.....

Approved by..... G. F. Ferreira MMedChir PhD

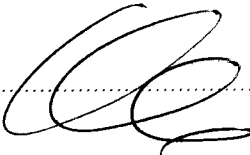
signed.....

Approved by .....

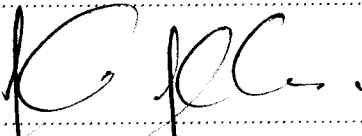
signed.....

APPROVAL PAGE


Approved by ..... Prof. Krika Egingebian

signed..... 

Approved by ..... Prof. JOHN E. JELLS

signed..... 

Approved by..... G. F. Ferreira MMedChir PhD

signed..... 

Approved by .....

signed.....

## TABLE OF CONTENTS

	PAGE
1. ACKNOWLEDGEMENTS.....	2
2. SUMMARY.....	4
3. DECLARATION.....	5
4. INTRODUCTION.....	6
5. LITERATURE REVIEW.....	9
6. OBJECTIVES.....	11
7. PATIENTS AND METHODS.....	12
8. FOLLOW UP.....	16
9. ASSESSMENT.....	17
10. RESULTS.....	20
11. DISCUSSION.....	24
12. CONCLUSIONS.....	25
13. APPENDIX.....	26
14. REFERENCES.....	29

ACKNOWLEDGEMENT.

I would like to thank Mr. James M. Cairns for the invaluable help and encouragement which he gave me during the early days of starting this project. He was really my resource person who provided much of the ideas which are incorporated in this project.

I am greatly indebted to Professor Krikor for his critical reading of the paper for the many suggestions and correction that he offered. The project would never have materialized without his supervision .

There are many people I would like to thank who made this project a reality. Mr. Chris Tetham for the lessons on the motor bike, without which I would not have been mobile. The Gullicks for their understanding and encouragement. Mr. Raphael Ghiri of the St. Francis record department for the hard work he put in with retrieval of the case notes.

Thanks also are due to Mr. Nindi from the X-ray department for the wonderful work he did retrieving the X-rays.

I would like to thank Dr. Bharskaran who allowed me to use his computer for the beginning of this project and to Mr Mwale the manager of the health information system. Mr Richard Tumeo and Mr Hector Chimese who gave me my first lessons in computer literacy.

I would like to thank Professor Simms and Dr. Ng'andu for helping me with the statistical analysis.

Let me say thank you to all those who have helped in realizing this project, who may not have been mentioned by name but please know that I am nevertheless grateful.

**SUMMARY.**

The treatment of supracondylar fractures can be by open operative manipulation and fixation or by closed manipulation alone. This is a follow-up study of supracondylar fractures of the humerus treated by closed means at St. Francis hospital in Katete. The follow-up is of 35 patients who were treated between 1992 and 1994. Around 61 villages were visited.

Patients were evaluated and the function of both limbs were recorded. The uninjured elbow then acted as a control and the two limbs were compared.

Of the 35 patients followed up 32 had excellent results. which is a 91.4% success rate.

The project results were very encouraging and support the concept of treating these fractures conservatively.



## INTRODUCTION.

Supracondylar fractures are among the most common fractures encountered among children in Zambia. There are two main methods of treating them. These are closed (conservative) and open (operative)

In the conservative method non operative techniques are employed. The arm is manipulated and immobilization is maintained either with a collar and cuff, Plaster of Paris or adhesive tape. The method does not involve the use of any implants. In technologically advanced countries the trend has been to use open or operative techniques. Nonetheless the practice in most hospitals of the world including those in Zambia is to use the closed method.

Operative methods can be subdivided into two main categories.

- (i) Open manipulation and fixation of the fracture with some form of an implant.
- (ii) Closed manipulation of the fracture and fixation of the fracture with an implant such as a K-wire through the skin without opening the fracture. This is termed "percutaneous fixation."

Operative techniques are the methods in which the fracture is manipulated and fixed internally with some form of fixation, gives the patient the benefit of using the arm early. This is the open method's main advantage.

However it has many disadvantages. Open techniques require sterile theater facilities, the implants used can be very expensive and open methods have to be done by experienced surgeons. As a rule open techniques have a risk of infection and patients should have no wounds or any other source of infection which may contraindicate surgery. One of the documented long term complications is late ulnar nerve injury attributed to the migration of the K-wire (Prischusuk, 1992). In order to overcome such problems, absorbable materials were used but the results were disappointing (Wilkin 1990). The advantage in this case was supposed to be that once in place absorbable implants did not need to be removed as is often the case with the conventional metal implants (Botman et al, 1993).

Because of these problems, some surgeons advocated closed manipulation with percutaneous fixation. In this case the elbow is manipulated preferably under fluoroscopic guidance without opening the fracture, and transfixing pins (K-wire) are passed percutaneously. This has been the modern trend. A method of fixation with crossing of the K-wires for better stability is also described and good results were claimed (Paradis et al, 1993, Boyd, 1994).

Kasser included details of the percutaneous pinning in his instructional course (1992) and a comparison of the percutaneous pinning and open reduction with fixation showed that the two methods carried the same morbidity and were equally safe (Crammer et al, 1992).

Closed techniques have the advantage of being relatively easy to perform. All that is needed is a good general anaesthetic, an assistant and a collar and cuff after manipulation to hold the fractured fragments in position. The procedure can be performed by a relatively inexperienced surgeon with good results. Closed techniques can be used in dirty theaters safely. The disadvantages of the closed techniques are that they may not always achieve anatomical reduction and the patient has to keep the elbow flexed in a collar and cuff for at least three weeks.

The main method of treating supracondylar fractures of the humerus at St Francis Hospital, Katete was the conservative approach described by Jellis (1991), which he termed the classical method of reduction and immobilization. According to him, fractures with minimal swelling may be reduced by longitudinal traction and backward pressure on the humeral shaft. While maintaining this traction and backward pressure, the fracture is locked in place by flexing the elbow to at least 110 degrees and pronating the forearm.

This manoeuvre tightens the periosteum and triceps aponeurosis over the fracture posteriorly and the medial periosteal hinge. Holding this reduction is a balancing act and the reduction will be lost at lesser degrees of flexion. The reduction should be held in place by applying a collar and cuff sling in that position. Bandaging or Plaster of Paris cast application were not recommended as these may increase the chances of venous obstruction and a compartment syndrome developing thus the importance of an observer, whether doctor, nurse or mother to make sure that the radial pulse is palpable and understands the significance of continuing or increasing pain.

#### **LITERATURE REVIEW.**

There is a lot of literature on the management of supracondylar fractures of the humerus and these can be classified in two main categories namely;

1. Conservative methods and
2. Operative methods.

Many surgeons still support the conservative method. Grant H.W. et al. made a long term follow up of children who had supracondylar fracture of the humerus in Scotland. Their results show that if displacement was less than 25% there was good results and functionally almost all did well.

Albuger P.P. et.al. (1992) also did a follow study of 39 children with supracondylar fracture of the humerus and reported a 92% success rate of healing using the conservative methods.

Echun, Watters and Bem (1991) Did a one year audit of supracondylar fractures of the humerus in the University Teaching Hospital. Lusaka. and the results are in favour of the conservative approach.

St. Francis Hospital in Katete also had to date encouraging results in support of the conservative method and form the basis of this study.

## **OBJECTIVES.**

The aim of this study was to follow up conservative management of supracondylar fracture of the humerus as treated at St. Francis hospital in Katete, to ascertain the function of the fractured limb at least six months to two years after discharge and determine any disability that might have occurred since discharge.

## **SETTING.**

This was in Katete district in chiefs Mbang'ombe and Kawazas' areas as well as parts of Chadiza district. The patients fell into the St. Francis Hospital catchment area.

## **RATIONALE.**

This project was carried out to show that the conservative management as practiced in St. Francis gives good objective results and should be encouraged and used as a standard procedure.

Review of literature had shown that the closed method of management gives good results but there had been no home based follow up to evaluate such results. I hope this data will encourage the district health specialist or general medical officers to use it, as there will be data to prove that the method is worth using. Its advantages are that it is easy to master, not costly, is non-invasive and is a relatively safe procedure.

## **PATIENTS AND METHODS.**

Patients were selected from the registry of St. Francis hospital. The first step was to collect all files on supracondylar fractures of the humerus registered in St. Francis hospital from 1992 to 1994. 99 case notes were retrieved and the addresses noted down. From the hospital number it was possible to retrieve the X-rays. Patients whose fractures had occurred at least six months before the commencement of the follow up and had both X-rays and case notes were recruited into the study.

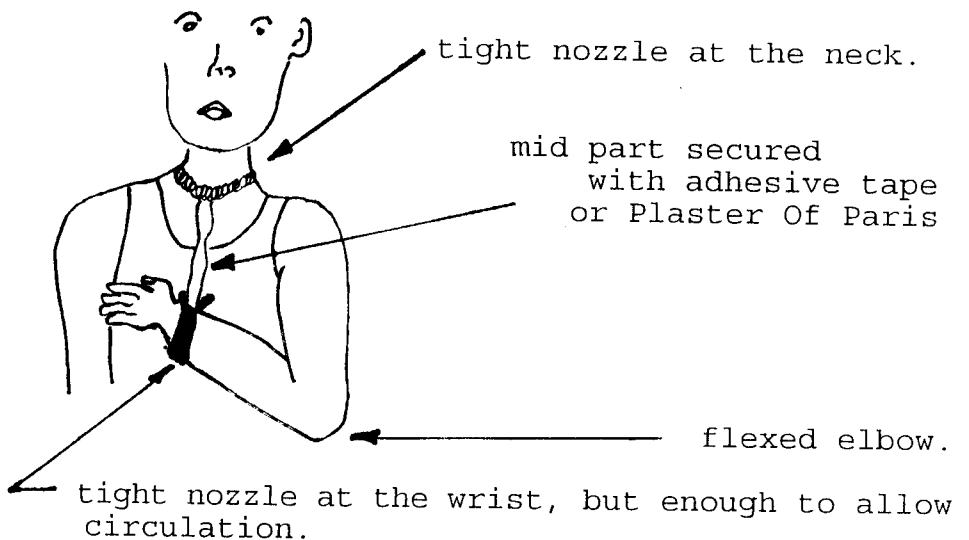
In St. Francis hospital ,Katete patients were admitted to the surgical wards through the outpatient department and were sent directly to the X-ray department where both the a-p and lateral views were obtained.If there was neurovascular damage the patient was taken to the theater immediately. Most patients however came with a swollen limb without neurovascular compromise and in these patients the limb was elevated in a roller towel until the swelling had subsided.This usually occurred within two days. In the meantime the patient was put on a circulation observation chart (see Appendix) The observations were done hourly or every fifteen minutes depending on the severity and discretion of the treating doctor.The patient was put on the next theater list as soon as the swelling had gone down.The operation itself is well described in " Primary Surgery, Vol.. 2. Trauma " King. (1987)

Under general anaesthesia the elbow was manipulated carefully and the result compared with the uninjured limb. The position of the olecranon in relation to the humerus was carefully noted. The amount of supination in flexion to be achieved was guided by comparing it with the normal limb. The fracture was pulled longitudinally on the extended elbow for at least a minute while the assistant pulled the limb in the opposite direction. This was done to disimpact the fracture. If the fractured end moved freely disimpaction had occurred. Medial and lateral displacement was corrected if this had not already occurred during disimpaction. Continuing the axial traction, the operator then flexes the elbow with the right hand thumb on the olecranon, at the same time the forearm is held in external rotation to replace the carrying angle and thereafter rested in pronation. If following manipulation the radial pulse was lost the forearm was re-extended. If the pulse returned then the loss was due to swelling of the limb and further elevation of the limb was carried out. If the pulse was still absent after extending the elbow, remanipulation with prolonged traction was performed. At the end of manipulation a collar and cuff was applied such that the nozzles at the neck and the wrist were tight and difficult to remove while maintaining circulation. An adhesive tape or Plaster of Paris was applied in between the two ends to secure the nozzles (see diagram below).



This was even more important in the rural setting because the people there believe that having the collar and cuff around the neck is enough and that it is not necessary to have the elbow maintained in a flexed position. The M.U.A. were done by Mr. Cairns and doctors posted to the surgical wards, usually M.Med post graduate students from The University Teaching Hospital.

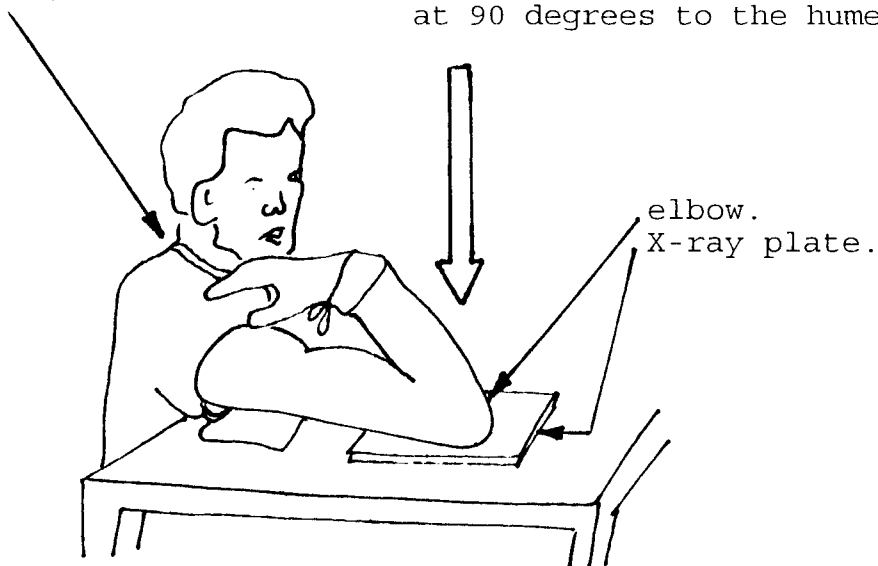
**DIAGRAM SHOWING HOW TO SECURE THE COLLAR AND CUFF.**



Post operatively the patient was sent for a check X-ray . This was done with the rays passing through at 90 degrees in relation to the humerus in the antero-posterior view as shown in the diagram below. It was important that the A-P view was taken as indicated in the diagram. Otherwise it was difficult to interpret the X-rays correctly. A pre-operative X-ray is preferably taken in the same position for easy comparison with the post operative X-ray. However a certain degree of unavoidable bias may have been introduced into the radiological grading due to projection differences in the pre-operative and post-operative views.

collar and cuff.

X-rays should be centered  
at 90 degrees to the humerus.



A lateral view was also taken .

A good reduction was achieved if there was;-

1. No angulation on the AP view.
2. No significant bowing in the lateral view.
3. The two ends of the fracture had no gap in between.

If these criteria were met then the reduction was considered satisfactory otherwise it was remanipulated. With a satisfactory X-ray the patient was discharged on a collar and cuff and was reviewed in three weeks. No further X-rays were indicated only clinical assessment remained.

#### **FOLLOW UP.**

The 61 villages unfortunately were not clustered in one place but widely spaced apart with a minimum of ten kilometers in between them. Some patients were several villages apart, however they had to be followed up. It was a very difficult exercise at times, as the Honda had to be dragged uphill on occasion. On arrival at the village permission was sought from the village head man and the parents of the patient. The purpose of the research was fully explained to them. Permission was easily granted when they realized I was from St. Francis hospital. Ethical issues did not arise here because no new techniques or invasive procedures were performed.

## ASSESSMENT

Assessment was done by evaluation of the grip, supination and pronation, extension and flexion and inflammation were looked for. As per proforma the patients were evaluated for;

(i). GRIP; This was achieved by asking patients to hold my index fingers in their clenched hands while I tried to pull my fingers off. The grading was as follows:

If I could not move my fingers off the patients grip...3  
If I could only slightly move my fingers. (mildly impaired)..... 2  
When I could move my fingers off though I could feel the effort of being held by the patient ..... 1  
When the patient could hardly hold my fingers ..... 0

(ii). SUPINATION AND PRONATION; In this case the patient with a flexed elbow at 90 degrees was asked to pronate maximally from a neutral position and the angle achieved was noted down. Then from the neutral position again the patient was asked to supinate as much as they could and the angle was again measured with a goniometre. The scoring is as follows;

The patient from a neutral position could pronate and supinate 90 degrees. (Full pronation and supination)... 3

When the patient could pronate and supinate between 90 and 60 degrees. (Partial pronation and supination)..... 2

When the patient could pronate and supinate between 45 and 60 degrees. (Restricted pronation and supination).....1

When the patients pronation and supination was less than 45 degrees. (Severely restricted)..... 0

EXTENSION AND FLEXION; The patient was asked to fully extend and flex the elbow. The range was measured with a goniometre and noted down.

If the patient was able to move the elbow from 0 to 180 degrees.....4

If the range was from 30 to 120 degrees.....3

When the elbow could move from between 30 - 40 degrees to 90-120 degrees.....2

In this case the range was more restricted from between 45-60 to 75-90 degrees .....1

Almost a fixed flexed joint with less than 15 degrees of movement..... 0.

PAIN; This was a subjective evaluation guided by the patients degree of complaint the pain was graded as follows; If the patient complains of no pain at all.....3

When the patient complained of pain only on palpation...2

When the elbow was painful even without any external provocation.....1.

If pain was severe enough to prevent the patient from sleeping..... 0

INFLAMMATION; This was a more objective observation which was elicited by inspection the grading was as follows;

No sign of inflammation on inspection .....3

Superficial inflammation without cellulitis.....2

Marked inflammation with cellulitis..... 1  
Obvious infection with pus..... 0  
The total from the above was what we termed as functional  
grade abbreviated to "F" Since the assessment was done for  
both the upper limbs the fractured limb had its  
abbreviation as "F1" and the uninjured arm was "F2"  
The carrying angle was measured with a goniometre and  
entered as degrees. This was abbreviated as "C" as above  
"C1" was for the injured limb and "C2" for the control.

## RESULTS.

Of the 99 cases which were retrieved only 60 of them qualified to be included in the study as the age limit was 16 years. The range was from 5 to 16 years with a mean of 11.4 years (see graph 1). Of the 60 only 35 patients were traced others had migrated, a group of refugees from a nearby camp had gone back to Mozambique. Two patients were from Lusaka and could not be followed up and one patient had died from causes other than the fracture.

NEUROLOGICAL DEFICIT; There was no patient with neurological deficit in this series.

GRIP; All patients followed up had a normal grip

PAIN; Only one patient complained of pain during the follow up. There was one patient who felt pain while doing intensive manual labour. The patient however admitted that he had fallen on the same arm several times since the injury. All the other patients reported no pain at all.

SUPINATION AND PRONATION; All patients seen had a full range of movements. They all supinated and pronated fully.

EXTENSION AND FLEXION. Most of the patients seen had ranges of movement which were normal only a few had some mild form of impairment.

INFLAMMATION      No patient in the series had any inflammation. All had healed up wounds if there were any at the time of injury.

#### FUNCTIONAL GRADE

The above parameters were given a score each as discussed in the assessment section. These scores were added up and the total score was the functional grade. For the normal limb these added up to 16 which was the maximum score. For the injured limbs the results were as in the table below and graph 2 in the appendix.

functional grade	number of patients
16	28
15	04
14	02
13	00
12	00
11	01
10-0	00

The table and graph clearly show that most of the patients i.e. 32 of the 35 had a functional grade excellent (table 3 in the appendix). There were two patients with very good results and only one had a good result. No patient had a grade below 11 (eleven). Functionally there were no poor results.



#### CARRYING ANGLE.

The carrying angles were measured and recorded. The normal variations of carrying angles are large 0-23 degrees (Mc. Rae 1976) and in our series emphasis was more on the variance between the two upper limbs. A difference of 5 degrees and above was significant in that physical deformity became apparent. The carrying angles measured ranged from 0 to 15 degrees. Almost all had identical carrying angles on both limbs except for 7 cases in which the carrying angles differed by 2 to 6 degrees. The patient with a 6 degrees variance had visible deformity.

The calculation of P was based on the student t test. The carrying angle and the functional angles were added. The total from both the injured and uninjured limb, which acted as a control, were used to calculate the standard deviation which in turn allowed us to calculate "P".

#### RADIOLOGICAL GRADE.

X-rays taken at the time of injury before the manipulation under anaesthesia (M.U.A.) were compared with the X-rays taken post M.U.A. Table 4 at the appendix show how grading was done. The bigger the number the larger the displacement there was. This is illustrated by the graph 2a and 2b. The graph was based on the following tables.

PRE-OP X-RAYS		POST-OP X-RAYS	
GRADE	NUMBER OF PATIENTS.	GRADE	NUMBER OF PATIENTS.
0	6	0	20
1	7	1	12
2	3	2	3
3	5	3	0
4	11	4	0
5	3	5	0

These results show that all forms of severity were encountered. However post operatively all had been corrected with 20 of the 35 patient in full correction. (grade 0) Twelve were in grade 1 and only 3 were in grade 2 which is a moderate displacement without lateral or medial displacement (see table 1 in the appendix). Even where the X-rays seemed unsatisfactory the functional results were good, suggesting that radiology does not always predict functional outcome.

## DISCUSSION.

Supracondylar fractures of the humerus treated with open methods give fairly good results (Paradis et,al. 1993). In a comparative study between percutaneous pinning and open reduction Crammer et,al (1992) recommended that if percutaneous pinning fails then an open technique should be employed. This in essence suggests that the operative method of percutaneous pinning has problems in addition to the late ulnar nerve injury (Prischasuk 1992).

The closed manipulation is a widely accepted and recommended procedure and is advocated even among the surgeons who advocate operative techniques (Boyd 1994). The problem with the management of supracondylar fractures of the humerus is how to maintain the alignment following manipulation. Malalignment should manifest itself in a carrying angle very different from the uninjured limb at least 6 degrees in some cases with visible disability.

In our series despite the non availability of fluoroscopic guidance, the correction of the displacement was very good. All forms of severity were encountered in the pre-operative X-rays (graph 2a). These had been reduced to acceptable levels post-operatively (graph 2b).

The carrying angles in the results were all equal except in three cases with a variance less than 6 degrees. Functionally all had good function using the grading devised for the project.

**CONCLUSION.**

Our Null Hypothesis is that there is no difference between the injured and uninjured limbs in terms of function and carrying angle which showed how deformed the elbow was.

On the basis of the results  $P$  is less than 0.5. We can not reject the Null hypothesis and conclude that conservative management of supracondylar fractures of the humerus with a collar and cuff as practiced at St. Francis gave good results.

The method is cost effective because no invasive procedures are used and no implants are employed which might require removal later. A clinical evaluation is all that is needed for patient follow up.

PROFORMA FOR SUPRACONDYLAR FRACTURES.

ST. FRANCIS HOSPITAL.

KATETE.

NAME.....HOSP. No...../.....

AGE ..... DATE OF INJURY.....

RADIOLOGICAL GRADE; PRE-M.U.A.....POST M.U.A.....

ASSESSMENT; (MARK X ON THE FRACTURED SIDE)

RIGHT.

LEFT.

1. GRIP

.....

.....

2. SUP/PRO.

.....

.....

3. EXT/FLEX.

.....

.....

4. PAIN

.....

.....

5. INFLAMMATION

.....

.....

TOTAL SCORE

.....

.....

(FUNCTIONAL GRADE)

CARRYING ANGLE

.....

.....

ADDITIONAL NOTES;

Table 2

- 0.....No displacement.
- 1.....Displacement less than one centimeter, bone ends in contact.
- 2.....Moderate displacement posteriorly, less than 2 cm with no displacement on the lateral or medial aspect.
- 3.....Marked displacement posteriorly and a lateral or medial displacement of less than 2 cm.
- 4.....Gross displacement with rotation along the axis.
- 5.....Fracture complete with a gap between two ends, may be open or closed.

REFERENCES.

1. Alburger P.D. Wetdner P.L. Berz R.R. (1991) Supracondylar fractures of the humerus in children. *Journal of Paediatric Orthopaedics*. 12(1):16-9.
2. Boyd D.N. Aronson D.P. (1994) Supracondylar fractures. A prospective study of percutaneous pinning. *Journal of Paediatric Orthopaedics*. 12(6):789.
3. Crammer K.E., Devito D.P., Green N.E. (1992). Comparison of closed reduction and percutaneous pinning and open reduction in displaced supracondylar fractures in children. *Journal of Orthopaedic Trauma*. 6(4) 407-12.
4. Echun D, Watters D and Bem C. (1991) One year audit of the management of the supracondylar fractures of the humerus. *Proceedings Of The Association Of Surgeons Of East Africa*. 14: 98-99.
5. Furrem Maric G. Rvedi T. (1991) Management of displaced supracondylar fractures in children. *Injury. British Journal of Accident Surgery*. 22(22):256-62.
6. Grant H.N. Wilson L.E. Bisset W.H. (1993). Long term follow up of children with supracondylar fractures of the humerus. *European Paediatric Surgery* 3(5): 284-6.
7. Jellis J. E. (1991) Active Conservative Management Of Supracondylar Fractures. *Proceedings Of The Association Of Surgeons Of East Africa*. 14: 67-70.

8. Kasser J.R. (1990) Percutaneous pinning of supracondylar fractures of the humerus. *Instructional course lectures*. **41**:385-90.
9. Maurice King (1987). *Primary Surgery Vol 2. Trauma*. Pages 239-246.
10. R.M.H.Mc Minn (1990) *Last's Anatomy*. Pages 80-90. Churchill Livingstone. Edinburgh.
11. Ronald Mc Rae. (1976) *Clinical orthopaedic Examination*. Page 37-42. Churchill livingstone. Edinburgh.
12. Paradis G. Levettee D. Gagnon N. Cemirec (1993) Supracondylar fractures of the humerus in children, Techniques and results of crossed percutaneous K-fixation. *Clinical Orthopaedics and Related Research*. (296) :231-7.
13. Prischasuk S. (1992) Late ulnar nerve injury following K-wire fixation of supracondylar fracture of the humerus. *Journal of the Medical Association of Thailand*. **75**(8):492-4
14. Swinscow T.D.V. (1983) Statistics at square one. *British Medical Journal*. London.
15. Wilkin K.E. (1990) The operative management of supracondylar fractures of the humerus. *Orthopaedic Clinics of North America*. (Review) **2**:(2): 269-89 April.



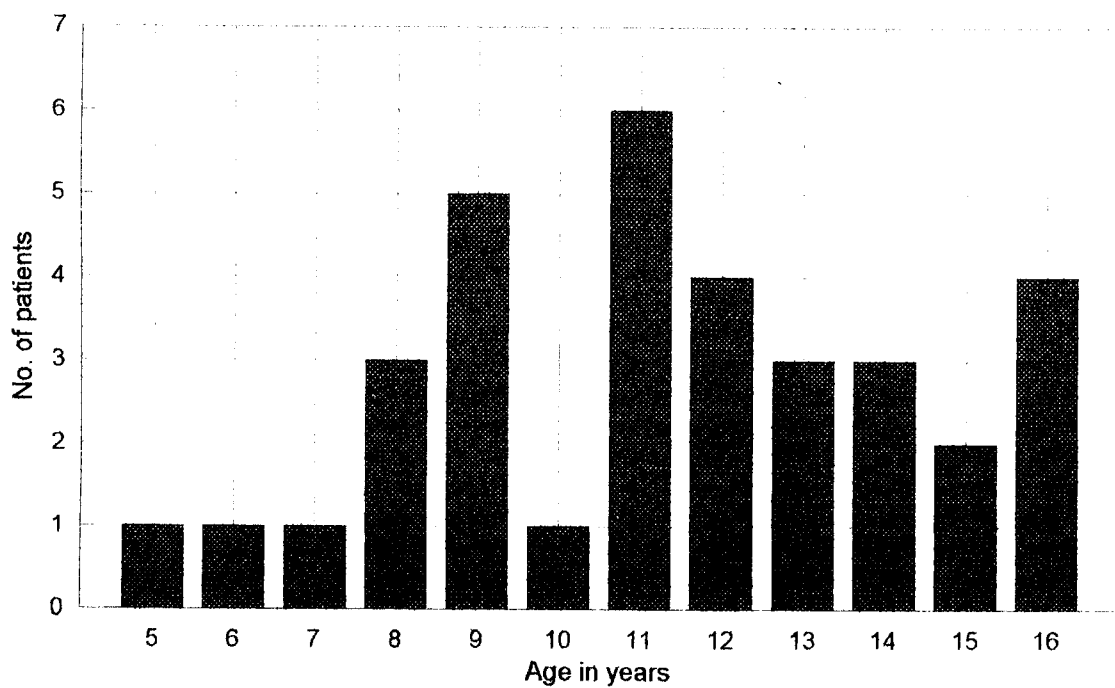


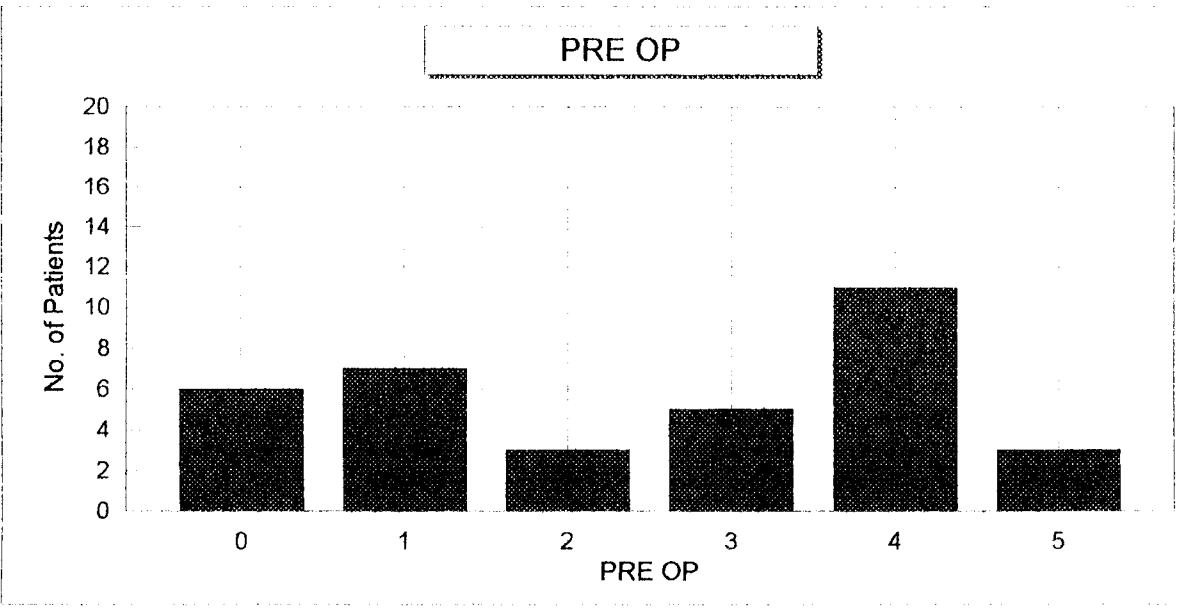
TABLE 1  
RADIOLOGICAL GRADE      FUNCTIONAL GRADE (F)      CARRYING ANGLE (C)

No.	Age	PRE OP	POST OP	F <sub>1</sub>	F <sub>2</sub>	C <sub>1</sub>	C <sub>2</sub>	F <sub>1</sub> +C <sub>1</sub>
1	11	0	0	16	16	10	10	26
2	12	4	1	16	16	10	10	26
3	11	0	0	16	16	5	5	21
4	11	0	0	16	16	5	5	21
5	11	1	0	16	16	9	10	25
6	11	0	0	16	16	8	8	24
7	16	1	0	16	16	5	5	21
8	13	2	0	16	16	8	8	23
9	5	5	0	16	16	5	5	21
10	14	5	0	16	16	8	10	24
11	6	0	0	16	16	5	5	21
12	16	1	0	16	16	10	10	26
13	7	1	0	16	16	8	10	24
14	9	3	1	16	16	3	3	19
15	15	1	0	16	16	0	0	16
16	9	4	1	16	16	16	10	26
17	16	1	0	16	16	5	5	21
18	9	1	0	16	16	8	8	24
19	8	0	0	16	16	3	5	19
20	8	4	1	16	16	3	3	19
21	9	4	1	11	16	3	3	14
22	11	4	1	16	16	15	15	31
23	10	4	2	14	16	3	5	17
24	15	4	1	16	16	8	5	24
25	12	5	1	16	16	10	5	26
26	9	3	0	16	16	3	3	19
27	14	3	1	16	16	5	5	21
28	13	2	1	15	16	8	5	23
29	14	4	1	15	16	10	10	25
30	16	3	0	16	16	5	5	21
31	14	4	1	14	16	5	5	19
32	13	4	1	15	16	5	5	20
33	12	2	2	16	16	10	10	26
34	8	4	0	16	16	5	5	21
35	12	3	0	16	16	3	3	19

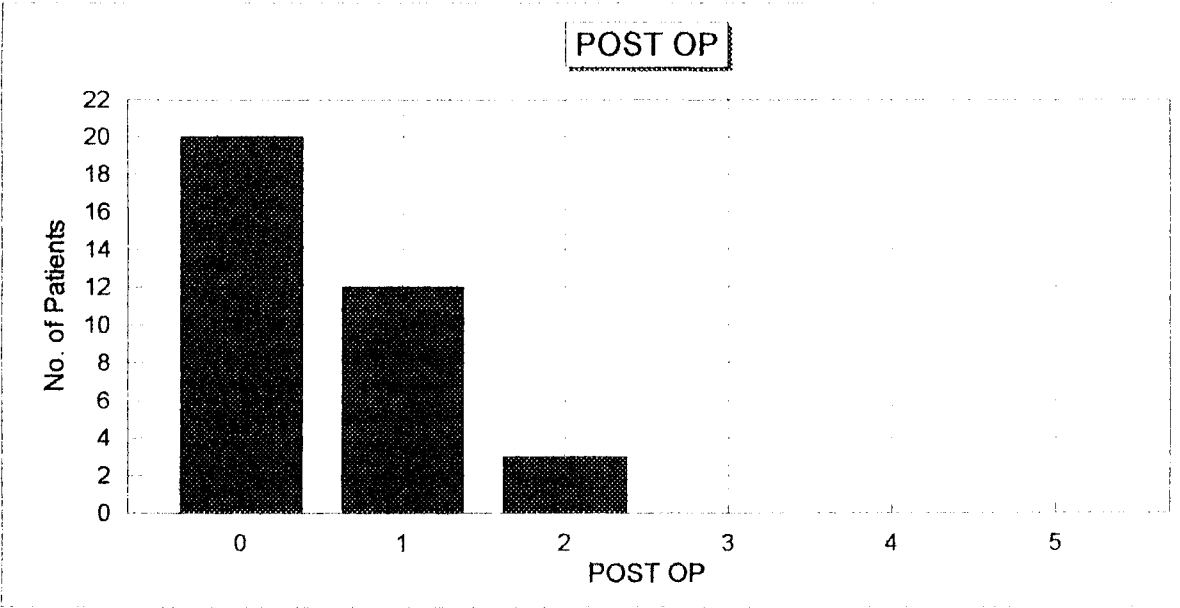
1 C<sub>1</sub> Fractured, F<sub>2</sub> C<sub>2</sub> Control

AGE DISTRIBUTION





RADIOLOGICAL GRADE



RADIOLOGICAL GRADE