STUDY OF RESULTS OF PERCUTANEOUS PARALLEL LATERAL AND CROSS PINNING IN TYPE III SUPRACONDYLAR FRACTURES OF HUMERUS IN CHILDREN

BY

Dr. K. SARAVANAN

A Dissertation submitted to the

BOOLEAN EDUCATION

In partial fulfillment of the requirement for the Degree of

M.Ch in (ORTHOPAEDICS)

2014
USAIM M.Ch (Orth)

Copyright Transfer and Author Agreement

In consideration of the review by the examination board towards submission for the M.Ch (Orth) and/or editing by The Journal of the M.Ch (Orth) of the material submitted for publication entitled:

Study of Results of Percutaneous Parallel Lateral and Cross Pinning in Type III Supracondylar Fractures of Humerus in Children

(the “work”) by the undersigned hereby agrees as follows:

1. Each of the Author(s) hereby transfers, assigns and otherwise conveys to The Journal all right, title and interest in the work, including but not limited to any and all copyright(s)

2. Each of the Author(s) hereby also grants permission to The Journal to use such authors name and likeness in connection with any promotional activity by the Journal, including but not limited to, promotions for upcoming issues or publications.

3. Each of the Author(s) hereby warrants, represents that the Author has read and approved the final version of the work and it is original; The Journal shall have the right to use the Data in reviewing and/or editing the Work for the purpose of publication.

Author’s Signature:

Name : Dr.K.SARAVANAN

Date:
# CONTENTS

<table>
<thead>
<tr>
<th>TITLE</th>
<th>PAGE NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Aims and Objectives</td>
<td>3</td>
</tr>
<tr>
<td>3. Relevant anatomy of the elbow classification of supracondylar fracture</td>
<td>9</td>
</tr>
<tr>
<td>4. Materials and Methods</td>
<td>15</td>
</tr>
<tr>
<td>5. Results</td>
<td>25</td>
</tr>
<tr>
<td>6. Discussion</td>
<td>36</td>
</tr>
<tr>
<td>7. Conclusion</td>
<td>42</td>
</tr>
<tr>
<td>8. Case Reports</td>
<td>43</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE NO.</th>
<th>DESCRIPTION</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Sex</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>Side</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Fracture type</td>
<td>28</td>
</tr>
<tr>
<td>5</td>
<td>Nerve injury</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td>Type of fixation</td>
<td>30</td>
</tr>
<tr>
<td>7</td>
<td>Pin tract infection</td>
<td>31</td>
</tr>
<tr>
<td>8</td>
<td>Post operative ulnar nerve palsy</td>
<td>32</td>
</tr>
<tr>
<td>9</td>
<td>Loss of Rom</td>
<td>33</td>
</tr>
<tr>
<td>10</td>
<td>Loss of carrying angle</td>
<td>34</td>
</tr>
<tr>
<td>11</td>
<td>Outcome</td>
<td>35</td>
</tr>
</tbody>
</table>
# LIST OF GRAPHS

<table>
<thead>
<tr>
<th>GRAPH NO.</th>
<th>DESCRIPTION</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sex</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>Side</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>Fracture type</td>
<td>28</td>
</tr>
<tr>
<td>4</td>
<td>Nerve injury</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>Type of fixation</td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>Pin tract infection</td>
<td>31</td>
</tr>
<tr>
<td>7</td>
<td>Post operative ulnar nerve palsy</td>
<td>32</td>
</tr>
<tr>
<td>8</td>
<td>Loss of Rom</td>
<td>33</td>
</tr>
<tr>
<td>9</td>
<td>Loss of carrying angle</td>
<td>34</td>
</tr>
<tr>
<td>10</td>
<td>Outcome</td>
<td>35</td>
</tr>
<tr>
<td>PLATE NO.</td>
<td>DESCRIPTION</td>
<td>PAGE NO.</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td>1</td>
<td>Plate – 1</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Plate – 2</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Plate – 3</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>Plate – 4</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>Plate – 5</td>
<td>19</td>
</tr>
<tr>
<td>6</td>
<td>Plate – 6</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Plate – 7</td>
<td>21</td>
</tr>
<tr>
<td>8</td>
<td>Plate – 8</td>
<td>22</td>
</tr>
<tr>
<td>9</td>
<td>Plate – 9</td>
<td>43</td>
</tr>
<tr>
<td>10</td>
<td>Plate – 10</td>
<td>44</td>
</tr>
<tr>
<td>11</td>
<td>Plate – 11</td>
<td>45</td>
</tr>
<tr>
<td>12</td>
<td>Plate – 12</td>
<td>46</td>
</tr>
<tr>
<td>13</td>
<td>Plate – 13</td>
<td>47</td>
</tr>
<tr>
<td>14</td>
<td>Plate – 14</td>
<td>48</td>
</tr>
<tr>
<td>15</td>
<td>Plate – 15</td>
<td>49</td>
</tr>
</tbody>
</table>
ABSTRACT

Most commonly accepted treatment of Type III supracondylar fracture of humerus in children is closed reduction and percutaneous pinning. This study analysis the results of parallel lateral pinning and crossed pinning in 30 cases (18 lateral pinning, 12 cross pinning). The analysis of carrying angle and range of movements was made, ulnar nerve injury, and functional outcome was graded according to Mitchell and adams criteria, there is no statistically significant difference with regard to functional outcome, between the two groups. Both methods produced satisfactory results in all cases. Ulnar nerve palsy occurred in one case (3.3%) after crossed pinning,

Study concluded that lateral pinning, if done in parallel fashion and 4 cortex purchase, provides good stability equal to crossed pinning and it totally avoid the possibility of ulnar nerve injury.
INTRODUCTION

Supracondylar fractures of humerus in children is one of the most common fracture seen in orthopaedic out patient department all over the world accounting for 50% to 70% of all elbow fractures in children in the first decade of life. Treatment of supracondylar fractures has included closed reduction and casting in hyper-flexion, traction, open reduction with pinning and closed reduction with pinning.

The high rate of complications associated with non-operative treatment led to the evolution of current techniques of percutaneous pinning for these difficult fractures over the past three decades. Standardization of surgical techniques for performing pin fixation with radiographic control has markedly reduced the incidence of poor outcomes.

The advantages of percutaneous pinning methods include easier management of extensively swollen elbows, better maintenance of reduction and decreased risk of associated complications.

Arino et al reported that it was almost 21%, ulnar nerve deficit was found in 15% of patients who were treated with medial and lateral pin as per the report of chai.
The present study is to prove the lateral pin construct, if placed properly, in parallel construct can provide the same stability like crossed fixation, at the same time avoiding the possibility of iatrogenic ulnar nerve injury.
AIMS AND OBJECTIVES

Historical Background

Supracondylar fractures were mentioned in the works of Hippocrates. However, it was not until the 17 century A.D. that medical literature the included methods of treatment of these fractures.

Non-operative Methods

Ingerbrightson in 1908 used overhead skin traction for treating these fractures. He demonstrated better results with this method than other methods.

Bauman, Bohler and Heygroves in 1920, introduced olecrenon pin traction.

Cotton in 1924 advised a method of closed reduction of the fracture and immobilisation in plaster strapping around the chest.

Classification: Gartland in 1959, classified extension-type supracondylar fractures in children into three types. Type I fractures are non-displaced, type II are displaced with an intact posterior cortex and type III are completely displaced without cortical contact. Further, type IIIa fractures have posteromedial displacement of distal fragment and type IIIb have postero lateral displacement.
French in 1959, concluded that cubitus varus deformity is usually caused by failure to correct the rotational displacement of the distal fragment in the horizontal plane which leads to coronal tilting and anterior angulation of the distal fragment.\textsuperscript{4} The deformity is only cosmetic and does not interfere with function.

**Percutaneous Pinning**

Fowles and Kassab in 1974 used one lateral oblique pin and a vertical pin through olecranon.\textsuperscript{10} In their series, elbow joint infection and limitation of flexion occurred. Also, those cases pinned in poor position resulted in cubitus varus deformity.

Flynn et al. in 1974, concluded that closed reduction and percutaneous pinning provided stability.\textsuperscript{11} Correction of rotational deformity which predisposes to medial tilt and easy access for observation are its major advantages. They described 98% satisfactory results with closed reduction and blind percutaneous pinning.

Zions et al. in 1994, studied the torsional strength of pin configurations used to fix the supracondylar fracture of the humerus in children and concluded that because two crossed pins placed from medial and lateral condyles provided the greatest resistance to gross rotational displacement, this method may be
preferable in most fractures.\textsuperscript{19} However, the alternative of three lateral pins or even two lateral pins may be considered, when gross swelling of the elbow makes the safer placement of a medial pin difficult.

Topping et al. in 1995 in their clinical evaluation of crossed pin versus lateral pin fixation in displaced supracondylar fractures, concluded that cross pin fixation offers no clinically significant advantages over two laterally placed pins.\textsuperscript{20} The risk of ulnar nerve injury during medial pin placement although small and transient can be avoided by two laterally placed pins.

Mostafavi and Spero in 2000, studied results of 42 children with displaced supracondylar fractures of humerus (6 Gartland Type II and 36 Gartland type III) treated with crossed pin fixation. In 88\%, the tear drop configuration was restored successfully.\textsuperscript{22} All fractures healed without loss of reduction. No patients had iatrogenic ulnar nerve injury. They concluded that crossed pin fixation of supracondylar humerus fractures is a safe and effective way of maintaining skeletal stability in children and a careful technique safeguards against ulnar nerve injury. They noted pintract related infections in two cases (5\%) in their series.
PLATE - 1

Patterns of k wiring

Lat.parallel k wiring
Skaggs et al. in 2001, studied results of operative treatment of supracondylar fractures in children and the consequences of pin placement.\textsuperscript{23}

Their results showed that there was no difference with regard to maintenance of fracture as seen on anteroposterior and lateral radiographs between the crossed pins and lateral pins. The configuration of pins did not affect maintenance of reduction. They concluded that fixation with only lateral pins is safe and effective for both type II and type III fractures. The use of only lateral pins prevents iatrogenic ulnar nerve injury. They did not recommend the routine use of crossed pins. If a medial pin is used, the elbow should not be hyperflexed during its insertion to avoid ulnar nerve injury.

David L. Skaggs, et al Revolutinised Lateral entry pinning important technical points for fixation with lateral entry pin.

1. Maximize separation of the pin in fracture site
2. Engage sufficient bone in both the proximal and distal fragment.
3. Maintain a low threshold for use of a third lateral entry pin if there is concern about fracture stability or the location of the first two pins.\textsuperscript{(JBJS, Am., Apr.2004;86:702-707).}
RELEVANT ANATOMY OF THE ELBOW
CLASSIFICATION OF SUPRACONDYLAR FRACTURE

The lower end of humerus has an articular and a non-articular part. The articular part forms articulations with the radius and ulna at the elbow by means of a lateral and convex capitellum and a medial pulley shaped trochlea.

The carrying angle

The medial edge of trochlea projects down 6mm more than the lateral edge. This spiral orientation of trochlea or humero ulnar joints results in an angular valgus alignment of humerus with the forearm. This angle is termed the carrying angle. The transverse axis of elbow is not perpendicular to the long axis of humerus and even of the forearm but is slightly oblique to both, because of the spiral orientation of humero- ulnar joint. This obliquity of axis of elbow causes the long axis of humerus and forearm to be parallel, when they are superimposed in full flexion. The angle also disappears in midprone position of the forearm.
Neurovascular Relationships

At the elbow, the structures from the lateral to medial side are the radial nerve, the biceps tendon, the brachial artery and the median nerve. The brachial artery extends from the lower border of the teres major muscle to a point in front of the elbow at the level of the neck of the radius, just medial to the tendon of the biceps brachii. At the level of the neck of the radius, one inch distal to the transverse crease of the elbow, the brachial artery divides into its two terminal branches, the larger ulnar and the smaller radial artery. The branches from the brachial, the profundabrachii, ulnar and radial arteries form an extensive vascular anastomosis around the elbow.

Nerve supply of the elbow joint is from the articular branches of the musculocutaneous and the radial nerve, but the ulnar, median and the anterior interosseous nerves also contribute.

At the elbow, the ulnar nerve passes behind the medial epicondyle to enter the forearm. The median nerve after crossing the brachial artery from the lateral to medial side enters the forearm between the heads of pronator teres. Here the nerve gives off the anterior interosseous branch. The radial nerve gives off the posterior interosseous nerve at the level of the lateral epicondyle and then continues as the superficial radial nerve, lying lateral to the radial artery.
MECHANISM OF INJURY

The mechanism involves hyperextension, abduction of the elbow and fall on the dorsiflexed hand with the elbow extended. The three major factors that make the humerus in children vulnerable during this period to supracondylar fractures are the ligamentous laxity, the relationship of the joint structures in hyper extension and the bony morphology of the supracondylar area.

Abraham et al demonstrated that periosteum fails progressively in three stages.15 First, the periosteum being intact, stretches and is detached from the anterior surface of the humerus. In the second stage, the detached periosteum is torn as it is pulled distally across the sharp edge of the proximal fragment. The final stage involves complete displacement with the periosteum being completely torn anteriorly. The periosteum remains intact posteriorly and to some extent medially and laterally. The periosteal tag can get interposed between the fracture fragments, preventing complete reduction.

The soft tissue changes involve the brachialis muscle and the anterior neurovascular structures. With gross displacements, the bony spikes may penetrate the muscle and its fascia and lie subcutaneously. With the posterolateral displacement of the distal fragment, there may be involvement of the median or anterior interosseous nerve or brachial artery. When there is
posteromedial displacement, the radial nerve or the posterior interosseous nerve, may be involved.

**Clinical features:** include tenderness and soft tissue swelling over the supracondylar area. In type III fractures, the elbow develops an ‘s’ shaped configuration as a result of two points of angulation.

A puckering or dimpling of the skin in the anterior posterior portion of distal arm, known as the “pucker sign” indicates that the distal spike of proximal fragment has penetrated the brachialis muscle and the dermal layer.

There may also be internal or external rotation of the elbow with either varus or valgus angulation depending on the type of displacement of the distal fragment.

Distal neurovascular status may be compromised at times.

**Gartland’s Classification**

Type – I : Nondisplaced

Type – II : Displaced with variable angulation, but posterior cortex of the humerus is intact.

A. Posterior tilt

B. Posterior translation
PLATE - 3

**Buckering sign**

**S-shaped deformity**
Type – III : Completely displaced with no cortical contact

A. Posteromedial

B. Posterolateral

Type – IV : Unstable in flexion and extension
MATERIALS AND METHODS

A comparative study of 30 cases of Type III Supracondylar Fracture of Humerus in children from August 2010 to August 2012 study done from the cases operated by single surgeon at Vinayaka Mission’s Medical College, Karaikal and KS Hospital, Karaikal, Puducherry U.T.

18 children underwent lateral pinning and 12 children underwent cross pinning.

Clinical data, undertaken are age, gender, side, fracture displacement, surgical details, pin configuration, pre-OP complications.

Inclusion Criteria:

1. All type III SC fracture from age 3 to 12 years

Exclusion Criteria:

1. All type I, II SC fracture
2. Open supracondylar fractures
3. Children with vascular injury which needs repair.
Clinical Assessment

All children assessed for deformity, puckering sign, distal neurovascular deficit.

Radiological assessment

All children undergone AP, lateral X rays for assessment of displacement pattern, comminution, and classification according to gartland.

Reduction

- All cases treated as emergency and posted for closed reduction and pinning under GA/ or block at the earliest.
- Once child anaesthetized, Fracture reduction done with traction, counter traction, lateral rotation, lateral tilt of distal fragment done under C-Arm.
- Distal fragment slided, titled, slowly anteriorly by milking maneuver with both hands.
- Gradually elbow is flexed, till finger tips can touch the shoulder. If flexion restricted, reduction to be repeated. Reduction checked in C-Arm by tilting it horizontally and not the arm. If arm is rotated, reduction will be lost in unstable fractures.
- Reduction checked in AP (Jones view) in hyper flexion – assessment done by medial, lateral cortial alignment, tilt, Baumann’s angle.
In lateral view reduction checked with tear drop sign, absence of crescent, fish tail sign.

Technique of Lateral Pinning

1.8mm or 2mm K wires selected according to the age. First wire started from the tip of lateral epicondyle directed across the fracture towards the medial cortex in 50° to 60° angle. K wire position in lateral view confirmed. 2nd wire passed 1 cm below the first K wire and passed exactly parallel to it, crossing the olecranon fossa and having 4 cortical purchase.

Elbow extended and rotated, stability of fracture assessed under C-Arm. If we feel like cortical purchases are inadequate, we can put 3rd wire in similar fashion, between the parallel wires.

All wires cut after bending, outside the skin.
PLATE - 4

TRACTION IN 30° FLEXION

REDUCING THE POSTERIOR TILT

MILKING OF DISTAL FRAGMENT
PLATE - 5

STRAPPING AFTER REDUCTION

CROSS TABLE LAT
PARALLEL WIRING
PLATE - 8

Milking of ulnar nerve
**Technique of crossed wire**

First wire is always lateral and introduced from tip of lateral epicondyle to opposite cortex. Once first wire is holding, elbow can be extended slightly so that the medial pinning will be easy.

Medial pinning tone will great caution to avoid ulnar N injury. Palpating the nerve and milking it posteriorly usually prevents the ulnar N injury. Very rarely mini-open technique advocated.

**Post OP Period**

1. All children assessed for nerve palsy and for compartment syndrome, clinically by assessing finger movements, stretch pain, pulse in initial 24 hours.
2. Check X-ray, AP, lateral obtained without slab.
3. If no gross swelling, finger movements normal children discharged after 24 hours.
4. Children kept on regular follow up on every 5 or 7 days for K wire dressing.
5. Oral antibiotics, anti inflammatory, analgesics, anti edema drugs given 5 days.

At the end of 4 week in children younger than 6 years and 5 weeks in children older than 6 years – Radiological assessment
done with AP, lateal X-rays.

6. After visible callus wires are removed in 4 or 5 weeks. Depends upon the age.

7. Immediately after wire removal, plaster splint discarded – child to encourage todo active elbow movements for 2 to 3 days.

8. After the period children put on passive mobilization, with physiotherapist, on daily basis till full range of movement achieved.


Assessment of results

Functional outcome was assessed on the basis of Mitchell and Adams criteria.

The outcome was considered excellent, when the elbow had normal shape and movement of the elbow with a change in carrying angle of less than 5 degrees and limitation of elbow movement of less than 10 degrees. Results were graded as good, when the change in the carrying angle was between 5-15 degrees and limitation of movement between 10-20 degrees. When the change in carrying angle was more than 15 degrees and limitation of movements more than 20 degrees, the results were considered poor.

Statistical analysis was done by Chi-square test, t test and Fischer’s exact test
RESULTS

TABLE: 1 - AGE

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>30</td>
<td>3</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE</th>
<th>N</th>
<th>MEAN</th>
<th>Std. Deviation</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP</td>
<td>18</td>
<td>7.1176</td>
<td>3.19926</td>
<td>0.60200</td>
</tr>
<tr>
<td>CP</td>
<td>12</td>
<td>6.5357</td>
<td>3.10891</td>
<td>P=0.55 ns</td>
</tr>
</tbody>
</table>
### TABLE: 2 - SEX

<table>
<thead>
<tr>
<th>SEX</th>
<th>FREQUENCY</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEMALE</td>
<td>10</td>
<td>33.30</td>
</tr>
<tr>
<td>MALE</td>
<td>20</td>
<td>66.70</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

![Sex Frequency Pie Chart](chart.png)
TABLE-3: SIDE

<table>
<thead>
<tr>
<th>SIDE</th>
<th>FREQUENCY</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEFT</td>
<td>16</td>
<td>53.30</td>
</tr>
<tr>
<td>RIGHT</td>
<td>14</td>
<td>46.70</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>
TABLE-4: FRACTURE TYPE

<table>
<thead>
<tr>
<th>FRACTURE TYPE</th>
<th>FREQUENCY</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSTERO-LATERAL</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>POSTERO-MEDIAL</td>
<td>18</td>
<td>60</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

![FRACTURE TYPE Diagram]
### TABLE-5: NERVE INJURY

<table>
<thead>
<tr>
<th>NERVE INJURY</th>
<th>FREQUENCY</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEDIAN NERVE</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>RADIAL NERVE</td>
<td>2</td>
<td>6.7</td>
</tr>
<tr>
<td>NIL</td>
<td>27</td>
<td>90</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

![Nerve Injury Diagram]
**TABLE-6: TYPE OF FIXATION**

<table>
<thead>
<tr>
<th>TYPE OF FIXATION</th>
<th>FREQUENCY</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>LATERAL PINNING</td>
<td>18</td>
<td>37.80</td>
</tr>
<tr>
<td>CROSSED PINNING</td>
<td>12</td>
<td>62.20</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

![Pie chart showing the distribution of types of fixation](image)

Legend:
- LATERAL PINNING
- CROSSED PINNING
### TABLE-7: PIN TRACT INFECTION

<table>
<thead>
<tr>
<th>PIN TRACT INFECTION</th>
<th>COUNT</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LATERAL PINNING</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>CROSSED PINNING</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2</td>
<td>100</td>
</tr>
</tbody>
</table>

**PIN TRACT INFECTION**

![Graph showing PIN tract infection counts and percentages for lateral and crossed pinning.]
TABLE-8: POST-OPERATIVE ULNAR NERVE PALSY

<table>
<thead>
<tr>
<th>POST OPERATIVE ULNAR N PALSY</th>
<th>COUNT</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LATERAL PINNING</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CROSSED PINNING</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1</td>
<td>50</td>
</tr>
</tbody>
</table>

![Post-operative Ulnar Nerve Palsy Graph]

- Percentage for Lateral Pinning: 0%
- Percentage for Crossed Pinning: 50%
- Total Count: 1
# TABLE-9: LOSS OF ROM

<table>
<thead>
<tr>
<th>TYPE</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP</td>
<td>6</td>
</tr>
<tr>
<td>CP</td>
<td>4</td>
</tr>
</tbody>
</table>

![Graph showing Loss of ROM with LP having 6 and CP having 4]
### TABLE-10: LOSS OF CARRYING ANGLE

<table>
<thead>
<tr>
<th>TYPE</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP</td>
<td>8</td>
</tr>
<tr>
<td>CP</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Bar Chart: Loss of Carrying Angle

- LP: 8
- CP: 4
TABLE – 11: OUTCOME

<table>
<thead>
<tr>
<th></th>
<th>LP</th>
<th>CP</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXCELLENT</td>
<td>12</td>
<td>9</td>
<td>21</td>
</tr>
<tr>
<td>GOOD</td>
<td>6</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>18</td>
<td>12</td>
<td>30</td>
</tr>
</tbody>
</table>
DISCUSSION

In this study, thirty children with type III Supracondylar Fractures of Humerus who were treated with closed reduction and percutaneous crossed pinning (medial-lateral) or lateral pinning methods were evaluated both retrospectively and prospectively.

The age group of patients considered was between 3 and 12 years. The peak incidence was in 5-8 years age group with an average age of 6.75 years.

This was similar to series by Wilkins with a peak incidence of 5-8 years and an average age of 6.7 years.

In our series, incidence in male children was 20 (66.70)% and 10 (33.30)% in females.

This male preponderance was also noted in the series of Wilkins.\textsuperscript{30}

The left side was involved 2.2 times (53.30% of cases) more commonly than the right in our study, which is comparable to that of Aronson and Prager (2 times). Left side is 16 cases, right side 14 cases involved.

The common mechanism of injury in our series was fall on an outstretched hand (96%) which is same as that in series by Mostafavi.

In our series, there was 60% incidence of posteromedial displacements and 40% postero-lateral displacements.
The incidence of pre-operative nerve injuries was 10% (3 cases), which is comparable to that in Wilkins series of 7.7%. Radial and median nerves were equally involved with no ulnar nerve involvement. Neurological recovery was complete in all cases by 3 months.

Radial pulsation was either weak or absent in 4 cases in our series but peripheral circulation was intact in all of them with normal dynamic functions of hand. Oxygen saturation levels at the periphery were noted to be satisfactory in these cases. Cases with posterolateral displacement had more incidence of weak or absent radial pulse (80%) as compared to cases with posteromedial displacement (51%). These cases were kept under constant observation with frequent neurovascular assessment. All cases regained normal radial pulsation within 24-48 hours following reduction of fracture and percutaneous pinning.

The average hospital stay for a patient in our study was 2 days with a range of 1 to 14 days. The average hospital stay in other series were 3.4 days by Aronson and Prager and 4.2 days by Nacht et al.

The follow-up period for cases ranged from 5 months to 24 months with an average follow-up duration of 12 months. This was comparable to that of series by Aronson and Prager (17.2 months). The minimum duration of 5 months of follow-up in our series was adequate to assess fracture union, malalignment, range of motion and recovery from nerve injuries.
In our series, a total of 30 cases were treated; 18 patients (60%) underwent crossed pinning with medial and lateral pins and 12 patients (40%) underwent lateral pinning. The choice of method of pin fixation was made according to operating surgeon’s personal preference.

Pin tract infection with pin loosening occurred in 2 patients in our series (6.6%). In the series by Mostafavi, the incidence of pin tract infection was 5%.

One patient had superficial infection, treated with dressing antibiotics. In other patient pin tract infection with pin loosening, necessitated earlier removal of ‘K’ wires (at 2 weeks). The infection was treated with appropriate antibiotics and regular wound dressing. The above elbow slab was continued in these patients.

There were 1 case of iatrogenic ulnar nerve palsy following medial pinning (3.3%). There were both motor and sensory deficits, but complete neurological recovery occurred by the end of 4 months, medial pin removed in the immediate post operative period.

There were no iatrogenic nerve injuries following lateral pinning.

The incidence of ulnar nerve injury with medial pinning in other series were – 8% in the series by Skaggs et al. and 5% in the series by Solak and 0 – 6%. Others have reported that these injuries occur more commonly.
Although ulnar nerve injury recovered in most of the cases but there are several reports of permanent ulnar nerve injuries.

Iatrogenic nerve injury almost always involves the ulnar nerve following the placement of the medial pin for crossed pinning.

The incidence of ulnar nerve injury was reduced in our series by taking precautions such as inserting the lateral pin first and avoiding hyperflexion of elbow during medial pin placement and milling of ulnar nerve before putting ‘K’ wire.

All patients achieved radiological union at an average of 7.6 weeks. This compared favorably with the series by Mostafavi where union occurred at an average of 7.2 weeks.

The correlation between the type of pinning and functional outcome was made on the basis of change in the carrying angle and range of motion as compared to the normal side.

In our series, the average change in carrying angle for cases treated with lateral pinning was 3.1 degrees (range: 0-8 degrees) with 8 patients having change of carrying angle between 5-8°. In the series by Aronson and Prager, this was 2.2 degrees (range 0-8 degrees). All cases had increase in carrying angle.

The average change in carrying angle in cases treated by crossed pinning
was 2.5 degrees with range of 0-7 degrees. 4 patients had loss of carrying angle between 5-7° in this group.

The difference in the carrying angle between the two groups was not statistically significant (p=0.345).

However, there was no cubitus varus deformity in either group in our series and patients were satisfied with the cosmetic appearance of their elbows.

The slightly higher change of carrying angle towards valgus in lateral pinning cases may be related to impaction of lateral cortex with 2 or 3 wires while the medial cortex was untouched.

In our series, the average loss of range of movement was 7.2 degrees (range 0-16 degrees) for cases with crossed pinning. This compared favorably with series by Nacht et al (7.8 degrees).

For cases with lateral pinning, the average loss of range of movement was 8.4 degrees (range 0-14 degrees) which compares favorably with the series by Aronson and Prager which demonstrated a loss of range of movement of 10 degrees.

The difference with regard to loss of range of movement between the two groups was not statistically significant (p=0.204) with both groups showing excellent or good range of movements.
In our series, no significant improvement in range of motion was observed between the sixth month exam and the final follow-up exam. It is therefore inferred that no significant improvement in the range of motion could be obtained after the first six months following surgery.

Functional outcome following two types of pinning was evaluated according to Mitchell and Adams criteria.

In our series, the functional outcome following cross pinning was excellent in 75% and good in 25% of cases. There were no poor results. This compared favorably with the series by Mostafavi with 88% excellent results.

In our series cases treated with lateral pinning showed 67% excellent and 23% good results with no poor results. In the series by Aronson and Prager excellent results were found in 88% and good results in 12%. The difference in functional outcome between two groups was not statistically significant (x² = 0.817 P = .366).
CONCLUSION

In our study we concluded that there is no significant difference between the stability provided by cross pinning and parallel lateral pinning method. But fixation of medial wire is technically difficult in swollen elbow and iatrogenic ulnar nerve injury is a possible complication. In contrast lateral pinning is easy to perform even in swollen elbow, and when practiced 4 cortex purchase we can achieve stable fixation without ulnar nerve injury.

Therefore we concluded that percutaneous parallel lateral pinning is a safe and easy method of fixing the all type III supracondylar fracture, when compare to criss-cross wiring and we recommend this procedure can be followed as a routine.
PLATE - 9

CASE – 1

PRE-OP

IMM.POST OP

PRE-OP

IMM.POST OP
PLATE - 11

CARRYING ANGLE
PLATE -12

CASE – 2

PRE-OP

IMM. POST OP

1 MONTH POST OP
PLATE - 13

Normal carrying angle

Flexion

Extension
PLATE - 14

CASE – 3

PRE-OP

IMM.POST-OP

1 MONTH – POST-OP

2 MONTHS – POST-OP
PLATE - 15

NORMAL CARRYING ANGLE

FLEXION

EXTENSION

RECOVERED MEDIAN NERVE
BIBLIOGRAPHY


25. Shannon F J. et al.; Dorgan’s percutaneous lateral cross wiring of


33. Herrring JA, editor.