ELBOW INJURIES IN CHILDREN
The "RARE INJURIES" that may present major problems

Medial Epicondyle

Radial Neck

Olecranon

KAYE E. WILKINS, M.D.
Clinical Professor
Departments of Orthopaedics & Pediatrics
The University of Texas Health Science Ctr.
at San Antonio, Texas
ELBOW INJURIES IN CHILDREN

The "RARE INJURIES" that may present Major Problems include:

The Rare Injuries

I. Medial Epicondyle

A. Anatomical Considerations
   1. Structural Aspects
      a. It is an apophysis.
      b. It is posteromedial.
      c. Serves as origin of ulnar collateral ligament which is the key to elbow stability.
      d. In the older child it is extra-articular.
   2. Ossification
      a. Preosseous - Part of the total distal epiphysis.
      b. Ossification begins: 4-6 yrs.
      c. Last to fuse: 15-16 years.

B. Incidence
   1. A later injury occurring between 9-14 years (correlates with dislocations).
   2. Higher in boys.
   3. 50% occur with elbow dislocation.

C. Mechanisms of Injury
   1. Direct blow
   2. Pure avulsion
   3. Elbow dislocation

D. Classification of Fractures
   1. Acute Injuries
      a. Undisplaced
      b. Minimally displaced
      c. Significantly displaced
         1) Elbow not dislocated
         2) Elbow dislocated
      d. Entrapment of fragment in joint
         1) Elbow not dislocated
         2) Elbow still dislocated
      e. Fractures through the epicondylar apophysis
         1) Without displacement
         2) With displacement
      f. Chronic Tension Stress Injuries (Little League Elbow Syndrome)

E. Diagnostic Dilemmas
   1. Differentiate from Medial Condyle.
      a. Beware in young children!
      b. Elbow dislocation rare in first decade.
      c. Suspect if any metaphyseal bone.
      d. Entrapment can occur even if only a portion of epicondyle is avulsed.

F. Treatment
   1. Acute Injuries (Operative vs. Non-operative)
      a. Myths regarding non-operative treatment
         1) Growth deformity
         2) Painful non-union
         3) Weakened forearm flexors
         4) Late ulnar nerve symptoms
      b. The literature can support either operative or non-operative methods for routine fractures.
         1) Operative Proponents: Hines and co-workers - 96% excellent results
         2) Non-operative management
            a) Joseffson and Danielson - excellent results even with non-union of fragment.
            b) Comparison studies by Bede and Fowles showed better results in those managed non-operatively.
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c. Stiffness is a common sequelae.
   1) Thus, it is important to start motion early regardless of operative or non-operative intervention.

d. In most cases non-operative management is adequate.

e. Indications for operative management.
   1) Absolute
      a) Incarceration in the joint.
      b) Ulnar nerve dysfunction - may be relative?
   2) Relative
      a) Need for a stable elbow.
         (1) Necessary if there will be strong valgus forces across the joint in future activities such as: Baseball, Tennis, Gymnastics or Heavy Labor.
         (2) Less important in non-dominant extremity.
         (3) Can use gravity valgus stress test to assess elbow stability.

3) Technical Points
   a) Stabilize with screw to allow early motion.

f. Incarceration in Joint
   1) Acute - extract surgically. Manipulation can injure ulnar nerve.
   2) Late:
      a) Patrick originally felt if after 4 weeks results equal if left alone.
      b) Fowles has shown good results can be obtained where fragment is extracted in late cases.

2. Chronic Stress
   a. Rest and muscle strengthening are the key factors.
   b. Assess pitching techniques.

II. RADIAL NECK FRACTURES

A. Anatomical Considerations.
   1. Normally pre-ossification the radial neck is angulated (pseudo fracture).
   2. Ossification: 5-6 years (May be bipartite).
   3. The proximal radioulnar joint is exactly congruous.
      a) Translocation can result in a CAM effect [FIGURE 1]

STUDY QUESTIONS

1. What is the incidence of forearm weakness, ulnar nerve dysfunction and chronic elbow pain associated with untreated displaced medial epicondyle?
2. What is the significance of the "gravity valgus stress test"? When is it indicated?
3. What are the indications for operative intervention in fractures of the medial epicondyle?
4. What is the cause of "Little League Elbow"? How can it be prevented? What are the long term effects of pitching in the Little Leagues?
B. Mechanisms of Injury
1. Their major categories
   a. Primary displacement of the head.
   b. Primary displacement neck.
   c. Chronic stress forces across the growth centers of the proximal radius.
2. Associated Injuries
   a. Greenstick Olecranon
   b. Medial Epicondyle
C. Classification
1. Related to mechanism of injury [TABLE 1]
2. Related to fracture pattern. (Valgus Injuries - Figure 2)
   a) Pure metaphyseal neck fracture.
   b) Type II - Salter-Harris
   c) Type IV - Salter-Harris
D. Displacement Patterns [FIGURE 4, Pg. 6]
   1. Angulation
   2. Translocations
   3. Complete Displacement
E. Diagnostic Dilemmas
   1. In young children, radial head pain may be referred to the wrist.

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**TABLE I: CLASSIFICATION OF FRACTURES INVOLVING THE PROXIMAL RADIUS**

<table>
<thead>
<tr>
<th>GROUP I</th>
<th>Primary displacement of the radial head.</th>
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<tbody>
<tr>
<td>A.</td>
<td>Valgus Fractures [FIGURE 2, Pg. 5]</td>
</tr>
<tr>
<td>1.</td>
<td>Type A: Salter-Harris Type I and II injuries of the proximal radial physis.</td>
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<tr>
<td>2.</td>
<td>Type B: Salter-Harris Type IV injuries of the proximal radial physis.</td>
</tr>
<tr>
<td>3.</td>
<td>Type C: Fractures involving only the proximal radial metaphysis.</td>
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<tr>
<td>B.</td>
<td>Fractures associated with elbow dislocation [FIGURE 3, Pg. 5]</td>
</tr>
<tr>
<td>1.</td>
<td>Type D: Reduction injuries</td>
</tr>
<tr>
<td>2.</td>
<td>Type E: Dislocation injuries</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>GROUP II</th>
<th>Primary displacement of the radial neck.</th>
</tr>
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<tbody>
<tr>
<td>A.</td>
<td>Angular injuries (Monteggia Type III Variant)</td>
</tr>
<tr>
<td>B.</td>
<td>Torsional Injuries</td>
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</tbody>
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<th>GROUP III</th>
<th>Stress Injuries</th>
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<tr>
<td>A.</td>
<td>Osteochondritis dissecans of the radial head.</td>
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<tr>
<td>B.</td>
<td>Physeal injuries with neck angulation.</td>
</tr>
</tbody>
</table>
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2. Accessory ossification centers may simulate fractures. If in doubt, get comparison films.
3. The radiocapitellar view or an arthrogram may help better delineate the true location of the radial head and neck.

F. Treatment
1. Initial Considerations
   a. Remember - A significantly dislocated radial head indicates more severe soft tissue injury.
   b. Warn the parents beforehand of the grim prognosis.
   c. This injury has a high incidence of poor results.

2. Non-operative Methods
   a. Manipulative closed reduction as proposed by Patterson, first line of management. [FIGURE 5, Pg. 6] If this fails the flexion pronation technique as proposed by Kaufmann, et al., may be another effective method of closed reduction.

   a. Use of the Ace wrap. In some cases wrapping the forearm tightly with an ace wrap may reduce the fragment.
   b. Finally if all closed methods fail, manipulating the fragment with a percutaneous Awl or other type of sharp instrument may provide a satisfactory reduction.

4. Acceptable Limits
   a. Less than 30° probably does not need manipulation.
   b. 30° to 60° probably needs manipulation.
   c. Greater than 60° or with severe translocation may require open reduction.

1) It is also important to examine the patient clinically, under anesthesia.
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2) 50° of supination and pronation will result in a very functional extremity.

5. Open Reduction
   a. Can you improve function?
   b. A poor x-ray may function better than an anatomical reduction.
   c. Internal fixation may not be necessary. Often the fracture is stable once reduced by methods.
   d. Transcapetellar pin is a no-no! If fixation required, secure it to the adjacent olecranon.

G. Complications
1. Loss of motion
2. Radial head overgrowth
3. Non-union
4. Avascular necrosis
5. Radioulnar synostosis
III. OLECRANON FRACTURES

A. Ossification Pattern [FIGURE 6]

B. Classification
   1. Two major categories
      a. Physeal Fractures
      b. Metaphyseal Fractures

C. Physeal Fractures
   1. Two Fracture Patterns [FIGURE 7, Pg. 8]

D. Metaphyseal Fractures
   1. Types
      a. Flexion Injuries [FIGURE 8, Pg. 8]
      b. Extension Injuries
         1) Valgus Pattern [FIGURE 9, Pg. 8]
         2) Varus Patterns [FIGURE 10, Pg. 8]
      c. Shear Injuries
         1) Elbow Extended [FIGURE 11, Pg. 9]
         2) Elbow Flexed [FIGURE 12, Pg. 9]

E. Treatment
   1. Flexion Injuries
      a. Murphy23 found a screw across the fracture site with tension band wire was shown to be the strongest.
      b. PDS (Polydioxanonee) suture can be used instead of stainless wire for tension band.
   2. In extension and some shear injuries, the intact posterior perilumene can serve as a tension band mechanism.
      a. Flexing the elbow tightens this band thus securing the fracture fragments together.

F. Complications
1. Rare
2. Delayed loss of reduction
3. Pseudoarthrosis - Don't confuse with congenital pseudoarthrosis of the olecranon.
4. Apophyseal Arrest - Probably of no clinical significance.

**STUDY QUESTIONS**

1. Describe the normal ossification patterns of the olecranon.
2. How are fractures of the olecranon classified?
3. What are the indications for surgical intervention?
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REFERENCES

1. MEDIAL EPICONDYLE


   Found that in those patients in which surgical intervention was added to the trauma of elbow dislocation, that the post-operative function was poorer than those who did not undergo surgery.


   A long term study of non-operative managed fractures. Good results despite the fact that 60% demonstrated non-union.


   Demonstrated that extracting the fragment on up to fourteen weeks post injury can still result in resumption of at
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The most recent large series of epicondylar fractures. Emphasizes good results with conservative measures.


Two articles which define the true function of the various portions of the medial collateral ligament. Describes the valgus stress test to determine elbow stability after a fracture of the medial epicondyle.


Two consecutive articles detailing the long term effects of throwing on young individuals. Demonstrated that when moderation is practiced in games that the long term effects were minimal.


First to warn about the detrimental clinical effects of excessive throwing in Little League pitchers.

The original radiographic description of chronic irritation of the medial epicondyle from excessive throwing in Little League pitchers.

A classic article reviewing a series of 143 cases of epicondylar fracture. His results discounted many of the previously held concepts regarding these fractures. He emphasizes that there are very few sequelae and indications for operative intervention.

Describes the use of Fridic Stimulation of the flexor muscules to extract the epicondyle from the joint.

Describes a simple manipulative technique for extracting the medial epicondyle from the joint.

Describes a technique of reducing the fractures by pressure over the radial head with the elbow flexed at 90° and forcibly pronating the forearm. This is a useful alternative technique when the standard Patterson technique fails.

Was the first to describe the CAM effect that occurs with translocation of the radial head and emphasizes its importance in correcting this type of deformity to allow resumption of full supination and pronation.

Describes in detail the radial capitellar view which outlines better the radial head and neck, and the coronoid process.

Points out the pitfalls of referred pain of radial head fractures to the wrist. Can be source of an overlooked diagnosis.

Reports on a large series of 47 injuries. Divides them into five types. Describes radial neck fractures as occurring when an elbow dislocation is reduced. A good review of the complications.

Reviews the various mechanisms of injury. Divides mechanisms into valgus stress and those occurring with elbow dislocations. Outlines some good principles of treatment.

Outlines the displacement forces that occur with fracture of the radial neck. Describes a manipulative technique.

II. RADIAL NECK

A comparison of the various fixation methods. Shows that a screw across the fracture site, combined with a tension band, provides the strongest fixation.

III. OLECRANON

Defines in detail the normal ossification pattern of the olecranon. Delineates the differences between normal ossification and a fracture.


The most recent and extensive review of olecranon fractures in children. Points out that many of these are part of a complex injury to the joint. Defines many of the complications associated with this injury. Divides the injuries into groups.