FRACTURES
of the
SHOULDER REGION
in
CHILDREN

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FRACTURES OF THE SHOULDER REGION IN CHILDREN

I. Basic Anatomy

A. Proximal Humeral Physis (Figure 1)

![Figure 1: Proximal Humeral Physis]

1. Irregular physeal line - conical shape.
2. Develops from two separate ossification centers which fuse at age seven.
3. Physis is more proximal posteriorly which provides some stability.
4. Periosteum thicker posteromedial; thinner anterolateral which affects the displacement patterns.

B. Muscle attachments to Proximal Humerus

1. The four muscles which attached to the epiphysis dictate the direction of displacement as being abduction (Figure 2).
2. The pectoralis major is attached to the distal fragment and pulls it anteriorly.
C. Acromioclavicular (AC) Joint (Figure 3).

1. Distal clavicle has a secondary ossification center which fuses with shaft at about nineteen years. Often epiphysis remains unossified until late.

2. The distal clavicle has a very thick periosteal which attaches to the coracoclavicular ligament and capsule of the A.C. joint.

D. Sternoclavicular Joint (Figure 4).

1. Again, there is a separate medial physis and epiphysis.
2. The strong capsular ligaments attach to the epiphysis rather than the metaphysis.
Figure 3
Acromioclavicular Joint

Figure 4
Sternoclavicular Joint
II. **Sternoclavicular Joint Dislocations**

A. **Patterns**

1. Actually a fracture through the proximal physis since the tough capsular ligament holds the epiphysis in place.
2. Anterior - no vital structures.
3. Posterior - may impinge on the intrathoracic vital structures.

B. **Mechanism of Injury**

1. Force usually applied to point of shoulder with anterior or posterior direction dictating the direction of the proximal metaphyseal fragment.

C. **Diagnosis**

1. Difficult in plain x-rays.
2. Clinical swelling may be present in either type.
3. Plain x-rays - Cephalic directed views may help
   a. if anterior proximal clavicle anterior
   b. if posterior proximal clavicle is posterior
4. CT Scan best for diagnosis.

D. **Treatment**

1. Anterior
   a. Leave alone.
   b. Sling for comfort.
   c. Reassure parents lump will resolve.
2. Posterior
   a. Needs reduction if acute, even if no symptoms of intrathoracic impingement.
   b. Use towel clip plus hyperabduction of shoulder to reduce.
   c. If old and asymptomatic, leave alone.

III. **Fractures of the Shaft of the Clavicle**

A. **Patterns - Vary with age.**
1. Infant - Transverse with minimal displacement
2. Small Children - Green Stick
3. Older Children - Adolescents, complete with bayonet apposition.

B. Mechanism of Injury - Direct blow to shoulder; rarely direct injury to clavicle itself.

C. Diagnosis - Usually obvious clinically and on X-rays. In small undisplaced fractures may require oblique views.

D. Treatment

1. Remember to discuss with parents beforehand, goal of treatment is to make the patient comfortable.
2. Thus treatment is aimed at patient comfort and recovery. It does not "set" the bones.
3. Infants - Leave alone, handle with care - no mobilization needed.
4. Small children with green stick integrity. Sling is enough.
5. Older children with bayonet apposition need Figure of Eight strap to support shoulders.

   a. Open Fractures
   b. Neurovascular Compromise
   c. Severe tingeing of skin, the fragment may need to be manipulated by closed methods.
   e. Congenital pseudoarthrosis - Many are symptomatic, but requires open reduction, internal fixation and bone grafting.

IV. Acromioclavicular Separations

A. Patterns

1. May also be physeal injury
2. The metaphysis is weaker than the strong periosteal tube.
3. Rarely do coracoclavicular ligaments fail they remain attached to periosteal tube (Figure 5)
D. Treatment

1. Non-operative - Support with sling & start early motion for Types I, II and III up to the age of fifteen.
2. Types III after the age of fifteen, IV and VI require open reduction, repair of periosteal tube and temporary internal fixation.

V. Fracture Proximal Humeral Physis

A. Patterns

1. Usually Salter-Harris Type I or II (see Figure 1).
2. Weak anterolateral periosteum and a strong posteromedial physis plus muscle pull cause the metaphyseal fragment to be directed anteriorly and laterally.
3. In infants the epiphysis may be unossified and thus the true displacement unrecognized. May be confused with a glenohumeral dislocation.
4. Neer and Horowitz described four grades of displacement.
a. Grade I  - less than 5 mm.
b. Grade II  - to 1/3 the width of the humerus
c. Grade III - to 2/3 the width of the humerus
d. Grade IV - Greater than 2/3 displacement

B. Mechanism

1. Dameron feels it is a force directed longitudinally up the extremity with the shoulder extended and adducted. This places all the force on the anterolateral weak periostium and physis thus causing failure here.
2. In neonates - may be an obstetrical injury, especially with shoulder presentations.
3. In older infants and old children - can be a result of child abuse.
4. Stress fractures can occur in baseball pitchers from repetitive rotary forces (Little League Shoulder).

C. Diagnosis

1. Usually the evident on routine x-rays.
2. True anterior displacement however, may be seen only on transthoracic x-rays.
3. If comminuted polytomies or CT scans may be helpful.

D. Treatment

1. By and large most can be treated non-operatively with simple sling and swath or modified velpeau (Jacksonville Sling).

   a. In high performance athletes who do throwing activities, i.e. pitchers, quarterbacks, full shoulder motion may be necessary.
   b. With closed reduction deformity alone can recur.
   c. Closed reduction with short term percutaneous pins effective in restoring anatomical alignment.
   e. If fragment comminuted and can not be stabilized by percutaneous pins, then olecranon pin traction is an attractive alternative. This can also be used in bed ridden patients with multiple injuries.
   f. Shoulder spicas are cumbersome and usually not effective. Statue of Liberty cast can produce brachial plexus injury.
VI. Fracture of the Proximal Humeral Metaphysis

A. Patterns

1. The most common injury in young child around the shoulder.
2. In young children metaphyseal fractures most common. In older children and adolescents proximal physis more likely to be injured.
3. Overall metaphyseal fractures two times more common than physeal injuries.
4. Displacement usually minimal with green stick angulation more commonly in valgus. Rarely in varus.
5. If completely displaced, usually bayonet apposition since the shoulder adductors are attached to proximal fragment.

B. Mechanism

1. Usually hyperabduction (rarely hyperadduction).
2. Most common skeletal injury in horseback riding is this fracture.

C. Diagnosis

1. Undisplaced fractures may have only minimal swelling.
2. Considerable pain and swelling with displaced fractures.
3. X-ray evaluation same as for proximal physis.

D. Treatment

1. Non-operative unless neurovascular compromise.
2. Sling and Swathe or modified Velpeau (Jacksonville) usually sufficient.
3. Bayonet apposition, even in adolescents, will provide good function.
4. Olecranon traction may be necessary in multiple injured bed ridden patients or those who are very uncomfortable with sling and swathe.
STUDY QUESTIONS
Clavicle Fractures

1. Up to what age can a fracture dislocation of the outer end of the clavicle be treated conservatively? What is the pathology involved in this injury?

2. What injury does a physeal fracture of the medial end of the clavicle simulate? Up to what age can this lesion be treated conservatively?

References

A brief report detailing the intact periosteum attached to the intact coracoclavicular ligaments in fracture dislocations of the distal clavicle. Recommended conservative measures up to the age of 16.


Describes the pathology of separation of the physis of the medial end of the clavicle. Up to age 25 these will remodel and need only conservative care.

STUDY QUESTIONS
Acromioclavicular Joint Injuries

1. What are the various types of injuries that can occur with the acromioclavicular joint children? What are the recommended modalities of treatment for each type?

References

Classifies acromioclavicular joint injuries in children into six types according to severity and types of injuries. Emphasizes that these are usually either fractures of the distal clavicle or "pseudo dislocations".

Describes a displacement of the distal clavicle from the periosteal tube. Recommends open reduction and surgical closure of periosteal tube.


Reviews AC joint lesions in children and adolescents. Felt that all those below the age of thirteen years could be treated conservatively. Describes a lesion in which the failure occurs through the phyleal line of the coracoid process.

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**STUDY QUESTIONS**

**Proximal Humeral Physis and Metaphysis**

1. What are the indications for surgical intervention in treating displaced fractures of the proximal humeral physis?

2. Describe the usual displacement and pathology involved in these fractures.

3. What are the usually accepted non-operative methods of treatment?

4. Differentiate the clinical findings of this injury from a true brachial plexus injury in an infant.

5. What is the pathology involved in "Little League Shoulder"?

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**References**


Found that manipulation had little effect upon outcome. Maximum shortening was less than 2 cm. No significant varus deformity. Recommended only a collar and cuff.


Reports a large series from France. While twenty-five percent were treated
surgically, the authors still emphasized the superiority of nonoperative methods. Felt the hanging arm cast was ineffective.


Describes a chronic stress fracture of the proximal humeral physis in Little League pitcher.


Reports two cases in neonates. Describes the clinical and radiographic picture of this unusual injury. Delineates the differentiation from a pure brachial plexus injury.


Follow up of sixty-nine patients with displaced fracture of the proximal humeral physis. Emphasizes the good results obtained with closed methods. Describes the anatomical pathology in newborn dissections.


The classic article which reviews long term results of eighty-nine fractures of the proximal humeral physis. Categorizes patients into four grades of displacement with recommendations for treatment. Advocates closed management of almost all types. The irreducible fractures often have interposition of the long head of the biceps.


An early article of follow up results in forty-four cases. Demonstrated poorer results in those with operative intervention despite a good radiologic appearance.