



THE UNIVERSITY OF TOLEDO MEDICAL CENTER

# ORTHOPAEDIC MONTHLY

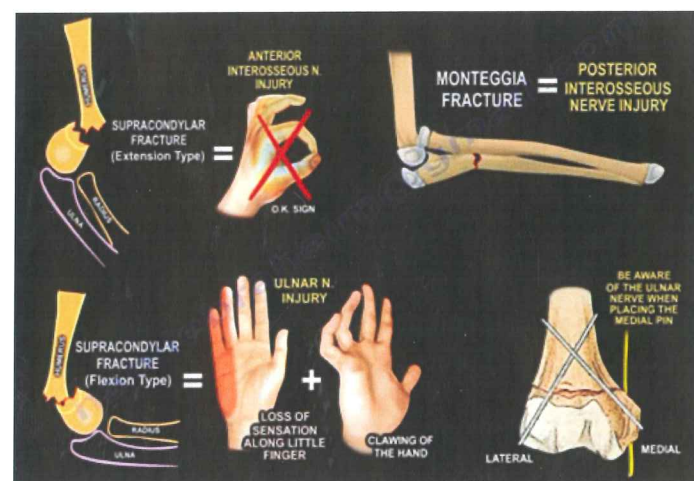
VOLUME 6, ISSUE 5 OCTOBER 2016

## Pediatric Fracture Complications

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Certain fractures have specific complications in children. The fractures listed in this article have specific complications.

- **Supracondylar Fracture:** cubitus varus deformity occurs due to malunion of the fracture. Volkmann's Ischemic Contracture occurs due to interruption of blood supply or compartment syndrome.
- **Lateral Condylar Fractures:** Nonunion - cubitus valgus and ulnar nerve symptoms. It takes up to 1 year to develop ulnar nerve symptoms.
- **Radial Head/Neck Fractures:** may be associated with compartment syndrome.
- **Fracture of the Distal Ulnar Growth Plate:** involves the growth plate of the ulna. There will be growth arrest in about 50% of the cases.
- **Fracture of the Femoral Neck:** will cause osteonecrosis!
- **Fracture of the Femur:**
  - ☒ Diaphyseal femur – in children older than 5 years of age will have over growth. Treatment with external fixation can develop a refracture.
  - ☒ Distal femur – growth plate injury will cause growth arrest in about 60% of the cases. Physal injury can lead to physal bar and growth arrest. If the physal bar is located in the peripheral area, there will be an angular deformity. If the physal bar is located in the central area, there will be a shortening.
- **Proximal Tibial Epiphyseal Injury:** will cause a vascular injury.



- **Proximal Tibial Metaphyseal Injury:** will cause progressive valgus deformity.
- **Tibial Tubercle Injury:** Type III – fracture extends to the primary ossification center. This injury may cause compartment syndrome.
- **Medial Malleolus Fracture of the Ankle:** Salter-Harris Type IV – fracture through all three elements of the bone, the physis, metaphysis and epiphysis. Has a high rate of growth disturbance.
- **Distal Tibia Physal Injury:** may cause rotational deformity with an increase in external rotation of the foot.

## Flail Chest

Flail chest involves three or more ribs with segmental fractures. This should be a life threatening condition. A segment of the rib cage breaks and becomes separated or detached from the chest wall. It usually requires significant violent force in order to break the ribs in this way!

The segmented rib fractures work independently. If the segmented section moves right, then the rest of the ribs move left. The flail chest moves in the opposite direction of the rest of the chest wall. The

fractured segment goes in while the rest of the chest goes out. This is called paradoxical breathing.

A pulmonary contusion may be associated with the flail chest segment. This contusion could be more significant than the flail segment! There may also be a noticeable chest wall deformity with presence of air in the subcutaneous tissue (crepitus).

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Trauma to the chest may cause scapular fractures or clavicle fractures. What are the symptoms?

- The patient will have chest pain and shortness of breath.
- Paradoxical movement of the flail segment.

The constant movement of the ribs is really painful. The broken rib may puncture the lung and cause a pneumothorax.

It is difficult to see if the fractures are displaced or nondisplaced. A CT scan is probably better for visualizing these fractures.

The prognosis varies and depends on the severity of the condition; however, the death rate ranges between 10%-25% depending on the injury. About 8% of patients who are admitted to the hospital with fractured ribs will have a flail chest.

What is the treatment of flail chest?

•Observation: If there is no respiratory compromise, there is no flail chest segment. Give the patient pain control. Avoid suppression of breathing. Give the patient positive pressure ventilation.

•Surgery - May help in reducing the duration of ventilator support and aid in the pulmonary function. Usually a plate and screw system is used. - Patient will need aggressive pulmonary toilet and physiotherapy.

- Do open reduction and internal fixation when:

- There is severe pain and displaced ribs.
- There is a flail chest segment.
- The rib fractures are associated with failure to wean the patient off of ventilation.
- There are open rib fractures.

## Scapular Fractures

Scapular fractures are typically high energy injuries with an increase in the Injury Severity Score (ISS).

50% of scapular fractures involve the body and spine of the scapula. 10% of scapular fractures involve the glenoid fossa. Fracture usually occurs due to a high energy trauma with about 80% - 90% associated injuries.

Associated Conditions:

- Rib fractures
- Head injury
- Ipsilateral upper extremity injury
- Pulmonary contusion
- Pneumothorax
- Hemopneumothorax

Pulmonary injury occurs in about 37% of the cases (mostly pneumothorax or hemopneumothorax). An isolated scapular injury is really a marker for possible injury to the chest region. The patient will need to be admitted for the observation of pulmonary complications

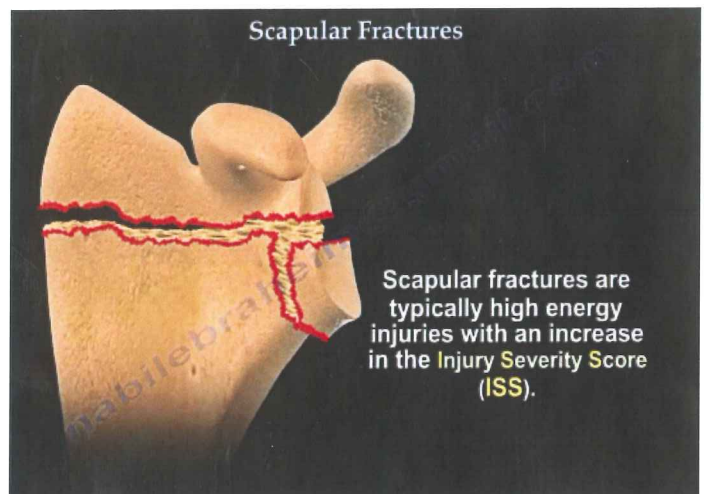
Neurovascular deficit occurs in about 10% of the patients.

Injury of the scapula can be missed or the diagnosis could be delayed in about 10% of the patients. 90% of fractures involving the scapula are nondisplaced or minimally displaced.

Treatment of these fractures is usually nonsurgical. Most scapular fractures are treated conservatively, even if the fracture is moderately displaced! Treat the patient with a sling. Have the patient perform Codman's Pendulum exercises for two weeks, then advise the patient to do active and passive range of motion.

Classification of scapular fractures are based on the fracture location.

- Extra-articular Fractures:



1. Acromial Fracture:

- Fracture will probably need surgery.
- Reduction of the subacromial space by inferior displacement of the acromion.

2. Coracoid Fracture:

- Fracture occurs proximal to the CC ligament.
- It is usually associated with injuries to the Superior Shoulder Suspensory Complex (SSSC) and it may need surgery.

3. Scapular Neck Fractures/Clavicle Fracture:

- Management of these fractures is controversial.
- Most of these fractures are treated conservatively, even if the fracture is moderately displaced.

Treatment: Give the patient a sling and send them to physical therapy for progressive range of motion. Union of the fracture occurs in about 6 weeks with little or no functional deficit!

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When do you do surgery?

Surgery is done when there is involvement of the glenoid cavity more than 25% with humeral head subluxation. Surgery is done when there is an intra-articular fracture with step-off more than 5 mm or if there is a major gap within the joint. If there is more than 40° of angulation, more than 1 cm of translation or if there is excessive medicalization of the glenoid, surgery is also done. The surgical approach is based on the major fracture fragment displacement.

- Anterior approach (anterior glenoid rim fracture):
  - Such as bony Bankart fracture.
  - Avoid injury to the axillary nerve.
- Posterior approach:
  - It is a tough dissection, usually done with a straight posterior approach or modified Judet approach.
  - Do straight posterior approach with a transverse incision over the spine of the scapula and detach the posterior deltoid, entering through an interval between the teres minor and the infraspinatus muscles.
  - The straight posterior approach may be used for posterior glenoid rim fractures, scapular neck fractures or for fractures along the lateral border of the scapula.

- Modified Judet approach will begin at the acromion, then go along the spine of the scapula.

- This approach is used for more complex fractures of the scapula.

Injury of the superior shoulder suspensory complex (SSSC): It is called a "floating shoulder" because of the glenohumeral joint is without attachment to the rest of the skeleton and others refer to this as a SSSC injury. You will need to decide if this injury is stable or unstable (unstable will probably need surgery). The injury is typically a scapular neck fracture with a clavicle shaft fracture. It is easier to plate the clavicle than to fix the scapula.

It has been found that treating this injury with a sling may sometimes have a superior outcome to performing surgery. There is no support for surgery, just because you have a floating shoulder. Surgical stabilization is needed only with specific indication to this fracture. If the clavicle fracture meets the criteria for fixation, fix it! If the scapular fracture meets the criteria for fixation, fix it!

Scapulothoracic Dissociation: Scapulothoracic dissociation is similar to a closed forequarter amputation. The x-ray will show lateral displacement of the scapula. Check the patient for neurovascular injury. The subclavian artery and brachial plexus could be injured! Usually, there are more cases of brachial plexus injury than arterial injury. The outcome will depend on the neurovascular status of the patient.

## Hitchhike Sign

Extension of the thumb is sometimes called the hitchhike sign. The hitchhike sign is used to identify a problem in two different conditions:

1. Radial nerve or posterior interosseous nerve palsy (fracture of the distal humerus will affect the radial nerve and a Monteggia fracture will affect the posterior interosseous nerve). The fracture may cause injury to the radial nerve which results in paralysis of the wrist and finger extensors (wrist drop).
2. Diastrophic dwarfism or diastrophic dysplasia (DTD) is an enzymatic deficiency or defect. If it is a deficiency, the condition is probably autosomal recessive, such as vitamin D dependent rickets or Gaucher's disease.

Examine the patient before and after surgery! A patient with a posterior interosseous nerve injury can perform wrist extension, but not finger extension. The radial nerve gives innervation to the wrist, finger and thumb extensors. The posterior interosseous nerve will give finger and thumb extension only. Injury at a higher level is probably associated with the radial nerve. Injury at a lower level, usually occurring around the elbow, is usually associated with the posterior interosseous nerve.

The first thing to check for is if the patient can do the hitchhike sign. Ask the patient to "hitchhike", if they can do this, the radial nerve and posterior interosseous nerve functions are intact. If the patient cannot perform the hitchhike sign, the posterior interosseous nerve may be affected and the radial nerve may be unaffected.

Ask the patient to extend the wrist! If the patient can extend the



wrist, the radial nerve is unaffected up to the level of the posterior interosseous nerve, meaning the PIN is the one that is involved. Remember, sometimes it is hard to distinguish whether the patient has a true wrist drop or not (based on the splinting and immobilization and also the examination). The patient may extend the fingers by the intrinsic muscles, which predominantly involve the ulnar nerve with some medial contribution. If you want to examine the fingers as well, extend the wrist then ask the patient to extend the fingers. This is more complicated than asking the patient to perform the hitchhike sign.

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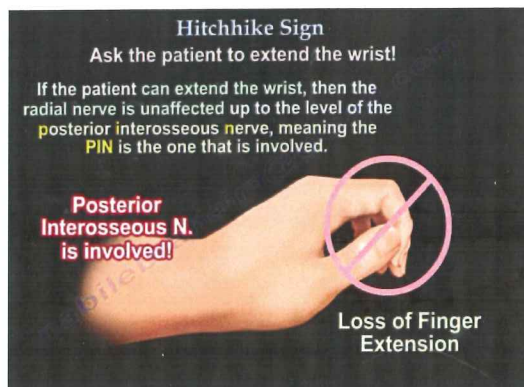
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#### *Hitchhike Sign continued*

Patients affected by DTD will have a short stature with very short arms and legs. However, in this case it is sulfate transport protein defect. The patient will have hitchhiker thumb, cauliflower ear and club foot. It is an autosomal recessive defect that affects the sulfate transport protein. This condition usually appears on exams and it is associated with a mutation in the diastrophic dysplasia sulfate transported (DTDST) gene on ch 5.



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