

Non-Accidental Trauma : Part 2

Uncommon Injuries

Educational Module
June, 2018

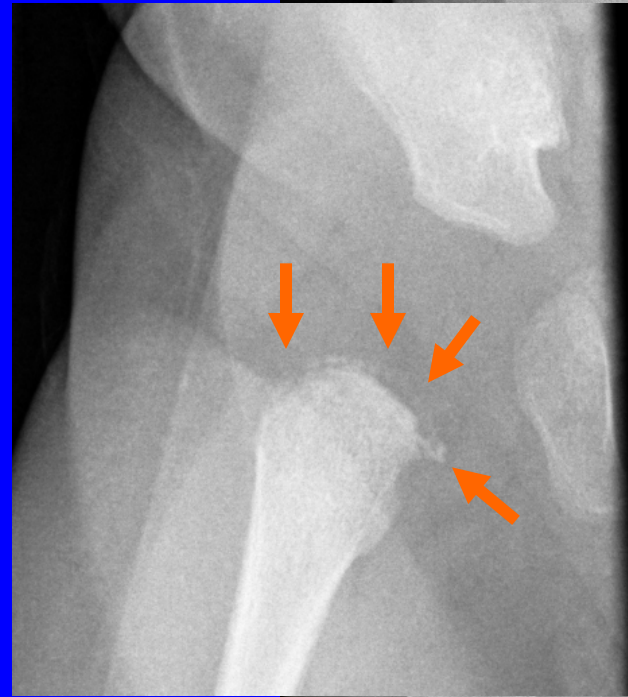
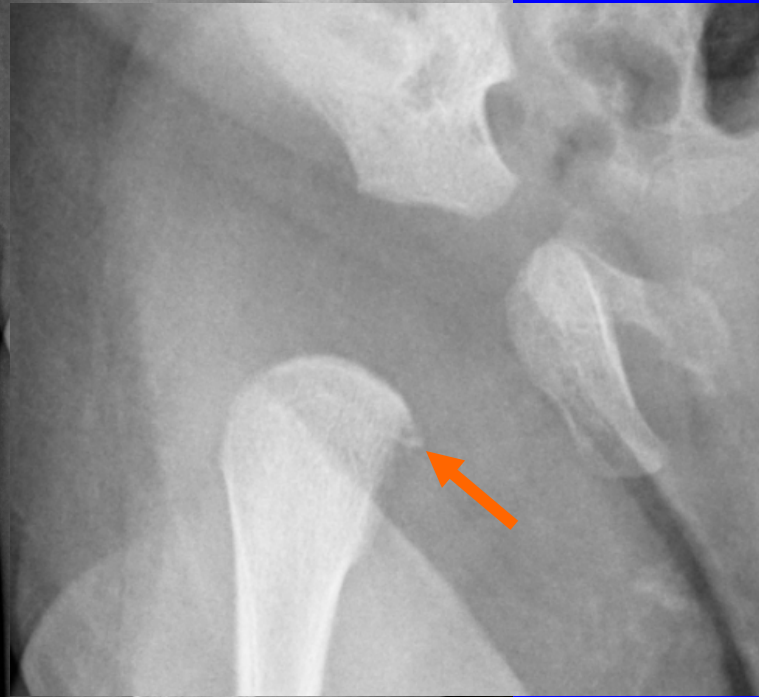
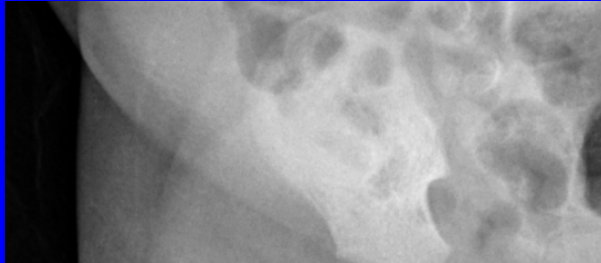


Eglal (Gila) Shalaby-Rana, M.D.
Diagnostic Imaging and Radiology

48 day old with head abusive head trauma. Image from skeletal survey

F/U 20 days later

**CML
proximal
femur**

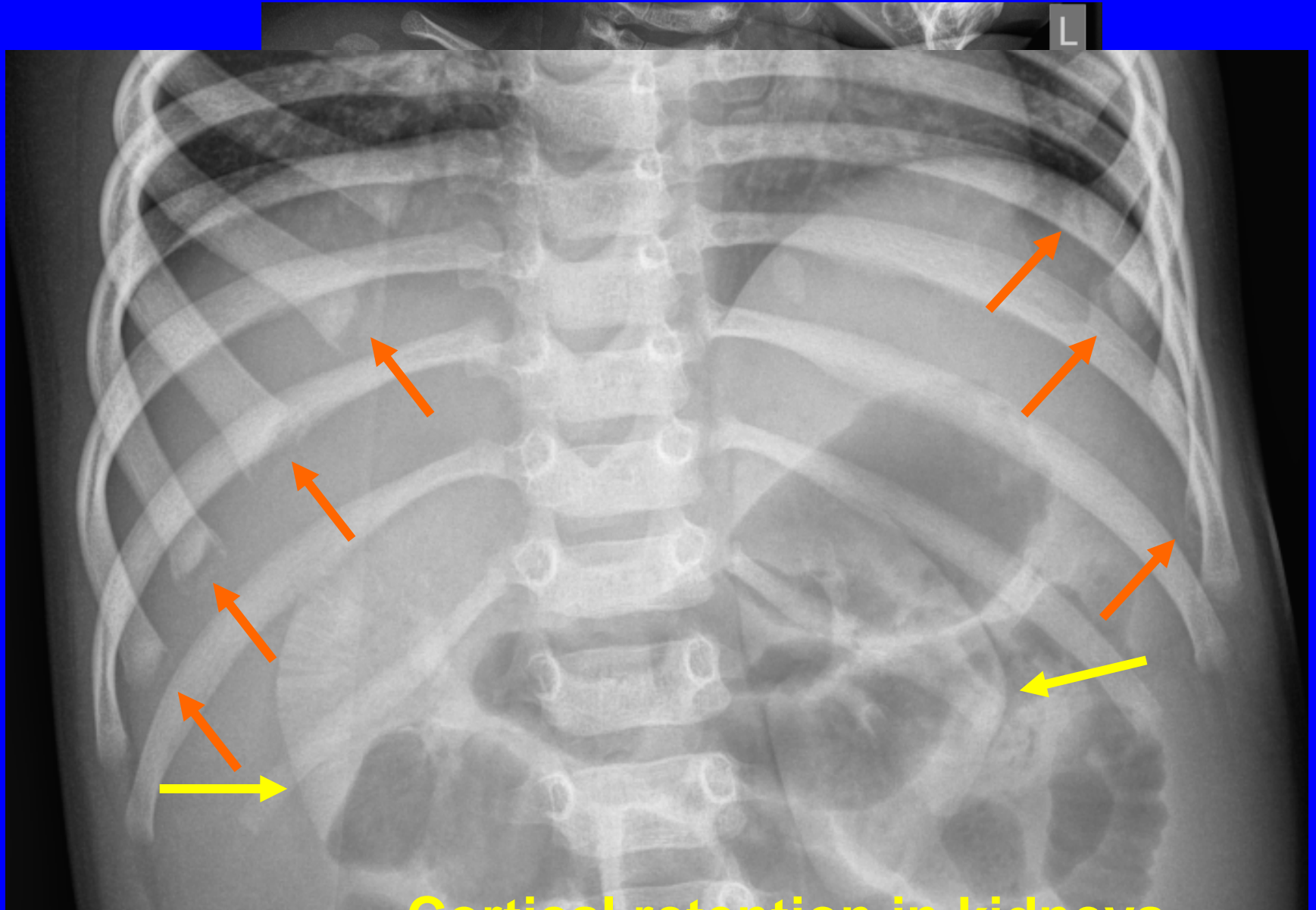


cm

CML proximal femur

- Uncommon site of CML
- May be bilateral
- Sometimes the entire CML is better seen on follow-up radiographs (which may be true of any CML)

15 month old with suspected non-accidental trauma



Cortical retention in kidneys

Same patient: cone down LT ribs
Anterior rib end fractures: similar appearance to a CML

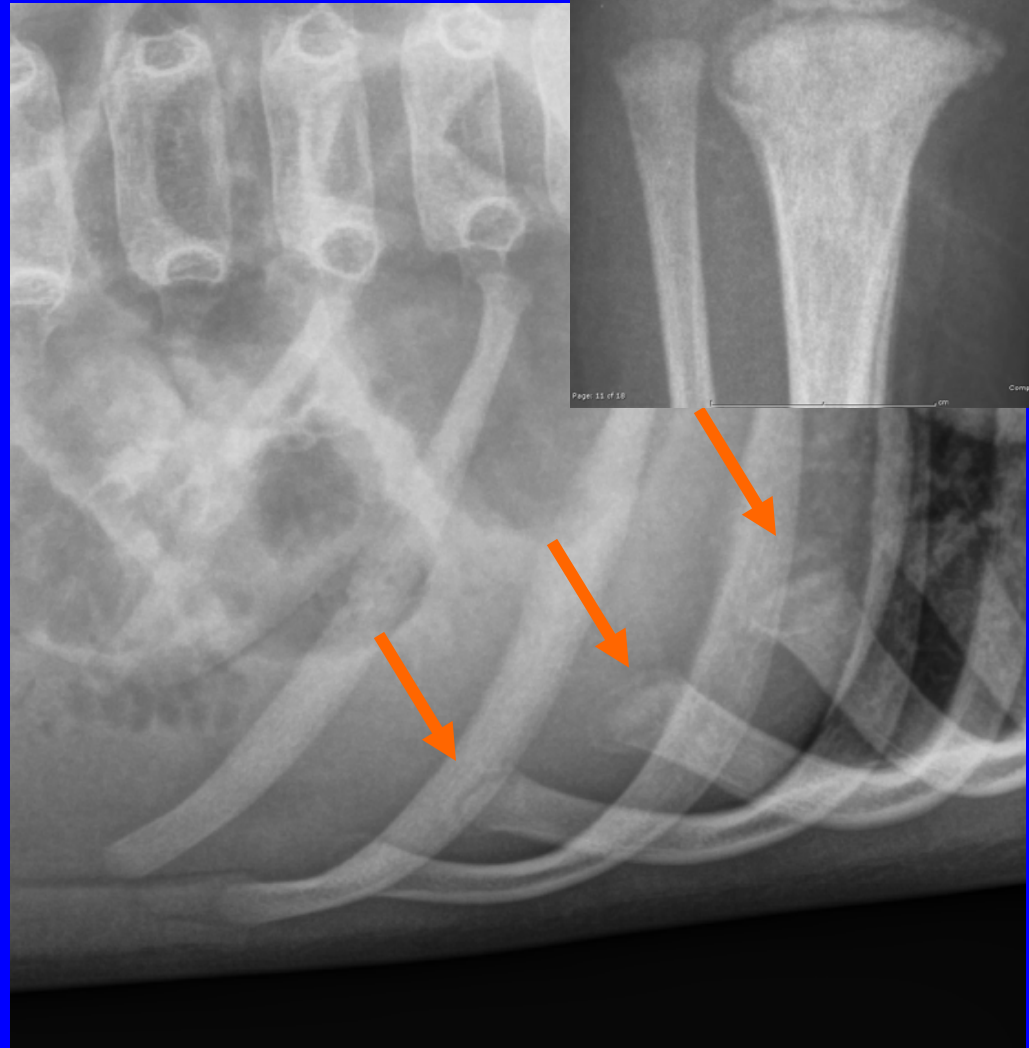
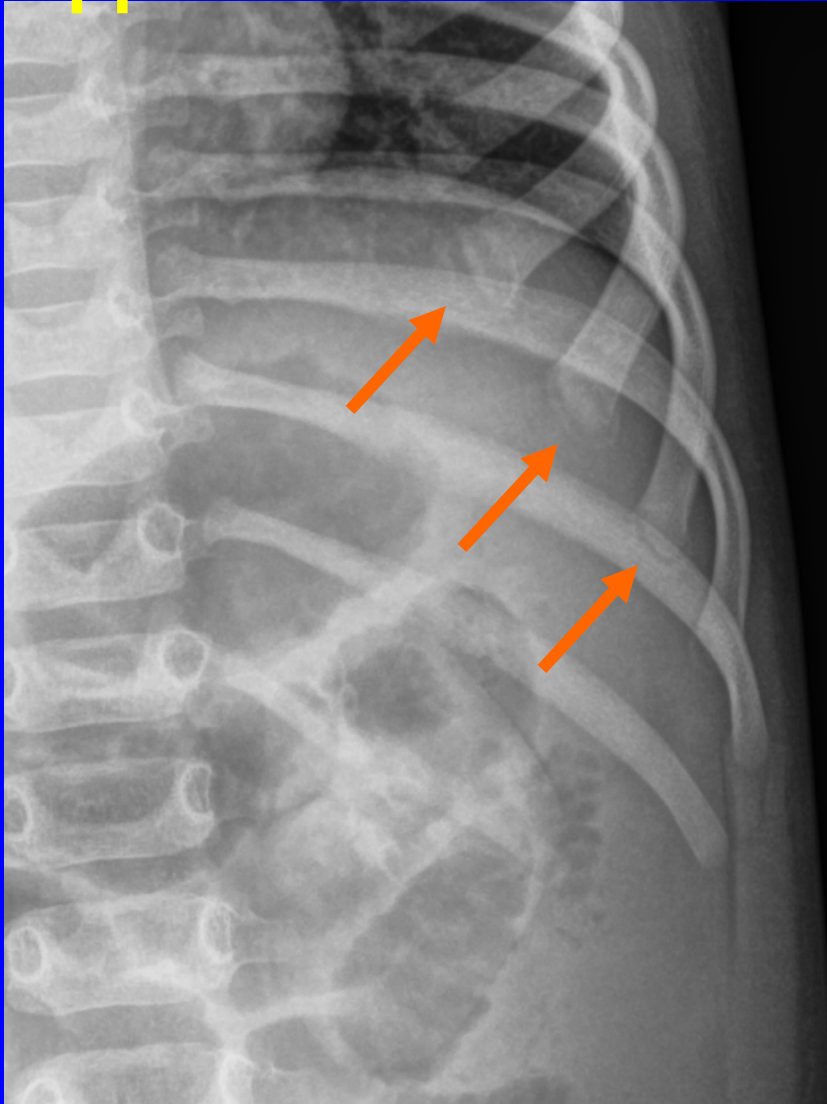
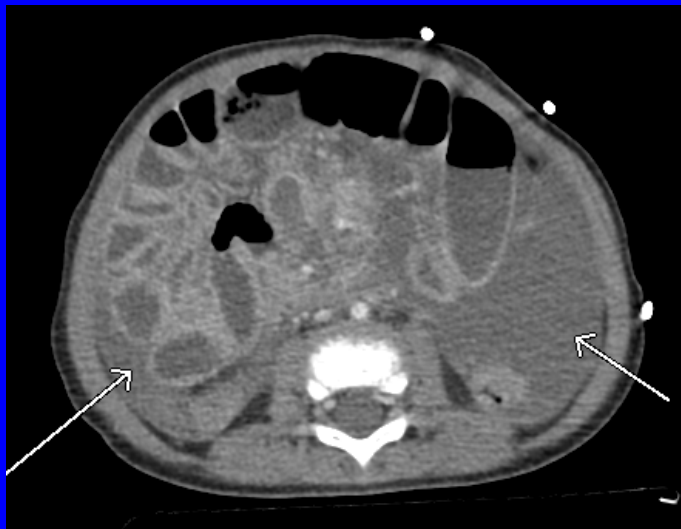
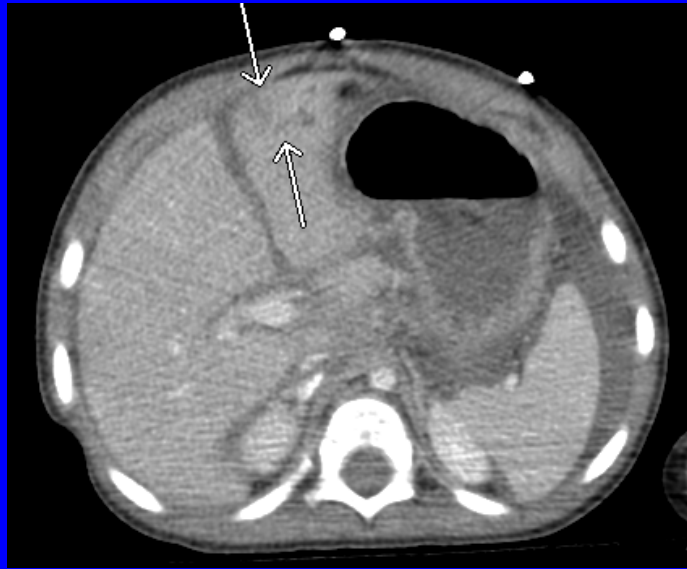


Image rotated clock-wise

Same patient: CT abdomen.

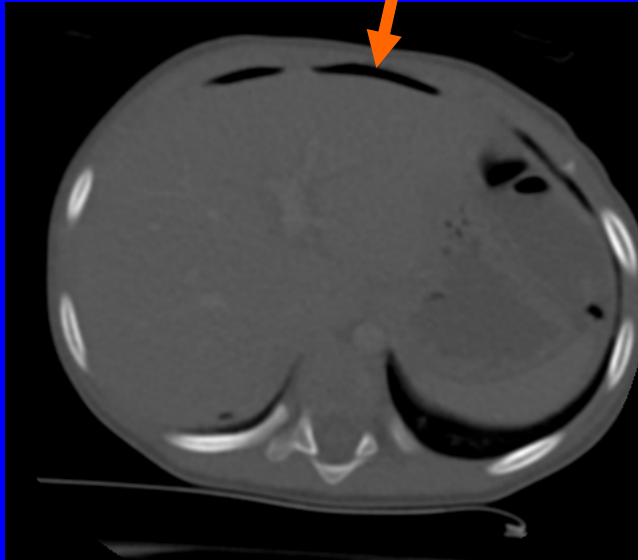
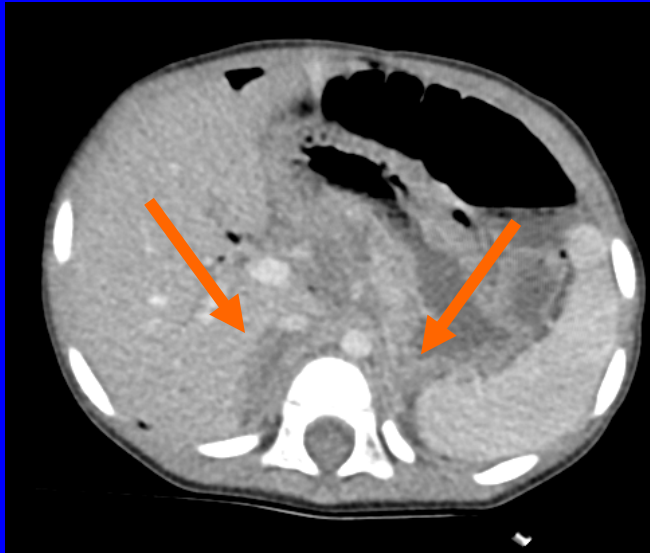
LT lobe liver hematoma. Hemoperitoneum with hypoperfusion complex.



Companion case: 18 month old with vomiting and abdominal pain; CT abdomen done at outside hospital

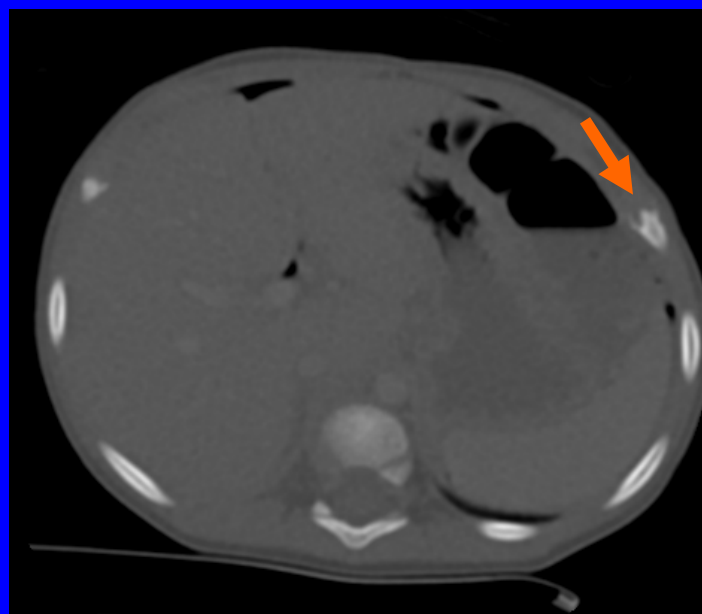


Free air due to jejunal perforation.

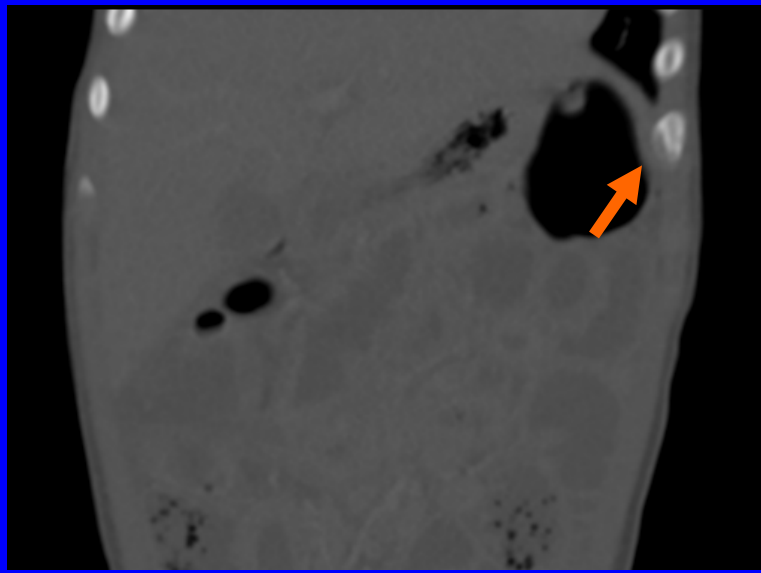
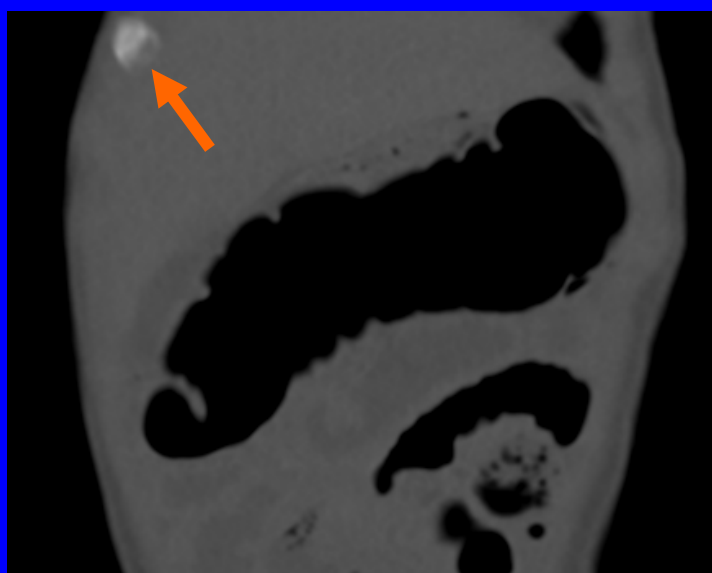


Bilateral RT > LT adrenal hemorrhages

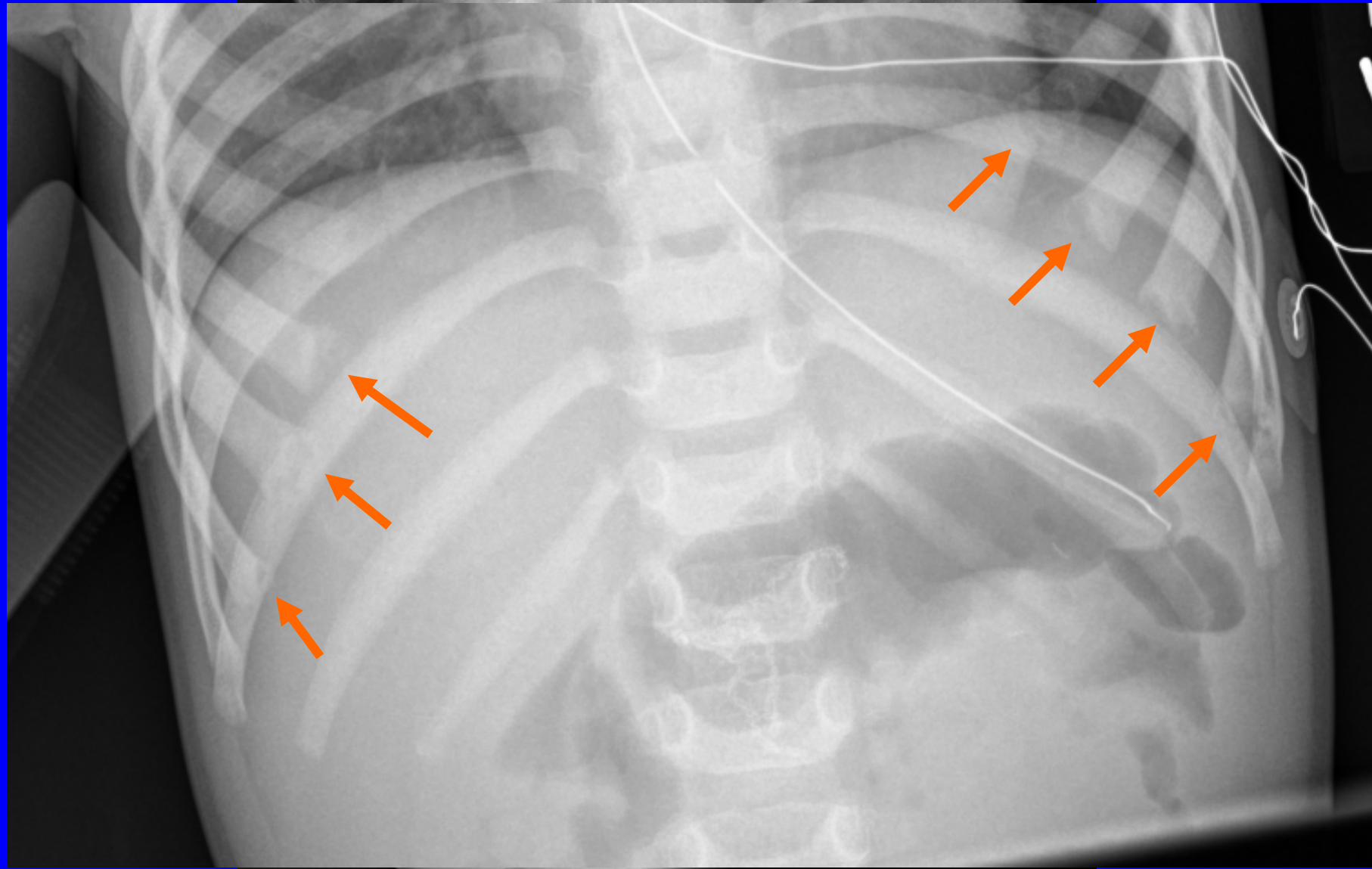
Same patient: 18 month old with vomiting and abdominal pain; CT abdomen done at OSH



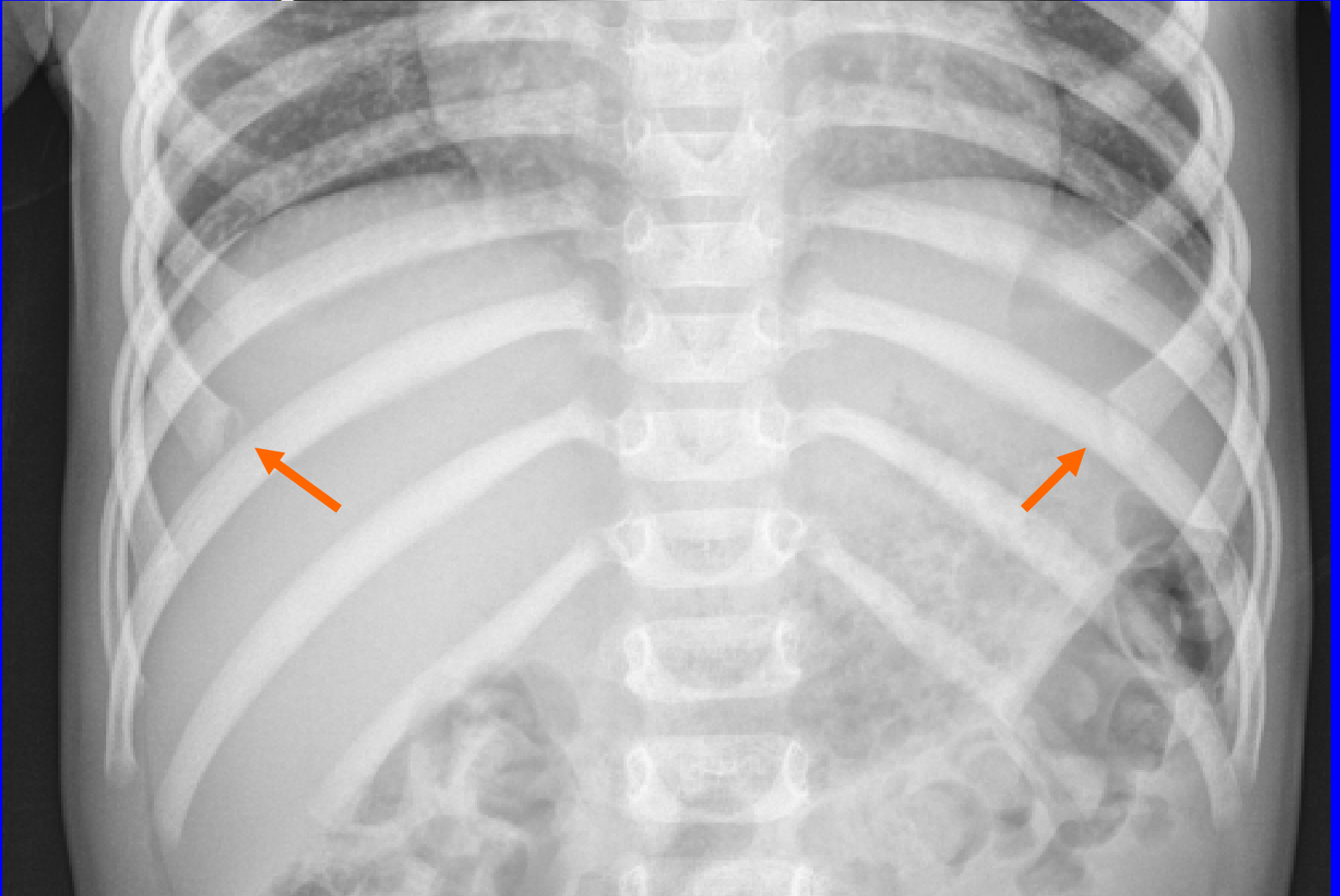
**Fractures
of
anterior
rib ends**



Same patient; image from Skeletal Survey
Fractures of bilateral anterior rib ends



Another Companion case. 20 month old with bruising to cheek and neck. **Fracture bilateral anterior rib ends**

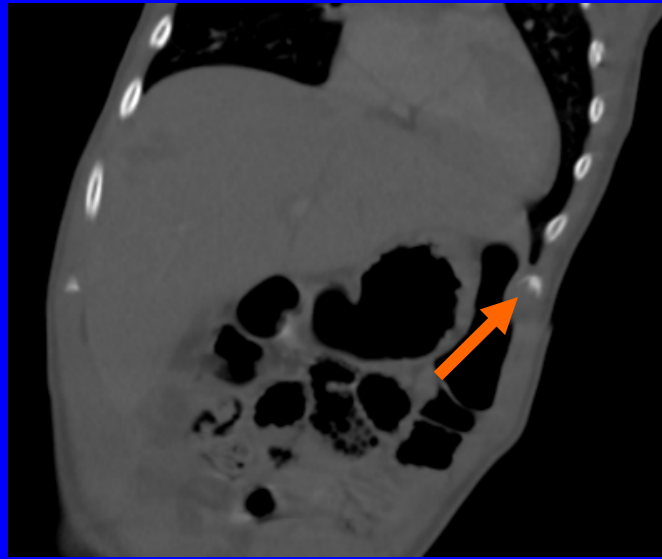
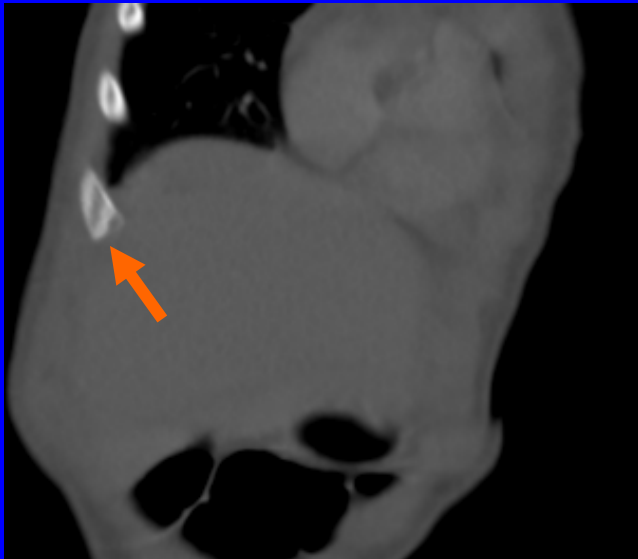


Same patient. Elevated transaminases.

Grade 2 liver hematoma



Fracture
bilateral
anterior
rib ends--



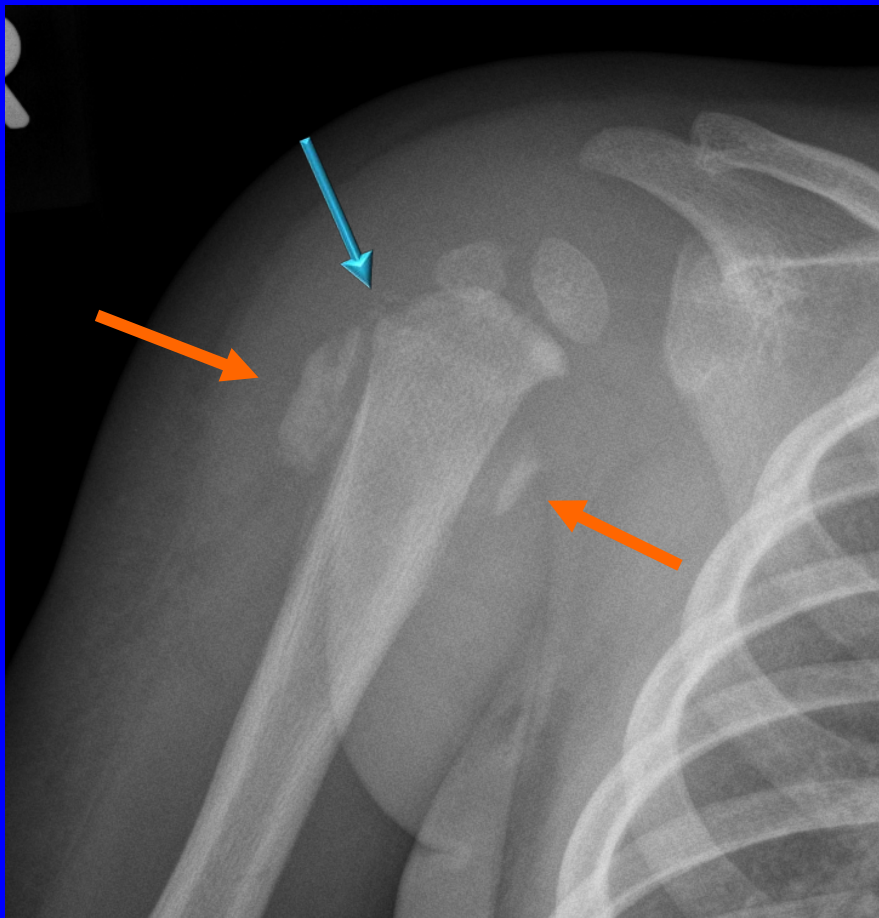
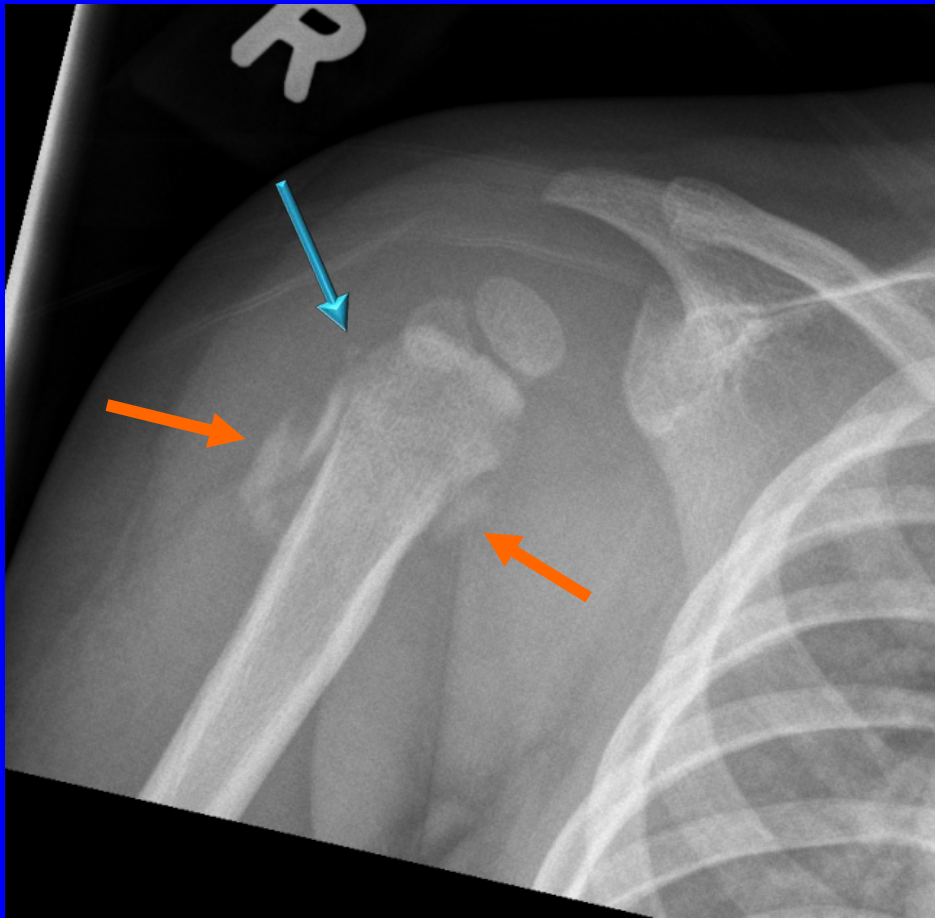
seen best
on
Coronal
reformats

Anterior rib end fractures

- The least common location of rib fracture (posterior and lateral more common)
- Fracture is at a costochondral junction, like a CML, so they have the appearance of a CML and heal like a CML: by fusing to the main bone and little periosteal reaction
- Often associated with intra-abdominal injury

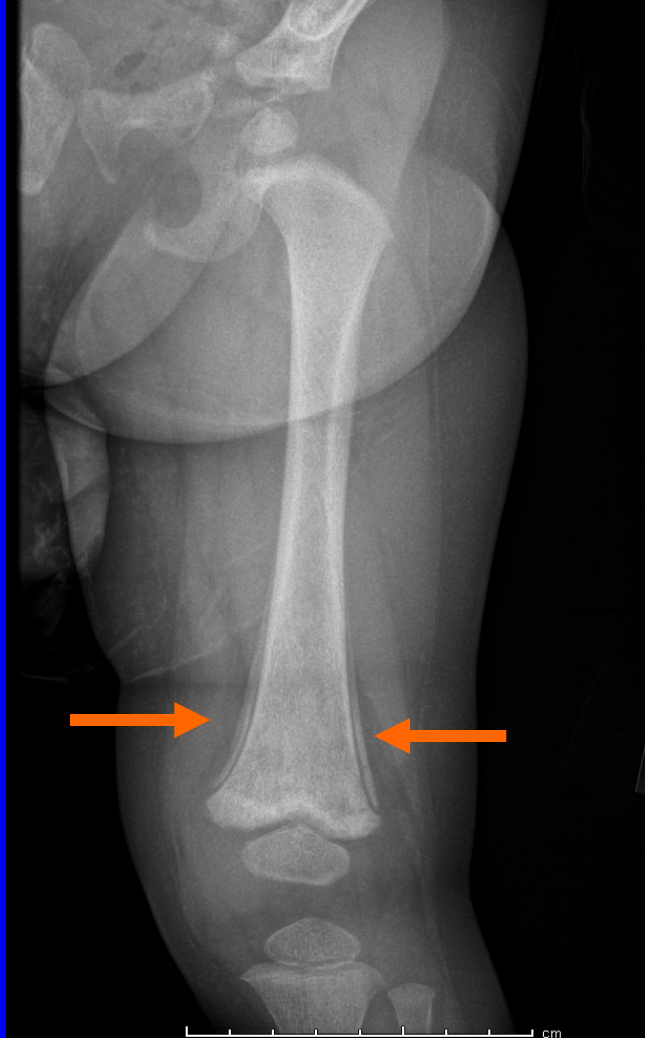
Ng and Hall. Pediatr Radiol 1998

10 month old with decrease use RT arm. History of decreased use of LT lower extremity two weeks prior



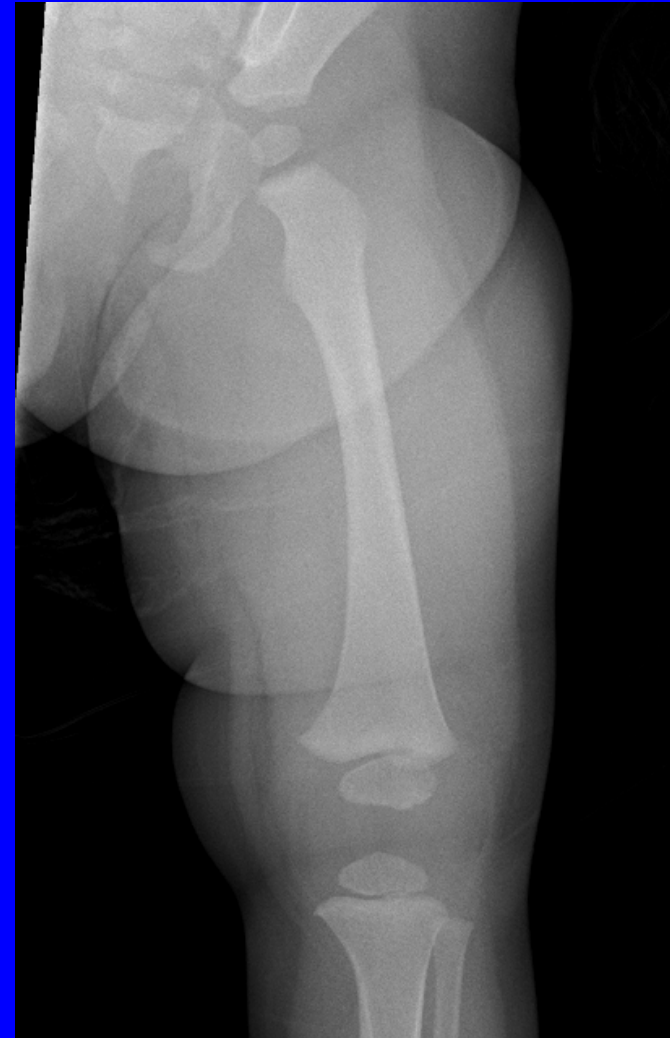
10 month old with decrease use RT arm. History of decreased use of LT lower extremity two weeks prior

Current femur x-ray

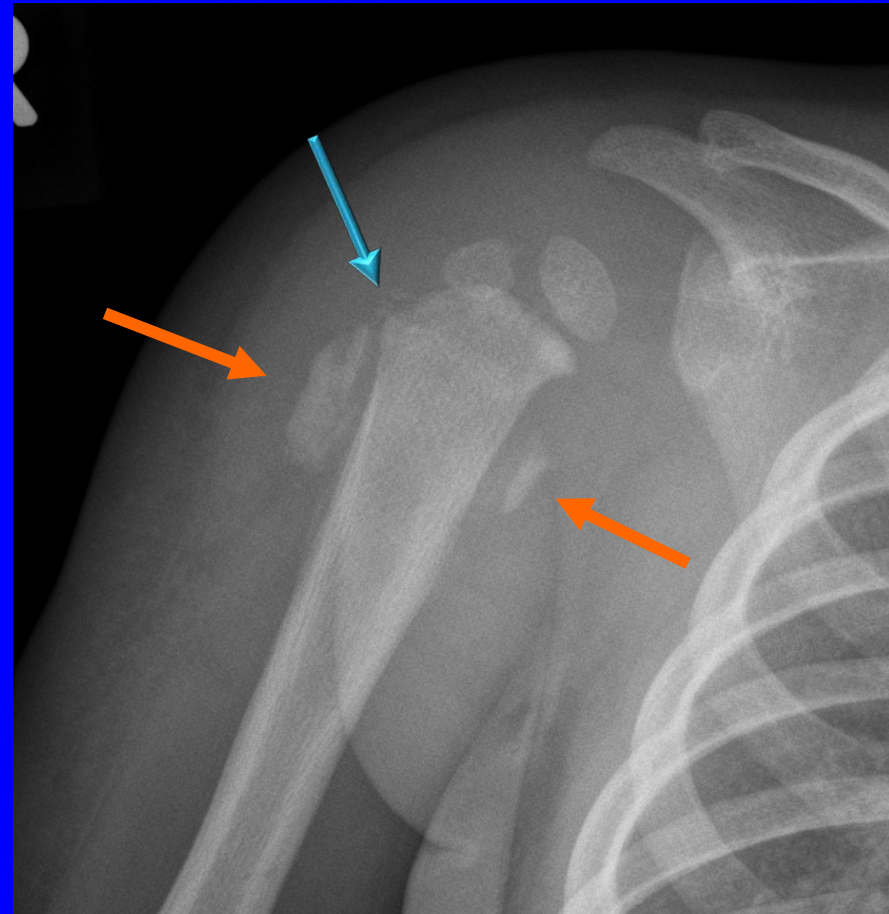
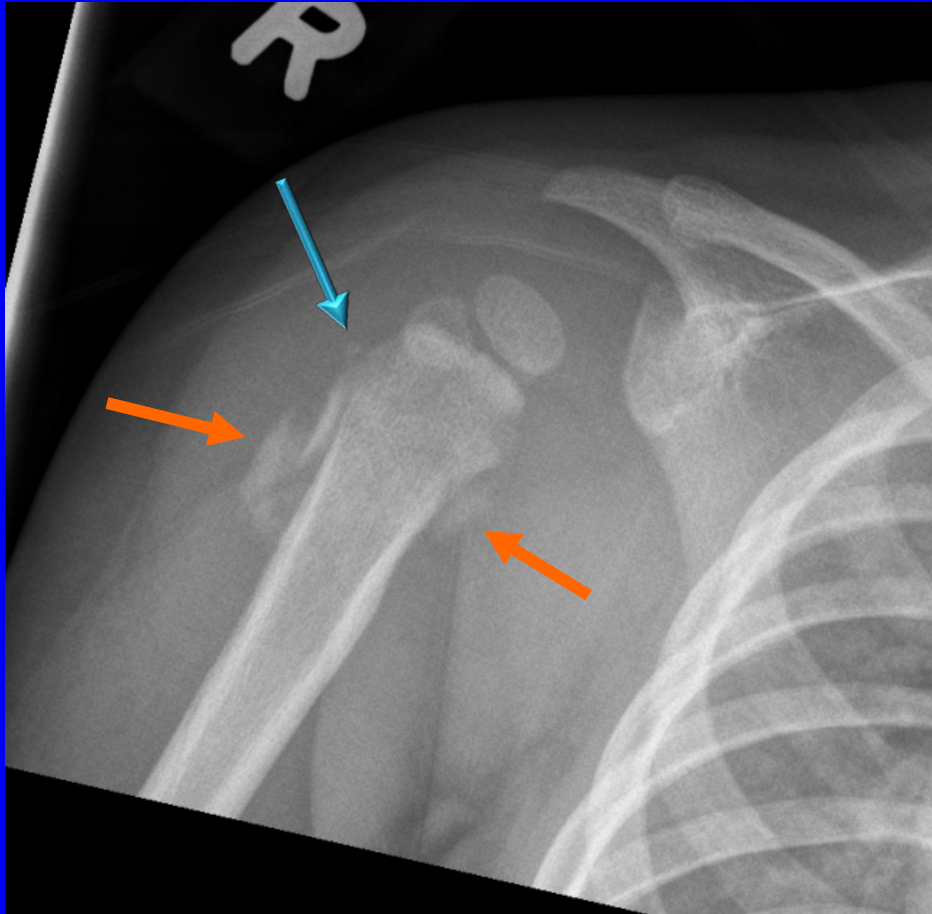


**Calcifying
subperiosteal
hemorrhage;
no fracture in
shaft**

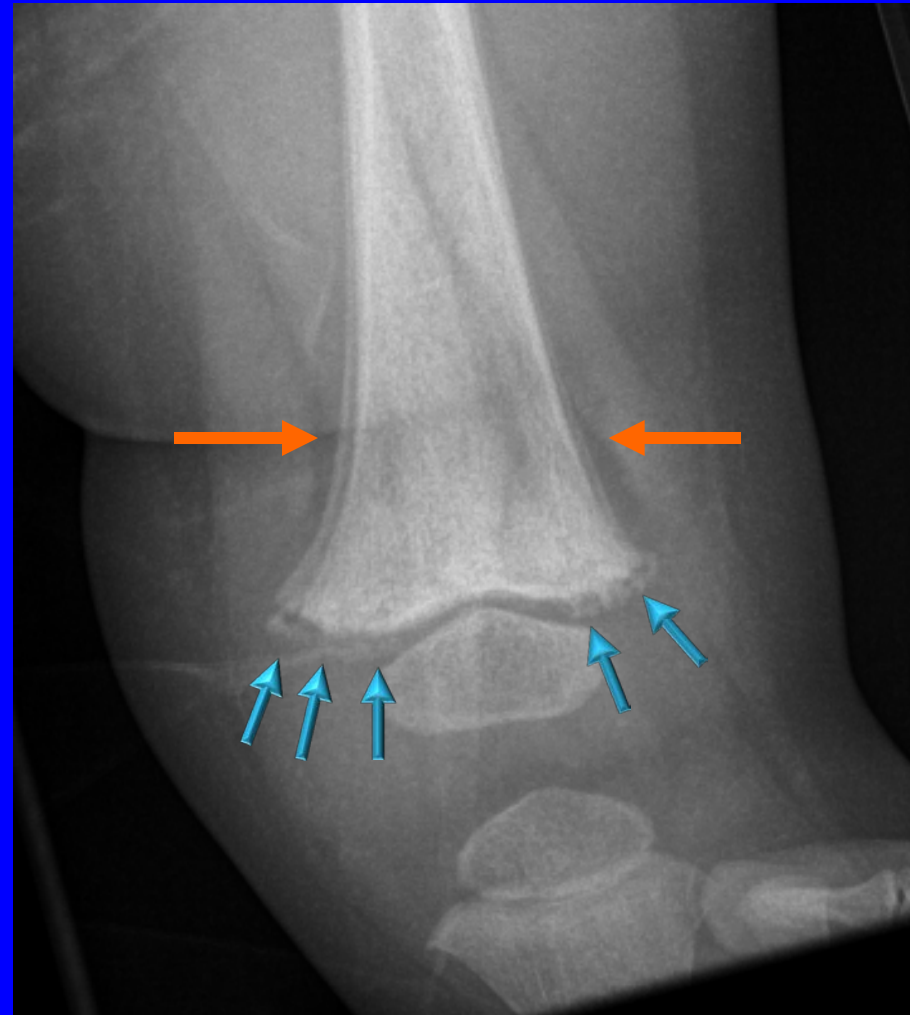
Femur x-ray 2 weeks prior



10 month old with decrease use RT arm. History of decreased use of LT lower extremity two weeks prior
Calcifying subperiosteal hemorrhage; likely CML (blue arrows)



Follow-up imaging on this same patient 3 weeks later.
Progressively calcifying subperiosteal hemorrhages
and now more apparent LT distal femur CML



Subperiosteal Hemorrhage

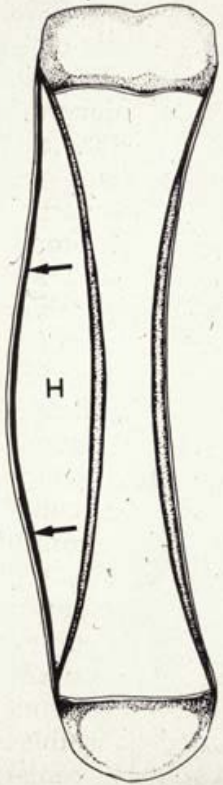
Periosteum: loosely applied in infants.

When a bone is subjected to shearing forces, may result in a *subperiosteal hemorrhage* – same mechanism as a CML.

So CML may be associated with a subperiosteal hemorrhage

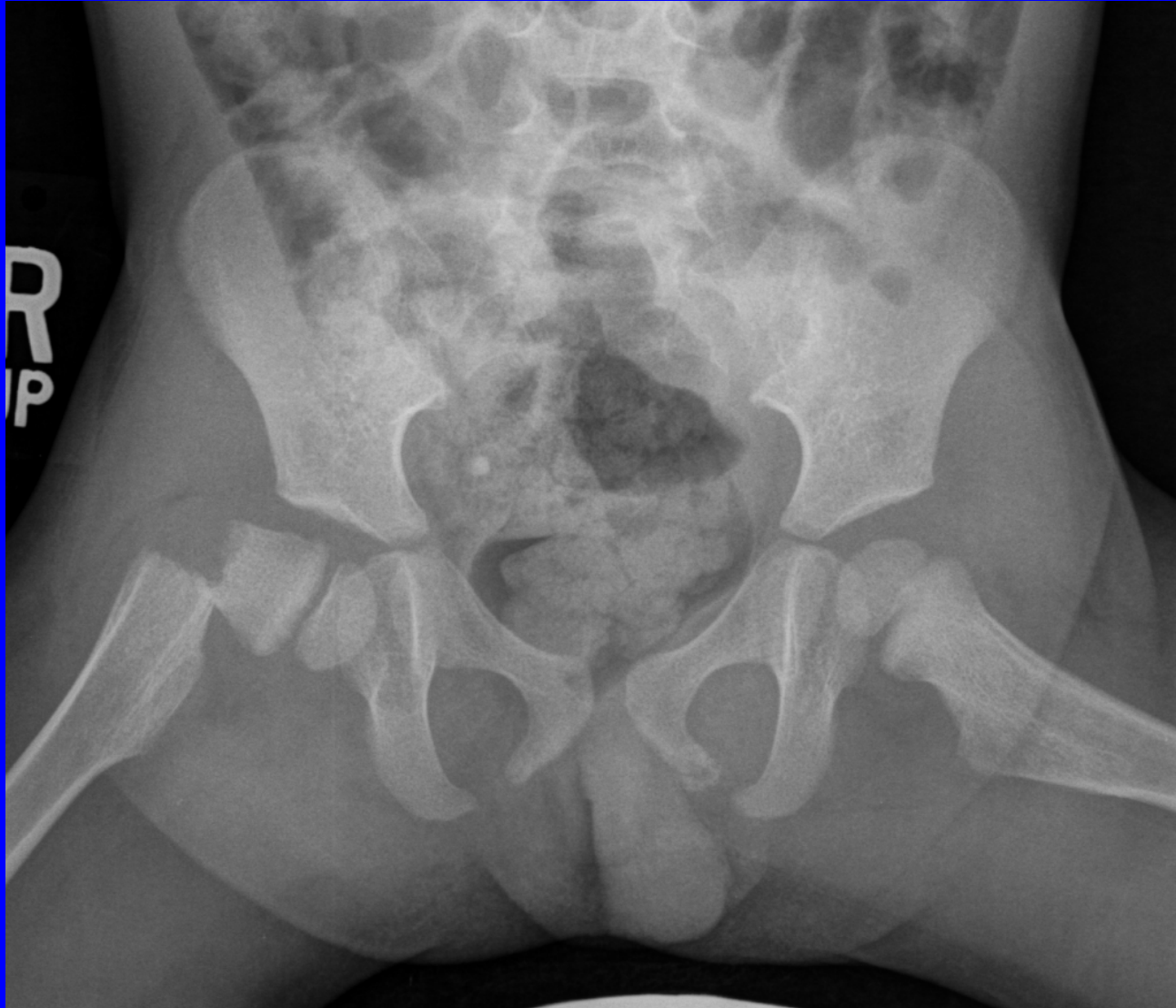
This subperiosteal hemorrhage becomes apparent *only upon healing on f/u imaging*: amorphous calcification of the blood situated *slightly away from but parallel* to the bone.

Most often seen in the humerus and femur.

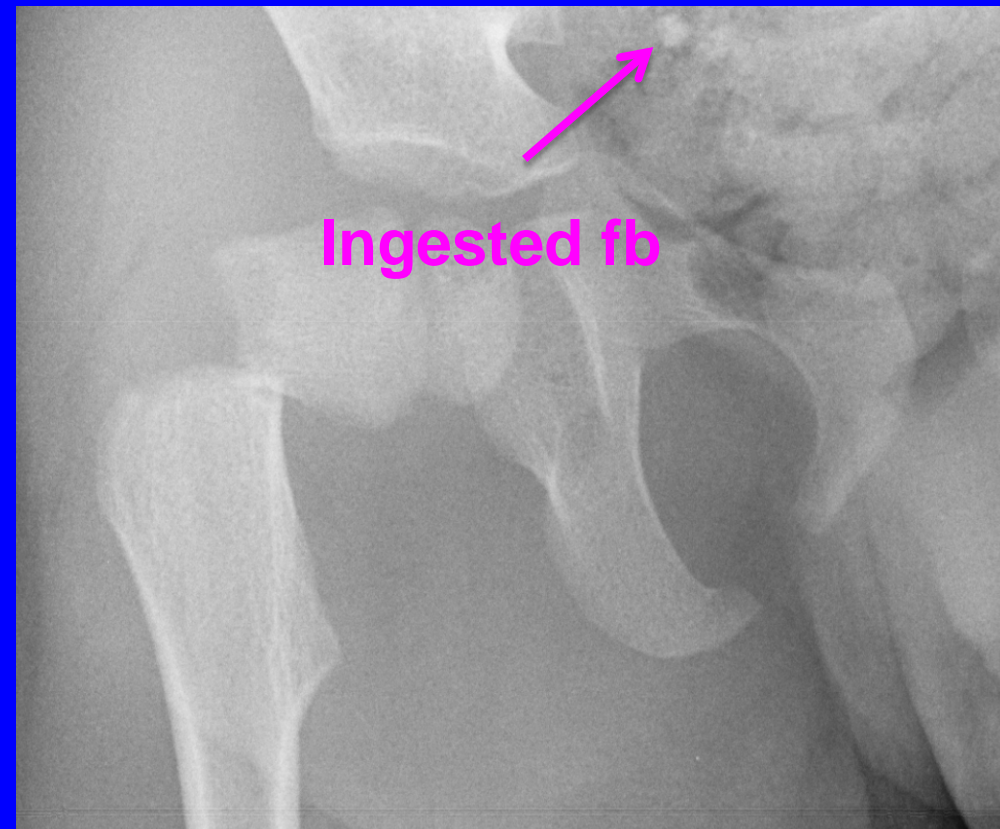


*Diagnostic
Imaging of
Child Abuse.
P. Kleinman;
3rd Edition*

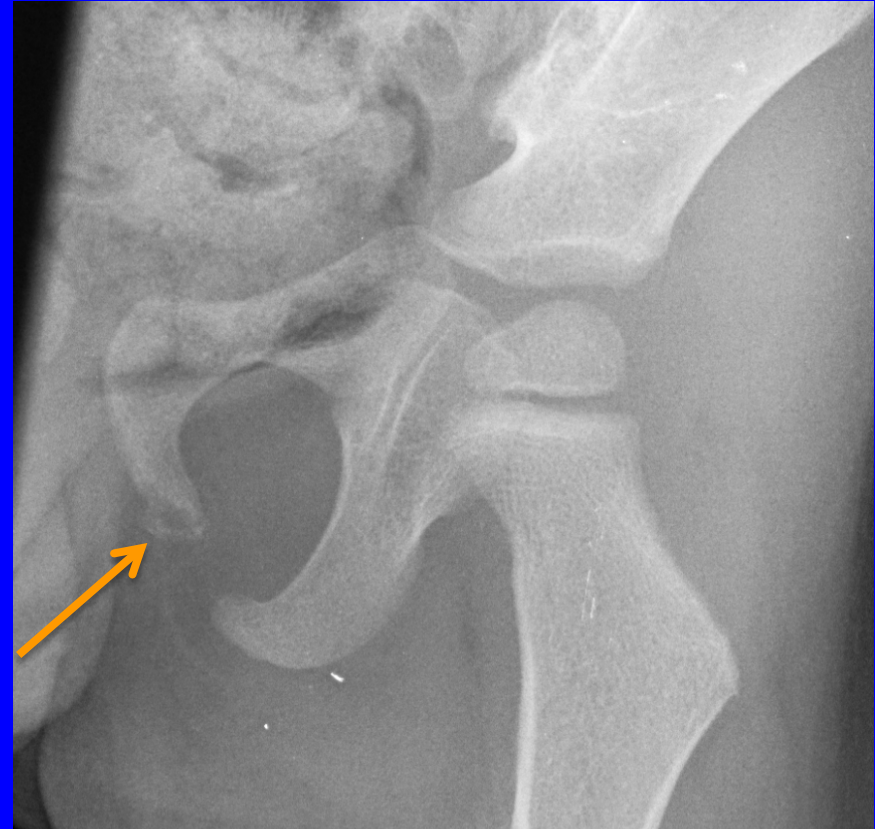
31 month old fell off the toilet, won't move the RT leg.
Besides the RT proximal femur fracture, what other abnormality is present?



31 month old fell off the toilet, won't move the RT leg.
Besides the RT proximal femur fracture, what other
abnormality is present?



RIGHT

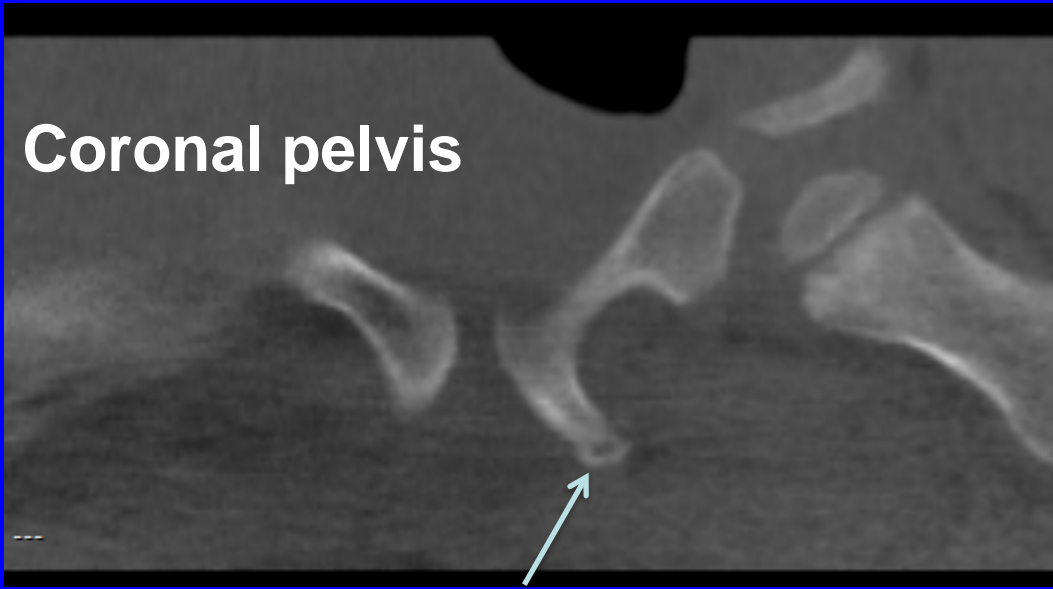


LEFT

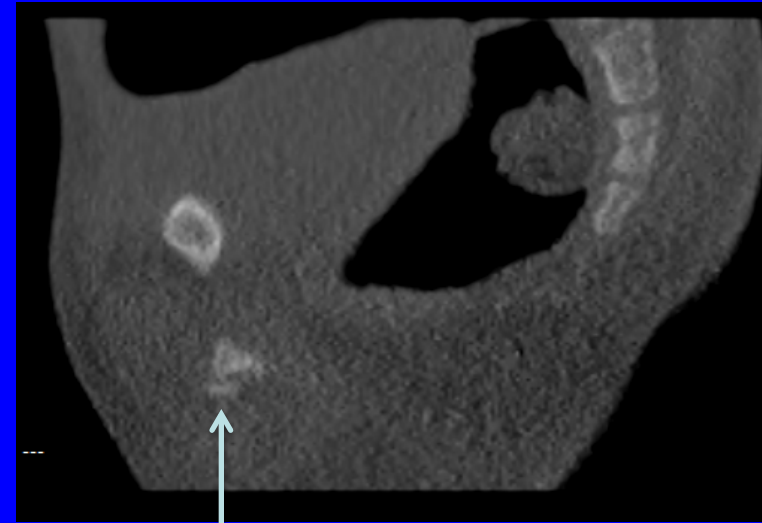
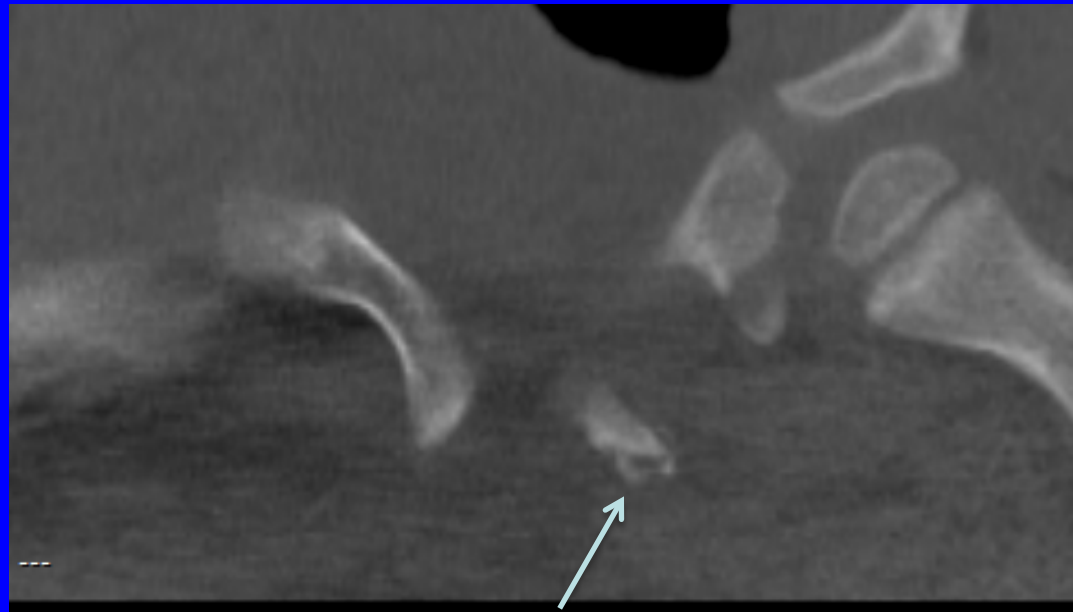
How might you further
evaluate this finding?

31 month old fell off the toilet, won't move the RT leg

Coronal pelvis



Healing LT inferior
pubic ramus fracture



Sagittal pelvis

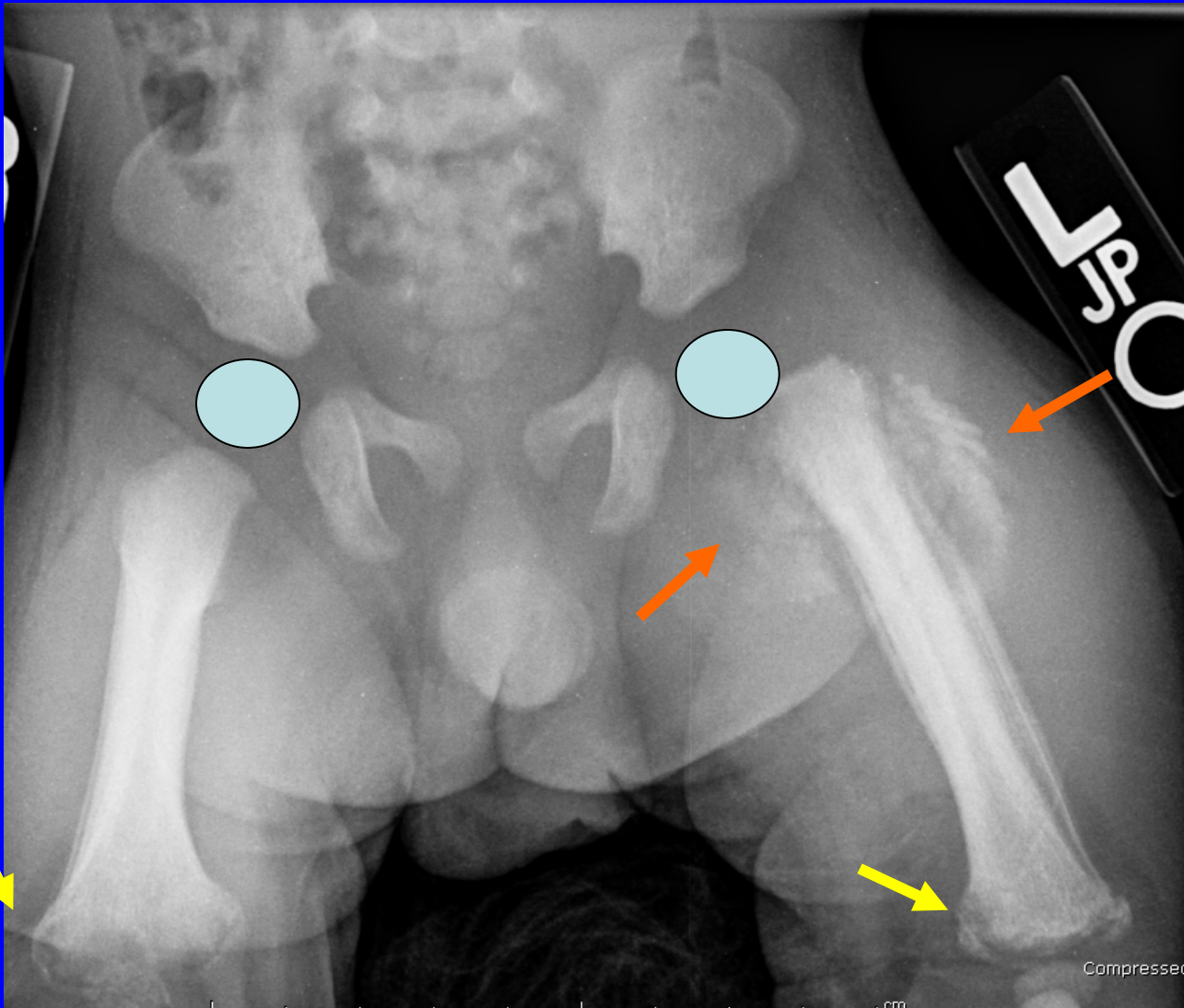
Pelvic fractures

- Rare abusive injury
- Most often in patients with multiple injuries including extensive soft tissue injuries and fractures of the small bones of the hand
- Occasionally associated with sexual abuse

Ablin et al. Pediatr Radiol 1992

Unpublished data from CNMC

2 month old boy with multiple fractures. Image from skeletal survey. **Calcifying subperiosteal hemorrhage**
LT proximal femur. Healing bilateral
distal femur
CML's.

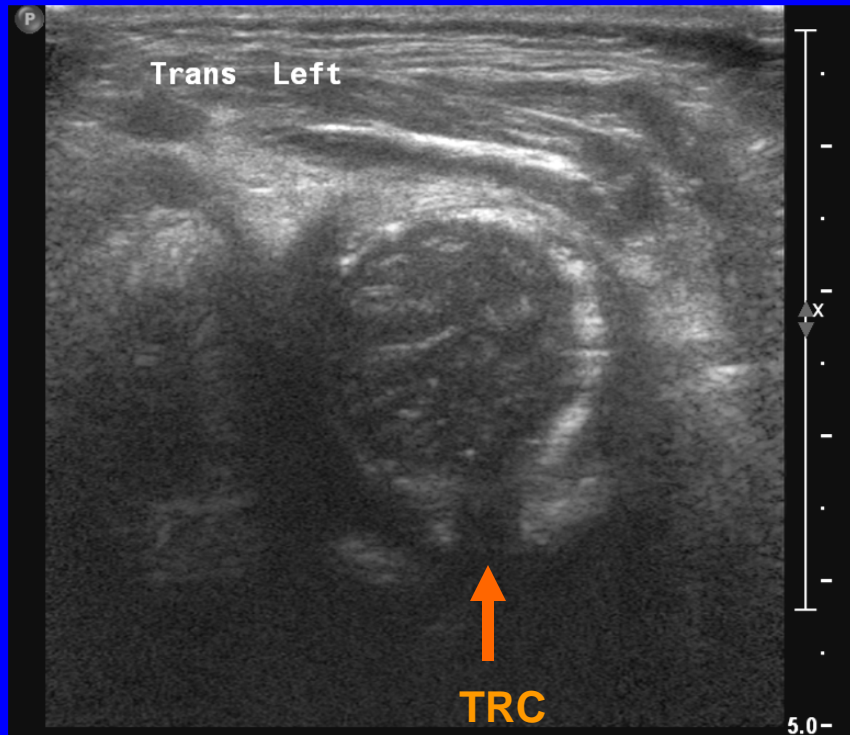


distal femur
CML's.

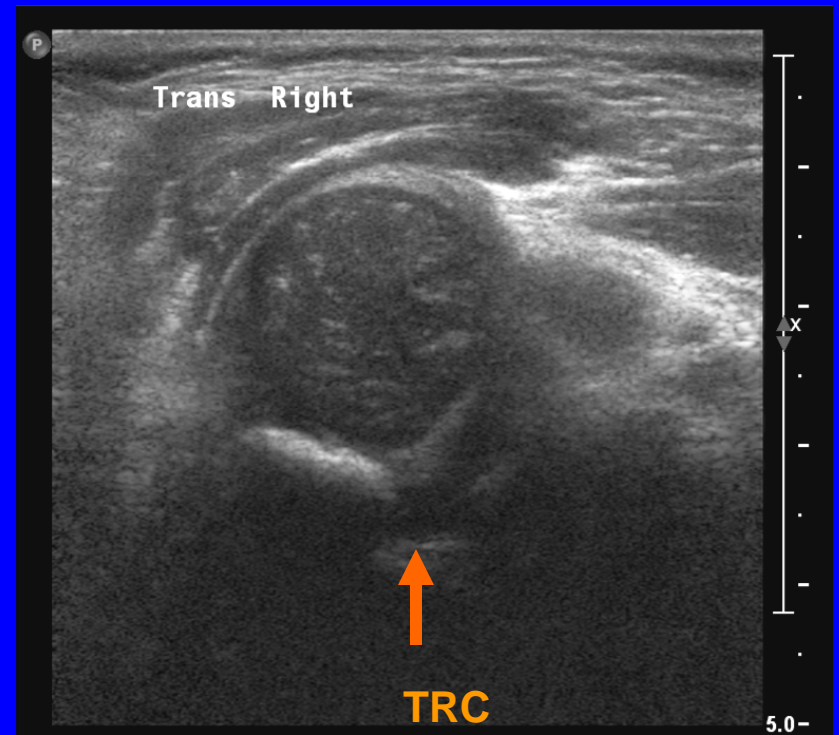
Is the LT hip normally located?

What study would be helpful?

2 month old boy with multiple fractures. Hip ultrasound.



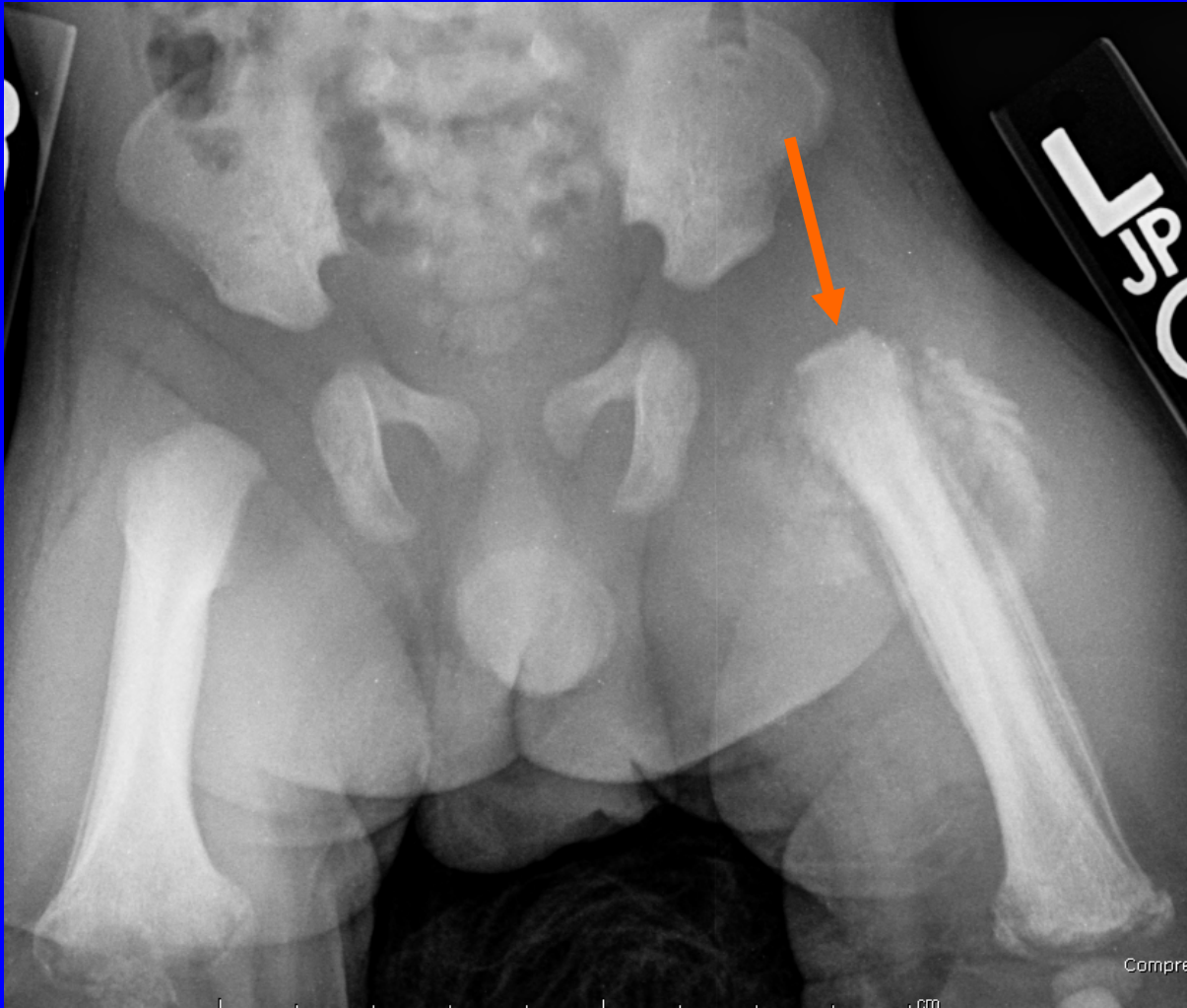
Trans Left



Trans Right

The LT hip is normally located.

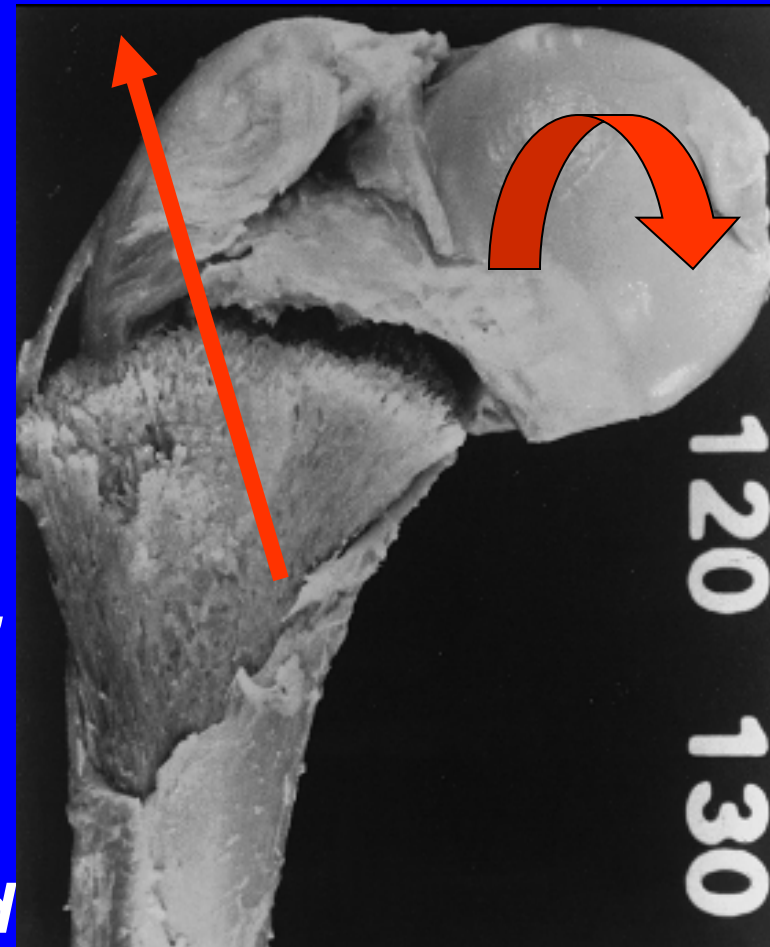
LT Proximal femoral growth plate fracture (Salter-Harris 1) with lateral displacement of the distal fracture fragment. Simulates a dislocation when the femoral head is unossified.



Proximal femur growth plate fracture

Simulated in 6 neonate cadavers by Ogden in 1984

- Salter-Harris **type I** fracture
- **Medial** migration of epiphysis
- periosteum disrupted **ant.**, preserved **post.**
- proximal femur “**button-holes**” through anterior defect **proximally and laterally**
- leads to **coxa vara if untreated**

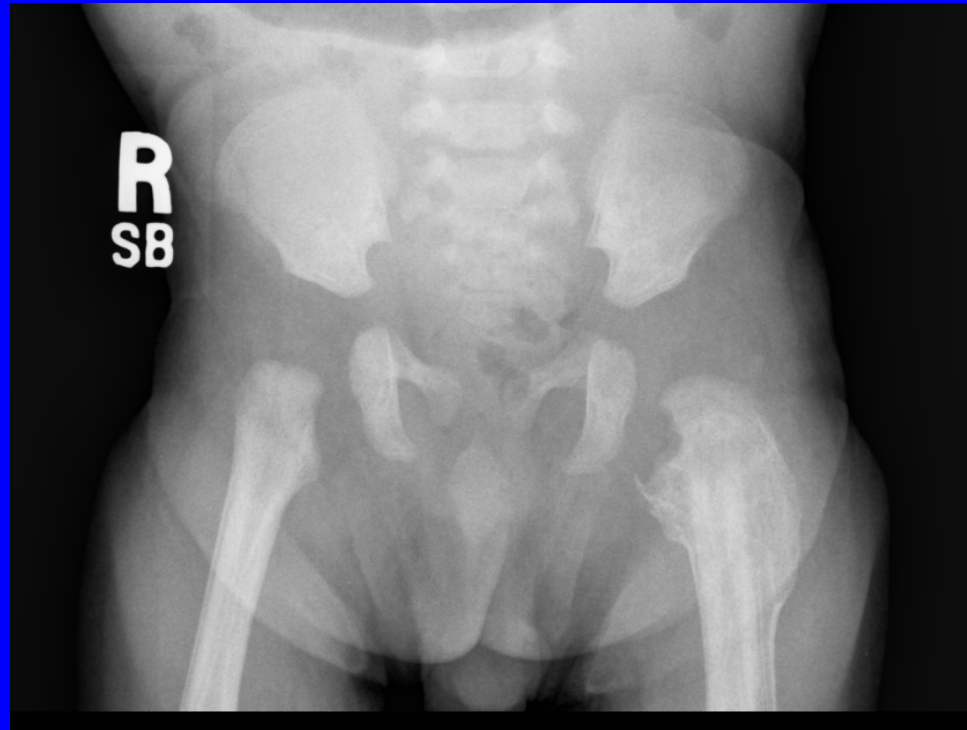


From Ogden. *J Pediatr Ortho* 1984

Same patient after treatment in a spica cast

2 months

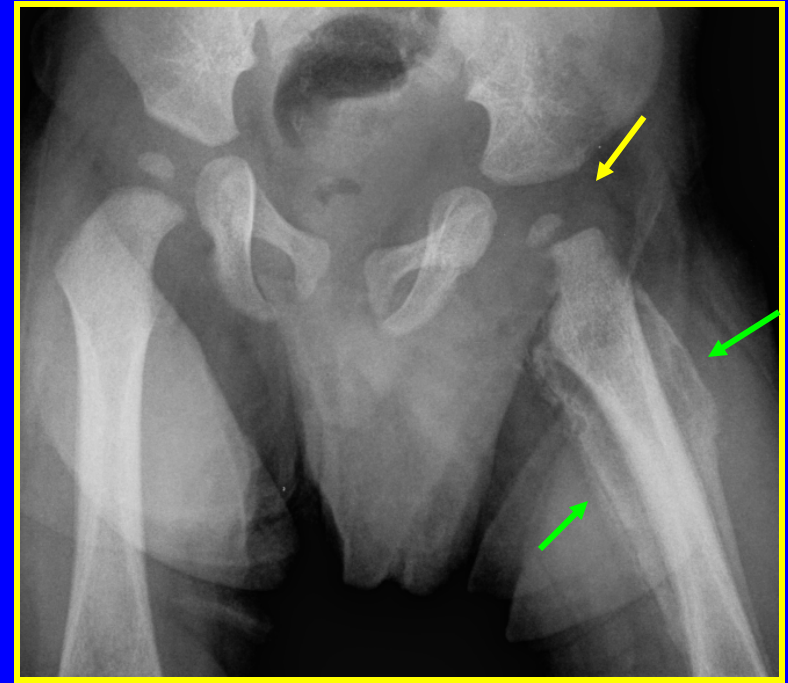
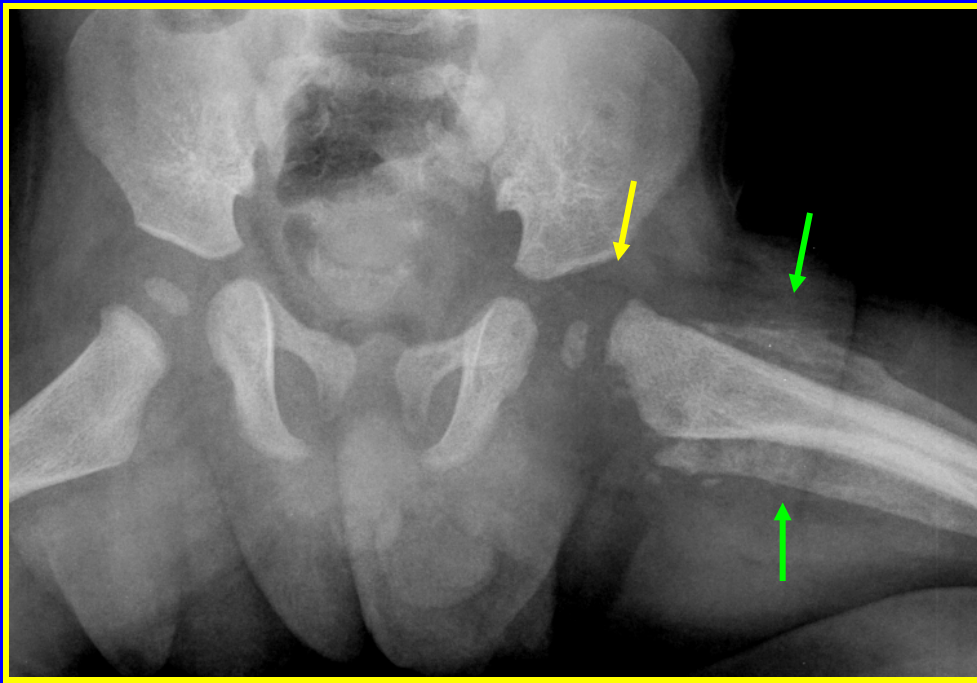
5 months



Progressively healing LT proximal femur growth plate fracture

Another patient: Proximal Femur Growth Plate Fracture with calcifying subperiosteal hemorrhage.

With presence of ossified femoral head, the diagnosis is more apparent



Proximal Femur Growth Plate Fractures

- ❖ A rare abusive injury due to sudden severe traction and external rotation of the femur

Ogden et al. J of Pediatr Ortho 1984

- ❖ Hip ultrasound very helpful when femoral head not yet ossified.

- ❖ Untreated, this injury can lead to coxa vara deformity with shortened limb.

- ❖ Well known to occur from birth trauma during breech extraction.

- ❖ Shown to occur due to seizure

Paris N. PRev Chir Orthop. 2008

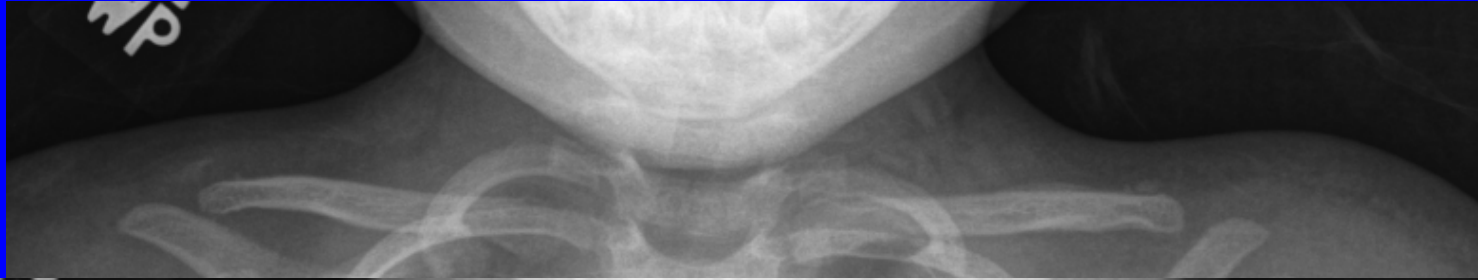
13 month old with swelling LT upper arm.

**Healing
supracondylar
fracture with
calcifying
subperiosteal
hemorrhage.**

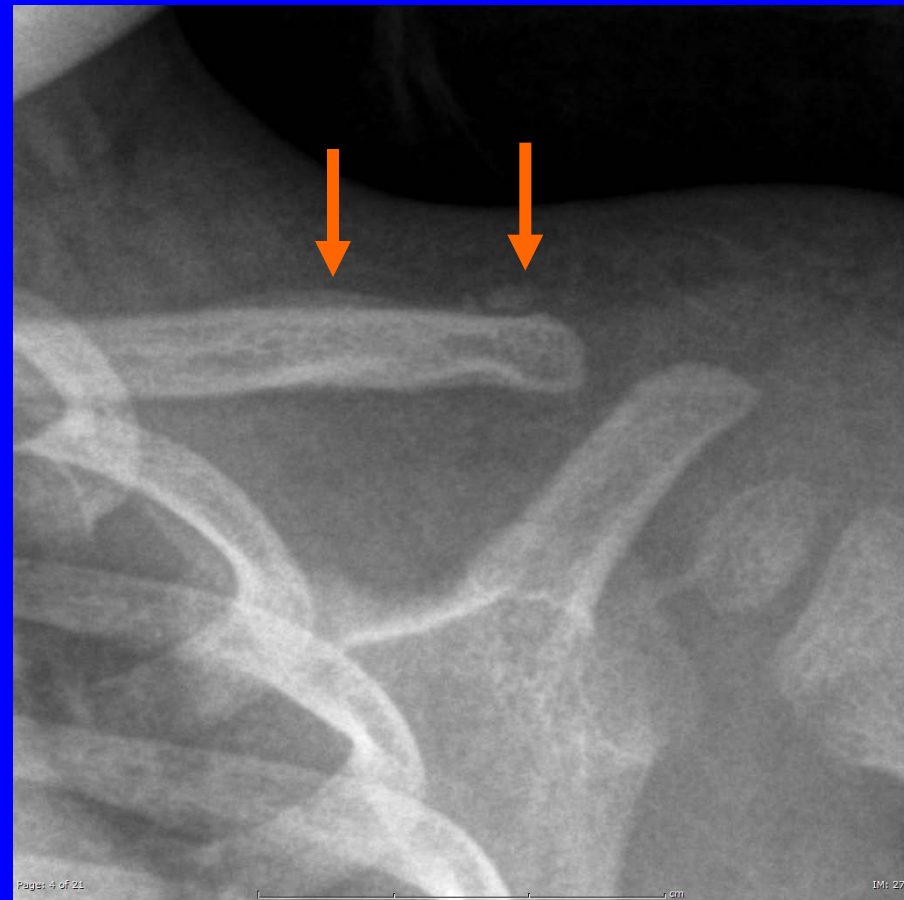
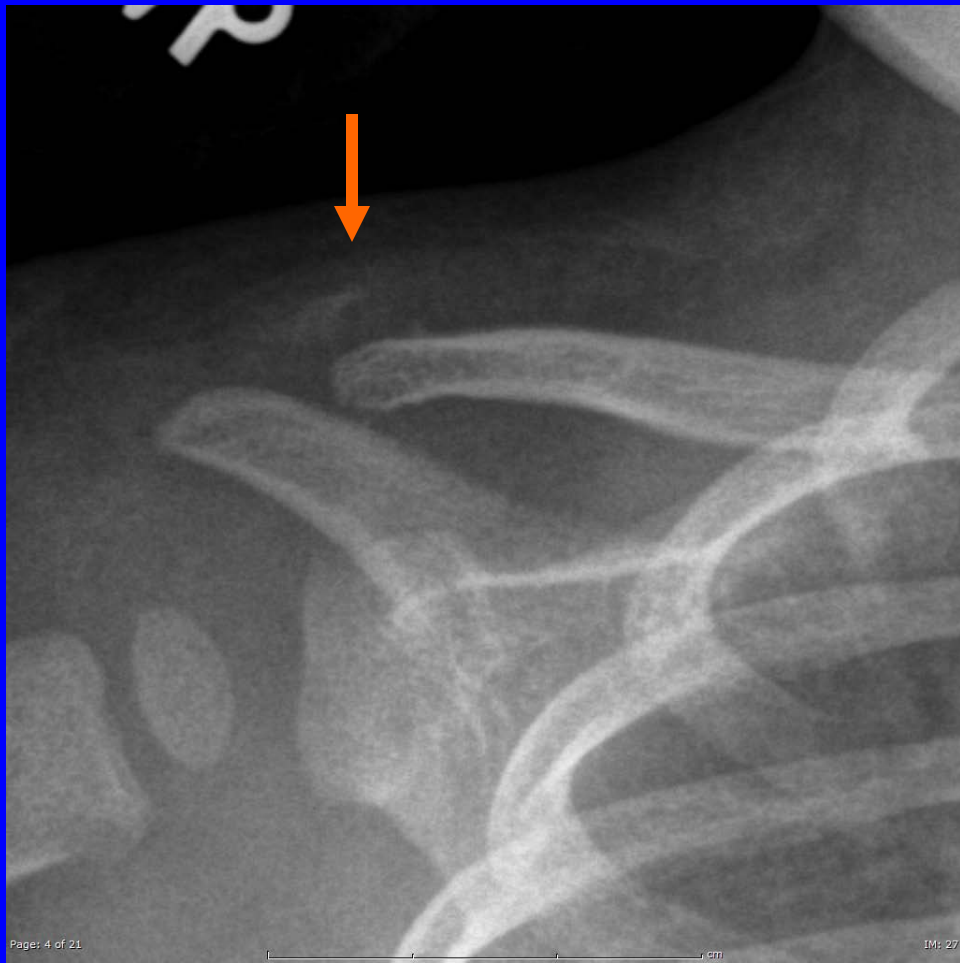
What other
abnormality is
present?



AP Ribs on the same patient

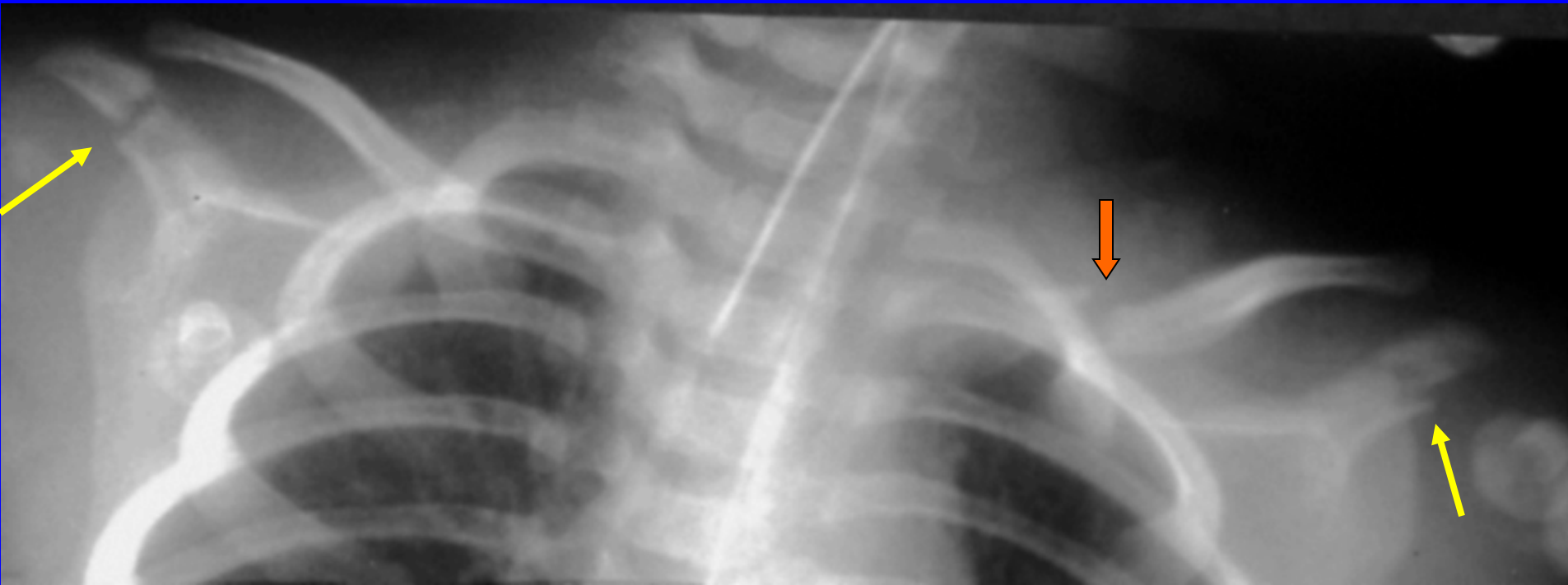


Cone down
from AP ribs



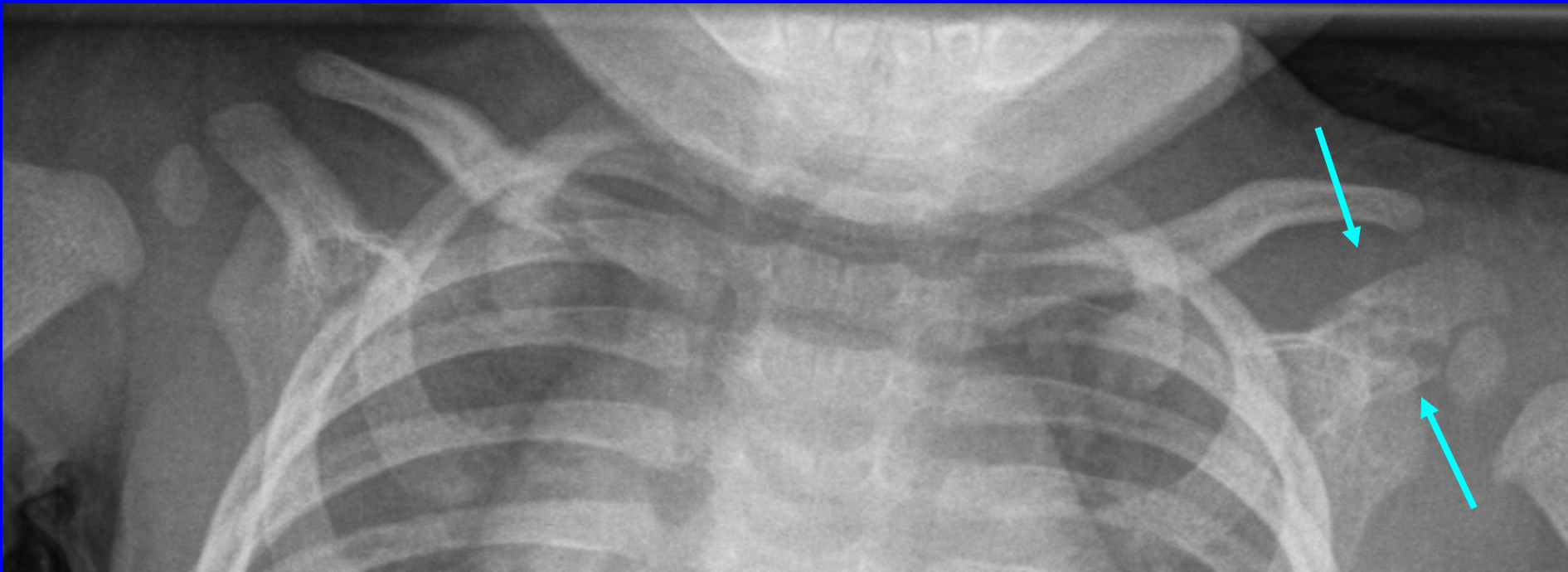
**Healing bilateral distal
clavicle fractures**

9 mos old, tumbled from bleachers; came in seizing.
CT head: subdural hemorrhage and cerebral edema.



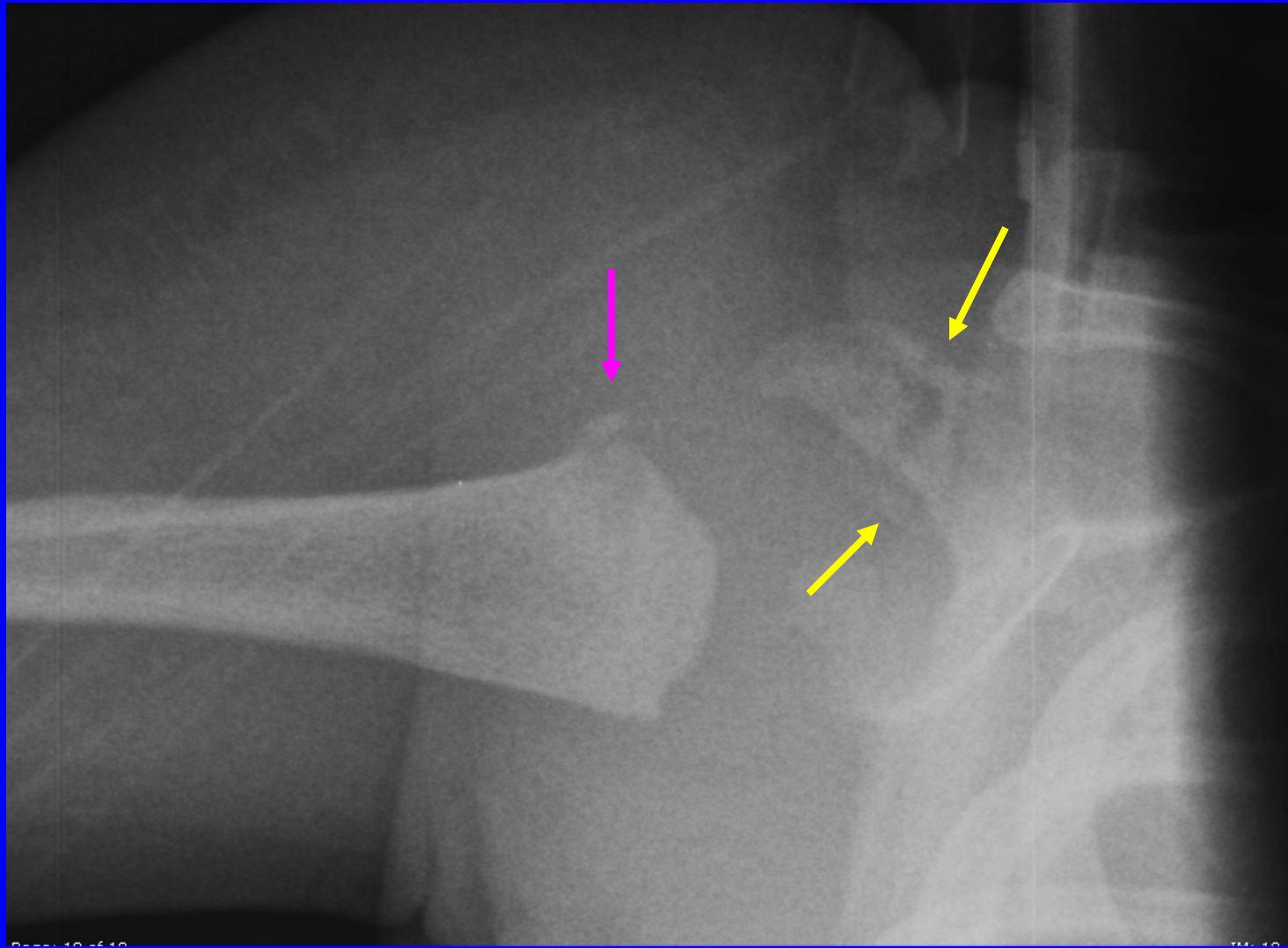
Acute bilateral acromion and LT clavicle fractures

6 month old infant, image from skeletal survey



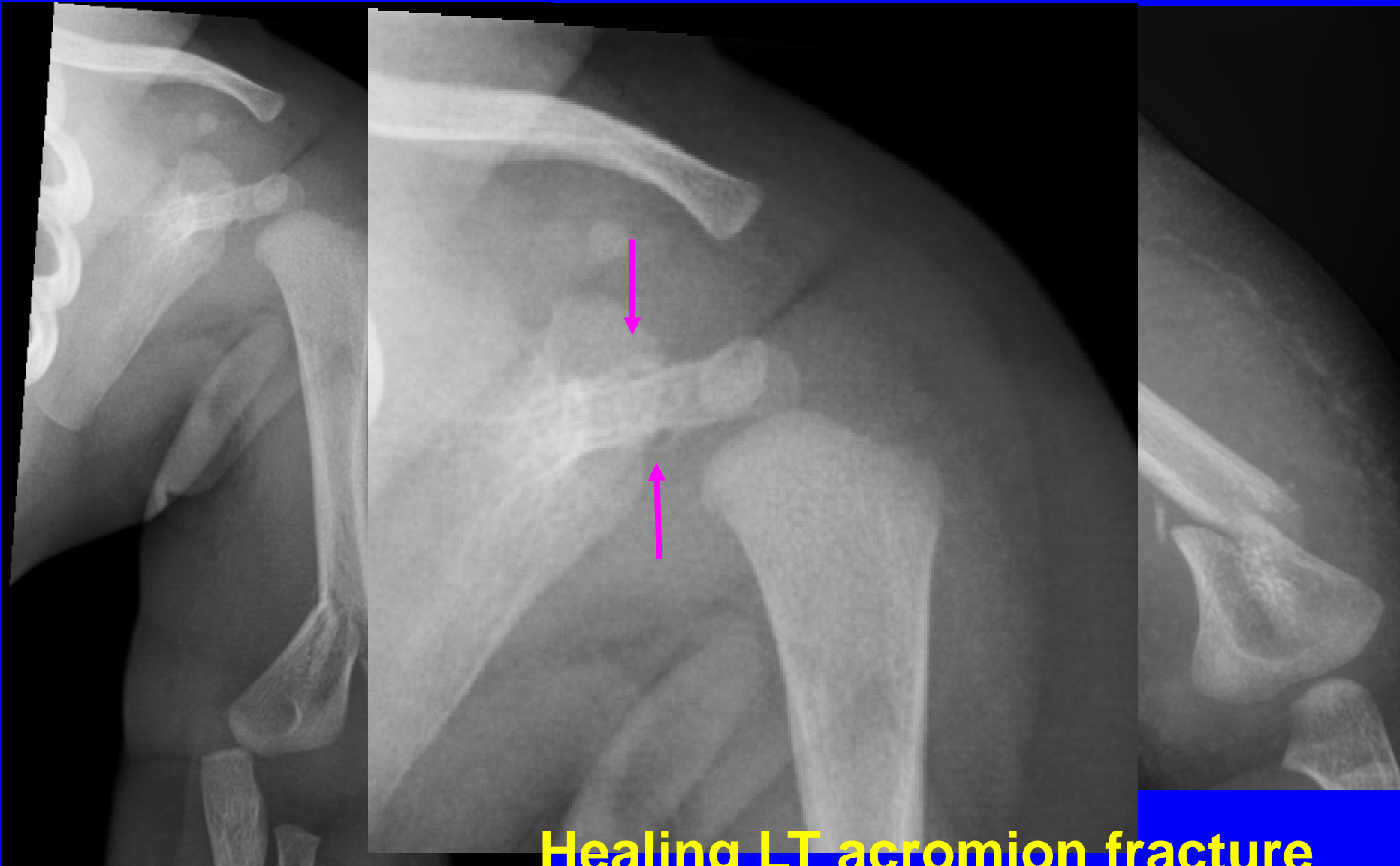
Healing LT acromion fracture

4 mos old w/ intracranial hemorrhage—RT shoulder



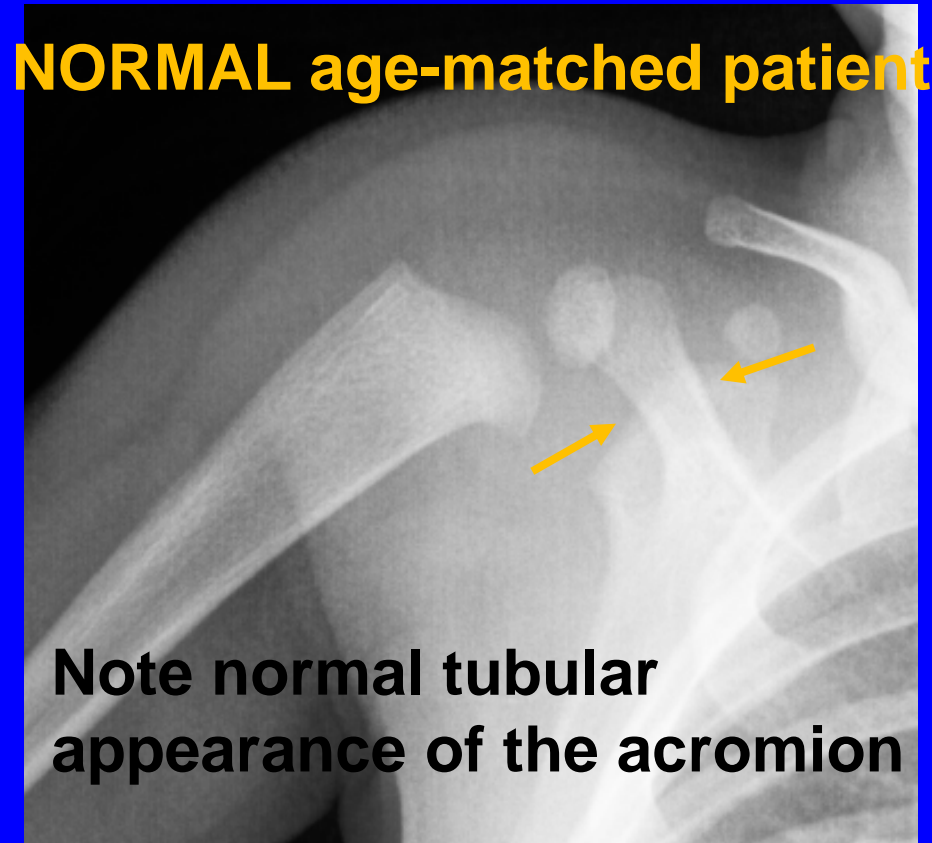
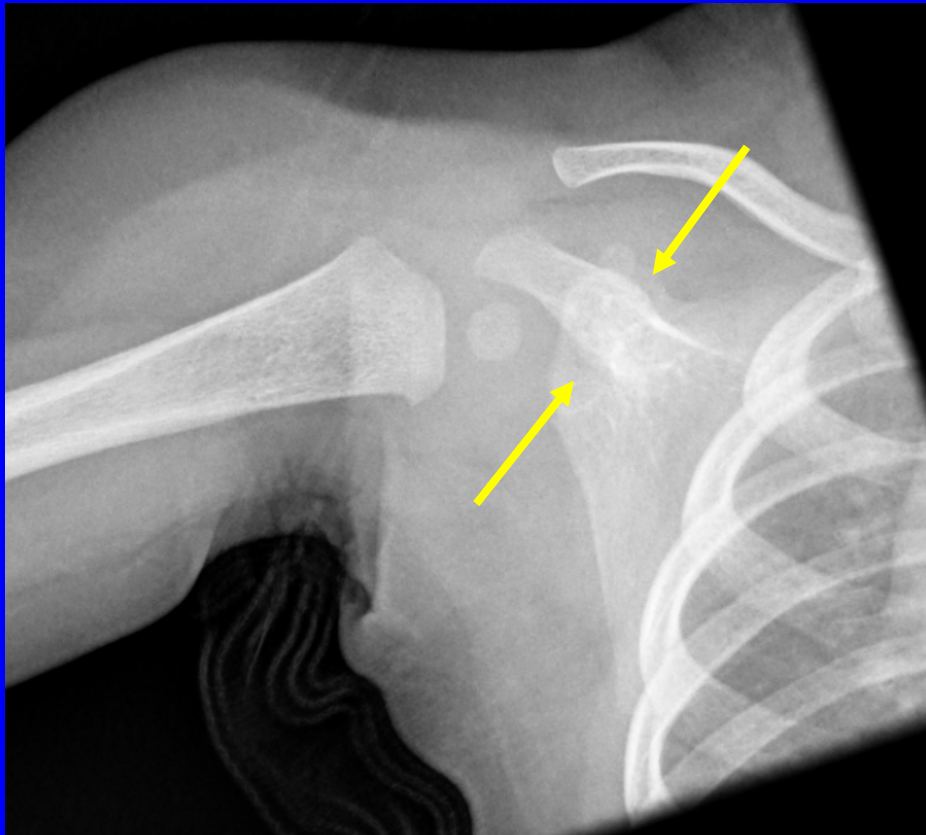
Healing RT acromion fx. RT proximal humerus CML

5 month old with swollen LT arm. What other fracture is present in addition to the supracondylar fracture?



Healing LT acromion fracture

Same patient. Images from Skeletal Survey: Comparison of LT and RT shoulders. **Is the RT acromion normal?**



Note normal tubular appearance of the acromion

RIGHT

LEFT

Late healing RT acromion fracture

Distal Clavicle and Acromion Fractures

- Mechanism of injury: traction on shoulder, usually pulling on the distal upper extremity
- Both uncommon, but acromion fracture even less common
- Both carry a high specificity for abuse
- Bilateral acromion fractures reported due to seizure *Jacob et al; Pediatr Radiol 2011.*

SUMMARY

Overview of uncommon injuries in NAT

- Proximal femur CML
- Anterior rib end fractures
- Subperiosteal hemorrhage
- Pelvic fractures
- Proximal femur growth plate fractures
- Distal clavicle fractures
- Acromion fractures