



Pediatric Fracture Care

Sukhdeep K. Dulai, MD, MHSc, FRCSC
Pediatric Update – September 20, 2013
Edmonton, AB






UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Disclosure


- **Faculty:** Sukhdeep Dulai
- **Relationships with commercial interests:**
 - Grants/Research Support: None
 - Speakers Bureau/Honoraria: None
 - Consulting Fees: None
 - Other: None



UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Objectives


- 1) Discuss the common acute musculoskeletal injuries seen in children.
- 2) Provide a guide to the utility of radiography in the setting of pediatric musculoskeletal injury.
- 3) Review the principles of acute pediatric fracture management.
- 4) Identify pediatric musculoskeletal injuries that can lead to long-term complications and strategies to minimize morbidity in these cases.



UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery


Cases

- 1) Adolescent knee injury
- 2) Acute lower limb injury
- 3) Acute upper limb injury
- 4) The limping tween/teen
- 5) How did they do that?? (aka the unexplained injury)

 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Case 1

- 13 yo girl playing soccer → twisted her knee while the foot was planted
- Pain and swelling in the knee
- Coach suggested RICE
- Presents to your clinic the next day using her brother's crutches and wearing a tensor bandage

 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery


Differential Diagnosis for Knee Pain

• Patellofemoral syndrome	• MCL tear
• Fracture	• LCL tear
• Osteochondritis Dissecans	• ACL tear
• Osgood-Schlatter's Disease	• PCL tear
• Sinding-Larsen-Johansson Syndrome	• Meniscal injury
• Patellar dislocation/instability	• Discoid Meniscus
• Quadriceps tendon tear	• Perthes
• Septic knee	• Slipped Capital Femoral Epiphysis
• Osteomyelitis	• Primary Bone Malignancy
	• Leukemia
	•etc.

 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Acute Knee Injuries

- **Clues on History to help distinguish:
Urgent vs. Not-so-urgent**
 - Acuity of symptoms
 - History of Trauma/ Mechanism of Injury
 - Timing of Joint Effusion
 - Previous injuries/episodes
 - Recollection of a “pop” during the injury

 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery


Acute Knee Injuries

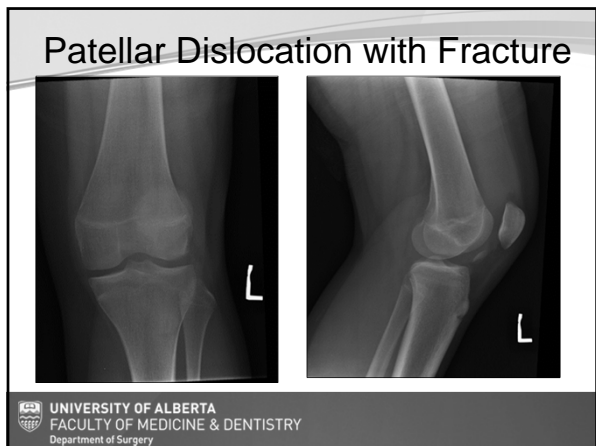
- **Physical Exam findings suggesting urgency:**
 - Inability to Weight bear
 - Presence of Deformity
 - Presence of Large Effusion
 - Focal Tenderness
 - Mechanical Signs
 - Instability

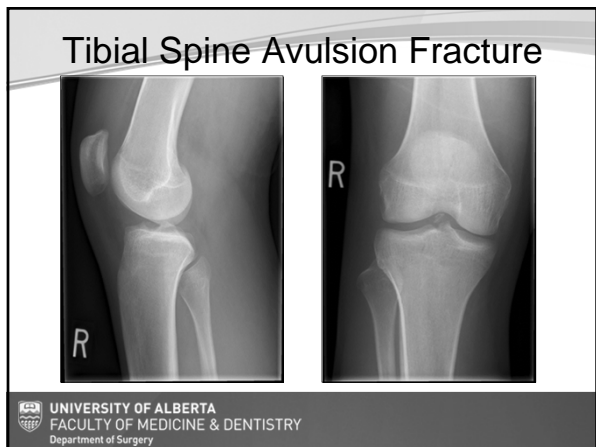
 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

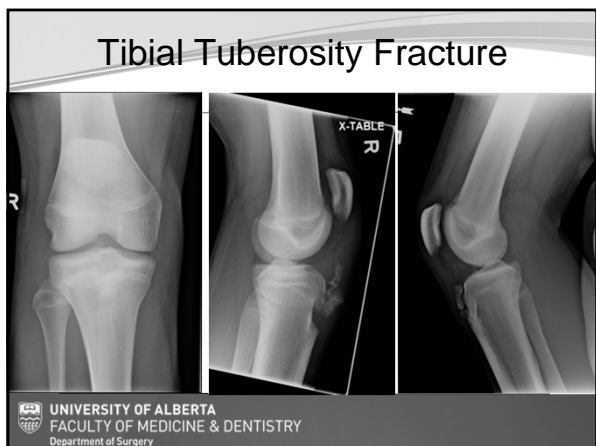
Acute Knee Injuries

- **Investigations**
 - Knee Radiographs:
 - AP and lateral - standard
 - Skyline if patient able to range and concern of patellofemoral injury
 - Tunnel Views – best for OCD
 - Hip radiographs if any suspicion
 - Urgent MRI
 - If acute hemarthrosis is present or the knee is locked AND history/physical exam/plain radiographs are inconclusive

 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery







Acute Knee Injuries: Tips

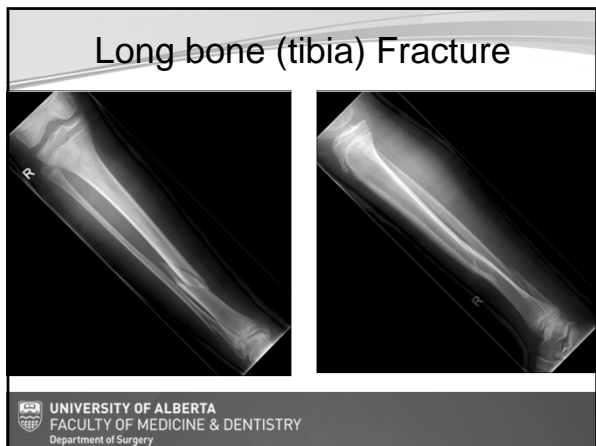
- An acute hemarthrosis warrants urgent investigation.
- Unexplained mechanical symptoms require further imaging.
- Avoid radiographs that require a joint to be moved to a position that the patient cannot achieve actively.
- Refer intra-articular fractures to orthopedics early

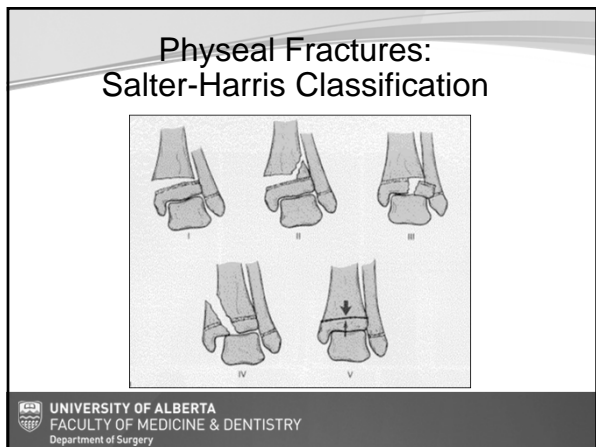
Acute Knee Injuries: Tips

- Limit bracing after acute soft tissue knee injuries.
- When ordering physiotherapy: be specific, let patients know what to expect and what is expected of them.
- Referral options include peds sports med clinic at Glen Sather Clinic
 - 11-18 years of age
 - within one month
 - sports related injury

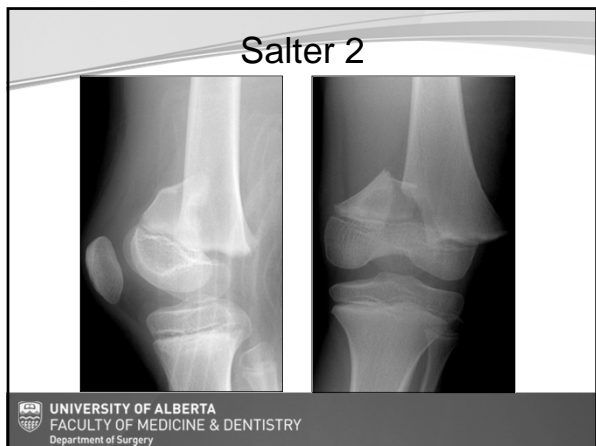
Case 2

- 12 y.o. boy fell awkwardly from playground equipment
- Acute pain in leg and unable to weightbear
- Swollen, tender leg

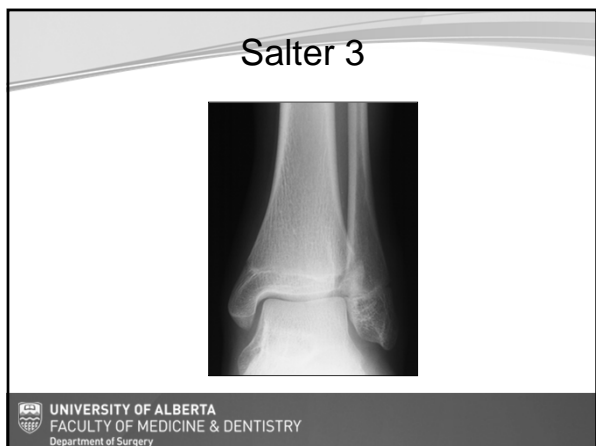


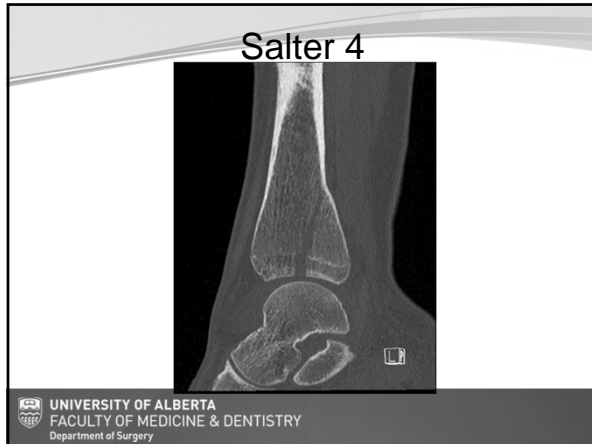












Pediatric Fractures

- Indications for urgent/emergent orthopedic referral:
 - Persistent joint dislocation/subluxation
 - Open fractures
 - Displaced fractures with intra-articular extension
 - Displaced femur fractures that cannot be reduced and held with a cast
 - Obvious clinical deformity that cannot be resolved with closed reduction
 - Unstable fractures in the setting of polytrauma
 - Fractures in patients with contraindications to casting
 - Displaced fractures in which there is a contraindication to reduction in the ED

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Pediatric Fractures

- When should a reduction be attempted in the ED?
 - Joint dislocation/subluxation
 - Fractures with clinical deformity
 - Displaced fractures that are associated with vascular compromise
 - Fractures with significant angulation/displacement that would not be expected to remodel but may not need surgery

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Pediatric Fractures

- What is acceptable deformity?
 - Exact criteria varies with age due to varying remodeling potential but this is what you need to consider:
 - Any growth plate injuries- reduction attempts after 3 days have a higher risk of growth arrest.
 - In children younger than 10y, bayonet apposition is acceptable if the fracture can be stabilized in a cast and there is no clinical deformity.
 - No displacement is tolerable in intra-articular fractures.
 - Fractures around the elbow do not remodel very well and are prone to complications.


UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Remodelling

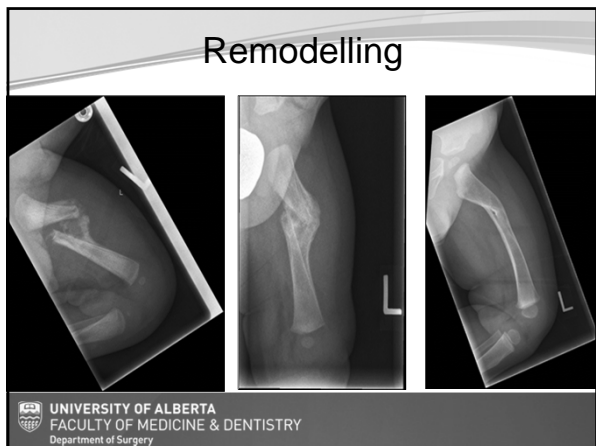
- Greatest when:
 - significant growth remaining
 - fracture is closer to the growth plate
 - deformity is in the plane of joint movement
- Not helpful in correcting:
 - displacement in intra-articular fractures
 - marked shortening
 - malrotation
 - fractures with deformity at right angles to plane of joint movement

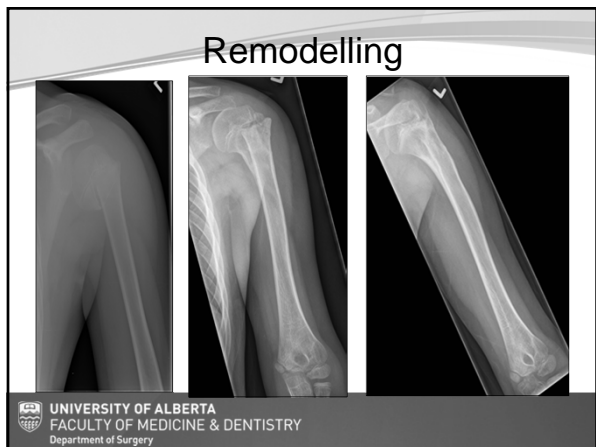
UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Will this remodel?



UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery



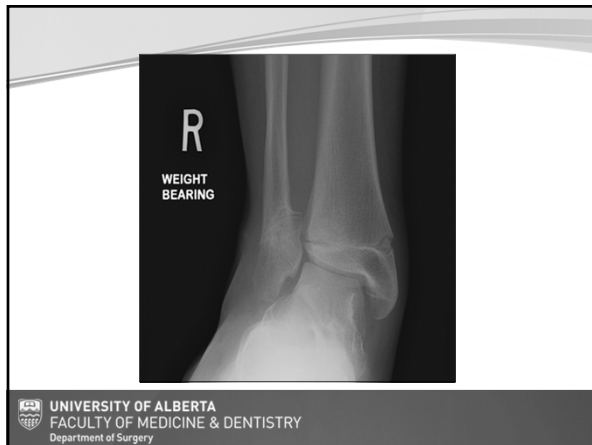


Growth Plate Injuries

- central or complete growth arrest leads to progressive limb length discrepancy
- partial, peripheral growth arrest leads to progressive angular deformity
- Magnitude of deformity/discrepancy depends on growth plate involved and amount of growth remaining

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery





Pediatric Fractures

- What follow-up is required for children with fractures that do not require immediate surgery?
 - Stable fractures: (eg. buckle fractures)
 - RCT (Howard et al.)- splinting is acceptable (vs. casting)
 - Follow-up is not always necessary (if parents are reliable and splint can be used)
 - Length of immobilization/splinting will depend on age of patient and their healing potential
 - Physeal injuries need longer follow-up to document normal growth

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery



Pediatric Fractures

- What follow-up is required for children with fractures that do not require immediate surgery?
 - (Potentially) Unstable fractures:
 - Should have follow-up within approx 10 days
 - If you think the patient may need surgery, consult ortho early

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery


Case 3

- 5 year old playing on the trampoline
- Landed awkwardly on upper extremity
- Swollen, tender, deformed elbow

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery


Pediatric Elbow Injuries:

- Very common
- Beware
- Tips:
 - Get comparison views
 - Examine the patient carefully to define the region of tenderness to focus your assessment of the radiographs

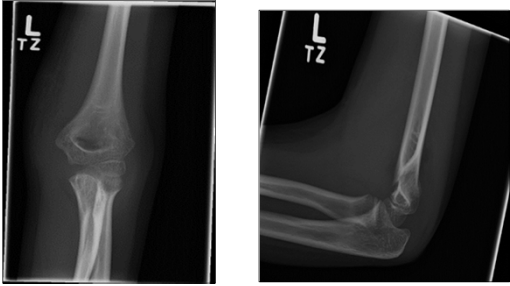
 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery


Displaced Supracondylar #

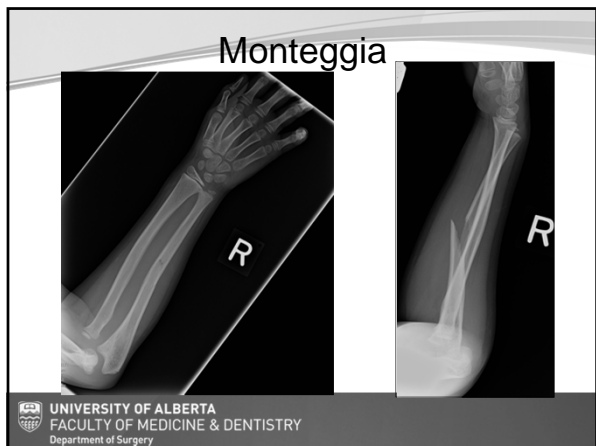


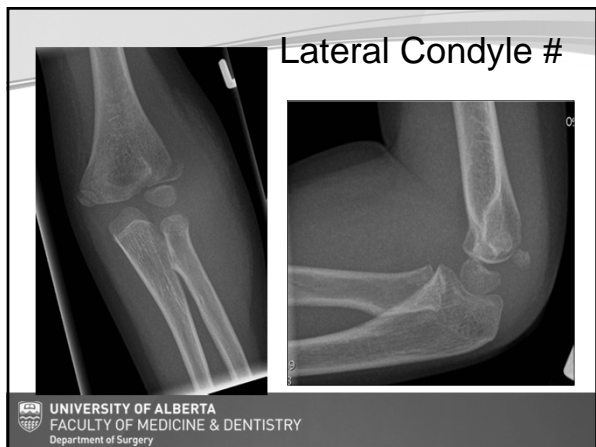
 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

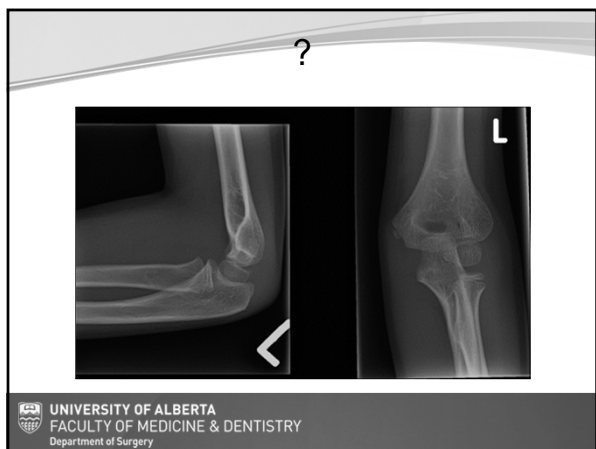
Undisplaced Supracondylar #




 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery







Normal Comparison!



UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Pediatric Fractures

- Reduction tips and tricks:
 - Ensure you have help
 - Avoid situations where family may be observing
 - During reduction, be aware of the periosteum
 - Maintain your hold on the reduction until the cast/splint has completely hardened
 - Apply a mold to the cast
 - Positioning is key (use gravity to help you)
 - Use adequate (but not excessive padding)
 - When in doubt, a longer cast is better than a shorter one
 - If uncertain about whether surgery will be indicated, apply a cast
 - If swelling prevents a cast, consider a bivalved cast or a ¾ splint (half slabs or removable splints should only be used for stable fractures in reliable patients)

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Case 4

- 12 y.o boy
- BMI 35
- Slipped and fell on the ice
- Complaining of pain to his right knee
- Limping
- O/E: external rotation of limb and pain with hip flexion, non-tender to knee

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Slipped Capital Femoral Epiphysis (SCFE)

- Atraumatic displacement of proximal femoral epiphysis with respect to the metaphysis
- May have history of minor trauma
- Classic patient:
 - Prepubertal
 - Male
 - Obese

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

SCFE

- Clinical presentation
 - Limp
 - ****Knee**** or thigh or groin pain
 - Hip maintained externally rotated and slightly flexed
 - Decreased hip range of motion (especially flexion and internal rotation)
 - If patient unable to weightbear: UNSTABLE
 - If patient able to weightbear: STABLE


UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

SCFE

- Investigations:
 - AP and frogleg lateral of hips
 - *****do not force the hip past the comfortable ROM*****
 - Epiphysis slips posteriorly and inferiorly with respect to the femoral neck
 - Early on, best seen on lateral view

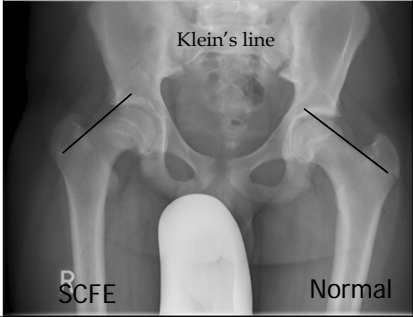
UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

SCFE: lateral radiograph



UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

SCFE: AP radiograph




Klein's line

R SCFE Normal

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

SCFE: Treatment

- If UNSTABLE: send to ER immediately; this is a surgical emergency
- If STABLE: send an urgent outpatient consult to orthopedics and place child on crutches
- Complications:
 - AVN
 - Risk of contralateral slip

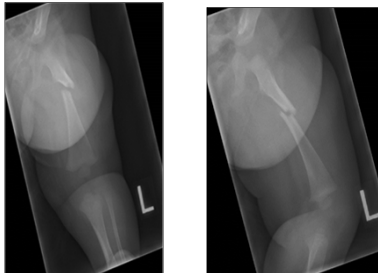


UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Case 5

- 2 m.o. girl presents to your office with refusal to move left lower extremity
- Mother states that child has been inconsolable since being picked up from daycare that afternoon
- Well previously
- Systemically well

How did this happen???





Non-Accidental Injury


- Majority are under 18 months
- Fracture present in 25-50% .
- A Fracture in NAI has a 5% Mortality
The Children's Hospital, LA

NAI

- History:
 - Unclear or changing story
 - Described mechanism does not fit injury
 - History is inconsistent with child's level of mobility
 - Delayed presentation
- Physical exam:
 - Conjunctival hemorrhages
 - Abnormal bruising patterns (eg. On torso or face or neck)
 - Unusual fracture patterns

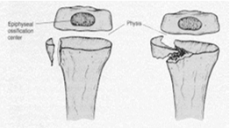
 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery




 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

NAI : Suspicious fractures

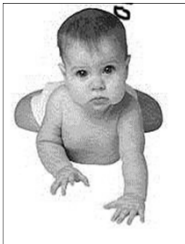
- Multiple fractures in different stages of healing
- Rib # (esp. Posterior)
- Spiral shaft # (long bones)
- Metaphyseal Bucket Handle #
- Metaphyseal Corner #



 UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Management of NAI

- .Detailed History
- .Precise Documentation
- .Expert Examination
- .Radiographic Skeletal Survey
- .BE SUSPICIOUS!!!




UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Take Home Points

- . Comparison radiographs are invaluable
- . Quicker healing times and greater likelihood of boney injury in children necessitate earlier referral when needed
- . Prolonged follow-up is appropriate when the growth plate is potentially injured
- . Always consider NAI
- . When examining the knee, examine the hip!

UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery

Thank You



UNIVERSITY OF ALBERTA
FACULTY OF MEDICINE & DENTISTRY
Department of Surgery
