Hidden Gems: Assessing the Pediatric Orthopedic Polytrauma Patient

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SOCIETY OF TRAUMA NURSES

Learning Objectives

- Discuss anatomical differences in the pediatric patient that can influence the initial management during resuscitation
- Identify associated patterns of injury in the child with orthopedic injuries
- Describe ongoing management of the polytrauma patient with orthopedic injuries

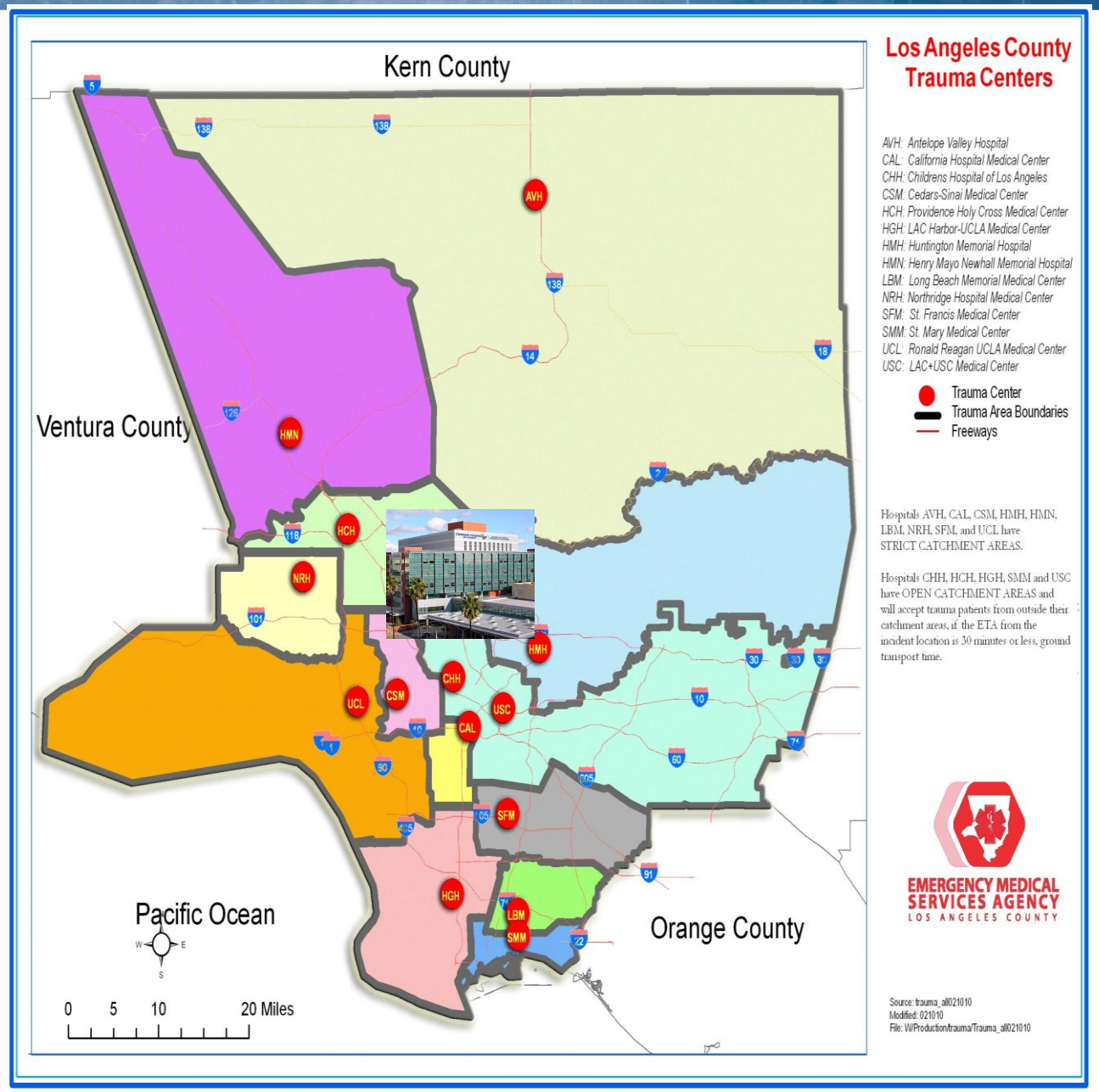
Disclosure Statement

- I have no conflict of interest relative to this educational activity.

Successful Completion

- To successfully complete this course, participants must attend the entire event and complete/submit the evaluation at the end of the session.
- Society of Trauma Nurses is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

Children's Hospital Los Angeles
ACS Verified Level 1 Pediatric Trauma Center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Los Angeles County
Trauma Centers
AVH: Antelope Valley Hospital
CAL: California Hospital Medical Center
CHH: Childrens Hospital of Los Angeles
CSM: Cedars-Sinai Medical Center
HCH: Providence Holy Cross Medical Center
HGH: LAC Harbor-UCLA Medical Center
HMH: Huntington Memorial Hospital
HMN: Henry Mayo Newhall Memorial Hospital
LBM: Long Beach Memorial Medical Center
NRH: Northridge Hospital Medical Center
SFM: St. Francis Medical Center
SMM: St. Mary Medical Center
UCL: Ronald Reagan UCLA Medical Center
USC: LAC+USC Medical Center
Trauma Center
Trauma Area Boundaries
Freeways
Hospitals AVH, CAL, CSM, HMH, HMN, LBM, NRH, SFM, and UCL have STRICT CATCHMENT AREAS.
Hospitals CHH, HCH, HGH, SMM and USC have OPEN CATCHMENT AREAS and will accept trauma patients from outside their catchment areas, if the ETA from the incident location is 30 minutes or less, ground transport time.
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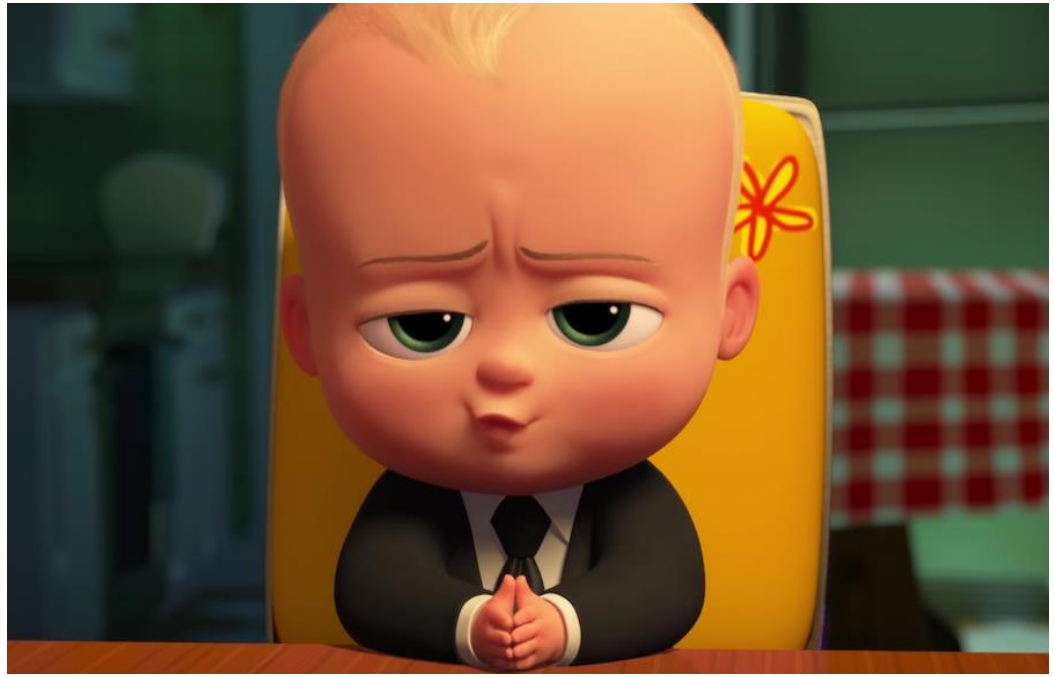
Epidemiology

- Pediatric Traumatic Injury:
  - Remains to be the leader in cause of death and disability in children
  - Outnumbers all major diseases
  - Serious public health issue
  - Motor vehicle associated causes of injuries
    - Common cause of serious injury

Anatomical Differences

- Smaller body mass
- Larger head
  - Larger occiput
  - Smaller mid-face
  - Open fontanelles
  - Shorter neck
  - Passive flexion of neck



Anatomical Differences

- Epiglottis is large and floppy
- Tongue and tonsils are large
- Infants trachea is short
- Chest wall is thin and flexible

Anatomical Differences

- Weaker abdominal muscles allow the abdomen to protrude
  - Liver, kidneys, and spleen are not well protected
  - Organs are closer together
  - At risk for multiple organ injury

Physiologic Differences

- Higher body surface area compared with body mass
- Smaller total blood volume
  - Tachycardia, poor skin perfusion

Common Mechanism & Patterns of Injury

Pedestrian:

- Low speed
  - Lower extremity fractures
- High speed
  - Multiple trauma
  - Head and neck injuries
  - Lower extremity fractures

Advanced Trauma Life Support, 2012

Case Study

2 year old girl s/p auto vs pedestrian. Child was found pinned under rear car tire. Child screaming, crying and had emesis at the scene.

According to Waddell's triad what could be her injury pattern?

Waddell's Triad

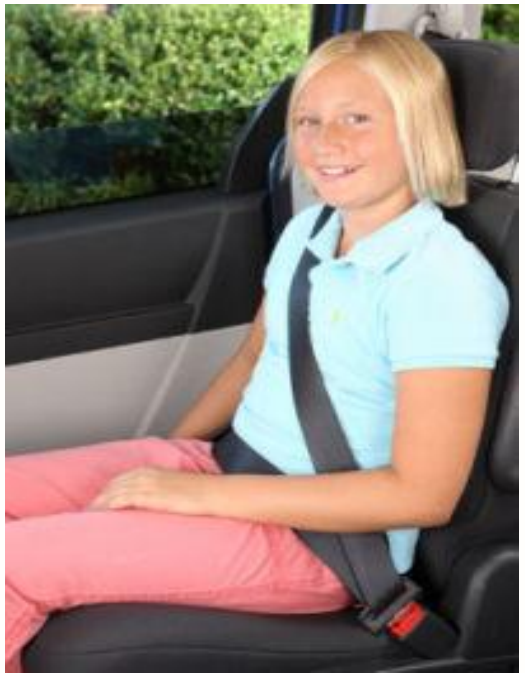
Injury pattern:

- Orthopedic- femur, pelvis, lower extremity
- Thoracic, abdominal
- Head, neck

Common Mechanism & Patterns of Injury

Automobile:

- Unrestrained
  - Multiple trauma, head and neck injuries, scalp and facial lacerations
- Restrained
  - Seatbelt sign, chest & abdomen injuries lower spine fractures



Advanced Trauma Life Support, 2012

Common Mechanism & Patterns of Injury

Fall From a Height:

- Low
  - Upper extremity fracture
- Medium
  - Head and neck injuries
  - Upper and lower extremity fractures
- High
  - Multiple trauma, head & neck injuries
  - Upper and lower extremity fractures

Advanced Trauma Life Support, 2012

Common Mechanism & Patterns of Injury

Fall From a Bicycle:

- Without a helmet
  - Head and neck injuries
  - Scalp and facial laceration
  - Upper extremity fractures
- With helmet
  - Upper extremity fractures
- Striking handlebar
  - Internal abdominal injuries

Advanced Trauma Life Support, 2012

Pediatric Initial Resuscitation

- Priorities are similar to adults
- Key: anatomic & physiologic differences
- Assessment and management priorities are same

Initial Assessment

- Quick patient assessment in 10 seconds
- Treatment priorities are established
  - Based on injuries
  - Vital signs
  - Injury mechanism
- ABCDE
- Life threatening conditions are identified

Exposure/Environment control

- Completely undress the patient
- Cover with warm blankets or external warming device
- Warmed IV fluids
- Warm room environment

Secondary Survey:

- Full head to toe physical exam

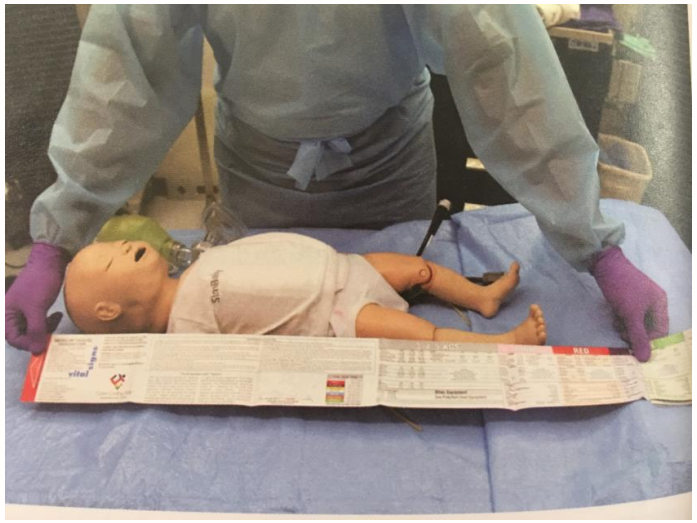
Tertiary Survey

- Done within 24 hours or when alert and oriented
- May need to be done more than one time

Case Study

9 year old girl unrestrained, s/p high-speed rollover MVC, child ejected from vehicle, found approximately 20 feet from point of impact

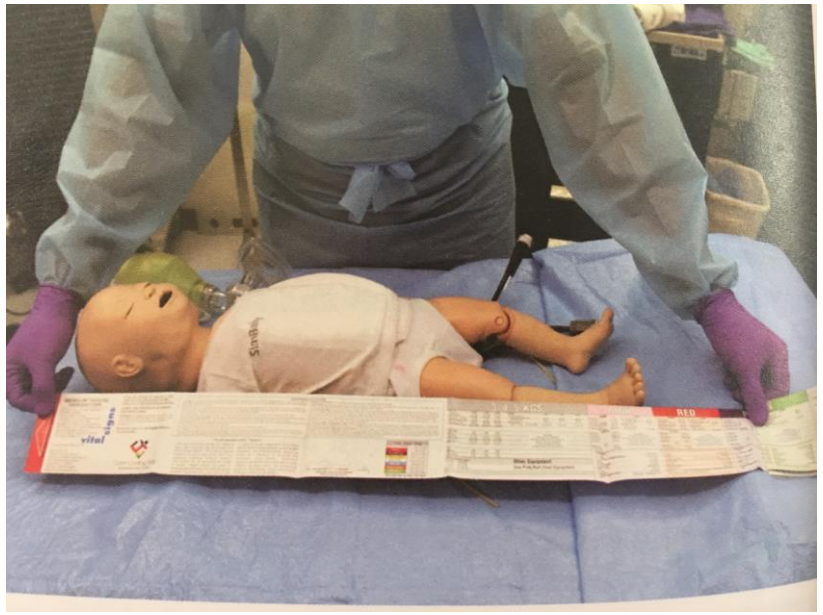
-*What possible orthopedic injuries could this child have?*

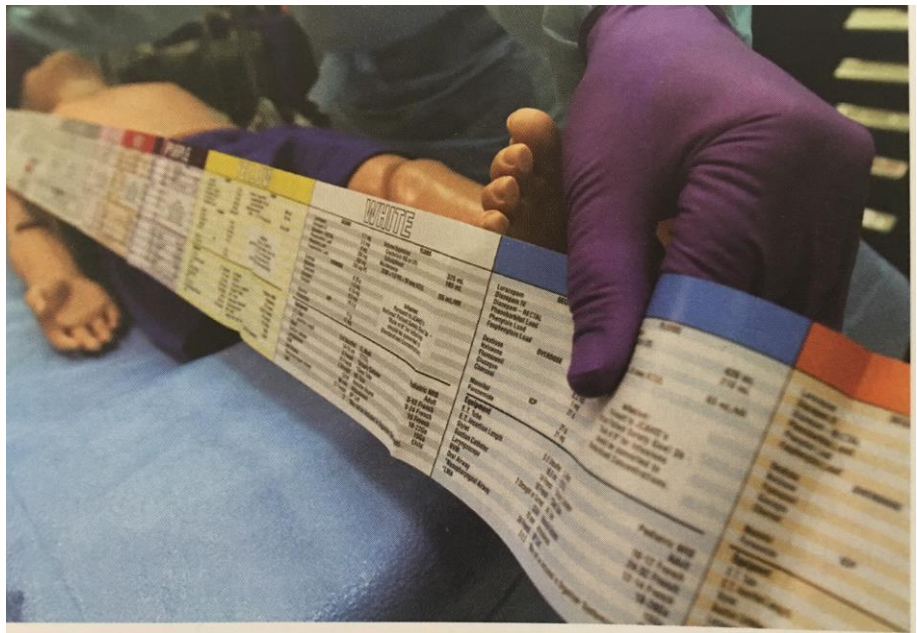


-What nursing measures would prepare you to receive this patient comes to your trauma bay?

Equipment

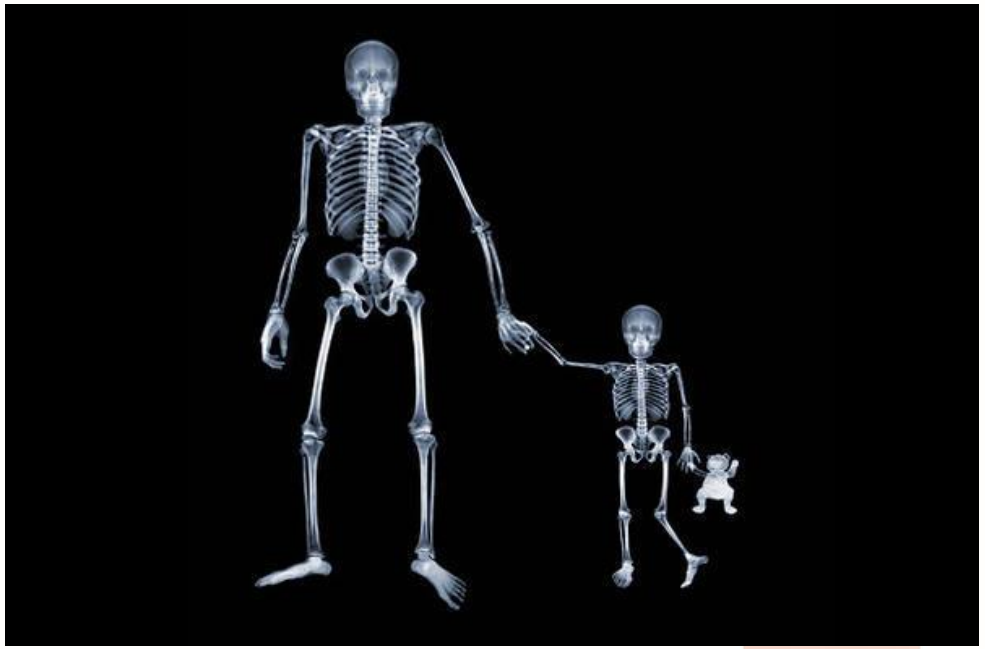
- Immediately available
- Appropriate age, weight, size, amount
- Ideal: length-based resuscitation tape
  - Adjunct for rapid determination





Pediatric Standard Imaging

- Radiographic Imaging should be used cautiously and if:
  - Needed information can't be obtained by other means
  - Needed information gained will change clinical management
  - Information obtained is at the lowest possible radiation
  - Obtaining the information won't delay transfer of patient to higher level care

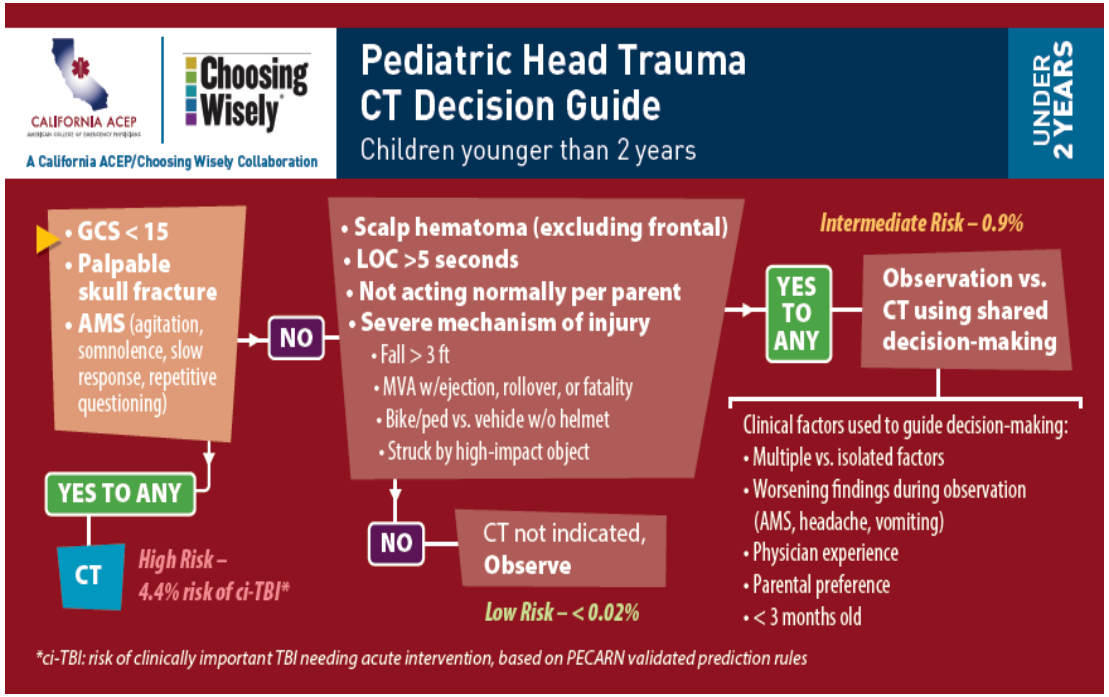


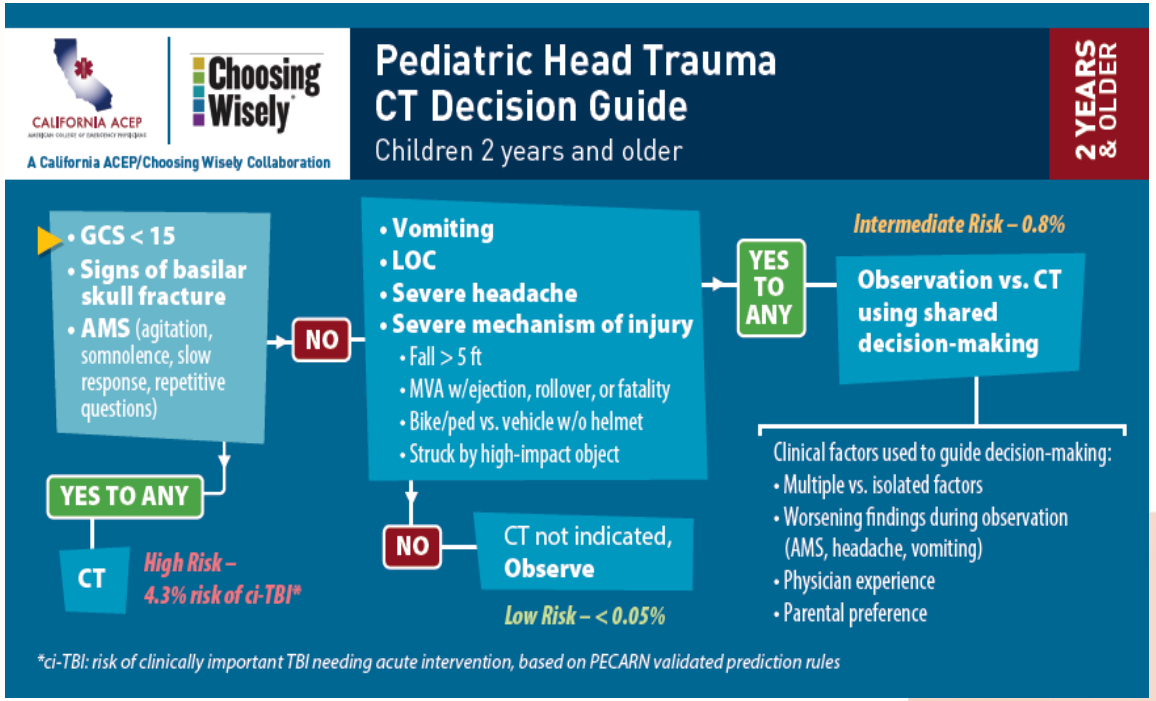
(Advanced Trauma Life Support, 2012)

Pediatric Standard Imaging

- CT head w/o contrast if meets PECARN criteria
- XR AP/lateral cervical spine <9 years old
  - Add odontoid view >9 years old
- XR chest when indicated with mechanism of injury
- XR pelvis when indicated with mechanism of injury
- CT abdomen w/IV contrast:
  - Patients with significant distracting injury, GCS < 14, or any one of the six clinical screening criteria should undergo CT scan of the abdomen and pelvis with intravenous contrast.

PECARN Guidelines





Blunt Abdominal Clinical Screening

Patients with a Glasgow Coma Scale ≥ 14 and no distracting injuries, sustaining blunt trauma with significant mechanism of injury (see "High Energy Mechanism" definition in section 3) will undergo clinical screening for intra-abdominal injury which includes:

1) Abdominal tenderness on physical exam
2) Hematocrit < 30
3) AST > 200 or ALT > 125
4) Urinalysis with > 25 RBC per HPF
5) Age-adjusted hypotension
6) Femur fracture, associated with high-energy mechanism

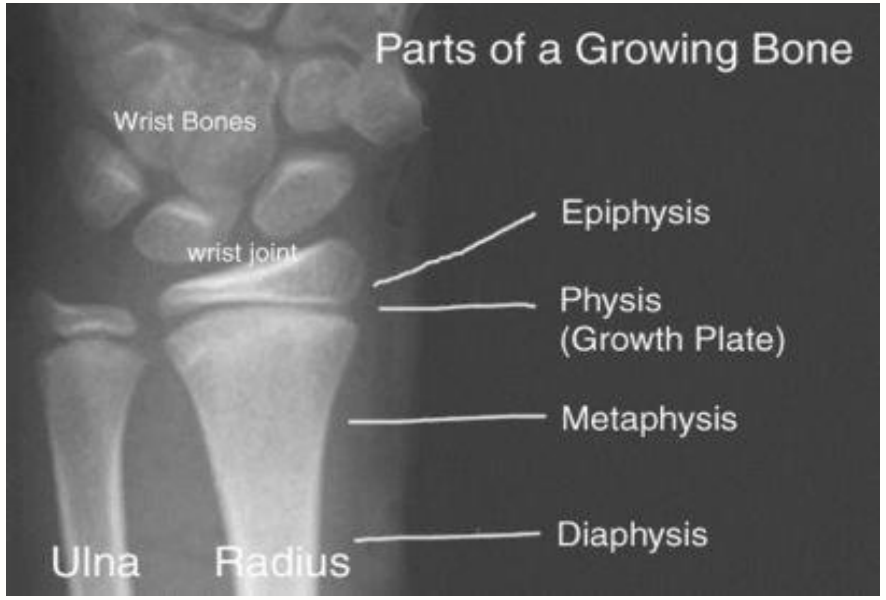
CHLA Policy Number: TRAU-18

Patients with significant distracting injury, GCS < 14, or any one of the above six clinical screening criteria should undergo CT Scan of the Abdomen and Pelvis with intravenous contrast.

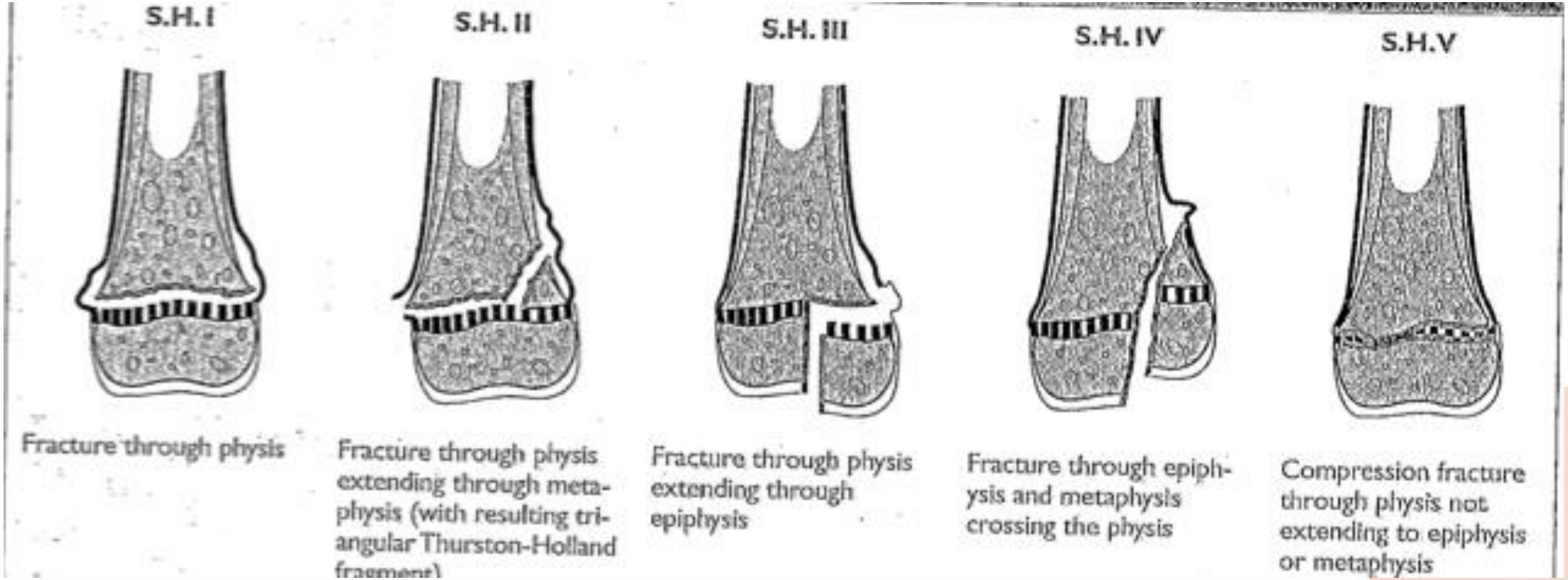
Bone Basics

Anatomy

- Open growth plates
- Physis
- Metaphysis
- Epiphysis



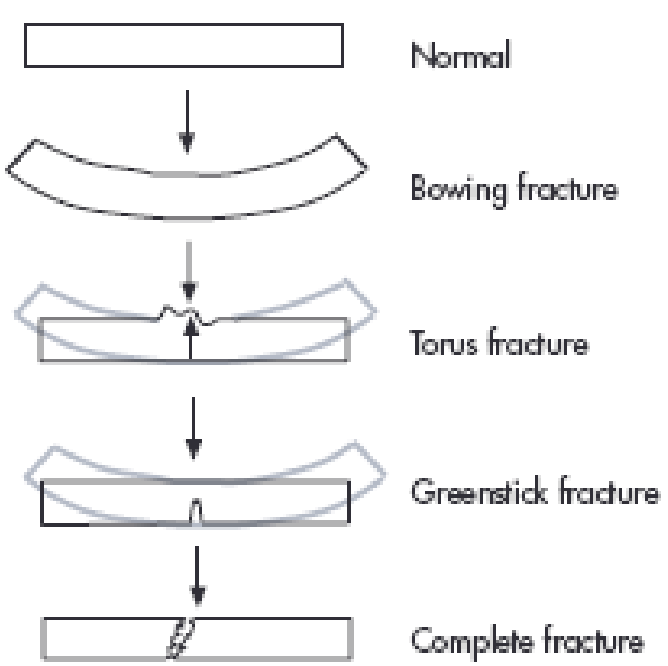
Salter Harris Classification



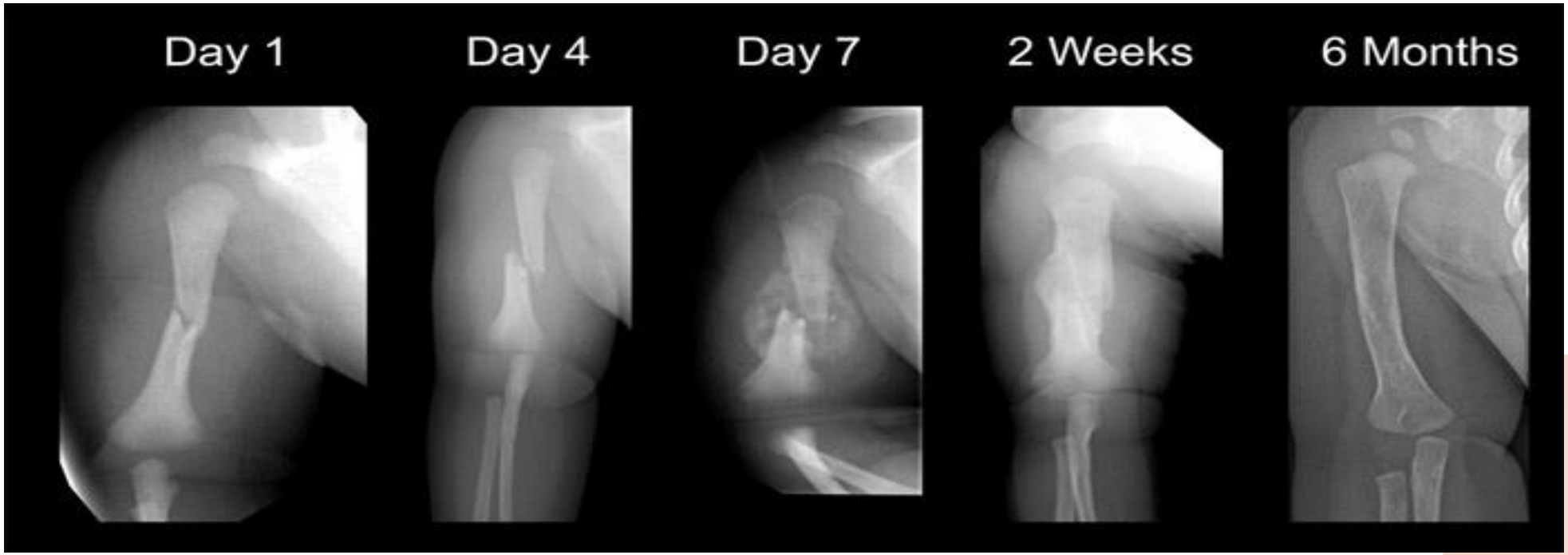
Skeletal Differences

Comparison to adult bone:

- More porous, less dense
- More pliable
- Can absorb more energy
- Thick periosteum
  - Limits displacement
- Highly vascular periosteum
  - Ability to remodel

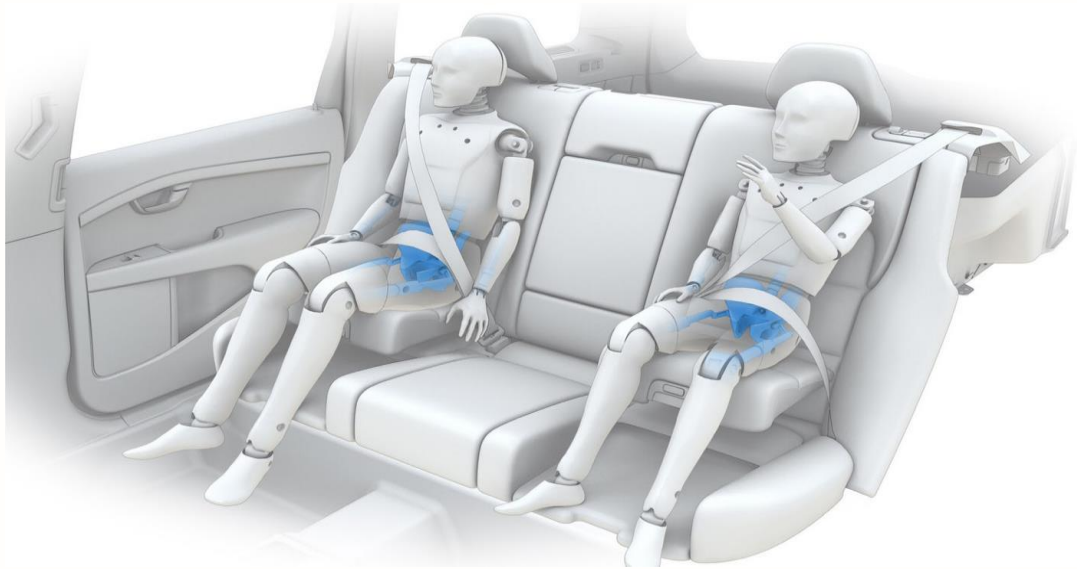


Pediatric Fracture Remodeling



Pelvic Fractures

- Epidemiology
  - Uncommon
  - High mechanism of energy
  - Blood loss less in children than adults
  - Associated with other injuries
    - Closed head injury
    - Abdominal
    - GU
    - Limb
- Concerning Physical Exam Findings
  - Limb length discrepancy
  - Blood at the urethral meatus
  - Rotational deformity of the lower extremity

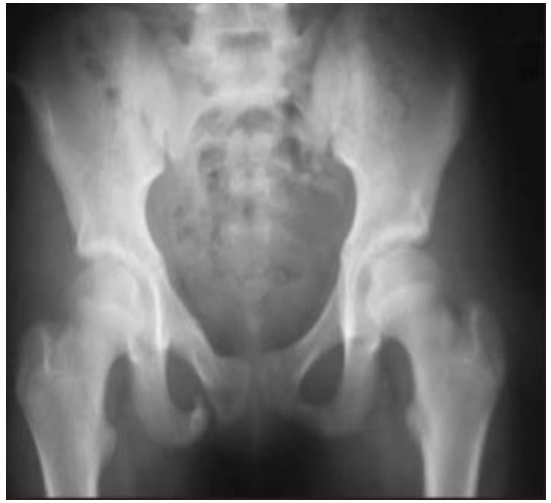


Pelvic Fracture: Hidden Gems

- Bladder/urethra injury
- Abdominal injury
- Femur fracture
  - Mid-shaft/middle third are the most common
  - Potential for hemorrhage

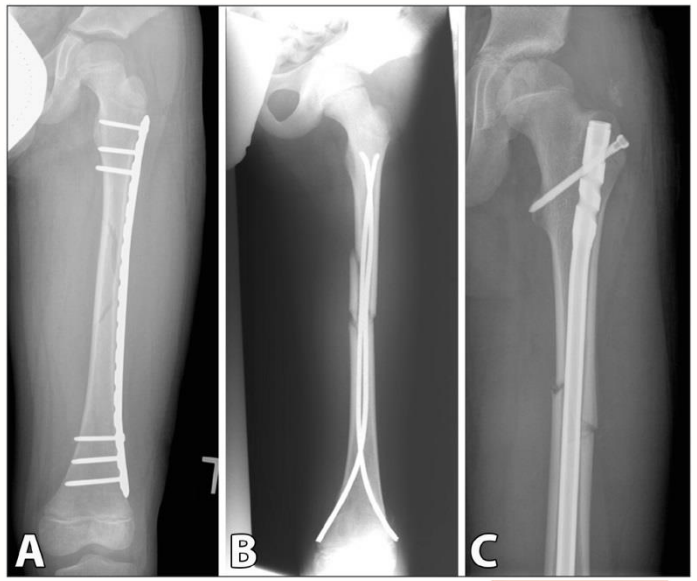
Pelvic Fracture Treatment:

- Mechanical stabilization until definitive care
- Most can be treated non surgically
- If fracture not stable than surgical treatment



Femur Fractures

- *High mechanism injury
  - Motor vehicle crash
  - Auto vs. Peds
- Physical Exam
  - Localized pain & swelling
  - Neurovascular status
- Treatment
  - Cast
  - Flexible IM nail or Interlocked IM nail



Case Study

10 year old boy s/p fall from 70-100 feet while hiking. He comes to your trauma bay with deformed lower extremities and a right thigh puncture wound

What nursing intervention is appropriate in regards to his right thigh wound, and what type of injury are you suspecting?

Open Fractures

- Initiate IV antibiotics based on grade of injury
- Control bleeding
- Assessment
- Dressing
- Stabilize
- Aggressive irrigation & debridement

Spine Injuries

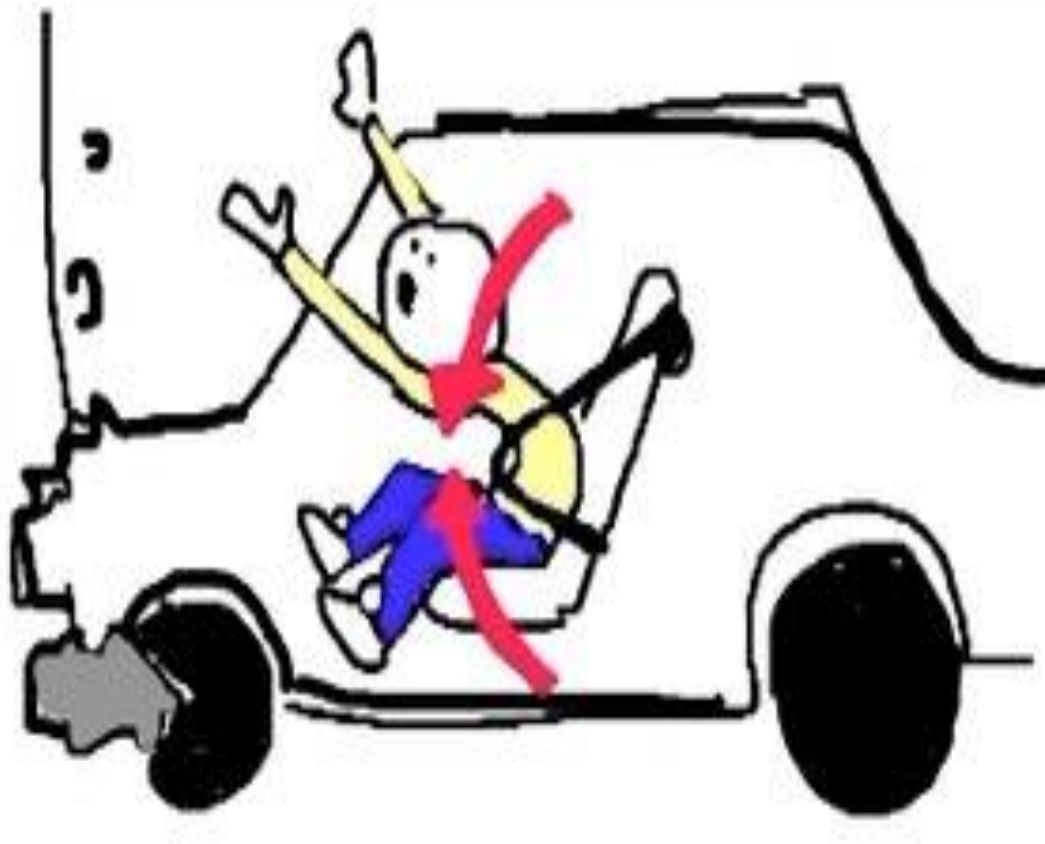
- Importance of identifying early during primary survey
- Be mindful of mechanism of injury and risk for spine injury
- Spine precautions until imaging reviewed
- SCIWORA
  - Children are at risk due to their incomplete development
- Advocate for your patient to prevent pressure ulcers

“Seatbelt Sign” Hidden Gems

- Spine fracture
  - Chance fractures
  - Vertebral bodies
- Abdominal injury
- Chest injury
- Clavicle fracture

Workup

- CT abdomen with IV contrast

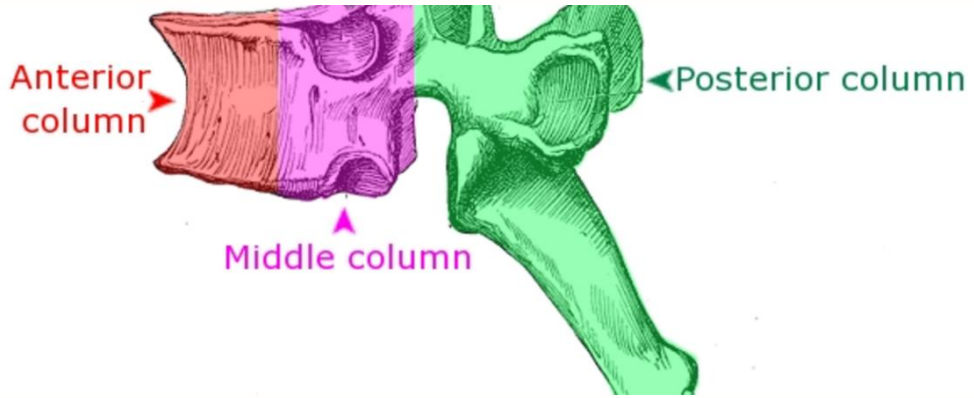


Chance Fracture

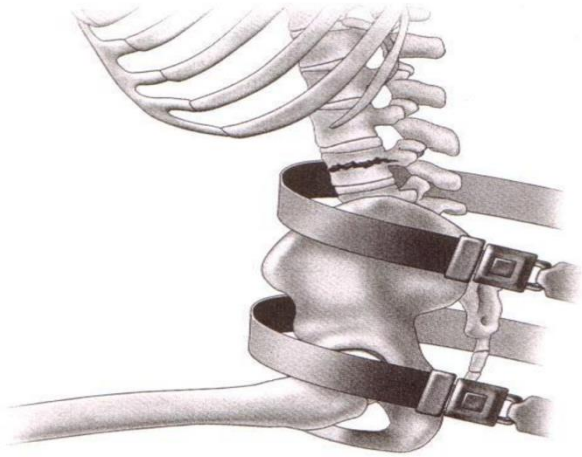
3 column fracture with posterior spinous ligament

Mechanism:
hyper flexion of thoracolumbar spine

Non-Operative:
Neuro intact and only bone involvement

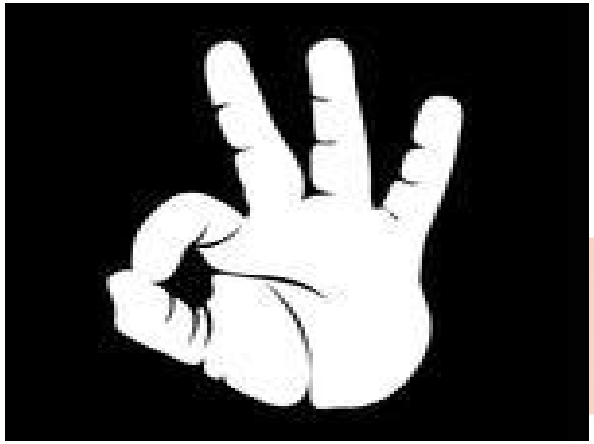


<u>Surgical Indications:</u>
If neuro deficits; unstable spine with injury to posterior ligaments
Flexion distraction injury (unstable)
Fracture dislocation
> 50% spinal canal compromise
> 25 degrees kyphosis



Motor Nerve Exam

- Radial nerve
  - Extension of wrist and thumb
- Median nerve
  - Flexion of digits 2-3
- Ulnar nerve
  - Abduction of digits 3-5
- Anterior interosseous nerve
  - Flexion of index and thumb DIP



Orthopedic Extremity Emergencies

Clinical Findings

- Neurological compromise
- Vascular compromise
- Compartment syndrome

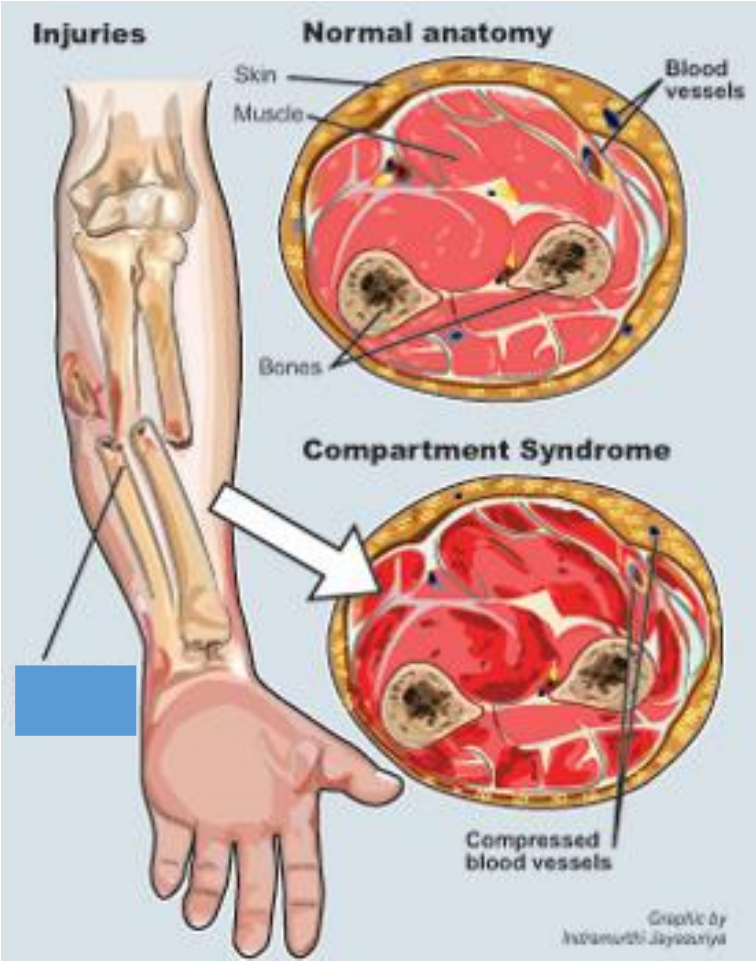
Case Study

5 year old boy s/p auto vs. pedestrian with right closed femur fracture, right tibia fracture, grade 2 liver laceration. He is 12 hours from closed reduction of rt. femur and rt. tibia fracture w/application of spica cast. Night nurse reports patient was restless and c/o pain, requiring morphine q1 hour. On morning rounds his toes are swollen, cap refill >3, toes are cool, sensation decreased. He only has pain when asked to wiggle his toes.

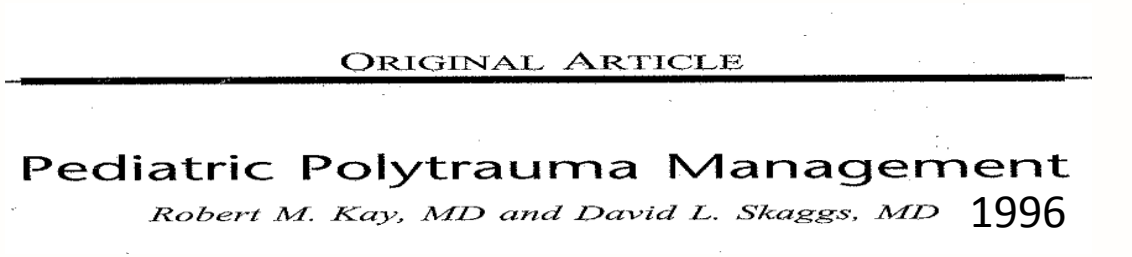
What orthopedic problem can be occurring with this child?

Compartment Syndrome

- Increased pressure in the muscle compartments
- Causes
  - Trauma
  - Tight cast, dressing
- 5 P's
  - Less reliable in pediatrics than adults
- Complications
  - Neurologic deficit
  - Infection
  - Muscle necrosis



Review of Literature

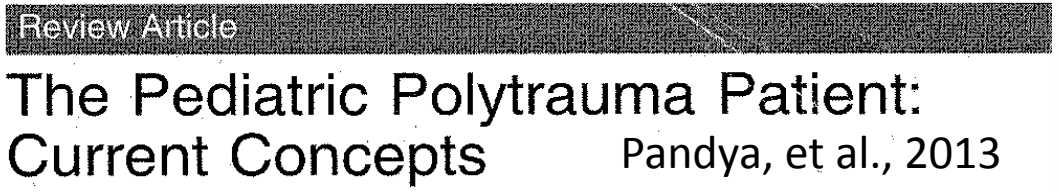


ORIGINAL ARTICLE

Pediatric Polytrauma Management

Robert M. Kay, MD and David L. Skaggs, MD 1996

- Philosophy of trauma centers
- Trauma Care Algorithm
- Complete orthopedic exam
- Pelvic Fractures
  - Associated GU injuries
- Open fractures
- SCIWORA
  - Unique to pediatrics
- Recovery



Review Article

The Pediatric Polytrauma Patient: Current Concepts Pandya, et al., 2013

- Trauma Bay ABC's
- Pelvic Fractures: skeletally immature vs. mature
- Open Fractures
  - Similar recs as Kay & Skaggs (1996)
- Surgical Fixation can be done early if needed
- Compartment syndrome
- SCIWORA
  - Rare

Nursing Considerations For Polytrauma with Musculoskeletal Injuries

- Identify any life threatening injuries
- Identify limb deformities and obvious external bleeding
- Evaluate neurovascular status before and after splinting
- Cover open fractures with moistened dressing
- Immobilization of injured extremities
- Monitor for compartment syndrome
- Adequate pain management
- Prevention of pressure ulcer

Summary

Pediatric Orthopedic Success:

- Know the anatomic and physiologic differences in children
- Initial trauma resuscitation priorities are similar to adults
- Polytrauma patients involved in high energy mechanism should be presumed that all organ systems may be injured until proven otherwise
- Frequent thorough orthopedic exams are the key to successful nursing management of these patients

Resources

- Advanced trauma life support. Ninth Edition (ATLS)
- Advanced trauma care for nurses (ATCN)
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