

A Systematic Approach to Evaluating Pediatric Patients with Injuries Concerning for Non-Accidental Trauma



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I have no disclosures to report

Learning objectives

1. Identify injury patterns concerning for non-accidental trauma
2. Participants will be able to explain the recommended work-up for Pediatric patients with injuries concerning for non-accidental trauma
3. Participants will be able to identify resources within their facility for collaboration and management of patients with non-accidental trauma



Before we begin:

Please enter this link on your phone:

<https://questionpro.io>

Child Abuse

Physical acts of violence ranging from those leaving no marks to injuries causing permanent disability, disfigurement or death.

Hitting, kicking, punching, beating, stabbing, biting, pushing, shoving, throwing, pulling, dragging, dropping, shaking, strangling/choking, smothering, burning, scalding, poisoning.

Sexual abuse: sexual violence against children that occurs in the context of a caregiver relationship

Includes injuries to anal or genital and surrounding areas that occur during the attempted or completed sexual abuse, as well as other injuries that resulted during commission (bruising due to restraining, etc).

A recent act or failure to act on the part of a parent or caretaker which results in death, serious physical or emotional harm, sexual abuse or exploitation or an act or failure to act, which presents an imminent risk of serious harm.

Intentional caregiver behavior that conveys to child they are worthless, flawed, unloved, unwanted, endangered, or valued only to meet another's needs.

Child Abuse Definition

Child abuse defined by CAPTA as:

“Any recent act or failure to act on the part of a parent or caretaker which results in death, serious physical or emotional harm, sexual abuse or exploitation; or an act or failure to act, which presents an imminent risk of serious harm.”

The Justice for Victims of Trafficking Act (P.L. 114–22) in 2015 added the requirement to include sex trafficking victims in the definition of child abuse and neglect.

Child Abuse/Non-Accidental Trauma

Leading cause of injury and death during early childhood

Affects 9 of every 1000 children in the United States every year

Children < 12 months had victimization rate of 25.3 per 1000


History of Child Abuse Prevention

The Child Abuse Prevention and Treatment Act

Including the Substance Use-Disorder Prevention That Promotes Opioid Recovery and Treatment for Patients and Communities Act

As Amended by

P.L. 115-271



U.S. Department of Health and Human Services
Administration for Children and Families
Administration on Children, Youth and Families
Children's Bureau

In 1974 Congress enacted the Child Abuse Prevention and Treatment Act (CAPTA)

Created a single federal focus for preventing and responding to abuse or neglect, and to ensure children's safety

Under the act, states receive grant funds and are required to have procedures in place for receiving and responding to allegations of abuse or neglect

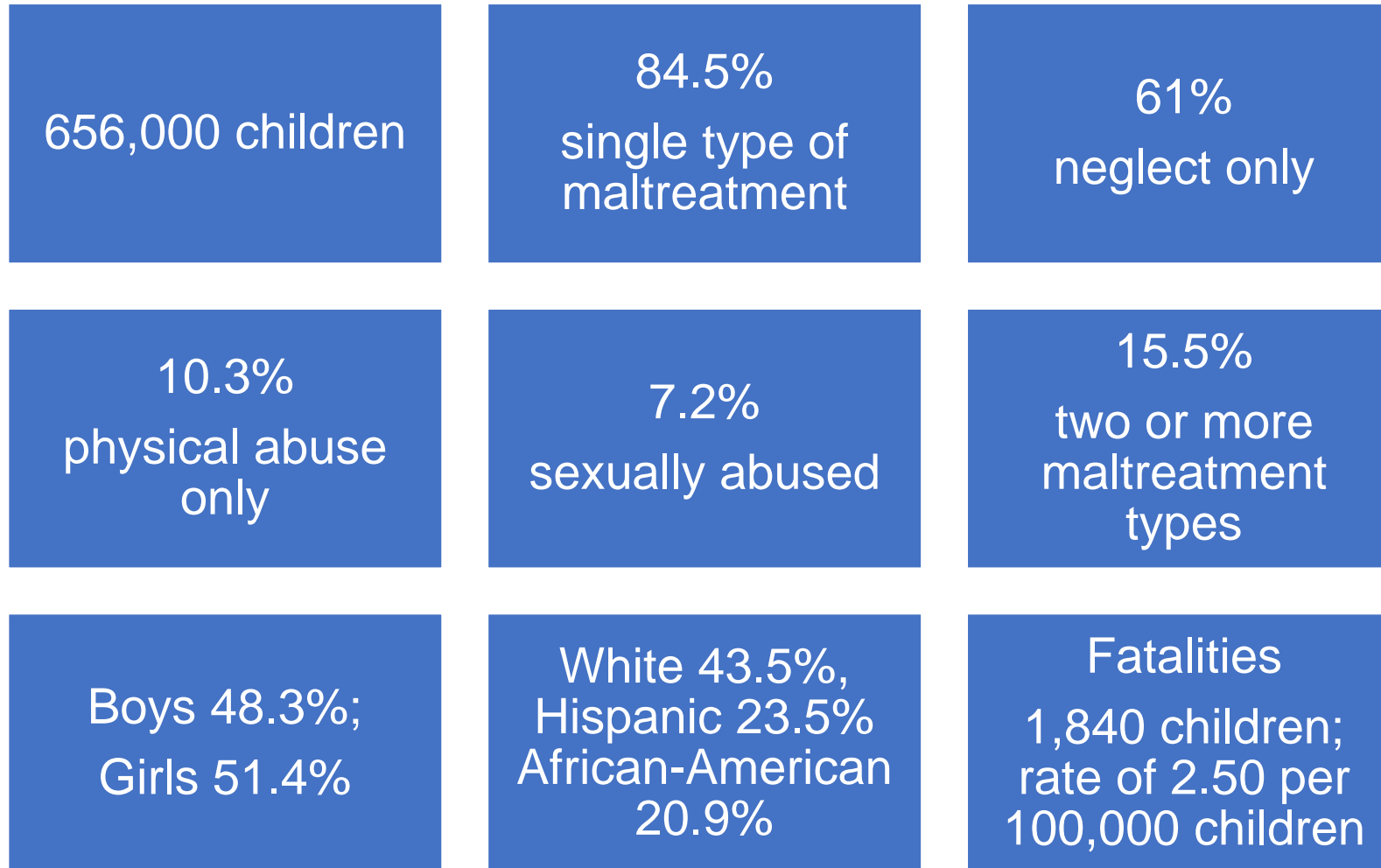
Identifies a Federal role in supporting research, evaluation, technical assistance, and data collection activities



NATIONAL DATA ARCHIVE ON CHILD ABUSE AND NEGLECT

- Established in response to the Child Abuse Prevention and Treatment Act of 1988
- Federally sponsored
- Collects and analyzes data on child abuse and neglect known to child protective services (CPS) agencies in the U.S
- Data is submitted voluntarily by the 50 states, the District of Columbia, and the Commonwealth of Puerto Rico annually

NCANDS Child Maltreatment Statistics



Caregiver/perpetrator characteristics

Caregiver abuse rates	Caregiver risk factors
<ul style="list-style-type: none">• 39.0%- maltreated by mother alone• 22.6% - father acting alone• 21.0% - both parents (two parents of known sex)• 14.2%- non-parent caregiver.• 5.3% - nonparent relative• 3% unmarried partner(s) of parent	<ul style="list-style-type: none">• Alcohol abuse• Domestic Violence: the caregiver may be the perpetrator or the victim of the domestic violence• Drug use• Financial Problems• Inadequate Housing• Public Assistance• Any Caregiver Disability

Understanding Non-accidental trauma in the United States: A national trauma databank study

- Purpose: to characterize NAT patterns, epidemiology, outcomes and trends using the 2007-2014 National Trauma Databank
- NTDB datasets is the largest aggregation of trauma data; 5 million records from over 900 trauma centers in the U.S
- **Study cohort: ≤ 15 years**

Results

678,503 children
with traumatic
injuries

19,149
sustained NAT

91%
In children
<5 years

71%
In children
<1 year

59% male
41% female

55% white
27% African
American
18% other

22%
Hispanic or latino

82% uninsured or
had public health
insurance

Median ISS – 10;
higher for fatalities
(26)

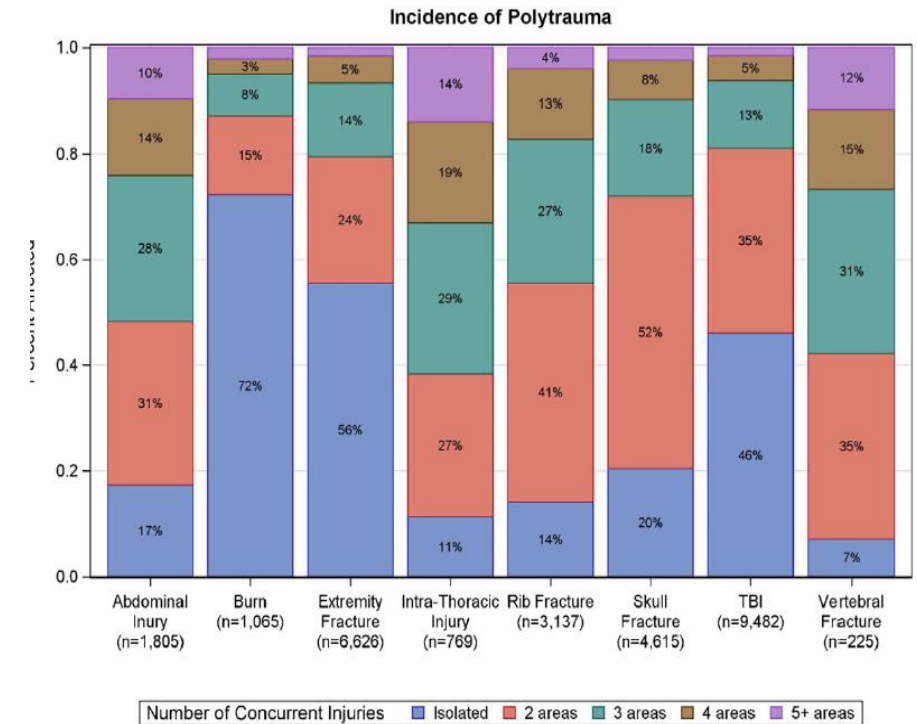
9%
Mortality rate

Incidence of Polytrauma

Table 2
Injury Patterns of NAT. This matrix represents the incidence of concurrent injuries.

Patterns of Injuries	Burns (n = 1065)	Abrasions Contusions (n = 7282)	Extremity Fracture (n = 6626)	Hollow Viscus Injury (n = 508)	Rib Fracture (n = 3137)	Skull Fracture (4615)	Solid Organ Injury (1297)	Spinal Injury (225)	Traumatic Brain Injury (9482)	Thoracic Injury (769)
Burns	100% (1065)	5% (346)	2% (130)	4% (20)	2% (70)	1% (64)	4% (53)	2% (4)	1% (134)	2% (19)
Abrasions/Contusions	32% (346)	100% (7282)	30% (1959)	49% (250)	37% (1146)	44% (2038)	53% (691)	52% (118)	44% (4151)	51% (395)
Extremity Fracture	12% (130)	27% (1959)	100% (6626)	14% (69)	49% (1525)	22% (995)	22% (286)	22% (49)	17% (1583)	25% (190)
Hollow Viscus Injury	2% (20)	3% (250)	1% (69)	100% (508)	2% (77)	1% (55)	17% (216)	5% (11)	1% (141)	10% (74)
Rib Fractures	7% (70)	16% (1146)	23% (1525)	15% (77)	100% (3137)	17% (793)	36% (461)	22% (49)	15% (1431)	41% (316)
Skull Fracture	6% (64)	28% (2038)	15% (995)	11% (55)	25% (793)	100% (4615)	18% (233)	24% (55)	33% (3145)	23% (176)
Solid Organ Injury	5% (53)	9% (691)	4% (286)	43% (216)	15% (461)	5% (233)	100% (1297)	12% (26)	5% (498)	31% (237)
Spinal Injury	0% (4)	2% (118)	1% (49)	2% (11)	2% (49)	1% (55)	2% (26)	100% (225)	2% (193)	5% (37)
Traumatic Brain Injury	13% (134)	57% (4151)	24% (1583)	28% (141)	46% (1431)	68% (3145)	38% (498)	86% (193)	100% (9482)	57% (441)
Thoracic Injury	2% (19)	5% (395)	3% (190)	15% (74)	10% (316)	4% (176)	18% (237)	16% (37)	5% (441)	100% (769)

E.H. Rosenfeld et al. / Journal of Pediatric Surgery 55 (2020) 693–697



of Polytrauma. The x axis represents the presenting injuries and the y axis illustrates the percent of patients who were found to have injuries of additional body pa

Why is this study important?



- Injury patterns
- NAT is not isolated to 1 part of the body
- Have high suspicion for multiple injuries
- Being able to identify patterns of injury may help identify children at risk of adverse outcomes

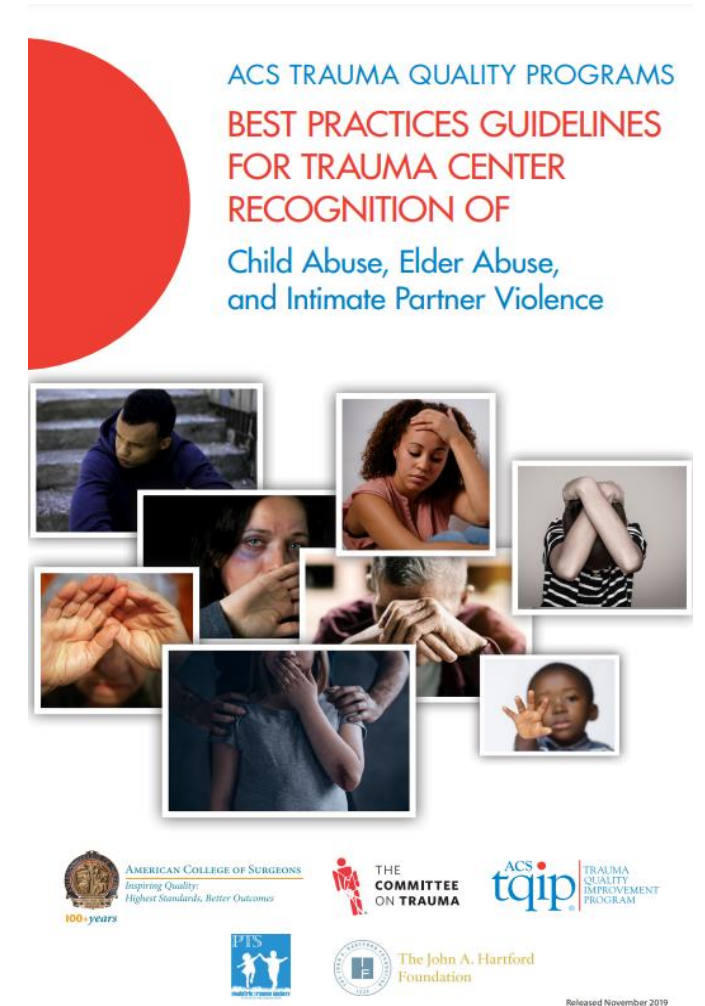
Approach to Work-up and management




Screening Strategies

No gold standard exists to confirm or rule out abuse

- **Mass screening:** applied to all patients coming into ED
- **Selective screening:** A tool is applied to selected high-risk groups
 - TEN-4 FACESp, Bruising Clinical Decision Rule (BCDR), burns, and head injury (PEDIBIRN, PIBIS, PredAHT)
 - Escobar, et al. and the Western Pediatric Society summarized the existing highest quality evidence regarding the association between various elements of history, physical examination, and diagnostic tests with a diagnosis of physical child abuse.
- **Multiphase screening:** Two or more screenings are applied at different times



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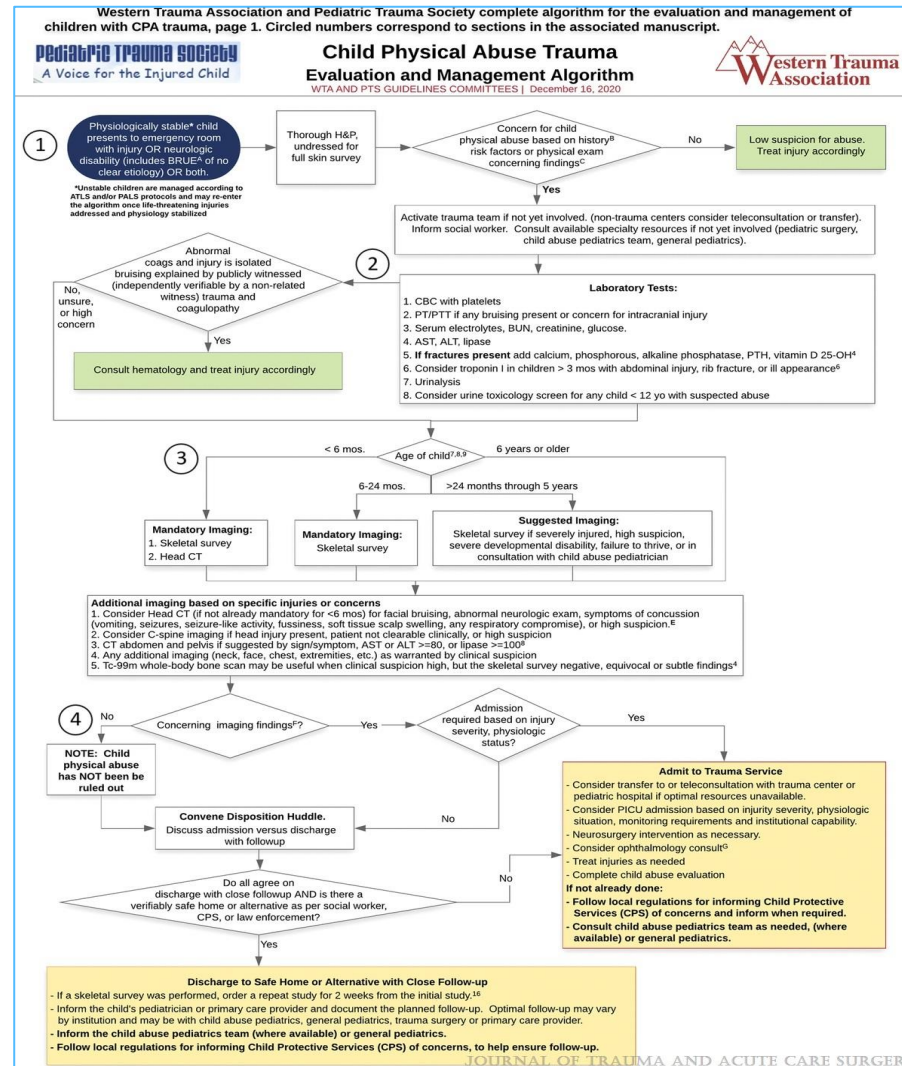
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Released November 2019

Child physical abuse trauma evaluation and management: A Western Trauma Association and Pediatric Trauma Society critical decisions algorithm

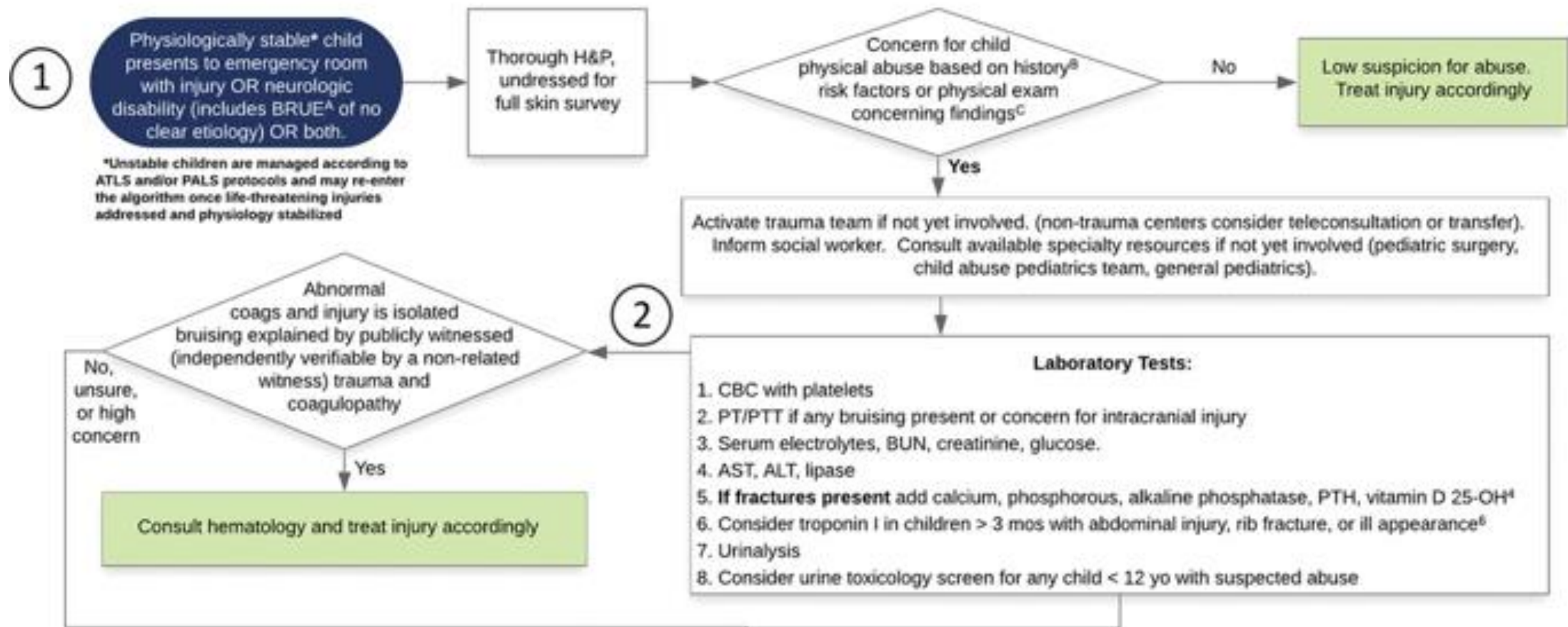


Western Trauma Association and Pediatric Trauma Society complete algorithm for the evaluation and management of children with CPA trauma, page 1. Circled numbers correspond to sections in the associated manuscript.



Child Physical Abuse Trauma Evaluation and Management Algorithm

WTA AND PTS GUIDELINES COMMITTEES | December 16, 2020



Western Trauma Association and Pediatric Trauma Society CPA complete algorithm page 2 with detailed annotation corresponding with references to lettered blocks from page 1.

<p>A. Presentation: BRUE (brief resolved unexplained event, formerly known as ALTE or acute life threatening event) as defined by the NIH is when an infant younger than 1 yo stops breathing, has a change in muscle tone, turns pale or blue in color, or is unresponsive. The event occurs suddenly, lasts less than 30 to 60 seconds, and is frightening to the person caring for the infant.¹</p>		
<p>B. History Risk Factors²:</p> <ol style="list-style-type: none"> History is absent, vague, changing, implausible, or clearly inconsistent with injury. Significant story variation over time or between witnesses Referred for suspected child abuse <p>Red Flag Factors (may be relevant in context of other risk factors or injuries)</p> <ol style="list-style-type: none"> Unwitnessed or not publically witnessed (independently verifiable by a non-related witness) injury or neurologic event Delay in seeking care Prior ED visit for injury Domestic violence in home Premature infant (<37 weeks) Low birth weight/intra-uterine growth retardation (IUGR) Chronic medical conditions Known abuse in sibling/other child, or intimate partner violence in the home 	<p>C. Physical Exam - Concerning Findings:</p> <ol style="list-style-type: none"> Bruise anywhere on an infant < 4 mos. without confirmed trauma in public setting to account for bruising Any bruise in child <=4 yo in the 'TEN' region (torso (chest, abdomen, back, buttocks, genitourinary region, and hips), ears and neck) or FACES-p (frenulum, angle of jaw, cheek, eyelids, subconjunctivae; p for patterned (#4)).^{3,4} Bruise, mark or scar in pattern that suggests being hit with an object Perineal or genital injury Burn injury suggestive of abuse: a) contact - heated contact of an object (cigarette, iron, knife) against the skin or b) scald - immersion burns to hands, feet, buttocks and perineum with flexion sparing of popliteal fossa or groin (tub burn) Any injury in a non-ambulating child Unexplained injury or injury without history Failure-to-thrive (by growth charts; see definition^D) Large head in children under 1 yo (by occipitofrontal circumference > 85th%ile) Signs of neglect (untreated dental caries) 	<p>D. Failure to Thrive (FTT)⁵</p> <p>The American Academy of Pediatrics defines FTT as "a significantly prolonged cessation of appropriate weight gain compared with recognized norms for age and gender after having achieved a stable pattern (eg, weight-for-age decreasing across 2 major percentile channels from a previously established growth pattern; weight-for-length < 80% of ideal weight). This is often accompanied by normal height velocity. Despite these accepted definitions, caution must be applied when diagnosing FTT on the basis of percentile shifts, because growth variants are common. Actual weight <70% of predicted weight-for-length requires urgent attention."</p>
<p>E. Abusive Head Trauma</p> <p>-The CDC defines abusive head trauma (AHT) as: "an injury to the skull or intracranial contents of an infant or young child (< 5 years of age) due to inflicted blunt impact and/or violent shaking." Excluded from this case definition are (1) unintentional injuries resulting from neglectful supervision and (2) gunshot, stab, or wounds from penetrating trauma.¹⁰</p> <p>- The 5-point Pittsburgh Infant Brain Injury Score may help determine when to obtain head CT on well appearing infants (age>30 days, < 1 yr) presenting without clear history of trauma but any of the following: (1) BRUE/ALTE (2) vomiting without diarrhea (3) seizures or seizure-like activity (4) soft tissue scalp swelling (5) bruising (6) other nonspecific neurologic symptom not described above, such as lethargy, fussiness, or poor feeding. Calculate the score by: Any skin finding (bruise, scratch, cut, swelling) (2 points), Age >= 3 months (1 point), head circumference > 85th %ile (1 point) and hemoglobin < 11.2 (1 point). Score >= 2 imaging recommended (sensitivity 93%, specificity 53%).¹¹</p>	<p>F. Concerning Radiology Findings²:</p> <ol style="list-style-type: none"> Metaphyseal or corner fracture Rib fractures (especially posterior) in any child < 3 years old Any fracture in a non-ambulating child An undiagnosed healing fracture Subdural or subarachnoid hemorrhage on neuro-imaging, particularly in absence of skull fracture in child < 1 year Isolated humerus or femur fracture in child <18 mos, without public trauma to account for it.¹² Hollow viscus injury, particularly duodenal and small bowel injury, in children <4 years, or combined hollow viscus + solid organ injury.¹³ 	<p>G. Ophthalmology^{14, 15}</p> <ul style="list-style-type: none"> Dilated indirect ophthalmoscopy should be performed selectively for children with suspected abusive head trauma in high suspicion or unclear situations provided the neurosurgical situation permits. Patients at highest risk for retinal findings most commonly have intracranial injury on neuroimaging; particularly subdural hemorrhage. Isolated skull fracture does not appear to correlate with risk for retinal findings. A child considered low risk for retinal hemorrhages (no intracranial hemorrhage, normal mental status, and no head or facial bruising) does not automatically require a dilated ophthalmological examination, but should be at the discretion of the treating team. When indicated, retinal examination should ideally take place within 24-48 hours but may still add value if done later.



“Red Flags” on history, physical exam or radiography

History of Present Illness

- No history or inconsistent history
- Changing history
- Unwitnessed injury
- Delay in Seeking care
- Prior ED visit
- Domestic Violence in home
- Premature infant (<37 weeks)
- Low birth weight/IUGR
- Chronic Medical Conditions

Physical Exam Findings

- Torn frenulum
- FTT (weight, length, head circumference)
- Large head in infants
- Any bruise in any non-ambulating child
- Any bruise in a non-exploratory location (especially the torso), ears, neck in patient <4 years old
- Bruises, marks, or scars in patterns that suggest hitting with an object

Radiographic Findings

- Metaphyseal fractures
- Rib fractures (especially posterior) in infants
- Any fracture in a non-ambulating infant
- An undiagnosed healing fracture
- SDH and/or SAH on neuro-imaging in young children, particularly in the absence of skull fracture < 1 year

If yes to any of the above red flags and concern for injury is present, consider all of the following:

Consult

- Trauma team
 - SCAN team*
 - Social work
 - If abnormal head CT consider:
 - Neurosurgery consult
 - Ophthalmology consult for retinal exam
- Note: dilated eye exam *may* not be necessary as part of the evaluation for physical abuse if ALL the following are met:
- normal head CT, or CT with a single, simple non-occipital skull fracture
 - normal mental status/ neurologic exam.
 - No facial bruising
 - SCAN team agrees that ophthalmologic evaluation is not needed

Labs

- General for most patients:
- CBC & Platelets; PT/PTT/INR
 - CMP
 - Lipase
 - Urinalysis
- If fractures are present:
- Phos
 - PTH
 - Vit D 25-OH

Disposition

- For suspected NAT cases involving head trauma – admission as clinically indicated with either intracranial abnormality identified on head CT or suspected seizures from abusive head trauma:
- Admission to trauma service with q4 hour neuro checks and further child abuse work-up
- Consider PICU admission for
- Any child with intracranial injury/bleed or skull fracture
 - Any child with normal head CT/no seizures but GCS<15
- For suspected NAT cases not involving head trauma:
- Admission to med/surg or PICU as medically indicated
- Outpatient f/u with SCAN team as needed

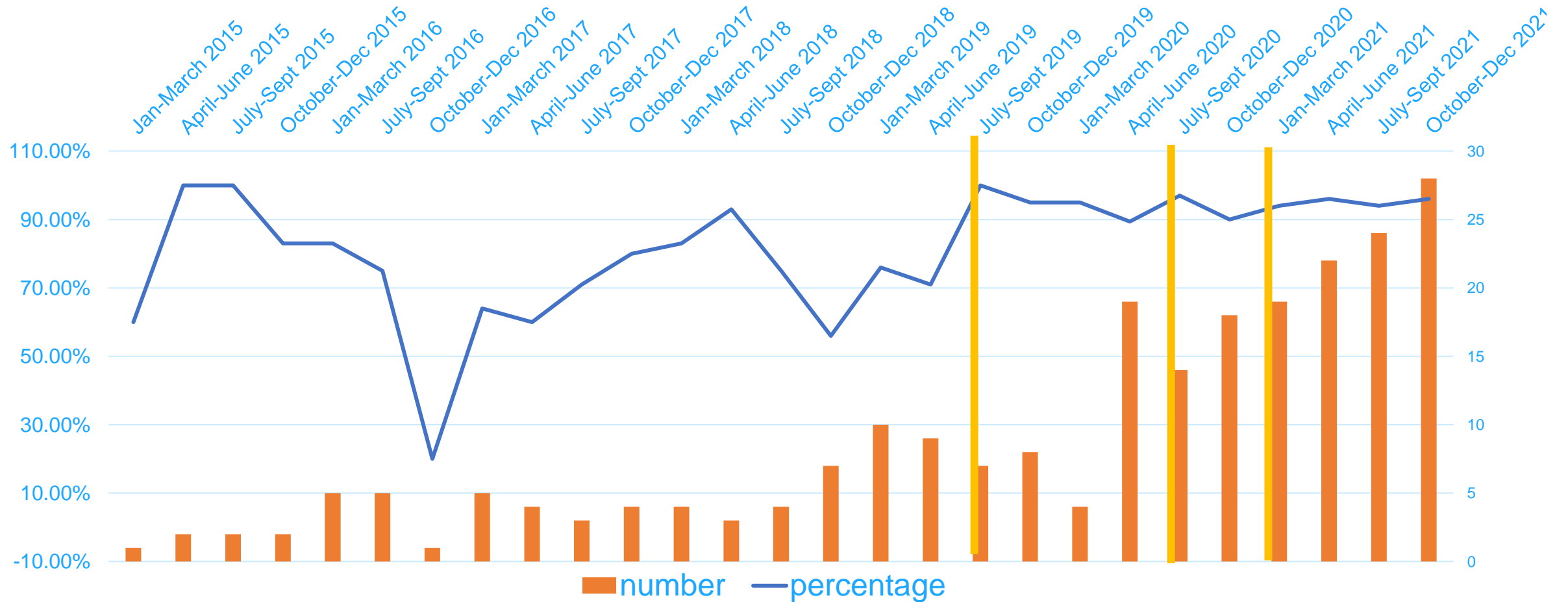
Radiology

- Skeletal Survey for < 2 years old
- In ED if needed for disposition OR within 24 hours of admission
- Head CT** if
- <6 months of age and other findings of abuse
 - Bruising to face or head injuries AND <12 months of age
 - Neurologic Symptoms <12 months of age (including soft symptoms such as fussiness, vomiting)
- Abdominal CT if
- Signs or symptoms of abdominal trauma
 - ALT or AST twice normal

Special Considerations

- *SCAN team will advise regarding making report to Child Protective Services if injuries are severe and above diagnosis is clear cut and/or there are other young children in the same home.
- **Consider Brain MRI

CHOC NAT Guideline Compliance



EMR Clinical Screening

CHILD ABUSE SCREENING TOOL

Disclaimer: A positive child abuse screen will initiate an electronic physician notification and does not necessarily mean that sufficient suspicion exists to warrant mandated child abuse reporting.

Is Child Able to Cruise or Walk?

Yes
 No

Child is

Verbal
 Non-Verbal

1. For children presenting for evaluation of a possible injury, was there a possible or definite delay in seeking medical attention given the severity of the injury/injuries?

No/NA Yes

2. Are you concerned that the history may not be consistent with the injury or illness?

No Yes

3. Are any of the following findings present on physical examination?

No Yes

- a. In a child < 6 months ANY bruise, burn, subconjunctival hemorrhage, or frenulum injury
- b. In a child > or = to 6 months:
 - i. Bruises, burns, or other markings in the shape of an object
 - ii. Bruises on non-bony prominences/protected regions (e.g. torso, genitalia/buttocks,
 - iii. More bruises than you would expect to see even in an active child

4. Are there findings that might reflect poor supervision, care, nourishment or hygiene?

No Yes

5. Are there any additional comments or concerns related to child abuse or neglect and/or additional explanations for any 'yes' responses above?

No Yes

6. Additional comments and/or additional explanations for any 'yes' responses above

***ALL CHILDREN < 4 YRS AGE MUST BE UNDRESSED COMPLETELY**
Children > or = 4yrs of age should be completely undressed if any of the screening questions are positive or you have concern for abuse or neglect

Red Flags

None
Anti-Social, Destructive Behavior
Caretaker's Interaction with Child is Impatient, Unsympathetic, Emotionless
Demonstrates Unusual Sexual Knowledge or Behavior
Depressed, Withdrawn, Apathetic
Exaggerated Fearfulness
Frightened of Caretaker and/or Going Home
Ingestion
Length of Time Before Seeking Medical Attention
Past History of Injuries
Self-Conscious of Body Beyond That Expected of Age
Shows Extremes In Behavior (I.E. Overly Compliant or Aggressive)
Sleep, Speech or Eating Disorders
Submersion Injury
Unexplained Injuries
Wary of Physical Contact with Adults

Case Study 1



HPI: Patient is a 4-month-old male presenting to ED with mother who stated she thinks he is having pain in his legs with diaper changes. Infant was in care of father day prior while she was taking a nap, and he told her the baby had rolled off the couch onto the hardwood floor. The infant had been fussy and irritable all night. Of note, 1 week prior he fell off a toddler bed onto a carpeted floor.

PMH: Healthy infant, no birth or pregnancy complications. He receives regular well-child care and his immunizations are up to date. Mother is a stay-at-home mom and baby is not in the care of anyone other than his parents.

PE: On exam patient is awake, alert and fussy, but consolable with nursing. Mild edema noted to right leg, cries with palpation. The remainder of the physical exam is normal.

Work-up: Right leg ray showed femur fracture

Based on infant's initial presentation and xray findings, what would you expect the next steps to be?

Red Flags on history, physical exam, or radiography

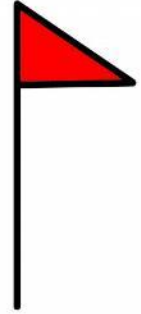
- History of Present illness
 - No history or inconsistent history
 - Injury does not fit with given mechanism of injury
 - Not publicly witnessed
 - Changing history
 - Unwitnessed injury
 - Delay in seeking care
 - Prior ED visit
 - Domestic Violence in the home
 - Known abuse in sibling/other child
 - Premature infant (<37 weeks)
 - Low Birth Weight/IUGR
 - Chronic Medical conditions

Increased rates of abuse in children with special needs (Dev delay, CP, prematurity, etc)

Red Flag Physical Exam Findings



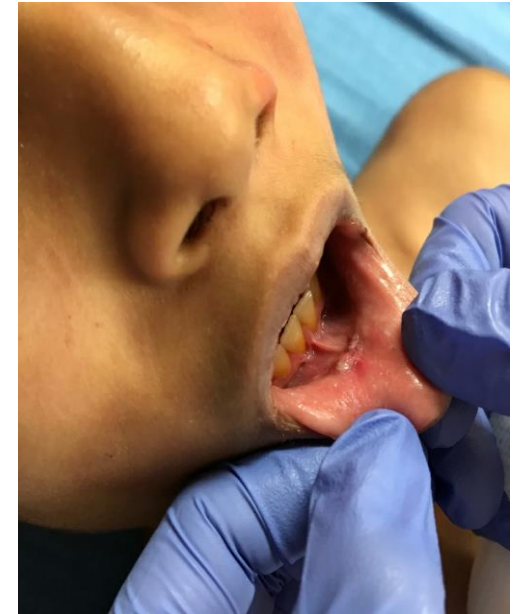
Red flag: Physical Exam findings



- Torn Frenulum (upper, lower, under tongue)
- Failure to Thrive
- Large head in infants <1 year
- Any bruise in a non-ambulating child
- Any bruise in a non-exploratory location (especially the torso), ear, neck, in patients < 4 years
- Bruises, marks, or scars in patterns suggestive of being hit with an object
- Burn injury suggestive of abuse
- Signs of neglect (dirty, dental caries)
- Perineal or Genital Injury

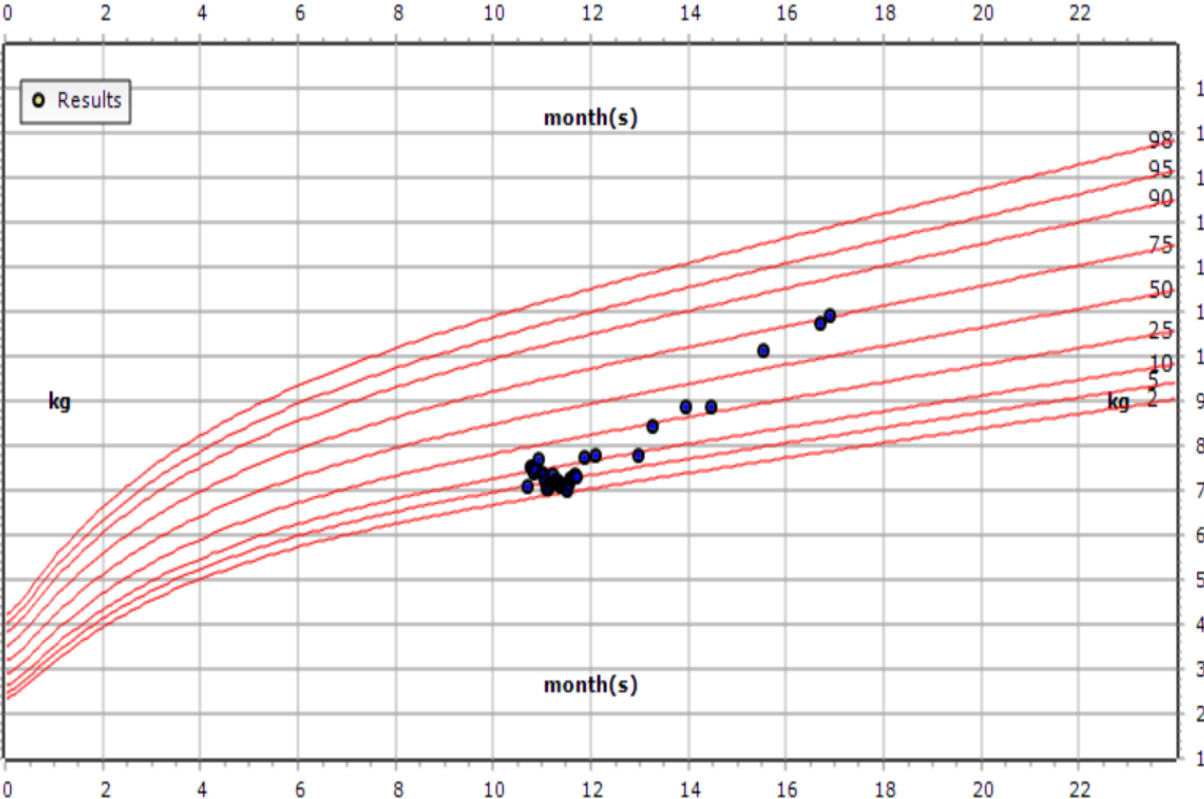
Red Flag: Torn frenulum

- Believed to be pathognomonic of abuse
- Most common abusive injury to the mouth
- Force-feeding, gagging, gripping and violent rubbing of, or a direct blow to the mouth

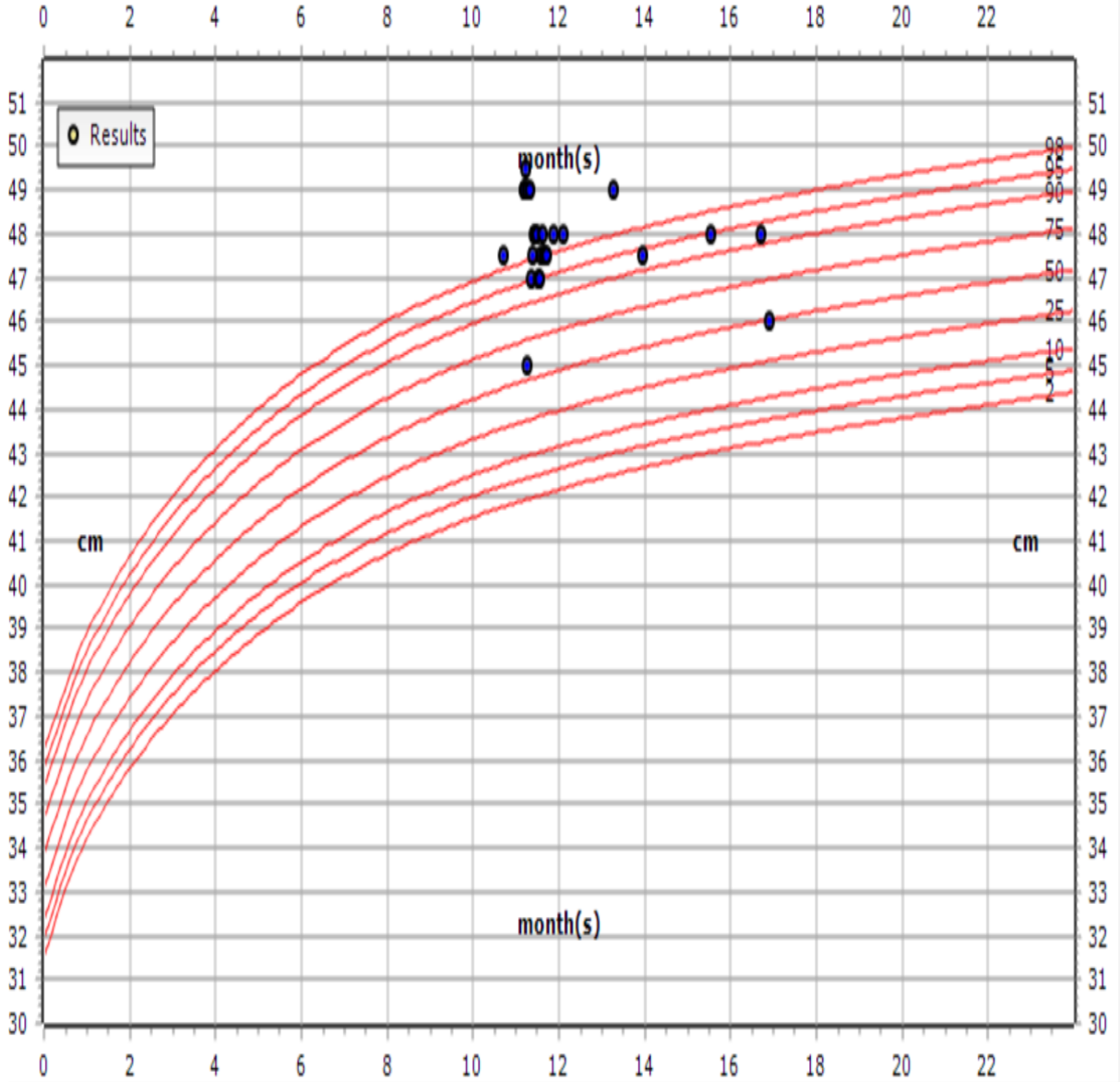


Red Flags: FTT, large OFC

WHO Weight-for-age, 0-2 years, Girls



WHO Head circumference-for-age, 0-2 years, Girls



Red Flag: Bruising

- Respect the bruise
- “One and done”
 - >80% of children sustain a single bruise from a single mechanism of injury
- Bruises associated with abuse:
 - Multiple bruises
 - Non-bony prominences
 - Petechia
 - Non-mobile
 - Bruises cannot be dated
 - May be seen on opposite sides of the body

Trunk
Ears
Neck

4 years or younger

Frenulum
Auricular area
Cheek
Eyes
Sclera
Patterned bruising



4 Any bruising on a child less than 4 months

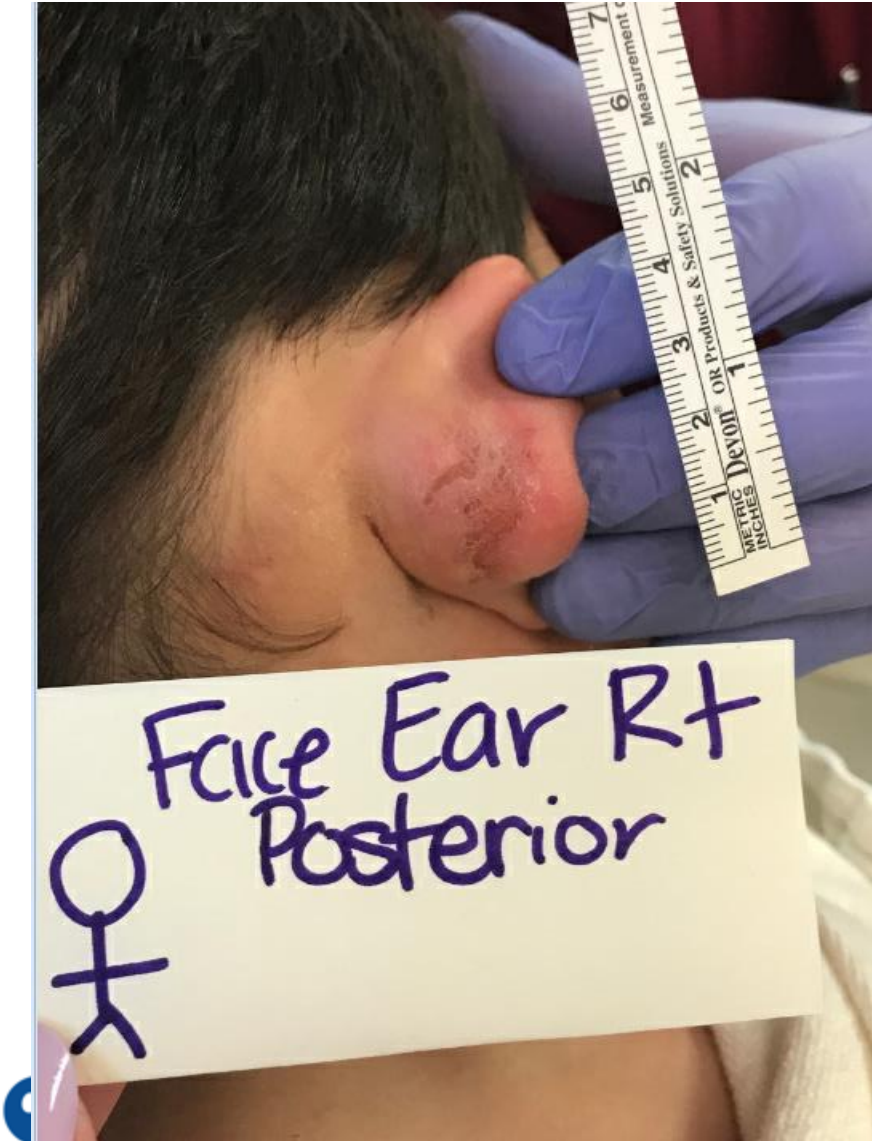


“Kids that don’t bruise rarely bruise.”

Red Flag: Any bruise in any non-ambulating child



Red flag: Any bruise in a non-exploratory location



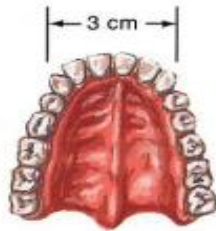


Typical bruise left by gag

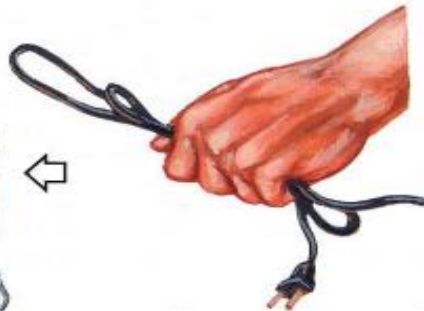
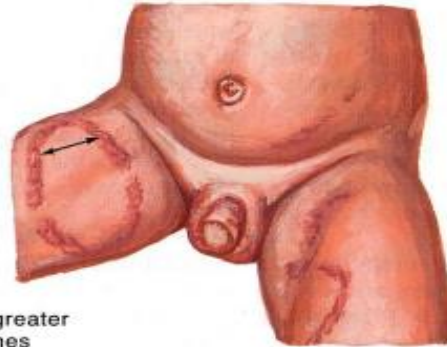
Pigment changes in chronic binding injury



Blistering and edema in acute binding injury



Bite pattern. 3 cm or greater distance between canines indicates adult bite



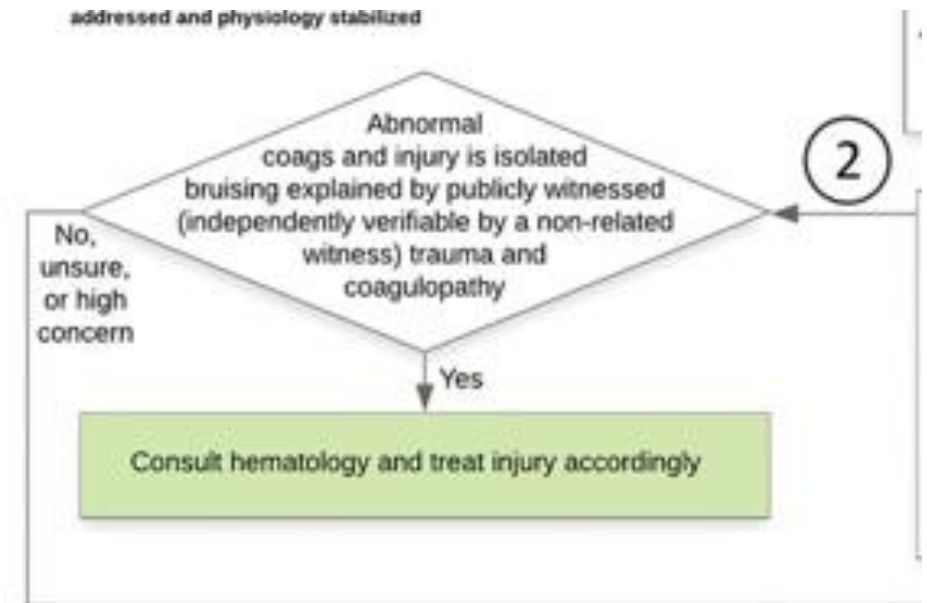
Loop or cord marks on buttocks



Typical slap pattern

Differential Diagnosis for Bruising:

- Most commonly confused with abuse:
 - Hemophilia
 - von Willebrand disease
- May mimic abuse:
 - Disorders of fibrinogen
 - Vitamin K deficiency
 - Thrombocytopenia
 - Leukemia
 - Aplastic anemia
 - Disorders of platelet function
 - Disseminated intravascular coagulation



Red Flag - Burns

Level of water results in uniform demarcation line

Flexing results in apposition of skin surfaces and burn protection

Surface contact protects skin from hot water

Immersion burns often result in typical patterns that give clues to mechanism of injury

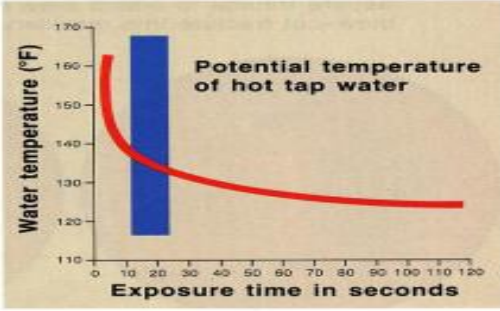
Immersion demarcation line

Areas of skin spared by flexion

Typical immersion burn. Uniform degree of injury with interspersed protected areas

Scald or splash injury from liquids usually results in single burn that diminishes in intensity from point of contact

Typical scald or splash burn



Correlation of time and temperature needed for full-thickness burn

Inflicted vs. Accidental burns

Accidental Burns	Inflicted Burns
<p>Scald burns:</p> <ul style="list-style-type: none">• V-shaped, asymmetric, tapering• Irregular borders• Splash marks• Unilateral, anterior chest and shoulder• Decreasing burn severity towards abdomen	<p>Scald burns:</p> <ul style="list-style-type: none">• Sparing soles of feet• Stocking or glove• Waterlines• Well demarcated borders• Sparing of back of knees or groin• Tub burn: bilateral feet, lower limbs, buttocks, perineum, donut sign
<p>Contact burns:</p> <ul style="list-style-type: none">• Single location• No clear demarcated edges• Child usually less than 4 years old	<p>Contact burns:</p> <ul style="list-style-type: none">• On limbs, back of hand• Sharply demarcated• Multiple punched out circular burns in various stages of healing (cigarette)

Perineal and Genital Injuries



Complete history and physical exam

Consults

Child Abuse Pediatrician
Social Work
Consider Trauma consult
CPS
Police
Psychology



Management

Any needed medical treatment of injuries
Pain control
Documentation including photo
documentation
Forensic evidence

STI testing and HIV assessment
STI and HIV ppx
Forensic evidence
Pregnancy testing and ppx
Tox screen

Red Flag Radiographic findings; Differential Dx and Birth Trauma



Red flag: Radiologic findings



- Metaphyseal fractures
- Rib fractures (especially posterior) in infants
- Any fracture in a non-ambulating child
- An undiagnosed healing fracture
- SDH or SAH on neuro-imaging in young children, especially in the absence of skull fracture <1 year

Red flag: Classic Metaphyseal fractures



- AKA “corner fractures” or “bucket handle fractures”
- Under 18 months, are considered highly specific for abuse
- Most common long bone fracture seen in infants who have died from NAT
- Fracture on imaging is seen as a discrete, localized triangular fragment of bone at the metaphyseal margin (only seen in 2-D images).
- On AP image will appear as more of a bucket handle.

Classic Metaphyseal fractures

- Occurs when child is shaken with great force/speed while holding around the chest causing flailing of the upper and lower limbs or shaking a child while holding onto the hands or feet
- Can also get with pulling and twisting
- Causes horizontal force across the metaphysis, which does **not** occur in a fall or blunt trauma
- Lesion is perpendicular to the long axis of the bone
- Treatment:
 - Cast/splint until adequate callus is formed
 - Operative repair is rarely necessary

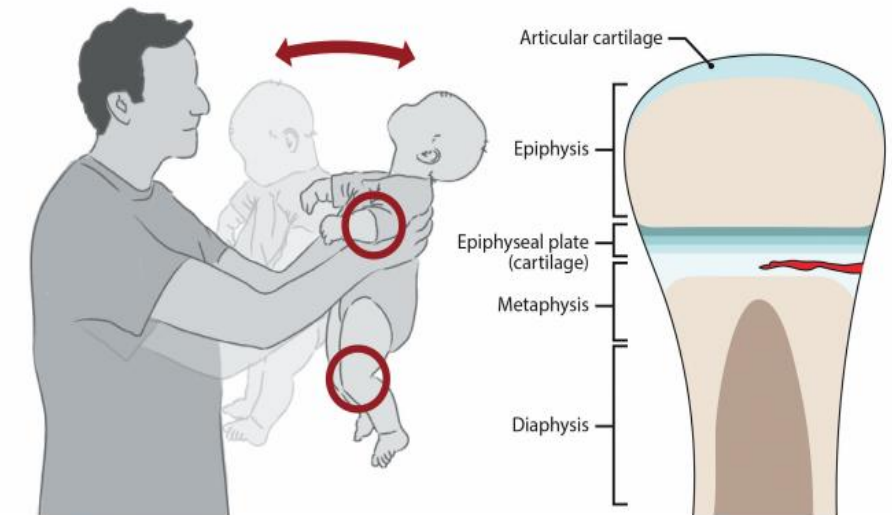


Figure 1: Proposed mechanism of metaphyseal injury from shaking with diagrammatic illustration of site of fracture. Created under contract by professional medical illustrator Diana Kryski.

Red Flag: Rib fractures

- Posterior rib and multiple rib fractures – highly specific for abuse
- Caused by anterior-posterior compression of the chest
- The tight squeezing of an infant's chest produces a complex array of compressive and levering forces on all parts of the roughly tubular rib cage
- Can also result in injury to costovertebral junction, lateral ribs and anterior costochondral junction

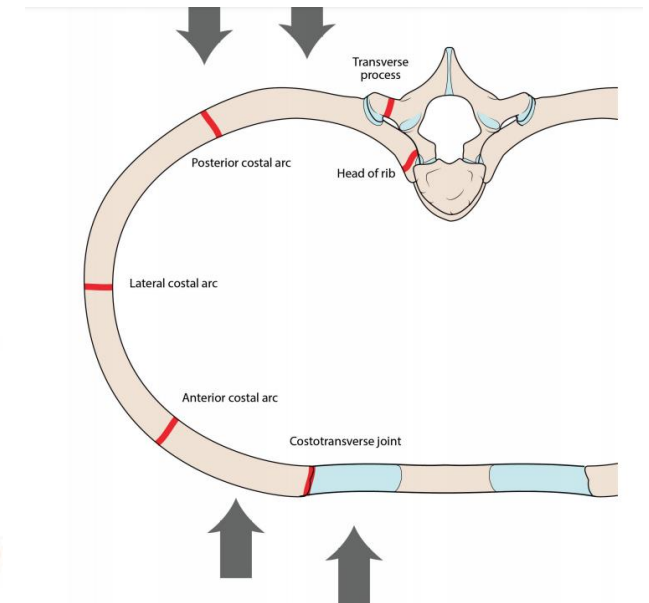
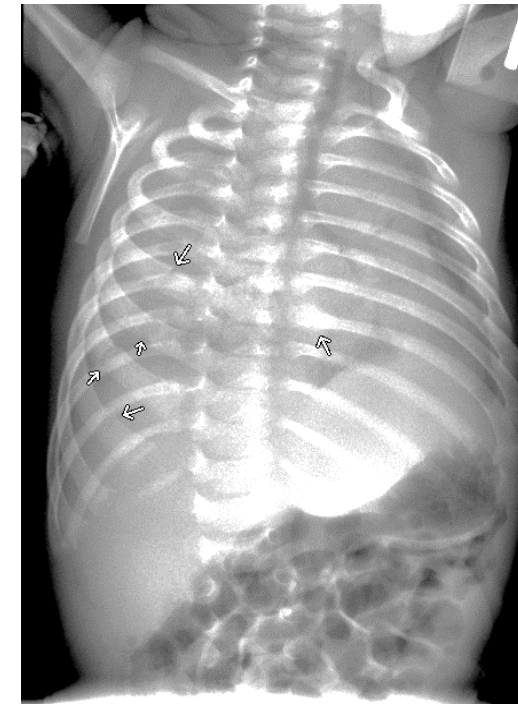
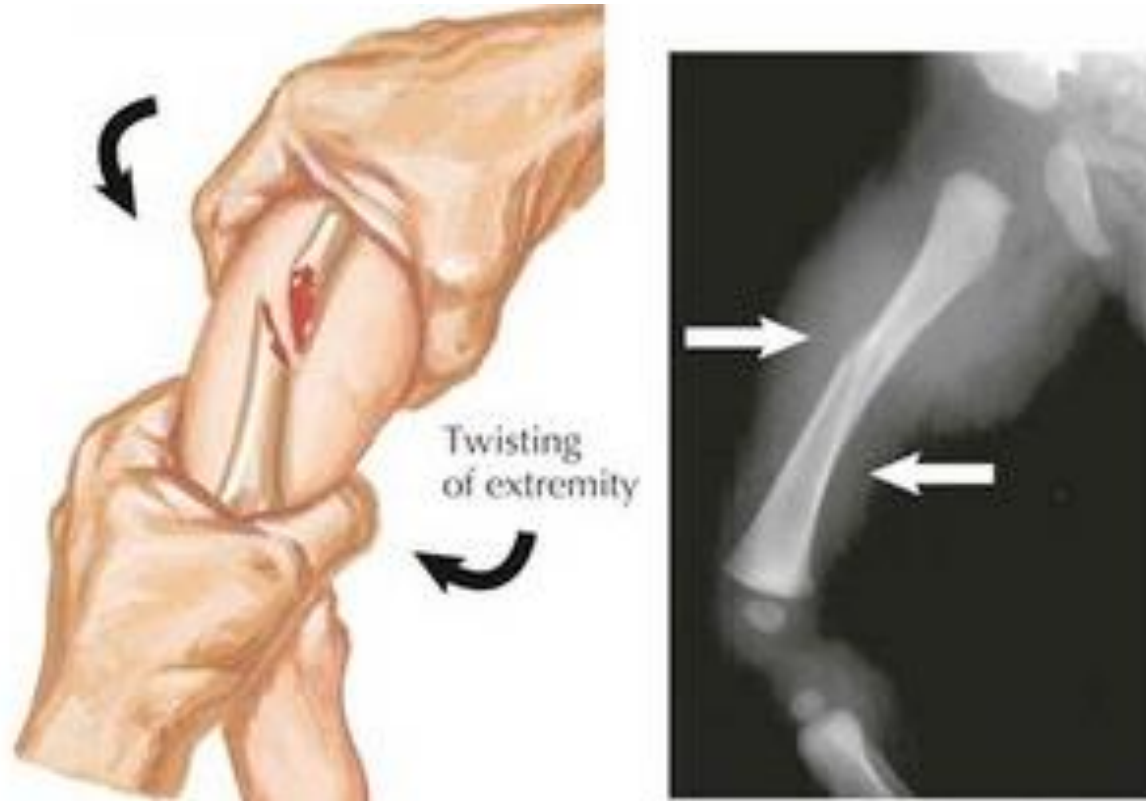


Figure 3: Classic sites of rib fracture from application of external force. Created under contract by professional medical illustrator Diana Kryski.

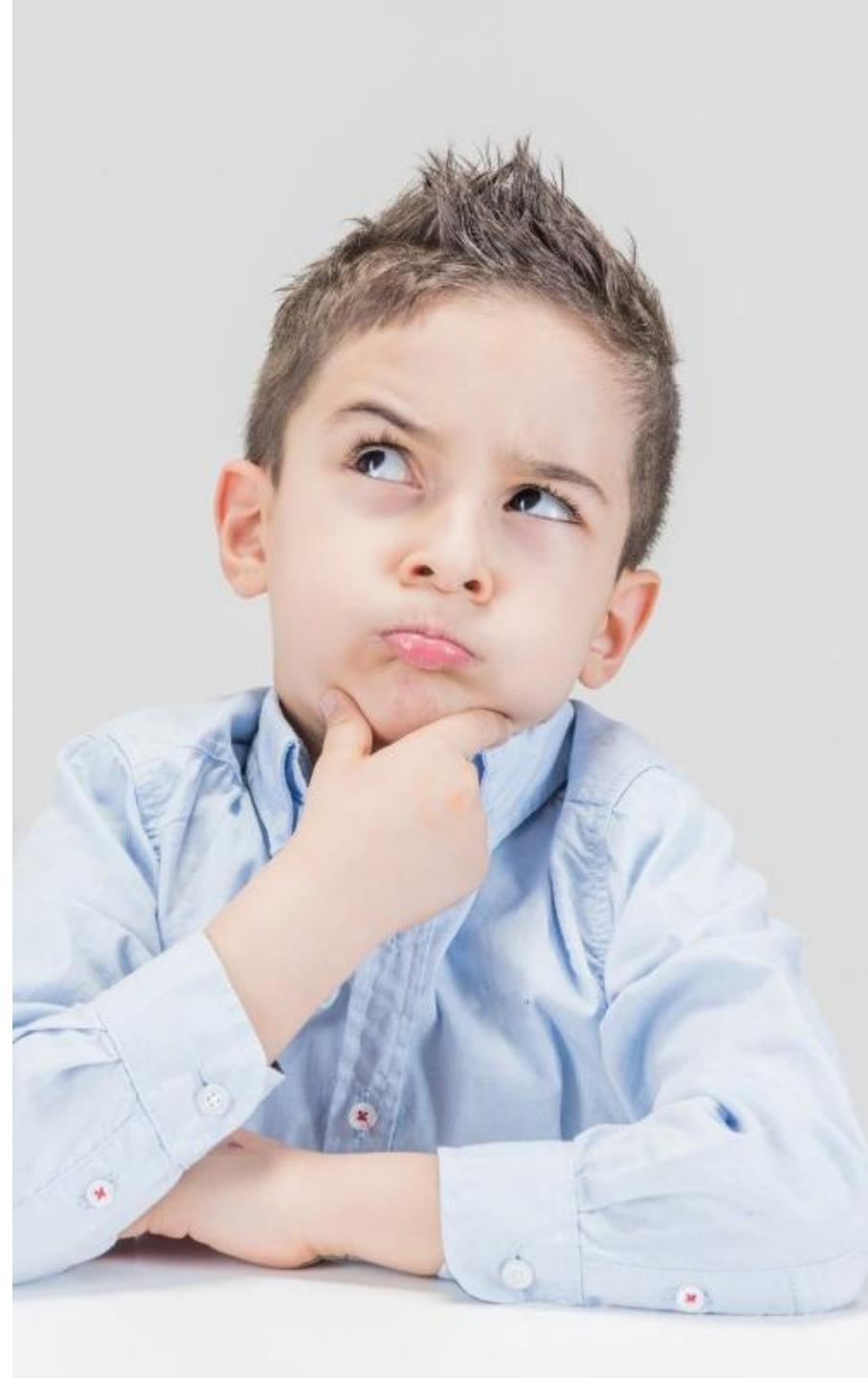
Red flag: Fracture in non-ambulating infant

Spiral fractures



Differential Diagnosis for Fractures

- Metabolic bone disease accounts for approximately 1% of fractures
- Diagnosis that could resemble NAT:
 - Osteogenesis imperfecta
 - Osteopenia of prematurity (during the first 6 months of life)
 - Rickets (vitamin D deficiency)
 - Hypervitaminosis A
 - Caffey's disease
 - Scurvy (vitamin C deficiency)
 - Osteomyelitis
 - Job Syndrome
 - Disuse osteopenia (paralysis or palsy)
 - Birth Trauma



Birth Trauma - Fractures

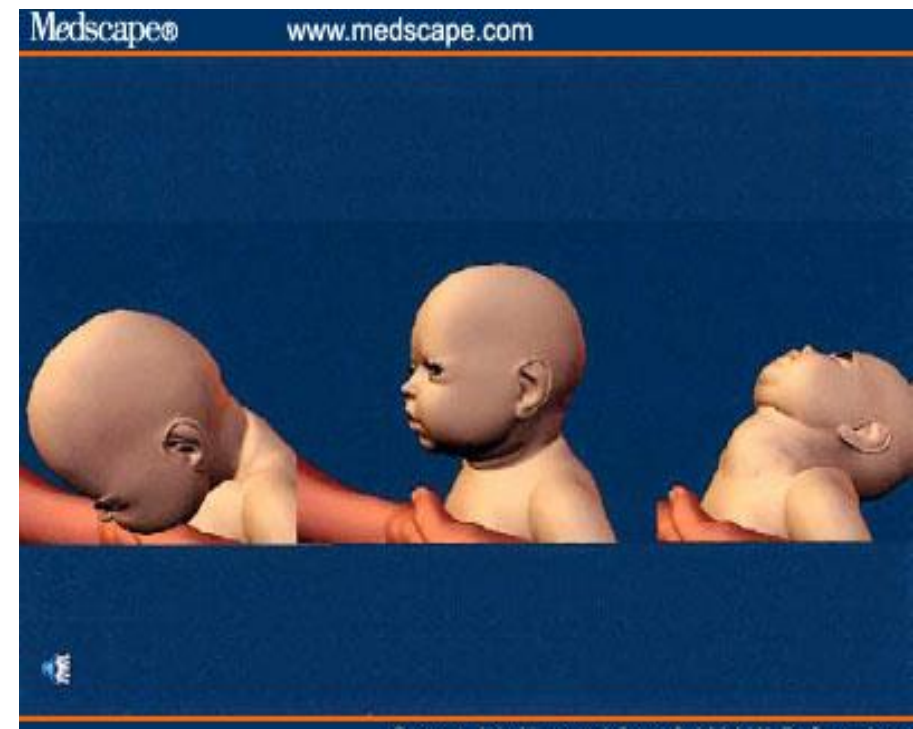
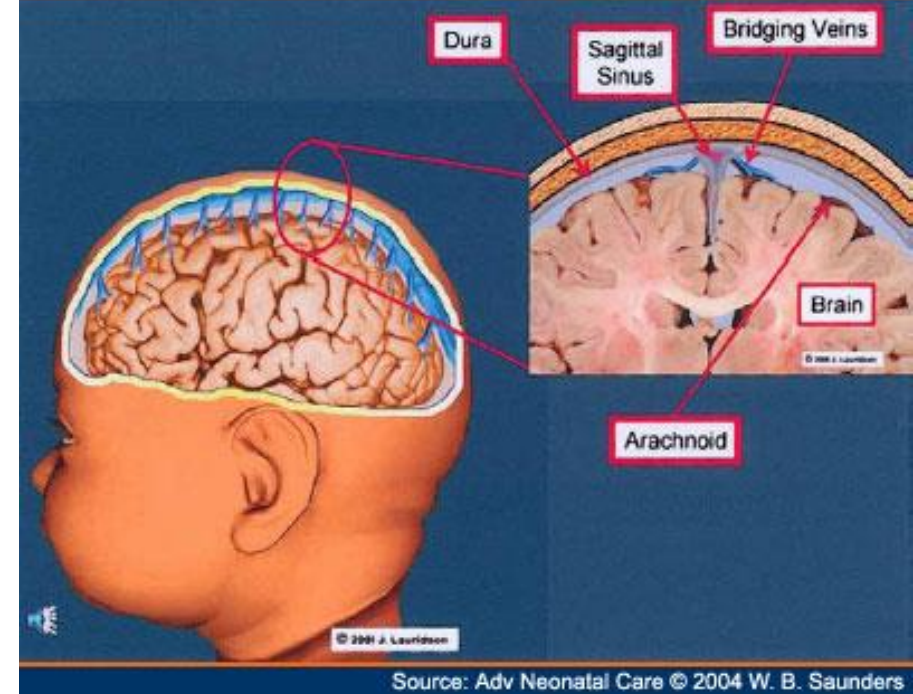


- Clavicle: From anterior shoulder being compressed against the maternal symphysis pubis or when maneuvers are performed for shoulder dystocia
- Skull: Associated with instrument-assisted vaginal delivery or cesarean after failed assisted vaginal delivery
- Humerus: May result from direct trauma to the arm from shoulder dystocia (very rare)
- Femur: Associated with difficult vaginal breech delivery due to applying too much power or in the wrong direction to the bone
- Rib: sometimes seen in association with a clavicle fracture, are uncommon but reported. May be caused by the shoulder compression forces to the chest, or due to bone fragility

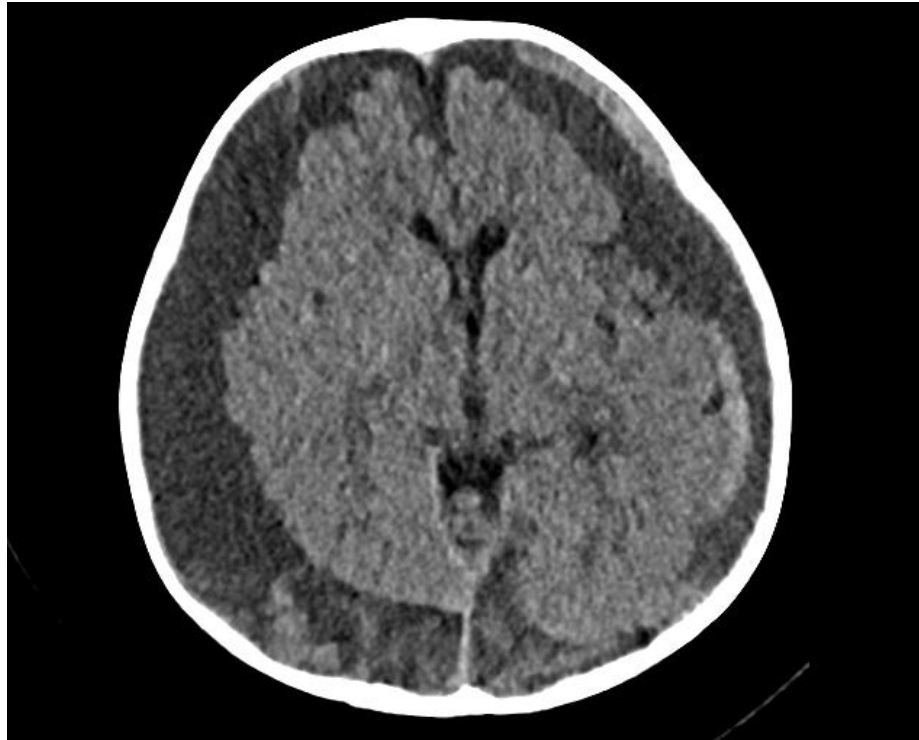
Red flag: SDH or SAH in absence of skull fx <1 year

i.e. shaken baby syndrome, abusive head trauma

- Repeated acceleration-deceleration of the head
- Subdural hematoma, unilateral or bilateral over the cerebral convexities, and/or in the interhemispheric fissure
- Results in rupture of bridging vessels, leading to subdural hemorrhage
- Spinal subdural hemorrhage is more common in children with abusive (versus accidental) head trauma



Differential Diagnosis of Intracranial Hemorrhage



Subdural Hemorrhage can be associated with:

- Hematologic disease (hemophilia, von Willebrand disease, Vit K deficiency)
- Oncologic disease
- Metabolic and genetic disease
- Congenital Malformations
- Autoimmune disease
- Vasculitis
- Poisoning
- Iatrogenic complications
- Benign Macrocrania of Infancy
- Birth trauma

Birth head trauma

Intracranial hemorrhage

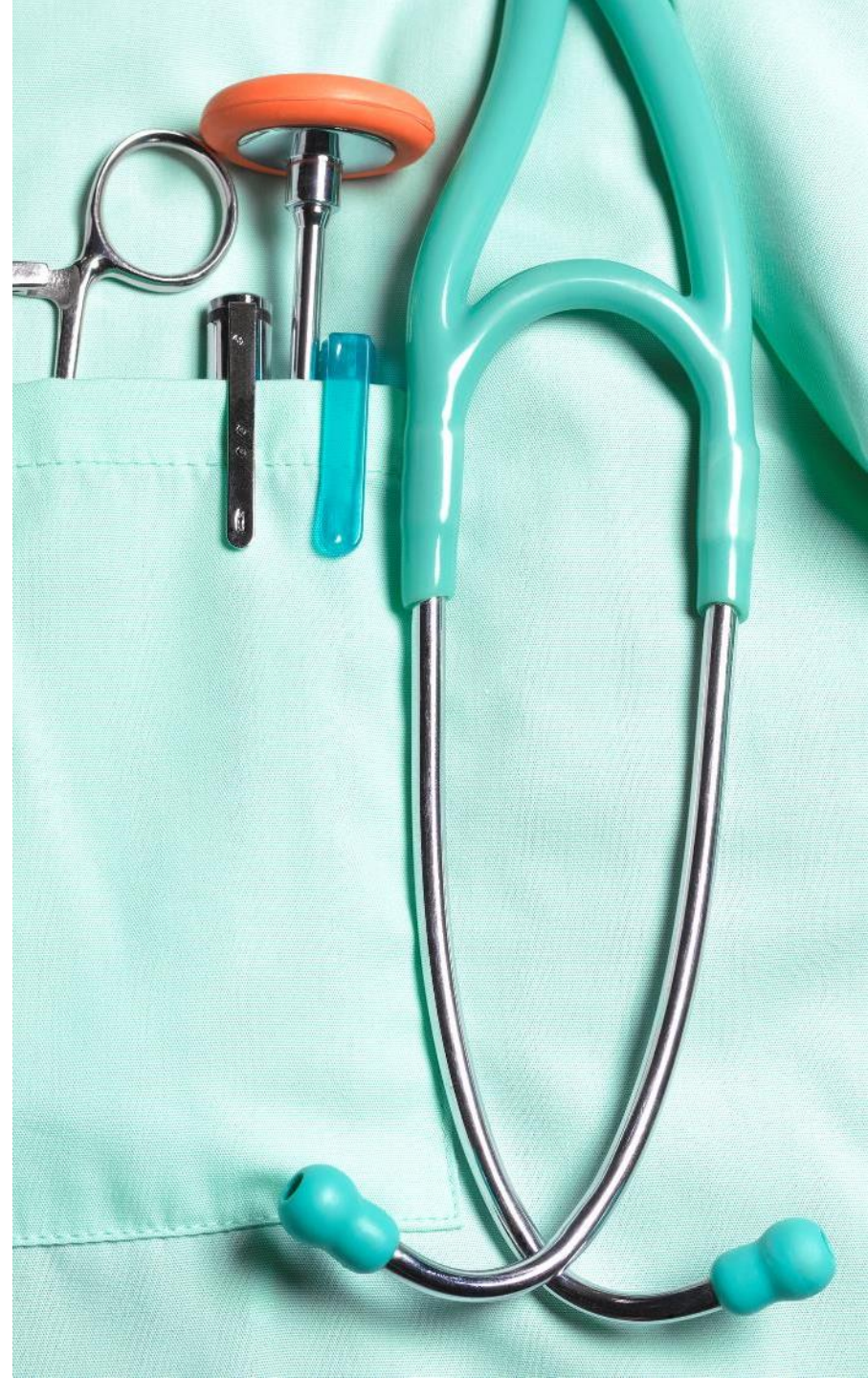
- Subdural hemorrhage
- Epidural hemorrhage

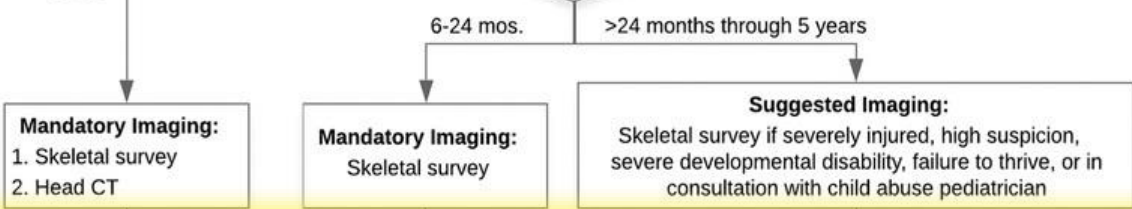
Birth Scalp hemorrhages

- Cephalohematoma
- Subgaleal
- Caput Succadeneum



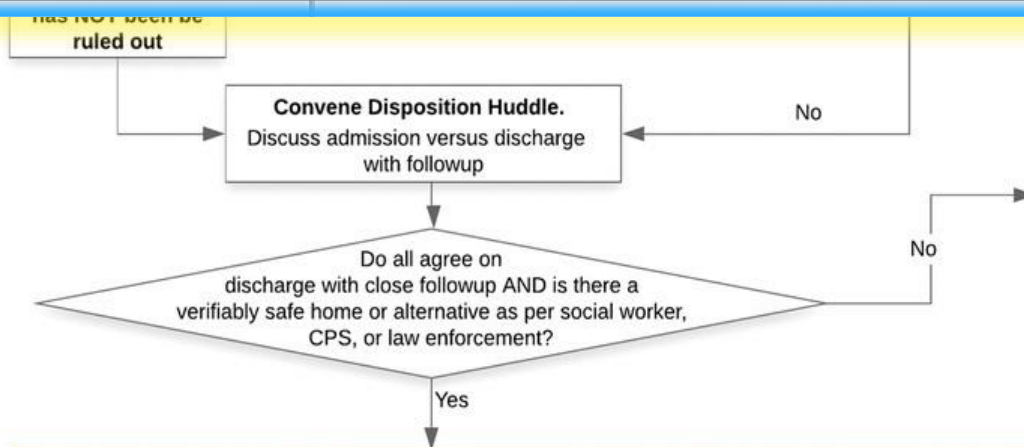
Clinical Work-up





Additional imaging based on specific injuries or concerns

1. Consider Head CT (if not already mandatory for <6 mos) for facial bruising, abnormal neurologic exam, symptoms of concussion (vomiting, seizures, seizure-like activity, fussiness, soft tissue scalp swelling, any respiratory compromise), or high suspicion.¹¹
2. Consider C-spine imaging if head injury present, patient not clearable clinically, or high suspicion
3. CT abdomen and pelvis if suggested by sign/symptom, AST or ALT ≥ 80 , or lipase ≥ 100 ⁸
4. Any additional imaging (neck, face, chest, extremities, etc.) as warranted by clinical suspicion
5. Tc-99m whole-body bone scan may be useful when clinical suspicion high, but the skeletal survey negative, equivocal or subtle findings⁴



- Consider transfer to or teleconsultation with trauma center or pediatric hospital if optimal resources unavailable.
 - Consider PICU admission based on injury severity, physiologic situation, monitoring requirements and institutional capability.
 - Neurosurgery intervention as necessary.
 - Consider ophthalmology consult⁶
 - Treat injuries as needed
 - Complete child abuse evaluation
- If not already done:**
- Follow local regulations for informing Child Protective Services (CPS) of concerns and inform when required.
 - Consult child abuse pediatrics team as needed, (where available) or general pediatrics.

- Discharge to Safe Home or Alternative with Close Follow-up**
- If a skeletal survey was performed, order a repeat study for 2 weeks from the initial study.¹⁶
 - Inform the child's pediatrician or primary care provider and document the planned follow-up. Optimal follow-up may vary by institution and may be with child abuse pediatrics, general pediatrics, trauma surgery or primary care provider.
 - Inform the child abuse pediatrics team (where available) or general pediatrics.
 - Follow local regulations for informing Child Protective Services (CPS) of concerns, to help ensure follow-up.

Work-up for NAT

< 6 months – mandatory imaging

- Skeletal Survey
- Head CT

6-24 months – mandatory imaging

- Skeletal Survey

24 months – 5 years – suggested imaging

- Skeletal survey- severely injured, high suspicion, severe disability, FTT or in consult with child abuse pediatrician.

Imaging studies to consider based on injury (any age)

- Head CT if – facial bruising, abnormal neurologic exam, TBI symptoms (vomiting, seizures, fussiness, scalp soft-tissue swelling, respiratory compromise or high suspicion.
- C-spine imaging – if head injury present, c-spine not clearable clinically or high suspicion
- CT abdomen pelvis – S/S, AST or ALT ≥ 80 or lipase >100
- Additional imaging –based on clinical suspicion

Labs

General for most patients:

- CBC & Platelets; PT/PTT/INR, CMP, creatinine, glucose
- Urinalysis

AST/ALT

- screening for blunt abdominal trauma
- AST or ALT >80 should prompt CT of abdomen/pelvis

Lipase

- Increases the sensitivity and decreases risk of missed pancreatic injuries
- Obtain CT when Lipase >100

Coags

- PT/PTT
- Useful to eval for a coagulopathy that could account for bruising

Troponin Levels

- May help assess for blunt cardiac injury
- Obtain if >3 months, abdominal injury, rib fx and ill appearance

If fractures are present:

- Serum calcium
- Phosphorous
- Parathyroid hormone
- Alk phos
- Vit D 25-OH

Consider urine tox screen for any patient <12 years old and suspected abuse

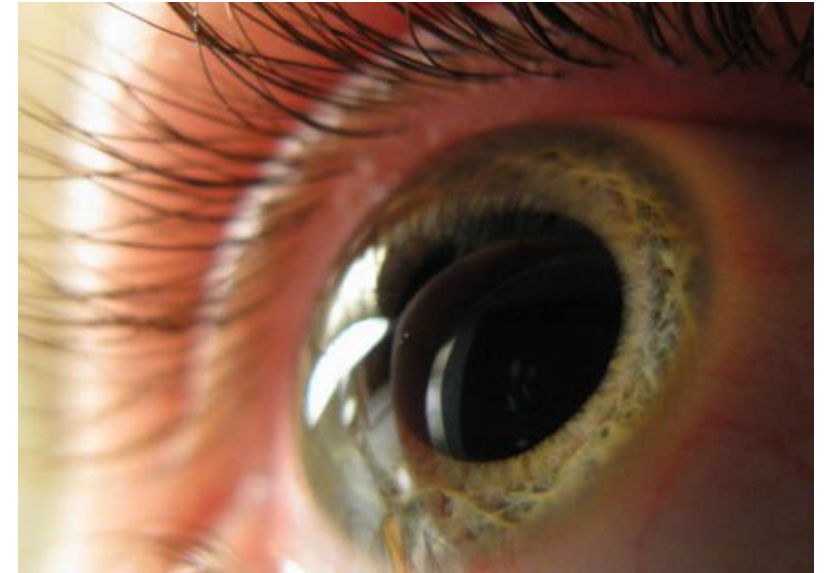


Ophthalmology consult - Dilated eye exam

Ideally within the first 24 hours after admission
(certainly within 72 hours)

Dilated eye exam *may* not be necessary as part of the evaluation for physical abuse If ALL the following are met:

- normal head CT, or CT with a single, simple non-occipital skull fracture
- normal mental status/neurologic exam
- No facial bruising
- Child abuse team agrees that ophthalmologic evaluation is not needed

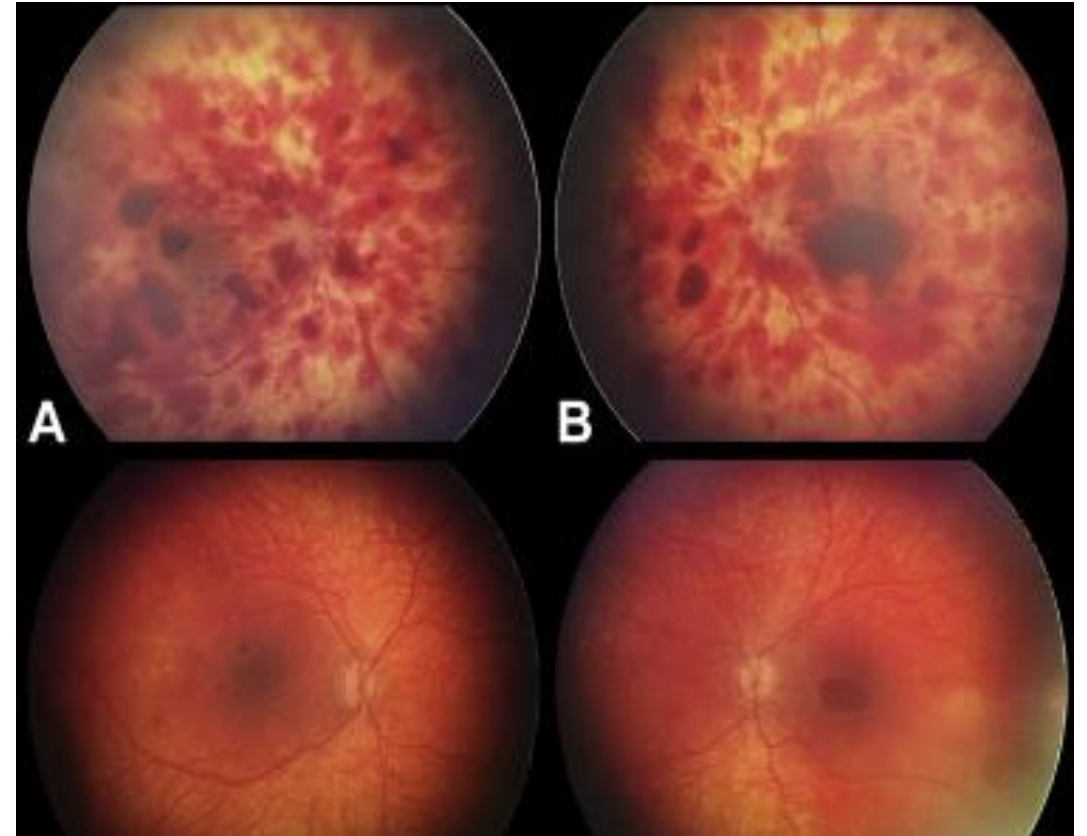


Outpatient providers who suspect abusive head trauma should make an urgent referral to an ophthalmologist who should be available for prompt evaluation

Retinal Hemorrhage

More common findings in NAT:

- Normal outer eye
- Large numbers of RH in both the eyes
- Present in all layers of the retina
- Extension into the periphery and posterior segment
- No retinal sign that was unique to abusive injury
- NAT vs vaginal delivery:
 - Abusive head trauma shows larger RH
 - More severe retinal findings
 - Involve all 3 retinal layers
 - Higher percental of vitreous hemorrhages

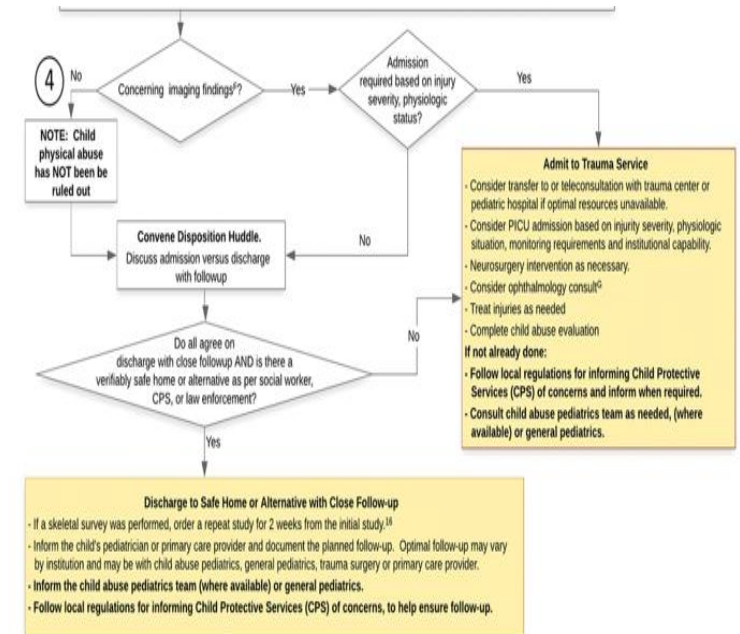


Disposition and Psychosocial Considerations



Disposition

- Admission as clinically indicated to PICU or floor
- Consider PICU admission for
 - Any child with intracranial injury/bleed or skull fracture
 - Any child with normal head CT/no seizures but GCS<15
- For suspected NAT cases not involving head trauma:
 - Admission to floor or PICU as medically indicated
- Social Work and Child Abuse team consult



Social Work and CPS involvement

Child Abuse Report (CAR) – Mandated Reporting

- All patients with suspected or confirmed NAT should have a Social Work Consult and Child Abuse Pediatrician if available
- Should consider if there are other young children living in the home
- CPS and the patient's home county will determine if a hold needs to be placed
- CPS and county social work will determine disposition for the child in cases of suspected or confirmed NAT
- **The ultimate goal is to keep the child safe**

Communication with family

- Clear and effective
- Develop rapport
- Explain why certain screening tests are necessary
- Maintain cultural sensitivity
- State your role as an advocate for the child
- Be direct and objective
- Avoid accusatory and nonjudgmental statements
- Use a Trauma-Informed care approach



Case presentation 2:

HPI: Patient is a 2-week-old male presenting to ED with oblique right femur fracture at 3 days of age. Discharged from OSH and 1.5 hours after being home the grandmother noted patient's right leg to be swollen and he was fussy during diaper changes. Right femur fracture found on x-ray. There was no history of fall, accidents or trauma.

PMH: Full-term SGA male born at OSH by scheduled C-section due to a breech presentation. Review of outside records did not document of any kind of trauma. There was a comment about a right hip clip on one of the initial evaluations but no other mention of abnormal exam.

Physical exam: Awake, well-appearing, Weight 4%, Head and length <3rd percentile, mild swelling R thigh compared to the L, no open wounds or deformity. No apparent TTP or agitation. Foot warm and well perfused, palpable pulse, spontaneously moves leg without problems. Moves all extremities appropriately.



Work-up and Disposition

Work-up

- Skeletal survey – Right Mid-shaft femoral fracture; otherwise, negative
- Cranial US and Head CTs - negative
- Labs – CBC, CMP, Ca, Phos, Alk phos – all WNL
- Orthopedics: RLE splinted with posterior splint, bias wrap; Aim for non-op management
- Ophthalmology exam: Negative for retinal hemorrhage
- Genetics consult: work-up for metabolic bone disease including hypophosphatasia, OI – negative
- Social work and Child abuse Pediatrician

Disposition

- CAR filed – discharged home with mother

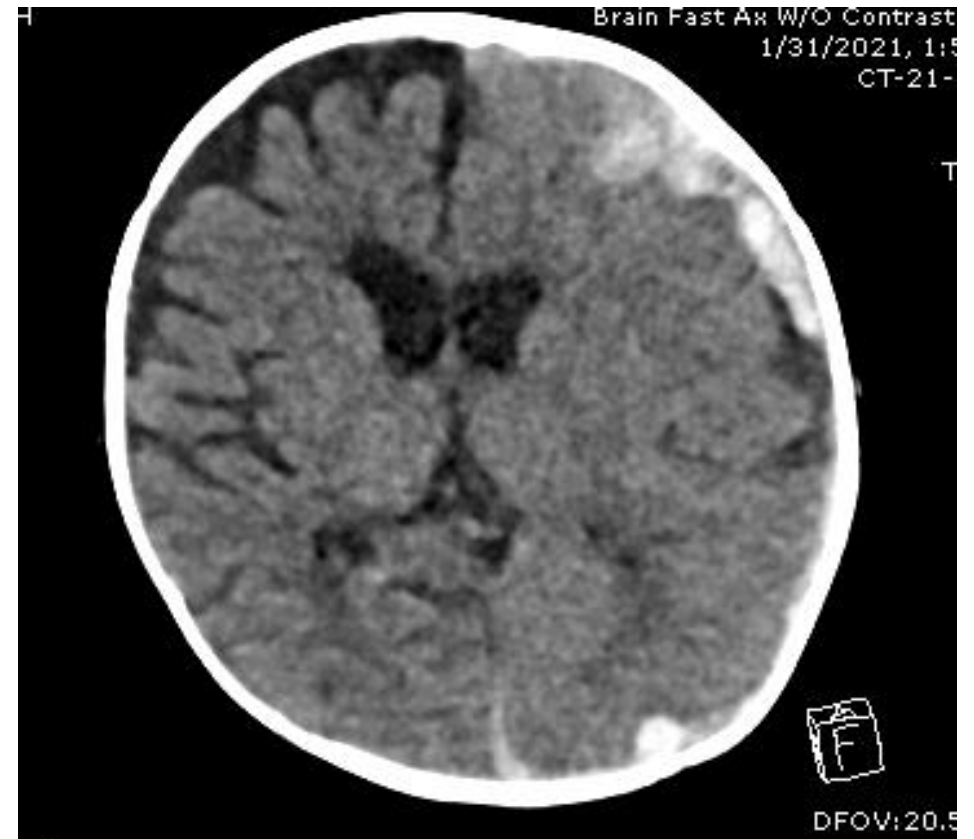
Can we confidently say this is or is not
child abuse?

Case presentation 3:

HPI: 5-month-old M with a hx of in utero drug exposure presented to the ED for seizure. Seizure started 12 minutes PTA and was witnessed by foster mom. Had a 5-day history of persistent fevers and had 1 episode of NBNB emesis. No rash, cough, congestion or diarrhea. No SOB or wheezing. No sick contacts. No prior history of seizures. No known head trauma. Has been meeting developmental milestones up until now.

PMH: In utero drug exposure. No NICU stay. No other significant PMHx. Vaccines UTD. Lives with foster parents (Muncle and wife). Had visit week prior at facility - per foster dad these are supervised visits for 2 hrs, 1 time per week.

Physical exam: Vital Signs:Temp: 38.8 DegC HR: 196 RR: 37 BP: 118/73 O2 Sat: 99 on RA. General: Unresponsive, convulsing Skin: Warm. dry. no pallor. no rash. not cyanotic. No erythema, edema or lesions. Head: Normocephalic. atraumatic. anterior fontanelle soft and flat. Eye: Pupils are equal, round and reactive to light. normal conjunctiva. R gaze deviation.



Work-up and Disposition

Labs: COVID positive, hyponatremia, anemia, leukocytosis

Head CT: Acute extensive hemispheric subdural hemorrhages noted throughout the frontotemporoparietal region. There is left frontal cortical hemorrhagic contusion with surrounding cytotoxic edema. Mild left to right midline shift with left hemispheric cerebral edema. Brain MR with diffusion is indicated to evaluate the exact age of hemorrhages. Nonaccidental trauma should be considered.

Skeletal survey: negative

Ophthalmology: Normal dilated fundus exam. No evidence of retinal hemorrhages in either eye.

Hematology: Severe Hemophilia A or FACTOR VIII (8) Deficiency or Severe TYPE 3 Von willebrand

Can we confidently say this is or is not
child abuse?

Case presentation 4:

HPI: 10mo old ex 35 wk F transferred from OSH ED after presenting with 3 days of NBNB emesis, diarrhea, and worsening abdominal distension. Had 2-3 episodes of emesis and diarrhea (nonbloody) daily. Caregiver noted bruising on abdomen and worsening distension that AM which prompted ED visit. Otherwise, afebrile and acting at baseline. Developed a vaginal rash 3 days prior after onset of diarrhea, not significantly improved with A+D ointment. No cough, congestion, sick contacts, recent travels.

PMH: Hydrocephalus, macrocephaly, and in utero drug exposure. In foster care - Aunt is main caregiver at home.

PE: Lying in crib, **not able to lift head vs gravity, cries with exam**, HEENT: **Macrocephalic. multiple red scabs on posterior aspect**. PERRL, EOML. **R upper lid bruising**. Nares patent without discharge. MMM, no cleft palate, no erythema, no exudate, oral thrush noted on tongue. Neck Supple, no LAD. **lip frenulum intact**. Respiratory: CTAB, good air exchange throughout, no w/r/r, no retractions. **Thin chest with visible ribs**. Cardiovascular: RRR, normal S1, S2, no m/r/g. Genitourinary: Normal female genitalia. Tanner 1. **Superficial erosion of skin/denuded skin in GU area**. female, **extensive skin sloughing and wasting of muscle, appears burn-like over anterior GU skin extending into leg folds**. Gastrointestinal: **Full, distended**, non-tender, normoactive bowel sounds, no HSM, no masses. No rigidity. **Whines with palpation diffusely**. Extremities: Warm and well perfused, Cap refill <2 sec, no cyanosis, clubbing or edema. **Thin extremities**. Integumentary: Warm, dry, **scattered ecchymosis on back, abdomen, extremities. Three discreet marks over anterior abdomen with bruising, patterned appearance. Spine with multiple dark spots bruising vs birth marks**. Neurologic: Face symmetric, symmetric palate rise, withdrawing with normal strength to exam.

Workup and results

Abdominal CT: Multiple intraabdominal injuries including liver lac, pancreatic transection with associated injury to pancreatic duct. 4 cm Irregularly marginated low-density lesion within the left lobe of liver may represent hepatic hematoma versus abscess. Pancreatic transection at the level of mid body with large 6 cm pseudocyst versus hematoma along the ventral pancreatic surface in the lesser sac. Large ascites. No evidence of free air. Mural thickening involving descending and sigmoid colon, possible colonic injury.

Head CT : Large bilateral mixed attenuation subdural hematomas with evidence of acute/subacute on chronic bleeding. No evidence of skull fracture. Normal appearance of brain parenchyma.

Skeletal Survey: Questionable healing posterior right second rib fracture. Subtle periosteal reaction of the distal right humerus and left femur. There is also subtle periosteal reaction of the proximal left humerus with cortical irregularity concerning for fractures, left proximal humerus demonstrates some healing changes.

Can we confidently say this is or is not
child abuse?

Sentinel events:

- 8/11/20: Normal development. Given 1st set of vaccines f/u 2 month for vaccines and WCC visit.
- 8/31/20: Sick visit for vomiting. Right ear with wax and irritable with manipulation. **On exam there were bruises noted on the left arm and 3 lightly pigmented bruises 1 cmx1 cm on the abdomen.** She was sent for labs CBC and CMP. Diagnosed with OM, vomiting and spontaneous bruising.
- 10/21/20: no show
- 10/19/20: sick visit for coughing and scab on scalp. Foster mom had concerns about pt having a curve in her spine and not being able to sit on her own. On exam she was noted to protuberance on lumbar spine. Pt was also noted to have developmental delay, **scalp with erythematous patches on the occipital scalp with yellow flaking, bruising of the left arm and thighs.** Diagnosed with developmental delay, deforming dorsopathies, seborrhea, spontaneous ecchymoses. Again labs were ordered, CBC, PT, PTT, CMP, lead, UA and Iron studies and x-rays.
- 11/20/20: no show
- 12/2/20: Visit for results for x-rays - **Foster parents had a concern of the head being too big. no abnormalities on exam. Diagnosed with Macrocephaly referred to neurology, Developmental delay referred to developmental clinic at children's hospital, Deforming dorsopathies referred to orthopedics.**

Sentinel Events

- What may appear as a minor injury could be a sentinel event
- ~25-27% of children seen in the emergency department for physical abuse or abusive head trauma had been seen previously for a suspected sentinel injury
- There is little we can do to prevent child abuse - If caught early, we have the potential to prevent further abuse and even a fatality.



Take home points for child abuse

Put every child <2 years of age in a gown

Have high index of suspicion for all infants coming in with head trauma, especially in a non-mobile child

Don't forget to look under the tongue for torn frenulum

Remember TENS 4-Faces-P

Identify your team and/or county resources

Follow Western Pediatric Trauma Society's algorithm and/or create institution-specific guidelines

You don't want to be a sentinel event

April is National Child Abuse Prevention Month, a time to recognize that we each can play a part in promoting the social and emotional well-being of children and families in communities.



Abuse Prevention

- Address individual risk factors
- Work to create healthy family environments
- Provide professional help and support for dysfunctional families
- Identify problems that might lead to violence
- Raise public awareness about violence
- Address cultural, social and economic factors that contribute to violence



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Thank You



LONG LIVE CHILDHOOD

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