

Medical Evaluations in Physical Abuse: Bruises

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Disclosures

- Dr. Strickler has no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider(s) of commercial services discussed in this CME activity.

Objectives

- Review characteristics of abusive versus non-abusive bruises
- Recognize patterns in bruises
- Review mimics of abusive bruising
- Review laboratory/medical evaluation of bruises concerning for physical abuse

Introduction

- Skin (cutaneous) injury is the most common presentation of physical abuse
 - Bruising is the most common skin injury in physical abuse
 - Thorough medical history, developmental history and presenting history is essential to diagnosis

Types of “Bruises”

- **Petechia**

- Prominent red or purple pinpoint hemorrhages caused by damage to small surface blood vessels (capillaries)
- Traumatic causes
 - High speed/force impact (i.e. slap)
 - Forced compression over time (i.e. squeezing/strangulation)
- Medical causes
 - Coughing, vomiting, straining, bleeding disorder



Types of “Bruises”

- **Hematoma**: collection of blood forming a mass under the skin
- **Ecchymosis**: visualized blood that has tracked from one location to another
 - Photo from AAP visual diagnosis



Concern for Abuse or Not?

- Consider
 - location
 - appearance (pattern?)
 - Volume
 - severity
 - age/developmental capacity of child
 - and presenting history
- Concerning bruises
 - central location (buttocks, abdomen, chest)
 - non-ambulatory infant
 - bruise in the pattern of an object
 - TEN-4 Rule: torso, ears, neck, < 4 months old

Patterned bruises: Belts



Patterned Bruises: Hands



Abusive Bruise Mimics

- Idiopathic Thrombocytopenic Purpura (ITP)
- Henoch Schonlein Purpura (HSP)
- Malignancy (cancer)
- Birthmarks (“Mongolian Spots”)
- Phytophotodermatitis



Laboratory Evaluation

- Determine if necessary
- Common Initial screens: Complete blood count and coagulation studies
- Expanded Screens: Factor Activity levels to test for specific Hemophilias, Von Willebrand Screen
- Consideration of Referral for pediatric hematology consultation if high level of concern for bleeding disorder

Recommended Literature

American Academy
of Pediatrics



DEDICATED TO THE HEALTH OF ALL CHILDREN™

Guidance for the Clinician in
Rendering Pediatric Care

CLINICAL REPORT

Evaluation for Bleeding Disorders in Suspected Child Abuse

[Evaluation for bleeding disorders in suspected child abuse.](#)

1. Anderst JD, Carpenter SL, Abshire TC; Section on Hematology/Oncology and Committee on Child Abuse and Neglect of the American Academy of Pediatrics. Pediatrics. 2013 Apr;131(4):e1314-22. doi: 10.1542/peds.2013-0195. Epub 2013 Mar 25. PMID: 23530182



Medical Evaluations in Physical Abuse: Burns



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Objectives

- Review types of burns
- Review common appearances of different types of burns
- Recognize mimics of burns

Burns

- Approximately 10% of pediatric burns are abusive
- Common burn mechanisms: Contact or scald
- **Contact burns**
 - hot solid objects (irons, curling irons, radiators, cigarettes), caustic material
- **Scald burns**
 - Hot liquids (water, beverages, soups, etc.)

Contact burn



Patterned Contact Burns



Abusive Immersion Scald Burns

- Often associated with soiling (vomiting, incontinence) that requires cleaning the child.
- Areas submerged are burned with clear lines of demarcation, whereas areas above the water line are spared
- Simultaneous burning of buttocks, genitals, and both feet are highly specific for abuse



Level of water results in uniform demarcation line

Flexing results in apposition of skin surfaces and burn protection

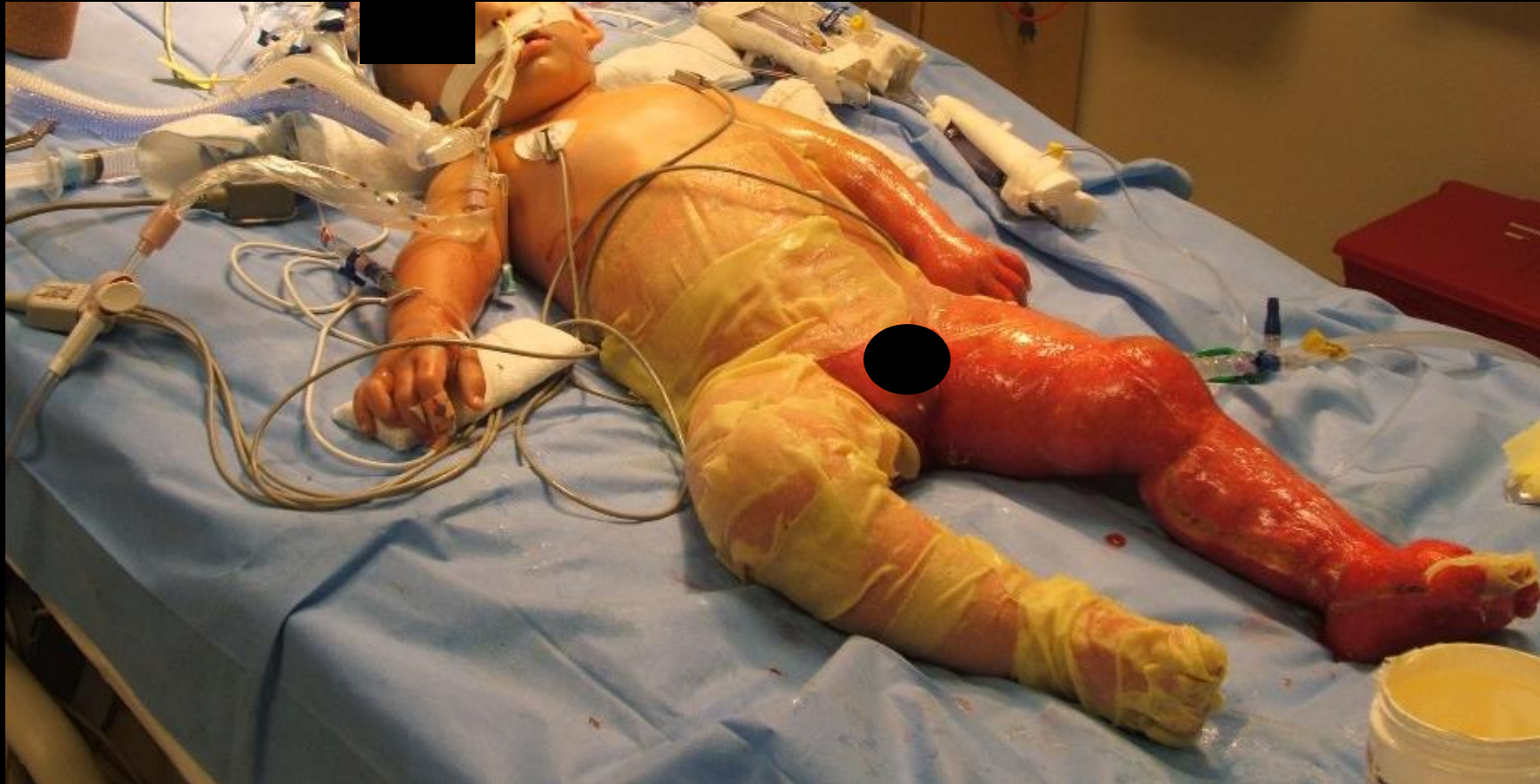
Surface contact protects skin from hot water

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

Immersion Scald



Immersion Scald



Accidental bathing scald



Accidental Clothing Saturation Scald



Burn Mimic: Bullous Impetigo



Multidisciplinary Collaboration

- Scene investigation
 - Scalds: measurements of max water temp, hot water heater settings, function of faucets, time to heat water
 - scene photos
 - video re-enactments
 - Witness interviews
- Medical Care
 - UNM Children's Hospital: state burn center
 - Texas Tech: Designated pediatric burn center

Child Abuse Response Team (CART) Evaluation Guideline in Pediatric Burn Patients

Patient presents to UNM PED with a burn

Burn Care as appropriate**

Decisions regarding admission include need for CART consult

Goals:

- CART notification of all patients < 2 years of age presenting to PED with a burn
- Notify CYFD and LE appropriately*

Suspicion of Abuse

Apparent immersion pattern (especially with simultaneous burns on buttocks, genitals, and feet, or stocking/glove distribution)

Patterned contact burns

Other injuries concerning for abusive trauma or neglect

High Suspicion

Low Suspicion

Age < 2

Call CART
Pager: 3801-2509 or on-call attending per ~~ambien~~

Report to CYFD/LE*

Skeletal Survey
Head CT w/o contrast if indicated or < 6 months

Fill out Child Abuse reporting Ad-Hoc

Age ≥ 2

Call CART
Pager: 380-2509 or on-call attending per ~~ambien~~

Report to CYFD/LE*

Fill out Child Abuse reporting Ad-Hoc

Age < 2

Call CART
Pager: 380-2509 during business hours or leave message at non-urgent consult line 5-4495

No report to CYFD/LE* unless there is evidence of abuse/neglect

Age ≥ 2

No CART referral, CYFD/LE* report unless otherwise indicated

*Contact Numbers

CYFD = Children, Youth, and Families Department
Statewide Central Intake: 1-855-333-SAFE (7233)
LE = Law Enforcement
Dependent on location of alleged abuse, FBI/Tribal Services on tribal land
Albuquerque Police Department: 1-505-242-COPS (2677)
Bernalillo County Sheriff's Department: 1-505-867-2304

**Burn Care

All providers should collaborate to avoid unnecessary dressing takedown and discomfort of patients. Inform CART immediately and directly of the anticipated time, date, and location of sedated burn care to facilitate physical examination and photo documentation.

A Thriving New Mexican child and a pandemic puppy



Medical Evaluations in Physical Abuse: Fractures



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Objectives

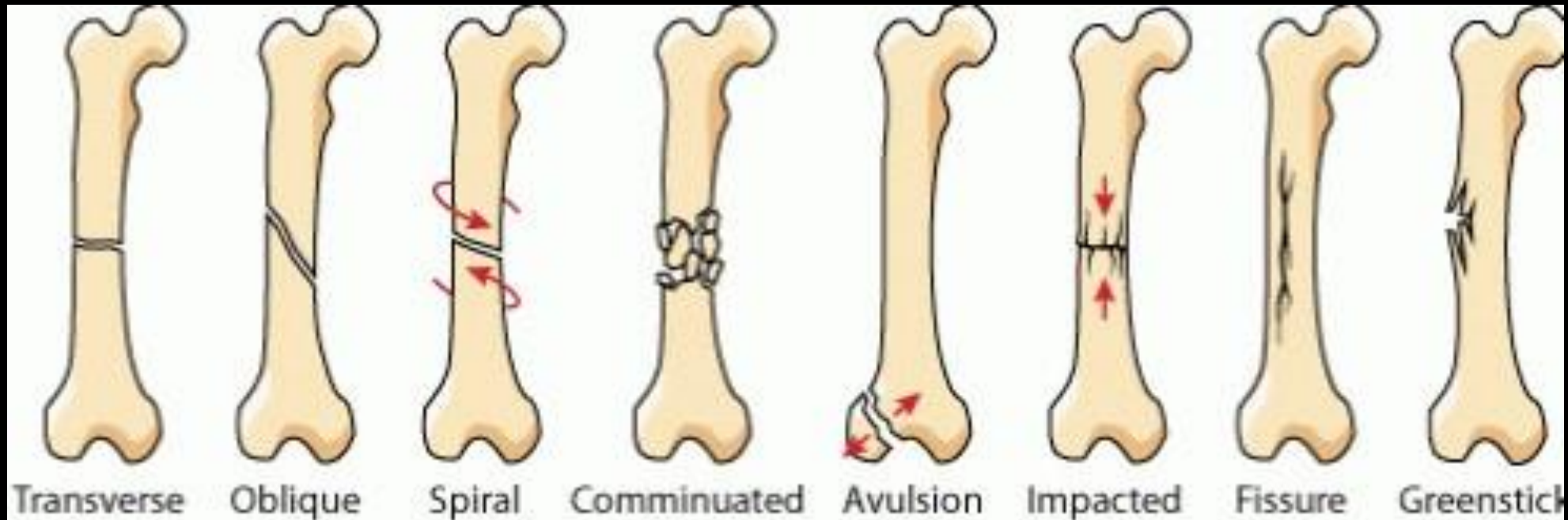
- Review different types/shapes of fractures
- Review the different levels of fracture specificity for abuse
- Discuss the concept of child development and mobility in context of fracture assessment
- Brief illustrative case review

Fractures

- Account for approximately 25% of childhood injuries
- $\frac{1}{4}$ of fractures in children <12 months are attributable to abuse

***There is no fracture type that is pathognomonic for abuse although some types are highly specific

Fracture Type/Morphology



Mechanics of Common Fractures

- **Transverse**
 - Direct blow or bending forces
- **Spiral**
 - Torsion (twisting) along longitudinal axis
- **Oblique**
 - Combined longitudinal compression and twisting
- **Buckle**
 - Axial loading (impaction)
- **Corner Metaphyseal Fracture**
 - Combined twisting and extraction

Literature Favorite

Evaluating long bone fractures in children: a biomechanical approach with illustrative cases[☆]

Mary Clyde Pierce^{a,*}, Gina E. Bertocci^b, Eva Vogeley^c, Morey S. Moreland^d

Child Abuse & Neglect 28 (2004) 505–524

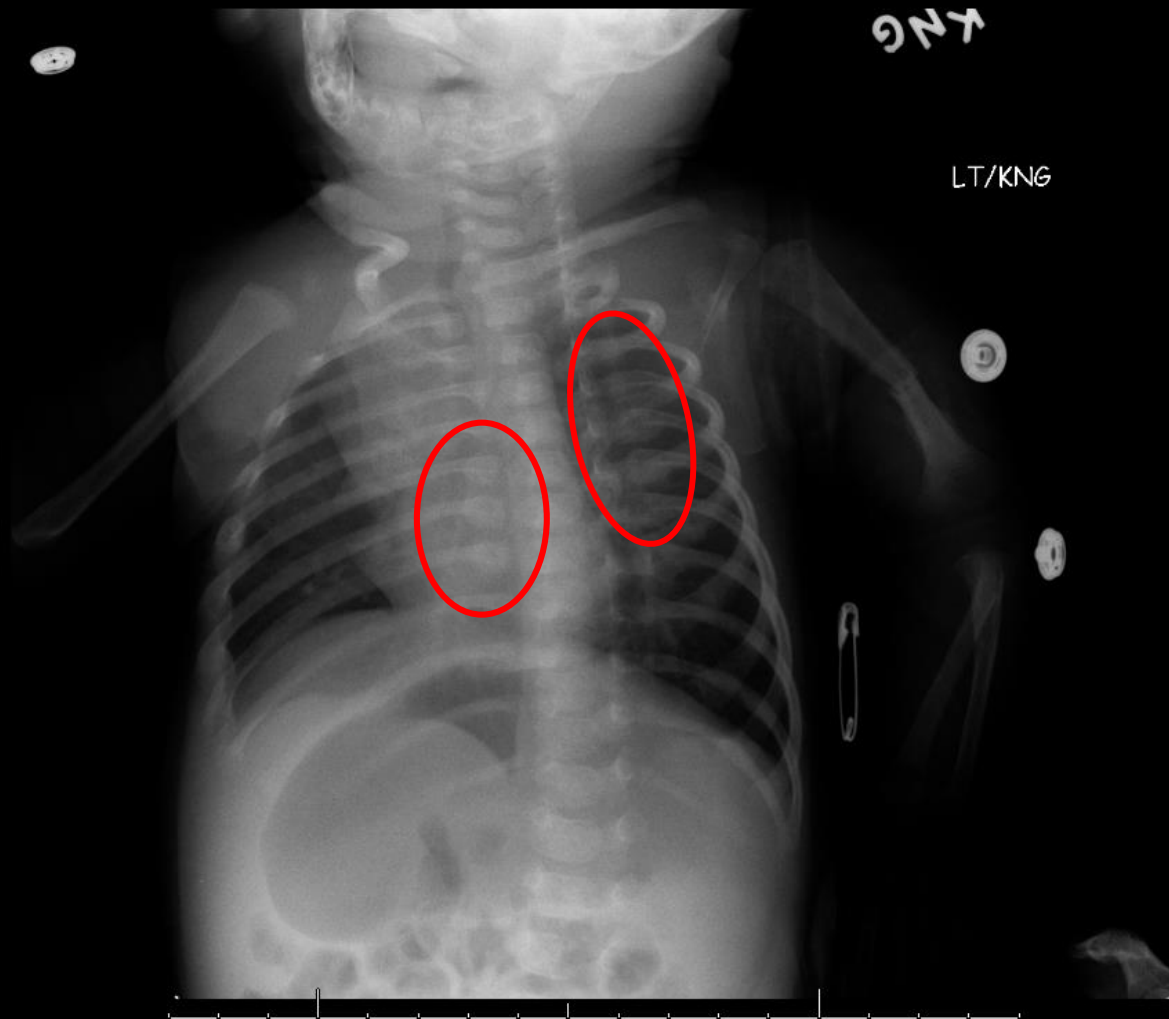
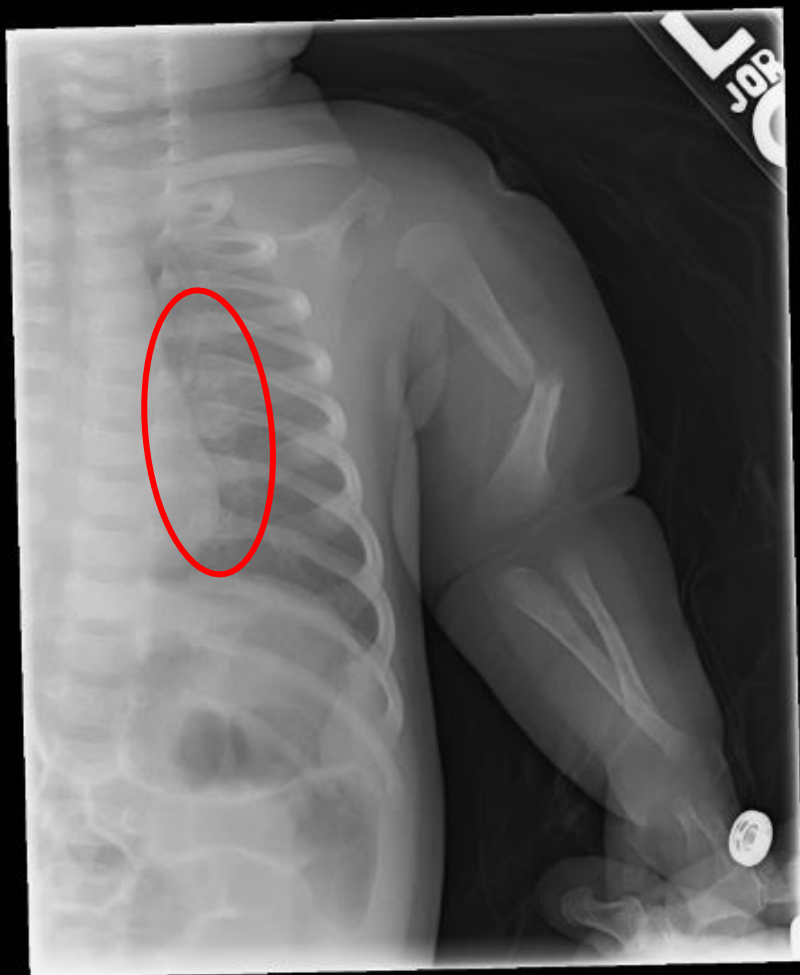
Highly Specific Fractures

- Corner Metaphyseal Fractures
- Rib fractures – especially posterior
- Scapular fractures
- Sternal Fractures

Corner Metaphyseal Fracture – AKA Bucket Handle Fracture/Corner Metaphyseal Lesion



Rib Fractures



Moderately Specific Fractures

- Multiple – Especially bilateral
- Fractures of different ages
- Vertebral body fractures
- Finger fractures
- Complex skull fractures

Non-Specific Fractures

- Diaphyseal (shaft of long bone) fractures
- Mid-shaft clavicle (collarbone) fractures
- Linear skull fractures

How Can You Be Sure?

Understand biomechanics of injury and child development

- Does mechanism of injury fit the type of fracture?
- Fractures in a non-ambulatory child should always be questioned
- Interpret history in the context of age, development, and mobility of child

Femur Fracture



- 2 year old female fell backward while trying to climb out of a hanging tire swing at the park.

Femur Fracture



- 2 month old male, inconsolable with no history of trauma.
- ***Age/development/mobility are key features of injury interpretation

❖ **RED FLAGS** when considering a suspicious fracture

- Confessed abuse or injury that was un-witnessed
- Trauma history is absent, vague, or changing
- History is not consistent with injury or developmental stage of patient
- Delay in seeking care
- Additional concerning injuries- i.e. bruising or burns
- Prior ED visit for injuries
- Femur or Tibia fracture in a non-ambulatory child
- Injury occurred during domestic violence

FRACTURE SPECIFIC RED FLAGS

- Multiple fractures, especially bilateral
- Fractures of different ages/stages of healing
- Epiphyseal separations

*** IMPORTANT PATHWAY DEFINITIONS**

- **Toddler's fracture**- spiral fracture of the tibia/fibula in ambulating child, usually non-displaced and not usually sign of child abuse
- **Classic metaphyseal lesion**- planar fractures through metaphysis of long bones due to torsional/tractional shearing strains occurring with vigorous pulling or twisting; radiographically appear as corner or bucket handle fracture. These are pathognomonic for child abuse
- **Standard fracture labs**- calcium, phosphorous, Vitamin D25OH, intact parathyroid hormone, alkaline phosphatase

CHILD WITH A SUSPICIOUS FRACTURE

- File a report with CYFD (1-855-333-7233)
- Consult the Child Abuse Response Team (CART) per amion.com

$0 \leq 12$ months

ANY fracture **except**:

- Linear parietal skull fracture with fall ≥ 2 feet
- Clavicle fracture due to birth trauma
- Toddler's fracture in ambulatory infant*

See red flags❖

- Skeletal survey
- If positive skeletal survey, order standard fracture labs*
- CBC, CMP
- Abdominal CT if LFTs > 80
- Head CT for any infant < 6 months
- If positive head CT, order ophthalmology consult

$12 \text{ months} \leq 2$ years

- Rib fracture
- Classic metaphyseal lesion*
- Complex skull fracture
- Humeral fracture after short fall < 3 feet
- Femur, vertebral, sternal, or scapular fractures

See red flags❖

- Skeletal survey
- If positive skeletal survey, order standard fracture labs*
- CBC, CMP
- Abdominal CT if LFTs > 80

2 – 5 years

Fracture associated with high suspicion for abuse

See red flags❖

- Skeletal survey if high suspicion for abuse, and per review with CART
- If positive skeletal survey, order standard fracture labs*
- CBC, CMP
- Abdominal CT if LFTs > 80

> 5 years

Fracture associated with high suspicion for abuse

See red flags❖

- Skeletal survey **ONLY** if clinically indicated, and per review with CART
- If positive skeletal survey, order standard fracture labs*
- CBC, CMP
- Abdominal CT if LFTs > 80



Medical Evaluations in Physical Abuse: Head Trauma



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Objectives

- Understand unique risk factors for abusive head trauma in infants
- Describe general mechanism of abusive head trauma
- Review common clinical and imaging findings in abusive head trauma

Abusive Head Trauma

- Leading cause of morbidity and mortality from physical abuse
- Common in young infants who have been crying inconsolably
- Risk factors for head trauma due to shaking in infants
 - Large head, weak neck, small body size, incomplete development of central nervous system

Abusive Head Trauma Mechanisms

- Impact

- Skin injury
- Skull fracture
- Intracranial hemorrhage, brain contusion or laceration (that result from skull deformation)

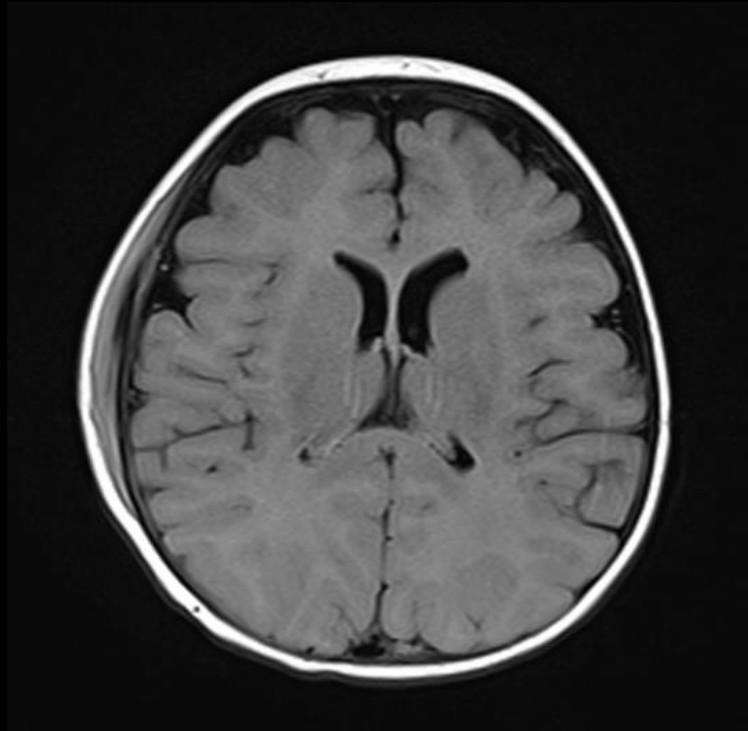
- Shaking

- head acceleration/ deceleration

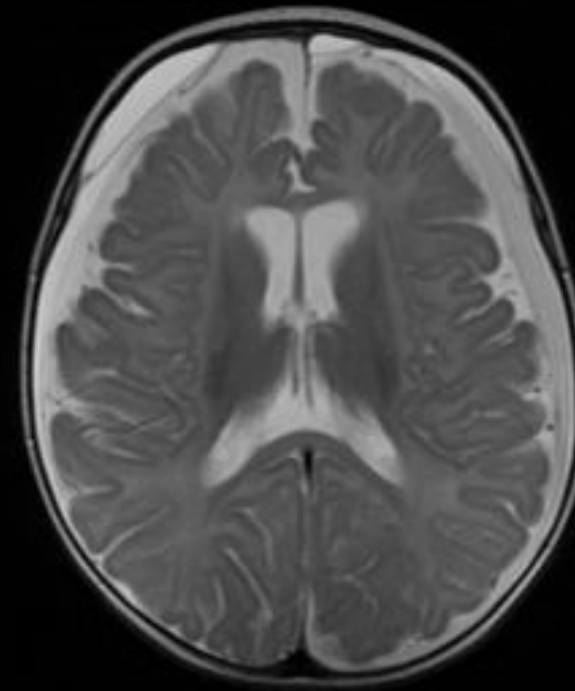
- Often rotational
- Forces transmitted through the neck or cranial impact
 - Concussion
 - Subdural hemorrhage-torn bridging veins
 - Associated Subarachnoid hemorrhage, brain contusion or laceration (that results solely from rotational cranial acceleration)
 - Deep brain injuries

Identification of Abusive Head Trauma – CT Scan

Primary Injury- Contact



Primary Injury- shaking



Identification of Abusive Head Trauma

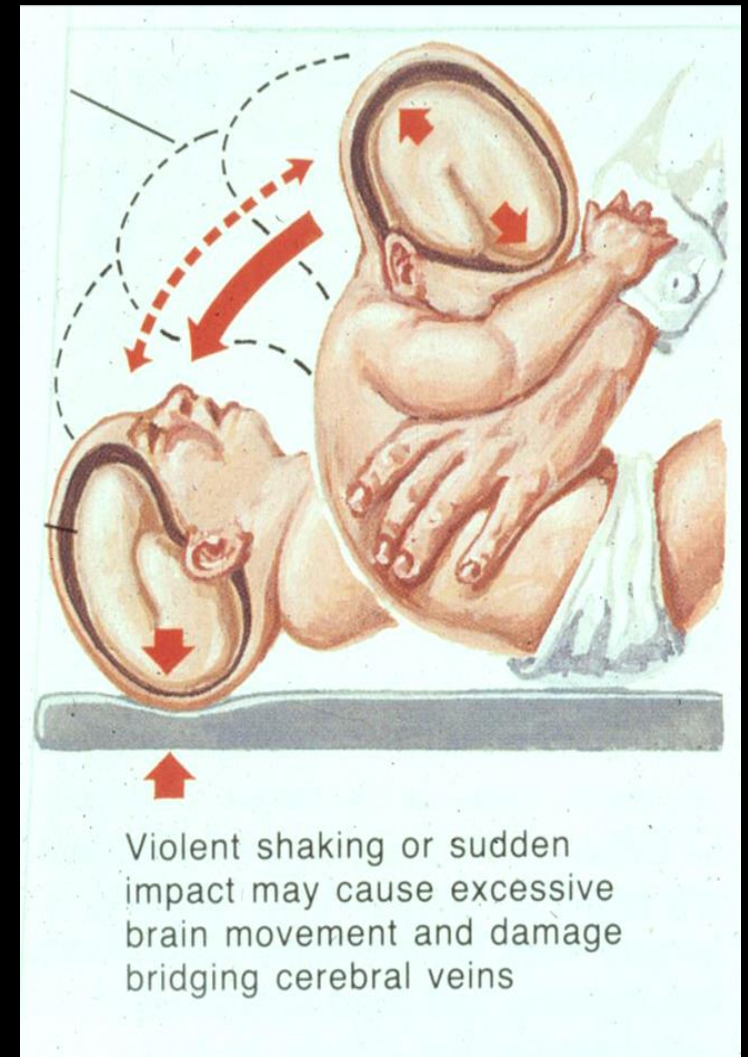
Subdural Hemorrhage (SDH)

- May occur from contact/impact force
 - Deformation of the skull
 - Occurs on the side of impact
 - Usually associated with other impact injury (fracture/soft tissue injury)
- May occur from noncontact force
 - Due inertial forces; acceleration, deceleration
 - Dura is fixed to the skull, and brain is free to move relative to dura → stress on veins
 - Unilateral or bilateral, often inter-hemispheric, usually small volume
- May occur from combination of forces
 - Impact to the head which results in inertial forces on the brain

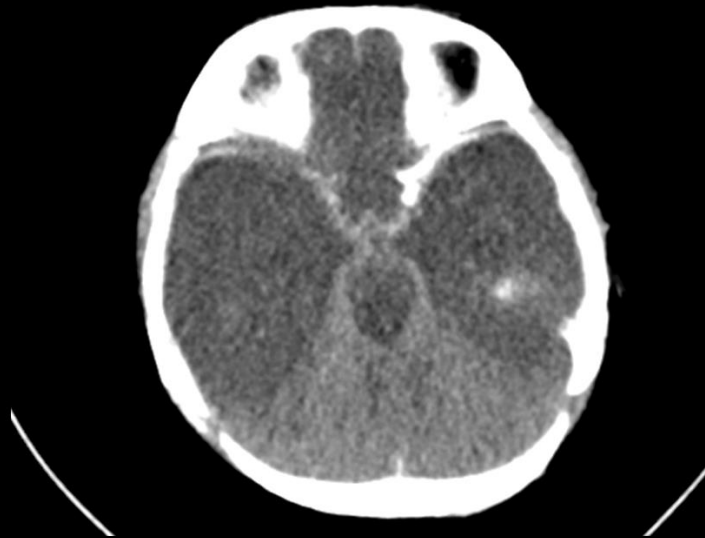
Identification of Abusive Head Trauma

Brain Tissue Injuries

- Parenchymal Contusions (brain bruise)
 - Contact or shaking forces
- Traumatic/Diffuse Axonal Injury
 - Shaking forces
 - Shearing of brain tissue at the grey-white matter interface
 - Focal or widespread
 - Associated with worse outcome



Identification of Abusive Head Trauma



Cor

- **Secondary injury**
- Results from biochemical and metabolic responses to primary injury
- Injury to the brain
 - Ischemia (lack of blood flow)
 - Inflammation
 - Hypoxia (lack of oxygen)
 - Cell death – infarction/stroke

Abusive Head Trauma

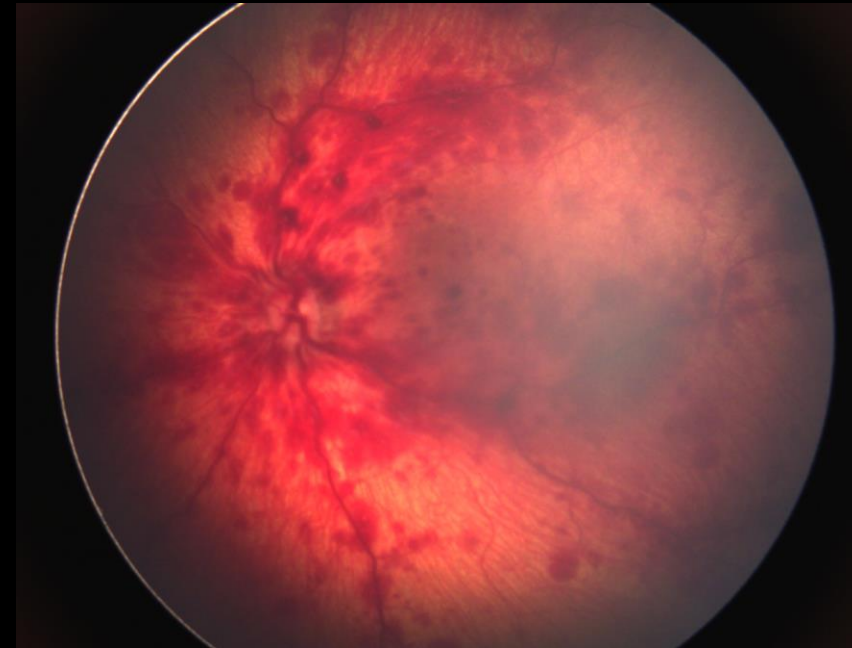
- Possible presentations
 - irritability, lethargy, vomiting, apnea (not breathing), loss of consciousness, seizures
- Obvious external injury (scalp bruising) may minimal or absent, even with impact injury!
- There is often no history of trauma or history of minimal trauma such as a short fall prior to onset of symptoms

Abusive Head Trauma

- Ophthalmologic (Eye) Exam
 - Up to 80% of children with abusive head injury have retinal hemorrhages
 - unilateral or bilateral
 - Severe hemorrhagic retinopathy is very specific for abusive head injury
 - visual outcome variable and most dependent on brain injury

Retinal Hemorrhages (RH)

- RH caused by many conditions
 - Usually few in number
 - Usually only in the back of the eye
 - Usually in only one layer of the retina
- RH caused by AHT
 - Too numerous to count
 - Involving multiple layers
 - Extending forward to the ora serrata
 - Especially if retinoschisis is present
- Retinoschisis does not occur in the setting of medical disease alone!



Rafting the Rio Chama



BONUS: Sentinel Injuries in Physical Abuse

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Objectives

- Define sentinel injury
- Identify common presentations of sentinel injury
- Sentinel injury case review
- Review recommended medical evaluation in presentations of sentinel injuries

Definitions of Sentinel Injury

- A visible or otherwise detectable minor injury in a **pre-mobile** infant that is poorly explained therefore concerning for child abuse
 - Often clinically insignificant from a treatment perspective
 - Heal quickly and completely without direct sequelae
 - Often recognized retrospectively

Types of Sentinel Injury

- Sentinel Injury breakdown
 - 80% bruises
 - Including subconjunctival hemorrhage
 - 11% Moth injury
 - 7% fracture*

Sheets, L. et al. Sentinel Injury in Infants Evaluated for Child Physical Abuse. Pediatrics 2013;131:701-707.

Case

- 3-month-old infant, presented to community ED after father reported noting a “pop” after infant’s arm inadvertently became stuck behind his back during swaddling.

Case

- X-ray identified acute oblique mid to distal diaphyseal fracture of the left humerus.
- Father then changed history stating he fell while holding the baby, and the baby's arm was outstretched.
- CYFD/Law Enforcement notified and infant transferred to UNM for Child Abuse Pediatrics consult

Acute humerus fracture



Case

- Child Abuse Pediatric exam notable for healed transection of superior labial frenulum, left upper arm swelling, and multiple linear petechial bruises on the left leg
- No additional injuries identified on skeletal survey and head CT

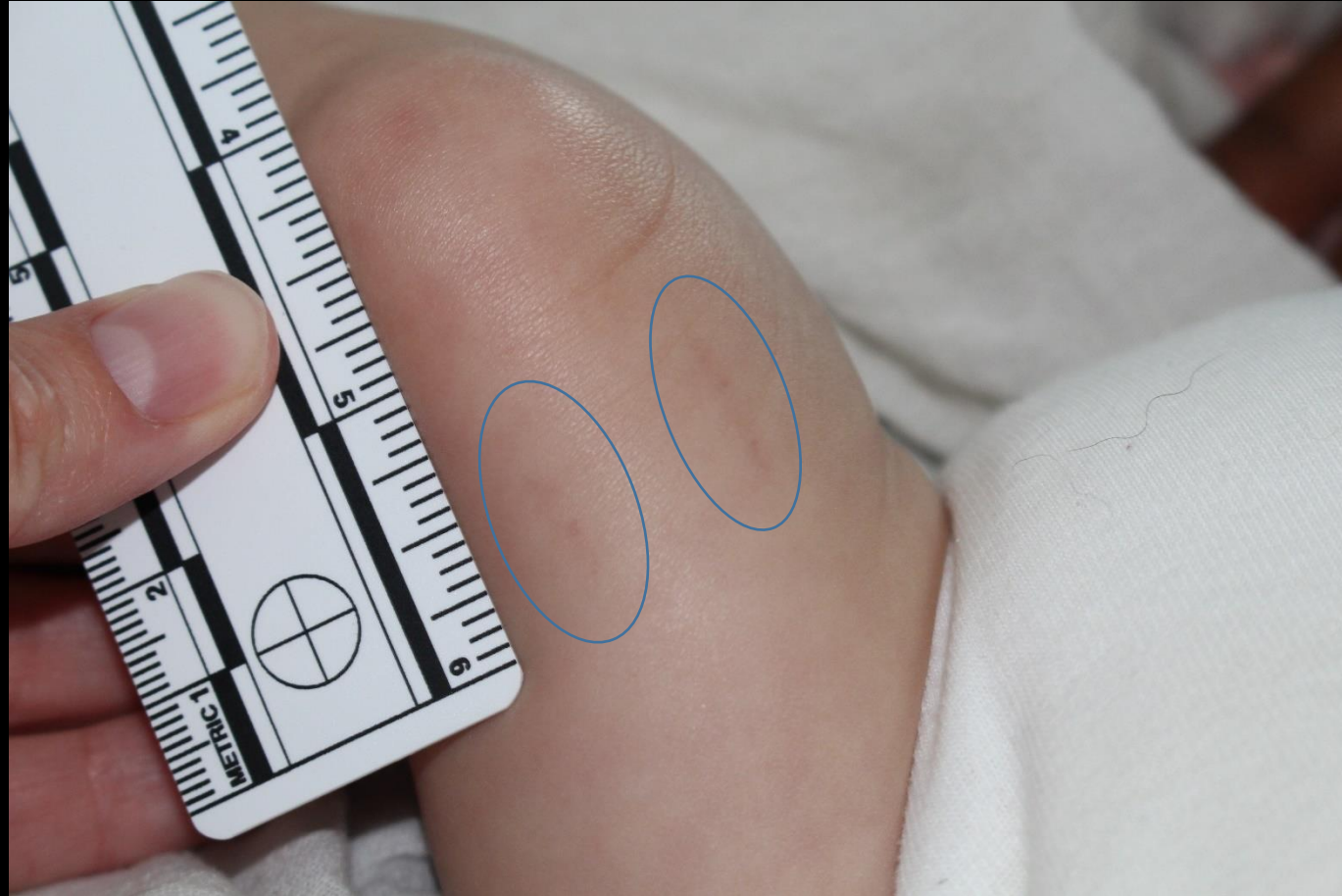
Healed tear of superior labial frenulum



Linear petechial bruise (medial left knee)



Linear petechial bruises (left anterior thigh)



Multiple linear petechial bruises (posterior left thigh)



Case

- CART medical record review revealed UNM Peds ED visit approx. 2 weeks prior and admission for fussiness, poor feeding, and intermittent bleeding of a “lesion” on the mucosa of the central upper lip, pointed out by father to clinicians.
 - No trauma history was reported
 - 3 day admission with initial IVF requirement
 - Discharge without clear “inciting” event identified, no referral to protective services or child abuse pediatrician

Acute and Healing Superior Labial Frenulum Tears



Medical Evaluation in Sentinel Injury

- IMAGING
 - SKELETAL SURVEY (SS)
 - 11-13% of children <2 years of age evaluated for suspected abuse have occult injury on SS
 - 25-30% of children <2 years of age with a clinical diagnosis of physical abuse have occult injury on SS

Belfer, RA et al. Use of the skeletal survey in the evaluation of child maltreatment. Am J Emer Med. 2001; 19(2):122-124

Day, F et al. A retrospective case series of skeletal surveys in children with suspected non-accidental injury. J Clin Forensic Med. 2006; 13(2): 55-59

Medical Evaluation in Sentinel Injury

- NEUROIMAGING (Non-contrast Head CT or MRI)
 - Approx. 30-40% of neurologically normal children < 2 years of age with high risk presentation for abuse have occult head injury identified on imaging.
- Laskey, A et al. Occult head trauma in young suspected victims of physical abuse. J Pediatr. 2004;144:719-722
- Rubin, D et al. Occult head injury in high risk abused children. Pediatrics. 2003;111:1382-1386.

Questions?

