MEDICAL ASPECTS OF PEDIATRIC ABUSIVE HEAD TRAUMA

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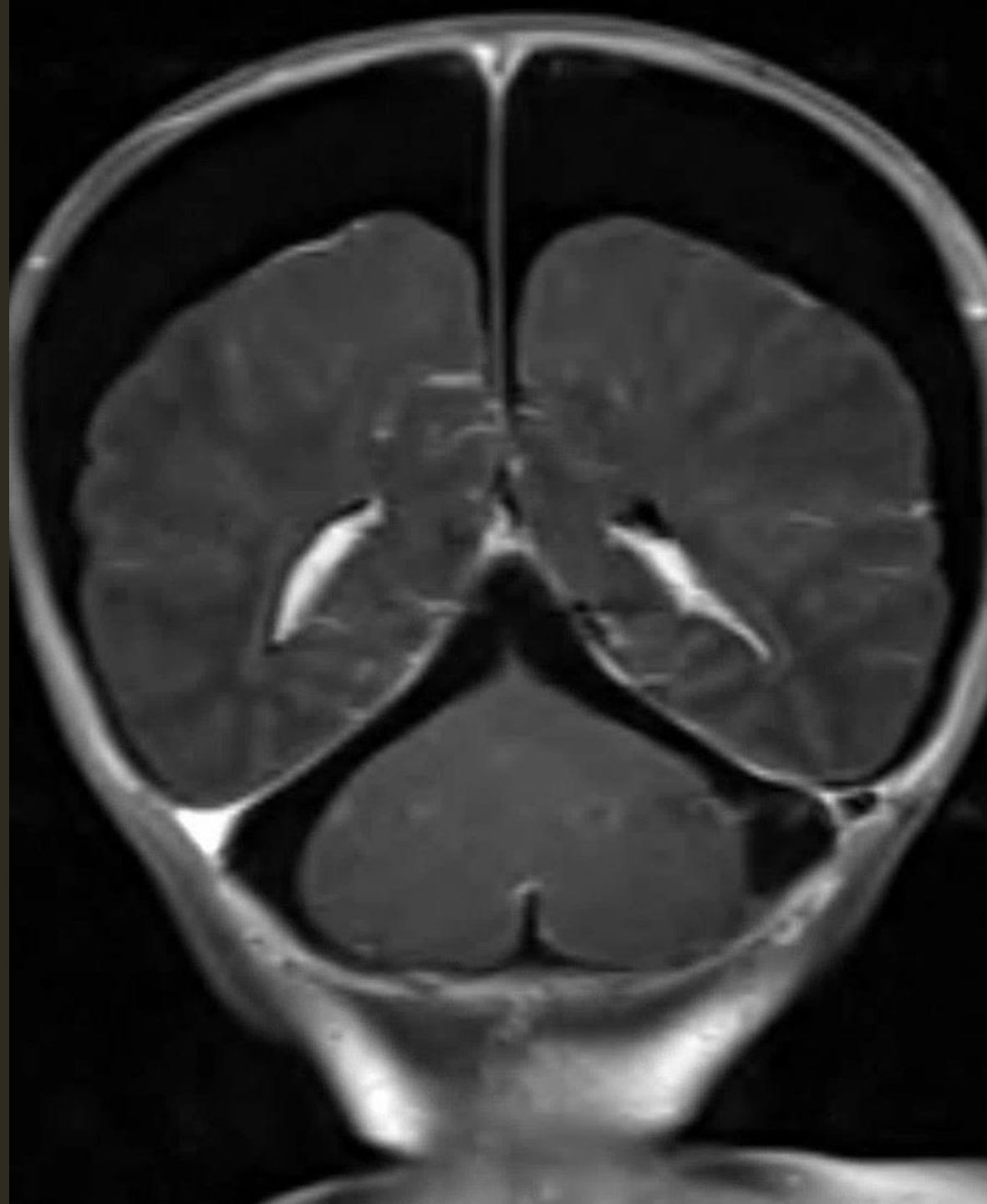
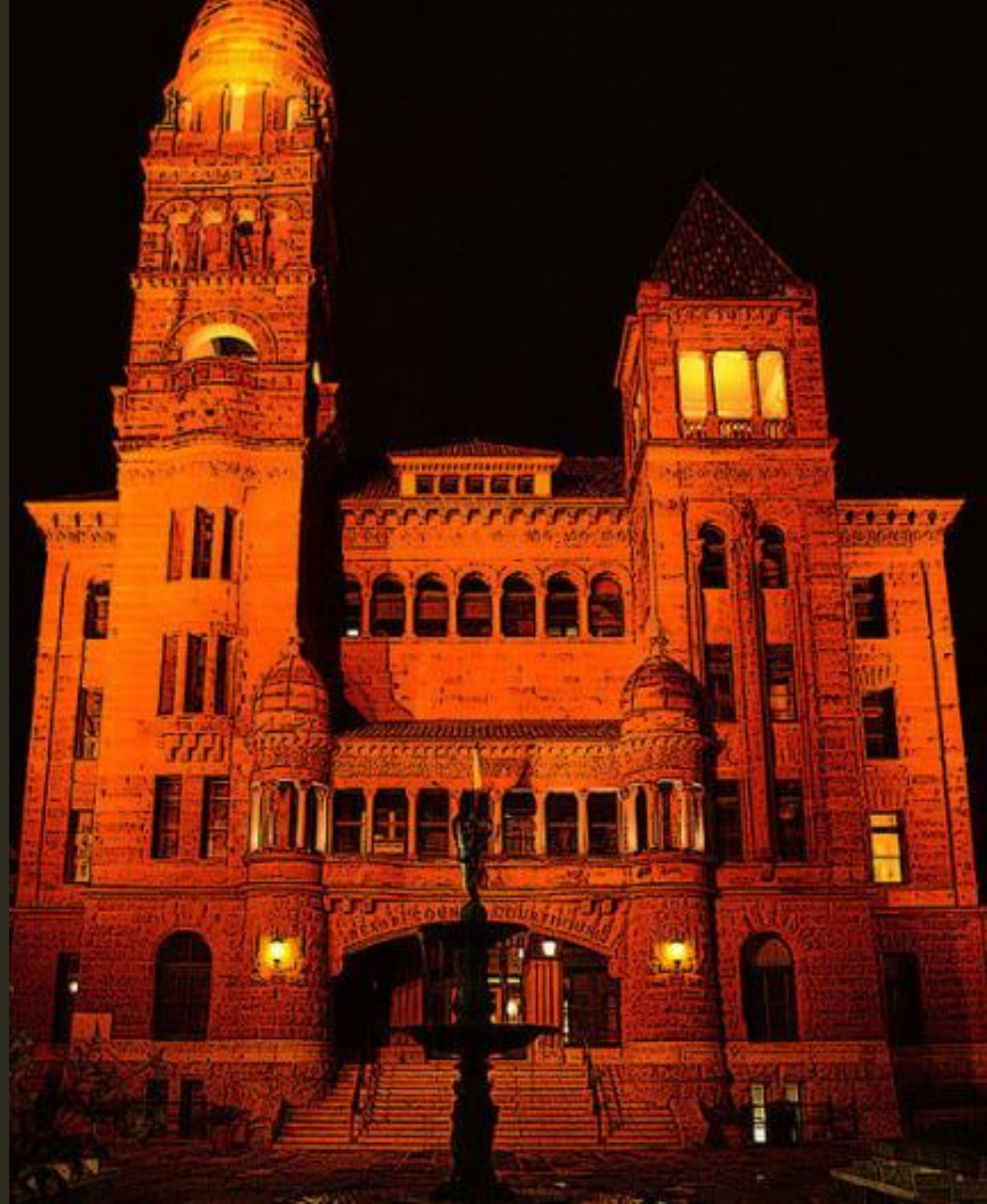


UT Health
San Antonio
The University of Texas
Health Science Center at San Antonio

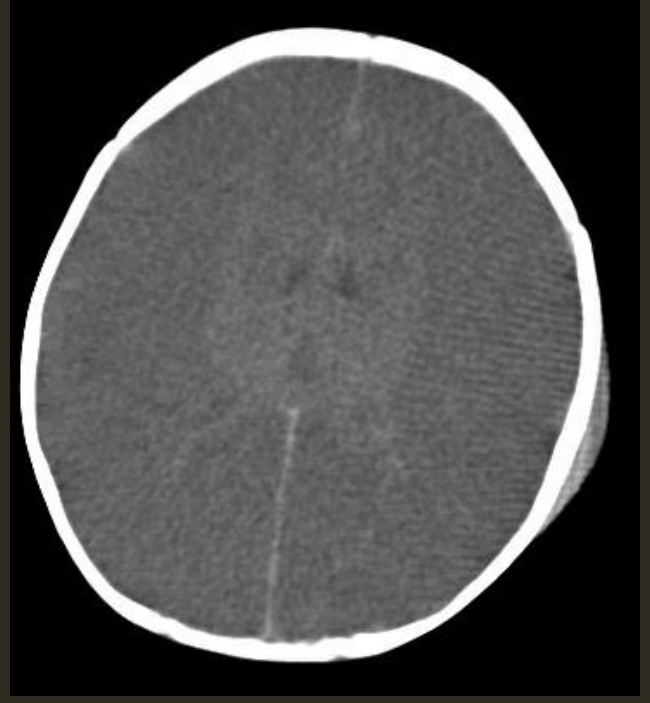
DISCLOSURE

I provide expert testimony in child abuse cases.



CASE 1 – CLINICAL SCENARIO

- 3 month old male with altered mental status while in care of grandmother's boyfriend
- Reportedly hit his head on a steering wheel and fell to the car floor when boyfriend slammed on breaks



CASE 1 – CLINICAL SCENARIO

- Subdural hematomas
- Bilateral retinal hemorrhages
- Multiple fractures of different ages:
  - Rib fractures
  - Classic metaphyseal lesions
  - Skull fracture
  - Radius fracture
- Fatal abusive head injury

OBJECTIVES

1

Determine which head injuries and fractures should raise concern for physical abuse

2

Understand the types of forces required to produce various injuries

3

Be familiar with other conditions that may mimic abusive injuries

ABUSIVE HEAD TRAUMA

- Head injury is the most common cause of death in child abuse cases
- Around 25% of all hospital admissions of infants and children with head injuries are non-accidental
- Mortality of abusive head trauma is ~25%
  - Significantly higher for children with inflicted injury compared to accidental injuries

TYPES OF HEAD INJURY

External head injury

- Scalp / ear bruising indicates contact
- Often absent even in fatal injuries

Skull fractures

Intracranial trauma

- Epidural hematomas
- Subdural hematomas
- Parenchymal injury

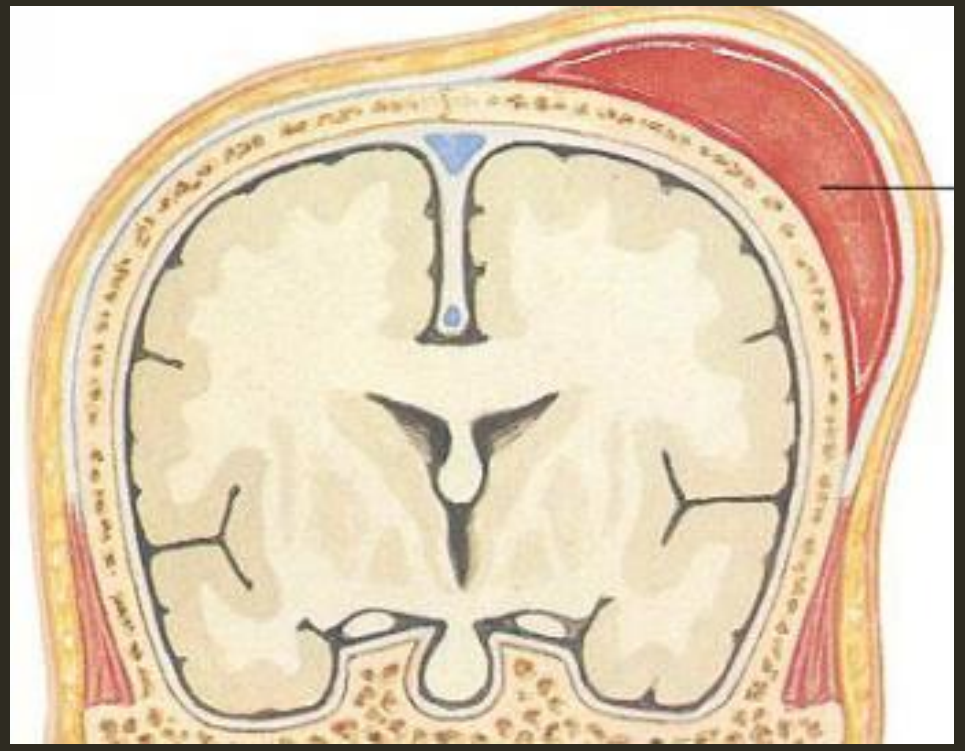
EAR INJURIES

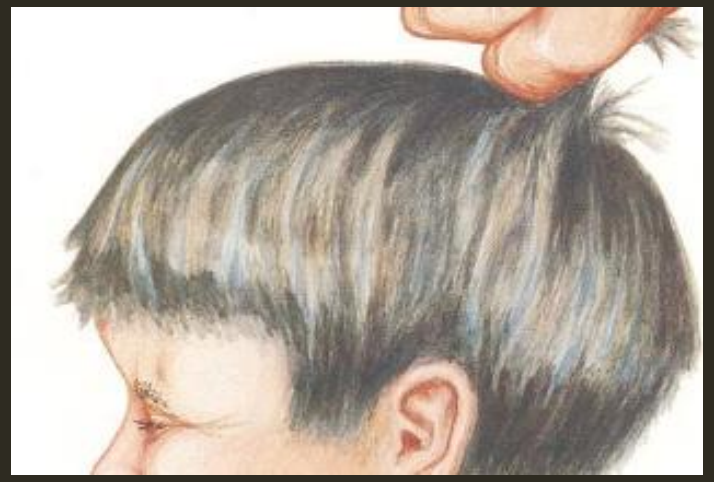
Ear bruising is concerning in a child of any age

EAR INJURIES

- Left auricular hematoma in a 6 week old female with 3 day history of ear swelling
- Mother reported that 1 year old brother hit her with a sippy cup

EAR INJURY?





SUBGALEAL HEMATOMA

- Scalp bleeding in the potential space between the periosteum and the galea aponeurosis
- Presents with boggy mass over scalp
- Swelling increases gradually over several hours to days
- Patients may develop raccoon eyes

SUBGALEAL HEMATOMA

- Per mother, “He is learning how to walk. He bumps into things. It’s nothing major.”
- Photographs 24 hours apart

SKULL FRACTURES

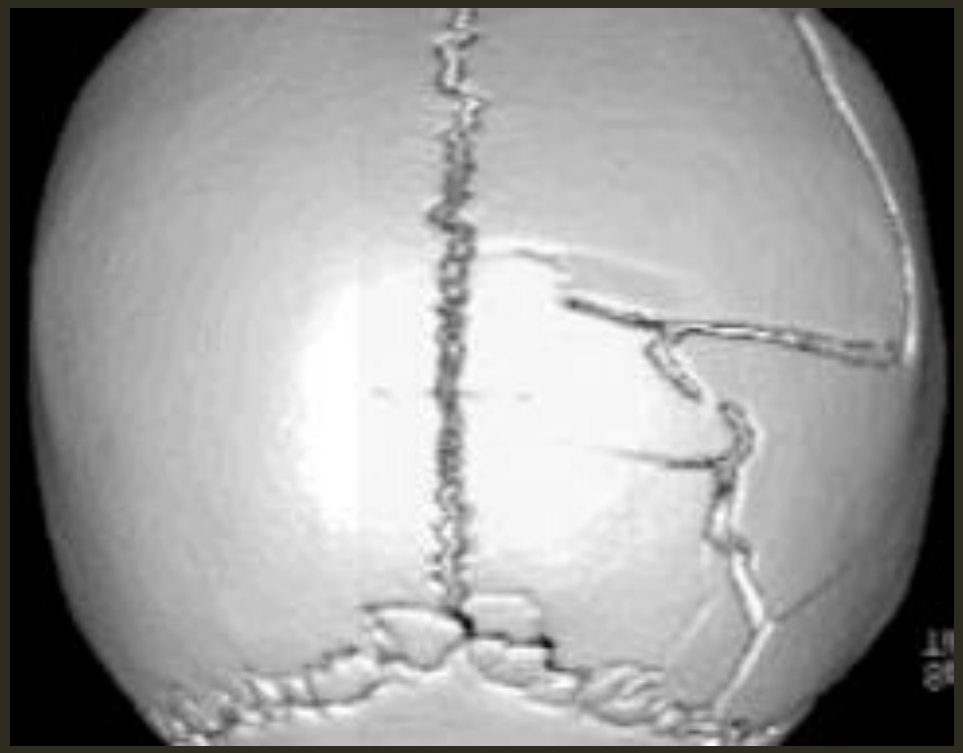
- Most common fracture in children less than 2 years of age
- Proportion of skull fractures secondary to abuse (0-35 months) is low (12%)
- Second most common fracture attributable to abuse overall
- Result from impact to the head
- Most often affect the parietal bones

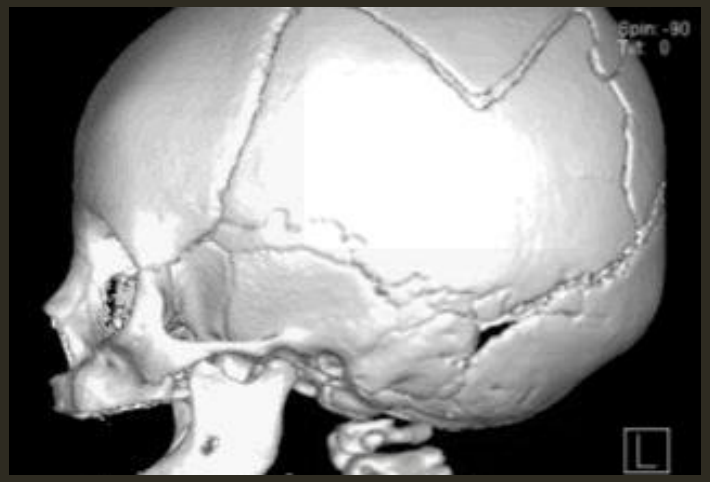
TYPES OF SKULL FRACTURES

- Single linear – unbranched line
- Complex – a fracture with multiple components, including branching
- Depressed – skull has an inward displacement of the bone, normal curvature is disrupted

LINEAR SKULL FRACTURE

- 5 month old who “rolled off futon” while in care of mother’s boyfriend
- Cried immediately, then easily consoled, no other symptoms
- Simple linear left parietal skull fracture





COMPLEX SKULL FRACTURE

- 5 month old in unrestrained car seat when driver “turned a corner too fast and caused him to fall onto the floor of the car”
- Complex fracture involving multiple bones

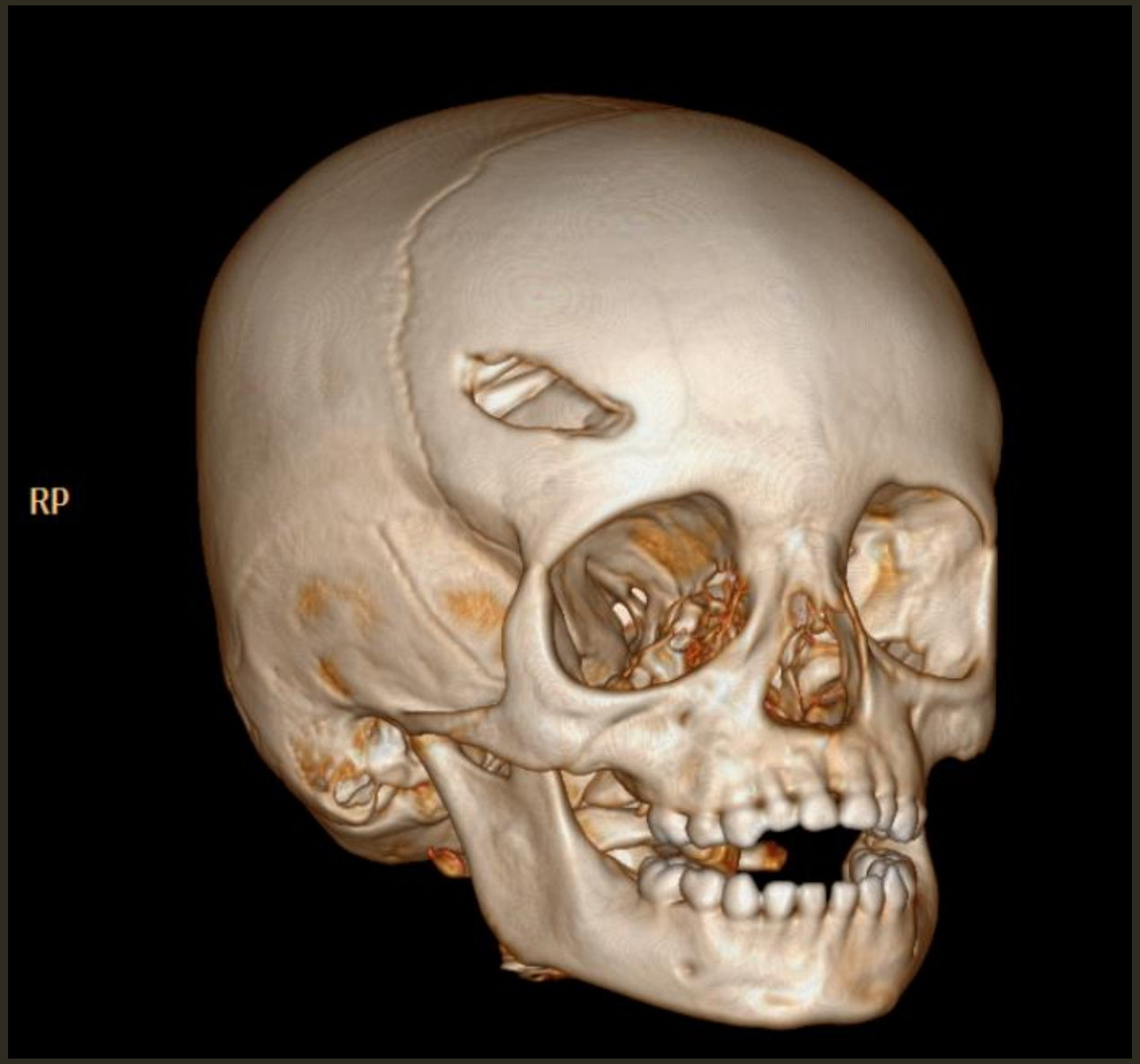
ABUSIVE HEAD TRAUMA

- Patterned and non-patterned, multiplanar facial bruising with petechial component
- Evidence of multiple impacts to the head

RES/SHAD

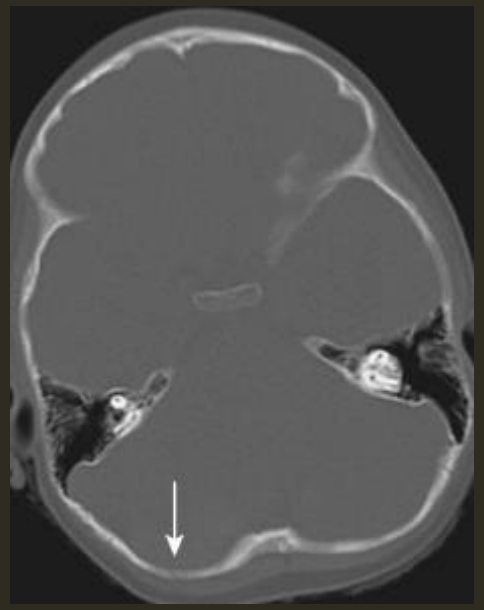
DEPRESSED SKULL FRACTURE

- 2 year old whose father “gently tossed the iPad to his son because he wanted to watch cartoons”
- Depressed skull fracture of the right frontal bone



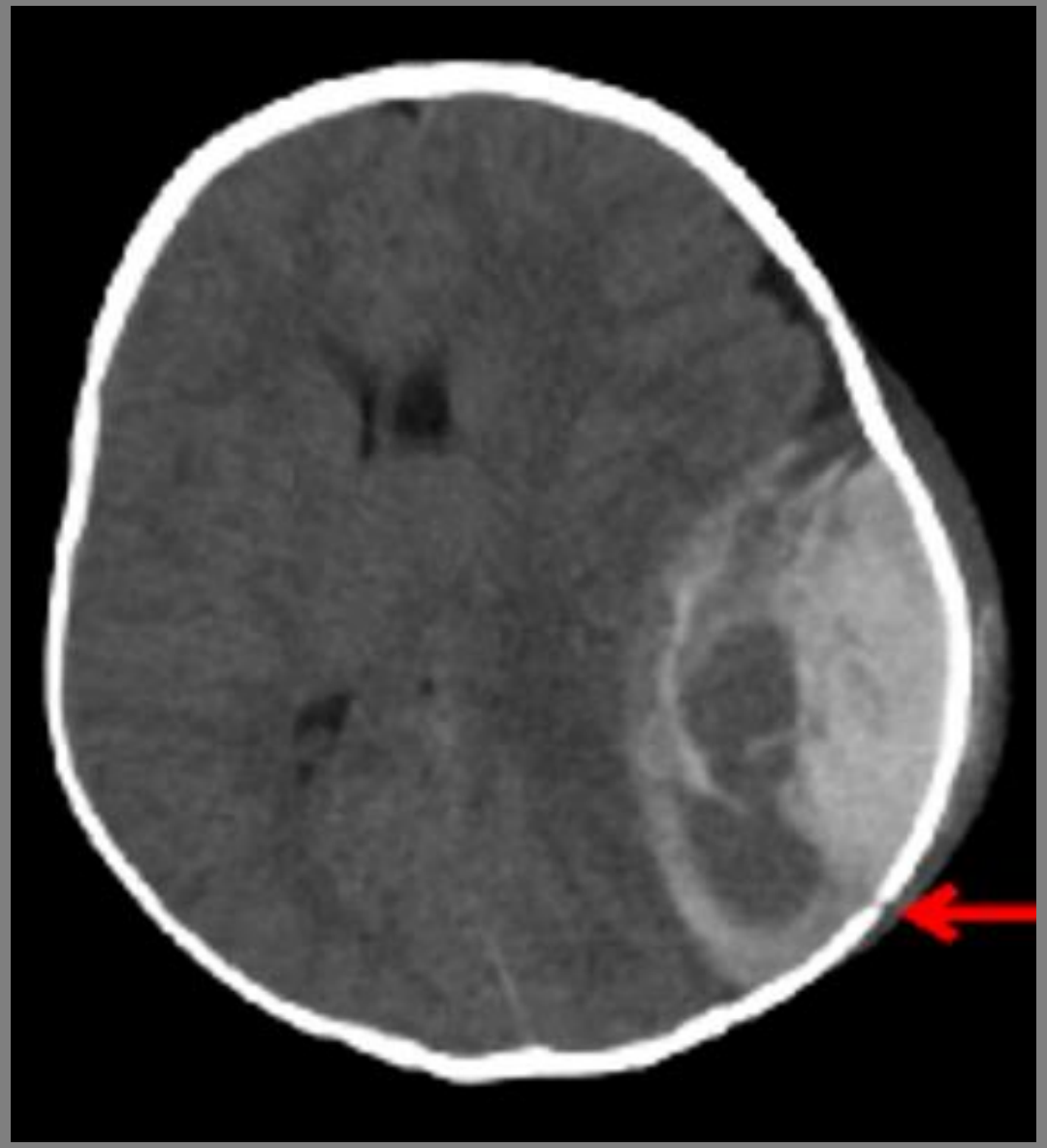
SKULL FRACTURE WITH EPIDURAL HEMATOMA

- Skull fractures are present in 80-90% of impacts resulting in epidural hematomas
- Not common in abusive head trauma

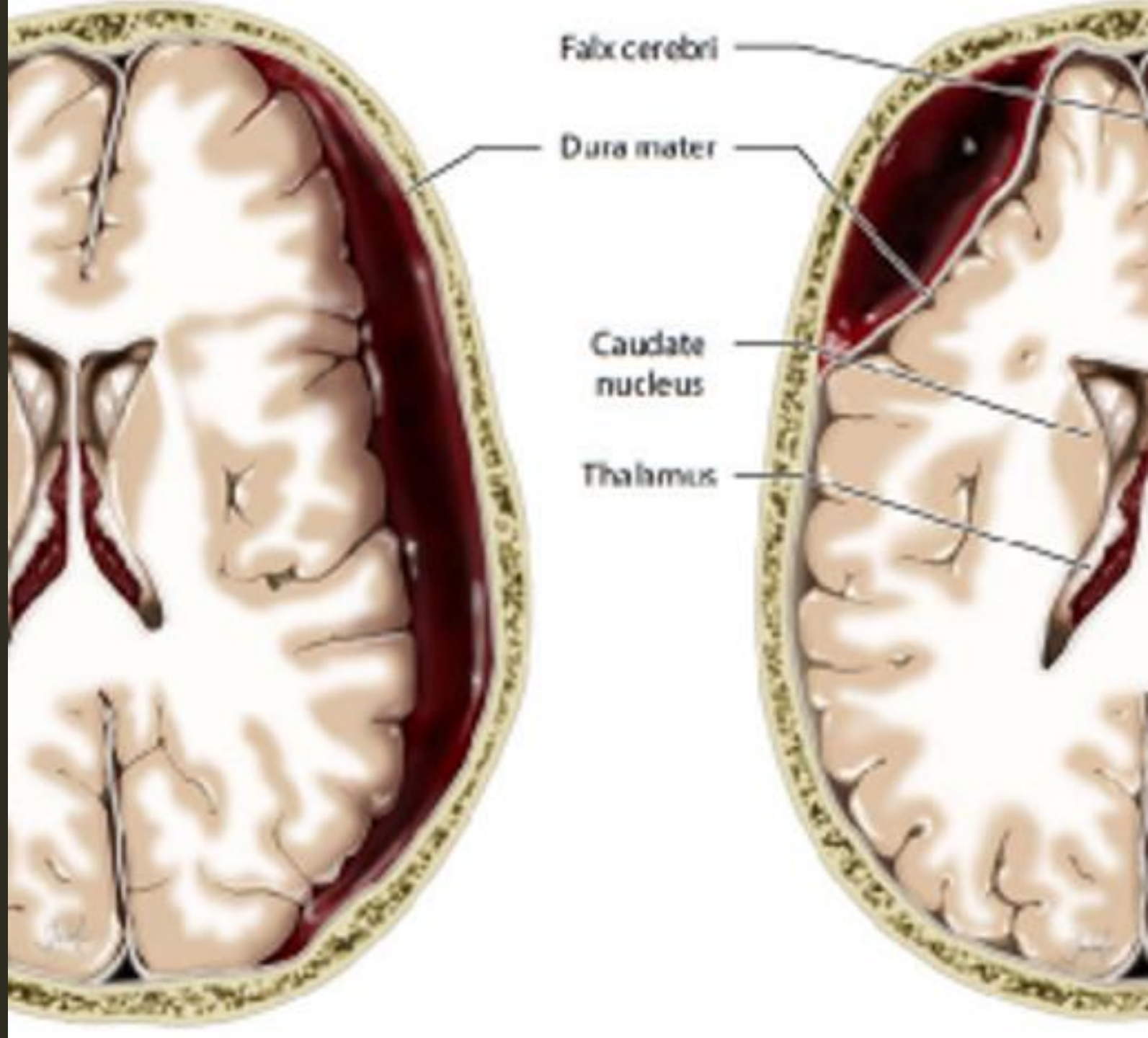


EPIDURAL HEMATOMA

- Usually accidental
- Life-threatening



SUBDURAL VS. EPIDURAL



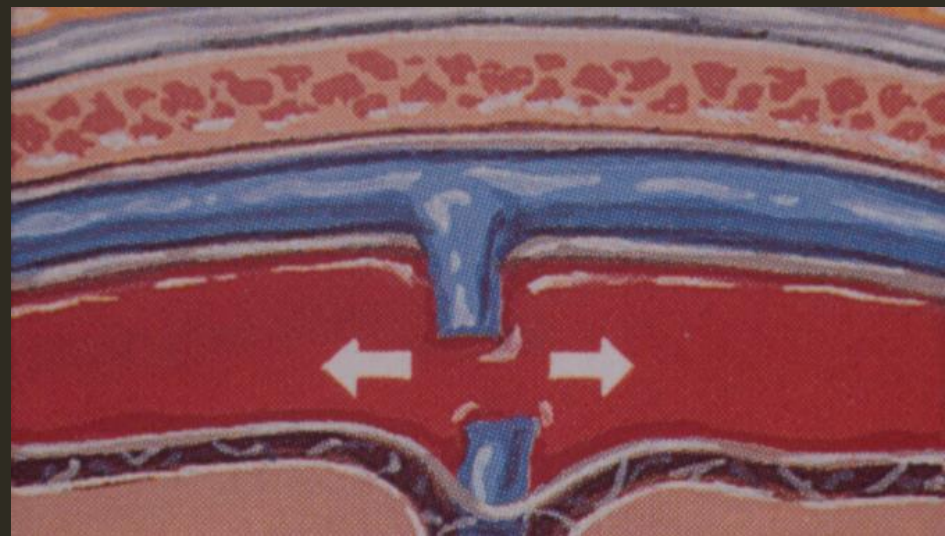
SUBDURAL HEMORRHAGE

- The characteristic CNS lesion in abusive head trauma
- Occurs when a frustrated caregiver shakes and / or slams a child onto a surface
- "The act of shaking / slamming is so violent that competent individuals observing the shaking would recognize it as dangerous."

  -AAP

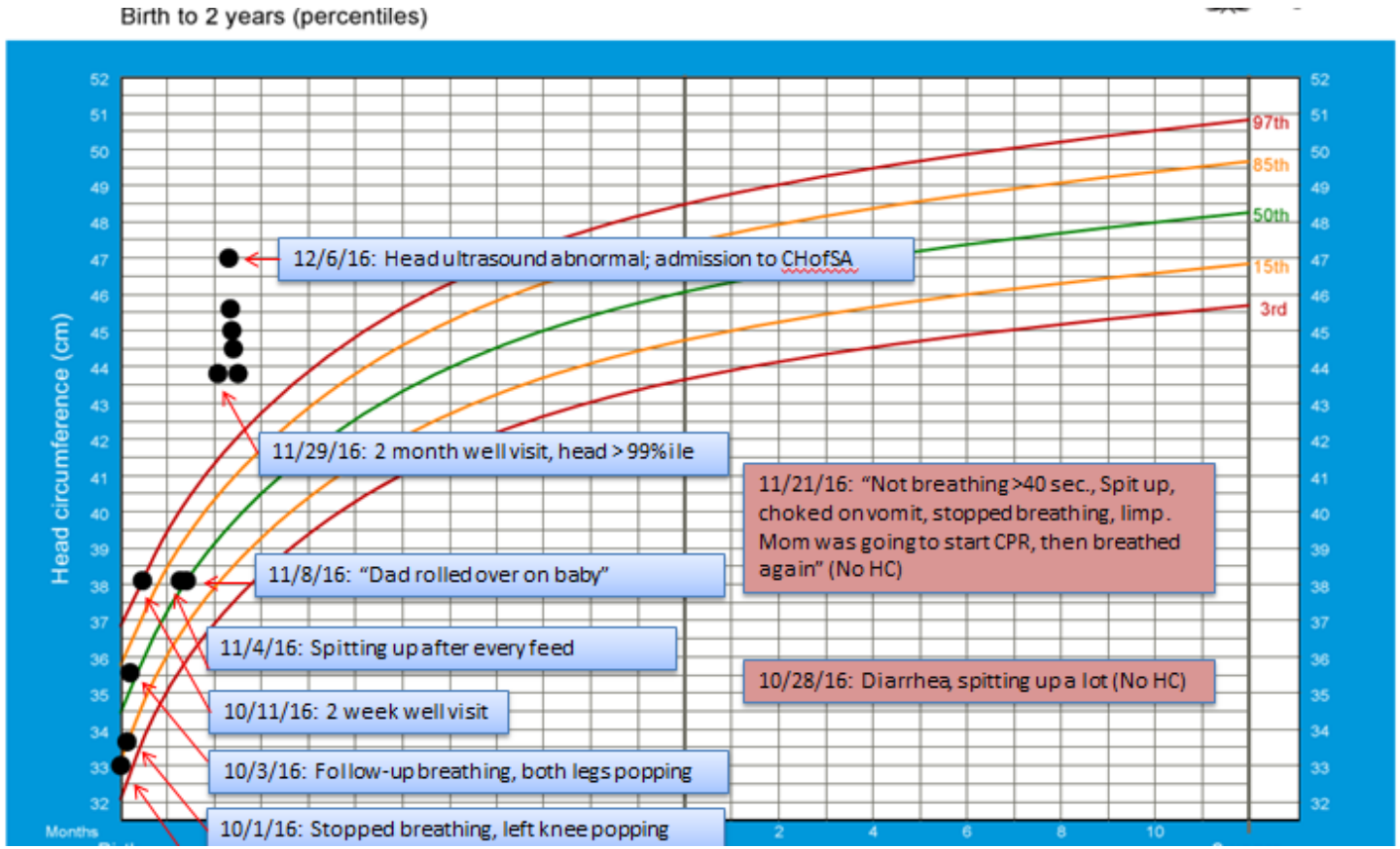
SUBDURAL HEMORRHAGE

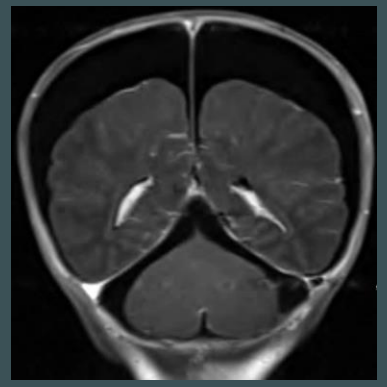
- Extreme acceleration-deceleration forces, with or without impact, cause the brain to move at a different rate of speed than the venous sinuses and calvarium
- Causes stretching and tearing of the bridging veins



SUBDURAL HEMORRHAGE

- 3 month old with sudden increase in head circumference
- SDH covering entire convexity of the brain, including posterior fossa
- Bilateral retinal hemorrhages
- Several fractures in different stages of healing

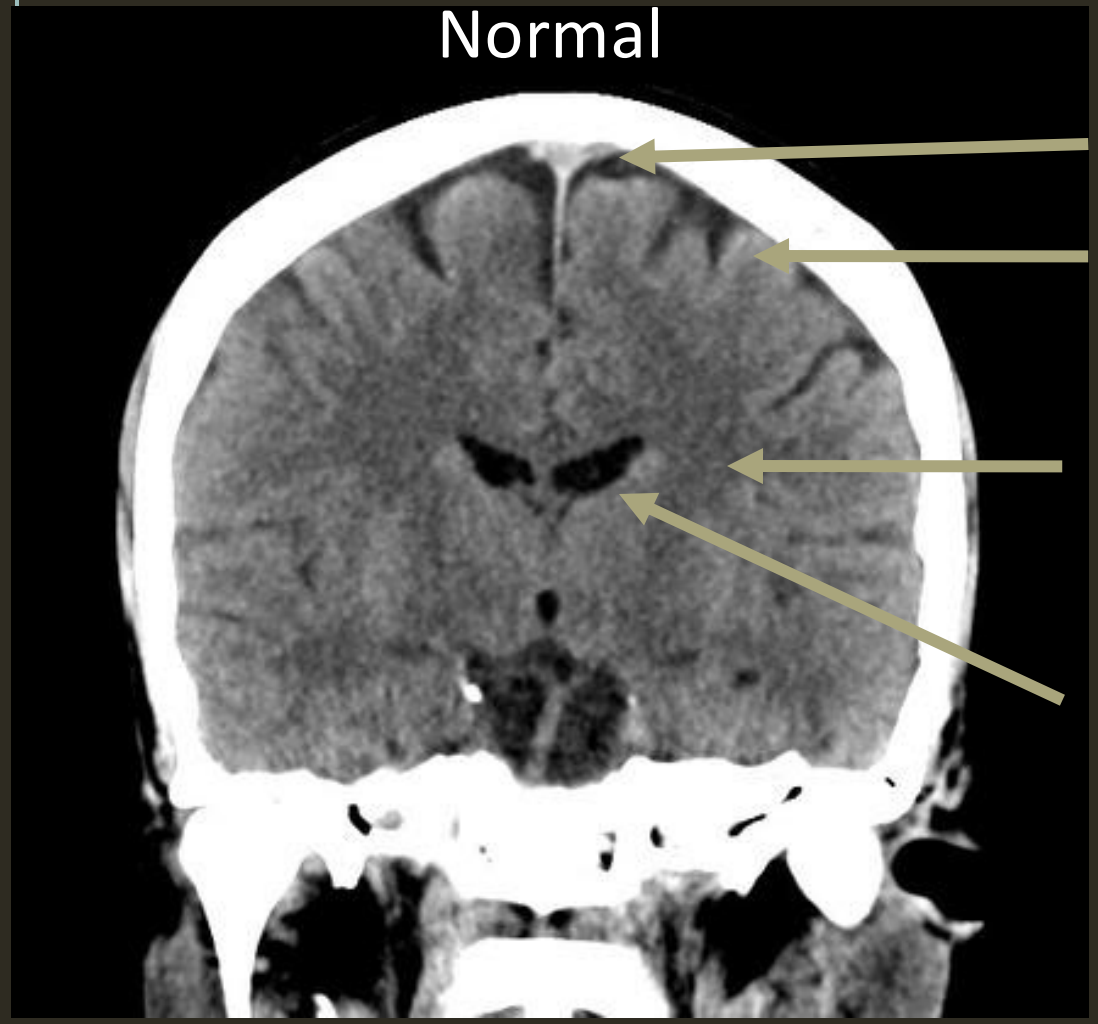




MISSED CASES

- Up to 45% of children who are diagnosed with abusive head trauma have had at least 1 visit to a doctor before the correct diagnosis was made
- Symptoms are often nonspecific
- When identified, abused children often have injuries of different ages

INTRACRANIAL INJURIES



Dark normal fluid

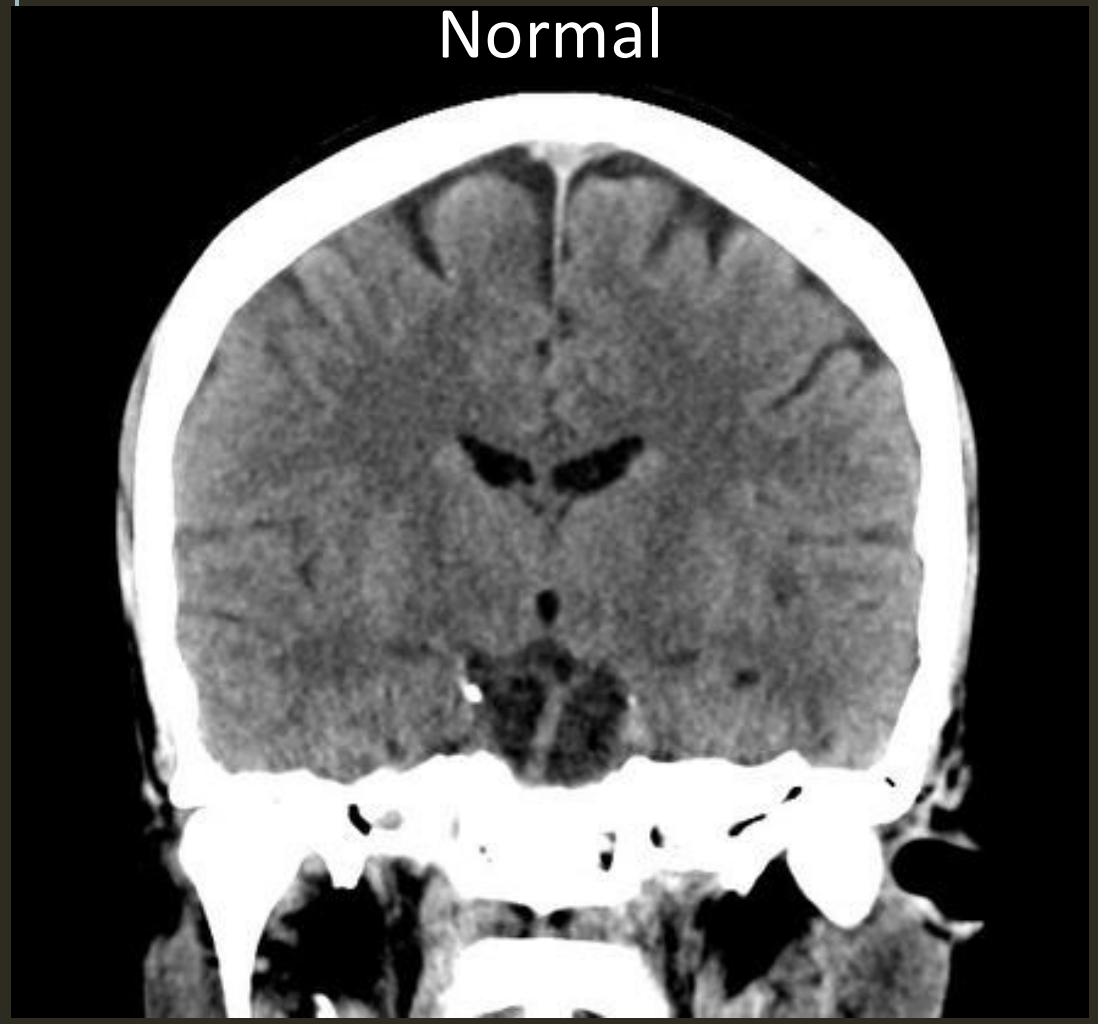
Bright grey matter

Dark white matter

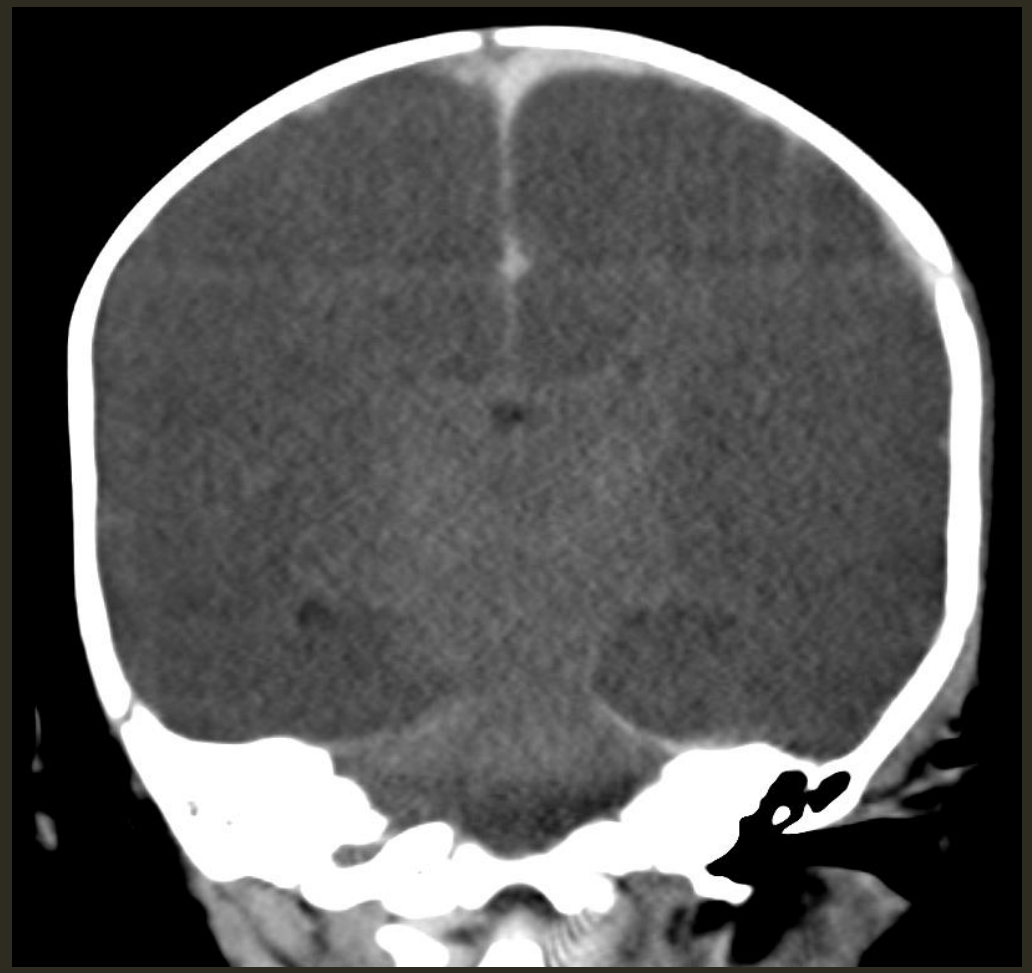
Open normal dark ventricles

INTRACRANIAL INJURIES

Normal



Case 1



HYPOXIC BRAIN INJURY

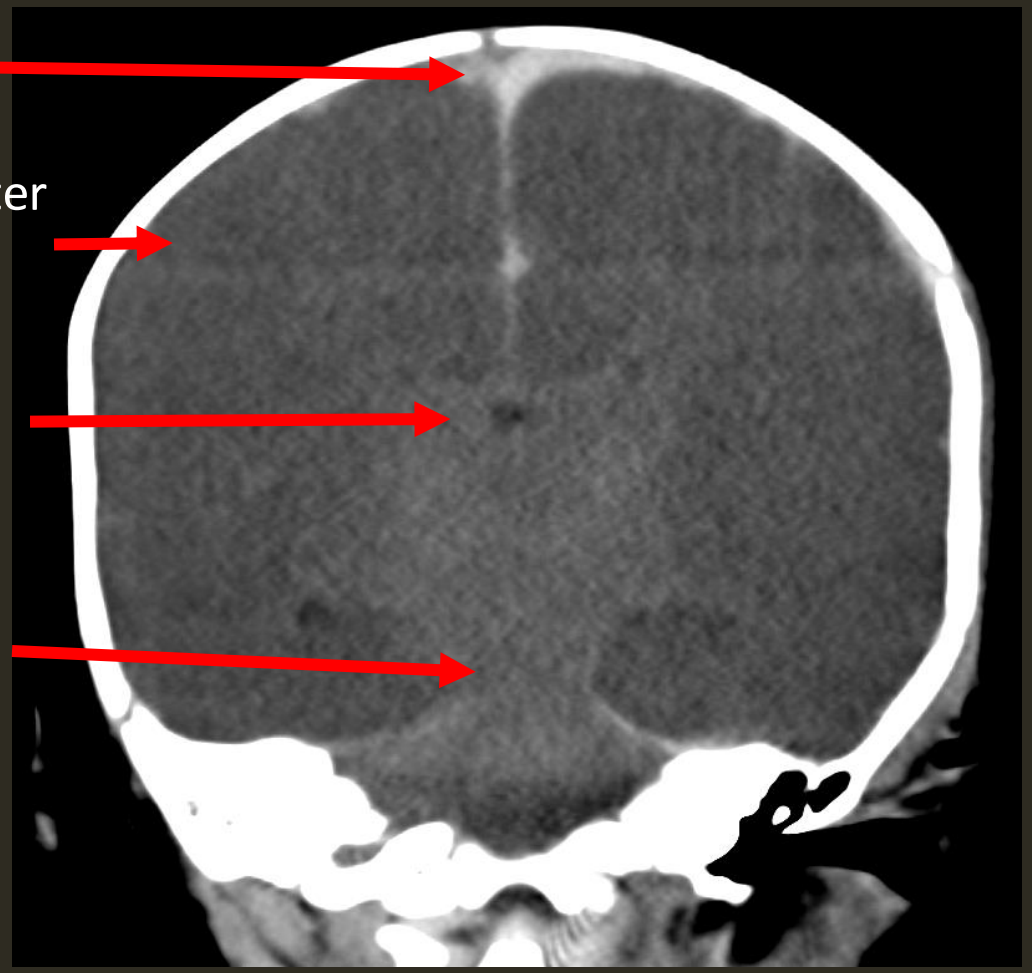
Case 1

Bright blood

Dark grey AND white matter
(no differentiation)

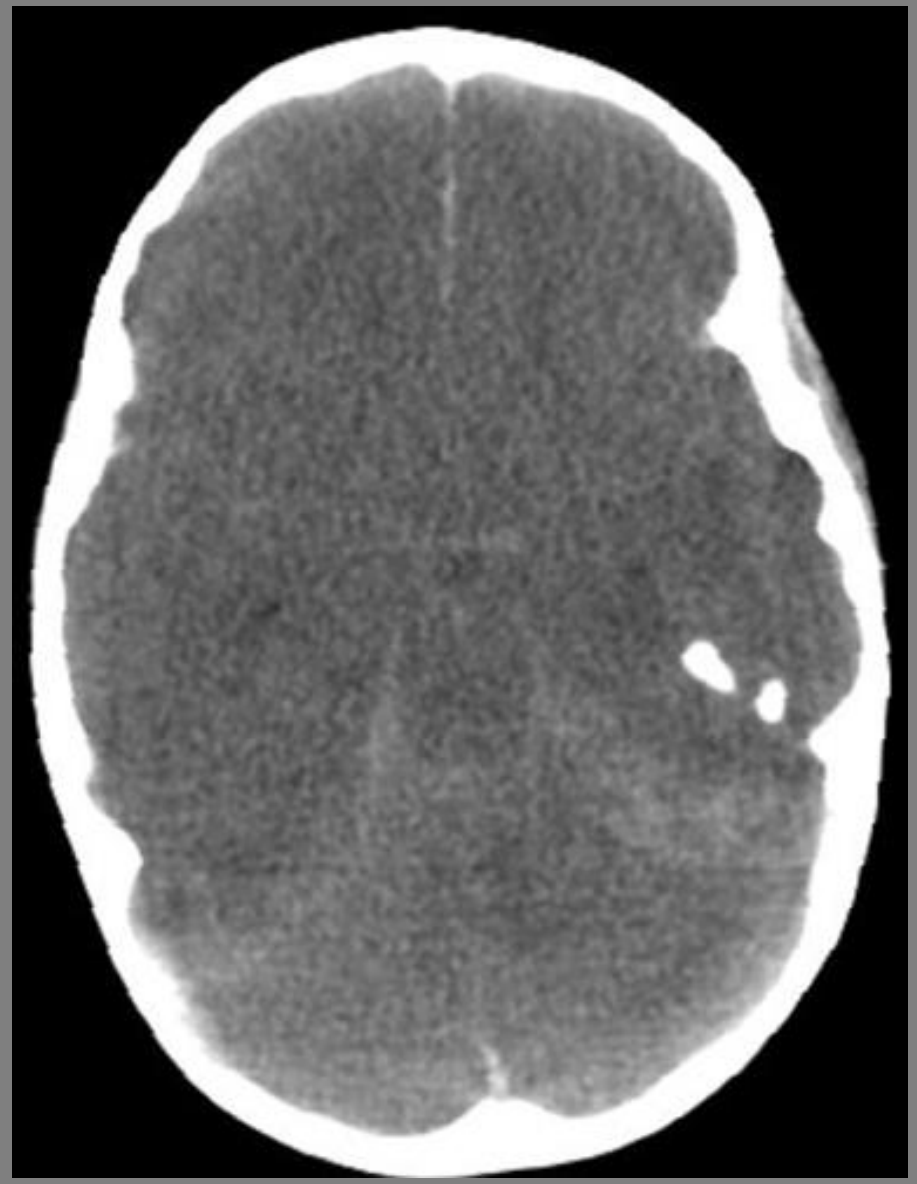
Absence of ventricles
= swollen brain

Bright brainstem, dark
other part of brain



CEREBRAL EDEMA WITH HYPOXIC BRAIN INJURY

- Rotational forces in abusive head trauma cause diffuse axonal injury resulting in cerebral edema



NO BONE TO
THE RIGHT SIDE
OF HEAD

SYMPTOMS OF ABUSIVE HEAD TRAUMA

Mild

- Immediate onset of symptoms
- Non-specific and not obviously due to shaking
  - Irritability
  - Poor feeding
  - Vomiting
  - Lethargy

Severe

- Immediate onset of symptoms
  - Respiratory distress
  - Seizure
  - Death

EXPLANATIONS FOR THE INJURY

- Two most common histories given for infants with abusive head trauma:

  1.) Fall from a low height

  2.) No specific history of trauma

  - Perpetrator describes the symptoms of the head injury (seizures, apnea, vomiting)

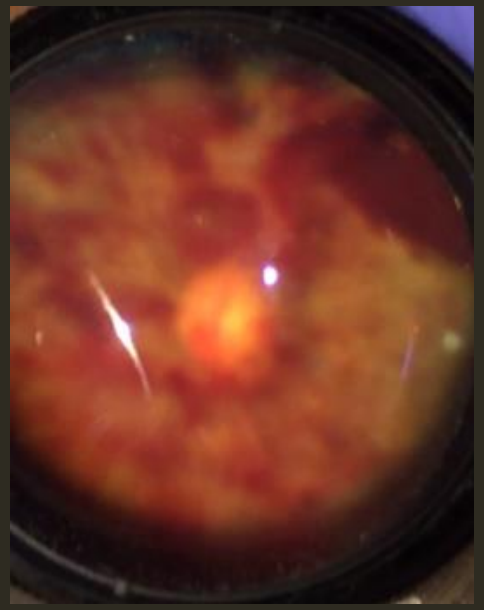
- Major brain damage requires major events

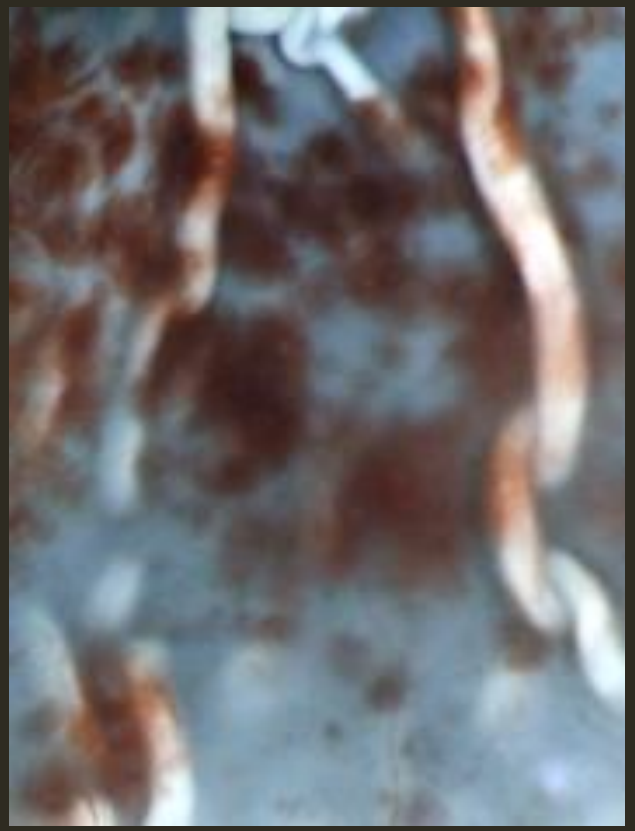
5 MONTH OLD

"…he became angry and upset and started crying more and more so I held him in my arms and noticed he was going to pass out… He was drinking and I don't know what happened. Maybe he choked, but he was crying. He just started to pass out…. He was vomiting the milk and some vomit was coming out of his nose. He wasn't moving."

RETINAL HEMORRHAGES

- Present in 80% of abusive head trauma cases
  - In nearly 100% of fatal cases
- The absence of retinal hemorrhages does not rule out abuse
- Caused by rapid acceleration-deceleration





RETINAL HEMORRHAGES

Normal Retina

Case 1 Retinas

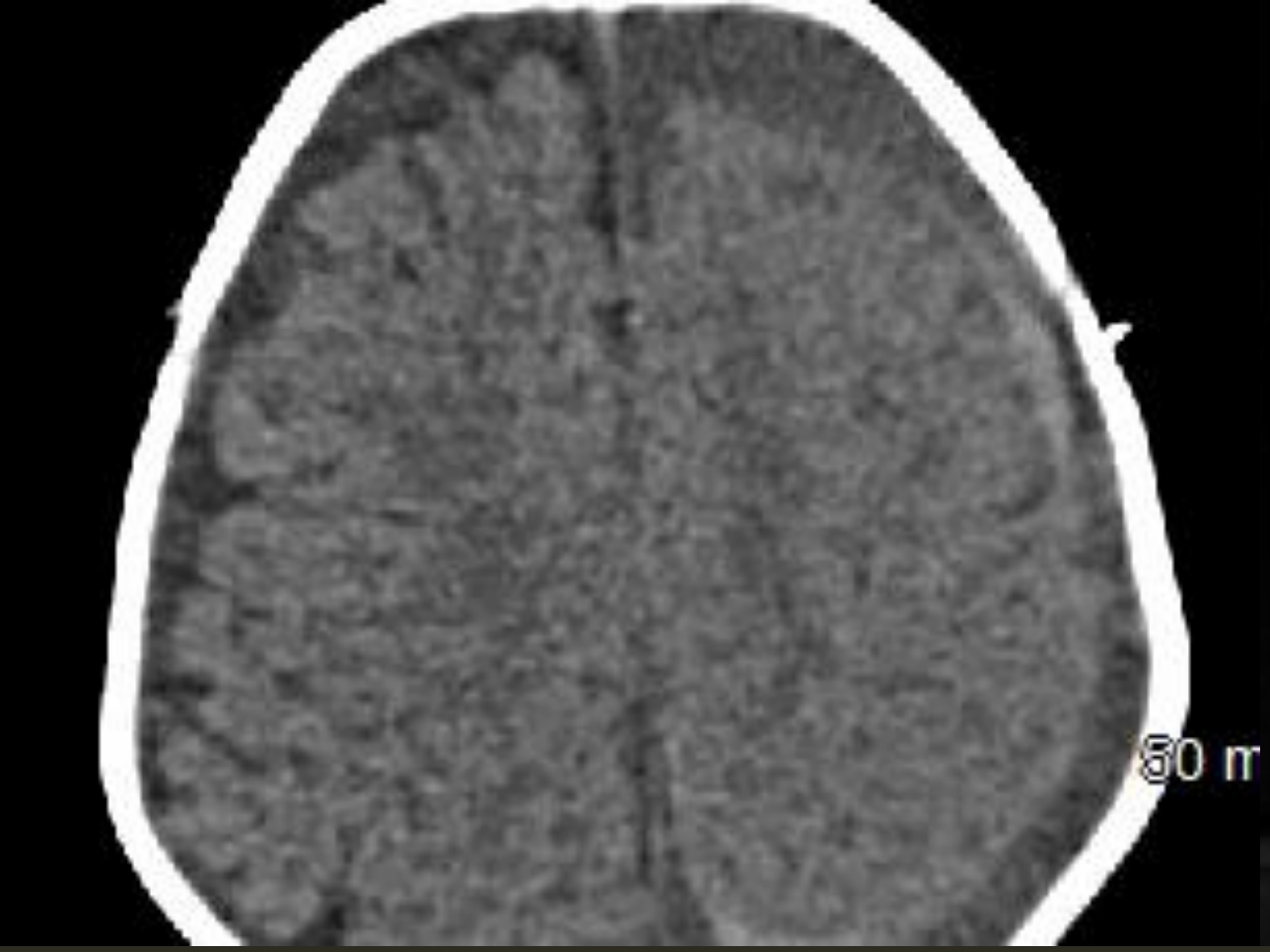
Bilateral multi-layered retinal hemorrhage too numerous to count.
These injuries are not seen in simple falls.

THE VICTIMS OF ABUSIVE HEAD TRAUMA

- More likely to be male (64%)
- Median age is 2 – 6 months
- Increased risk with history of:
  - Prematurity
  - Multiple gestation
  - Developmental delay
  - Disabled

CASE 2

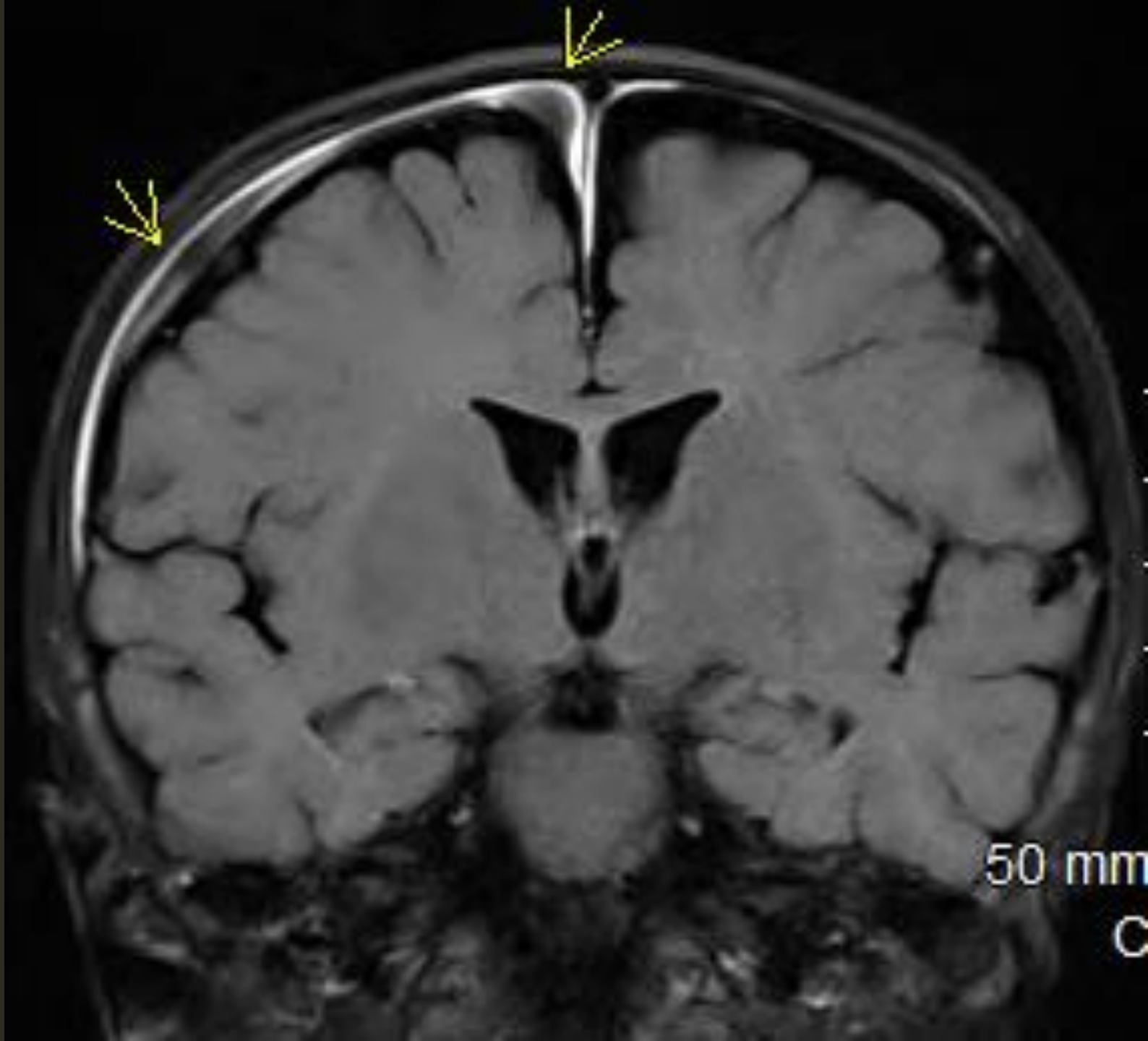
- 7 month old born at 34 weeks gestation with vomiting
- Fell out of car seat and choked on milk



CASE 2

CASE 2 TWIN

CASE 2
TWIN



THE PERPETRATORS OF ABUSIVE HEAD TRAUMA

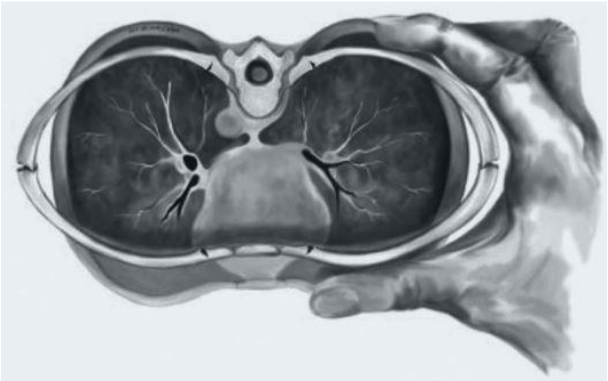
- Males are the perpetrator in more than 60% of cases:
  - Fathers
  - Mothers' boyfriends
  - Step-fathers
- Mothers account for 15%
- Babysitters account for 10%

RIB FRACTURES WITH ABUSIVE HEAD TRAUMA

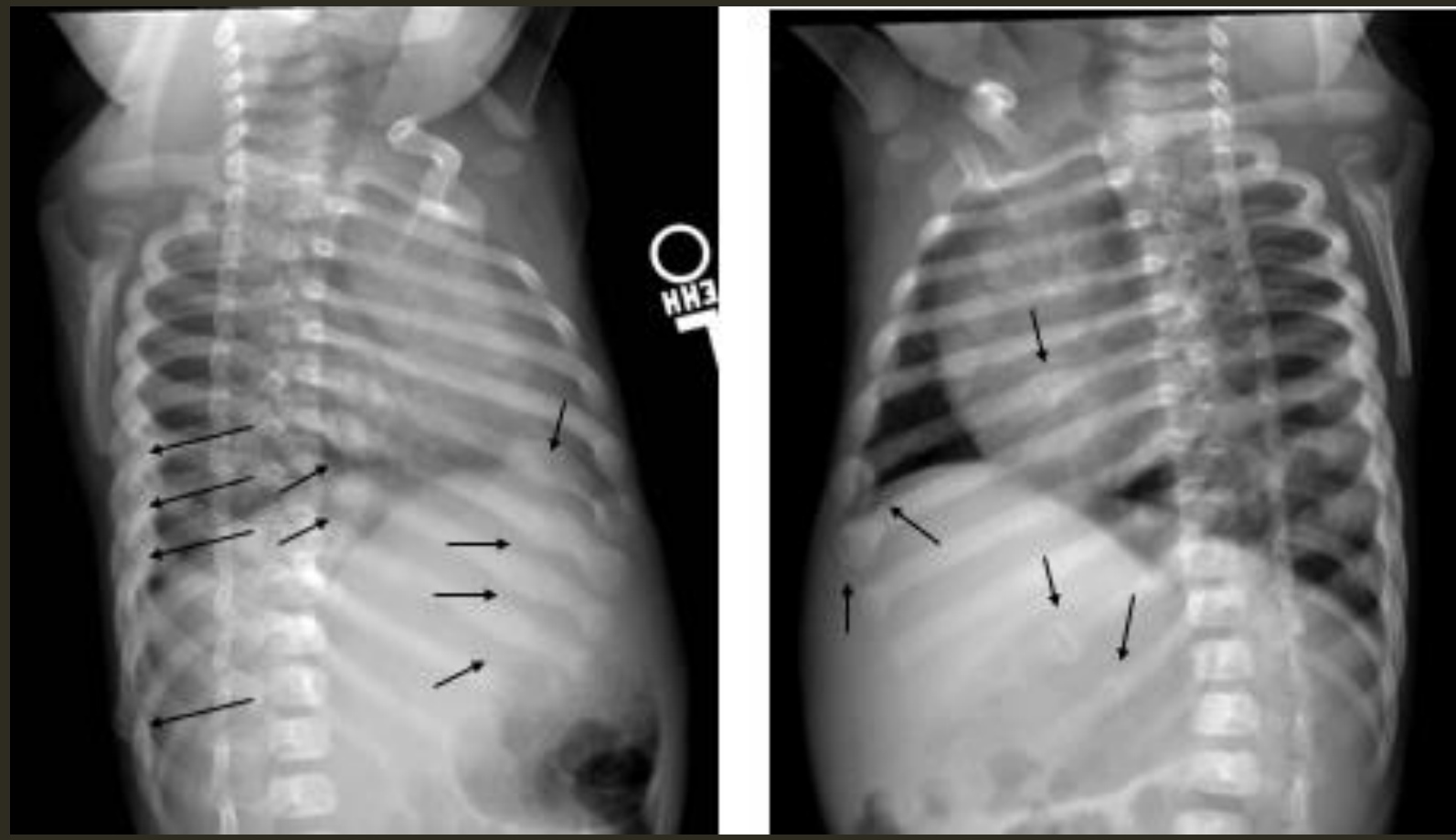
- Posterior ribs and their vertebral articulation act as a lever mechanism
- Mechanical failure of rib occurs near the fulcrum, the transverse process

RIB FRACTURES

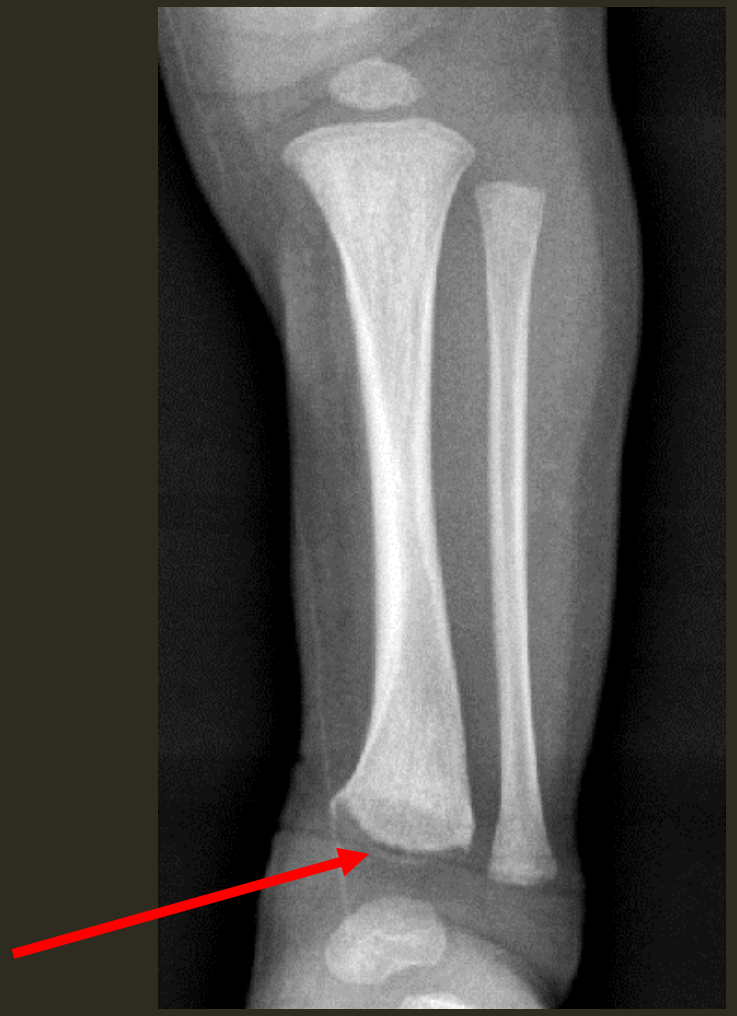
- Account for up to 50% of all fractures in abused children
  - Less than 1% of accidental fractures in children
- Most abusive rib fractures will not have a history of trauma
  - Common with abusive head trauma



RIB FRACTURES



CLASSIC METAPHYSEAL LESIONS



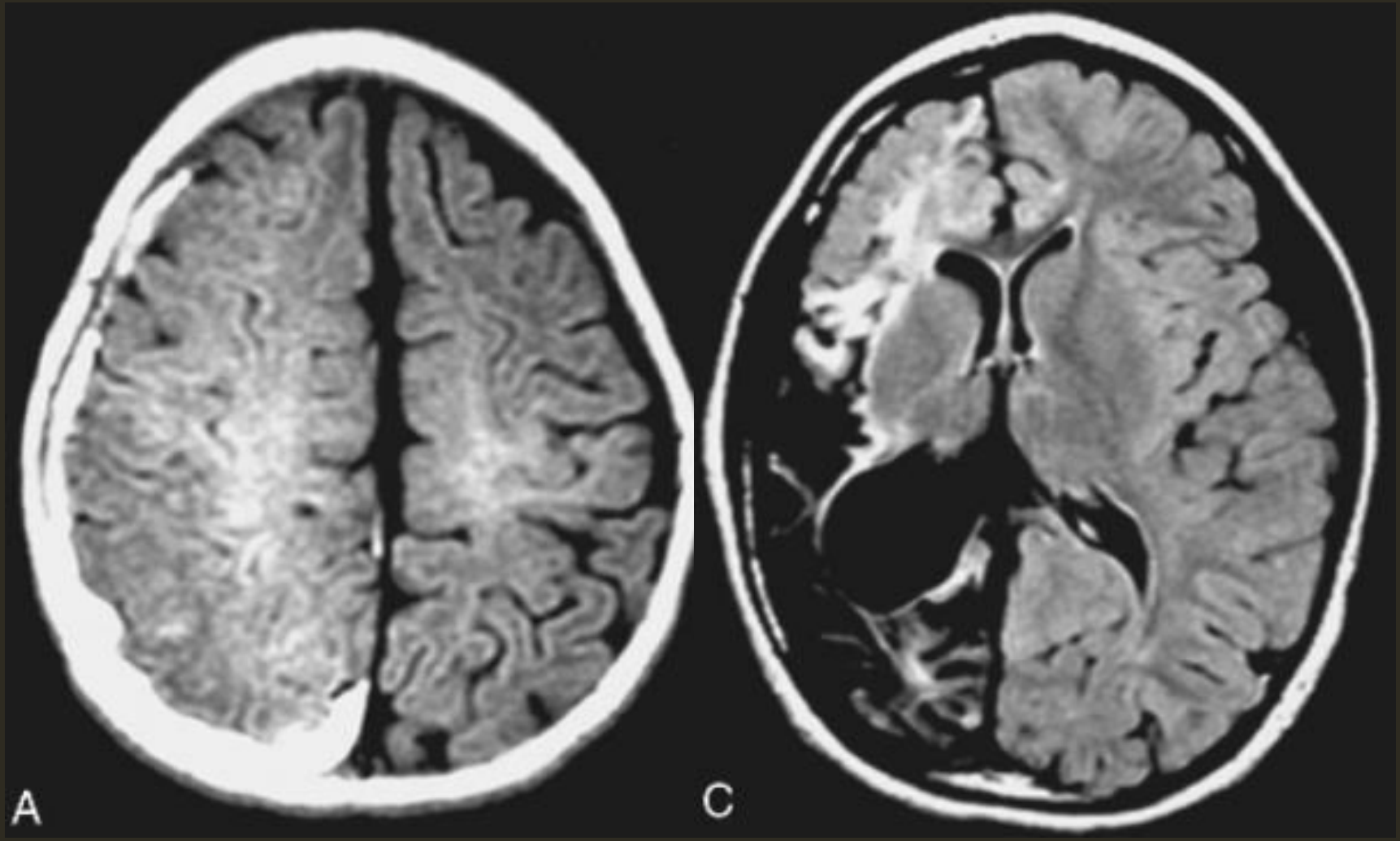
- 25 day old with fussiness, irregular breathing, and seizures
- Head CT:
  - Acute subdural hemorrhages
  - Parietal skull fracture

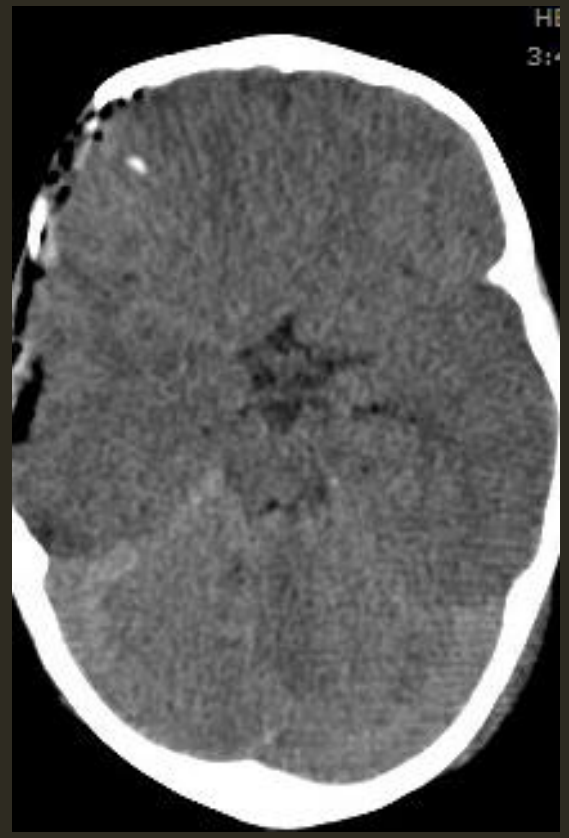
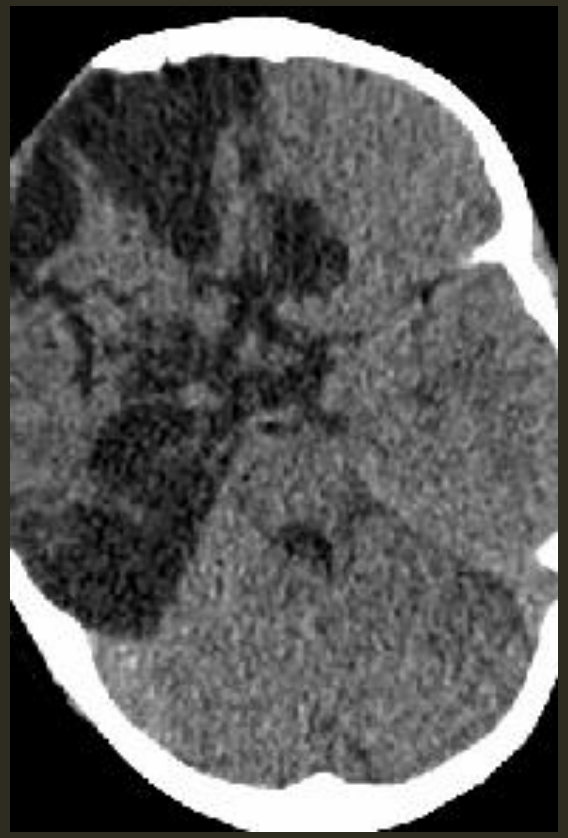
OUTCOMES OF ABUSIVE HEAD TRAUMA

20% of victims die

Survivors have varying degrees of:

- Paralysis
- Blindness
- Developmental delay
- Cerebral palsy
- Seizures
- Deafness
- Permanent vegetative state



OUTCOMES OF ABUSIVE HEAD TRAUMA

CASE 1 – ABUSIVE HEAD TRAUMA VERSUS ACCIDENTAL FALLS

- Chadwick et al. evaluated 317 children who fell
  - One death in 117 children who fell 10 – 45 feet
  - SEVEN deaths in 100 children with a history of a short fall (< 4 feet)
    - ALL 7 children who died had other factors suggesting false histories

Short falls can have serious or lethal outcomes in <<<1% of cases.

Chadwick, DL et al. Deaths from falls in children: how far is fatal? *J Trauma* (1991)

TAKE HOME POINTS

- Remember that major brain damage requires major events
- A detailed history is extremely important for any injury

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