

# BRUISING AND FRACTURES IN NON MOBILE BABIES

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GP Masterclass, June 2023

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# Recent Rapid Reviews – Feb '21-Nov '22

- Death of a 7 month baby girl, drowned when left unsupervised in bath
- Death of a 3 month old baby boy, co-sleeping with mum
- Serious neurological injury – 10 month old girl, found floppy and apnoeic in cot, sustained injuries consistent with shaking, multiple healing fractures on skeletal survey
- Death of 9 month old baby girl, unsafe sleep position whilst in care of private childcare provider
- Serious injury – 11 week old baby boy sent to ED via GP with 'sore, floppy arm' CT revealed subdural bleed, abusive fractures of differing ages
- Serious neurological injury- 4 month old baby boy, AHT due to shaking, prior admission with unexplained bruise at 8 weeks of age
- Death of 3 month old baby boy, unsafe sleep and alcohol

# Recurring Themes

- All under the age of 1
- Safe Sleep
- Hidden Males
- Alcohol/substance misuse
- Vulnerable families – poverty, mental health, previous involvement CSC, complex trauma
- Bruising/injury in non mobile babies

# Learning Aims

- Maintain professional curiosity at all times
- Identify babies at risk
- Easy referral pathways for S47 assessment
- Recognition that accidental bruising in a non mobile baby is unusual and needs MDT assessment

# Bruising –what do we know?

- Most common (and overlooked/underappreciated) injury seen in physical abuse
- Diagnostic dilemma – abusive vs accidental
- One child a week dies as a result of deliberately inflicted injury/abuse/neglect, a significant proportion of whom will have had harbinger injuries (28-64%)
- **Accidental bruising is rare in pre-mobile infants (0-1.3%)**



# Definitions

- **Bruise** – bleeding beneath the skin due to blunt force trauma. External force exceeds vessel integrity, vessels are crushed and leak. No break down of skin
- **Contusion** – bruise in deeper tissues
- **Haematoma** – extravasated blood filling a cavity/potential space, usually associated with swelling
- **Petechiae** – pinpoint (0.1-2mm) haemorrhages into the skin due to an acute rise in venous pressure
- **Abrasions** – blunt force trauma where friction removes the outer superficial layers of skin as a result of simultaneously applied pressure and movement (scratch, graze)
- **Lacerations** – ragged/irregular tear of the skin due to crushing/blunt force trauma and shearing forces
- **Incisions** – sharp force trauma – sharply defined edges of skin (knives, glass, tin can)

# Bruising may be a harbinger injury



# Harbinger Injuries

- H. Smith, V. Coupes. RMCH. ADC 2007
- Record review of children presenting with GBH level injuries agreed to have been caused by abuse over a 5 year period
- 43 cases
- Age range 11 days- 4 years
- 37 infants
- 35 head injuries
- 13 previous harbinger injury (30%)
- 11 were bruises in non mobile infants
- 8 were bruises to head and neck
- 1 bruise to torso
- 2 bruises to upper arms
- 8 had been seen by clinicians but only 1 case investigated
- 6 children died, 3 of these had previous injuries documented in health records



# Harbinger injuries

- Serious abuse may be preceded by less severe assault leaving apparently minor bruising
- **Presence of bruising in a non mobile infant should always lead to a paediatric assessment and critical consideration of any explanation given**
- Low threshold for proceeding to skeletal survey and brain imaging (infants with abusive head trauma and occult fractures may have no external signs of injury)



# Sentinel injuries

- Additional case series building on this concept:
- Missed opportunities to diagnose child physical abuse;
  - Retrospective study of 77 infants with abusive fractures – 32% had a missed opportunity for earlier diagnosis of maltreatment (bruises)
  - 146 infants <6 months with isolated bruise – 23.3% positive skeletal survey, 27.4% positive neuroradiology
  - ‘Sentinel injuries in infants evaluated for child physical abuse’. Pediatrics 2013; 131:701-7

## Case controlled study

200 definite abuse/ 100 intermediate abuse/ 101 case controls

27% sentinel injury in abused/8% in intermediate/ none in controls

- 80% bruising/ 11% intraoral injury/ 7% other injury
- 60% < 3 months
- **In half of cases medical providers overlooked the injuries or dismissed them as insignificant**

# Why are we dismissing the importance of bruises?

- Common/inconsequential finding on active toddlers and children
- Rarely needs intervention/treatment
- Plausible but fabricated history of trauma
- Lack of professional curiosity/respectful scepticism
- Fear of breakdown in relationships with families
- Brief consultation/OOH
- Time involved with a referral to MASSH
- Lack understanding of CP procedures



# NICE guidance CG89-when to suspect child maltreatment

- **‘Bruising in any child not independently mobile should prompt suspicion of maltreatment’**
- Refer to CSC
- A decision that a child has not suffered abuse must be a joint decision and must not be made by a single agency



- Was this bruise a result of an accident or was it inflicted?
- Never interpret bruise in isolation – refer to CSC & paediatrics
- A systematic approach is required –  
history/explanation, developmental stage, full examination, relevant investigations, consideration of family/social history

# Medical opinion

- It relies on our knowledge of patterns of accidental bruising compared to patterns of non accidental bruising in this age group.
- RCPCH - Child Protection Portal resources– Child Protection Companion – produced by CPSIG since 2006, regularly updated to reflect latest evidence, research, practice

Systematic reviews of Child Protection Evidence:

[www.rcpch.ac.uk/key-topics/child-protection/evidence-reviews](http://www.rcpch.ac.uk/key-topics/child-protection/evidence-reviews)

- So what do we know?



# Its all in the history...



- Just because its nonspecific doesn't mean it is accidental: Any injury can be inflicted
- Just because its suspicious doesn't mean it is inflicted: (almost) any injury can be accidental...with the right history

Example: Bruises to shins →

- *Most likely* to be accidental injuries, in isolation
- *Consistent with* allegation of being kicked

*"I have cautiously accepted the explanation of accidental injury offered, however any pattern of unusual, frequent or unexplained injuries should be viewed as a cumulative chronology..."*

# Accidental bruises

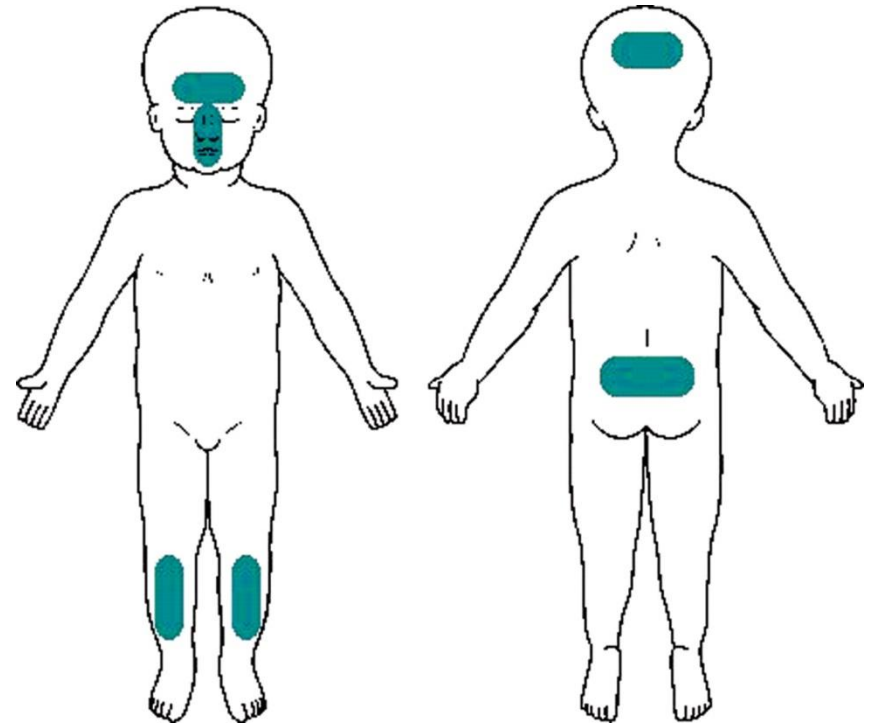
- Knowledge from series of small studies where mechanism of injury is known
- Often based on ED presentations/ some based on descriptive data in other health care/education settings
- Usually involve small numbers
- ‘Bruising characteristics from unintentional injuries in children: The green flag study’; Mary Clyde Pierce ACD 2017
- ‘Childhood bruising distribution observed from eight mechanisms of unintentional injury’; Hibberd O, ACD 2017





# Accidental bruises

- **Number** – 81.7% accidents result in one bruise, (>1 with RTA, fall down 10+ stairs/>2m, sports).  
*General rule: 'one and done' though 2-4 can occur from a single injury. Never >5 from single incident*
- **Location** – 73% over bony prominences (forehead, chin, knees, shins, elbow)
- **Anterior surface body** – 78%
- **Development** – 99% in mobile children (17% infants who cruise will bruise, 52% early walkers, 85% independently mobile)  
*'once cruise, likely to bruise'*
- **Size** – small, less than 15mm



# Bruising prevalence

- <6 months = < 2%
- 6-8 months = 6%
- 9-12 months = 18%
- 12-15 months = 51%



# Accidental bruising

- Potential causes in pre-mobile infants;
  - Bumping into mother's tooth
  - Falling asleep on a dummy
  - Banging themselves with a rattle
  - Having a toy dropped on them
  - Rolling into something
- The most common sites for bruises in pre-mobile infants is the head and facial T and below knees
- All other sites rarely affected
- Accidental bruising increases with increased family size

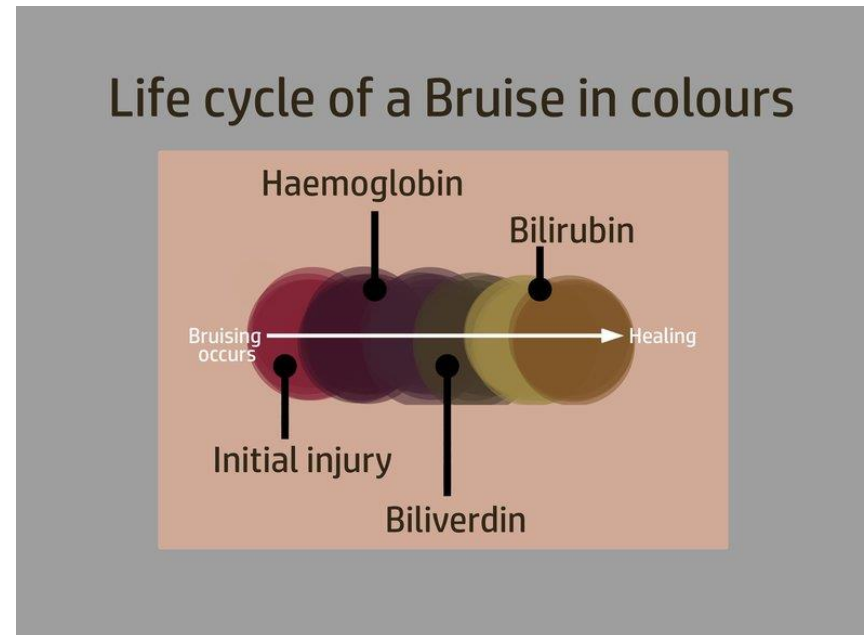


# Accidental bruising-rare sites

- <5% accidental bruising was to the cheeks
- <6% were around the eyes
- Disabled children – bruises on dorsum  
feet/thighs/arms/hands/arms/abdo are more common  
(lower legs, ears, neck, chin, genitalia and anterior  
chest wall less so)
- Premobile & early mobile:
  - ears/neck/genitalia/hands/buttock/trunk <0.2%
- Mobile:
  - Ears/neck/genitalia/hands <1%

# Timing

- Superficial bruises appear almost at once, deep bruises within hours-days
- **Bruises of the same age on the same person may be different colours and may change at different rates**
- Unable to accurately age a bruise – red can occur at anytime and yellow generally after 18hrs but perception is individual

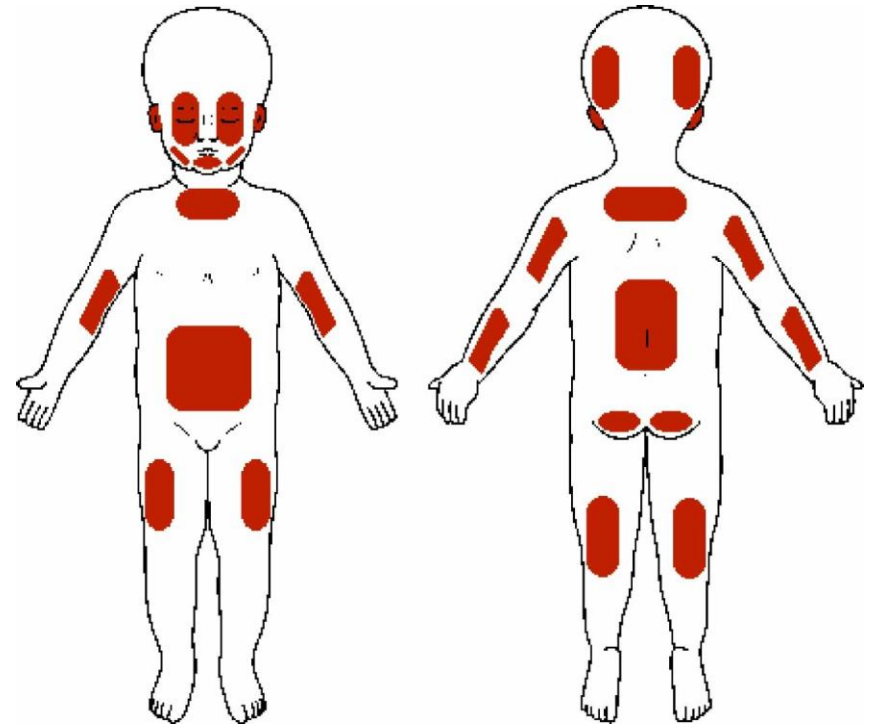


# Accidental bruising – red flags

- **Posterior surface** – 5%, fall/impacting object
- **Linear pattern** – 0.9%, fall on edge furniture
- **Multiple bruises from single incident (4-5)**- 0.9%, fall >10 steps/sports/MVC
- **Bruising to front & back of body** – 0.3% hit by car, fall down 12 steps
- **Petechiae** – 0.3%, fall off horse
- **Ear, neck, genital bruise** – 0%, **>5 bruises** -0%

# Non accidental bruising

- So are there features in a bruise that make inflicted injury more likely?
- RCPCH child protection evidence systematic reviews (formerly CORE info)
- 44 studies addressing the characteristics of abusive vs non-abusive bruising in children



# Bruising alarm bells



- **Amount:** Frequent / multiple/ extensive
  - Rare to have >4 bruises accidentally
- **Patterned** – uniformed shapes, imprints
- **Clusters** (includes defensive injuries, grips, pinch), bilateral
- **Petechiae** (unless bleeding disorder)
- **Site: soft or protected**
  - Abdomen, arms, hands
  - Buttocks & genitals
  - Ears, neck & face
  - **Soft tissue** (away from bony prominences)
- **Non mobile children & babies**
  - accidental bruising is rare (<1%)
  - Sentinel/herald & harbinger injury



# Non accidental bruising -Location

- The commonest site is the head
- Inflicted injuries tend to be away from bony prominences on soft parts of the body
- Ear/face/neck/trunk/buttocks/thighs/genitalia/hands/feet/arms seen more in abuse than controls
- TEN -4-FACESp, bruising clinical decision rule has a 96% sensitivity, 87% specificity for predicting abusive trauma
- **Any part of the body is vulnerable to abuse**

**T**Trunk

**E**ars

**N**eck

**4** years or younger

**F**renulum

**A**uricular area

**C**heek

**E**yes

**S**clera

**P**atterned bruising



**4** Any bruising on a child less than 4 months



*"Kids that don't cruise rarely bruise."*

# PATTERNED/SHAPED BRUISES

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94% patterned bruises secondary to abuse

# Slap

- Parallel linear bruises
- May be petechiae
- Separated by areas of central sparing
- Often on cheek



# Tramline



- Linear objects – rigid or flexible
- Negative imprinting – object sinks into skin, edges drag skin down and tear marginal blood vessels leading to bruising with central sparing
- Often ascribed to discipline

# Pinch



- 2 small areas 1-2 cm, relatively round
- Initially separated by normal skin, bruising may later coalesce

# Fingertip



- Oval/round
- One surface up to 4 bruises
- Other surface thumb imprint
- Reasonable to assume significant force
- Can be accidental (saving child from running into road)

# Implement



- Outline of object on skin
- Ligatures
- Rope – areas of bruising interspersed with areas of abrasion
- Belt/cord – loop marks, lines of petechiae, central sparing

# Bite

- Opposing semi-circular/circular bruises
- Associated abrasions from teeth marks
- Human bites = 2-5 cms
- >3 cms = adult
  - Adult teeth by 12 years
- Puncture wound and tearing suggest carnivore animal bite



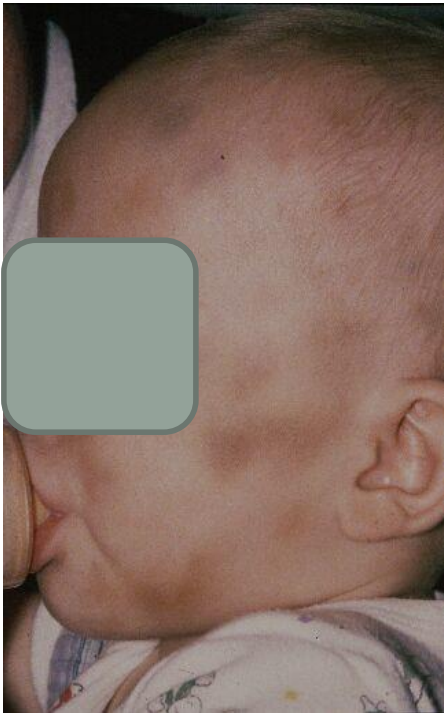








# Non Accidental Bruising

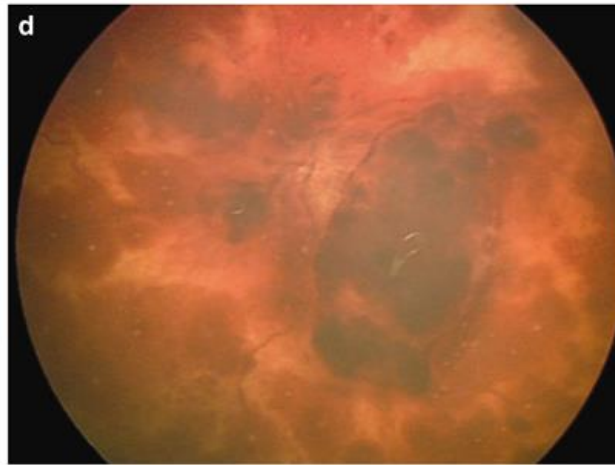
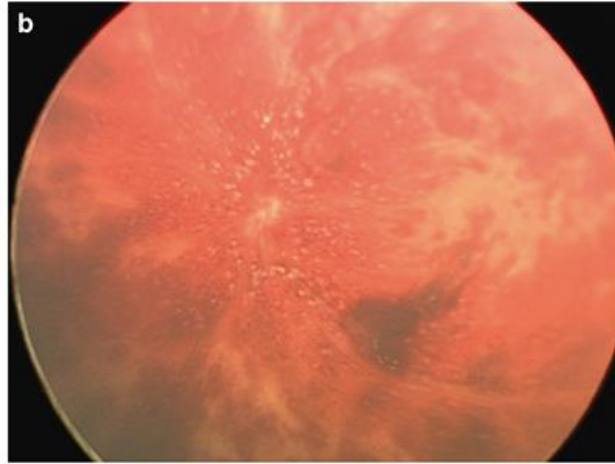
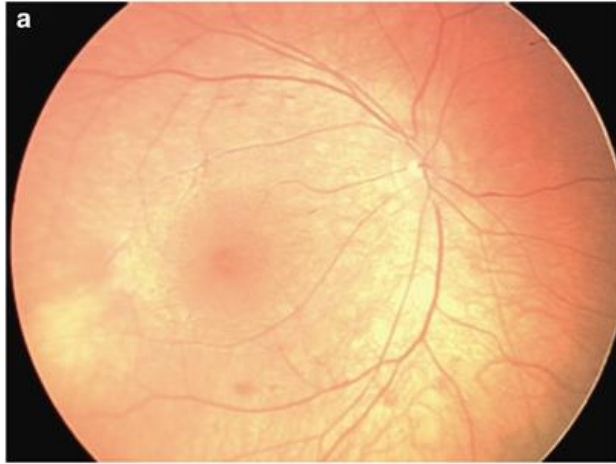


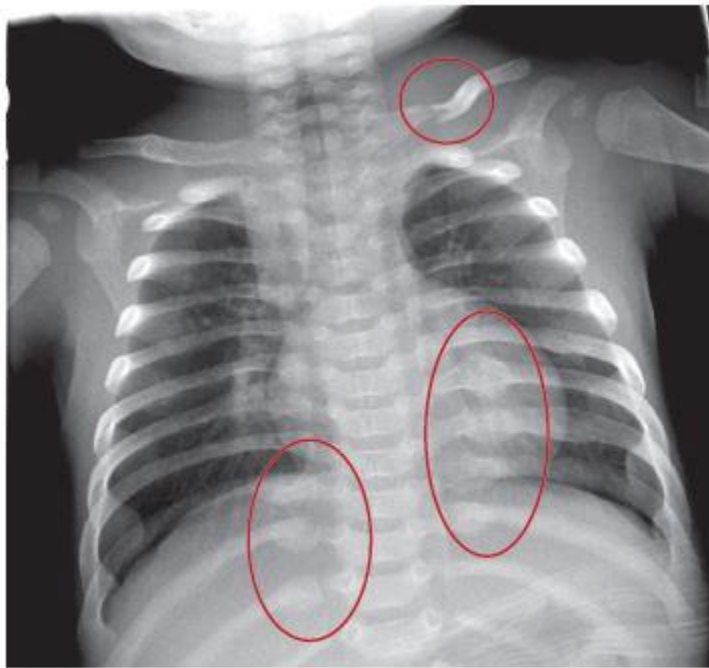
- **Clustering** of bruises is common
- They may be defensive injuries
- upper arm/side chest/outer thigh
- **Petechiae – PPV**  
**80%** (CI 64-90)

# Non accidental bruising



- 12 weeks (born 35 wks)
- PAU – unsettled, poor feeding, one vomit
- First child to a young Mum, care leaver
- O/E full fontanelle, irritable, single bruise to right cheek, frenulum intact





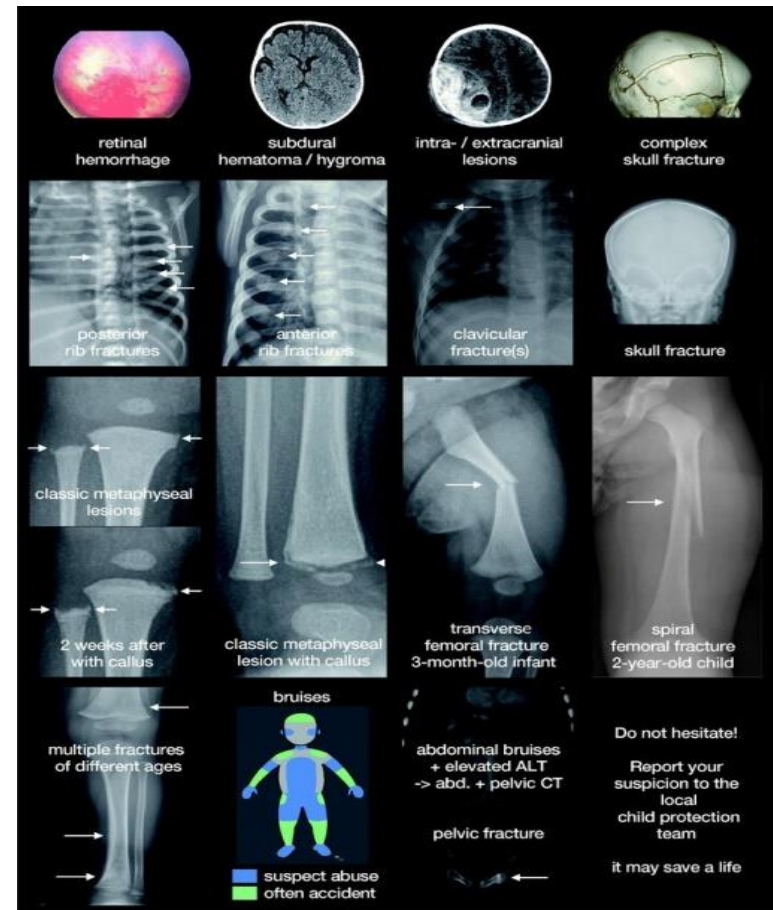
**Figure 2. Multiple bilateral posterior rib fractures that are healing can be seen in an infant who also has an acute left clavicle fracture.**





# Skeletal survey necessary if

- <2yrs if suspect physical abuse/ AHT/twin or sibling abused
- <12 months if bruising to the following areas
  - Cheeks/eye area/ ear/neck
  - Upper arms/legs not over bony prominences
  - Hands, feet
  - Torso, buttocks, genital region
  - > 1 bruise NOT limited to bony prominences
- <9 months
  - >1 bruise in any location
- <6 months
  - Includes bony prominence unless single bruise and history of a fall.



# Changes to the Guideline for skeletal surveys

- Includes requirement to perform skeletal surveys on twins/triplets
- Consider in other siblings under 2 yrs
- Reporting to be done by 2 paediatric radiologists
- Follow up full skeletal survey 11-14 days later
- MRI at day 2-5 if abnormality on CT ( includes fracture)
- 2 paediatric nurses
- Information leaflet
- Written consent

# Systematic review - fractures

- 1/3 children sustain a fracture before 16<sup>th</sup> Birthday
- **Abusive fractures more common in children <18 months** (80% of abusive fractures in this age group, greatest risk <4 months)
- **Multiple** fractures more common in abuse
- **Rib fractures (in absence of major trauma/birth injury) high predictive** value for abuse, common finding in AHT. Uncommon after CPR, 0.5-1.3%, anterior/costochondral rather than posterior
- Femoral fractures in non-mobile suggest abuse, mid shaft femoral fractures most common fracture for both abuse and accidental injury
- **Humeral fractures <18 months associated with abuse** (spiral/oblique), supracondylar humeral fractures in mobile usually accidental
- Linear skull fractures seen in both abuse and accidental injury
- **Metaphyseal fractures more common in abuse and fatal abuse**

## ***Location of Abusive Fractures in Infants birth to 11 months***

Adapted from Leventhal et al (2008)

### ***Rib Fractures***

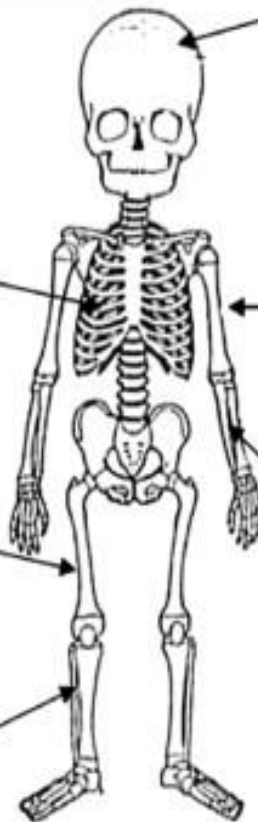
- Third most common fracture in infants birth to 11 months
- 69% attributed to abuse in infants birth to 11 months

### ***Femur Fractures***

- Extremity fractures second most common in infants birth to 11 months.
- Most common fracture of the extremities
- 30% attributed to abuse in infants birth to 11 months

### ***Tibia & Fibula Fractures***

- Extremity fractures second most common in infants birth to 11 months.
- 58% attributed to abuse in infants birth to 11 months.



### ***Skull Fractures***

- Most common fracture in infants birth to 11 months.
- 17% attributed to abuse in infants birth to 11 months

### ***Humerus Fractures***

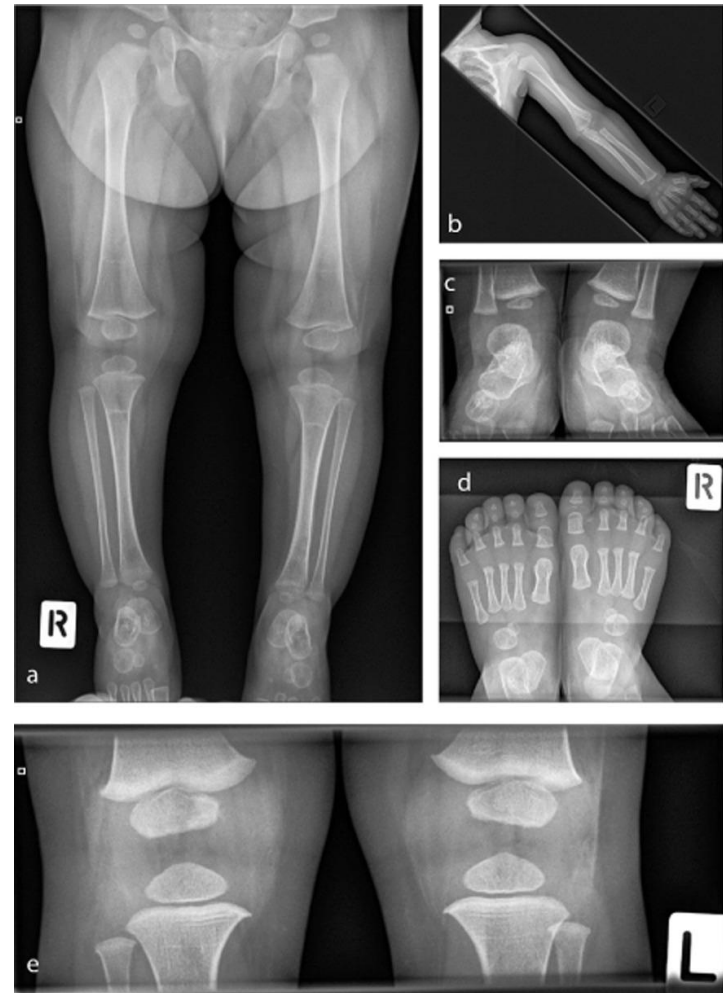
- Extremity fractures second most common in infants birth to 11 months.
- Second most common fracture of the extremities.
- 43% attributed to abuse in infants birth to 11 months

### ***Radius & Ulna Fractures***

- Extremity fractures second most common in infants birth to 11 months.
- 62% attributed to abuse in infants birth to 11 months.

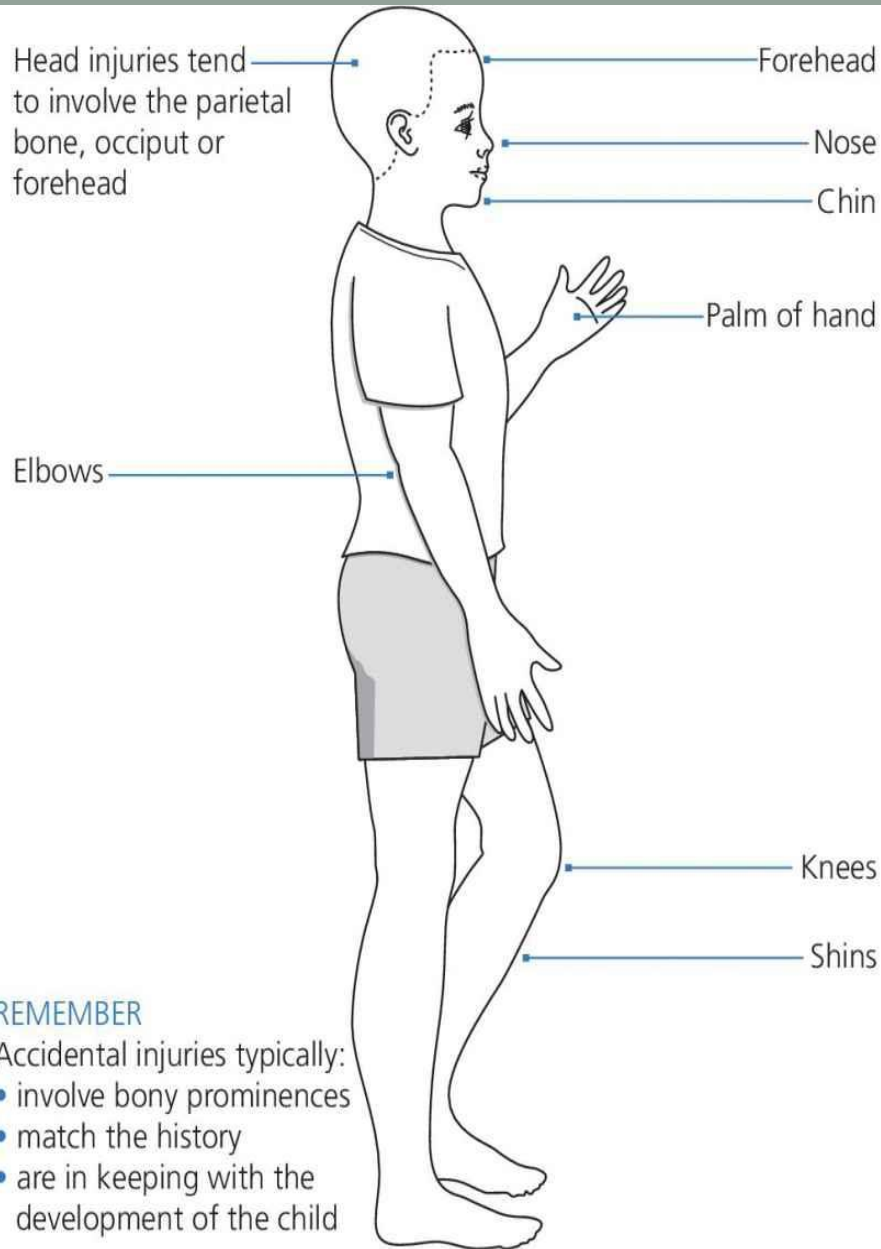
# Systematic review - fractures

- Radiological dating of fractures is inexact – accuracy is in terms of weeks rather than days
- Radiological investigations recommended = full initial and repeat skeletal surveys after 11-14 days
- Studies suggest that up to 12% of the <2 year old contacts of children with serious abusive injuries will have positive findings on skeletal survey (Twins at particularly high risk)
- Abusive fractures often occult – you have to look for them, can occur without overlying skin injury
- 23.3% of 137 infants <6 months investigated for isolated single bruise had occult fracture

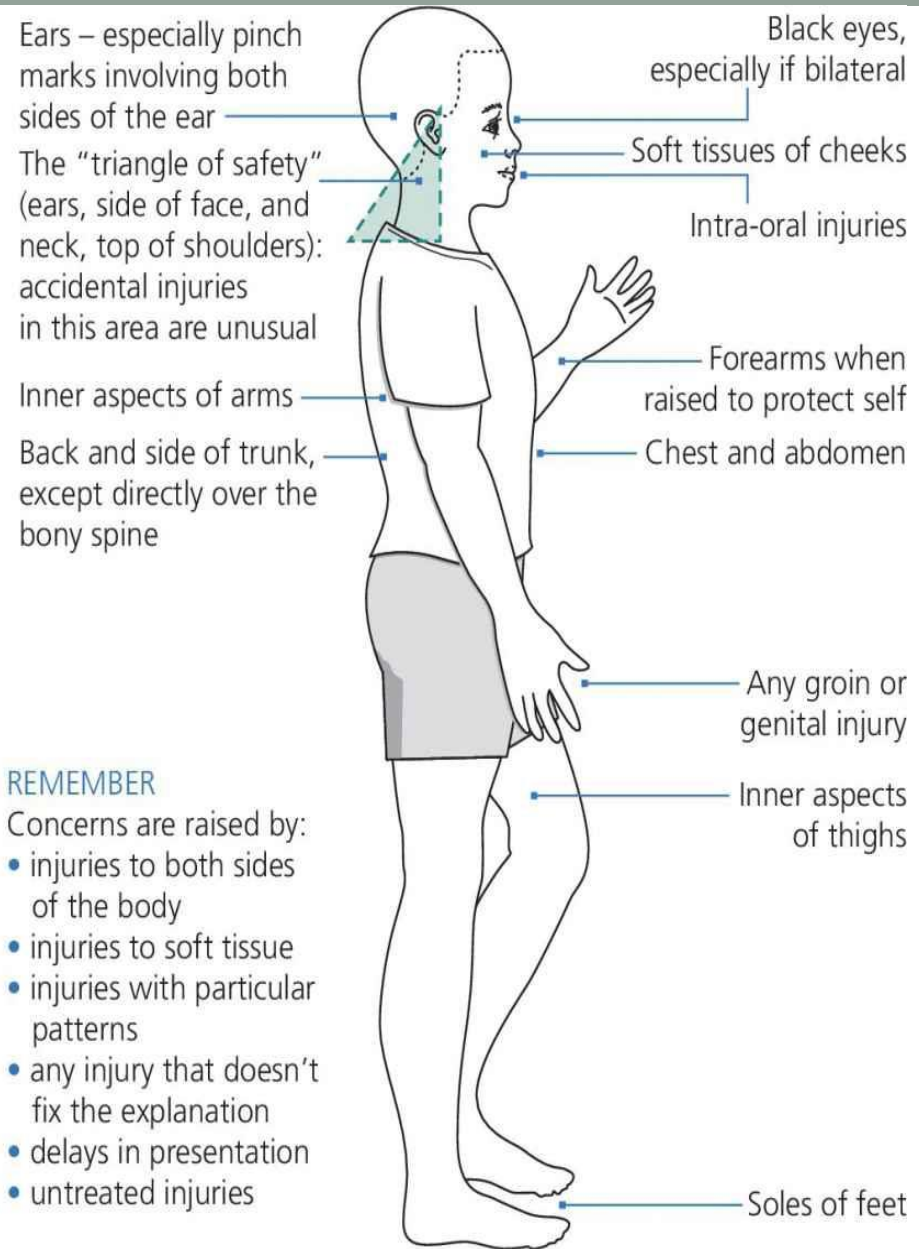


# Summary – characteristics suggestive of abuse

- Bruising in children who are not independently mobile
- Bruising away from bony prominences
- Bruises to face/neck/ear/hands/genitalia/abdo/buttocks/arms (TEN concept in <4yrs)
- Multiple bruises in clusters
- Multiple bruises of uniform shape
- Bruises carrying imprint of implement/ligature
- Bruises accompanied by petechiae
- Fatal AHT and abusive fractures can occur without bruising



(a) Typical accidental injuries



(b) Typical abusive injuries

**REMEMBER**

- Accidental injuries typically:
- involve bony prominences
  - match the history
  - are in keeping with the development of the child

**REMEMBER**

- Concerns are raised by:
- injuries to both sides of the body
  - injuries to soft tissue
  - injuries with particular patterns
  - any injury that doesn't fix the explanation
  - delays in presentation
  - untreated injuries

# Accidental bruising is rare in the pre-mobile child and needs investigation

Bruising can be subtle and difficult to spot on darker skin tones

Never interpret a bruise in isolation – assess in context of medical/social history, developmental stage, explanation given, full clinical examination and relevant investigation



# Key messages



- Injuries
  - If in doubt get it checked out
  - If they don’t cruise, they don’t bruise
  - If you don’t look you wont find
- Child Protection Medical assessments
  - Ask right question to get meaningful answer
  - Consent needed!
  - Its not quick...
- Part of the jigsaw only
  - No injury ≠ safe
  - Non-specific ≠ accidental

# TEN-4-FACESp Bruising Rule

Kids are kids, and sometimes they play in ways that result in minor cuts, scrapes, and bruises. These minor injuries are often found on bony areas of the body like knees, shins, elbows, and foreheads. However, there are other types of bruises that should be a red flag for possible abuse.

**When is bruising concerning for abuse in children younger than 4 years of age?** If bruising in any of the three components – Regions, Infants, Patterns – is present, strongly consider evaluating for child abuse and/or consulting with an expert in child abuse.

## REGIONS

### “TEN”

Torso | Ears | Neck



### “FACES”

Frenulum  
Angle of Jaw  
Cheeks (fleshy part)  
Eyelids  
Subconjunctivae

## INFANTS

“4” = infants ages  
4 months and younger



## PATTERNS

“p” = patterned bruising

