

## Interpretation of skin injuries

Maryanne Lobo

- Common skin injuries in children
- Definitions
- forces that cause skin injuries
- Factors that influence the appearance of skin injuries
- Dating of skin injuries
- differentiation of accidental from abusive skin injuries
- Patterns of abusive skin injuries
- Patterns of skin injuries
- Medical conditions that mimic skin injuries

### Definitions

- Wound: (old English *wund*) “disruption of the continuity of tissues by external mechanical force”. Legal-breach of full thickness of skin
- Injury: (from Latin *injuria*) wider meaning “hurt or damage to body” by external force: physical, thermal, chemicals, irradiation, electricity
- Lesion: (from Latin *laesio*, a hurt) originally meant an injury but now means “any area of injury, disease, or degeneration in a tissue causing change in structure or function”
- Trauma is bodily harm with or without structural alterations resulting from interaction with physical/chemical agents, imparting energy to tissues

### TYPES OF SKIN INJURY

- *Bruises*
- *Abrasions*
- *Lacerations*
- *Incised wounds*
- Puncture and stab wounds
- Gunshot wounds
- *Burns*

### Bruises

- A haemorrhage into a tissue-skin, muscle or internal organs
- Old English *brysan* –to crush and old French *bruser*-to break
- = Contusion from Latin *contundere* to thump
- = Ecchymosis Greek *ek*-out and *chymos* –juice
- Haematoma - extravasated blood filling a cavity or potential space. Usually associated with swelling
- Petechiae -pinpoint (0.1-2mm) hemorrhages into the skin due direct forces or indirect forces- rise in venous pressure
- Definition: A bruise of the skin “is a haemorrhage beneath the skin caused by blunt force trauma causing a discolouration of the skin without an associated break in the skin surface”

### FACTORS THAT INFLUENCE APPEARANCE OF BRUISES

#### 1. Depth of bruise:

- Subepidermal bruises-superficial-forensic importance when caused by impact with patterned object. May fade quickly.
- Deep bruises may not be clinically evident for e.g. in abusive head trauma-can have bruises under surface of scalp

## 2. Degree of force

- While the force is the critical factor causing the injury- the size of the bruise or its presence are not always a reflection of the degree of force
- 72 % of childhood fractures do not have overlying bruises

## 3 Bleeding disorder

- Minor trauma results in significant bruising

## 4 Drugs

Steroids and aspirin

**5 Laxity of skin/ Type of skin:** Bruises more common periorbital area and scrotum; uncommon in palms and soles

## 6 Underlying soft tissue/bony “anvil”/site of injury

Resilient soft tissues like buttocks and abdominal wall bruise less than tissues over bone like head, chin and shins

## 7 Age of victim

- Old-vessel fragility
- Young - smaller volume of soft tissue, more active

## 8. Colour of skin

- Hard to visualise in dark skinned individuals

## 9. Age of injury/time since injury

- “come out”
- Continued bleeding from ruptured vessels
- Percolation of free blood from origin in deeper tissues
- Haemolysis-Hb stains more than intact red cells

**10 Movement of bruises:** Blood moves from site of injury along fascial planes and other tissues and by effect of gravity

## 11 Wounding objects can cause a pattern

### Aging of bruises

Forensic science International 1991; 50: 227-238:

- Any yellow colour means bruise is at least 18 hr old
- Red, blue, purple or black any time from 1 hr to resolution
- Bruises in different locations of identical age and cause on the same person have different colours and change colours at different rates

Archives of Dis Child 2005; 90: 185-189

- 167 studies reviewed, three were included: two studies described colour assessment in vivo and one from photographs
- Bariciak et al study showed a significant association between red/blue/purple colour and recent bruising and yellow/brown and green with older bruising, both this study and Stephenson and Bialas reported that any colour could be present in fresh, intermediate, and old bruises.
- Results on yellow colouration were conflicting. Stephenson and Bialas showed yellow colour in 10 bruises only after 24 hours, Carpenter after 48 hours, and Bariciak et al noted yellow/green/brown within 48 hours. Stephenson and Bialas reported that red was only seen in those of one week or less.

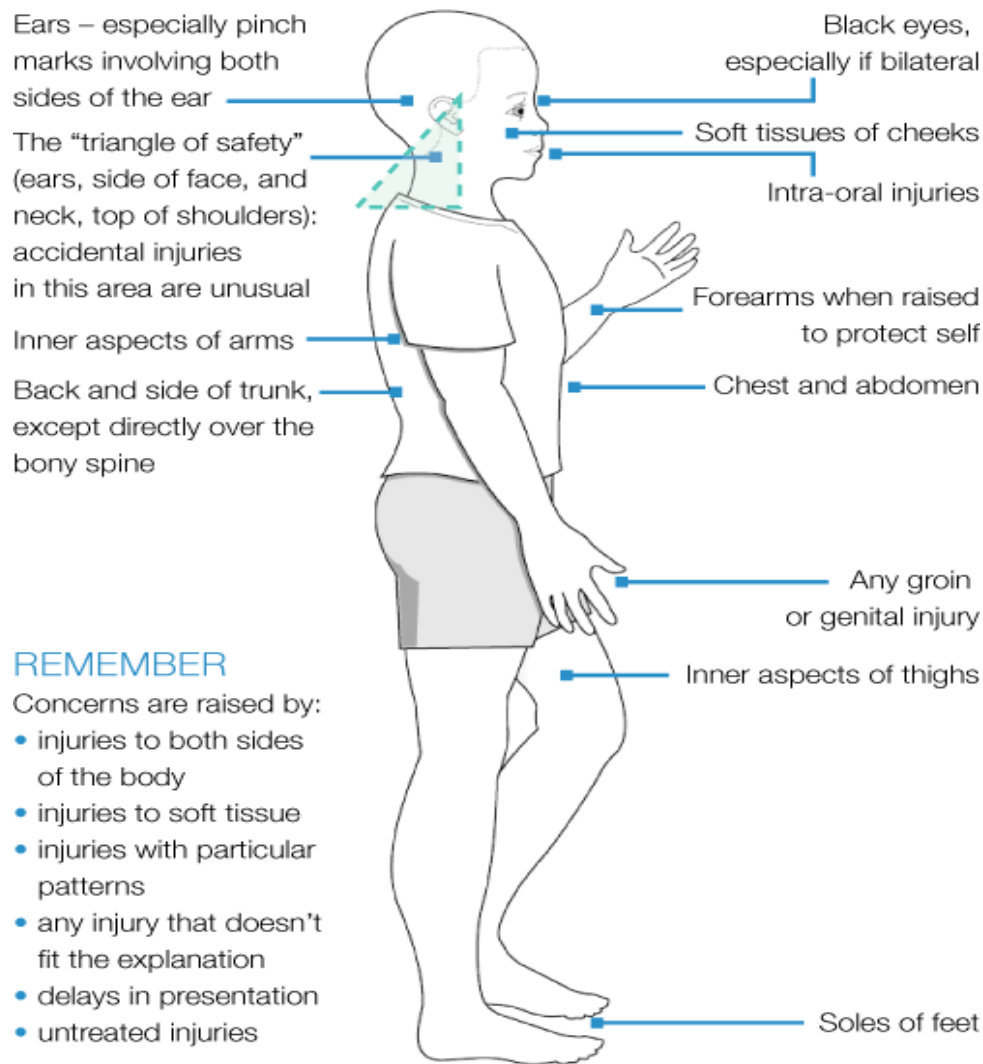
- The accuracy with which clinicians correctly aged a bruise to within 24 hours of its occurrence was less than 40%.
- The accuracy with which they could identify fresh, intermediate, or old bruises was 55-63%.
- Intra- and inter-observer reliability was poor.

**A bruise cannot accurately be aged from clinical assessment in vivo or on a photograph. At this point in time the practice of estimating the age of a bruise from its colour has no scientific basis and should be avoided in child protection proceedings.**

Distinguishing bruises in abused children from non-abused children-Age

Study	Population	Lesions studied	Age	% with lesions
Robertson et al 1982	Normal children	Bruises and abrasions	2w-2 mo 3-9 mo 18 mo-11 yr	3.3 1.1 50-65
Mortimer and Friedrich 1983	Normal children	Bruises	<1 yr	0.9
Sugar et al 1999	Normal children	Bruises	0-2 mo 3-5 mo 6-8 mo 9-11 mo 12-14 mo 15-17 mo 18-23 mo 24-35 mo	0.04 0.7 5.6 19.3 22.6 42.8 49.4 60.9
Sugar et al 1999	Well child visits	Bruises	Pre cruisers Cruisers Walkers	2.2 17.8 51.9
Wedgewood 1990	Hospitalized children-non abused	Bruises	Pre cruisers Walk up stairs	0 100

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#### Abusive v Accidental bruise patterns

- Accidental bruises-small, frontal, over bony prominences
- Abusive-large, multiple, in clusters, bilateral, patterned, away from bony prominences, imprint of implement, over head, neck and face and next over buttocks, trunk and arms.

#### Patterned bruises

- Patterned intradermal bruise due to impact with a hard, patterned object with ridges/grooves.
- Skin over ridges is compressed and vessels remain intact.
- Skin forced into grooves and dermal vessels ruptured
- The resulting accumulation of a small amount of blood, near the epidermis
- May demonstrate the obvious pattern of the causal surface (tyre, shoe tread, car bumper, clothing, gun muzzle)
- It is often useful to trace the outline onto an acetate sheet for later comparison.

#### Tramline bruising

- Parallel linear bruising
- Negative imprint

- Capillaries break as blood is pushed way from point of impact
- A solid stick bruise is limited to the convexity of the body surface (remember that a soft body part such as a buttock will mould and flatten.
- A flexible cord will wrap around the convexity producing a longer and often curved tramline bruise and may have looped ends

#### Patterned bruises

- Doughnut pattern caused by forcible contact with a round hard object such as a ball
- Facial bruises-soft parts-cheeks, right periorbital, and bilateral concerning for abusive injury
- black eye: peri-orbital haematoma, fist blow to orbit, or fractured skull (R.T.A., gunshot), or tracking from forehead bruise.
- Slap bruises: Parallel linear bruises, might be petechial, separated by areas of central sparing, often on the cheek
- Fingertip/pad bruising: small discoid or oval bruises in a cluster, may be discrete or blurred if a struggle occurred (dynamic nature of force), slightly larger than the finger tips due to outward spread of blood, on limbs and face (child abuse), thighs (nappy changes, rape), neck (throttling -manual strangulation)
- Finger impression bruises: any number, linear, parallel, on locations that may have been grasped or grabbed, can wrap itself around contours
- Pinch mark bruises: paired oval or round bruises with spared area between may have abrasions within the bruises
- Bruises on ear often on the front and the back of the ear: Ear protected from blunt trauma in accidents by prominence of head and shoulders, blunt force directed to ear bruise on posterior surface from ear crushed against side of head, or ear pinched or grabbed or the blow can fold or crimp the pinna
- Petechiae in SVC distribution along with subconjunctival haemorrhages, petechiae in external auditory canal, tympanic membrane and palate may be from forcible compression of the chest, strangulation/suffocation and inverting a child
- Bilateral buttock bruising: over soft fleshy parts of the buttocks with sparing of the gluteal cleft
- Defensive pattern: Bruises clustered over one outer arm and forearm, ipsilateral shoulder and upper back as child pivots away from the attacker holding up arm and forearm to protect face and front of chest
- Bruises over mouth and lips may corroborate history of hand forcibly paced over mouth
- Bruising over shoulder prominences may corroborate being forcibly pushed up against wall during an assault
- Severe sub-galeal haematoma: blood can track to the periorbital area, can track to behind ears-may be mistaken for Battle sign, may push ears forwards and may have features of traction alopecia-patchy hair loss, broken hairs and petechiae around the hair follicles
- Large number pf cluster of bruises on locations not usually injures in accidental trauma

#### Bite marks

- Human bites compress flesh-bruises, abrasions, small lacerations. Near circular or shallow oval in shape

- May be a series of separate bruises with central linear abrasion or a continuous curved line of bruising
- Dog bites tears flesh-large lacerations and avulsions. Deeply arched or U shaped.
- Canine marks are the most prominent or deep part of the bite
- Distance between maxillary canine teeth in adults is 2.5 - 4 cm
- If inter-canine distance is <2.5cm –likely child, 2.5-3 cm likely child or small adult, 3cm or more –likely adult
- Forensic odontologist-when fresh may give clues to assailant-missing teeth, displaced teeth etc
- Teeth may close down on flat surface but more often a block of tissue is drawn into the mouth. Results in suction bruise (hickey) between the dental impressions.
- Source of DNA, salivary amylase if fresh
- Self-inflicted-fabricated assault-accessible body part

#### Love bite (hickey)

- Not a bite. No teeth marks
- Suction bruise caused by firm application of the lips against the skin, forming an air-tight seal, oral suction causing a shower of petechial bruises from rupture of numerous small vessels
- Normally found on teenagers after the weekend
- Also seen on neck, breasts in sexual assault
- Must be human in origin.
- A similar appearance is seen between the dental arches of a true bite

#### Mimics of bruises

- Birth marks: Congenital dermal melanocytosis, haemangiomas
- Cultural practices
- Texta, pigment from clothes!
- Coagulation disorders, ITP, DIC
- Sepsis
- Malignancy
- Drug ingestion
- Vitamin K and C deficiencies
- HSP, other vasculitis, Haemorrhagic oedema of infancy
- Connective tissue disorders, striae
- Erythema nodosum, erythema multiforme, mastocytosis

### Abrasions

#### Types

- Scrape/Graze Abrasion (brush or scuff)
- Scratch or linear abrasion

Clinically trivial, minimal bleeding or exudation, heals by crusting/scabbing, heals without scarring, commonly with bruises and lacerations

Direct impact-imprint and may reflect causative surface

1. Always reflects site of impact

2. Often indicate causative object or surface-patterned-tread of shoe or tyre mark broad, dried abrasions. caused by dragging or scraping the surface of the skin against a rugged surface
3. Often indicate direction of impact
4. Trace materials may be seen
5. Broad, dried abrasions. caused by dragging or scraping the surface of the skin against a rugged surface or as a body slides on pavement
6. Finger nail abrasions in neck from strangulation

### **Laceration**

- From Latin - *lacerare* to tear
- Ragged or irregular tears or splits in the skin, subcutaneous tissues or organs resulting from crushing or blunt force trauma (trauma by impact)
- Common over bones-scalp, chin, knees-skin is crushed and pinned against bone
- Soft tissue can be lacerated by blunt protruding object that pulls obliquely on the skin stretching and tearing it.
- Rolling or grinding movement of for e.g. a wheel can also stretch and tear skin
- Indicates site of impact
- Ragged edge
- Bruised or abraded
- Tissue bridges
- Little specific information about causal object
- Trace evidence in wound
- Rarely self-inflicted
- Lacerations often confused with abrasions
- Incised wounds often called lacerations-resulting in incorrect conclusions about how the injury was sustained
- Laceration of frenulum concerning for forced feeding or forced insertion of object in mouth however it is not always indicative of abuse it may also be caused by force directly to mouth as from fall-there will be in this case bruised lips and possible dental injury as well

### **Incised wound**

- clean cut edges
- length is greater than depth of wound
- no abrasions or bruises
- no bridging tissues
- little specific information about causal object

### **Aging of skin wounds**

- 4 stages of healing
- Initial acute inflammatory reaction followed by crusting/scabbing/healing/scar formation
- These changes are used to ESTIMATE timing of injury
- Unreliable, many variables
- Multiple abrasions with different appearances may have been sustained at the same time

### Factors that affect wound healing

- Characteristics of the individual: Medical issues –DM, Ehlers Danlos, eczema, immunodeficiency, Malnutrition, Obesity slows healing, Age - faster in children and Medications - NSAIDs, steroids
- Characteristics of the wound: Location - mouth, anus and genitals heal fast, wounds on extremities heal slowest, denervated or moving tissue heals more slowly, size of injury, type - crush injuries heal slower than shear injuries, treatment infection, FB's

### **Assessment of skin injuries**

#### History

- History of mechanism of injury; State historian and document words verbatim, obtain if possible, a history from other sources (through Child Protection and police)
- Time of injury, who witnessed the injury, time to presentation for treatment
- Obtain history from child if possible
- Other history as you would in any child: developmental history, past medical history- bleeding tendencies and medical conditions that may cause skin lesions that mimic abusive skin trauma, history of behaviour problems
- Family and social history is important for assessment of risk to the child; but beware of bias caused by poor social circumstances.
- Be alert to:

inconsistencies in history

delay in presentation

denial that the lesion is an injury

attributing injury to siblings, pets, self-harm, accidents

report of injury by person other than the carer

parent/carer presenting as indifferent

#### Examination

- Document what the skin injury is
- Size, number, colour, shape and anatomical location
- Look in hidden places –scalp under hair, ears, groin/genitalia, mouth, fundus examination
- Consider if this is a mimic
- Diagram documentation-neatly labelled
- Clinical photography
- Investigations
- Secondary consultation- Local emergency department, paediatrician, VFPMS
- Report to child protection

#### Investigations

Clotting screen-when to order?

- Older children, clear Hx, no red flags, patterned bruises – probably not indicated
- Younger children, widespread distribution, Hx unclear or suspicious for coagulation disorder
- Commonest acquired is ITP, commonest inherited is VW disease
- Children with a clotting disorder can also be abused

What tests do we do?

- FBE and film
- PT, APTT, INR and Fibrinogen



- Von Willebrand screen and blood group
- LFT, Ca and renal function (platelet dysfunction)
- Factors VIII, IX, XIII
- PFA100?

#### Imaging

- Skeletal survey / bone scan or 2 Skeletal surveys 2 weeks apart
- Ct or MRI brain- significant bruising around the head, face and neck

### **Indications for skeletal survey in children under 2 years of age presenting with bruising**

**SS is necessary in children <24 months with bruising if any of following features are present;**

History of confessed abuse

History of bruising occurring during family violence

Additional injuries on examination (e.g. burns, whip marks, bites)

Patterned bruising

> 4 bruises away from bony prominences

Ear, neck, torso, buttocks, genital region, hands, feet if no Hx of trauma

**SS is also necessary in children < 12 months with bruising in following locations;**

Cheeks, eye area, ear, neck

Upper arms or legs (not over bony prominences)

Hands, feet

Torso, buttocks, genital region

> 1 bruise away from bony prominence

**SS is also necessary in children < 9 months old with bruising in the following locations;**

> 1 bruise in any location

**SS is also necessary in children < 6 months old with bruising in the following locations;**

Bony prominences (T-zone, frontal scalp, extremity bony prominences) EXCEPT if single bruise and Hx of fall

### Interpretation

#### Consider

- History of mechanism
- The age, development, and general health of the child
- The injuries noted, their location and patterns
- Define the terms used
- Is this child developmentally capable of sustaining injury in the manner described?
- The injury/injuries and the pattern of injuries in view of the explanation given
- Could this injury have been caused by the mechanism described by carer?
- Could this injury have been caused by an accidental mechanism?
- What are the other possible causes for the injuries seen?
- Could they be a skin condition and not an injury?

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