THERMAL INJURIES IN CHILDREN

Maryanne Lobo

Epidemiology

- Children < 5 yr - at high risk
- The 2006 National Injury Surveillance Unit reported that in Australia 191 children per 100 000 population <4 yr were hospitalised for burns - 12% of all persons hospitalised for burns
- Rates for children 5-14 yr < 50 per 100 000 population.
- In hospitalised burns 75% of infants (predominantly > 7 mo) and 63% of 1-4 yr were scalds.

Causes

- Accident: Unavoidable or understandable lapse in the usual protection given to children
- Neglect/negligence: failure to protect the child from inadequate parenting
- Abuse: deliberately inflicting the injury

Epidemiology of abusive burns

- In 1.7 - 25% of children hospitalised with burns - inflicted
- Lower end of this range in UK, Australia and New Zealand
- Burns from neglect thought to be > than abusive burns in Australia and New Zealand
- Children with inflicted burns are younger, have longer hospital stays and greater mortality vs. children with accidental burns

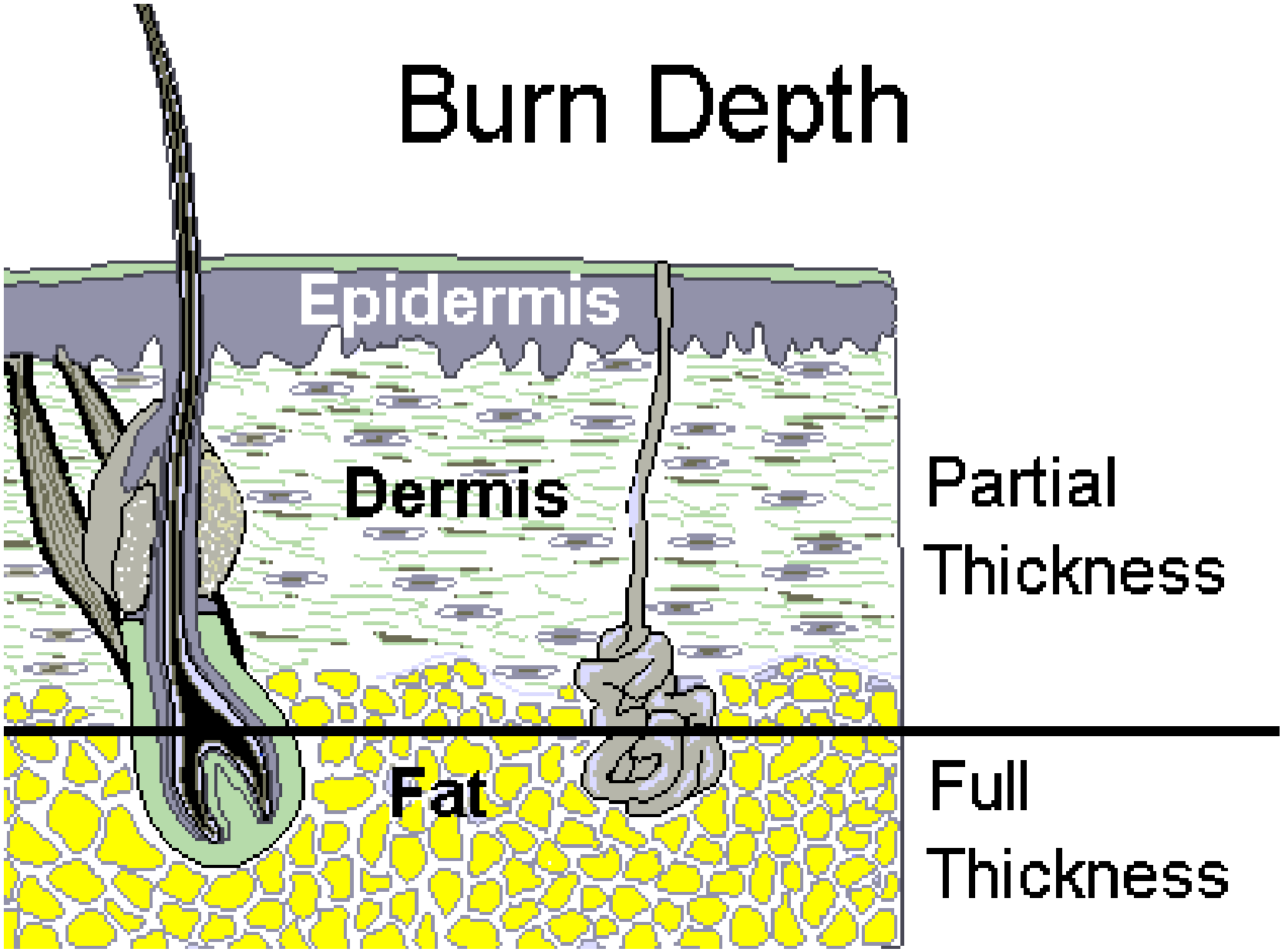
Risk factors for burns in children

- Male
- 1-2 yrs
- Young mother
- Single parent
- Having older siblings
- Lower SES
- Kitchen > bathroom

Classification

- According to depth
- According to body surface affected
- According to cause

Burn Depth



Classification of burns

Superficial burn (first degree burn):

- involves epidermis
- painful
- dry (non blistered)
- red
- blanches on pressure
- heals in 3-6d without scarring

Classification of burns

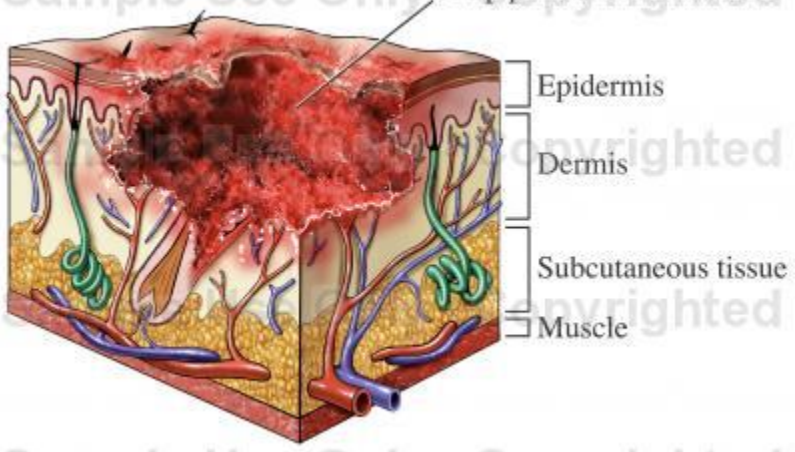
Superficial partial thickness burns (second degree burns)

- involves epidermis and dermis
- painful with air movement or change in temperature
- red, blistered, seep fluid
- blanches with pressure
- heals in 7-21 d
- burned area may be darker or lighter in colour but no scarring

Classification of burns

Deep partial thickness burns (third degree burns)

- extends deeper into the dermis
- almost always blisters, blisters immediately and blisters may persist for several weeks
- painful on deep pressure
- does not blanch on pressure
- takes > 21 d to heal
- always scars and the scar may be severe



Classification of burns

Full thickness burns (fourth degree)

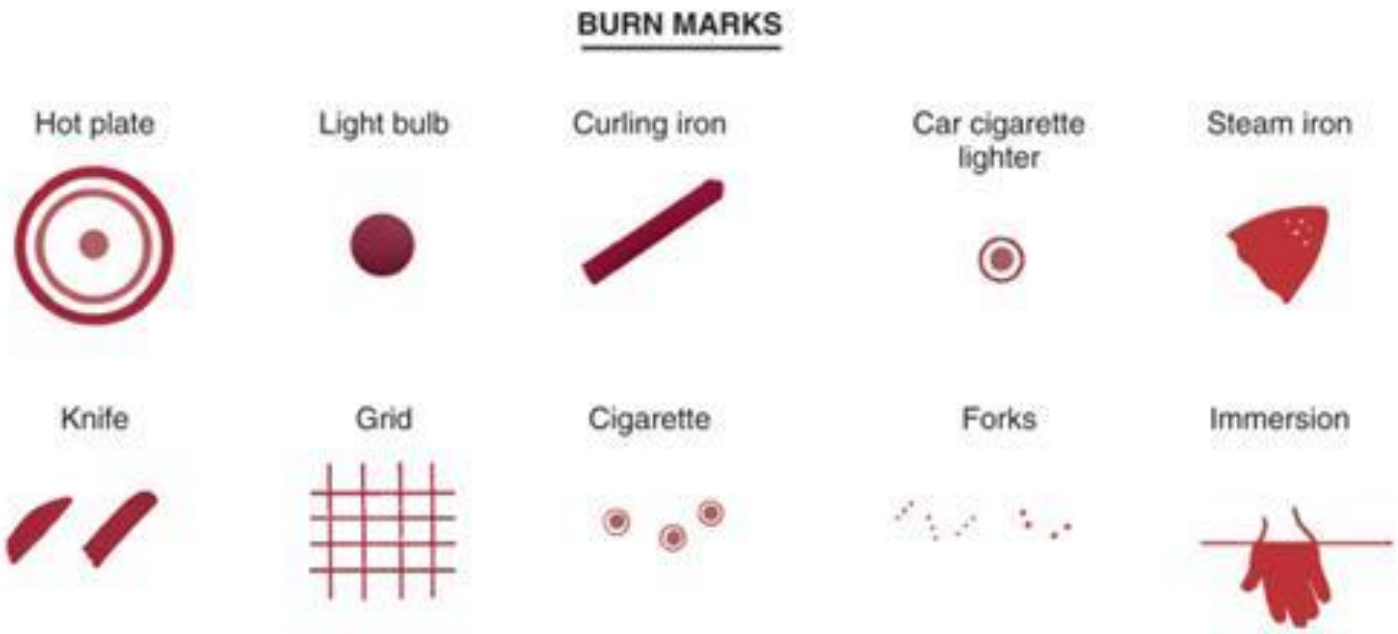
- all layers of the skin completely destroying the skin
- painless
- waxy white, leathery grey or charred black
- dry
- does not blanch with pressure
- does not heal without surgery
- scarring is severe

Types of thermal injury

- Contact dry burns
- Cigarette burns
- Scalds
- Fire burns
- Radiant burns
- Chemical burns
- Electric burns
- Friction burns
- Cold injury

Contact burns

- caused by hot objects usually metallic
- looks like a brand mark, sharply demarcated and with the shape of the object that caused it
- burn is dry and tends to be of a uniform depth



Abusive contact burns caused by potato smasher-number

Contact burn caused by curling iron

- age of child, number of burns and location concerning for abuse

- age of child, single area location suggests accidental contact

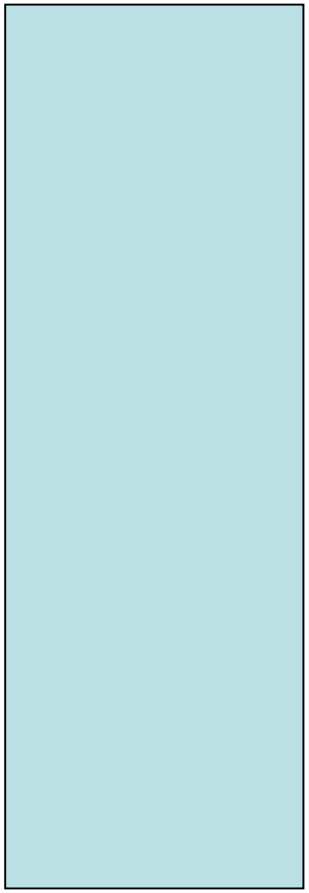
Abusive contact burn caused by head of dryer

- location atypical for accidental burn

Contact burn

- patterned contact burn from metal grate surrounding heater
- location atypical for accidental

Contact with hot car seat



Cigarette burns

- burn at temp of 200 C
- circular, punched out
- 0.8 cm to 1 cm
- sharply demarcated eschar
- surrounding collarette of exfoliation and tissue reaction

Cigarette burns

Accidental cigarette burns-brushing against a lit cigarette
- single
- superficial
- not completely round, more linear appearance
- higher degree of intensity on one side

Common sites
- face
- hands

Cigarette burns

Inflicted

- deep, multiple, circular, any location

Scald burns

- Caused by hot liquids or steam

- Patterns:

1. Spill/Splash/Geographical or Flow type scalds also called Cascade or Pour scalds
2. Immersion scalds

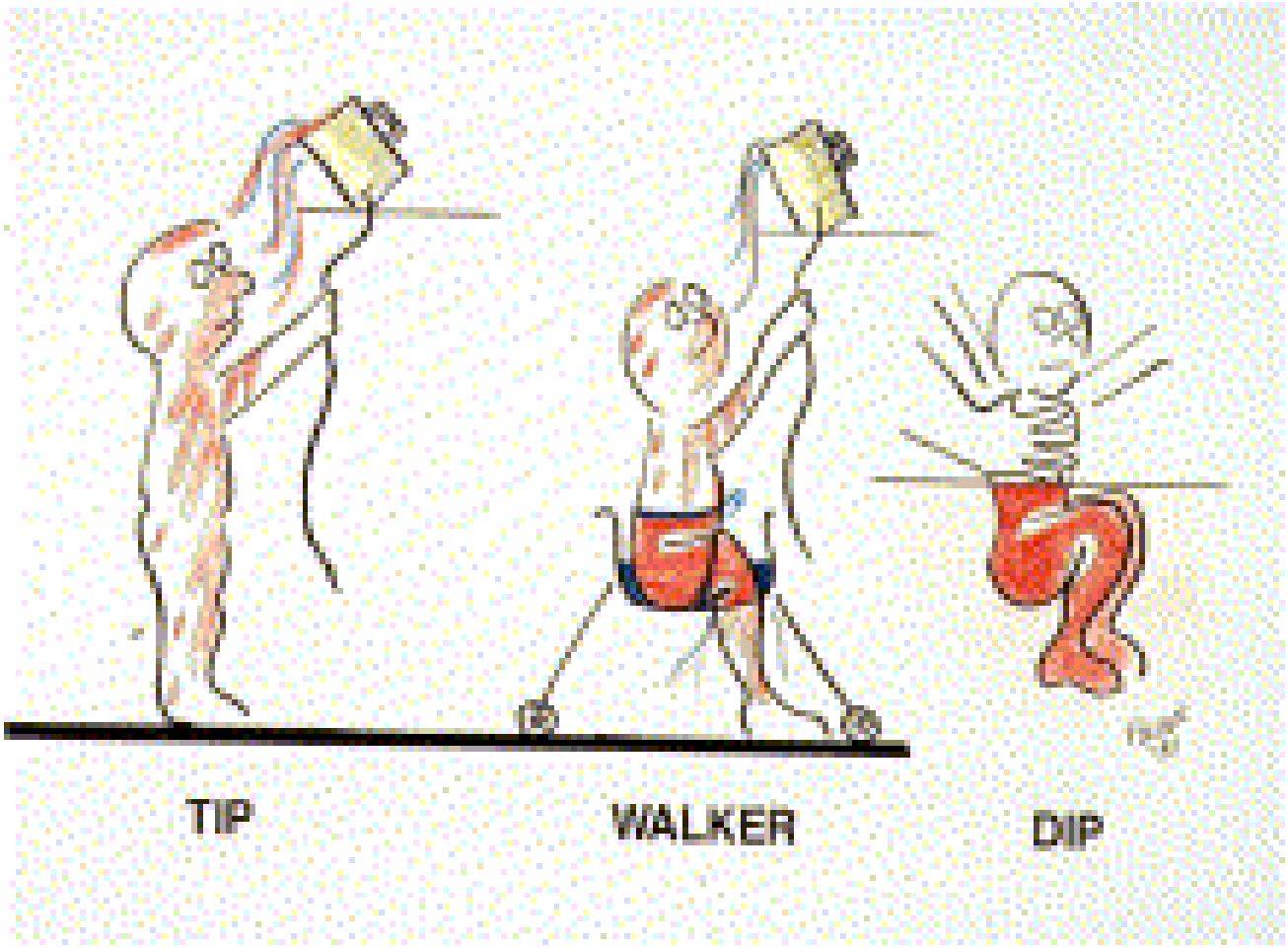
Time to burn by water temperature

- 1 sec at 65 C
- 2 sec at 60 C
- 12 sec at 55 C
- 2 min at 50 C
- The time to burn in children would be shorter as a child's skin is thinner than that of an adult

Features of scald burns

- clothing wet
- skin sodden, bleached
- red line of demarcation between burned and non burned skin
- vesication most marked over burned area
- flow, trickle and splash marks

Spill/splash/geographical



- hot liquid falls from height
- accidental pulls or spills
- splash burns at site of initial contact
- usually superficial as contact time is short

JPHC, Vol 26, Issue 3 2012

Hot water splash marks

- Greenbaum et al Intentional burn injury: an evidence based, clinical and forensic review. Burns. Vol 30, Issue 7, 2004 628-640

Spill/splash/geographical-accidental scald pattern

- younger child - accidental spill or flow scalds are usually frontal, asymmetric and on head, neck and upper trunk
- older child may occur on the lower trunk, and limbs including legs and thighs.

Maguire S Arch Dis Child Educ Pract Ed 2010;95:170-177

Spill/geographical-frontal asymmetric and on the head, neck, upper trunk accidental scald pattern

Spill burns

- uneven in depth; deeper at the first point of contact become superficial distally as the liquid cools as it flows downwards
- as the hot liquid flows down it causes scalds in the shape of flow tracks and ends in an inverted arrow head or arrow down shape

Tap flow scald

- note splash marks
- flow track
- arrow head at the distal end of flow

Immersion burns

- concerning for abuse
- location: buttocks, perineum, extremities
- circumferential
- uniform depth
- absence of splash marks
- tide marks
- sparing

Immersion burns-location perineum, buttocks and extremities-very concerning for abuse

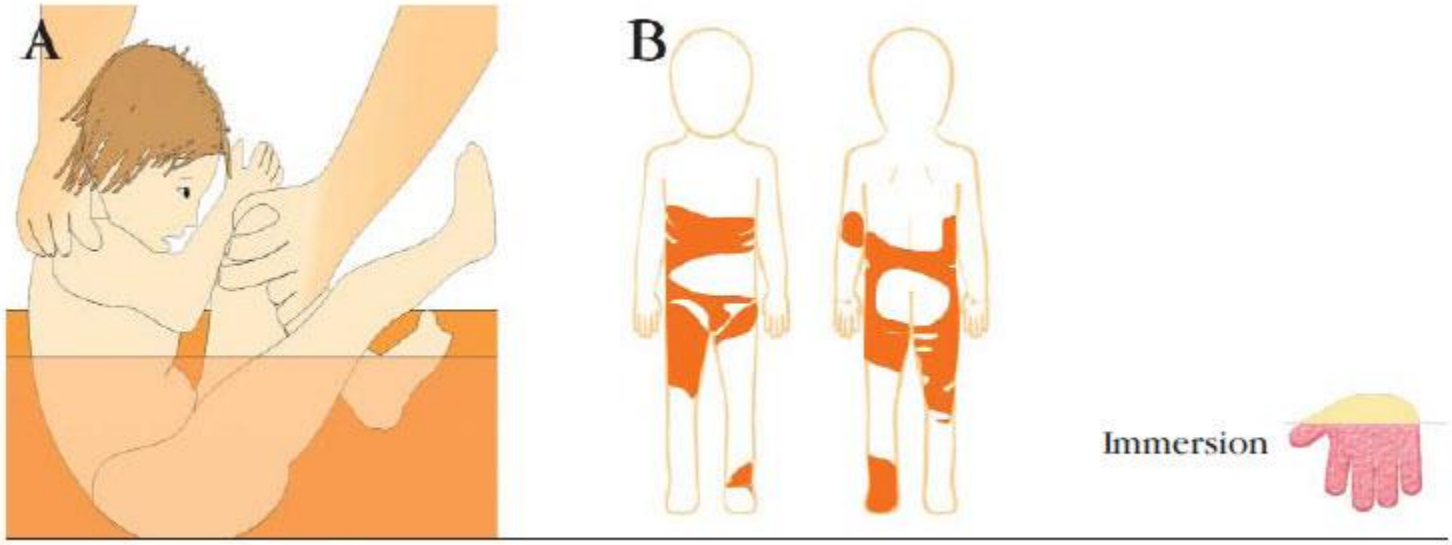
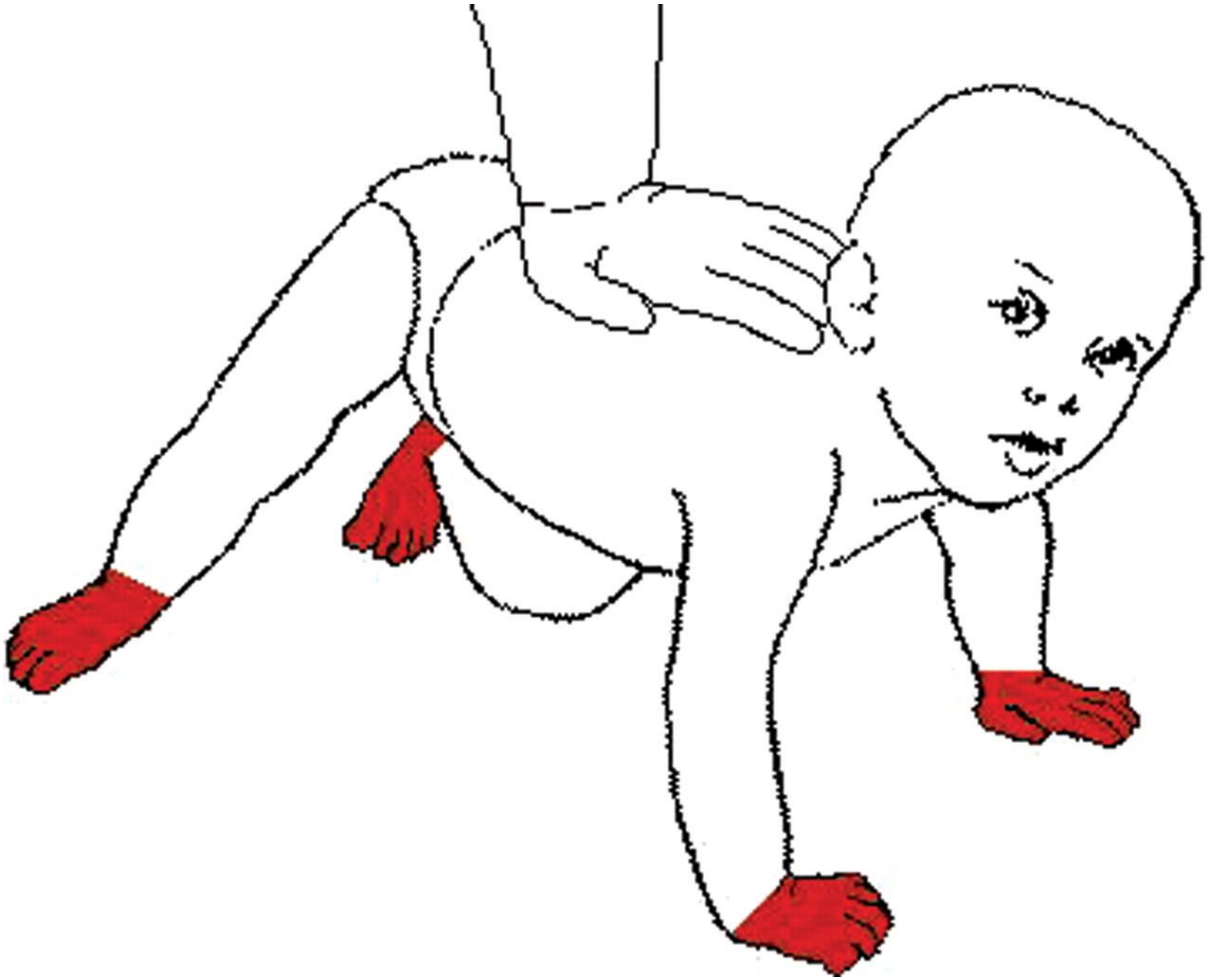


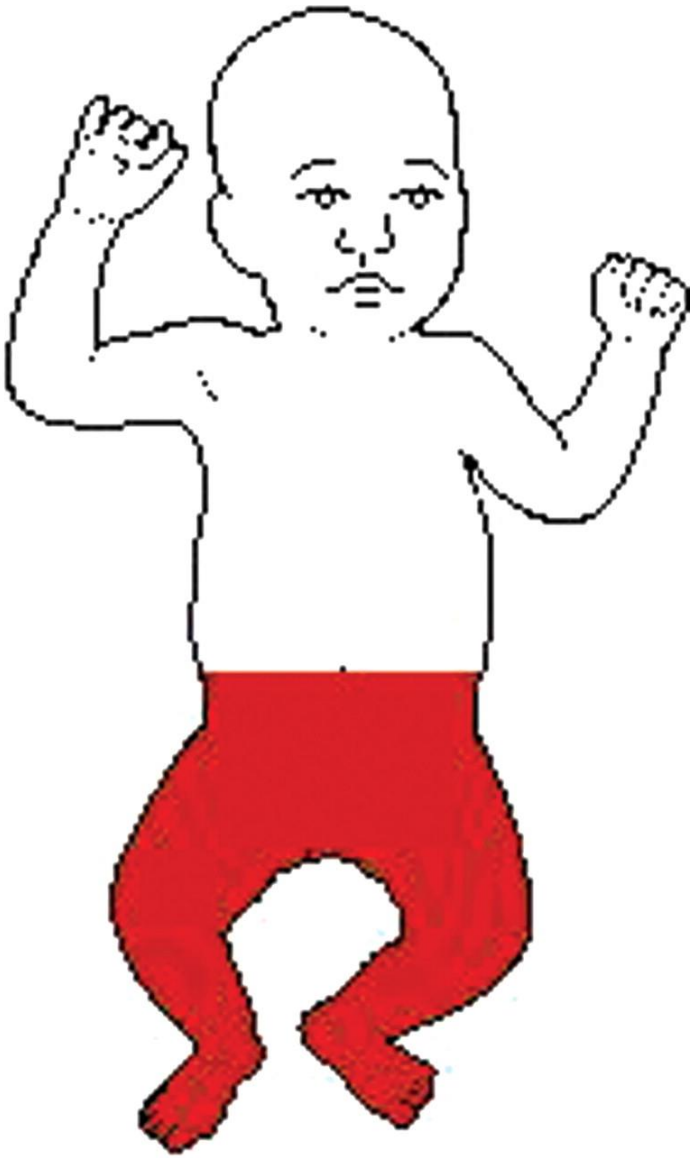
FIGURE 2: A. Scald; B. "Zebra striae" with preservation of the gluteal region (resting point) and C. "glove" burn
Adapted source: Kos L, Shwayder T[8]

Abusive immersion scald ‘glove and stocking’ pattern



Abusive immersion scald pattern

- uniformity of depth of burns
- water line or tide marks-horizontal marks indicating depth of immersion



Maguire S Arch Dis Child Educ Pract Ed 2010;95:170-177

From: **Scald Abuse**

Arch Dermatol. 2002;138(3):318-320. doi:10.1001/archderm.138.3.318

Figure Legend:

Large serous bullae of the buttocks and perineum with surrounding erythema. The arrow indicates the gluteal cleft tide mark.

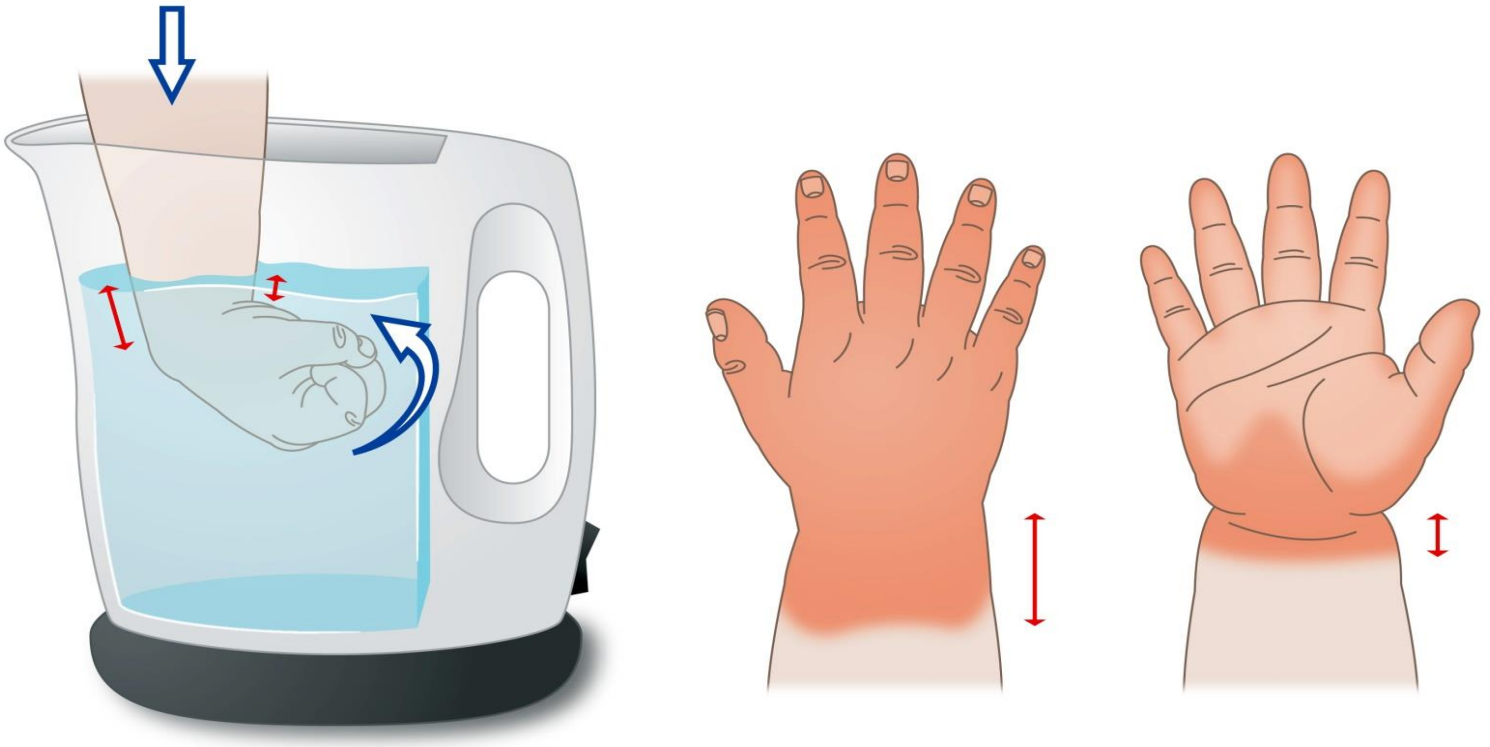
Bilateral sock scald burns

- absence of splash marks concerning for abuse
- however debatable, at temp < 54C takes time to burn so absence of splash marks neither supports or refutes abuse.
- abused children could struggles and have splash marks

Interpretation of the pattern of burns-immersion

- circumferential
- water tide mark
- sparing of flexures

Interpretation of the immersion burns-sparing

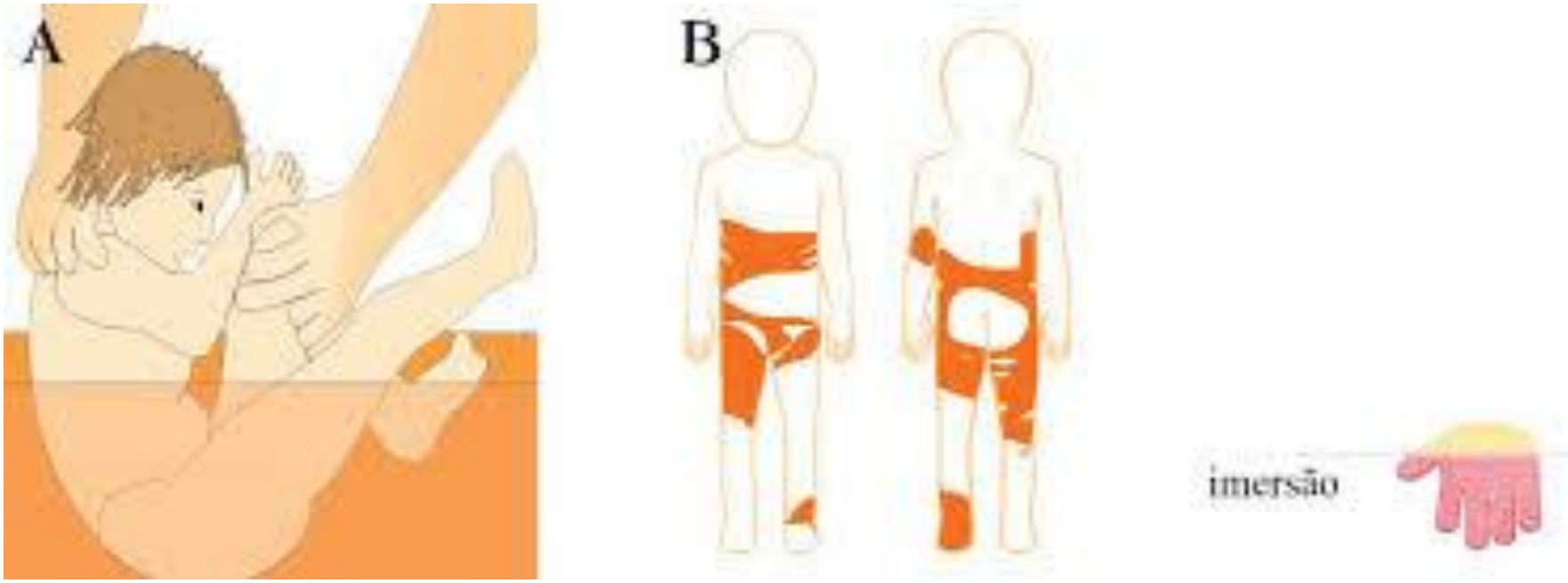


- hand immersed in hot liquid
- back of hand first contacted the water
- wrist and fingers were flexed
- partially protecting palmar surface

Immersion burns-sparing

- “Hole in the doughnut” or “halo sign”
- when a child is forcibly seated in hot water in a tub the contact of the buttocks with the cooler surface of the tub causes an area on the buttocks that escapes burning or has less severe burning.

Immersion burns-sparing-zebra stripes scald pattern



Arch Dermatol. 2002;138(3):318-320. doi:10.1001/archderm.138.3.318

Flame burns

- clothing burned
- skin dry and charred
- blistering may be seen at the edge
- red line of demarcation between burned and non burned skin
- ulceration only when burn is infected

Radiation burns-sunburns

- sunburns are radiant burns
- superficial or superficial partial thickness
- may be from neglect

Chemical burns

- clothing have typical stains and odour
- skin may be stained- black by hydrochloric acid, yellow by nitric acid, and brown by sulphuric acid
- vesication rarely seen
- red line of demarcation rarely seen
- burns are deep or deep partial thickness
- significant ulceration due to penetration and devitalisation effects of the corrosives

Electric burns

Low voltage burns

- mostly in children <5 yrs
- mouth and hand
- contact with wire with worn out insulation
- small burn
- but deep and involving muscle, vessels and tendons

High voltage burns

- entry charred centrally depressed and leathery
- exit- exploded
- widespread tissue destruction between
- high fatality

Friction burn

- Friction burn is a form of abrasion and burn caused by rubbing of the skin against a surface when the friction is severe enough to generate heat

- Deep friction burn from touching moving belt of treadmill

Cold Injury

Non freezing:

- Chilblains: cold wet weather, painful or itchy purple red papules or reddened swollen toes, nose, ears
- Immersion foot

Freezing

- Frost nip
- Frost bite

Frosting or Aerosol burn

- aerosol sprayed very close to the skin
- for sustained periods
- fluorinated hydrocarbon propellant lowers skin temperature by 60 C
- results in a cold injury

Differential Diagnosis

- Cigarette burns-

  impetigo, papular urticaria
- Scalds: staphylococcal scalded skin syndrome, TEN, any blistering disorder, phytophotodermatitis

Features concerning for abusive burns

1. **History incompatible with examination findings;**
- denial by carer that the injury is a burn
- history not compatible with the physical features of the burns for example history stating a flow mechanism when the pattern is clearly one of immersion scalds
- when the pattern of burns is incompatible with the development of the child

2. **Delay in presentation for treatment**
3. **Child brought in someone other than parent**
4. **Blaming a sibling**
5. **Passive introverted fearful child**

Features concerning for abusive burns

6. **Associated unrelated injury:** Bruises, lacerations and swellings more common in children with intentional scalds compared to children with accidental scalds. Rarely scalds are associated with sexual abuse
7. **Coexisting fractures:** Obvious fractures on examination of a child with burns or occult fractures on imaging suggest that burns may be inflicted
8. **Scars from previous burn in juries**
9. **Clinical features of neglect and failure to thrive**.
10. **Total burn surface area**: There is disagreement whether total burn surface area is greater in inflicted rather than accidental burns