

Features of Pediatric Burns and Co-existing Injuries Caused by Neglect, Intentional, and Unintentional Trauma

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I have no financial disclosures.



Learning Objectives

At the conclusion of this presentation participants should be able to:

- Contrast distinguishing characteristics of negligent, intentional, and unintentional burn injuries in children
- Recognize co-existing injuries that commonly present in children with negligent, intentional and unintentional burns
- Summarize interventions to prevent pediatric burn injuries

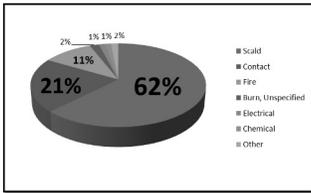


IMPACT

"If a child suffers a burn by the age of three, they are seven times more likely to suffer from abuse or neglect by their sixth birthday"



Epidemiology



- Third most frequent cause of injury resulting in death behind MVA and drowning
> 2000 children die annually
- 40,000 children hospitalized yearly
- Burns constitute ~10% of inflicted injuries
- Boys, children < 4 yo, children with disabilities at highest risk
- 6-26% of burns are inflicted
- Inflicted burns have a higher mortality rate

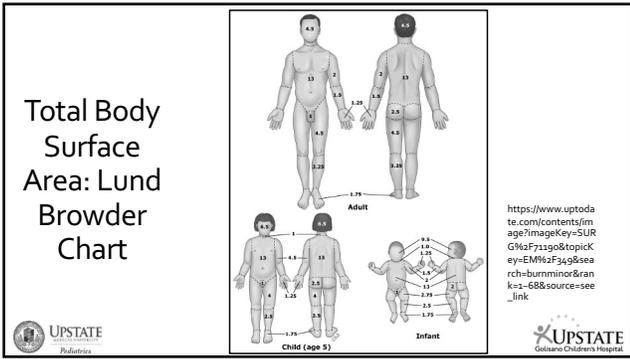
Source: American Burn Association National Burn Repository 2014

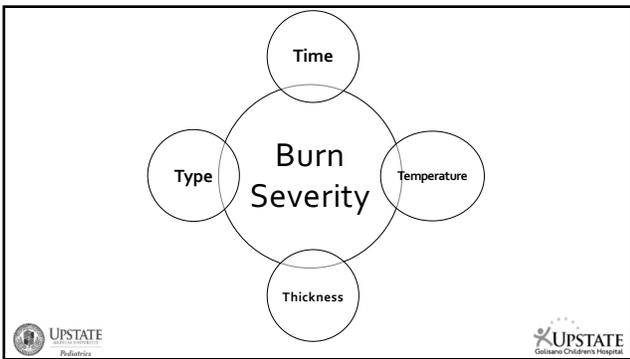


HISTORY

- 'Toxic trio' (maternal mental health, domestic abuse, drug abuse)
- Changing mechanism or lack of mechanism of injury
- Reported mechanism does not fit with the developmental stage of the patient
- Presence or history of a social worker
- History of multiple previous attendances for injuries or previous burns
- A delay in presentation for medical review





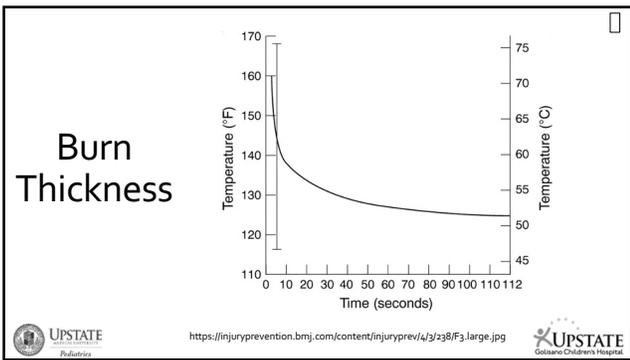


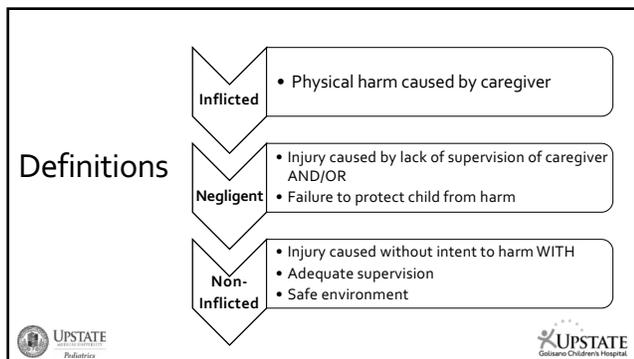
Classification of Burn Thickness

Clinical appearance	Thickness	Degree	Depth	Characteristics
	Superficial	First	Epidermis	Pain, redness, mild swelling
	Superficial Partial	Second	Dermis: papillary region	Pain, blisters, red/pink skin, severe swelling
	Deep partial		Dermis: reticular region	White, leathery, relatively painless
	Full	Third	Hypodermis (subcutaneous tissue)	Charred, insensate, eschar formation

<http://www.roshreview.com>

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Types of Burns: Thermal

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Scalds: Splash/Spill

Youngest age
of pull down
scald = 8
months

- Child pulls down (48%) hot liquid such as cup/mug (55%) onto himself/herself
- Child reaches for hot liquid
- Child spills hot food/drink directly from microwave (more common in 5-16 yo)
 - ✓ Front of body (96%)
 - ✓ Face, arms, upper trunk (<5 yo)
 - ✓ Lower trunk, legs and hands (5-16 yo)
- Irregular margins
- Non-uniform depth
- Pattern may be altered if child is wearing clothes
- Identify area of first contact = "splash" marks




Splash/Spill



Visual Diagnosis of Child Abuse AAP, 2018




Scalds: Immersion

Youngest age
of child
crawling in
bathtub= 16
months

- Child falls or immersed into tub/container of hot liquid
- Depth is uniform
- Distinct borders
- Sharply defined "water lines"
- May see "splash marks" if child falls in
- Most commonly water in sink or bathtub
- Classic patterns of "glove" or "stocking" appearance
- Involves lower limbs or perineum/buttocks with doughnut-shaped sparing
- Skinfold sparing where child flexed during event
- Inflicted injuries often occur during toilet training or soiling of clothes




Stocking & Glove



Burn-Related Child and Adult Abuse | SpringerLink



Care of outpatient burns | Plastic Surgery Key




Zebra Pattern



Non-accidental Injury (Physical Abuse) | Plastic Surgery Key



Forced submersion in a flexed position



'Zebra' stripe



'Doughnut hole' sparing




Contact

Characteristics of inflicted:

- Age > 3 yo
- Full thickness
- Location on the limbs, back or neck
- Clear edges of demarcation
- Co-existing injuries
- Cigarettes, irons, hairdryers, and heaters

Burn marks

Marks from heated objects cause burns in a pattern that duplicates that of the object. Familiarity with the common heated objects that are used to traumatise children facilitates recognition of possible intentional injuries. The location of the burn is important in determining its cause. Children tend to explore surfaces with the palmar surface of the hand and rarely touch a heated object repeatedly or for a long time.

Reproduced from Dubowitz H, Lane WG. Abused and neglected children. In: Nelson's Textbook of Pediatrics. Kingston RK, Stanton SF, Stricker PG, Schor NF (Eds), 20th ed. Elsevier: Philadelphia, 2015. Illustration used with permission of Elsevier Inc. All rights reserved.




Contact

- Look for patterns
- Children <5 yo → 83% of burns are due to touching objects in the home (42% irons)
- Children 5-16 yo → 46% sustain outdoor injuries
- 67% of non-inflicted burns affect the hands (usually palm)



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Cigarette Burns

- ✓ Often in different stages of healing
- Common to find in groups
- Frequently accompanied by other injuries → multiple blunt force trauma and sexual abuse



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Flame

- 70% occur in children > 5 yo
- Fuel and lighters and commonly involved
- Face and hands are the most common site

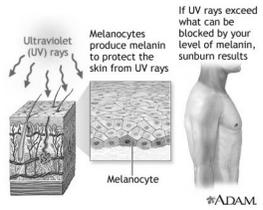


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Types of Burns: Radiation

- ✓ Sunburns
- ✓ Tanning Beds
- ✓ Radiation Therapy



Types of Burns: Friction

- Treadmill
- Turf



https://images-prod.healthline.com/htmlsresource/images/Image-Galleries/turf-burn/3522-Turf_Burn_person_dark_skin-648x364-slides.jpg



Types of Burns: Chemical

- Bleach



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Types of Burns: Chemical

- **Acids** → Coagulative Necrosis
 - ✓ Drain Cleaner, Batteries
- **Alkali** → Liquefactive Necrosis
 - Deeper Penetration, GI Perforation
 - Lye, Oven and Drain Cleaner



"Exploratory Tasting"

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Types of Burns: Electrical

- Electrical Cables
- Outlets

- 3-9% of admissions to burn centers annually
- Low vs High Voltage
- Visible areas usually show small portion of actual tissue destruction
- Can lead to:
 - ✓ Joint Contractures
 - ✓ Permanent Defects
 - ✓ Compartment Syndrome
 - ✓ Cardiac Arrhythmias



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Coexistent Injuries

Fifteen-minute consultation: Childhood burns: inflicted, neglect or accidental

Stephen Mullen,¹ Roisin Begley,² Zoe Roberts,² Alison Mary Kemp³

Table 1 Comparing percentage of diagnostic investigations performed (bold) and percentage of positive results (in brackets) for children with burns versus^a other, whom were referred to a Child Abuse Paediatricians.^a

	Burns	Comparison
CT head	25% (+12%)	61% (+44%)
Skeletal survey	55% (+16%)	72% (+23%)
Transaminases	35% (+2.6%)	55% (+4.9%)

^aOther included the remainder of children referred for child maltreatment investigations, that is, other forms of physical abuse, neglect and sexual abuse.

- Up to 1/3 of children with inflicted burns in a study by Fagen et al. (2015) had skeletal injuries
- Healing rib fractures and shaft fractures were the most common

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Coexistent Injuries



- Prospective, observational cross-sectional study of children < 10 yo referred to CAP
- Burns 215/2890 = **7.4%**
- Cutaneous findings 55/215 = **25.6%**
- Occult fractures 19/119 = **16%**
- Of 25% (55/215) AHT screening 8/55 = **14% positive**
- Of patients with elevated ALT/AST → 14/76 (18%)
 - 1/14 = **7.1% abdominal trauma**



	Inflicted	Non-inflicted	Negligent
History	Inconsistent history, delay in seeking care, lack of parent concern, changing history, siblings blamed for injury, younger age (13-15 mo)	Adequate explanation/Prompt medical care usually sought	Delay in seeking care, younger age (13-15 mo)
Location	Posterior trunk, buttocks, genital, lower legs, feet	Face, Neck, Anterior trunk, Upper Limb	Depends on mechanism
Severity	Deep partial and Full thickness	Superficial (only type of burn where superficial is commonly diagnosed)	Deep partial and Full thickness
Laterality	More often bilateral, symmetric	More often unilateral, asymmetric	More often unilateral, asymmetric
Burn Type	Scalds > Contact	Scalds > Contact	Scalds > Contact
Agent	Hot water	Hot beverages/food	Hot Beverage
Mechanism	Immersion	Splash/Spill	Immersion or Splash/Spill
Pattern	Circumferential, stocking glove, zebra stripes, doughnut, uniform depth	Irregular margins, non-uniform depth	Depends on mechanism
TBSA	↑ 10%	↓ 10%	↓ 10%
Other Injuries	Bruising, Fractures	None	Bruising, Fractures
Management	More often require surgery	Less often require surgery	Less often require surgery
Other Characteristics	Previous abuse, domestic violence, parental mental illness/substance use, prior accidental injuries, prior CPS, single younger parents, lower SES, longer hospital stays	No prior CPS Preservation of family unit more common	Prior CPS, Single parent, Parental substance use, usually occurs in the home

Medical Mimics



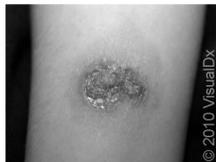
Dermatitis



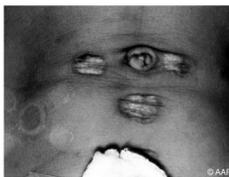
Skin Irritation
Small circular skin lesions may be mistaken for cigarette burns. This infant had marks on both ankles that were reported as possible burns; he was removed from his parents' custody. Investigation revealed that the lesions perfectly matched the location of the stiff leather and Velcro straps of his sneakers.



Infections



Cultural Practices



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Phytophotodermatitis



Drug Induced



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Scene Investigation



- Multidisciplinary team approach
 - CPS
 - Law Enforcement
 - Child Abuse Pediatrician
 - Burn Surgeon
- Home visit
- Corroborate facts
 - Interviews
- Collect further evidence
 - Photographs
 - Measurements
 - Water temperature



Prevention



Prevention



- Patient education to set hot water heater to 120 degrees F
- Community and school-based burn safety education
- Check temperature of bath water with your hand
- Don't cook, drink, or carry hot beverages or foods while holding a child
- Keep hot foods and liquids away from table and counter edges. Don't use tablecloths or place mats, which young children can pull down
- Turn the handles of your pots and pans toward the rear of the stove and use back burners when possible
- Don't leave the stove unattended when you're cooking
- Address outlets and electrical cords. Cover unused electrical outlets with safety caps. Keep electrical cords and wires out of the way and replace frayed, broken or worn electrical cords



Prevention



- Establish 'no' zones
- Block access to stove, fireplace, space heaters and radiators. Don't leave a child unattended when these items are in use
- Keep hot devices out of reach. Store items designed to get hot, such as clothes irons or curling irons, unplugged and out of reach.
- Be careful with food or liquids warmed in a microwave, which might heat foods unevenly. Never warm a baby's bottle in the microwave.
- Choose a cool-mist vaporizer. They prevent steam burns.
- Apply for grants to supply thermometers and thermostatic mixing valves



Grant Project: The Idea

- Trend in children admitted with burns where scene investigation delayed by requesting water temperatures OR case workers could not obtain
- Scene investigations where measurements were not taken
- Presents challenges with corroborating alleged history and mechanism for injuries
- Led to longer lengths of hospital stay in some children



Grant Project: Literature

Communication

We have all been working in our own little silos forever: Exploring a cross-sector response to child maltreatment
 Kristine A Campbell, M.D., M.Sc., Amy Anne Wulfsberg, M.S., Chuck Norlin, M.D.

Resources

Child Abuse & Neglect
 Journal homepage: www.elsevier.com/locate/jchabu

The impact of the COVID-19 pandemic on child protective services caseworkers and administrators
 Vanessa Brown¹, Lauren Brown², Rachel Berger³, Tammy Hubley⁴, Andrea Williams⁵, Sarah DeGuz⁶, Margaret Egan⁷, Catherine Henderson⁸, Kelli Perro⁹, Justine Tabb¹⁰, Judy C. Chast¹¹, Mona Roseman¹²

Education

Child Abuse & Neglect
 Journal homepage: www.elsevier.com/locate/jchabu

Research article

Interdisciplinary collaboration needed in obtaining high-quality medical information in child abuse investigations
 Elizabeth A. Clark¹, Nehal L. Johnson², Lynn K. Shoop³

Grant Project

ADVOCATES FOR UPSTATE Supporting healthcare and scholarship through fundraising and service

"Improving Investigations for Child Maltreatment through Community Partnership"

- \$3,628 funded
- In-person & virtual quarterly workshops to local and regional CPS workers focusing on child maltreatment education and best practices/techniques for scene investigation
 - CAP, fire, and police department collaboration
- 150 customized toolkits distributed to caseworkers
 - Flashlight, tape measure, forensic odontology no.2 ruler, digital thermometer
- **Goal:** Using surveys and medical chart review, we hope to show an improvement in caseworker medical knowledge, communication with healthcare workers, and enhance scene investigations (*improve time and completion*) by providing essential resources (*toolkits*) and workshops

THANK YOU!

HAPPY TO ANSWER ANY QUESTIONS ☺



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