

SPECIAL  
POINTS OF  
INTEREST:

- No single feature proves abuse.
- History of the injury, ability of child and the injury/wound appearance—do all three match together? If not, why not?
- Accidents occur (acts of omission).
- Multidiscipline team discussions provide multiple views on case review.
- Contact children (all other children; all disabled adults) should be cared for immediately with consideration for removal and interval (forensic interview or interview in the field). All non-verbal contact children should undergo a forensic medical evaluation as soon as possible. Do not assume a content infant has no injuries.
- Initial investigation should include measurements (but/sink height), hot water heater settings in tap water injuries.

# APSAC ALERT

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## Pediatric Burn Abuse Evaluation

By Arne Graff, MD

Approximately 3.5 million children are evaluated in the United States yearly for maltreatment. Of this number, slightly over 900,000 cases are confirmed and 16% of the cases involve physical abuse. In maltreated children, skin injuries are a commonly found type of abuse and burns are found in 5-22% of the cases. And in hospital burn units, the incidence of inflicted burns ranges from 8-25%. Burns can result in long term disability, chronic pain and mental health illnesses. In general, abuse-related burns are most commonly seen in children under the age of 3. Accidental burn injuries are currently the third most common reason for “accidental” injury for children in the USA; fire injuries are highest in the under 5 year old age group. Due to multiple factors (limited verbal skills, no witness, etc) deciding between accidental and inflicted can be difficult.

Skin, composed of 3 layers, has multiple functions, including protection against: dehydration, infection, and temperature loss. The degree of burn injury (1st-4<sup>th</sup> degree) will determine not only the appearance of the wound and healing process, but also the symptoms the child may ex-

perience (3<sup>rd</sup> degree burn, with nerve injury, may have no pain to the wound). Skin thickness varies on the body (thin: eyelids, face, genital area; thick: palms, soles) and this may affect the degree of burn that occurs. A burn degree will depend on the



Immersion injury—courtesy of Dr. Ken Feldman

length of contact time and the source of the burn. Clothing worn (or applied to the skin) may increase heat to skin contact time, increasing the degree or area of burn. Diseases of the skin can also influence the appearance and extent of injury. Burn appearance will change (so the earliest exam and photographs are important) due to time, medications and healing. There is no good data supporting “age” determination of a burn so it may be difficult to prove delay in seeking care.

It is important to remember that “children are not little adults”: the skin thickness is

less until later in childhood, making the skin more at risk for burn (at lower temperatures); the child has less ability to save oneself from fire or from someone harming them or to verbalize the need for help/protection. Toddlers and elementary school aged children are curious and exploring with objects that might cause burns (open dishwasher); older children and teens burn injuries tend to occur from risk behaviors (fireworks). The most common age of inflicted burns is seen in children who most demanding (age, chronic illnesses).

The history is the most important part of the evaluation (obtained as close to the time of injury as possible) and should include (along with usual investigation questions: who, what, etc): complete medical history (see below), position of the child at the time of injury, time of injury and when care is sought (delay in care is concerning), social history (including discussion with CPS for past CPS history), family risk factors (see below), medication use, past medical history (allergic reactions or skin infections may appear to be burns; old unexplained injuries may suggest patterns of injuries) history of family medical problems (bleeding

or skin disorders that might mimic injuries), developmental history (what is the child's ability; can they perform what the injury requires), cultural or religious practices (Moxibustion, Coining) that are not intended to be abusive, but cause injury. This requires collecting all old medical records (sometimes from multiple sites).

**RISK FACTORS:** single parent families, previous history of abuse or neglect (child or siblings), history of domestic abuse, younger parents, instability to family, socially isolated, increase stress, caregiver has history of being a victim as a child (of abuse) and unrealistic expectations for caregivers.

**MECHANISMS:** forcible immersion, being held under flowing water, liquid agent thrown/spilled onto, wet material being held onto child, fall/reach into/onto, ingestion, and contact with object.

### **BURN PATTERNS**

1) **SPILL**—the burn may show higher degree of burn at the point of contact and the burn flow (following gravity) with lesser degree burn at the lowest point of injury. One may see splash burn marks. “V” pattern of burn.

2) **IMMERSION**—here the pattern may include: symmetry (both extremities), 360 degree of burn, same degree of burn over whole area, air-water tide marks (sharp), lack of splash marks (child being held still) and no sparing of skin to burn area.

3) **FLOW**—here the burn follows flow of material (faucet water) with similar degree of burn over area from top to bottom. Sparing of skin in area (not 360 degree involvement) and is often unilateral. Edges are often irregular.

4) **CONTACT**—object pattern may be seen (curling iron, grate, etc). Degree of burn depends on tem-

perature of agent and length of time in contact. Solid heated objects may transfer more heat and cause deeper burns. Chemicals in stool, in diapered victim, (laxative or other) should end at diaper/leg interface and spare the gluteal crease and flexion areas-where skin is applied to skin).

5) **SPLASH**—presence of splash injury suggests struggle/movement. To occur, the agent temperature must exceed 130 degrees. (In general: temperature of fluid agent less than 130 degree will not cause 2<sup>nd</sup> or 3<sup>rd</sup> degree burn with splash and agents >150 will cause 3<sup>rd</sup> degree wounds. Temperature of 130 degree requires 10 sec in child for 2<sup>nd</sup> degree burn and 140 degree occurs in 1 sec—30 sec and 3 sec in adults). Often not seen with immersion injury.

6) **CIGARETTE BURN**—manufactured cigarettes center heat can be in the 600-900 degree and outer edge up to 400 degrees (rolled cigarettes have less heat and more easily brush off the skin). Accidental wounds often are superficial and smudge-like; the abusive burn may have a more circular appearance (approximately 5-10 mm in diameter). A full thickness burn requires contact >1 sec. More than one burn implies non-accidental.

### **CONCERNING FEATURES (of burn)**

1) Sparing of palms and soles suggests contact with surface while immersed (“doughnut sign” with sparing of buttock center area) 2) presence of ligature marks or other physical injuries (fractures, burns) 3) unusual sites: 3<sup>rd</sup> degree burns to palms, soles; perineum, genital or buttock areas) any pattern burn (rectangle, lines) or glove/stocking distribution of burn, sharply defined tide water lines (air-water interface) 5) uniform degree of burn to wound 6) symmetry of burn (both hands) 7) flexion areas also having burn 8)

cigarette burn to body area not normally in potential contact with cigarette.

### **ACCIDENTAL BURN FEATURES**

1) irregular margins (suggests movement) 2) location-hand/finger, etc 3) splash burns present 4) asymmetry of burns 5) varying degree of burn within the wound.

### **OTHER BURN TYPES**

1) electrical- may have entrance and exit wounds and extent of injury is dependent on voltage and path of current 2) chemical-necrosis of tissue occurs; often deep; alkaline worse than acid. 3) cold weather 4) flame/fire injury-inhalation injuries associated with fires; dynamics of fire important to know 5) radiation (sunburn can be an abusive or neglect injury). Microwave injuries occur where skin is closest to the emitting site.

Thermal are the most common (including: scalds, flame, contact and radiation).

**MIMICS OF BURNS:** infections (impetigo), allergic reactions, medication adverse reactions, skin diseases, medical conditions

### **FORENSIC MEDICAL**

**EVALUATION:** medical examination (close to time of injury) should be a complete forensic exam, including the anal and genital areas (different types of abuse can co-exist); review of photographs of wound(s)—take multiple photos, from multiple angles; consider skeletal survey in all children under 2 years old; consider other exams including dilated eye exam, laboratory tests and scans of the head.



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