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July 1987

Autoclave  
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Materials

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106429

106434



Handling Infected Evidence **DATA BASE COPY**

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# FBI

## Law Enforcement Bulletin



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**The Cover:**

FBI Laboratory employee sterilizes evidence contaminated with the AIDS virus prior to examination. (See article p. 1.)

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# Children As Burn Victims

**“Burn injuries to children are often classified as accidents when abuse was the real cause.”**

By

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Each year an estimated 2 million people are burned in this country. The very young child is at greatest risk as burns are the second most frequent cause of accidental death in children 1 to 4 years.<sup>1</sup> As a form of child abuse, burns received little attention until 1965 when an article entirely devoted to children as burn victims was published.<sup>2</sup>

Over 70 percent of childhood burns occur in the home during the more stressful times of the day and more difficult months of the year—winter months, when the family is more indoor-oriented; late afternoon, when the child is more fatigued and hungry; and morning, when the child has just awoken.<sup>3</sup>

Early studies found the average age of the abused burn victim to be under 24 months. Boys are more frequently victimized than girls, and this type of abuse occurs more commonly in lower socio-economic, single-parent families.<sup>4</sup> In general, the victim of an abusive burn-related incident will be a child under 5 years of age who will suffer searing pain, possible disfigurement, and deep psychological scarring.

Burn injuries to children are often classified as accidents when abuse was the real cause. The following indicators, or “suspicion index,” are useful in determining if abuse may have been a factor in the burn incident:

- 1) Unexplained delay in treatment which exceeds 2 hours;
- 2) Injury that appears older than when the incident allegedly happened;

3) Ambivalence about seeking medical attention;

4) An account of the injury incompatible with the age and developmental characteristics of the child;

5) Caretaker’s insistence there were no witnesses to the “accident”;

6) Someone other than a parent or caretaker who brings the child to the emergency room;

7) Burn is blamed on the actions of a sibling or other child (which can happen);

8) The injured child is excessively withdrawn, submissive, overly polite, or does not react to painful procedures;

9) Isolated burn on the child’s buttocks; and

10) History of what happened changes several times or there are discrepancies in the stories given by each parent.<sup>5</sup>

Various reasons have been given by caretakers for burning a child. However, the leading trigger mechanism for the abuse is toilet training, soiling, or wetting. The parent or caretaker attempts to cleanse or purify the child’s skin from the repulsive nature of the child’s stool or urine. The average parent who scalds his or her child usually had no idea the water would cause such an injury, although this is not always true with other forms of burning.



Lieutenant Shepherd

The caretaker who commits this kind of abuse is often isolated, immature, easily frustrated, and has poor impulse controls. He or she can also be a perfectionist with unrealistic expectations for the children and may lack knowledge about child development.<sup>6</sup> Often, an adult caretaker is reluctant to admit he or she burned a child because of fear of punitive legal action, feelings of guilt or remorse, a desire to shield a spouse or loved one, and a need to avoid the social stigma.<sup>7</sup>

#### Types of Burns

Burns result from the effect of thermal energy on the skin. The skin, the body's largest organ, is divided into two layers, epidermis and dermis. The epidermis is the thinner of the two and rests on the outside of the body serving as a protective cover. The dermal layer makes up the bulk of the skin and is located between the epidermal layer and a subcutaneous area of muscle and bone. The nerve endings which transmit pain, temperature, and sensation are located only within the dermal layer of skin.<sup>8</sup>

The most commonly used classification of burns is first, second, or third degree, which only provides for a visual characteristic of the wound and is not actually descriptive of the injury. The preferred classification of burns used by most physicians is "partial" or "full thickness" burning. With a partial thickness burn, only part of the skin has either been damaged or destroyed and is equivalent to first degree or second degree burn. *This wound will heal by itself.* By contrast, all the skin is destroyed by a full thickness burn, and this type of burn may include destruction of muscle and bone. *The wound cannot heal by itself.*<sup>9</sup>

The depth of a burn will be determined by the temperature and amount of time the victim is exposed to the source of heat. The age of the victim is also a factor because younger children have thinner skin than adults. As a result, a child's skin will be destroyed more rapidly and by less heat.

Only an experienced medical practitioner can make the difficult determination of how deep a burn the child has sustained. However, there are several distinguishing features of partial thickness and full thickness burns which can be observed immediately after the incident.

Patches of reddened skin that blanch with fingertip pressure and refill are shallow, partial thickness burns. Blisters usually indicate deeper, partial thickness burning, especially if the blisters increase in size just after the burn occurs.<sup>10</sup>

A leathery surface with a color of white, tan, brown, red, or black represents a full thickness burn. The child will feel no pain due to the complete destruction of nerve endings. Small blisters may be present but will not increase in size.<sup>11</sup>

One reason for the increased mortality rate in children who have been burned is that the thinness of the skin on a young child increases the chances of a full thickness burn. A relatively small burn on a young child is more likely to produce a severe situation because more body surface per pound is affected than in an adult. A lower temperature and shorter duration of time in contact with the source of heat are two other factors associated with the thinner skin of young children.

Two general types of burns can occur on a child's body. They are known as wet burns and dry burns. Each type has its own set of characteristics that assist in identifying whether a wet or dry

**“One reason for the increased mortality rate in children who have been burned is that the thinness of the skin ... increases the chances of a full thickness burn.”**



Col. Ritchie T. Davis  
Director  
Michigan Department of State Police

Thicker Skinned Areas	Thinner Skinned Areas
Palms of Hands	Front Trunk
Soles of Feet	Inner Thighs
Back	Bottom of Forearms
Scalp	Inner Arm Area
Back of Neck	

source of heat caused the damage to the skin.

#### Wet Burns

A wet burn is characterized by a splattering effect combined with sloughing and peeling of skin. There will also be varying degrees of burns in close proximity. Conversely, a dry burn will have a well-shaped, branding type of margin around the injury. Scabbing will begin around the edges of the burn, and the odor of burnt skin is sometimes present. This type of burn will also have a general dry nature or look on the burn site.<sup>12</sup>

Scalding, specifically from hot tap water, is the most frequent cause of accidental injury in children.<sup>13</sup> There are a number of issues the investigator needs to consider when determining whether the scald was deliberate.

The most common abusive scald burn occurs when the child is dunked or immersed into a container of hot fluid. When a child is subjected to an immersion burn, the first source of information the investigator will rely on is the caretaker's story about how the injury occurred. This account should be balanced against the age and developmental characteristics of the child who was burned. Another point to consider is the suspicion index presented earlier in this article.

The resulting injury pattern on the child's body helps the investigator reconstruct how the child was positioned in the container where the injury allegedly occurred. The investigator must first consider whether the injury pattern appears consistent with the caretaker's version of what happened. If a "line of immersion" is visible, the investigator can determine the areas of the child's body that were beneath the surface of the fluid and those areas which did not come into contact with the fluid.

The most common immersion burn occurs when the caretaker dips the child's buttocks into the liquid while holding the child in a flexed position. The child's upper torso and lower legs and feet never come into contact with the fluid.

When a child is forced to sit in a vessel of hot liquid, a "doughnut" burn frequently appears, because the buttocks make firm contact with the bottom of the container, thus sparing this area from burning. The presence of a doughnut burn indicates someone was holding the child in place, making escape impossible.

A child involved in an immersion burn incident will go into a state of flexion, the tensing of body parts in reaction to what is happening. Examples of flexion areas on a child's body include:

- 1) Folds in the stomach,
- 2) Calf against back of thigh,
- 3) Arms tightened and held firmly against body or folded against body,
- 4) Thighs against abdomen,
- 5) Head against shoulder, and
- 6) Legs crossed, held tightly together.

The flexing action will not allow burning within the body's creases, causing a striped configuration of burned and unburned zones or a "zebra" burn. The lo-

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**“Well-formed or sharp lines of immersion that appear symmetrical on either the ankles or wrists is suspicious.”**

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cation and extent of the burn are not as important as the pattern in determining the possibility of abuse.<sup>14</sup>

Other common areas for immersion burns are the feet and hands of a child. When either of these appendages is immersed in hot liquid, the resulting injury pattern is known as a “stocking” burn or a “glove” burn. Immersion burns on the hands and feet in the form of splash burns are expected if the child is unrestrained and thrashing in the fluid. A distinct absence of any glove or stocking burns, combined with the presence of well-developed or sharp lines of immersion limited only to the buttocks, back, and perineum, would indicate the child was cradled and dipping was intentional.

Well-formed or sharp lines of immersion that appear symmetrical on either the ankles or wrist areas is suspicious. Whenever both feet of a child have been burned, and there is no evidence that the child tried to remove him- or herself from the liquid, abuse should be considered. A child attempting to enter a tub of water may place one foot into the tub with no idea that the water is scalding. However, once the painful effects of the water are felt, it would not be logical to assume that the child would then place the other foot into the water.

Parents and older brothers and sisters have been known to accidentally lower a child into a scalding tub. Their reactions to the child's injuries in terms of promptness in seeking medical treatment and degree of concern over the child's welfare are factors to consider when accidental causes are alleged. Many times, the primary care provider indicates he or she was not present at the time of the “accident” and can offer no explanation as to how the injury oc-

curred. However, accidental immersion burns should include the presence of splash burns.

When a child accidentally pulls a container of hot liquid from a counter or table top, the injury pattern should appear more serious at the point of contact, with lesser degrees of burning on the areas of the body which the liquid touched while descending. Liquids such as hot tea, coffee, or water will produce injury patterns similar to those in bathtub incidents, except the head, face, and shoulder are usually the points of contact. Splash burns caused by a liquid pulled from above can be difficult to distinguish from burns made when the liquid was deliberately thrown. This is especially true if the liquid first strikes the top of the head, face, chest, or abdomen, since a child reaching for a container filled with hot liquid will usually be burned on the head, face, neck, upper chest, and arm.<sup>15</sup> An absence of burns under the chin or within the armpit area might support the fact that the liquid was deliberately thrown.

Liquids of a thicker consistency, such as soups, sauces, oils, and gravy, will retain heat longer and will continue to damage the skin long after thinner fluids like water, tea, or coffee have cooled. The gravitational flow of the burn pattern and the position of the child at the time of the incident can be determined by closely observing the burn. Unlike an immersion burn, a splash will produce multiple depths of burns interspersed with unburned areas and tends to be less severe, due to the rapid cooling of the liquid after striking the skin.

The most frequent question asked by those involved with burn-related investigations centers on the amount of heat needed to burn a child. Secondary to this issue is the amount of time the child needs to be exposed to a certain

level of heat before the skin will be adversely affected.

Researchers have had difficulty in answering these questions because of the differences in the thickness of an adult's skin compared to a child's. It has been estimated that no household needs water temperatures that exceed 120°F. Bath water is considered comfortable between 100° and 105°F. However, hot water heater manufacturers still preset gas hot water heaters at 140°F and electric hot water heaters at 150°F.<sup>16</sup>

The likelihood of a deep partial thickness to full thickness burn increases drastically when the water temperature exceeds 127°F. At a temperature of 110°F, it would take 6 to 7 hours before a full thickness burn would occur on an adult.<sup>17</sup> Figure 1 provides the investigator with information about the amount of temperature and length of exposure required before a full thickness burn would be produced on an adult, keeping in mind a child's skin burns more rapidly.<sup>18</sup>

A potential problem for the investigator is the presence of a bacterial infection known as “scalded skin syndrome.” As its name implies, this infection looks like scalded skin and is found on children from infancy to age 10. This infection should not be confused with burning, even though its appearance may resemble skin which has been scalded. It has also been confused with impetigo. If a parent or caretaker suggests the child is suffering from an infection, a physician should be consulted.

#### **Contact Burns**

Contact burns, also known as dry burns, are the second most frequent type of abusive burns. Devices used to cause these burns include irons,

Figure 1

**FULL THICKNESS BURNS**

Temperature of Liquid	Time of Exposure
111°F	6-7 hours
120°F	10 minutes
125°F	2 minutes
127°F	1 minute
130°F	30 seconds
136°F	10 seconds
140°F	5 seconds
149°F	2 seconds
158°F	1 second

stoves, heaters, grates, radiator pipes, hot plates, and curling irons, essentially any common household device capable of producing heat.

However, the most common type of abusive contact burn is caused by cigarettes deliberately placed on a child's body. These burns have certain characteristics which may assist the investigator in distinguishing them from an accidental encounter.

The first item to look for is the location of the cigarette burn. Deliberate burning will usually occur on multiple areas, including the belt line or the trunk of the child, external genitals, and the hands or feet. Cigarette burns found in multiple patterns or on parts of the body that are normally clothed are abusive and indicate intent.

The hot ash portion of the cigarette tends to break off after contact with the skin. Any subsequent attempts at burning would require relighting and maintaining the ash to produce the number of injuries found on the child. Careful observation, along with a physician's opinion about the age of the burns, will provide insight concerning whether the injuries were produced during one or several episodes over a period of time.

Deliberate burning by a cigarette will produce small circular burns approximately 1/4 inch in diameter. The wound will vary from a blister to a crater type of injury, depending on the length of contact.<sup>19</sup> The healing process will involve the formation of a scab in the center of the wound which will then move toward the surrounding edges. Healed cigarette burns will appear similar in size, and the depth of the scar will be related to the depth of the burn. Accidental cigarette burns appear irregularly shaped, are less serious in terms of depth, and frequently occur on the face.

The greatest difficulty in determining whether a child was burned with a cigarette is the presence of impetigo, a skin disease characterized by the eruption of a blister or pimple containing pus. Investigators continue to report that medical examinations are inconclusive about the presence of cigarette burns due to impetigo setting in after the burn has taken place. Even under natural conditions, a child can develop impetigo which can look like a cigarette burn. Great caution and careful examination must be used in cigarette burn investigations.

Various other forms of contact burns leave symmetrical and deep imprints with crisp margins along the entire burn surface. This suggests a prolonged, firm contact with the hot surface. Comparatively, if the burn is a result of an accident, contact would involve a smaller area of skin and slurred margins, which would lack the full branding effect. One edge of the accidental contact burn is usually deeper and more serious in nature.<sup>20</sup>

One final type of contact burn which might be overlooked involves the use of small hot objects, such as the top of a metal cigarette lighter or the heated edge of a knife. As with other suspicious burns, the location and shape of

the burn will provide some direction for the investigator.

Other kinds of burns that should be considered by the investigator are light ray burns (the result of overexposure to the sun or other radiant energy), brush burns, and chemical burns. A brush burn can be caused by the combined effects of heat and abrasion due to friction. An example would be the result of a child sliding down a metal slide with bare legs coming into contact with the sun-heated surface of the slide. Of course, this form of burn is not considered abuse. Chemical burns caused by acids or alkalies may destroy tissue for weeks after the initial incident. Chemical burns are usually sharply localized and of greater depth than other forms of burns.

**Conclusion**

Thorough investigation of a burn case presents the investigator with many factors to review and forms of physical evidence to gather. When a child has been scalded, for example,

**ACCIDENTAL V. DELIBERATE CONTACT BURNS**

Accidental	Deliberate
Brief glancing contact	Prolonged steady contact
Small area of skin affected	Symmetrical deep imprints
Slurred margins	Crisp overall margins
Deeper burn on one edge	Suspicious area on body, e.g. buttocks, perineum
Leading edges of body	Bizarre shape

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## “Thorough investigation of a burn case presents the investigator with many factors to review and forms of physical evidence to gather.”

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measurements of the container and fixtures should be made and the location of the faucets on the wall or sink and the overall dimensions of the sink, bath, or utility tub documented. Also of importance would be the number of rotations needed to turn the water on and how long it takes before hot water begins to flow from the faucet. As with any other search, it should be performed in a lawful manner and with a search warrant where required.

The investigator should also determine the height of the child and the child's ability to reach the handles of each tap. Very young children do not reach far above their heads nor do they tend to stretch onto their toes to reach for something. The child's strength should be a consideration balanced against the degree of strength and dexterity needed to turn on a faucet.

Special attention should be paid to where the parent or caretaker said he or she was at the time of the incident, in terms of how long it would reasonably take to get to the child once it was discovered the child was in danger. If the adult indicated that no screams were heard, a determination should be made if other sounds, such things as a radio, television, traffic, or other children's voices, may have caused the child's cries for help to go unheeded.

During a scald investigation, the hot water heater is of primary importance. For example, what type of heater is it, is it in good working order, and what is the temperature setting on the heater? On gas hot water heaters, the thermostat will be found near the base of the heater. Electric heaters have a thermostat located behind a panel on the upper level, as well as a lower element which should be in plain view. Information on the gallon capacity, which appears on the face of the heater, should be recorded and photographed.

Water temperatures should be

measured at the site of the incident at 1-minute intervals using a candy or meat thermometer. This process is to be repeated at 1-minute intervals with hot water and then with cold water mixed for 6 to 10 minutes each.

When a child has been burned with a dry device, if at all possible, the investigator should determine if the object is still warm to the touch, while at the same time carefully recording the distance from the floor to the site of the burning surface, pan, hot plate, or stove. The device should be seized (pursuant to a search warrant) and tested at a crime laboratory for the presence of skin which may have adhered to the burning surface. The child's clothing, if any, along with any towels, blankets, sheets, or similar coverings in which the child may have been wrapped, may be evidence and should be treated as such.

In addition, a complete series of photographs should be taken of the scene, victim, devices, water heater, or other objects that may have an important role in the course of the investigation.

### Footnotes

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- <sup>7</sup>*Ibid.*, p. 86.
- <sup>8</sup>I. Feller and C.J. Archambeault, *Nursing the Burn Patient* (Ann Arbor, MI: Institute for Burn Medicine, 1973), pp. 3-5.

<sup>9</sup>*Ibid.*, pp. 5-7.

<sup>10</sup>*Ibid.*, p. 7.

<sup>11</sup>*Ibid.*, p. 7.

<sup>12</sup>K. W. Feldman, "Child Abuse by Burning," *The Battered Child*, 3d ed, C. H. Kempe and R. Heller, eds. (Chicago, IL: University of Chicago Press, 1980), p. 156.

<sup>13</sup>Supra note 3, pp. 1419-24.

<sup>14</sup>T. C. Jewett and N.S. Ellerstein, "Burns as a Manifestation of Child Abuse," *Child Abuse and Neglect: A Medical Reference*, N.S. Ellerstein, ed. (New York: Wiley, 1981), p. 189.

<sup>15</sup>Supra note 12, p. 152.

<sup>16</sup>B. Walsh, *Technical Background Information of Appliance Efficiency, Targets of Water Heaters* (Washington, DC: Federal Energy Administration, 1976).

<sup>17</sup>A. R. Moritz and F. C. Henriques, Jr., "Studies of Thermal Injury: The Relative Importance of the Time and Surface Temperature in the Causation of Cutaneous Burns," *American Journal of Pathology*, vol. 23, 1947, p. 695.

<sup>18</sup>*Ibid.*

<sup>19</sup>Supra note 5, p. 87.

<sup>20</sup>Supra note 12, p. 155.