

Management of Acute Pediatric Hand Burns



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KEYWORDS

• Pediatric • Hand • Burn • Escharotomy • Fasciotomy

KEY POINTS

- Determination of the burn depth and size is of the utmost importance at the initial examination once the patient has been stabilized from any other life-threatening injuries.
- The pathophysiology of hand burns can be subdivided into those primary effects related to the thermal effects of the injury; these are dependent on the time of contact and the temperature of the heat source involved, and the secondary effects of any ensuing edema, reduced circulation and infection.
- Treating physicians can help to improve any outcome by attenuating each of these effects by adhering to 5 principles: (1) preventing additional propagation of the burn to deeper structures, (2) rapid wound closure, (3) preservation of active and passive range of motion and maintaining elevation, (4) infection control, and (5) early active rehabilitation.

INTRODUCTION

The high frequency of hand burns seen in children is surely a function of their fearless, highly inquisitive nature and developing proprioceptive skills.¹ Within the United States burns are the fourth leading cause of emergency department visits among children less than 1 year of age and represent around 5% of deaths in all children, with a peak between the ages of 1 and 9 years.² Worldwide, approximately 500,000 children are admitted to the hospital with burn injuries every year.³ Referral to an accredited burn center is required for burns that involve the hand regardless of age. As with most burn injuries, a multidisciplinary approach is important; however, in the younger pediatric patient, extra resources such as child life services, pediatric psychotherapy, and music therapy all play major roles alongside the nurse, physical therapists, and psychiatrists so that together with the appropriate support for the family involved, a successful outcome can be achieved.

ETIOLOGY

Whenever a child presents with an injury that does not match the history of the incident, a high degree of suspicion should be sustained and a referral made to social services. Most burns sustained by children are not under any nefarious circumstances; however, if there is any suspicion or further clarification of the details concerning the injury is required, then admission to the burns unit is required until that information is revealed. The reported incidence of nonaccidental injury burns varies wildly from 3.8% to 26%,^{4,5} yet burns as a result of neglect outnumber those attributed to abuse to the tune of 9 to 1.⁶ Typical patterns of injury that are suspicious include a specific line of demarcation on the forearm depicting a glove like pattern of burn (forced immersion injury), contact burns to the dorsum of the hand (from an iron), and small well-delineated burns on the dorsum of the hand (from a cigarette or lighter).

Most burns sustained by children are accidental; of these, scald burns are generally more

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common in the younger age group (<3 years of age), with flame burns becoming increasingly frequent as children get older. Contact burns to the palmar surface of the hand are common in the very young, as they may lean on hot surfaces (oven doors) while trying to maintain balance. Friction burns are increasingly common in the very young, as they may stumble and fall onto the belt of a moving treadmill, resulting in the hand being caught beneath the machine, causing a friction burn, often to the dorsal surface of the hand. These injuries can be very deep, involving nerves, vessels, and tendons, thereby requiring increasingly complex reconstruction (full-thickness skin grafts or cross-finger flaps). Thankfully frostbite and electrical burns are rare and will be dealt with in other articles of this issue; chemical burns are even less common and should be dealt with in a similar way to adults.

ANATOMY

The anatomy of the hand of a child differs from that of an adult in a few crucial ways. First, the skin of a child is thinner, so it requires less thermal exposure time to result in a full-thickness injury. Second, the subcutaneous adipose tissue in a child is more profuse than an adult, and as such, protects deeper structures such as tendons and nerves and assists in the excision of full-thickness injuries resulting in a layer of soft tissue preservation on the dorsal surface of the hand. This general excess in adipose tissue in the younger child also allows for simpler harvest of full-thickness grafts from the inguinal region, if needed (Fig. 1).¹

The skin on the palmar surface has a thick dermis that is most abundant over the pulp of the finger tips, thinning only for the flexion creases. Grip stability is optimized by the secure attachments between deep fibro-osseous tissue and the surface using the vertical septa of the pulp, along with the ligaments of both Cleland (more dorsal) and Grayson (more volar). Following a burn injury with resulting edema, the compartments of the hand and digit are less able

to expand, resulting in elevated pressure and possibly decreased circulation. The likelihood of the child holding the hand in a dependent position and the relatively small size of the hand both contribute to worsening the situation. Not only the skin but also the nails of the child's hand can be damaged by both the thermal injury and any subsequent compartment syndrome, resulting in a discolored, deviated or notched nail, each of which is difficult to correct surgically.⁷

TREATMENT GOALS

The pathophysiology of hand burns can be subdivided into those primary effects related to the thermal effects of the injury; these are dependent on the time of contact and the temperature of the heat source involved, and the secondary effects of any ensuing edema, reduced circulation, and infection. Treating physicians can help to improve any outcome by attenuating each of these effects by adhering to 5 principles⁸:

1. Preventing additional propagation of the burn to deeper structures
2. Rapid wound closure
3. Preservation of active and passive range of motion and maintaining elevation
4. Infection control
5. Early active rehabilitation

INITIAL EVALUATION

Determination of the burn depth and size is of the utmost importance at the initial examination once the patient has been stabilized from any other life-threatening injuries. As with all trauma and massive burn the appropriate ATLS (Advanced Trauma Life Support) or ABLS (Advanced Burn Life Support) principles should preempt any specific treatment for a hand burn. A clear history of the circumstances surrounding the injury needs to be elicited, from the child if possible, although this will depend on the state of agitation and developmental stage for each patient. If this is not possible, then it should be obtained from a witness to the accident. Specific information that needs to



Fig. 1. Full-thickness burns (A) at presentation and (B) after grafting.

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