Reconstruction of the Adult and Pediatric Burned Hand

Ryan P. Cauley, MD, MPH[a], Lydia A. Helliwell, MD[a], Matthias B. Donelan, MD[a,b], Kyle R. Eberlin, MD[b,c,*]

KEYWORDS

• Burns • Reconstruction • Hand surgery • Skin grafting • Locoregional flaps

KEY POINTS

- Thermal injuries to the hand can greatly affect long-term function.
- Initial treatment should focus on contracture prevention.
- Surgical intervention should follow the standard reconstructive ladder and can involve several techniques from simple to complex including laser and steroid injection, contracture release and skin grafting, regional flaps and local tissue rearrangement, and pedicled and free flaps.
- Appropriately planned and well executed reconstructive interventions can help promote meaningful functional recovery.

INTRODUCTION

The hands represent 3% to 5% of the body's surface area; however, they are involved in 80% to 90% of large burns.[1] The dorsal aspect of the hand has thin cutaneous coverage over critical structures, such as extensor tendons, nerves, and veins, making this area highly vulnerable to thermal injury.[2–4] Although the thick glabrous skin of the palm is protective and less frequently injured, its important functional role in tactile sensation and grasping can make palmar burn injuries particularly disabling.[5]

Hands are important for the ability to manipulate the surrounding world. Therefore, hand burns can have a great impact on both quality of life and long-term functional outcomes.[3,6] Burns to the hand are often associated with significant motor and sensory deficits, tissue loss, and functionally limiting contracture.[4] The presence and severity of functional deficits of the hand may be associated with several factors, including the mechanism, location, and depth of the burn injury.[2,7] Given the complexity and importance of optimal treatment, all hand burns should be referred to a specialized burn center.[8,9]

The surgical treatment of contracture after burn injury should follow standard reconstructive principles and is determined by

1. The type, location, and severity of the deficit
2. The location and quality of uninjured tissue to be used in the reconstruction

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[a] Division of Plastic and Reconstructive Surgery, Massachusetts General Hospital, Harvard Medical School, 55 Fruit Street, Boston, MA 02114, USA; [b] Plastic and Reconstructive Surgery, Shriner's Hospital for Children, 51 Blossom Street, Boston, MA 02114, USA; [c] MGH Hand Surgery Fellowship, Division of Plastic and Reconstructive Surgery, Massachusetts General Hospital, Harvard Medical School, 55 Fruit Street, Boston, MA 02114, USA

* Corresponding author. MGH Hand Surgery Fellowship, Division of Plastic and Reconstructive Surgery, 55 Fruit Street, Boston, MA 02114.

E-mail address: keberlin@mgh.harvard.edu

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3. The patient's functional requirements and goals for reconstruction

Reconstructive options to treat functional deficits in the burned hand range from the simple (contracture release with skin grafting or local tissue rearrangement) to the complex (pollicization and free tissue transfer). This review focuses on contracture prevention, defining the functional deficits of the burned hand, and the myriad reconstructive options.

CONTRACTURE PREVENTION

The first aim in the treatment of hand burns is to minimize a patient's long-term functional impairment. The seeds for functionally significant contractures are planted early in the course of a burn patient's care; techniques for the prevention of contractures should begin in the acute phase. The authors strongly believe that one of the most important aspects of contracture prevention is a strong focus on tissue sparing, not only through the use of judicious tangential excision but also through the support of any potentially viable tissue through the optimization of resuscitation, hemodynamics, and infection control.

Occupational and physical therapy should be closely involved in a burn patient's care. Positioning is an important aspect of both acute and long-term treatment. Hands at risk of edema should be elevated and compression dressings may be needed. For awake patients, active range-of-motion exercises are often important.[6] The most common burn deformity is the intrinsic-minus position, in which the wrist is flexed, the metacarpophalangeal (MCP) joint is extended, and the interphalangeal (IP) joints are flexed (Fig. 1). Early splinting should be used to maintain a stable intrinsic-plus position, in which the wrist is extended, the MCP joint is flexed, the proximal interphalangeal joint (PIP) and distal interphalangeal joint (DIP) are maximally extended, and the thumb abducted.[1,6]

Fig. 1. Severe burned hand deformity with wrist flexion contracture, MCP joint hyperextension, IP joint flexion, and thumb adduction.

FUNCTIONAL DEFORMITIES AND REQUIREMENTS OF RECONSTRUCTION OF THE BURNED HAND

Burn scar contractures of the hand have been classified by McCauley[10] to include 4 grades (Table 1). Burn deformities occur because of thermal injury to the skin, but secondary changes occur in the tendons, ligaments, and joints of the hand that may also have an impact on function and require correction. Surgeons should primarily focus their reconstructive efforts on restoring the function of the hand, rather than improving the range of motion of individual digits.[11]

The typical burned hand deformity comprises several anatomic and functional impairments (Table 2). The classic deformity includes hyperextension of the MCP joints of the fingers, with flexion of the PIP and DIP joints resulting in a clawed posture of the digits. There can be syndactyly and/or nail bed deformity, with contracture of the first web space and adduction of the thumb.

Despite the complexity of the burned hand deformity, the reconstructive needs can often be simplified. Like other challenging reconstructive problems in the hand, there is a need for palmar breadth and a convex metacarpal arch. Additionally, there is a need for a palmarly abducted and

Table 1
McCauley grades of burn scar contracture

Grade I	Symptomatic tightness but no limitations in range of motion, normal architecture
Grade II	Mild decrease in range of motion without significant impact on activities of daily living, no distortion of normal architecture
Grade III	Functional deficit noted, with early changes in normal architecture of the hand
Grade IV	Loss of hand function with significant distortion of normal architecture of the hand

Subset classification for grade III and grade IV contractures: A, flexion contractures; B, extension contractures; and C, combination of flexion and extension contractures.

Adapted from McCauley RL. Reconstruction of the pediatric burned hand. Hand Clin 2009;25(4):545; with permission.