

Skin Coverage Considerations in a Mutilating Hand Injury



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KEYWORDS

• Hand • Microsurgery • Free flap • Reconstruction

KEY POINTS

- Investigators believe that free tissue transfer is the most suitable way of providing a soft tissue cover in a mutilated hand.
- When free flap transfer is not technically possible or where microsurgery facility is not available, carefully planned regional or pedicled flaps work well.
- Hand surgeons must approach mutilating hand injuries with the recognition that no 2 injuries are ever the same.
- Should try to replace like with like tissue.
- Both function and aesthetics should be given consideration.

INTRODUCTION

The hand is a highly specialized organ with a complex mechanical structure. Because of the role that hand plays in manipulating objects, it is the most frequent site of trauma in the body and is subject to mutilation through various injury mechanisms. Such mutilating injuries never occur the same way, and each injury requires meticulous evaluation. Once all deficiencies in tissue are identified, the decision must be made as to which portions must be sacrificed or preserved to maximize functional recovery.¹

When reconstructing a mutilated hand, the primary goal is to provide stable skin and soft tissue coverage. The secondary goals are to restore motor function, shape, and sensation to the hand. Del Piñal recommended the following criteria in defining the acceptable hand concept: a hand with 3 fingers of near normal length, near-normal PIP joint motion, good sensibility, and a functioning thumb.² Such guidelines are helpful in

organizing a reconstructive plan. What constitutes a set of components for a functional hand can vary, however, according to race, gender, age, occupation, inclination, lifestyle, and hand dominance. In addition, it is difficult for a surgeon to consider all of the ramifications these variations hold for reconstructive priority. Because of this, the authors tend to fall back to the classic principle of restoring as much of natural function as possible.

To maximize the restoration of functions, the initial aim should be to preserve as much of the vital structures as possible, such as neurovascular structures, bone and joint, tendon, and intrinsic musculature. Early skin coverage is the best method of preserving these tissues and, therefore, should be in the foremost consideration during the initial encounter and primary intervention in the management of a mutilated hand.

Skin coverage can largely be divided between nonmicrosurgical and microsurgical options.³

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Nonmicrosurgical options include skin graft and various local flaps but find limited use in providing adequate coverage. Skin grafts cannot be used over exposed vital structures and can result in severe contracture. Local flaps or pedicled flaps allow coverage with composite tissue but are limited to specific skin territories. Most such local flaps were developed for specific tissue defects of predetermined size and location and are inappropriate for use in mutilated hands, in which further sacrifice of soft tissue only adds to the devastation of tissues. Although delayed reconstruction is well tolerated in the lower extremity, this is not the same for the hand.⁴ Increasing the duration of immobilization can cause joint stiffness and tendon adhesion and makes an adverse effect for secondary procedure. Thus, the authors believe that early coverage using microsurgical free tissue transfer represents the best initial management of the mutilated hand. This article discusses options for free skin flap coverage of the mutilating hand.

FLAP SELECTION FOR HAND RESURFACING

Although advancement in microsurgical techniques have allowed a wide variety in free flap options, most instances of flap selection continue to be influenced by surgeon preference. Generally, the selection of a specific flap should reflect the following considerations: the size and depth of the tissue defect; injury mechanism; underlying structures, either exposed or requiring reconstruction; sensation; skin characteristics; donor-site morbidity; and the need for secondary procedure. Among these, the following specific issues must be addressed for a functional hand resurfacing:

1. Tissue thickness: the flap usually needs to be thin to allow for acceptable contour.
2. Sensation recovery: innervated flaps provide better outcomes.
3. Pliability: the flap needs to be pliable for 3-D resurfacing without impairment in motion.

4. Gliding capacity: the inner surface of the flap must be smooth to allow for tendon excursion.⁵

It is extremely difficult to identify a flap that satisfies all these requirements and each flap should be considered based on the characteristics of the skin according to the location of surface defect. Specialized surfaces are ideally replaced like with like tissue.

Skin characteristics differ significantly between dorsal and volar surfaces with inherent differences in physiologic role. The volar skin is composed of a thick layer of heavily cornified epithelial surface. The dermis is firmly attached to the underlying fibrous fascia and exhibits significant resistance to shearing force. The glabrous surface, although tough, provides tactile sensation. In contrast, the dorsal skin is thin and pliable, which allows for joint movement.^{6,7} Superior restoration of function is accorded to reconstructions using flaps that most closely match the tissue being replaced. Because of this, the decision-making process should compare the pros and cons of each flap under consideration. At the authors' institution, the algorithm for mutilated hand management considers skin resurfacing options based on location-specific characteristics (Fig. 1).

DORSAL SKIN COVERAGE

The most significant characteristic of the dorsal skin is that it is thin and allows for significant stretching. From the reconstructive perspective, this property necessitates that dorsal surface defects must not be resurfaced with bulky, nonpliable tissue, where such flaps result in poor range of motion and aesthetic outcome. Most of the widely used fasciocutaneous free flaps do not satisfy this requirement and are only appropriate for use where a bulky flap is used to fill dead space and where it would not interfere with joint motion (Fig. 2).

Several options are available for thin-skin resurfacing. The free forearm yields a thin cutaneous flap, using either the radial or the ulnar artery as



Location Size	Volar side	Dorsal side	Pulp
Small 	Venous free flap ? Toe plantar flap Thenar (iRASP) flap	Fascial flap with skin graft Various cutaneous flap with debulking	Hypothenar flap Second toe pulp flap
Large 	Medial plantar flap		Great toe pulp flap

Fig. 1. Algorithm of selecting the flap based on location of the defect. iRASP, innervated radial artery superficial palmar branch flap.

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