Management of Soft Tissue Defects of the Hand

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Disclosures for this Article

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Learning Objectives

- Discuss the role of the reconstructive elevator versus the ladder in the management of soft tissue defects in the hand.
- Describe the general treatment principle of soft tissue defects in the hand.
- Appraise the indications for various flaps in the management of soft tissue defects in the hand.
- Detail surgical techniques for different pedicle and free flaps for coverage of soft tissue defects in the hand.
- Assess treatment outcomes and suggest guidelines for improving aesthetic and functional results following hand flap coverage.

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Soft tissue coverage of the hand remains a challenging problem to the hand surgeon, but advances in the field of microsurgery have provided improved thin, pliable, durable flaps that offer cosmetic reconstructive options. The reconstructive elevator is poised to replace the reconstructive ladder, thereby allowing early reconstruction by the best available option. This reviews focus on the variety of pedicled, free fasciocutaneous, and venous flaps available for successful soft tissue coverage of the hand. *(J Hand Surg Am. 2015;40(6):1237–1244. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Hand, soft tissue, flap, reconstruction.

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Hand surgeons must recognize the reconstructive options for salvage of the severely injured upper extremity requiring soft tissue restoration. Within the United States, only 55% of level 1 trauma centers have immediate access to surgeons who are proficient in microsurgery.[1] Patients who have suffered traumatic or trauma-related amputations of the upper extremity face a difficult rehabilitative course and develop persistent pain in as many as 79% of cases.[2] Subsequently, greater than 30% of patients fitted for prostheses ultimately discontinue their use altogether.[3] Although many are able to return to employment, one-half to two-thirds of these patients are required to change their occupation for accommodation of their disability.[2]

The skin envelope of the hand has unique properties. Range of motion is possible through the hand's thin and elastic dorsal skin. The thick palmar skin, with its specialized Meissner and pacinian neurosensory receptors, provides protective and fine sensibility, resistance to shear forces, and contact stability. In order to maximize the aesthetics and function of the hand, the surgeon must keep these skin properties in mind for planning optimal reconstructions.

There are multiple local hand flaps, including homodigital and heterodigital flaps that are available for digital soft tissue coverage[4] and are not the subject of this review. The focus of this review is on pedicled, free fasciocutaneous, and venous flaps for hand soft tissue reconstruction. These flaps meet the reconstructive goals for soft tissue defects of the hand by providing a thin, pliable, and stable coverage.

CLINICAL FACTORS

In the era of microsurgery, the reconstructive elevator rather than the reconstructive ladder may be more appropriate when treating soft tissue defects of the hand.[5] The ladder would dictate primary closure, split-thickness (STSG) and full-thickness skin grafts, local pedicled flaps, and finally, distant free flaps as the sequential approach to closing a soft tissue defect. The elevator progresses directly to the best reconstructive option, often forgoing more simplistic alternatives. For example, the use of a thin fasciocutaneous flap to cover exposed hand tendons may provide an improved gliding surface compared with an STSG.

Soft tissue loss in the hand can have multiple etiologies including trauma, thermal injuries, cancer, and infection. In order to build a reconstructive plan, the hand surgeon should evaluate the location and size of the defect, status of the wound bed, and its depth. Adequate preparation of the wound bed is crucial for success in coverage. Defects secondary to trauma, thermal injury, or infectious processes may require serial debridement to remove all necrotic tissue and decrease bacterial counts. Radical debridement and coverage can be performed in 1 operative setting when *en bloc* resection to healthy tissue is possible.[6] For soft tissue loss secondary to a malignant tumor, negative margins must be obtained prior to final reconstruction.

Multiple techniques have been developed that serve as useful bridges until the wound and/or patient is ready for definitive soft tissue reconstruction. These include the use of negative-pressure therapy, cadaveric allografts, or acellular dermal matrices. Integra (LifeSciences Corporation, Plainsboro, NJ) is a bilayer dermal matrix with the bottom layer composed of bovine collagen and glycosaminoglycan. The top layer is composed of a thin sheet of silicone, which is removed and replaced with a thin STSG once the host tissues have revascularized the dermal matrix.[7]

The surgeon should determine whether the defect represents a partial- versus a full-thickness skin loss. Partial-thickness defects can easily be reconstructed with skin grafts. However, skin grafts require well-vascularized beds for survival. Exposed tendons and bone without paratenon or periosteum, respectively, will require coverage that provides additional blood supply and a surface for tendon gliding, such as a flap (Fig. 1). A flap is also better suited than a skin graft for exposure of critical structures, such as blood vessels or nerve, because it decreases the risk of desiccation and provides a thicker layer of coverage. If a pedicle flap is required for coverage, reverse planning of the defect allows for a precise reconstruction and decreases the potential for error. A systematic approach to reverse planning involves 3 steps: (1) create a template of the defect size, (2) determine the position of the pivot point, and (3) establish the pedicle length required to reach the defect. Based on these 3 factors, the surgeon will be able to determine whether a local pedicle flap will be sufficient or if a free flap will be necessary to cover the defect.[8]

Tissue expansion in the upper extremity is often overlooked, yet it allows for improved tissue match, primary closure of donor sites, and decreased cost barrier compared with other microsurgical options. The capsule surrounding the expander can provide an ideal environment for tendon gliding. However, tissue expansion in the extremities has been associated with increased complications, underlying the importance of appropriate patient selection and close follow-up. A series by Pandya et al[9] reported a 43% complication