

Local and Regional Flaps for Hand Coverage

Debdut Biswas, MD, Robert W. Wysocki, MD, John J. Fernandez, MD, Mark S. Cohen, MD

Hand surgeons are frequently challenged by the unique requirements of soft tissue coverage of the hand. Whereas many smaller soft tissue defects without involvement of deep structures are amenable to healing by secondary intention or skin grafting, larger lesions and those with exposed tendon, bone, or joint often require vascularized coverage that allows rapid healing without wound contraction. The purpose of this review was to present an overview of local and regional flaps commonly used for soft tissue reconstruction within the hand. (*J Hand Surg Am.* 2014;39(5):992–1004. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)

Key words Coverage, finger, flap, hand, soft tissue.

SOFT TISSUE DEFECTS IN THE HAND can result from a variety of mechanisms including trauma, infection, and malignant disorders. Reconstructive surgeons who encounter these conditions must account for the unique requirements and challenges of soft tissue coverage specific to the hand. The optimal soft tissue reconstruction protects against the development of contractures and facilitates tendon and joint mobility, while maintaining durability and sensibility of the hand. This is particularly true in situations where palmar soft tissue coverage is required.

The “reconstructive ladder,” originally described by Mathes and Nahai,¹ is based on the principle of using the simplest approach of coverage that adequately restores form and optimizes function. The simplest technique includes direct primary closure, followed by skin grafting, local and regional flaps, and ultimately, free vascularized tissue transfer.

The purpose of this review was to describe the clinical indications and outcomes of local and regional flap reconstructions commonly performed for soft tissue defects in the hand. Traditional techniques as

well as recent innovations in soft tissue coverage will be presented with a particular focus on a systematic approach to treating these challenging conditions.

CLINICAL EVALUATION AND WOUND PREPARATION

Sharp lacerations in the hand without substantial contamination or active infection are typically amenable to debridement and primary repair. For wounds not amenable to primary closure, the decision must be made as to what type of coverage to provide and the timing in doing so. Although skin grafts will survive on a vascular tissue bed, the exposure of “white structures” (nerve, tendon, and bone) typically requires vascularized soft tissue reconstruction. If local or regional flap coverage is being considered, healthy tissues in proximity to the defect should be evaluated as potential donor sites; additional studies may be necessary to determine the suitability of these tissues (ie, Doppler ultrasonography or angiography).

A systematic approach to soft tissue defects in the setting of complex hand trauma is mandatory. Although soft tissue coverage should be performed as expeditiously as possible, the need for radical and serial debridements of contaminated wounds is necessary before any soft tissue reconstruction. Quantitative tissue culture may be advisable before proceeding with skin grafting or flap coverage, particularly in chronically infected wounds or those with considerable contamination. In such cases, multiple debridements can decrease bacterial load

From the Section of Hand and Elbow Surgery, Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, IL.

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R.W.W. is a consultant for Acumed, Hillsboro, OR.

Corresponding author: Mark S. Cohen, MD, Section of Hand and Elbow Surgery, Department of Orthopaedic Surgery, Rush University Medical Center, 1611 W. Harrison Street, Chicago, IL 60612; e-mail: mcohen3@rush.edu.

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and optimize the condition of the wound bed to accommodate a skin graft or flap.

Skeletal stabilization of fractures is mandatory to provide a foundation for soft tissue coverage, and repair or reconstruction of nerve, arterial, or tendon injuries is typically performed before proceeding with flap reconstruction. In certain situations, definitive tendon reconstruction is delayed and silicone spacers are placed if a scar-free bed for tendon gliding cannot be ensured. Ideally, soft tissue coverage using skin grafts and flaps should be achieved within 48 hours to avoid the development of granulation tissue and no later than 10 days of injury to minimize infection risk.

Although the development of granulation tissue can help achieve relatively noninvasive biologic coverage of soft tissue defects in the lower extremities and trunk, granulation tissue development within the hand frequently matures into scar tissue, which fosters contracture and inhibits motion. Stable flap coverage is necessary to limit the development of granulation tissue and help best restore motion after soft tissue trauma to the hand.

Recent technical innovations in vacuum-assisted closure (VAC) therapy deserve special mention. These devices have improved the management of wounds before soft tissue closure by removing exudate, decreasing edema, and decreasing the dead space and overall dimensions of soft tissue defects. Although the application of such devices should be performed judiciously and temporarily when tendon or neurovascular structures are exposed, the use of VAC therapy may decrease requirements for flap coverage and safely delay definitive soft tissue reconstruction in select situations. Nonetheless, prolonged use of VAC therapy should be avoided because of concerns regarding the development of granulation tissue and its propensity for scar formation and resultant contracture. For the hand specifically, a VAC should be used only for short-term periods, typically less than 48 hours, to avoid excessive granulation tissue and scar development before definitive flap closure. Areas such as the midarm and midforearm are more tolerant of scarring and skin contracture and a VAC can be applied more liberally in those locations.

SKIN GRAFTING

The use of skin grafting deserves brief mention, because it remains a common technique within the armamentarium of hand surgeons for treatment of defects of the hand, particularly in cases in which only subcutaneous tissue or muscle are exposed. Tendons

can also be covered with skin grafts if the paratenon is intact. Split-thickness skin grafts are often performed for defects involving the dorsum of the hand, which require pliable, low-profile soft tissue coverage. Full-thickness grafts are almost always required for defects on the palmar side, to minimize contracture and restore optimal durability and sensibility.

Efforts continue to be devoted toward the development of synthetic skin substitutes, including several commercially available dermal regeneration templates that can achieve coverage even when deep structures are exposed. These products facilitate the formation of a neodermis and optimize conditions for staged split-thickness skin grafting once a fully vascularized bed is present.² Favorable cosmetic and functional outcomes have been reported with the use of dermal regeneration templates for deep hand defects after burns,³ tumor excision,⁴ and digital soft tissue injuries not amenable to local flap coverage.⁵ Although these series involved limited numbers of patients, favorable outcomes reported with the application of these synthetic products clearly highlight their use for hand coverage.

LOCAL AND REGIONAL FLAPS: PRINCIPLES AND DEFINITIONS

Although skin grafts may be appropriately applied to cover an adequately vascularized tissue bed, the hand surgeon frequently encounters other hand defects with exposed bone or tendon that require more advanced flap coverage. A myriad of local and regional flaps have been described for treatment of these defects, and are the focus of this review.

Local flaps

Local flaps (ie, V-Y advancement, z-plasty) originate from tissues directly adjacent to a defect and are typically completed in a single stage. Many of these flaps are random-pattern flaps that have no specifically recognized perfusing vasculature. They are typically transferred to the recipient site by a combination of rotation, transposition, or advancement. The Burrow triangle rotation flap (Fig. 1) is a frequently performed rotation flap that distributes the tension of closure over a defect to a larger surface area. This is accomplished by designing a curved incision incorporating a large adjacent region of soft tissue to be rotated into the defect; a back-cut helps achieve greater mobility and less tension on the repair. Rhomboid flaps are common transposition flaps performed by converting an existing defect into a rhomboid configuration and then pivoting adjacent donor tissue into the defect, such as defects involving the dorsum of the hand,

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