

Soft Tissue Coverage of the Hand and Upper Extremity: The Reconstructive Elevator

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Disclosures for this Article

Editors

David T. Netscher, MD, has no relevant conflicts of interest to disclose.

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All authors of this journal-based CME activity have no relevant conflicts of interest to disclose. In the printed or PDF version of this article, author affiliations can be found at the bottom of the first page.

Planners

David T. Netscher, MD, has no relevant conflicts of interest to disclose. The editorial and education staff involved with this journal-based CME activity has no relevant conflicts of interest to disclose.

Learning Objectives

Upon completion of this CME activity, the learner should achieve an understanding of:

- Wound assessment and choosing the best type of reconstruction to suit the functional and aesthetic requirements
- Technical guidelines to performing some of the more common flaps
- The available "intrinsic" flaps for wounds of the hand
- The available muscle and fascial flaps for larger wounds of the upper extremity

Deadline: Each examination purchased in 2016 must be completed by January 31, 2017, to be eligible for CME. A certificate will be issued upon completion of the activity. Estimated time to complete each JHS CME activity is up to one hour.

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Soft tissue reconstruction of the upper extremity is a complex topic because every defect has multiple potential solutions. Whereas the often-cited reconstructive ladder advised selection of the simplest reconstruction of the defect, the newer concept of the reconstructive elevator allows freedom to choose a more complex reconstruction to account for specialized function and aesthetic outcome. An algorithm for assessment of the defect is presented and demonstrated in this review, using 6 case examples to highlight key concepts. Representative flaps are presented and a discussion of functional and aesthetic outcomes is undertaken to provide a

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Received for publication December 16, 2015; accepted in revised form April 28, 2016.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

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0363-5023/16/4107-0008\$36.00/0
<http://dx.doi.org/10.1016/j.jhssa.2016.04.020>

framework for achieving the patient's and surgeon's goals of reconstruction. (*J Hand Surg Am.* 2016;41(7):782–792. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)

Key words Hand reconstruction, perforator flap, reconstructive elevator, soft tissue.



THE UPPER EXTREMITY ALLOWS US TO interact with the world and, hence, is commonly exposed to injury. Unlike many parts of the body, critical structures of the hand lie just beneath the skin. Consequently, soft tissue injuries of the upper extremity pose a more difficult reconstructive problem for the surgeon than similar injuries elsewhere.

As our reconstructive techniques improve, so do our expectations. The concept of the “reconstructive elevator,” proposed by Gottlieb and Krieger in 1994,¹ is uniquely applicable to the upper extremity, given its specialized function. In contrast to the reconstructive ladder, which recommends the simplest technique to close the wound, the elevator guides the surgeon to choose the closure method best suited to the defect. For example, a burn to the first web space could be reconstructed with a skin graft; however, subsequent scar contracture frequently creates a thumb adduction contracture. Alternatively, importing healthy tissue via a flap will maintain thumb mobility.

This “permission” granted by the elevator to skip rungs of the ladder poses a more complex task in reconstruction. This review provides a framework to help assess the defect and choose the best-suited reconstructive option.

TIMING OF RECONSTRUCTION

The first step for wound management is always debridement. Debridement may be performed under a tourniquet for better visualization, with wound edges assessed for viability once the majority of excision has been completed. Adjuncts to sharp debridement with scalpel or scissors, such as a water-powered debrider (Versajet; Smith and Nephew, London, UK), are useful in difficult to reach places such as web spaces.

It has been accepted since the 1980s that immediate coverage of soft tissue defects in the upper extremity with flaps is a safe and viable option,² although there is no evidence to suggest that delay in coverage leads to a higher rate of flap failure or wound infection.³ Negative-pressure (NP) dressings are a useful tool to temporize wounds prior to reconstruction. An NP dressing may be placed as soon as the wound bed is clean, generally after serial operative debridement.

The primary concern with prolonged NP therapy is formation of granulation tissue that develops into scar; thus, many authors have cautioned against use of this therapy in the hand for more than 48 hours.⁴ However, if patient or institutional factors prevent expeditious reconstruction, NP therapy can be maintained for several weeks with serial dressing changes. Granulation tissue may be excised at the time of definitive coverage using sharp debridement, diminishing the propensity to form function-limiting scar.

WOUND ASSESSMENT

For this review, upper extremity defects are divided into 3 admittedly arbitrary groups:

1. Skin-only defects
2. Volume-loss defects
3. Functional tissue defects

The first step in any complex reconstructive problem is defining the problem, and in this, one must be as specific as possible. For example, is the patient missing skin only or is the defect more substantial? The next step is assessing the functional aspects of the tissue. For example, is tissue on the dorsum of the finger gone or is the patient missing the pulp of the thumb where sensation is required for manipulation of small objects? The last step is to assess options for reconstruction, some of which may be inappropriate. For example, a patient with loss of palmar tissues is unlikely to have an intact palmar arch, in which case, some reverse-flow flaps are not possible.

Key principles of hand reconstruction should be observed: the surgeon should strive to match like tissue with like, restore function, and preserve mobility and sensation. Once the reconstructive option has been selected and the wound adequately delineated through debridement, the flap should be designed to fit the defect (Table 1).^{5–16}

Templating of defects is recommended. This can be done using an Esmarch bandage and transposing the template to ensure the flap has adequate size and reach. This key step ensures the surgeon does not design a flap that has inadequate length and allows assessment of the donor site for closure versus grafting, if required.

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