Traumatic Wounds of the Upper Extremity
Coverage Strategies

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KEYWORDS

• Soft tissue coverage • Upper limb reconstruction • Flap • Trauma

KEY POINTS

- Inadequate management of traumatic wounds of the upper extremity may lead to amputation or permanent disability and can be a major cause of psychological distress.
- Soft tissue coverage is required to salvage traumatized limbs and restore adequate function and form.
- An optimal coverage should be stable, durable, and able to withstand heavy demands of work; should allow free joint mobility; and should have an aesthetically acceptable appearance.
- Both autologous tissue and dermal skin substitutes can be used for coverage. Autologous coverage ranges from simple skin grafts to complex free flaps.

INTRODUCTION

Traumatic wounds of the upper extremity often result from serious and devastating injuries involving multiple components, including skin, bone, tendon, and neurovascular structures, which may threaten limb survival or impair limb function. Complex injuries commonly result from road traffic, workplace, or domestic accidents; assaults; and burns. Other mechanisms of injury include sharp, crush, avulsion, high-pressure, gunshot, explosion, thermal, chemical, electrical, or combined injuries.

Inadequate management can lead to amputation or permanent disability and is a major cause of psychological distress. Skin coverage is often required to salvage a limb with restoration of adequate function and form. An optimal coverage should be stable, durable, and able to withstand heavy demands of work; should allow free joint mobility; and should have aesthetically acceptable appearance.[1–3]

This article provides a summary of commonly used soft tissue reconstructive strategies for traumatic wounds of the upper extremity.

INITIAL EVALUATION AND MANAGEMENT IN EMERGENCY ROOM

On initial contact in the emergency room (ER), assess vitals and stability based on Advanced Cardiac Life Support and Advanced Trauma Life Support guidelines. In stable patients with no life-threatening and limb-threatening injuries, begin

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with a history focusing on clinical characteristics, comorbidities, profession, duration, mechanism, and severity of injury along with hand dominance, and associated injuries. Also note the status of tetanus prophylaxis, smoking, allergies, and time of last meal. Initial physical examination should be focused to determine suitability of the limb and injured parts for potential salvage, replantation, or use as spare parts. In particular, attention should be spent on the wound, focusing on extent and type of injury, contamination, extent of the defect, and neurovascular status of the injured limb. If grossly contaminated, wound cultures can be sent. Plain radiographs with the appropriate views should also be obtained to confirm or rule out skeletal injuries.[1–4]

URGENT REEVALUATION AND SURGICAL MANAGEMENT OF WOUNDS

In patients who can tolerate a surgical procedure, reevaluation should be performed in sterile conditions, under general anesthesia, with tourniquet control. It should be focused to achieve the following goals[1,4,5]:

- Removal of contamination (eg, foreign bodies mud, grease, oil)
- Identification and grading the severity of the injury
- Control of bleeding
- Layer-by-layer debridement of severely devitalized tissues
- Stabilization of bone and joints
- Restoration of circulation by microsurgical direct repair or grafting
- In selective and suitable condition, primary repair and reconstruction of nerves and tendons
- Soft tissue closure/coverage (**Fig. 1**)

TIMING OF WOUND CLOSURE/COVERAGE

- Primary wound closure with or without flap and with or without primary repair or reconstruction of other structures (tendon and nerves) is performed within 12 to 24 hours.[5,6]
- Delayed primary flap coverage with delayed reconstruction is done within 2 to 7 days.
- Secondary flap coverage with delayed reconstruction is best done after 7 days.

PRIMARY SOFT TISSUE WOUND CLOSURE/ COVERAGE

Primary closure should be planned for patients who are able to tolerate prolonged surgery and whose wounds are clean.

VACUUM-ASSISTED CLOSURE THERAPY

Vacuum-assisted closure (VAC) therapy is a simple method for both temporary wound coverage and optimization of the wound bed. The device works by application of controlled negative pressure to the wound in cyclical fashion. The negative pressure removes blood or serous fluid, thus decreasing edema and dead space, reducing bacterial count and potential infection, and increasing microperfusion and neovascularization of the wound bed. In many cases, application of VAC therapy can avoid the use of flaps for coverage of the wound[7,8](**Fig. 2**A,B).

STRATEGIES FOR SKIN AND SOFT TISSUE COVERAGE

Options for coverage are autologous tissue and dermal skin substitutes.[9] Choice of reconstructive technique depends on age of patient, nature and duration of trauma, wound characteristics, and condition of surrounding tissues. Exposed vital structures and need for secondary procedures also affect the selection of the optimum coverage technique.

Skin Grafts

Skin grafting is the most commonly performed procedure for coverage of defects that are not suitable for primary closure. A vascularized and healthy recipient bed is required for graft survival. VAC is a useful tool to help prepare a recipient bed for a graft. Relative contraindications to a primary skin graft include exposed tendon, nerves, bones, blood vessels, and joints. Choice of graft (full or split thickness) depends on condition and duration of wound, amount of dermis required, and location of defect. Full-thickness skin grafts (FTSGs) are generally more durable but do not stretch, result in larger donor site defects, and can be less sensate. Split-thickness skin grafting may be less durable but can stretch, are ultimately more sensate, do not result in donor site coverage needs, and can be more versatile. For example, meshing a split-thickness skin graft can avoid collection of blood or serum under the graft and can provide greater coverage area. However, a meshed graft gives a pebbled appearance. For a graft to take well, whether full or split thickness, it should be applied directly on a clean and vascularized recipient bed with a layered compression nonadherent dressing and immobilized against stress or shear[10] (**Fig. 2**).