

Soft Tissue Coverage of the Elbow



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KEYWORDS

• Pedicled flaps • Free flaps • Elbow defects • Elbow coverage

KEY POINTS

- Small defects of the posterior elbow can be covered with local flaps.
- Moderate defects require regional pedicled flaps. We prefer the antegrade posterior interosseous artery flap for posterior elbow coverage.
- Large defects of the elbow will require space-filling muscle free flaps. Half of the latissimus dorsi or gracilis are the free flaps that we favor.

INTRODUCTION

Soft tissue defects about the elbow may arise from a variety of insults to the upper extremity, including blunt and penetrating trauma, burns, infection, tumor resection, or from sequelae of prior treatment and associated patient morbidity.

These defects expose a complex set of anatomic structures that must be attended to, including bone, vessels, nerves, ligaments, muscles, tendons, and possibly implants, all while minimizing the functional and cosmetic deficits imposed by the reconstructive process.

Options available for soft tissue coverage are dependent on the patient's age, overall health, size of the soft tissue defect and associated injuries, availability of tissue, and socioeconomic factors, including expectations, work and family demands, and ability to care for the wound in the postoperative period.

Soft tissue coverage begins with primary closure of a wound and advances to increasingly more complex and demanding solutions, free tissue transfers, in what has been described as the reconstructive ladder.¹ The correct solution is the simplest one that minimizes patient morbidity, provides for a predictable return to function, and takes into consideration the previously mentioned patient factors.

Our discussion considers pedicled flaps about the elbow and free flaps. Local pedicle flaps are indicated in situations in which anatomic structures or implants are exposed and are absent native tissue or blood supply, or are at risk of infection.

Absolute contraindications to these flaps are few and include damage to the flap's vascular supply, those flaps that would compromise distal blood supply to the extremity, and possibly those patients with musculocutaneous, median, or radial nerve deficits where the flap may otherwise be used to restore function about the elbow.

Relative contraindications are varied, and include the patient's age, nutritional status, and associated comorbidities, such as diabetes, peripheral vascular disease, or tobacco use.

RADIAL FOREARM FLAP

The radial forearm flap (RFF) was performed in the 1970s by Chinese surgeons and was described to the West in 1982 by Song and colleagues.² The RFF is a fasciocutaneous flap that offers reliable and versatile coverage of elbow wounds, incorporating thin, pliable tissue. It can also meet the demands of incorporating sensate soft tissue coverage as well as vascularized bone graft.

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The foundation of the RFF is the proximal aspect of the radial artery, just beyond its emergence from the brachial artery. The distal limit of the RFF is the wrist flexion crease, and it is designed to include up to the volar two-thirds of the forearm. Because of this, the flap may have a long vascular leash and this affords a rotational zone for soft tissue coverage that can span the medial, lateral, dorsal, or volar aspects of the elbow.

If sensation is required, the lateral antebrachial cutaneous nerve of the forearm may be lifted with the cephalic vein to provide a neurotized fasciocutaneous flap. If vascularized bone graft is required for proximal ulna or radial bone defects, or for distal humeral bone defects, the anterolateral aspect of the distal radius can be incorporated.

Downsides to this flap include sacrificing the radial artery as well as donor site morbidity and cosmesis. The flap should be avoided in those patients with a compromised ulnar artery or an incomplete palmar arch. I feel that it is too much to sacrifice such a major artery for carrying a small amount of skin. Moreover, more elegant alternatives exist for elbow coverage.

LATERAL ARM FLAP

The lateral arm flap (LAF) was described separately by Song and colleagues³ and Katsaros and colleagues⁴ for the coverage of head and neck wounds in a free-flap technique. This flap is based proximally on the posterior radial collateral artery. Muruyama and Takeuchi⁵ described a modification of this as a rotational flap using the radial recurrent and posterior interosseous recurrent arteries. In this setting, this flap can be used to cover soft tissue defects at the elbow in similar fashion to the RFF.

The LAF can cover defects at any aspect of the elbow, although its rotational zone and overall area of coverage are smaller than that of the RFF. The LAF can incorporate vascularized bone from the humerus and can accommodate the need for sensate coverage with incorporation of the posterior brachial cutaneous nerve.

Advantages of this flap choice include the potential for less donor site morbidity, earlier return to motion at the elbow, and preservation of major arterial blood supplies to the distal extremity.

Disadvantages include the potential for sensory deficits in the zone of the posterior brachial cutaneous nerve, as well as an unsightly scar at the lateral aspect of the arm.

PEDICLE MUSCLE FLAPS FOR SMALL WOUNDS OF THE ELBOW

A variety of flap options exist for coverage of the elbow based on nearby muscular structures,

including the flexor carpi ulnaris flap, the brachioradialis flap, and the anconeus muscle flap. Although some of these may be designed to contain overlying cutaneous tissue, it is frequently such that a split-thickness skin graft will be required for superficial coverage of the wound and possibly aspects of the donor site.

The flexor carpi ulnaris (FCU) flap is available to reliably cover anterior elbow soft tissue defects. Proximally, the muscle has 2 origins, that of the medial epicondyle of the humerus and of the proximal ulna, whereas distally the FCU blends into the connective tissue investing the pisiform. The vascular supply of the FCU arises from the posterior ulnar recurrent artery, whereas the nervous supply is derived from perforating branches of the ulnar nerve just distal to the medial epicondyle.

The FCU flap has a number of advantages: it is the superficial-most muscle of the volar-ulnar forearm and as such dissection is straightforward. Subsequently, the flap can be accessed rapidly. The flap is primarily indicated for defects of the antecubital fossa, although investigators have described successful approaches to contain posterior defects of the elbow as well.⁶

The brachioradialis (BR) flap is based on the most superficial muscle belly of the mobile wad of the forearm. Although this unit is an important flexor of the elbow, if other flexors are intact, this flap can be performed with minimal functional loss of the extremity.

The muscle arises proximally from the lateral supracondylar ridge of the humerus, between the triceps and brachialis muscles, whereas distally it inserts onto the radial styloid. The vascular supply of the BR flap may arise from the brachial artery, the radial artery, or most commonly the radial recurrent artery. Owing to the length of the muscle, the potential range of rotation for the BR flap is very good. Rohrich and Ingram⁷ reported in a cadaveric study that 100% of anterior elbow wounds up to 3 cm in size could be covered by the BR flap, whereas 91% of posterior elbow wounds up to 3 cm could be covered.

The anconeus muscle (AM) flap has been described for posterior wound coverage of the elbow up to 7 cm. Although small, it is immediately accessible at the posterior elbow for coverage of wounds overlying the olecranon, distal triceps, or radiocapitellar joint.

The muscle originates along the lateral epicondyle of the humerus and inserts onto the olecranon. The vascular supply of the muscle is from a variety of sources, although the most important vessel on which to base the flap is the medial collateral artery.

Although the range of the AM flap is limited owing to its size, it is viewed as an expendable

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