Soft Tissue Coverage of the Arm

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KEYWORDS

• Soft tissue • Arm • Latissimus dorsi • Flap

KEY POINTS

- The latissimus dorsi is supplied by the thoracodorsal artery, which divides into the transverse and descending branch allowing the muscle to be split. There is a secondary supply from intercostal perforators.
- A skin paddle is usually taken based on perforators from descending branches along the anterior border of the muscle.
- Using the latissimus dorsi as a functional muscle requires placing the muscle on stretch, marking with sutures, and then replicating this at the time of reinsertion.
- The donor site may develop a seroma and the use of drains is advised.

INTRODUCTION

The arm presents with fewer challenges for soft tissue coverage than the rest of the upper extremity. The arm tends to be less exposed to trauma than the hand. The muscles about the arm are larger than those of the forearm, providing greater coverage for the humerus. Excluding the elbow and shoulder, the anterior aspect of the arm is covered by the biceps and brachialis, whereas the posterior aspect is covered by the triceps. Median and ulnar nerves along with the brachial artery are medial, whereas the radial nerve passes from proximal to distal by way of the spiral groove.

Although there are nerve and vascular structures, there are not the flexor and extensor tendons that require coverage, as found in the forearm and even more so in the hand. Thus in many situations coverage can be achieved by skin grafting. In addition, the greater circumference of the arm provides more available tissue from which to gain primary closure of local random pattern flaps.

The presence of the latissimus dorsi muscle in close proximity, its relative ease of dissection, and the ability to tailor it for large or small defects has meant that it serves as the main muscle for arm coverage.[1–7] Although there is a case report of using an expanded scapular flap, the latissimus dorsi is the flap of choice.[8]

LATISSIMUS DORSI

The use of the latissimus dorsi as a musculocutaneous pedicled flap is more than 100 years old.[9] It is large and thin, allowing it to cover substantial defects and mold into cavities. It can be raised with overlying skin or can be part of a chimeric flap using the subscapular system.[10]

The vascular pattern of the muscle is type 5, having a dominant blood supply from the thoracodorsal artery and a secondary supply of perforators from the intercostals. Within the muscle, the thoracodorsal divides into a descending branch and a transverse branch 94% of the time.[11] The motor nerve supply is the thoracodorsal nerve, which divides into 2 branches following the descending and transverse arterial branches. The muscle inserts into the medial lip of the bicipital groove, after twisting 180°, and arises from the lower 6 thoracic vertebrae and to the iliac crest by way of the thoracolumbar fascia. Other points of origin include the tip of the scapula, the lower

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4 ribs, and portions of serratus. The function of the muscle is to push off or draw the humerus down to the side from a flexed posture as in cross-country skiing. Along with the teres major, it forms the posterior axillary fold.

The anatomy of the latissimus dorsi allows coverage of substantial areas, although the proportion farthest away from the pedicle posterior and inferior may not survive.[12] It can be tailored as a partial muscle flap by taking the anterior border with only the descending branch. The vascular pedicle can be isolated and the nerve preserved to the portion that is left intact.

Skin can be taken with the muscle and a paddle is generally reliable anywhere along the midportion of the muscle. However, there are a significant number of cutaneous perforators 2 to 4 cm posterior to the anterior border, which enhance reliability and flexibility of the flap.[13,14] Although incorporating a skin flap has advantages in particular situations it increases the bulk of the flap and this should be taken into consideration. A skin graft helps to decrease bulk. When an innervated muscle is not required, denervation of the muscle allows for atrophy, which may improve contour in some situations.

Because the vascular pedicle is long and the insertion is on the humerus, the muscle covers both the arm and elbow at the same time.[15] There is a large amount of undermining because of the broad flat muscle, so postoperative seroma can occur. The use of suction-assisted drains for a prolonged period of time (2 weeks or more) is advised. Harvesting can be done endoscopically.[16]

The muscle has also been used both for coverage and simultaneously for elbow or shoulder function (most commonly elbow flexion[3–5,7,17]). It is important to mark the tension of the muscle with sutures before detachment. When subsequently performing appropriate proximal and distal fixation, the correct tension must be set based on the distance between the sutures. Postoperative splinting and therapy are keys for success.

OPERATIVE TECHNIQUE

The defect to be covered and the length of muscle required based on the anatomy of the insertion point are planned before surgery, along with whether and where a skin paddle needs to be placed. The steps of the operation, depending on the complexity, are visualized and written out.

The anterior margin of the muscle can be marked by asking the patient to adduct against resistance. If the patient is unable to do so, the anterior margin of the muscle can be estimated by drawing from the posterior axillary fold to the midline of the iliac crest. The muscle will be slightly posterior to this estimate. The superior margin of the muscle can be drawn in a curving line from the point of insertion to the thoracic spine, passing just superior to the inferior angle of the scapula.

A skin pedicle can be marked out with its long axis paralleling that of the anterior border of the muscle and beginning below the posterior axillary fold. The central axis of the skin paddle should be over the perforators, approximately 4 cm posterior to the muscle margin. A template of the defect can be used to design the skin flap, although a flap of 10 cm in width is approximately the size that can be easily closed.

The patient is prepped and draped in the lateral decubitus position with the arm free, draped, and resting on a Mayo stand. The arm can be moved throughout the procedure to avoid any position that may stretch the brachial plexus.

The anterior incision is made in the skin flap, or, when not using a skin paddle, the skin is incised along the anterior margin of the muscle. The muscle margin is identified and any adjustment of skin markings can be performed.

Lift the skin of the back off the muscle for the desired length of muscle based on preoperative planning. Elevate the muscle off the chest wall beginning at least 12 cm away from the humerus and working away from the vascular pedicle, which protects the pedicle. Slips to serratus and the lower ribs have to be divided. Intercostal perforators need to be clipped.

At this point, the surgeon should be able to see the deep and superficial planes of the muscle with attachments inferior, along the spine and scapula. The area about the neuromuscular pedicle has not been dissected. Divide the muscle distally accounting for some extra because of contracture, and reflect the muscle toward the humerus to continue the deep dissection of the pedicle.

Depending on how much rotation and mobility are required, the surgeon can now dissect the vascular pedicle and nerve, and divide the point of insertion. Vascular branches to the serratus anterior and the chest wall may have to be divided.

THORACODORSAL ARTERY PERFORATOR FLAP

The thoracodorsal artery perforator flap uses the perforators from the descending branch that pass through the latissimus dorsi muscle into the skin.[13,14] The skin for this flap overlies the anterior border of the muscle. Although this does not provide as large an area of tissue for coverage, it does spare the muscle. Its marking and elevation are similar to those of the latissimus dorsi flap,