Reconstruction of Posterior Trunk Defects

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ABSTRACT

The posterior trunk roughly encompasses the upper back from the shoulders to the lumbar area above the iliac crests. Long-term outcomes in the treatment of defects of the spine and bony thorax have been proved superior if flaps were used. Many local muscle and fasciocutaneous flaps are available alternatives. A guideline, patterned according to arbitrary anatomic territories of the back, is suggested as a starting point for the selection of appropriate primary and secondary flap options. Depending on flap availability, the latissimus dorsi and trapezius muscles are the workhorse flaps for the upper back, whereas perforator flaps have become a useful alternative for the lumbar region in lieu of free flaps.

KEYWORDS: Posterior trunk, back, perforator flaps, latissimus dorsi, trapezius muscles

Just what defines the posterior trunk is intuitively obvious, but actually somewhat nebulous. Geddes et al¹ have stated that the vascular anatomy of the trunk can be represented by four areas: the chest, abdomen, upper back, and lumbar regions. More specifically, the upper back extends superiorly from a line joining the spinous process of C7 bilaterally with the acromial angle, inferiorly to the lower margin of the 12th rib, and laterally to the midaxillary line.¹ The lumbar region commences at the inferior boundary of the upper back, then proceeds caudally to a line joining the two posterior superior iliac spines, ultimately to follow along the iliac crests.¹ These two regions most certainly include the posterior bony thorax enclosed by the rib cage and its articulations with the spinal column. Any compendium on chest wall reconstruction such as this, to be complete, must include guidelines for the posterior trunk, hereby defined as the sum of the upper back and lumbar areas. The gluteal region distal to this should be considered part of the lower extremity and therefore has been excluded.

Although congenital^{2,3} as well as acquired defects of the posterior trunk need our attention, the latter are far more common challenges encountered by the typical reconstructive surgeon. These usually are the result of trauma, iatrogenic or otherwise; oncologic ablations; or pressure sores.⁴⁻⁷ As with any wound prior to definitive coverage, immaculate debridement and eradication of any infection takes precedence. However, peculiar to this region is the need also to maintain skeletal stability not only of the rib cage to ensure adequate pulmonary ventilation but also of the spine for preservation of neural function.⁵

Once the wound bed is acceptable, soft tissue closure of the posterior trunk is frequently best accomplished using a flap, as healing by secondary intention or with a skin graft are not durable enough options for the long term. The relative simplicity and efficiency in using local tissues has proven efficacy. Traditionally, muscle or musculocutaneous flaps have been preferred, as muscle is malleable enough to fill into large voids,⁸ especially a problem when vertebrae or orthopedic hardware are

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exposed. The muscles of the back can be arbitrarily divided into a superficial, intermediate, or deep group.⁴ Only the superficial and deep groups are relevant for use here as muscle flaps. The superficial group includes all muscles connected to or involved with movement of the upper limbs (i.e., the trapezius, latissimus dorsi, levator scapulae, and rhomboid muscles).⁴ The deep muscles or erector spinae muscles are intrinsic back muscles essen-

tial for maintenance of posture, and more commonly are referred to as the paraspinous muscles.⁴

More recently, fasciocutaneous flaps, and in particular perforator flaps, have been developed as an alternative for coverage of the posterior trunk. Because minimal muscle function is disturbed during elevation of these flaps, ambulation will be unimpeded, and any underlying muscles will remain virtually intact to treat

Figure 1 The posterior trunk can be divided into four arbitrary anatomic territories, basically according to available flap options, (A) with the primary selection being the workhorse alternative or (B) the secondary choice a reasonable backup option.

recidivism, a common occurrence in patients with spinal cord injuries.⁹ Geddes et al¹ have shown that on average there are 24 perforators of the upper back with corresponding discrete perforasomes,¹⁰ superiorly arising from the thyrocervical trunk, laterally from the subscapular axis, and medially from the posterior intercostal arteries. The lumbar region is supplied by perforators from four paired sets of lumbar arteries.¹ Notably, apropos in this context, the first clinical series of fasciocutaneous flaps that actually used the term “perforator-based” was reported by Kroll and Rosenfield¹¹ for lumbosacral wounds using free-style local pedicled flaps dependent on unnamed paraspinal perforators.

METHODS

A guideline for the selection of flaps suitable for the posterior trunk is probably best divided into four territories primarily differentiated not by discrete anatomic boundaries but by the best available flap options (Fig. 1). Even this will be somewhat arbitrary, as a given flap may possibly service multiple such territories, and may or may not be available after wound preparation or for other reasons if its vascular supply has been compromised. Details of specific flap harvest have been omitted, instead referring to appropriate references and better prior sum-

maries on this topic.^{5,6,9,12,13} Note that in general, paraspinous muscle-advancement flaps, if adequate, can be used at all spinal levels, but, especially for larger defects, typically will still need to be reinforced by a second flap that can be selected following these guidelines.⁴

Posterior Cervical

The superior aspect of the upper back from the spine of the scapula to the nape of the neck can be considered the posterior cervical territory (Fig. 1). The origin of the lower portion of the trapezius muscle abuts the upper thoracic spine and is the only muscle found superficial to the latissimus dorsi muscle. As a muscle or musculocutaneous rotation flap based on the superficial branch of the transverse cervical artery, this is *the* workhorse local flap for this area (Fig. 2).¹⁴ Sometimes the dorsal scapular artery perforator flap, based on a musculocutaneous perforator of the trapezius muscle, can be a separate alternative if the anatomy is favorable, and skin coverage only is needed.¹⁵ Both these options can also be used for more cephalad defects of the posterior neck or even skull.

Upper Thoracic

Essentially encompassing the scapula and intervening area of the back, the option of choice for the upper

Figure 2 (A) Exposed vertebrae after cervical fusion. (B) Proposed lower trapezius musculocutaneous flap, with skin island extending slightly beyond palpable distal margin of muscle in this asthenic individual (circles denote protruding thoracic spinous processes). (C) Elevated flap rotated onto defect, prior to tunneling under intervening skin bridge. (D) Successful coverage 6 months later without further sequelae.

thoracic territory (Fig. 1) is the latissimus dorsi muscle or musculocutaneous flap, readily reached when based on orthograde perfusion via its dominant thoracodorsal pedicle (Fig. 3).^{13,16} For a narrow defect, a trapezius muscle “turnover” flap based on secondary segmental posterior intercostal perforators

has been successful, but rarely considered.¹⁷ If muscle is not essential, a musculocutaneous perforator of the latissimus dorsi muscle can supply a thoracodorsal artery perforator flap to sometimes reach this area.¹⁸ In addition, a scapular or parascapular septocutaneous flap served by the nearby cutaneous branch of the

Figure 3 (A) Dehiscence thoracic wound after spinal fusion. (B) Exposed orthopedic hardware after the requisite debridement. (C) Orthograde latissimus dorsi muscle flap covering hardware. (D) Direct skin approximation then could suffice to achieve wound healing.

Figure 4 (A) Exposed midthoracic vertebrae after resolution of infected cyst of uncertain cause. (B) Lateral back skin paddle on "reverse" pattern latissimus dorsi musculocutaneous flap. (C) Skin transferred into defect. (D) The healed back later that month.

circumflex scapular vessels may be another alternative.¹⁹

Midthoracic

The lower portion of the upper back from about the tip of the scapula to the costal margin of the 12th rib could be considered the midthoracic territory (Fig. 1). Sometimes an orthograde-based latissimus dorsi muscle flap can still reach here, but a more caudal defect may require sacrifice of the thoracodorsal pedicle and a "reverse" pattern of flow through secondary segmental perforators of the posterior intercostal arteries (Fig. 4).^{7,13,20–22} Again, if muscle is not essential, intercostal artery perforator flaps, usually based on a dorsal branch of the posterior intercostal artery, have been successful for coverage of the spine² and laterally can even reach the scapula.²³ Omentum has been infrequently used here as elsewhere in the posterior trunk, and almost always as a last resort.^{6,24}

Lumbar

As defined by Geddes et al,¹ the lumbar region extends caudally from below the costal margin of the

upper back to the posterior superior iliac spines and along the iliac crests (Fig. 1). This is without a doubt the most difficult region of the posterior trunk for obtaining satisfactory coverage. The "reverse" flow latissimus dorsi flap may sometimes be stretched to reach here.^{7,13,20–22} In this unique region, fasciocutaneous flaps may now have supplanted muscle flaps as the preferred option. The transverse lumbosacral flap has a long history in this regard essentially as a random flap,²⁵ but a lumbar artery perforator flap based specifically on discrete and identified perforators of the lumbar artery source vessels found here may be more reliable (Fig. 5).²⁶ Posterior intercostal artery and superior gluteal artery perforator flaps have also been reported to reach this area.^{2,26} The omentum always remains a backup option.^{6,24}

If the available local tissues of the lumbar region are inadequate either due to radiation damage, donor vessel injury, or simply muscle ablation or if the defect is too large, then a free flap could be justified.^{7,9} Unfortunately, the degree of difficulty for this here is compounded as recipient vessels are at a premium.²⁷ Often, even the gluteal vessels cannot be accessed.²⁸ A reported solution has been extension of the pedicle of the latissimus dorsi muscle with long

Figure 5 (A) Lumbar pressure sore. (B) Transverse oriented propeller flap eccentrically designed about lumbar artery perforators, "x," as identified with audible Doppler. Distance from right side of debrided pressure sore to perforator location or "hub" of flap equals distance from hub to left tip of flap. (C) Elevated flap with identified perforator (on microgrid) prior to rotation. (D) Flap rotated into defect about perforator "hub," with right side of flap positioned to allow tension-free closure of part of donor site. (E) Coverage was achieved, with rest of donor site closed primarily.

vascular grafts, which carries the well-known increased risk of vein grafts with microvascular transfers (Fig. 6).²⁹

DISCUSSION

The posterior trunk combines the area of the upper back and lumbar region. Unless focused in specialized centers,^{4,7} problems in this part of the body are infrequently encountered by the general reconstructive surgeon. Historically, long-term outcomes have been superior when flaps were used. For all these reasons, any guidelines as proposed here should be welcome as a starting point to assist in the selection of an appropriate flap (Fig. 1). Technical details on the actual harvest of these flaps has

intentionally been omitted to avoid being encyclopedic, as this information can be sought out from the appropriate reference once a flap has been selected.

Although a free flap can be used anywhere on the posterior trunk, the increased technical difficulty and paucity of available recipient vessels make this a less reliable option.^{27,29} Local muscle and musculocutaneous flaps continue to have tremendous usefulness primarily for their ability to both fill and cover the irregular contours most often created by wounds involving the spinal column. The paraspinal muscles can be used throughout the posterior trunk,⁴ but the latissimus dorsi and trapezius muscles remain the workhorse flaps. Perforator flaps have gained an important secondary role as another alternative, especially when coverage alone is

Figure 6 (A) Extensive lumbosacral radiation ulcer, with skin paddle designed over left latissimus dorsi muscle. (B) Latissimus dorsi musculocutaneous free flap, with pedicle extended by long vein grafts (above) connected to the thoracodorsal vessels serving as the recipient site. (C) Successful wound coverage, but donor site of left upper back required extensive skin grafting.

required. For the lumbar region, especially if paraspinal muscles are unavailable, in some hands these have even become the flap of choice to avoid a free tissue transfer,^{2,11,26} which oftentimes may be otherwise the only justifiable alternative.²⁹

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