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Reconstructive

The Dorsal Scapular Artery Perforator Flap: A Complete Muscle-sparing Technique

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Summary: Cervical and thoracic spine reconstruction can be a difficult area to provide stable soft tissue coverage. Historically, trapezius myocutaneous flaps and trapezius muscle turnover flaps have proven to be reliable and versatile methods for the reconstruction of these areas. However, sequelae such as restriction of shoulder movement have been reported, as well as unsightly "humpback" contour deformities from turnover flap bulk. The use of the trapezius muscle for coverage has evolved to include descriptions of a trapezius perforator flap to address some of the issues of donor site morbidity, as it is described as a muscle-sparing technique. Although described as "muscle-sparing," these approaches nonetheless involve sacrifice of trapezius muscle overlying the pedicle as that musculature is "deroofed" and divided off the pedicle during dissection. In this article, we present a detailed technical description of our novel technique to the trapezius perforator flap using a dorsal scapular artery flap for spinal reconstruction that is truly, completely muscle-sparing. This technique may prove useful for those patients in which even minimal disruption of trapezius muscle fibers is undesirable. *(Plast Reconstr Surg Glob Open 2021;9:e3933; doi: 10.1097/GOX.0000000000003933; Published online 24 November 2021.)*

INTRODUCTION

When reconstructing defects overlying the cervical and thoracic spine, the trapezius myocutaneous flap and the trapezius muscle turnover flap have proven to be reliable and versatile methods for the reconstruction of such defects.[1] However, their harvest can result in restriction of shoulder movement,[2] as well as discomfort and contour deformities from flap bulk.[3] To address these limitations, the fasciocutaneous trapezius perforator flap has been described with successful outcomes, including full range of shoulder motion. Although described as "muscle-sparing," this approach nonetheless involves compromise of trapezius muscle overlying the pedicle.[4–6] We present a detailed technical description of our novel fasciocutaneous dorsal scapular artery perforator flap technique for spinal reconstruction that is completely muscle-sparing, which was very important to our patient who relies on his upper body for mobility and transfers.

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CASE

Our patient is a 61-year-old man who underwent revision decompression and instrumentation of his T1–T4 thoracic vertebrae for an unstable hyperextension injury at the T2 level secondary to ankylosing spondylitis. Subsequent to this procedure, he had wound dehiscence secondary to postoperative infection, with exposure of portions of his thoracic spine, requiring several washouts, followed by application of negative pressure wound therapy (vacuum-assisted closure [VAC] or wound VAC). Over a period of approximately 1 month, the wound developed into a 12-cm-long and 6-cm-wide defect (Fig. 1). Additionally, he had contact dermatitis from the wound VAC tape that involved the skin of his upper back, which resulted in brisk capillary refill of his skin at the time of surgery.

SURGICAL TECHNIQUE

Markings

The patient was positioned prone. The midline of the back and the scapular spine were marked. Doppler ultrasound was then used to identify the dorsal scapular artery perforators 8–10 cm lateral to the midline and 6–8 cm inferior to the scapular spine.[6] The defect was templated and a skin paddle was designed in a transverse ellipse around the two auscultated perforators (Fig. 1).

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Surgical Technique

All flap borders were sharply incised and cautery was used to dissect down to the trapezius muscle fascia. The flap was then raised in a suprafascial plane from lateral to medial until the lateral border of the trapezius muscle was identified. A large direct perforator was identified coming around the lateral border of the trapezius muscle. Continued medial subfascial dissection revealed one more musculocutaneous perforator, which was compromised as it proved to be insufficient for venous drainage when each perforator was temporarily clamped. We traced the lateral perforator along its course under the trapezius muscle and up cranially (Fig. 2).

We elevated the trapezius muscle off of the pedicle's anterior surface. Once the tunnel was too deep to adequately visualize the cranial aspect of the pedicle, we split the trapezius muscle parallel to its muscle fibers and used a 1-inch penrose drain to create a window and second access point for further pedicle dissection. This technique avoids transection of the trapezius muscle fibers overlying the pedicle (Fig. 3).

The subtrapezius pocket was then connected to the spinal defect and developed until the flap rotated easily into the defect, with its pedicle curving gently under the trapezius muscle and continuing cranially under the rhomboid major muscle. The patient's contact dermatitis and brisk cap refill involved the skin of the medial aspect of the flap, which made the intraoperative visual assessment

Takeaways

Question: Is there a flap that can be used to cover defects in the posterior upper trunk that compromises no muscle for those who cannot tolerate even modest reductions in upper body function?

Findings: This article describes a technical description of a novel exposure and dissection of a dorsal scapular artery perforator flap that involves complete sparing of the overlying trapezius muscle, without deroofing over the path of pedicle as previously described.

Meaning: Complete muscle-sparing can be achieved using the dorsal scapular artery perforator flap, along with our technical modification during dissection.

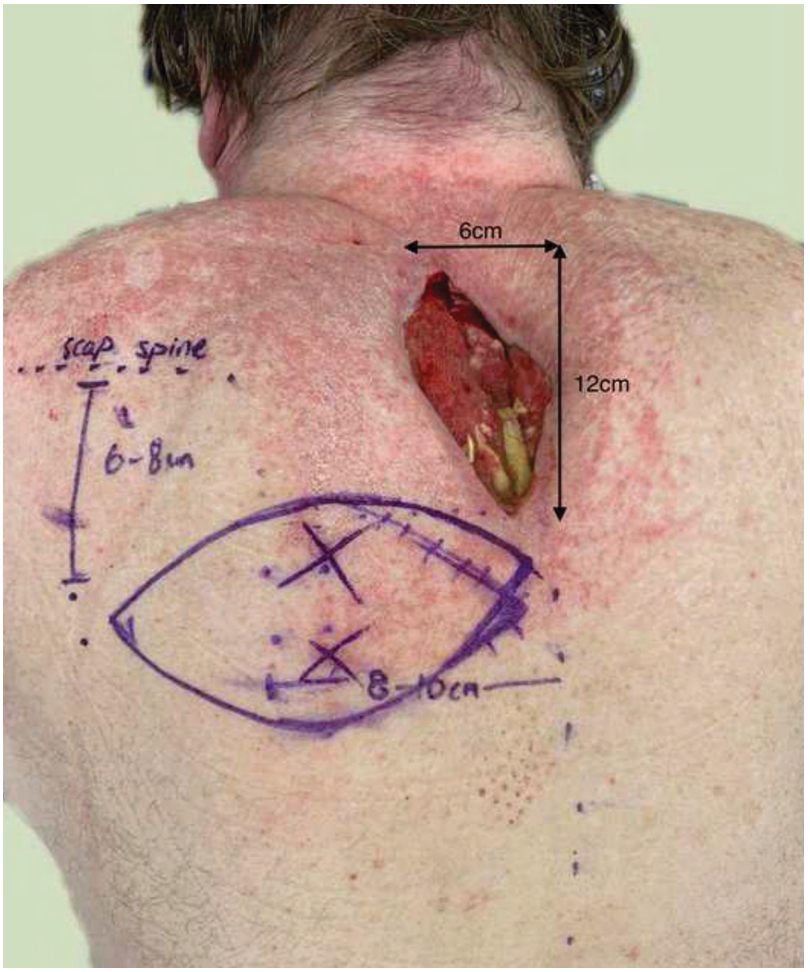

Fig. 1. The defect and markings can be seen in the image. The Doppler ultrasound was used to identify the dorsal scapular artery perforators 8–10 cm lateral to the midline and 6–8 cm inferior to the scapular spine. Two perforators were found in this region and marked with an "X."

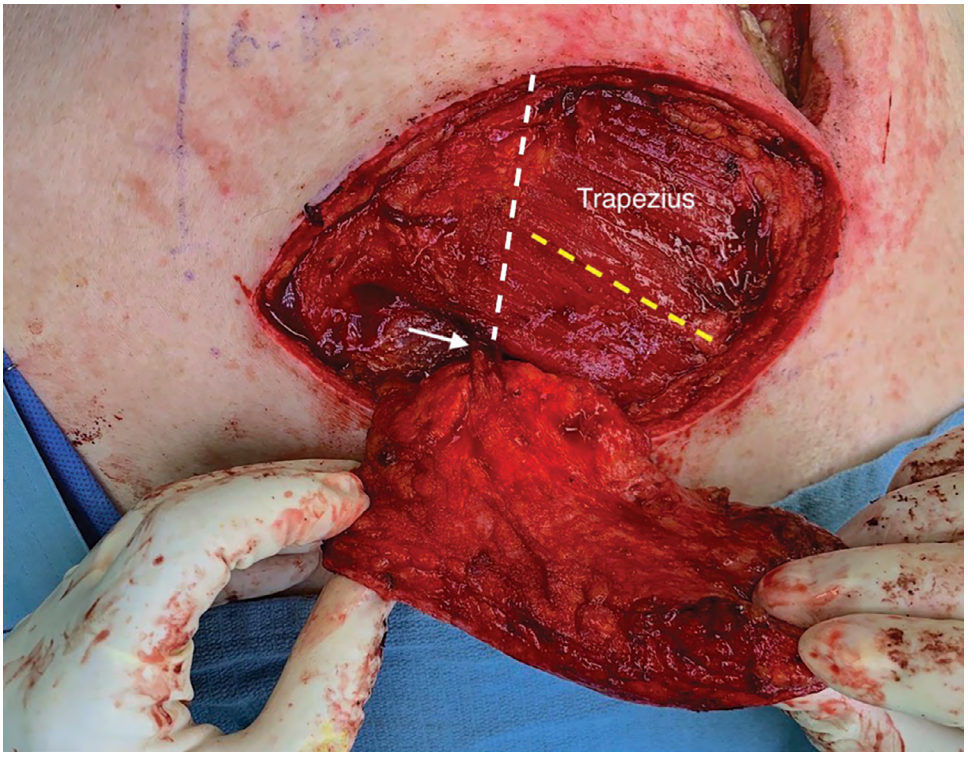

Fig. 2. Arrow pointing to the lateral perforator, which can be seen coursing immediately underneath the trapezius muscle, and continuing up cranially. The white dotted line denotes traditional muscle transection overlying the pedicle utilizing the deroofing technique. The yellow dotted line denotes the planned muscle split along its muscle fibers to create a second access point for pedicle dissection

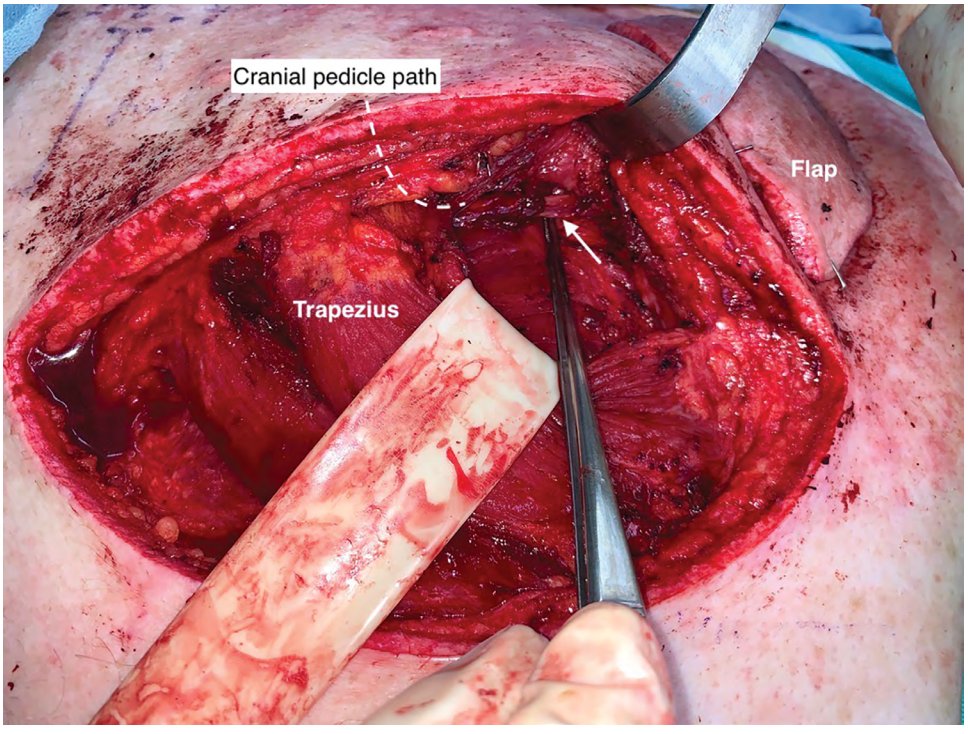

Fig. 3. The Penrose was used to assist with exposure and elevating the trapezius muscle to allow tunneling of the flap through the subtrapezius pocket. The white arrow shows the pedicle traveling underneath the submuscular pocket; it was tension- and compression-free.

of medial/distal flap perfusion more challenging. The lateral aspect of the flap was pristine, and no signs of venous congestion were observed throughout the case. Drains were placed into both donor and recipient sites and inset of the flap and direct closure of the donor site proceeded uneventfully.

RESULTS

Although our patient ultimately did very well, there were some postoperative issues with distal flap perfusion. Flaps as large as 20 × 20 cm can be safely harvested from the dorsal scapular artery perforator,[4] and our skin paddle was well within this margin. However, our patient's contact dermatitis compromised our intraoperative visual assessment of flap perfusion, and on postoperative day 1, distal tip ischemia was evident.

On postoperative day 2, there was early evidence of venous congestion that correlated with the time of peak swelling postoperatively, when the venous system is vulnerable, as it is a compressible low-flow system more prone to stasis. On postoperative day 3, we began leeching the area to provide a means of venous outflow while the postoperative swelling settled. The clinical picture was not consistent with an anastomotic or pedicle issue, which is why we elected to leech rather than to explore operatively. The venous congestion quickly improved, and the leeches were discontinued 48 hours later. The small area of distal-most ischemia declared itself to the cranial portion of the flap, and 12 days postoperatively, approximately a 1 × 2.5 cm rim of necrotic tissue at the superior/distal tip of the flap was debrided full-thickness, readvanced, and closed. The flap healed well without any further issues, and the reconstruction was successful in achieving its goal of stable soft tissue coverage with minimal donor site morbidity, with the patient having full range of motion

Fig. 4. Postoperative oblique view of the flap from debridement and readvancement, showing that there is no "hump" that can be associated with trapezius turnover flaps.

and the ability to perform his transfers at his baseline. Figure 4 depicts the smooth lateral contour the dorsal scapular artery perforator flap provides, in contrast to the bulk associated with traditional trapezius muscle flaps.

DISCUSSION

Obtaining stable soft tissue coverage for the cervicothoracic region can be difficult, as this region has high tensile and traction forces.[7] There are several additional possible perforator flaps that can be used to reconstruct the region of the upper back, including the thoracodorsal artery perforator flap, the dorsal intercostal artery perforator flap, the septocutaneous circumflex scapular artery perforator flap, and the subcostal artery perforator flap.[8] As mentioned previously, the dorsal scapular artery perforator flap was selected based on "minimal" donor site morbidity. In previous descriptions,[9,10] the intramuscular dissection of the pedicle involved the deroofing technique popularized by Wei and colleagues.[2] Although this technique facilitates swift skeletonization of the perforators and decreased operative time, it does transect a portion of the muscular fibers. To avoid this transection, once the dissection tunnel got too deep for adequate visualization, our window and penrose technique allowed us to continue the dissection without compromising any muscle. Although the dissection is more tedious and time-consuming than the deroofing technique as the exposure is not as wide, it was certainly feasible, and may be preferable to the conventional technique description to further decrease morbidity.

In addition, given our issues with distal flap perfusion, flap design can be aided by preoperative imaging with Doppler ultrasonography or CT angiography and can also be undertaken to help delineate the perforators before surgery. The use of intraoperative imaging with laser-assisted indocyanine green angiography, such as the SPY *Elite* (LifeCell Corporation, Branchburg, NJ) system, can help identify zones of adequate perfusion and may also assist with flap design in the initial surgery. Ultimately, a larger case-series is needed to determine if issues with venous congestion are common with this flap and dissection technique.

CONCLUSIONS

Our technical description of a completely muscle-sparing dorsal scapular artery perforator flap for spinal reconstruction enhances the current described technique and is our preferred alternative to the traditional trapezius muscle flaps to decrease donor site morbidity.

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