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Understanding the vascular anatomy of the trapezius flap

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KEYWORDS
Trapezius flap;
Pedicled flap;
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Myocutaneous flap;
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Objective: To describe the operative technique for harvesting a trapezius flap based on its pedicled arterial supply.
Findings: The trapezius flap is a versatile flap allowing for reconstruction of multiple head and neck surgical defects.
Results: The trapezius flap can be harvested based on the dorsal scapular artery or on the superficial cervical artery based on the orientation of the flap desired and the length of pedicle necessary.
Conclusion: The trapezius flap is a useful flap for complex head and neck reconstruction with minimal donor site morbidity. It is well tolerated in a myriad of patients.

Introduction

First introduced as a pedicled flap in 1979, the trapezius flap has been referred as 2 distinct flaps, an “upper” and a “lower” flap. McCraw reported use of an upper trapezius flap for the reconstruction of neck defects[1] while Demergasso and Piazza[2] described use of an upper trapezius flap for reconstruction of the posterior hypopharynx. In 1980, Baek published an operative technique for harvest of a lower trapezius myocutaneous flap for reconstruction of parotidectomy defects,[3] and Mathes and Nahai[4] describe muscle flap transposition with preservation of function.

To initially research the trapezius flap may pose a challenge as nomenclature has changed since its initial introduction and our understanding of the pertinent vascular anatomy has evolved thanks in part to cadaver studies.[4-6] In addition, the introduction of free tissue transfer has largely supplanted use of the trapezius flap as there are many other donor site options with significantly less morbidity.

Regional anatomy

The trapezius is a large, flat, superficial, triangular muscle comprised of 3 distinct directional fibers. The superior portion of the muscle descends from its attachment at the base of skull and C7 to T12 and attaches to the lateral clavicle, while the middle portion is oriented transversely and attaches to the acromion. The inferior aspect of the muscle ascends to attach as an aponeurosis to the medial aspect of the spine of the scapula. All together the trapezius has 3 functions: the upper fibers elevate, the middle fibers adduct, and the lower fibers depress the scapula. Muscles located deep to the trapezius include the levator scapulae, rhomboid major, and rhomboid minor (Figure 1—regional anatomy, arteries and nerve; see sample below)

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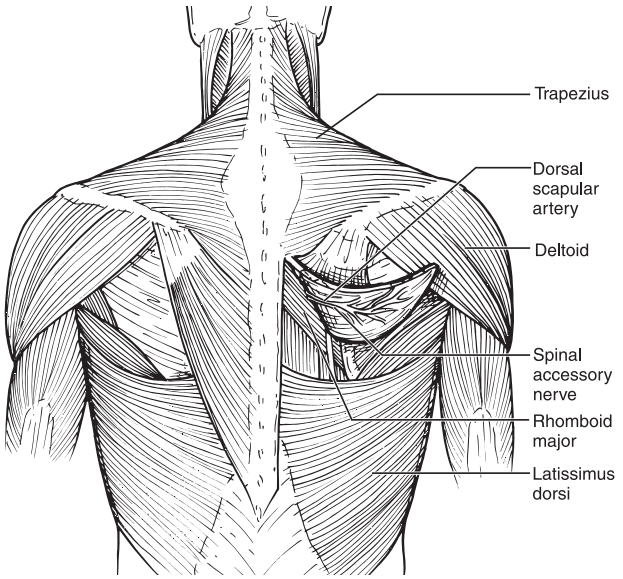

Figure 1 Regional anatomy.

The superior third of the trapezius is supplied by a branch of the occipital artery, and the middle third is supplied by the superficial cervical artery (SCA) which is the superficial branch of the transverse cervical artery (TCA). The lower third of the trapezius is supplied by the dorsal scapular artery (DSA) which is the deep branch of the TCA. There are also intercostal perforators which contribute to the blood supply of this portion of the muscle. There are variations in this vascular anatomy which were elucidated through cadaver studies whereby the SCA can also arise directly from the thyrocervical trunk in 24%, and the DSA can arise directly from the subclavian artery in 37%.[6] The TCA arises from the thyrocervical trunk in the majority of cases and divides into a superficial branch (SCA) which courses superficial to the levator scapulae, and a deep branch (DSA) which courses deep to the levator scapulae. The main branch of the DSA can be found within the rhomboid muscles, hence the need to divide a portion of the rhomboid major muscle when tracing the pedicle for an inferiorly based flap. The entire trapezius is innervated by the spinal accessory nerve (SAN) (CNXI) which courses along the deep aspect of the trapezius together with the SCA superiorly as well as C3 and C4 cervical nerves.

Nomenclature

Early description of the trapezius flap characterizes it by the orientation of the skin island as vertical or transverse, whereas others describe the flap as upper and lower based on whether the transverse portion of the muscle (upper) or the ascending fibers of the muscle (lower) were used for reconstruction. This variability in description of the flap has caused confusion in flap elevation, hence it is best to describe the flap in terms of the vascular pedicle. Since a superior trapezius flap based on the occipital artery is rarely indicated nor used, the focus of this article discusses trapezius flaps based on the SCA and DSA.

Operative technique

Trapezius flap based on the SCA

There is an ascending branch and a descending branch of the SCA which affects patient position, flap and skin island design, and operative technique, hence these will be discussed separately.

Indication: Coverage of soft tissue defects of the lateral and posterior neck, parotid, as well as osseous reconstruction of a portion of the mandible and floor of mouth. Mucosal defects of the hypopharynx and esophagus may also be reconstructed with this flap, although a free tissue transfer may provide a better clinical outcome.

Landmarks: Anterior border of the trapezius, spine of scapula, and tip of acromion, midline spine.

Skin island design: This can be either vertical or transverse for a myocutaneous flap and is typically vertically oriented for an osteomyocutaneous incorporating the spine of the scapula (Figure 2A).

Patient positioning: When harvesting a flap based upon the ascending branch of SCA position the patient supine with bump under the ipsilateral shoulder. A lateral decubitus position with inclusion of the ipsilateral arm and shoulder to allow manipulation during the procedure is recommended for harvest of the trapezius flap based upon the descending branch of SCA.

Preoperative Doppler assessment: The TCA can be found in the supraclavicular area of the neck and should be assessed prior to the beginning of the procedure as it may have been ligated in prior surgery.

Flap harvest: An incision is made transversely at the base of the neck in the posterior triangle. The TCA can be found at the base of the neck in the posterior triangle by dividing the omohyoid muscle. The TCA typically is a branch of the thyrocervical trunk and can be traced posteriorly in the neck. The SCA will run deep to the anterior edge of the trapezius along with the SAN and can be traced down on the underside of the trapezius muscle but superficial to the levator scapulae muscle. It is important to isolate the SAN from the SCA in order to avoid injury. The SCA then branches into an ascending and descending branch which can be selectively ligated depending on which branch is desired for the pedicle. For an osteomyocutaneous flap based on the ascending branch of the SCA, a segment of the spine of the scapula up to 10×2 cm can be harvested. Primary closure of the donor site is feasible as long as the width of the skin island does not exceed 8 cm vertically and 6 cm transversely. If a segment of scapular spine is used, the vertical skin island can extend up to 30 cm in length[7] (Figure 3).

Potential pitfalls: The SCA ends distally about the middle aspect of the scapula. When designing a skin island, it is important not to extend the flap too far inferiorly be-

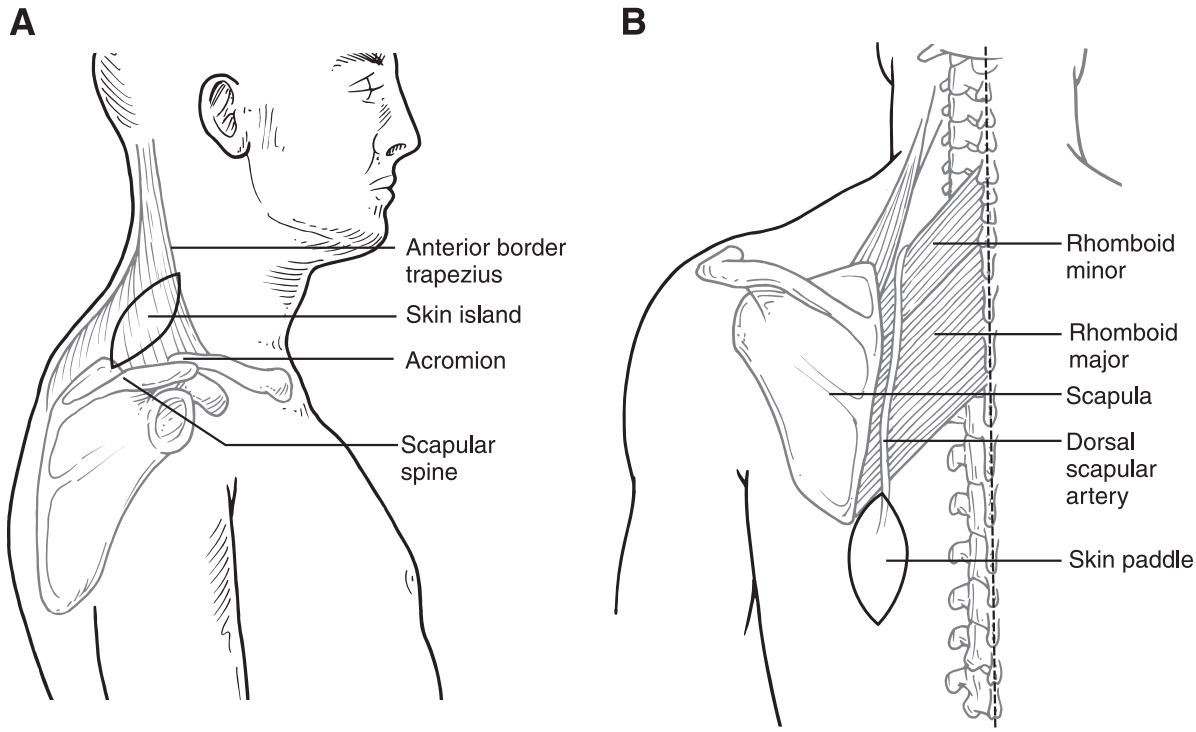

Figure 2 (A) Patient marking for SCA based flap. (B) Patient marking for DSA based flap.

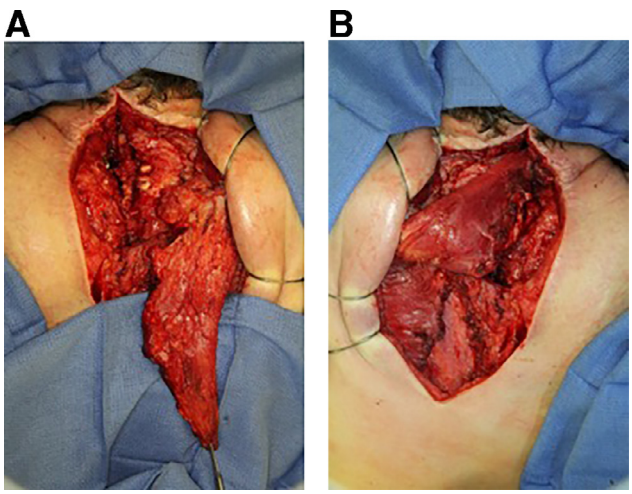

Figure 3 Intraoperative photo of a trapezius flap raised with side-by-side illustration. (A) Trapezius muscle-only flap. (B) Undersurface of trapezius showing pedicle delineated by arrow (DSA). Scott Troob, MD Department of Otolaryngology Head and Neck Surgery Columbia University.

yond this point as blood supply to this region is poor and may result in an inadequate vascular supply to the tip of the flap.

Trapezius flap based on the DSA

Indication: The flap can be raised on a long pedicle and can be used to reconstruct defects overlying the thoracic spine, posterior neck, scalp, oropharynx, oral cavity, and lateral orbit.

Landmarks: Midline spine, inferior border of the trapezius, spine of the scapula.

Skin island design: This is a myocutaneous flap only as opposed to the SCA based trapezius flap which can be designed as a myocutaneous or an osteomyocutaneous flap. The skin island is oriented typically vertically between the midline spine and the scapular spine. A transverse skin island in this region would limit the arc of rotation of the flap. In order to ensure vascularization, the skin island must overlap the distal aspect of the trapezius muscle by at least one-third of its diameter[8] (Figure 2B).

Patient positioning: Lateral decubitus with inclusion of the ipsilateral arm and shoulder to permit manipulation and rotation of the shoulder during the procedure.

Preoperative Doppler assessment: Again, the TCA should be assessed to ensure that it was not ligated in previous surgery. With the patient in lateral decubitus position, the DSA can be found with Doppler by first retracting the arm laterally and rotating it internally to allow more space between the scapula and the spine. An arterial Doppler signal can then be appreciated at the level of the superomedial border of the scapula.

Flap harvest: After the skin island is marked, a vertical incision is made between the spine of the scapula and the midline spine, and skin flaps are raised from medial to lateral. The inferolateral aspect of the trapezius muscle is identified, and the flap is raised from distal to proximal on the under surface of the trapezius muscle. The muscle is detached along its lateral border and the midline spine proceeding cephalad. The DSA will be encountered close to the medial border of the spine and dissection proceeds along the pedicle. To widen the arc of rotation, the rhom-

boid minor can be divided as can the descending branch of the DSA. Also the upper portion of the trapezius muscle should remain intact so as to protect the SAN and preserve function. To extend the length of the pedicle, the DSA can continue to be traced under the levator scapulae, and the flap can be tunneled either subcutaneously or deep to the levator scapulae. The donor site can be closed primarily with minimal morbidity.

Potential pitfalls: In an effort to increase the arc of rotation or length of the pedicle, care must be taken when dissecting under the levator scapulae not to injure the dorsal scapular nerve which provides motor innervation to the rhomboid muscles and the levator scapulae.

Clinical application

In 1979 Dermergasso and Piazza initially reported their experience with both myocutaneous and osteomyocutaneous trapezius flaps based on the SCA in 81 patients.[2] Five patients underwent complete reconstruction of the hypopharynx with a tubed myocutaneous flap while 23 patients underwent mandible reconstruction with an osteomyocutaneous flap. Since that time, in 1985 Panje[9] reported 24 cases of mandible reconstruction for patients with either primary malignancy or osteoradionecrosis with an osteomyocutaneous trapezius flap with similar reports by Gregor[10] and Dufresne.[11] This is still a valid option today in patients in whom a free tissue transfer such as a fibula or scapula flap is not feasible.[12] There have also been more recent clinical application of a SCA based myocutaneous flap for the reconstruction of the posterior scalp, neck,[13] and skull with reports of successful use of the flap for large posterior skull defects complicated by cerebrospinal fluid leakage and epidural abscess (Singh reference).

Clinical application of a DSA-based myocutaneous flap can be found in the literature under many different names including the extended lower trapezius myocutaneous flap, lower trapezius musculocutaneous flap, lower trapezius island musculocutaneous flap, vertical lower trapezius flap, extended vertical lower trapezius flap, and vertical island myocutaneous trapezius flap.[6,14-27] As these various names essentially describe the same flap, most authors agree that the flap is easy to raise, can afford a relatively large skin island, uses a thin and pliable part of the trapezius muscle, has a long pedicle length, and permits a wide arc of rotation. As a result the flap can be used for reconstruction of the posterior, lateral, and anterior neck, scalp, lateral face, hypopharynx and cervical esophagus. The flap has also been used in children as Parekh[21] reported the case of an 18-month old who developed a necrotizing soft tissue infection of the posterior neck and occipital scalp which was reconstructed with a DSA-based myocutaneous flap and Zheng published the successful reconstruction of 11 pediatric patients with face and neck burns.[27]

There are also reports of a trapezius free flap by Sadigh[28] whereby 4 patients underwent a trapezius free flap based on a perforator of the DSA for reconstruction of a hand soft tissue defect, ORN of the mandible, and soft tissue tumor of the back.

Conclusion

The trapezius flap is a versatile flap with multiple applications in the head and neck. Once a surgeon understands the vascular anatomy, it is possible to harvest with minimal morbidity and allow a long pedicle with a wide arc of rotation, especially with a DSA-based flap. Since its initial description in the literature, the breadth of free tissue transfer has greatly expanded, and other flap options often deemed better suited for reconstruction of the head and neck, especially for mucosal reconstruction of the oral cavity, hypopharynx, and cervical esophagus. However, the trapezius flap remains a viable option in the complex, heavily radiated head and neck patient as a free flap is not always a treatment option.

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Conflict of interest

There are no conflicts of interest.

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