Regional Salvage Flap Options in Head and Neck Reconstruction

Camil Correia, MD[1]   Weitao Wang, MD[2]   Aurora G. Vincent, MD[2]   David Chan, MD, FACS[3]
Yadranko Ducic, MD, FRCS(C), FACS[2]

[1] Department of Otolaryngology – Head and Neck Surgery, Northwestern University, Chicago, Illinois
[2] Otolaryngology and Facial Plastic Associates, Fort Worth, Texas
[3] Section of Otolaryngology – Head and Neck Surgery, University of Chicago, Chicago, Illinois

Address for correspondence Yadranko Ducic, MD, FRCS(C), FACS, Otolaryngology and Facial Plastic Surgery Associates, 923 Pennsylvania Avenue, Suite 100, Fort Worth, TX 76104 (e-mail: yducic@sbcglobal.net).

Abstract

Keywords

► regional flaps
► head and neck reconstruction
► salvage surgery
► depleted neck

Microvascular free tissue transfer is the standard in the complex head and neck reconstruction with success rates greater than 95%. Free tissue transfer allows for more versatility in reconstructing complex defects with better tissue match. Failures, however, do occur and subsequent free tissue transfer might not be an option due to either the patients' health or in a vessel depleted neck. In these challenging salvage scenarios, the head and neck reconstructive surgeon must turn to regional flaps for reconstruction. Here, we review multiple regional flap options for salvage head and neck reconstruction.

Microvascular free tissue transfer has become the standard in complex head and neck reconstruction at most major institutions. Free tissue transfer is more versatile in reconstructing complex defect with tissue that better matches the recipient site. Recent flap success rates have been reported greater than 95% in experienced hands.[1] Furthermore, in cases where the patient has had prior radiation, free tissue transfer lowers fistula and wound complication rates.[2] Unfortunately, despite relatively high success rates, failures do occur. While performing a second free tissue transfer is an option, sometimes due to patient factors (e.g., vessel depleted neck, hostile neck, peripheral vascular disease, etc.), it may be more advisable to use a regional option for reconstruction. Here, we review some salvage regional flap options that are typically still available after an ablative procedure.

Supraclavicular Artery Island Flap

Although this flap was first described in 1903 and subsequently performed in 1949, it was largely abandoned for decades due the high incidence of flap necrosis. In the 1990s, Pallua and Wolter performed detailed anatomic studies of this flap, and over the past couple of decades, the supraclavicular flap has seen a resurgence in head and neck reconstruction.[3,4]

The supraclavicular artery island flap (SCAIF) is based off of the supraclavicular artery which originates from the transverse cervical artery (TCA). This vessel runs laterally over the shoulder and the "classic" SCAIF is designed along this course.[5] Pallua and Wolter later described a more anterior placement of the skin paddle which is equally reliable to the classic design with better color match and pliability.[4] Although early reports of the SCAIF showed high distal necrosis rates, more recent case series show a partial flap loss between 6 and 18% and complete flap loss of 0 to 4%. Flap harvest times have been reported to be approximately 30 minutes after acquiring some experience.[6] The SCAIF has similar qualities to a radial forearm free flap and has been used in reconstructing oral cavity, external skin, and laryngopharyngectomy defects with similar complication rates to free flap but decrease in operative time.[7–11] Furthermore, the SCAIF may still be a salvage option even after prior ipsilateral neck dissection even when levels IV and V have been dissected.[12] ►**Fig. 1** diagrams out several anterior chest regional flaps, the respective blood supply, and relative area of reach.
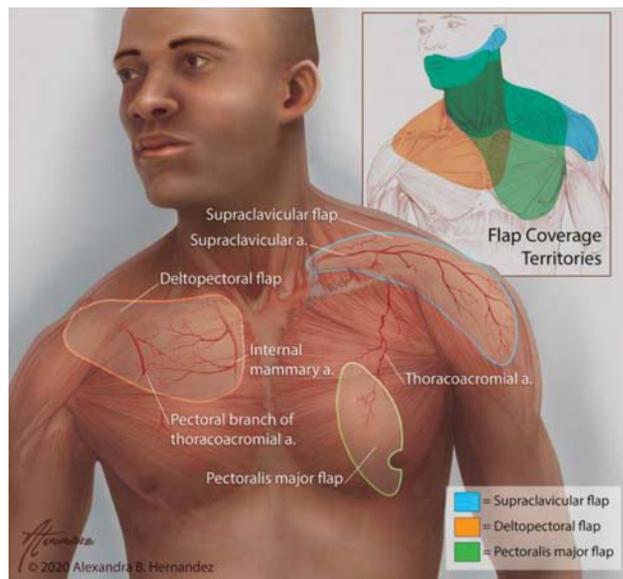
Fig. 1. Anterior chest and shoulder regional flaps diagrammed with respective blood supply, coverage territories, and general flap design.

Internal Mammary Artery Perforator Propeller Flap

The internal mammary artery perforator propeller flap (IMAP) is a variation of the deltopectoral flap based on the internal mammary perforators.[13] The perforators of the internal mammary artery penetrate the first 5 to 6 intercostal space. The perforators pierce the overlying intercostal and pectoralis major muscles to supply the medial chest wall skin. The second and third perforators are typically the largest. The IMAP is a thin, pliable flap with reliable axial blood supply, good color match, and low donor site morbidity. A large amount of skin can be harvested but the reach is limited to the jawline unless the internal mammary vessels are divided distally and mobilized. The flap is reliable (survival rate of 95%) and can be harvested relatively quickly (average 60 minutes).[14] The flap has been used for pharyngeal reconstruction after laryngectomy and laryngopharyngectomy; and is useful in anterior neck skin defects. In some cases, if the pedicle is short, rib resection may be necessary to improve arc of rotation. Distal tip necrosis can occur if the skin paddle is extended into the deltoid region.[14]

Latissimus Dorsi Flap

First described by Tansini for breast and chest wall reconstruction, the latissimus dorsi flap has been used in head and neck reconstruction as well. It has broad applications for head and neck defects due to the large amount of muscle and skin that can be harvested. The latissimus dorsi flap is based on the thoracodorsal vessels. The flap can be harvested as a myofascial flap or myofasciocutaneous flap. In cases where a thin fasciocutaneous flap is desired, the flap can be harvested based on its cutaneous perforators. It can be transferred as a free flap or pedicled flap. The pedicled flap can reach the anterior neck
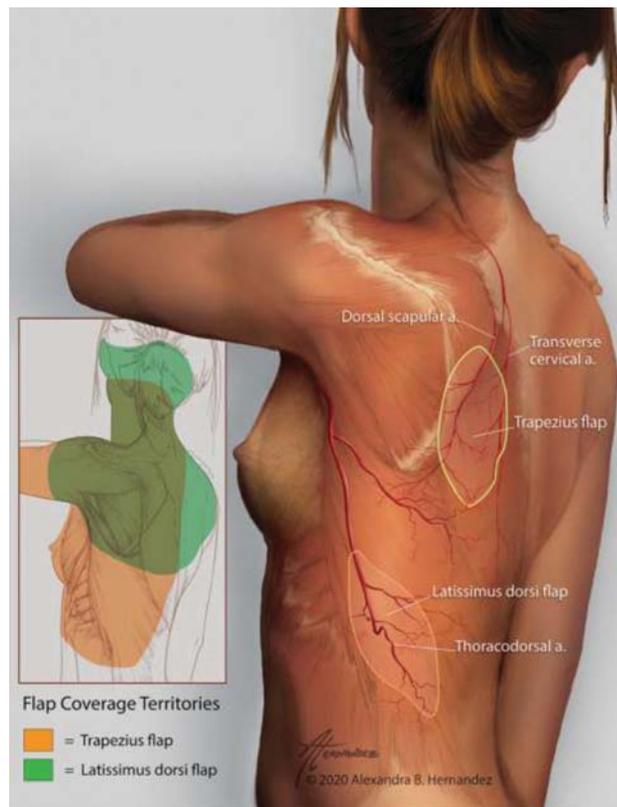

Fig. 2 Lateral and posterior regional flaps diagrammed with respective blood supply, coverage territories, and general flap design.

and the lateral scalp (►**Fig. 2**). When used as a pedicled flap, a subcutaneous tunnel is created in the axilla for transfer of the flap. Ligation of the circumflex scapular vessels is avoided as it helps to prevent kinking of the pedicle. The skin paddle is designed paralleling the anterior border of the muscle and the skin paddle should be designed longer than needed as it helps to relieve tension on the pedicle. While traditionally harvested in a lateral decubitus position, it is also possible to harvest from an anterior approach with the patient in a slightly elevated position.[15] See ►**Fig. 3** for patient example.

Infraclavicular Pedicled Flap

Another flap based on the thyrocervical trunk is the infraclavicular flap, first described and used by Yoo et al.[16,17] The vascular pedicle is based on an anterior perforator described by both Cordova et al and Pallua and Wolter.[4,18] While Pallua and Wolter referred to this flap as the anterior supraclavicular flap, Yoo et al referred to flaps based on this vessel the infraclavicular flap and this flap has been used as both a pedicled and free flap in head and neck reconstruction.[16,17] This vessel, like the supraclavicular vessels, is typically preserved after neck dissection and supplies the skin of the upper chest below the clavicle. This flap has been used for reconstructing various head and neck defects and also for vessel coverage after radical neck dissections. Alain et al reported their experience with infraclavicular pedicled flap and found that complication rates were comparable to other pedicled flaps used for head and neck reconstruction.[19]
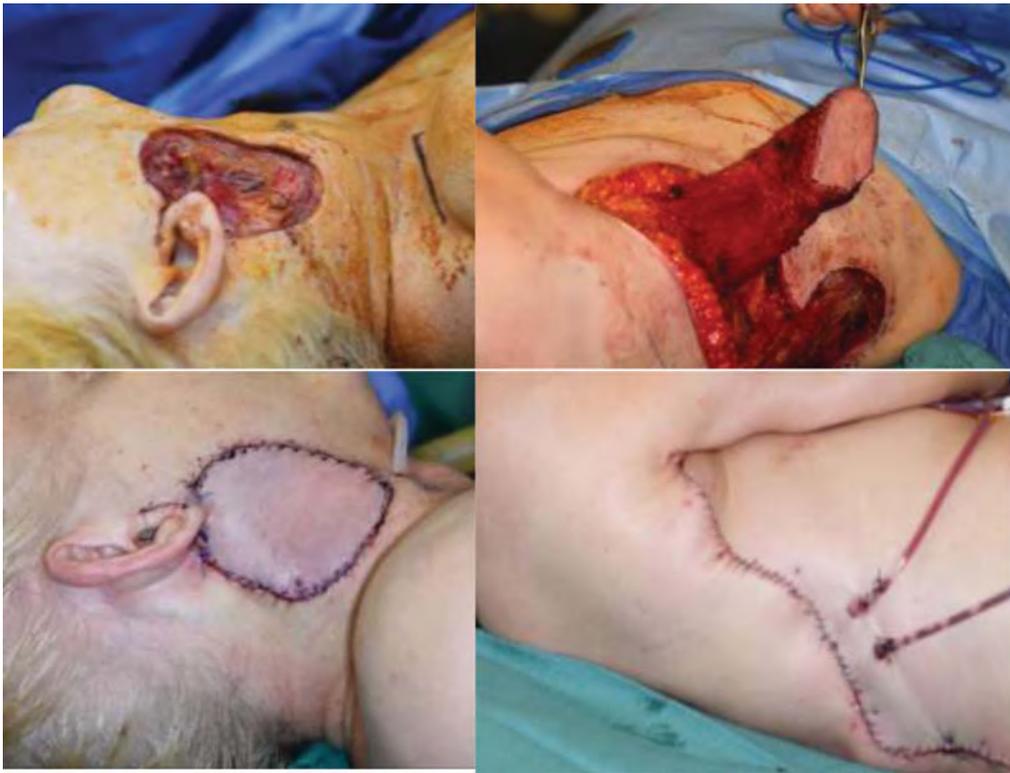
Fig. 3 Left upper, large left neck cutaneous defect. Right upper, pedicled latissimus myocutaneous flap harvested in lazy lateral decubitus position. Left lower, inset of latissimus flap into neck defect. Right lower, closure of donor site in lazy lateral decubitus position.

Pectoralis Flap

The major workhorse of head and neck reconstruction was first described in 1968 by Dr. Heuston in Melbourne, Australia to repair a large chest wall defect and was initially part of a deltopectoral flap.[20] In 1979, two parallel reports of use of the pectoralis major myocutaneous flap (PMMF) were published identifying the pectoral branch of the thoracoacromial artery as an independent pedicle and successful clinical use.[21,22] Since that time the flap has been described in various reports for repair of various head and neck defects including as a regional salvage for failed microvascular repairs. The main advantages of the flap include reliable, quick harvest, and the versatility of the design as well as bulk for use in vessel coverage. Reports have included use of costal bone for reconstruction of mandibular defects as well.

The muscle originates along the medial aspect of the clavicle, sternum, and the cartilage of the ribs to insert at the head of the humerus. The blood supply is based on the pectoral branch of the thoracoacromial artery, itself a branch of the axillary artery (►**Fig. 1**). This pedicle is invested in the fascia along the deep surface of the pectoralis major muscle. There are additional vascular supplies from the internal mammary artery medially and laterally from the long thoracic artery, which are typically divided during flap harvest to enable further reach. The innervation of the pectoralis major is the lateral pectoral nerve and is typically not preserved during harvest resulting in loss of bulk over time. This may or may not be advantageous for reconstruction depending upon the goal.

Clinical uses of the PMMF include repair of oral cavity, oropharynx, laryngopharyngectomy defects, coverage of exposed carotid, or to bolster primary closure of pharyngectomy defects. The PMMF has also been used for repair of the lateral skull base reaching as high as the zygomatic arch. The overall total flap loss rate of 2% or less and partial loss of between 7 and 9% make the PMMF arguably the most reliable regional flap and particularly useful in the salvage scenario.[23] Its bulk is useful for carotid protection and can improve cosmesis in the setting of a radical neck dissection with significant soft tissue loss. Tubed PMMF have been described to close cervical esophageal defects and the cutaneous portion of the flap may be split to provide coverage of both intra- and extraoral defects. The bulk of the flap may be detrimental in these latter scenarios despite denervation over time. The main disadvantages of the flap include the shorter pedicle length. Donor site morbidity is small with cosmesis considerations prompting flap design within the inframammary fold in women and little functional losses as the latissimus dorsi and clavicular fibers preserve adduction and medial rotation of the arm, respectively.

Temporalis Flap

The temporalis flap has been utilized in head and neck reconstruction for over a century. The traditional flap is based off the anterior and posterior deep temporalis artery. The flap can comprise of the entire temporalis muscle or just a segment, and as an alternative, the temporoparietal fascia can be elevated as an independent flap. Other important variants

have been described including the middle temporal artery flap for otologic surgery[24] as well as split flap technique allowing for coverage across midline.[25] This flap allows up to 360-degree arc of rotation if the muscle is separated from the zygoma or the coronoid. The temporalis flap has a long reach and has been used for reconstruction of scalp, cheek, eyelid, orbit, skull base, and neck and has also been used for dynamic facial reanimation. The flap has a relatively consistent and reliable pedicle course and is easy to raise. Disadvantages of the flap include its variable outflow resulting in many reports of venous congestion most of which resolve with conservative measures—pressure dressings, leeches, chemical leeching, or no intervention.[26] The donor site often requires split thickness skin grafting when designed as a fasciocutaneous flap, which can have variable cosmetic results or if the entire muscle is utilized there is noticeable temporal defects.

Deltopectoral Flap

There have been many reports of the deltopectoral flap as a rescue option in the case of ischemic free jejunal flaps and hypopharyngeal defects.[27] This flap was first described by Aymad in 1917 as a medially based fascia flap, which was subsequently the basis for Bakamijian's 1965 description of the deltopectoral flap.[28] The flap design includes the majority of anterior chest skin based medially and extending toward the shoulder with use of the second and third internal mammary perforators.[29] The perforators limit its arc of rotation; however, it has the advantage of being thin and pliable as well as having extensive reach.[30] This flap has been used in a variety of head and neck reconstruction, including defects in the oral cavity, oropharynx, larynx, and anterior neck. This flap has been tubed

for laryngopharyngectomy defects. Greater length and diversity can be achieved if the procedure is staged and has been used for facial defects. The large swath of skin provided does often result in a donor site which cannot be closed primarily. Several refinements have been made resulting in the development of the internal mammary artery flap (►Fig. 1).

Trapezius Flap

The trapezius flap was first described in 1984 by Nakajima and Fujino as a myocutaneous or muscle flap providing coverage for posterior neck defects.[31] The perforator pattern has been disputed, although traditionally it is thought of as a type II bifurcation. The dominant supply is based off the TCA, but Netterville and Wood reported in 1991 that the dorsal scapular artery is the dominant supply.[32] This is secondarily termed the lower trapezius flap (►Fig. 2). Thus, during flap harvest one can choose to utilize the superior cervical artery from the TCA, which provides a wider arc of rotation reaching as high as the orbit in some reports or the dorsal scapular artery, which is thought to be more robust vascular supply. The lower trapezius flap has been used for reconstruction of craniomaxillofacial,[33] intraoral,[34,35] oropharyngeal,[36] and neck defects.[37] A recent systematic review noted that the flap is reliable with 10% complication rate, no reported flap loss and 5% donor site morbidity.[38] Disadvantages of the trapezius flap include a potentially long harvest time and patient positioning (prone) may not be favorable depending on the site of resection. If the trapezius branch of the spinal accessory nerve is divided superiorly there can also be donor site morbidity including shoulder droop, pain, and weakness. See ►Fig. 4 for patient example.

Fig. 4 Left upper, left radical parotidectomy and total auriculectomy defect. Right upper, large trapezius myocutaneous pedicled flap paddle design. Left lower, trapezius flap raised. Right lower, local tissue rearrangement closure of donor site and inset of trapezius flap along auriculectomy defect.

Acromial System Flaps

The thoracoacromial system provides vascular supply for multiple axial rotational flaps for use in the head and neck. The delto-acromial and acromial branch of the thoracoacromial artery flaps have been described in the reconstruction of salvage head and neck defects.[39] The delto-acromial perforator flap has been used as an axial or free flap with a mean pedicle length of 8 cm. The flap is relatively thin and has the benefit of a consistent perforator arising from the common delto-acromial branch.[39] This flap has been used in the reconstruction of pharyngoesophageal defects as well as neck skin and can be positioned so that its pedicle is advanced via subcutaneous or subclavicular routes. While the acromial branch has a variable origination from the thoracoacromial system, it has the advantage of sparing the pectoralis major and has been used to cover shoulder and head and neck defects.[40] Furthermore, perforator flaps from the pectoral branch of the thoracoacromial system have been described in chimeric repairs of hypopharyngeal defects.[40,41] The acromial system flaps generally are able to be closed primarily; however, attention must be paid to shoulder mobility and rehabilitation early on so as to preserve function and thus donor site closure may require skin grafting to prevent contracture. Additionally, careful dissection and identification of pedicle of interest is required as PMMF is another regional salvage flap which has a proven track record in head and neck reconstruction, thus jeopardizing its future use is ill advised.

Conclusion

Free flap reconstruction is now the gold standard for reconstruction of head and neck defects. Unfortunately, not all patients are good candidates for these lengthy procedures. This may be in part due to a patient's general health and ability to tolerate anesthesia, their prior history of radiation/surgery, or having already had a failed free flap. Therefore, it is important for the contemporary head and neck reconstructive surgeon to be familiar with regional flaps options when another free flap is not feasible.

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