Current and Advancing Concepts in Pedicled Flaps, Old and New, for Oral and Maxillofacial Reconstruction

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Abstract

The reconstruction of postablative oral and maxillofacial defects frequently presents a challenging dilemma for the surgeon. This time the challenge comes from simpler, less costly, and often less morbid locoregional pedicled cutaneous flaps that offer equal if not superior patient outcomes. Costs, operating time and availability of expertise are major issues that influence efficient health delivery. Simple and widely reproducible techniques may be used successfully where applicable to overcome these issues. Researchers have demonstrated its technical ease of performance and reproducibility amongst trainees. This literature reviews three such flaps which are facial artery musculomucosal (FAMM) flap, submental flap and supraclavicular flap to explain their growing impact on oral and maxillofacial reconstructive surgery.

Keywords: Pedicled flaps; Oral and maxillofacial; Reconstruction; Tumor resection

Introduction

The correction of oral and maxillofacial deformities following oncologic surgery is an important objective that involves reproducing both the morphological and functional features of the lost tissues. Various techniques can be used for defect reconstruction, including skin grafts, local or regional flaps and free vascularized tissue transfer. Commonly used techniques, such as the radial forearm flap or anterior lateral thigh flap, have numberous disadvantages, e.g., donor-site morbidity, poor color match for cutaneous reconstruction, and excessive tissue bulk for intraoral reconstruction.

The location, function and size of the defect are the main factors in selecting the most appropriate reconstruction. For defects involving the oral cavity and a large area of the face, tissues used should be reliable, functionally and cosmetically acceptable, of suitable size and have minimal donor site morbidity. The flap should also match the recipient site in terms of colour, texture and thickness. The cost, expertise and logistics (e.g. operating time) are some of the serious concerns in the public healthcare delivery system. Simple and widely reproducible techniques may be used successfully where applicable to overcome these issues.

Our goal was to introduce the application of pedicled flap-facial artery musculomucosal (FAMM) flap, submental flap and supraclavicular flap in reconstructing oral defects. During the past 12 month period, we admitted 11 patients with oral cancer in our department. They received resection of the tumour and neck dissection. Because of the general conditions of the patients we decided not to perform any free flap for the really high risk of failure. Reconstruction of oral defects was done with pedicled flap (3 FAMM flap, 6 submental flap and 2 supraclavicular flap). Patients did not develop any marginal necrosis or venous congestion. The donor site healed primarily and no revision surgery was required.

In the past 2 years, we have found an increasing trend in the number of articles focusing on current and advancing concepts in pedicled flaps, old and new, for oral and maxillofacial reconstruction. A protocol covered all aspects of systematic review methodology. A literature search was performed in Medline, including hand searching. Combinations of searching terms and several criteria were applied for study identification, selection, and inclusion. Data were extracted based on the general characteristics, study characteristics, methodologic characteristics, and conclusions. Recent literature can be grouped into several categories as depicted in the following review of a selected number of flaps.

Facial Artery Musculomucosal Flap

The facial artery musculomucosal (FAMM) flap described by Pribaz et al. [1] in 1992 comes from the buccal aspect of the cheek and is supplied by the facial artery. The flap can be based inferiorly on facial artery or superiorly on retrograde flow from the angular artery. Venous outflow follows small veins in the submucosal plexus not the facial vein, which is rarely near the arterial pedicle, especially inferiorly. As the artery courses obliquely across the cheek from posterior inferior near the mandibular molars to anterosuperiorly near the nose, the pedicles are in the bucco-gingival sulci in either of these locations.

The flap provides unique vascularized mucosa replacement. The donor site is closed primarily with minimal morbidity. The inferiorly based flap provides easy repair of lower gingival, lower lip, vermillion, floor of mouth, and tongue defects. The superiorly base flap is an excellent option for repair of upper lip, vermillion, upper gingival and endo-nasal defects. It can require two stages when anterior floor of mouth defects are involved. One stage is sufficient for many defects. Duranceau and Ayad [2] in 2011 described a method by which it can be modified to one stage for others. Flaps as long as 8 cm can be transposed. Ayad et al. [3] series of 57 cases showed how tongue tethering can be avoided after repair of contiguous tongue / floor of mouth (FOM) defects by closing the FOM defect with the flap and allowing the superior tongue defect to heal secondarily.

When used to repair vestibular defects, the FAMM flap has several major advantages over conventional flaps. Because the FAMM flap is made of mucous tissue, it does not shrink postoperatively and remains soft. The FAMM flap can be transferred with mucous tissue as well as with muscle, thereby maintaining a wet surface and providing a better elastic cushion against prosthetic loading than full-thickness skin and mucosal grafts. These characteristics of the FAMM flap facilitate use of prosthesis. Also, its reliability, ease of harvest, proximity to the defect and similar mucosal lining, absence of external scar, and low rate of significant complications are invaluable advantages. As a disadvantage, bulky FAMM flaps can decrease the depth of the vestibule, causing discomfort and precluding use of a dental prosthesis. When used to repair mucosal defects, oedema may increase the bulkiness of FAMM flaps during the first 3 months after operation, but such bulkiness usually resolves within 6 months. In patients with alveolar bone defects, the FAMM flap is thick enough to fill the dead space created by bone resection. The main disadvantage of the FAMM flap is the size, especially the width, is limited by the presence of Stensen's duct. Another disadvantage is that a FAMM flap cannot be used in patients with malignant tumours in whom the facial artery is transected.

This is a unique flap for quick, easy, low morbidity repair of mucosal defects of the mouth, lip and nose. Ten publications in the past year speak to its growing popularity, especially for palatal repair [2, 4-12].

Submental Flap

The submental flap was introduced by Martin et al. [13] in 1990. This flap is pedicled on the submental artery, a constant branch of the facial artery with venous drainage more variable via the facial vein, internal jugular, or external jugular system. The color match provided for facial defects is unrivaled. Flaps as large as 150 cm² can be harvested with inconspicuous submental donor scars. The arc of rotation allows reconstruction of mid and lower facial, oral, and pharyngoesophageal defects. Potential reverse-flow flaps were originally proposed but Sterne et al. [14] described a flap loss secondary to valves in the facial veins. The authors described a 'hybrid' flap with antero or retrograde facial arterial supply and a venous pedicle divided and reanastomosed to a recipient vein closer to the defect [15]. With this approach, orbital, mid-forehead and high temporoparietal defects are accessible. The authors have reported on over 190 flaps for various defects around the head and neck [16]. The submental flap provides a large area of thin, pliable skin with optional mylohyoid muscle and anterior digastrics muscle and / or bone from the anterior mandible.

The most important advantages of this flap are the excellent colour, contour and texture match between the donor and recipient sites. The main indication for a submental flap is to cover particular facial defects, because the skin of the anterior neck is cosmetically acceptable and a good match with the facial region in terms of colour and thickness.

There are two limitations that preclude the use of this flap in certain situations: the thickness of the flap and the hair-bearing nature of the region in males, although in some cases the latter characteristic can be put to good use, such as to reconstruct the hair-bearing upper lip or temporal hairline. The submental flap is also used for intraoral reconstruction due to the short distance between the recipient and donor sites. Research has shown that this flap represents an important reconstructive choice for cheek mucosa and upper maxillary defects. With a cheek mucosal defect, the submental flap assures a good functional result with no restrictions on oral movement due to its pliability and the absence of postoperative retraction. Sometimes, it has the disadvantage of excessive bulk, which could limit oral functions. In this situation, the bulk can easily be reduced on an outpatient basis.

Another disadvantage that can be easily managed with laser treatment is the presence of hair growing on a submental flap inside the oral cavity, which the patient finds very uncomfortable. A posterolateral upper maxillary defect (distal to the canine tooth) can be easily corrected using this soft-tissue flap, which avoids communication between the oral cavity and paranasal sinus and permits the restoration of masticatory function using a dental prosthesis. There are a variety of reconstructive choices for such defects. It is quite easy to use a muscular flap, such as the temporalis or masseter muscle flap, but this often leads to scar retraction, which can result in trismus at this particular site. The submental flap is relatively free from this limitation and matches the recipient site in terms of thickness and pliability, allowing restoration of this oral site without the typical muscle flap outcomes.

The use of the submental flap for reconstruction following excision of an intraoral malignancy should be considered carefully. In such cases it may be complicated if neck dissection is planned in addition to the surgical resection of the primary site. Since the initial lymphatic drainage of these anatomic regions is toward the submental and submandibular lymph nodes, isolation of the flap pedicle with a thick surrounding layer of fatty tissue may compromise the continuity of the neck dissection. If reconstruction with a submental flap is considered in such cases, the neck dissection should be performed meticulously and the vascular pedicle should be thinned as much as possible to prevent incomplete removal of the lymph nodes. The submental flap is never used to

reconstruct a tumour defect with clinically or radiologically established nodal disease in the neck.

The low donor site morbidity is a relevant advantage of the submental island flap [17]. The donor site scar is aesthetically acceptable and is invisible in most cases, since when the upper limit of the flap is located at least 1 cm behind the mandibular arch, it is possible to hide the scar under its margin [18]. First of all, it is necessary to establish the maximum paddle width, especially in young patients, using a simple pinch test of the submental skin between two fingers to ensure primary closure of the donor site defect. This flap can be used for young and old patients, but gives the best results in elderly patients due to the laxity of the subcutaneous and skin tissue, which allows better primary closure of the donor site. In elderly patients, submental flap harvesting reduces submental wrinkles and adiposity if they exist, so it is well accepted by these patients. Eight other publications in the past year demonstrate its rapidly increasing application [19-26].

Supraclavicular Flap

First reported in 1979 by Lamberty [27, 28], the axialpattern supraclavicular flap uses skin from the supraclavicular region and shoulder. The flap failed to gain widespread acceptance most likely because of the aforementioned enthusiasm for the pectoralis musculocutaneous flap. Subsequently renewed enthusiasm for FTT such as the radial forearm flap and anterolateral thigh flap likely delayed resurgence in its use until this decade. It was not until 1997 when Pallua et al. [29] expanded the versatility of the flap by redefining its reliability for reconstructing chest wounds and then head and neck defects in 2000 [30].

The supraclavicular artery consistently arises from the transverse cervical artery. The transverse cervical artery arises from the thyrocervical trunk (90%), less commonly from the suprascapular artery or subclavian artery. The main axial perforator is found in a supraclavicular fossa triangle, defined by the posterior edge of the sternocleidomastoid muscle, superior border of the medial third clavicle, and anterior border of the trapezius muscle. Venous drainage is by way of two accompanying veins: the transverse cervical vein and a branch of the external jugular vein. The supraclavicular angiosome extends from the supraclavicular fossa over the shoulder's deltoid muscle. Flaps as long as 25 cm and as wide as 10 cm, have been safely harvested without tip necrosis. Elevation of the supraclavicular flap includes the deep fascia similar to the deltopectoral flap. Distal to proximal elevation is extremely quick. Proximal flap dissection around the vascular pedicle requires more attention. Careful division of fascial attachments of the supraclavicular fat identifies the main pedicle until the flap freely pivots without tension to the defect.

The flap provides thin pliable skin without compromising other potential pedicled flap options in the region such as the deltopectoral and pectoralis flaps. The flap can easily reach the midface, occipital, oral cavity and pharynx and has been used by the authors to reconstruct the contralateral mandibular alveolar ridge. Su et al. [31] reported a case of circumferential pharyngoesophageal reconstruction with the supraclavicular flap. The authors reported a series of four such reconstructions in 2012 [32].

Caution should be exercised in a previously operated neck, especially in which level V has been dissected. However, Su et al. [31] demonstrated that even in patients with vessel-depleted operated necks, the supraclavicular flap can serve as a viable option and the authors have had a similar experience. This is a very reliable skin flap of significant size, easy to harvest, within the surgical field and possessing minimal donor morbidity [33-39]. In 2013, Pallua and Wolter [40] described a new flap based on the anterior supraclavicular artery.

Conclusion

Choosing the right flap for oral and maxillofacial reconstruction depends on best meeting the needs of form and function. Selecting locoregional pedicled flaps can offer versatility, reliability and outcomes equal to if not superior to more complicated options. The continued application of the FAMM flap, submental flap and supraclavicular flap is helping to improve upon the standard of care in head and neck reconstruction for facial, oral and pharyngeal defects. Certain pedicled flaps provide equal and often superior alternatives with far less time, cost, expertise and patient morbidity involved.

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