Different Flaps for Oral and Maxillofacial Reconstruction: Review of Literature and a Clinical Guide to the Clinicians

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Abstract

There are different methods documented for reconstructing the oral and maxillofacial (OMF) region among which is the use of flaps (local or distant). New techniques of OMF reconstruction aim to restore function as well as improve aesthetics. This article intends to review the literature on different flaps used in oral and maxillofacial surgery (OMFS) and summarize their precise clinical use, taking into consideration the ease, difficulties, and the ultimate clinical outcomes. A review of the literature of local or distant flaps used in OMFS was done using Google database. There are many different methods of reconstruction in patients who have had defect in the OMF region. It is important for the OMF surgeon who is involved in the management of such patients to have an expertise concerning the selection of flap used to reconstruct such defects.

KeyWords: Distant flap, free flap, local flap, maxillofacial reconstruction.

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Introduction:

Management of different pathological lesions of the jaws often requires resection along with the surrounding structures, producing defects of varying sizes. Such defects may also result from maxillofacial trauma, burns, etc. [1] Reconstruction of such defects **(Table 1)** is important in many respects that include restoration of function and aesthetics rehabilitation.

The first and the foremost technique that is thought for the reconstruction of maxillofacial defects is the use of soft tissue flaps that range from different sizes and forms **(Table 2)**[1,2]. These flaps may involve simple advancements of skin to composites involving many different types of tissue. This article aims to review the literature about flaps used in oral and maxillofacial surgery and summarize their precise clinical implications taking into consideration the ease, difficulties, and the ultimate clinical outcomes.

Terminologies and General Concepts

The term flap originated in the 16th century from the Dutch word “flappe,” meaning one thing that adorned broad and loose, fixed solely by one side. The history of flap dates as way back as 600 B.C., when SushrutaSamita described nasal reconstruction using a check flap. A flap is a unit of tissue that is transferred from a donor site to a recipient site while maintaining its blood supply. There are several approaches to the classification of flaps, including donor site or destination, type or types of tissue to be transferred, and blood supply. There is no perfect classification system; however, multiple efforts have been made to standardize terminology in the literature. The evolution of flaps has been mirrored by scientific endeavors to reclassify them. An ideal classification system aids in communication, treatment planning, and outcome assessment.

By definition, the most basic means of flap classification is by tissue type. Tolhurst designed the "atomic" system of flap classification, in part based on tissue type. Flaps of any tissue type can be designed, provided that there is an underlying reliable vascular supply to maintain physiologic homeostasis in the recipient bed. Single-source tissue flaps typically include skin, fascia, muscle, or bone. Composite tissue flaps include more than one type of tissue, such as osteocutaneous or fasciocutaneous.

Flaps may also be described according to their proximity to the recipient site (local, regional, or distant).

Local flaps are those that are derived from the adjacent anatomic subsite. common examples of these include buccal fat pad flap.[2] They are descriptively stratified by the basic geometric movement required to facilitate wound closure: advancement, rotation, or transposition. A tongue flap is considered a local/random flap, whereas a facial artery myomucosal flap is considered a local/axial pattern flap. Mostof local flaps in head and neck reconstruction are used for cutaneous defects.

Regional flaps are methods of reconstruction in which tissue is obtained from an area slightly further away from the immediately neighboring tissue that surrounds the defect. This makes it different from a local flap and represents a slightly more complex reconstruction. A common example are the pectoralis major and temporalis muscle flaps usedfororal cavity reconstruction.[1,2]

Distant flaps could also be either free or pedicled. Pedicled distant flaps are infrequently used in head and neck reconstruction, as the use of distant/pedicled arm flap, the so-called Italian flap, for nasal reconstruction. [3]

Free flaps involve transfer of tissue from a remote site with accompanied vascular supply to a recipient bed. Blood flow is reestablished by microvascular anastomosis. Widely adopted after the introduction of the radial forearm free flap (RFFF) in the early 1980s, free flaps have revolutionized head and neck surgery.multiple flaps have been described, and their versatility, reliability, and utility for reconstruction are unmatched choices for reconstruction in the head[3,4].

Flaps also may be random or axial, random flaps depend on blood supply from the subdermal plexus, which is supplied by unknown musculocutaneous perforators. Axial pattern flaps achieve their blood supply directly from an anatomically known fasciocutaneous artery that runs beneath the flap's longitudinal axis. [3]

Table 1. Indications for reconstruction using flaps:

Defects caused by cancer surgeries
Posttraumatic defects
Facial reanimation
Oro-antral communication
Cleft palates
Post burn defects
Major pathologies
Rhinoplasties

Table 2. Classification of flaps based on blood supply, including the Mathes and Nahaisubclassification

Random (no named blood vessel)
Axial (named blood vessel) Mathes and Nahai classification)
One vascular pedicle (e.g., tensor fascia lata)
Dominant pedicle(s) and minor pedicle(s) (e.g., gracilis)
Two dominant pedicles (e.g., gluteus maximus)
Segmental vascular pedicles (e.g., sartorius)

In the past, most oropharyngeal defects were closed primarily using skin flaps or tubed pedicle flaps of skin from the trunk. These included forehead flap, deltopectoral flap, pectoralis major myocutaneous flap (PMMC), etc. However, defects reconstructed using regional pedicle flaps gave a compromised esthetic and functional result, and there arose the need for better options. Researchers have worked upon multiple newer techniques, but the fact that each of them has got certain limitations has left the clinician with a lot of disparity and personal choice **(Table 3).**

Table3. Criteria for choosing an ideal flab

Provision of a suitable color match to the surrounding skin of the recipient bed and fall within natural skin line
Retention, or provision of recovery, of clinically perceptible sensory innervations
Assurance of a compatible thickness
Attainment of sufficient laxity and tissue ablation such that mobile margins, as in an eyelid or lip.
Assurance that the resultant suture lines of either primary or secondary defects are restricted to anatomical units

Local Flaps

- **Buccal Fat Pad**

Buccal fat pad (BFD) is an encapsulated, specialized fatty tissue located between the buccinator muscle medially, the anterior margin of the masseter, and the mandibular ramus and zygomatic arch laterally. BFD was known as a surgical difficulty for many years because of its accidental encounter during various surgical procedures in the pterygomandibular area but later **Egyedi**[4]has proven it as a boon for OMF surgeons.

The flap is harvested through an incision in the posterosuperior vestibular sulcus opposing the second molar tooth. After incising the fascia, the fat pad is easily delivered into the oral cavity by blunt dissection. If the defect is not continuous with the donor site, the flap can be tunneled through mucosa,then sutured into position and allowed to mucosalize, which occurs within 3 to 4 weeks. [5]

This is a pedicled flap with its blood supply derived from the buccal and deep temporal branches of the maxillary artery and from vessels from the transverse facial artery. Because of its accessibility, available size, and minimal donor site morbidity, it has been used reliably to reconstruct soft and hard palatal, retro molar fossa and buccal mucosa, The flap is also used to repairoro antral communications, in conjunction with advancement flap, caused by dental extraction. [6]

- **Facial Artery Musculomucosal Flap**

FAMM flap was described by **Pribaz and colleagues** in 1992, [7] which contains mucosa, submucosa, buccinator muscle, buccal fat, and facial artery. It has been used in oropharyngeal reconstruction following cancer ablation, congenital or posttraumatic oroantral fistulas, cleft palate defects, for soft palate lengthening. [8] The flap can be either superiorly or inferiorly based as it can be used either in the anterior maxilla ry region, lips, or anterior floor of mouth. It has been shown to be a useful flap in certain situations although the variability of the facial artery can make it less reliable.[9] [10]

Regional Flaps

1-Pectoralis Major Myocutaneous Flap

Pectoralis major myocutaneous flap is the most commonly used muscle skin flap in soft tissue reconstruction of defects of the upper neck and jaw region that may include the underlying ribs. It was first described by **Hueston and McConchie** in 1968. Pectoralis major flap was introduced into head and neck reconstruction by **Ariyan** in 1979. [11]

PMMC flap has an axial blood supply and is based superiorly on the pectoral branch of the thoracoacromial artery. It is very useful in the head and neck region for reconstruction of soft tissue defects of the oropharynx, oral cavity, hypopharynx, and skin of the neck, to augment pharyngeal repairs following salvage. It is tunneled underneath the skin of the neck and so can re-create the sternocleidomastoid and protect the carotid vessels. It is a well-accepted versatile and reliable reconstructive technique for the head and neck region. However, because of its bulk, especially in obese patients, the esthetic outcome is poor. Pectoralis major myocutaneous flap still can be used as an option when free flaps are not indicated or show failure. [11,12]

2-Temporalis Flap

This flap was first described in 19956 and has been used for reconstruction of temporomandibular joint and orbital-zygomatic defects. It is supplied by the deep temporal branches of the maxillary artery and can be harvested with cranial bone or coronoid process of the mandible. It has also been used as a myofascial flap intraorally. **EstellésFerriol et al.** in 2005 [13] discussed that the myofascial flap is simpler to manage than the free microvascular flaps and safe because of its great vascularization. The merits of this flap includes its slim size, flexibility, and the fascia in contact with the oral cavity, which epithelize within 3 weeks making it resistant to the proteolytic action of saliva. The flap is capable of supporting skin grafts and/or nourishing bone grafts. [14] It requires only one surgical site, and the incision is extended into the hairline, and the muscle is elevated from an inconspicuous area. Thus, it produces minimal functions and esthetic morbidity. Temporalis muscle flap has been criticized because of its short arc of ration due to which it cannot reach the midline and most of the muscle bulk is used in the pedicle.

Free Flaps

The free vascularised tissue transfer,also known as free flap transfer, is now considered the gold standard for maxillofacial reconstruction [15,16]. It involves the harvesting and detachment of tissue with its own blood and sometimes nerve supply

and transferring it to repair a defect, where its blood and nerve supply are re-established by re-anastomosis to suitable recipient site vessels[16]. Success rates are estimated at between 90% and 94%. [17-19]

The free vascularised tissue transfer is advantageous over non-vascularised tissue transfer, as post-operative radiation affects the vascularised flap less severely compared to the non-vascularised flap. A number of different donor sites are used for free flap transfer, the selection of which depends on the recipient site location and the type of tissue being replaced. [16, 20]. The main types of flaps used in oral and maxillofacial reconstruction are discussed below.

Radial Forearm Free Flap

Radial forearm free flap was first described by **Yang et al**. in 1981. [14] and popularized by **Soutar et al.**[21] It is the workhorse of oral reconstruction due to its versatility, reliability, and flexibility. It is most often harvested as a fasciocutaneous flap that undergoes epithelialization providing a good attached mucosal lining for prosthetic rehabilitation. It can be considered as an excellent option for reconstruction of oral cavity, oropharyngeal, and hypopharyngeal defects, such as those found after hemiglossectomy or laryngectomy with partial pharyngectomy. Advantages with this flap include the large amount of thin, pliable skin that is available, relatively easy to raise, and has a reliable vasculature. The main disadvantages of this flap are inadequacy of available bone, that reduces the quality of osseointegration and donor site morbidity such as limited motion, grip strength and supination. [15]

Fibular Free Flap

Fibular free flap (FFF) was first used for mandibular reconstruction by **Hidalgo** in 1989. [22] The fibula free flap is regarded as the mainstay in mandibular reconstruction. [23] FFF is popular for several reasons; for example, it can be harvested by a second surgical team, provides a long segment of the bone (~25 cm), so it can be used to restore angle to angle mandibular defects, it is generally not a weight-bearing bone of the body, can actually be cut into smaller segments to re-create curvature of the mandible. The fibula allows placement of osseointegrated dental implants. [24] It can also be used for bony reconstruction of the maxilla and midface Disadvantages include donor site morbidity and numbness of the foot and toe. If the patient's blood supply to the foot is dominated by the peroneal artery, the FFF from that leg is contraindicated. [5]

Free Iliac Crest Flap

Also known as the deep circumflex iliac artery (DCIA), flap it uses the iliac crest bone with or without skin based on and vein. This flap was first described for reconstruction of the maxillofacial region by Bitter. [25] The main benefit of using the iliac crest as a free flap is the curvature of the ilium that is similar to that of the mandible. It can be quite a morbid procedure. Though causes gait problems due to pain, abdominal wall weakness, and frank herniation, part of these problems can resolved by using only the inner table of iliac bone . The success rate in a recent review may be as high as 96%. [26]

Discussion

Defects that result from tumor resection in the oral and maxillofacial region may cause a significant functional and esthetic deformity that is clearly related to the anatomical site and size of the tumor. A superfluity of regional cutaneous and myocutaneous flaps are offered for the management of such defects and are a well-accepted surgical option[4]. In oral and maxillofacial regions, reconstruction of surgical defects that result from pathological lesions or tumors have always been a challenge for clinicians due to its anatomical complexity that makes the reconstruction of these defects a tedious task. Previously, most oropharyngeal defects were closed primarily using skin flaps or tubed pedicle flaps of skin, for exampleforehead flap, deltopectoral flap, pectoralis major myocutaneous flap (PMMC), and so on. However, defects reconstructed using regional pedicle flaps gave a compromised esthetic and functional outcome, and there arose the requirement for better options. Researchers have worked upon multiple newer techniques, such as the free vascularized flaps that are now considered the gold standard for maxillofacial reconstruction.[16] However, the fact that each of them has got certain limitations has left the clinician with a lot of inequality and individual preference.

Conclusion

There is a large sort of reconstructive options that can be used in the oral and maxillofacial region after ablative surgery. Small defects can be repaired

either by direct closure or with grafts such as split thickness skin grafts,whereas larger defects can be closed either with local or regional flaps. In this era, the majority of larger defects are repaired using free vascularized tissue transfer, particularly the radial forearm free flap and free fibular flap. These flaps may be used on their own or in combination with other flaps to close a variety of three-dimensional defects that may occur as a result of tumor resection. It is important for the oral and maxillofacial surgeon to be aware of these techniques, notably those of free flap reconstructivetechniques . Familiarity with common problems related to cutaneous free flap reconstruction such as the retention and growth of hair and excessive flap thickness is additionally important. Such knowledge can facilitatein understanding the issues of reconstruction and aid planning the oral rehabilitation of the patient post convalescence.

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