

Buccinator-based myomucosal flaps in intraoral reconstruction: A review and new classification

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ABSTRACT

The buccinator-based myomucosal flaps are axial pattern flaps that are suitable in reconstruction of medium sized oral soft tissue defects; they are rich in blood supply, have appropriate thickness and considerable mucosal paddle, and they can secrete saliva. The present study describes surgical anatomy and blood supply of these flaps and demonstrates all possible modifications of these flaps (9 modifications). Many terms (> 10) have been used to refer to buccinator-based myomucosal flaps in the literatures. This report introduces a new classification system mainly based on the remaining attachments of buccinator muscle after flap elevation in pedicle variants and axial blood supply orientation in island variants.

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INTRODUCTION

Reconstruction of intraoral soft tissue defects from traumatic injuries, treatment of pathologic lesions, or congenital wide palatal clefts are interesting. Replacement of resected or defective mucosa with appropriate tissue has concerned surgeons for long.

Special kind of fasciocutaneous, myocutaneous, and muscle flaps for coverage of intraoral soft tissue defects have been designed.^[1-3] Replacement of mucosa with the same kind of tissue is physiologically optimal.^[4]

Pediculated mucosal flaps such as palatal rotation flaps, myomucosal tongue, and labial flaps can provide mucosa for soft tissue defects that cannot be managed by direct closure, secondary epithelialization, or free mucosal grafting.^[5-7]

Buccinator-based myomucosal flaps are rich in blood supply, have appropriate thickness and considerable

mucosal paddle,^[8] and they can secrete saliva; hence, they are good choices for the repair of intraoral medium sized mucosal defects.^[9] This article demonstrates all possible modifications of this flaps (9 modifications), and a new classification on this topic is presented.

Anatomy

Buccinator muscle originates posteriorly from pterygomandibular raphe and blend with orbicularis oris muscle anteriorly. Maxillary vestibule is its upper limit, and mandibular vestibule and external oblique ridges are lower limits. Oral mucosa covers intraoral side and, in external surface, it is adjacent to the facial artery and vein, buccal fat pad, and buccopharyngeal fascia. Nervous network from facial nerve (buccal plexus) is responsible for motor innervation. Sensory inputs are collected by buccal nerve, which is a branch of mandibular nerve, and enters the buccinator muscle via the posterior border. Some buccal lymph nodes and minor salivary glands also present in this region. Stensen duct penetrates the muscle and enters oral cavity slightly above the center of the muscle.^[10,11]

Blood supply

Facial artery and vein run obliquely from posterior-inferior part of buccinator muscle and run anteriorly toward nose in the oblique direction. Posterior superior alveolar (PSA) artery and vein enter it in the most posterior-superior corner and distribute over the buccinator muscle. This

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artery communicates with infraorbital artery branches. Buccal artery enters the posterior border of the muscle in junction with superior constrictor pharyngeal muscle; it accompanies buccal nerve. Rich venous plexus over buccinator muscle drain into facial vein or pterygoid plexus. All these vessels anastomosed with each other extensively [Figure 1].^[12,13]

CASE REPORTS

Case 1

The patient was a 12-year-old girl with benign pathologic lesion that involved soft palate. Posteriorly based buccinator myomucosal pedicle flap reconstructed the mucosal defect, immediately after resection [Figure 2].

This flap relies on buccal artery (a branch of maxillary artery) for survival. Long buccal nerve accompanies this artery, therefore, it is neurovascular pedicle flap and sensory return is predictable. There was no need for pedicle base division. Donor site closed primarily.

Case 2

The patient was a 40-year-old man with melanoma of anterior maxilla. Under general anesthesia, wide surgical resection, and supraomohyoid neck dissection (SOHND) in the right side was done. Bilateral superiorly based buccinator myomucosal pedicle flap was used for reconstruction [Figure 3]. In this patient facial artery and vein were transected during right SOHND. The patient received postoperative radiotherapy.

Case 3

The patient was a 38-year-old male patient with large oronasal fistula from surgical resection and radiotherapy

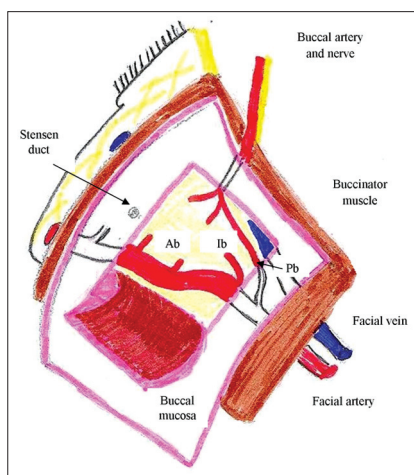


Figure 1: Schematic blood supply of buccinator-based myomucosal flaps. Facial artery and its branches (Ab, Ib, Pb), buccal artery, and nerve. Note anastomosis between Pb and buccal artery. Ab: Anterior buccal branch, Ib: Inferior buccal branch, Pb: Posterior buccal branch. Superior limit of most buccinator myomucosal flaps are under stensen duct opening, so these flaps are partial buccinator flaps

of nasal cavity angiofibroma, 10 years ago. Clinical picture was very similar to that of wide adult palatal cleft. Voice changes and difficulty in eating were the two main chief complaint of the patient. In delayed reconstruction 10 years after the first operation, the fistula closed with superiorly based buccinator island flap. Donor site was closed with inferiorly based masseter muscle flap effectively [Figure 4]. Buccal fat pad could not herniate in surgical field for donor site coverage, probably because of previous radiotherapy, thus masseter muscle flap became the choice.

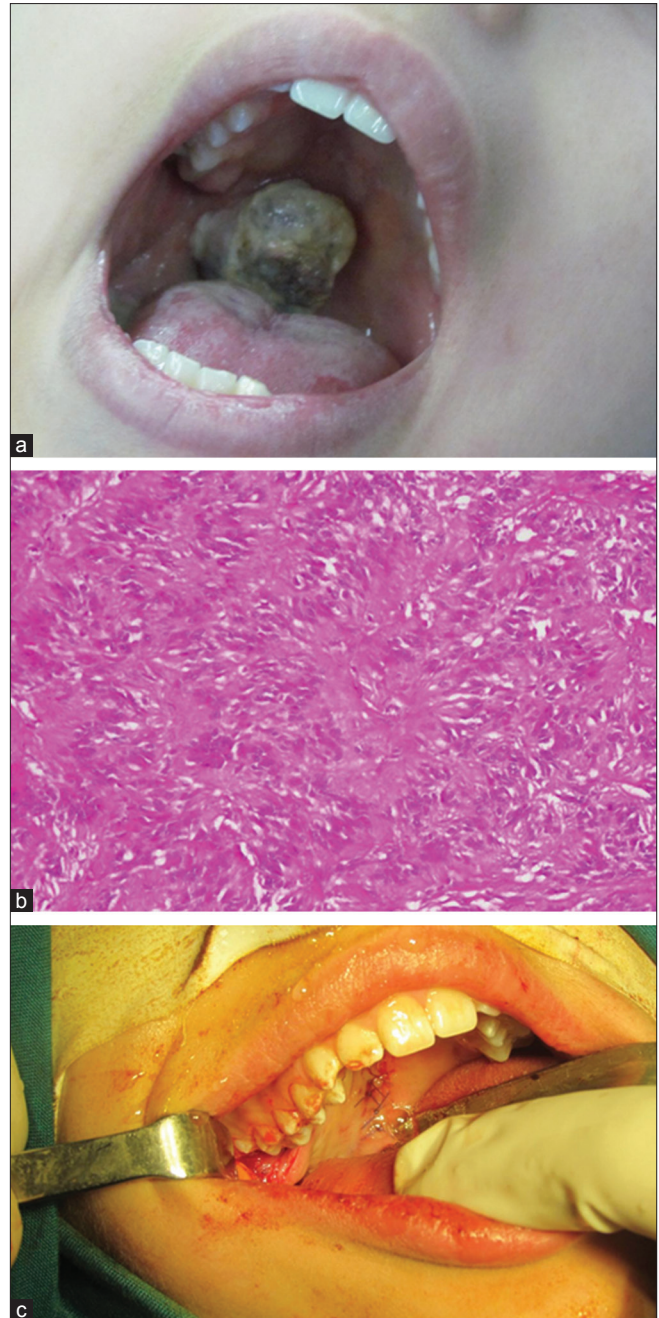


Figure 2: (a) Soft palate mass, (b) Antoni type a shows verocay bodies (H and E, x400), (c) Posteriorly based pedicled buccinator myomucosal flap reconstructed the defect

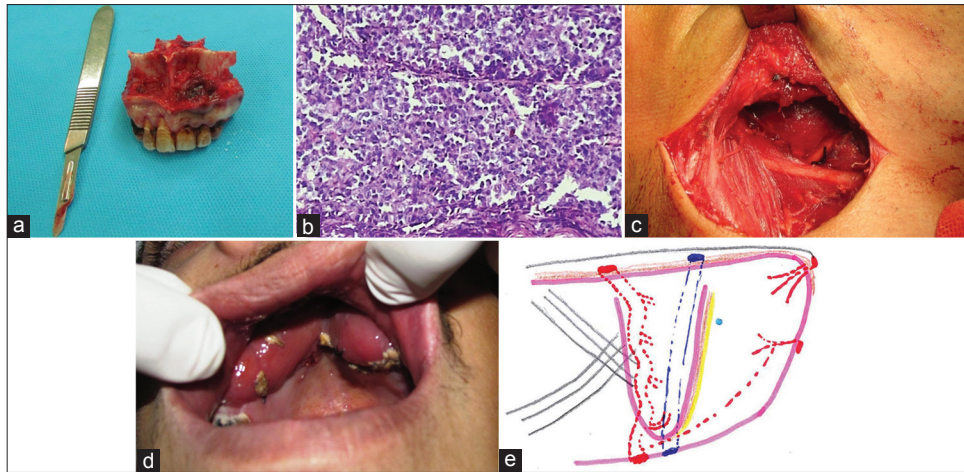


Figure 3: (a) Subtotal anterior maxillectomy, (b) Numerous atypical melanocytes that infiltrate the connective tissue as loosely arranged sheets (H and E, x400), (c) Facial artery and vein ligated during SOHND, (d) Bilateral superiorly based pedicled buccinator myomucosal flaps reconstructed the defect, (e) Schematic picture: Note the flap outline anterior to the stensen duct and incorporation of some fibers of orbicularis oris muscle in flap

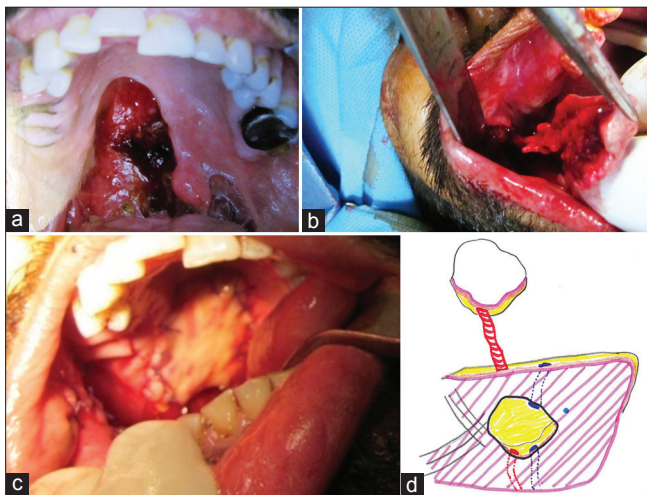


Figure 4: (a) Large defect of soft and hard palate 10 years after surgical resection of angiofibroma, (b-c) Superiorly based islanded buccinator myomucosal flap reconstructed the defect, (d) Schematic picture of the flap

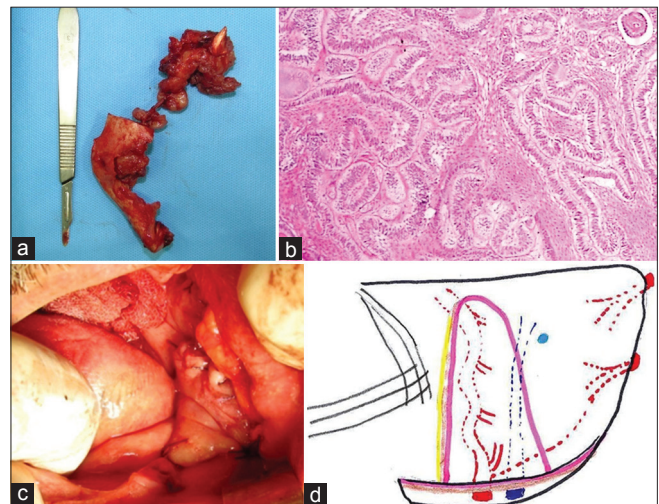


Figure 5: (a) Resected mandible that was involved by ameloblastoma with cortical perforation and soft tissue invasion (resection with continuity defect), (b) Ameloblastoma (plexiform pattern). Anastomosing cords of odontogenic epithelium (H and E, x100), (c) Inferiorly based buccinator myomucosal pedicled flap reconstructed the soft tissue defect and covered reconstruction plate, (d) Schematic picture of this flap

Case 4

The patient was a 65-year-old edentulous male with mandibular ramus and angle ameloblastoma with perforation of soft tissue lingual to the ridge. Bony segmental resection with the removal of overlying involved mucosa was done. Intraoral incisions were used for tumor resection. Inferiorly based buccinator myomucosal pedicle flap was used for reconstruction. Donor site closed primarily. There was no need for pedicle division [Figure 5].

Case 5

The patient was a 55-year-old female with squamous cell carcinoma of right lateral border of tongue (T3-N0-M0). Wide resection with safety margins was done. SOHND in the right side of the neck accompanied with preservation of facial vein and artery. The patient was dentate in posterior region, therefore inferiorly based buccinator

myomucosal island flap was used for reconstruction [Figure 6]. The formed flap was turned around the inferior border of the mandible and brought to the lingual side to cover the raw surface of lateral tongue. Donor site managed with buccal fat pad mobilization that clinically epithelialized 3 weeks later. The patient received postoperative radiotherapy.

Case 6

The patient was a 22-year-old man with biopsy proven central giant cell granuloma of the mandible (CGCG) with bone perforation and soft tissue involvement. Defective mucosa after enucleation of the lesion made reconstructive procedures necessary. Random pattern buccinator myomucosal flap without including the axial artery in base covered the defect, therefore, soft tissue

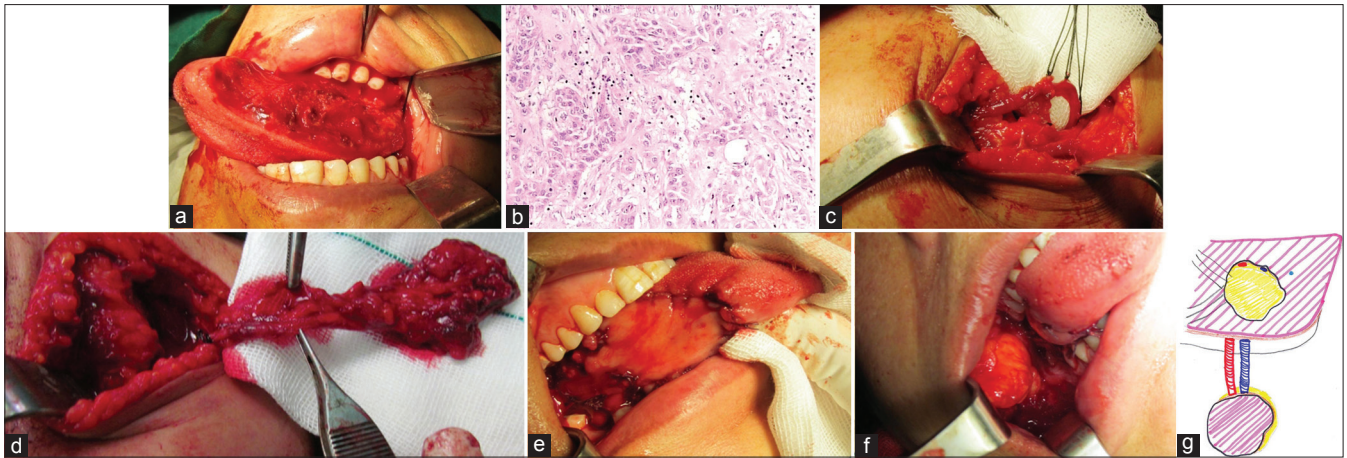


Figure 6: (a) Soft tissue defect after resection of tongue squamous cell carcinoma, (b) Squamous cell carcinoma. Islands of malignant squamous epithelium (H and E, x400), (c) Preservation of facial artery during SOHND. Glandular branches and submental artery are ligated, (d) Inferiorly based buccinator myomucosal islanded flap that contains facial artery and vein turned under mandibular border and brought medial to the mandible, (e) Reconstructed defect, (f) buccal fat pad transposition, (g) Schematic picture

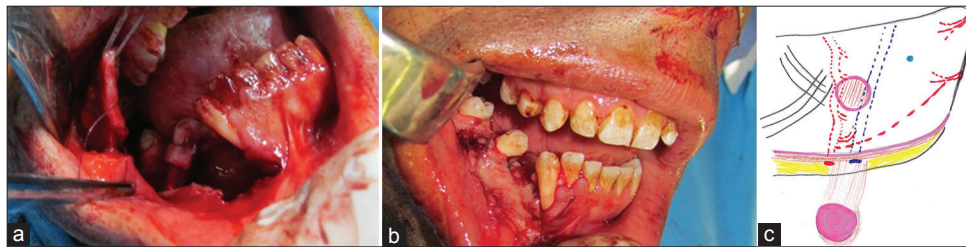


Figure 7: (a) Surgical defects after removal of mandibular CGCG. Random pattern buccinator myomucosal flap without including facial artery and vein is harvested, (b) Reconstructed defect, schematic picture. (c) Note that facial artery and vein are undisturbed

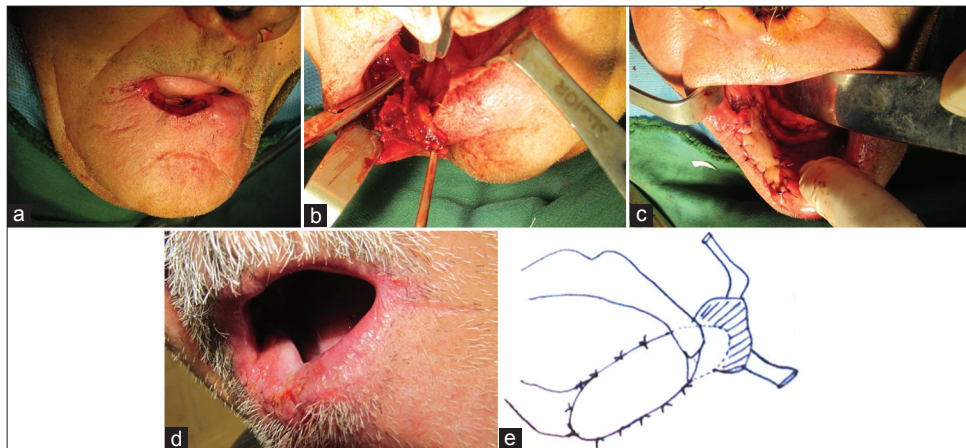


Figure 8: (a) Vermilion border and part of orbicularis oris muscle are resected for treatment of lower lip SCC (left side), (b) Anteriorly based pedicled buccinator myomucosal flap is harvested, (c) Reconstructed lesion immediately, (d) and 2 weeks after the operation, there was a need for pedicle division, (e) Schematic picture (right side of the lip)



Figure 9: (a) Peripheral giant cell granuloma in the area between the first permanent molar and unerupted canine tooth, (b) Posteriorly based islanded buccinator myomucosal flap reconstructed the lesion, (c) Schematic picture. (PSA): Posterior superior alveolar artery

dehiscence and the problem of exposed bone cavity was prevented. Donor site closed primarily [Figure 7].

Case 7

The patient was a 72-year-old man with lower lip squamous cell carcinoma (stage II). The lesion resected with safety margins, and denuded lip was reconstructed with anteriorly based buccinator myomucosal flap. The pedicle was 1 cm posterior to the oral commissure, and its width was 1.5 cm. The flap contained facial artery [Figure 8].

Case 8

The patient was a 9-year-old boy with large peripheral giant cell granuloma in the mandibular alveolar ridge that extends from the right first permanent molar to the right canine area. After tumor removal, there was denuded area that was covered with posteriorly based buccinator island flap. Buccal fat pad covered the donor site [Figure 9].

DISCUSSION

Buccinator-based myomucosal flaps are not suitable for large oral mucosal defect coverage. Stensen duct pierce buccinator muscle slightly above its center. Considering 0.5-1 cm safety distance from this orifice, practically only half of the buccinator muscle and overlying mucosa can be used for reconstruction. Partial buccinator flap is useful term for these flaps. Relocation of stensen duct adds more mucosa.^[14,15] Primary donor site closure is possible in defects < 2.5 cm in width. Larger donor sites always managed with buccal fat pad mobilization, which undergoes epithelialization. Skin graft or masseter muscle flap are other options.^[16-18]

The literature has several terms for buccinator-based myomucosal flaps such as Bozola flap,^[19] Zhao flap,^[20] FAMM flap,^[21] BUMMIF,^[22] Pedicled Facial Buccinator (FAB) Flap,^[23] BMMF,^[24] myomucosal cheek flap,^[25] buccal musculomucosal flap,^[26] buccal mucosal transposition flap,^[27] buccal flap,^[28] island cheek flap,^[29] BMF,^[30] and intraoral cheek transposition flap.^[31] These names are taken from the name of pioneer surgeons or abbreviation of the letters for description of the flap. In Table 1, some pioneer surgeons in this field and the terms that they have introduced in this topic are listed.

Bozola, Carstens, and Pribaz — all noted that facial artery gives some branches to the buccinator muscle. Bozola believed that most blood supply of the buccinator muscle comes from the buccal artery. Anteriorly based buccinator myomucosal flap was introduced by Carstens *et al.*^[32,33] They used anteriorly based in contrast with posteriorly based flap that was introduced by Bozola *et al.* Nowadays, anteriorly based buccinator

myomucosal flap should be used just for buccinator flaps, in which the pedicle is near oral commissure and superior, posterior, and inferior margins are incised. Facial artery should be incorporated in flap base. Flap pedicle can be between facial artery and vein or in between facial artery and oral commissure [Figure 10]. Facial artery branches to buccinator muscle (Ab) are responsible for flap survival. Facial vein can be ligated to give the flap more mobility.

Zhao *et al.*, with cadaveric dissection of blood supply of buccinator muscle called buccinator branches from facial artery that were pointed previously by Bozola, Carstens, and Pribaz are anterior buccal branches (Ab). Zhao *et al.*, indentified two other branching groups of

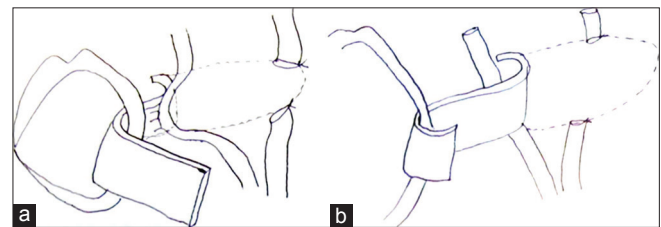


Figure 10: (a) Schematic picture of anteriorly based pedicled buccinator myomucosal flaps. Facial artery is incorporated in the base of the flap. Flap pedicle in between lip commissure and facial artery, (b) Flap pedicle in between facial artery and vein

Table 1: Some pioneer surgeons in buccinator-based myomucosal flaps and the terms that they introduced

Pioneer surgeon	Year	Term introduced	Predominat artery of flap
Bozola	1989	Posteriorly based	Buccal artery
Carstens	1991	Anteriorly based	Facial artery
Pribaz	1992	FAMM flap	Facial artery (Ab)
Zhao	1998	Posteriorly based island	Buccal artery and facial artery (Pb)
		Superiorly based Island	Facial artery (Ab)
Zhao	2003	Inferiorly based Island	Facial artery (Ab + Ib)
Massarelli	2012	Arterialized FAMMIF	Facial artery (Ab + Ib)

Ab: Anterior buccal branch, Pb: Posterior buccal branch, Ib: Inferior buccal branch

Table 2: New classification of buccinator-based myomucosal flaps suggested by literature

New classification	Previous name	Example
Posteriorly based pedicled buccinator flap	Bozola flap	Case 1
Superiorly based pedicled buccinator flap	Superiorly based FAMM flap	Case 2
Superiorly based islanded buccinator flap	Zhao flap (1999)	Case 3
Inferiorly based pedicled buccinator flap	Inferiorly based FAMM flap	Case 4
Inferiorly based islanded buccinator flap	Zhao flap (2003)	Case 5
Random pattern buccinator flap	Musculomucosal buccal flap	Case 6
Anteriorly based pedicled buccinator flap		Case 7
Posteriorly based island Pedicled buccinator flap	Bozola flap	Case 8

facial artery that nourish the buccinator muscle:

Posterior buccal (Pb) that nourish posterior half of the buccinator muscle and anastomose the buccal artery.

Inferior buccal branch (Ib) that nourish inferior part of the buccinator muscle [Figure 1]. Zhao *et al.*, showed that soft tissue around the axial facial vessels can be reduced to a minimal amount. This increases arch of rotation, omits the need for pedicle division, and allows mucosal reconstruction palatal/lingual to the dental arches.

Buccinator-based myomucosal flaps that are axial pattern and are based on facial artery and vein can have superior, inferior, or anterior bases. Nutrient vessels can be skeletonized (island flaps: Zhao modification and arterialized FAMMIF) or considerable soft tissue surround the axial vessels (pedicle flaps: FAMM flap and anteriorly based buccinator flap).

In Table 2, new classifications of buccinator-based myomucosal flaps that are suggested by the authors are given.

Posteriorly based pedicled buccinator flap are based on buccal artery (a branch of maxillary artery); therefore, their usage is not dependent on intact facial artery and vein. Incorporation of Ib (inferior buccal branch) makes its blood supply more predictable. Posteriorly based island pedicled buccinator flap is a variant, in which the mucosa is incised circumferentially and mucosal paddle is separated from the adjacent mucosa, but the flap is attached to the underlying pedicle that supply it via the buccal artery. This modification will increase flap mobility. The flap is islanded on a pedicle of the buccinator muscle. This concept comes from subcutaneous island pedicle skin flaps.^[34,35] Island term in this modification seldom points to skeletonized axial vessel (buccal artery), in contrast with superiorly or inferiorly based buccinator island flaps in which island term points to skeletonized facial artery.

Theoretical basis for superiorly based buccinator myomucosal flaps are based on anastomosis between facial artery and intracranial vessels via angular artery in the lateral side of the nose (reverse flow or retrograde). In 5-10% of patients, such anastomoses are absent.^[36,37]

In inferiorly based buccinator flaps, facial artery and vein should be preserved in neck dissections, so that this flap cannot be used in patients with positive nodes or previous neck dissection. This flap is very similar to the island cheek flap introduced by Sasaki in 1984.^[29]

Floor of the mouth defects and lateral border of the tongue can be repaired with inferiorly based flaps. In dentate

Table 3: Buccinator-based myomucosal pedicled flaps and their pivot points

Buccinator-based myomucosal flap	Pivot point
Posteriorly pedicled	Pterygomandibular raphe
Anteriorly pedicled	Oral commissure
Superiorly pedicled	Alar nose
Inferiorly pedicled	Retromolar trigone

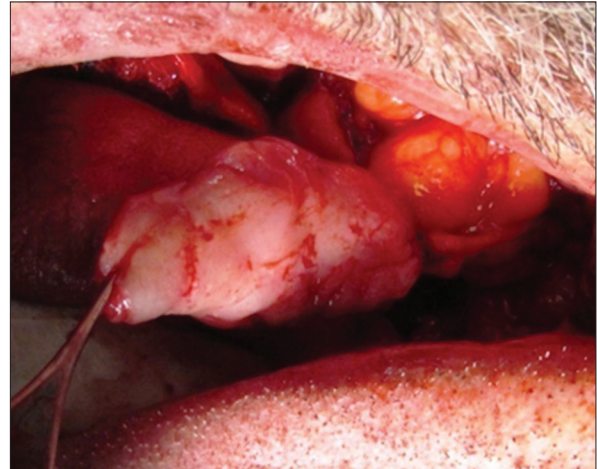


Figure 11: Inferiorly based buccinator myomucosal island flap that is harvested with intraoral incisions. Previous name of this flap was arterialized FAMMIF

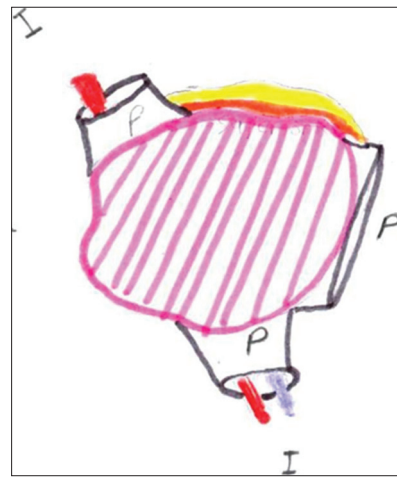


Figure 12: In axial pattern buccinator-based myomucosal flaps, the mucosal paddle is nearly constant. In superior or inferiorly based flaps, the long axis is vertical, but, in posterior or anteriorly based flaps, the long axis is horizontal. Anteriorly based buccinator myomucosal flap is not shown for simplicity. I: Islanded, P: Pedicled. The term island in posteriorly based buccinator myomucosal island flap almost always denote the island of mucosa that is attached to the underlying submucous pedicle which contains an axial vessel (buccal artery) not to skeletonized artery

patients, island modification and extraoral incision for mandibular lower border turnover is necessary. FAMM flap was the previous name for inferior/superiorly based pedicled buccinator myomucosal flaps. Inferiorly based island variant of this flap that is based only on facial artery and can be harvested with intraoral incision is called arterialized FAMMIF [Figure 11].^[14]

Random pattern buccinator flaps rely on abundant

vascular supply of buccinator muscle. Thin layer of buccinator muscle without including axial artery in it can survive if sufficient pedicle width is considered.

In axial pattern buccinator flaps based on facial or buccal artery, the size of mucosal paddle is nearly equal. The only difference is in which side of the paddle (superior, inferior, anterior, or posterior) is the base, pedicled or islanded [Figure 12]. Pivot point for buccinator-based myomucosal pedicled flaps is explained in Table 3. Random pattern buccinator flaps have much less mucosal paddle. Buccal flap term should be used just for cheek flaps, which include only buccal mucosa, and buccinator muscle remains undisturbed.

All modifications of buccinator-based myomucosal flaps can be done with intraoral incisions except some cases of inferior island variant that needs extraoral skin incision. These flaps can be used in reconstructive procedures other than oral cavity such as nasal cavity, orbit, and esophagus and skull base reconstructions.^[23,29,38,39]

Incorporation of facial artery and vein in flap base is ideal for flap survival, but studies have shown that these flaps can survive only if facial artery included in the flap and facial vein is ligated, like in Cases 3 and 7. Flap survival in this situation is explained by rich submucous venous plexus.^[21,40]

CONCLUSION

Several terms (> 10) have been used to refer to buccinator-based myomucosal flaps in the literature. To avoid confusion, we have introduced a new classification system for these flaps based mainly on the remaining attachment of buccinator muscle after flap elevation in pedicle variants and axial blood supply orientation in the island variants. Suggested classifications for these flaps are as follows:

- Posteriorly based buccinator myomucosal flap (pedicled or islanded)
- Superiorly based buccinator myomucosal flap (pedicled or islanded)
- Inferiorly based buccinator myomucosal flap (pedicled or islanded)
- Anteriorly based buccinator myomucosal flap (pedicled)
- Random pattern buccinator myomucosal flap (pedicled).

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