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Oroantral Communication and Fistula: Contemporary Diagnosis, Decision-Making and Multimodal Surgical Management-A Narrative Review

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Abstract
Oroantral communication (OAC) is an abnormal communication between the oral cavity and the maxillary sinus, most frequently encountered after extraction of posterior maxillary teeth and also after implant surgery, dentoalveolar infection, trauma, tumor or cyst surgery, orthognathic procedures and other iatrogenic events. When an OAC persists and becomes epithelialized, it is generally termed an oroantral fistula (OAF). Persistent communication permits passage of saliva, food and microorganisms into the sinus and may result in acute or chronic odontogenic maxillary sinusitis, impaired healing and failure of subsequent implant rehabilitation. The contemporary approach is therefore not simply "close the hole," but to establish a healthy, adequately drained sinus, eliminate the epithelialized tract and diseased tissue, and achieve a stable, tension-free, vascularized closure.

Emphasis is placed on diagnosis, radiographic assessment, timing, sinus infection control, size- and site-based decision-making, and selection among buccal advancement/sliding flaps, pedicled buccal fat pad, palatal rotational flaps, distant flaps, bone grafts, guided tissue regeneration and platelet-rich fibrin. The practical algorithms presented here should be regarded as decision aids rather than rigid size thresholds, because published recommendations vary and tissue quality, sinus disease, location and future prosthetic requirements frequently determine the optimal technique.

Keywords: *oroantral communication; oroantral fistula; maxillary sinusitis; buccal advancement flap; buccal fat pad; palatal rotational flap; guided tissue regeneration; platelet-rich fibrin; oral and maxillofacial surgery.*

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I. Introduction

OAC represents a direct pathway between the oral cavity and maxillary sinus. The posterior maxillary premolars and molars are particularly vulnerable because their roots may be separated from the sinus by only a thin bony lamella. The first molar is repeatedly identified as a common site. The decision-making review emphasizes that management depends on the size of the defect, time of diagnosis, infection, tissue quantity and quality, location, clinician experience and the possibility of future implant placement. [1,2]

An OAF develops when the communication fails to close and becomes lined by epithelium, often with granulation tissue or altered sinus mucosa. The reviews describe epithelialization as an important transition toward chronic fistulation, with one source noting that organization of the tract may occur over approximately 7–8 days. Clinically, however, the practical distinction is more useful as a continuum: an acute communication may still have a realistic chance of spontaneous closure, whereas a persistent epithelialized tract generally requires surgical management. [1–4]

The therapeutic objective is fourfold:
(1) eliminate sinus pathology and establish drainage;
(2) remove epithelialized or infected fistula tissue when indicated;
(3) achieve durable, tension-free closure with healthy vascularized tissue; and
(4) preserve or reconstruct the alveolar anatomy when future implant or prosthetic rehabilitation is planned. [1,5]

II. Definition and terminology

Term	Practical definition	Clinical implication
Oroantral communication (OAC)	An open abnormal communication between the oral cavity and maxillary sinus, usually acute or non-epithelialized.	Early diagnosis may permit conservative care or immediate primary closure.
Oroantral fistula (OAF)	A persistent pathological communication that has become epithelialized/organized.	Usually requires tract management and definitive closure.
Chronic OAF	A persistent epithelialized tract associated with chronic inflammation, sinus disease, or failure of previous closure.	Treat sinus pathology and soft-tissue/bony defect; recurrence risk is higher.

The literature does not use a single universally accepted diameter or time threshold. The uploaded sources variously describe spontaneous healing for very small defects, often <2–3 mm, simple suturing for selected defects below approximately 5 mm, and surgical closure for larger or persistent defects. Therefore, diameter should be used as one component of decision-making rather than as an isolated indication. [1–4]

III. Etiology and risk factors

- Extraction of maxillary posterior teeth, particularly molars, because of intimate root–sinus anatomy.
- Implant placement, implant displacement into the sinus, sinus floor augmentation and related implant complications.
- Dentoalveolar or periapical infection spreading toward the maxillary sinus.
- Removal of odontogenic cysts or benign/malignant tumors.
- Maxillary tuberosity or alveolar fracture and facial trauma.
- Orthognathic/maxillary surgery, including procedures involving the maxillary sinus floor.
- Osteomyelitis, osteoradionecrosis, flap dehiscence and other conditions causing loss of tissue integrity.
- Iatrogenic complications, including sinus surgery and Caldwell–Luc procedures.

Patient-related factors such as diabetes, cardiovascular disease, renal dysfunction, hematological disorders, immunosuppression, smoking, poor oral hygiene and previous radiotherapy can adversely affect infection control or wound healing. The decision-making review specifically highlights systemic disease and the quality of local tissue as determinants of postoperative risk. [1]

IV. Pathophysiology: why an OAC becomes an OAF

The open communication permits oral microorganisms, food debris and fluid to enter the maxillary sinus. Persistent contamination promotes mucosal inflammation, impaired mucociliary function, sinus obstruction and odontogenic maxillary sinusitis. Once the tract becomes epithelialized and surrounded by inflamed or diseased tissue, spontaneous closure becomes increasingly unlikely. [1–4]

The central biological principle is therefore: a fistula should not be closed over an uncontrolled sinus infection. Closure without adequate sinus drainage can trap infection within the antrum and predispose to recurrent fistulation. This principle is repeatedly emphasized in the uploaded decision-making and local-flap reviews. [1,2]

V. Clinical presentation

- Escape of fluids from the mouth into the nose or nasal regurgitation.
- Air passage or whistling through the fistula, especially during nose blowing or pressure changes.
- Unilateral nasal discharge or postnasal exudate.
- Foul or salty taste and halitosis.
- Pain or pressure in the maxillary teeth, alveolus or malar region.
- Altered nasal resonance or voice.
- Reduced smell or taste.
- Visible granulation tissue or antral polyp in a longstanding tract.
- Recurrent or chronic unilateral maxillary sinus symptoms.

Small communications may be clinically silent, particularly when covered by a polyp or granulation tissue. A negative clinical pressure test does not reliably exclude a small communication. [1,2,6]

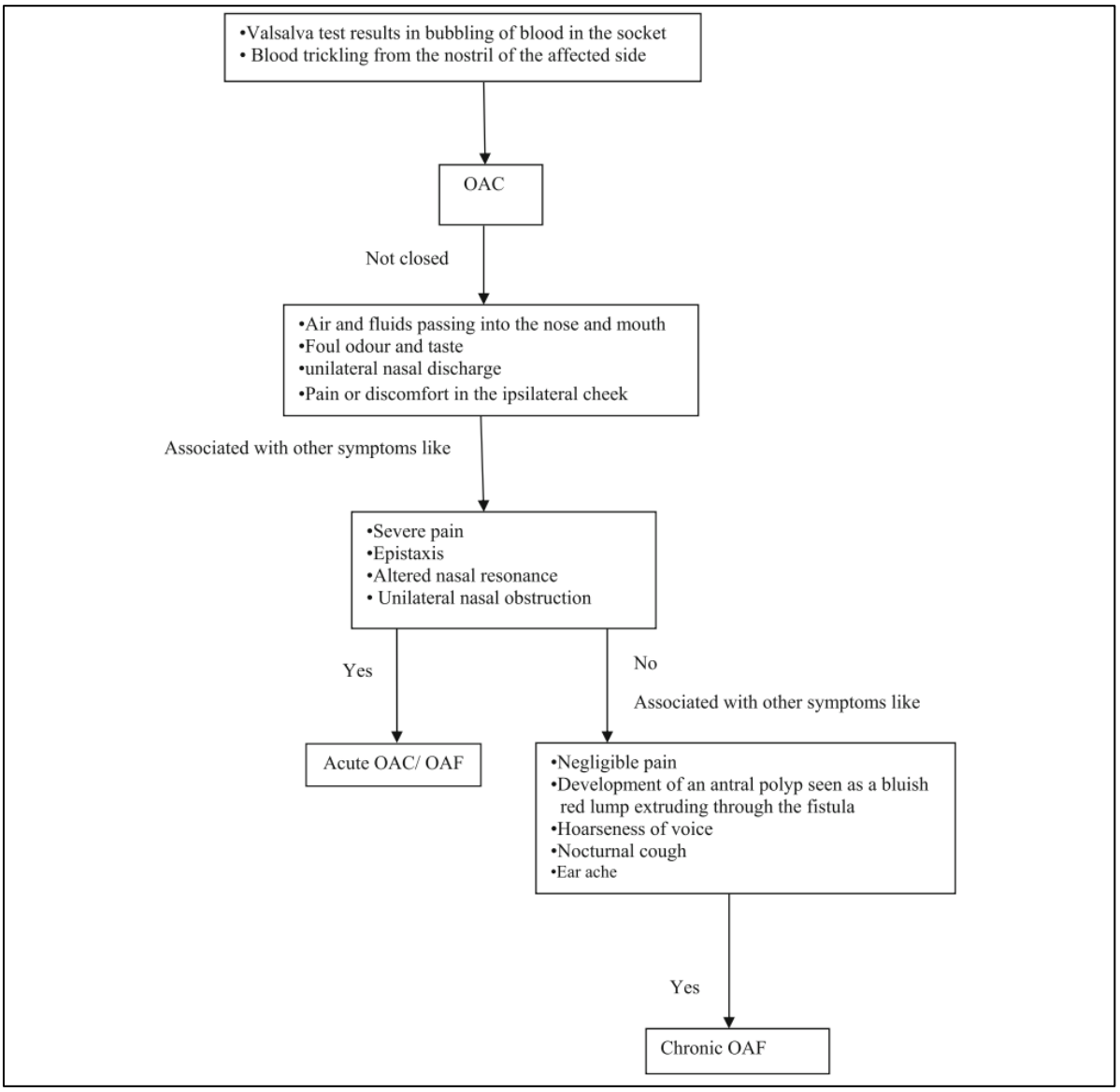


Fig. 1. Illustrates steps of decision-making in symptoms of OAC, OAF, and chronic OAF(1)

VI. Diagnosis and investigations

6.1 Clinical examination

Inspection should determine the location, approximate diameter, tissue quality, presence of granulation tissue, purulence and whether the defect is alveolar, palatal or vestibular. The surrounding mucosa should be assessed for scarring and the availability of tissue for flap mobilization.

The Valsalva maneuver may demonstrate air leakage through the communication. The cheek-blowing test has also been described. Importantly, the decision-making review warns that pressure tests may be falsely negative in small defects and that probing can introduce bacteria, enlarge the defect or injure an intact sinus membrane. Routine aggressive probing is therefore discouraged. [1,2]



Fig. 2 Illustrates steps of decision-making in diagnosis of antral perforation(1)

6.2 Radiographic assessment

Periapical and panoramic radiographs can demonstrate the bony defect, root fragments, displaced foreign bodies and gross sinus changes. Waters' view has historically been used to assess sinus opacification. CBCT is particularly valuable when the anatomy, defect size, sinus status, foreign body, implant position or future implant planning must be defined. [1,2,7]

Investigation	Best use	Key limitations
Periapical radiograph	Local dental anatomy, root fragments, alveolar defect.	Limited assessment of the entire sinus.
Panoramic radiograph	Approximate defect, displaced root/implant, gross sinus opacity.	Two-dimensional distortion; limited soft-tissue detail.
Waters view	Historical assessment of maxillary sinus opacity.	Less detailed than cross-sectional imaging.
CBCT	Defect anatomy, sinus opacification, foreign bodies, implant planning.	Radiation exposure; should be justified and optimized.
Nasal endoscopy/ENT evaluation	Ostiomeatal complex and chronic sinus disease; useful before definitive closure in selected cases.	Requires appropriate expertise; complements rather than replaces dental assessment.

VII. Timing and size: a practical interpretation

Early closure is consistently favored in the uploaded literature because prolonged sinus contamination increases the risk of sinusitis and chronic fistulation. Several sources recommend intervention within approximately 24–48 hours when an acute communication requires closure. Small defects in a healthy sinus may close spontaneously; larger defects, persistent communications and established fistulae generally require active treatment. [1–4]

Clinical situation	Reasonable postgraduate approach
Very small acute OAC; healthy sinus; stable clot; no epithelialization	Protect the clot, avoid pressure changes and observe closely; consider simple closure if the defect is clinically persistent.
Small persistent OAC, generally <3–5 mm, healthy sinus	Simple suturing or a small local flap may be sufficient depending on tissue quality and location.
>5 mm or persistent OAF	Definitive surgical closure is usually favored; choose a vascularized flap according to site and tissue availability.
Large (>10 mm), palatal or difficult-to-access defect	Consider palatal rotational flap, BFP ± mucosal coverage, combined techniques, or more advanced reconstruction.
Sinusitis present	Control sinus disease before definitive closure; acute disease may respond to medical therapy/irrigation, whereas chronic/severe disease may require ESS or Caldwell–Luc/ENT management.

VIII. Principles of surgical management

- Treat the sinus: establish drainage and control acute/chronic sinus infection before definitive closure when necessary.
- Excise the epithelialized fistula tract and nonviable/infected tissue when indicated.
- Prepare a healthy recipient bed with intact bone whenever feasible.
- Select a broad-based, well-vascularized flap with adequate reach.
- Achieve a tension-free closure; tension is a major threat to flap perfusion.
- Use a two-layer closure when additional mechanical protection is advantageous, particularly with BFP.
- Consider future prosthetic or implant rehabilitation before sacrificing vestibular depth or keratinized mucosa.
- Avoid excessive manipulation of the sinus membrane and do not create a new obstruction to physiologic sinus drainage.

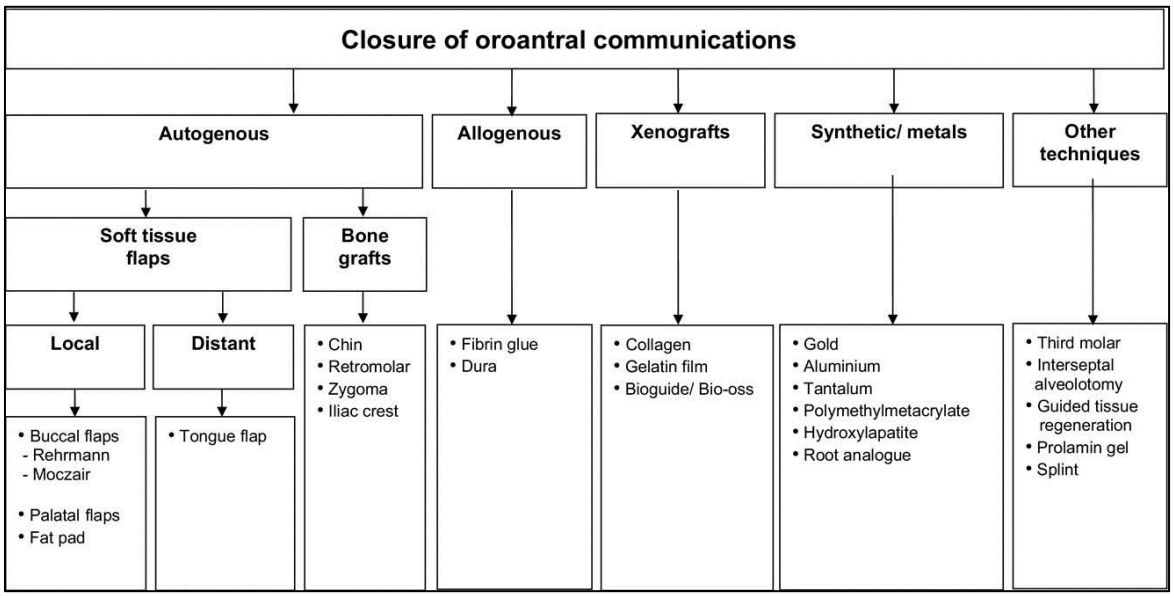


Fig-3: A summary of the treatment options for the oroantral communication(5)

IX. Management of associated maxillary sinusitis

Sinus status is the pivotal branch point in most contemporary algorithms. Acute sinusitis may be managed with appropriate antimicrobial therapy, nasal decongestant measures, analgesia and sinus irrigation according to the clinical situation and local antimicrobial guidance. The Kwon review describes medication plus sinus irrigation for acute disease and recommends ESS or Caldwell–Luc for chronic sinus disease in selected cases. [2]

In chronic or severe sinus disease, closure of the oral defect without addressing the sinus is prone to failure. Collaboration with an otorhinolaryngologist is appropriate when there is ostiomeatal complex disease, extensive mucosal pathology, retained foreign material or persistent infection. [2,6,8]

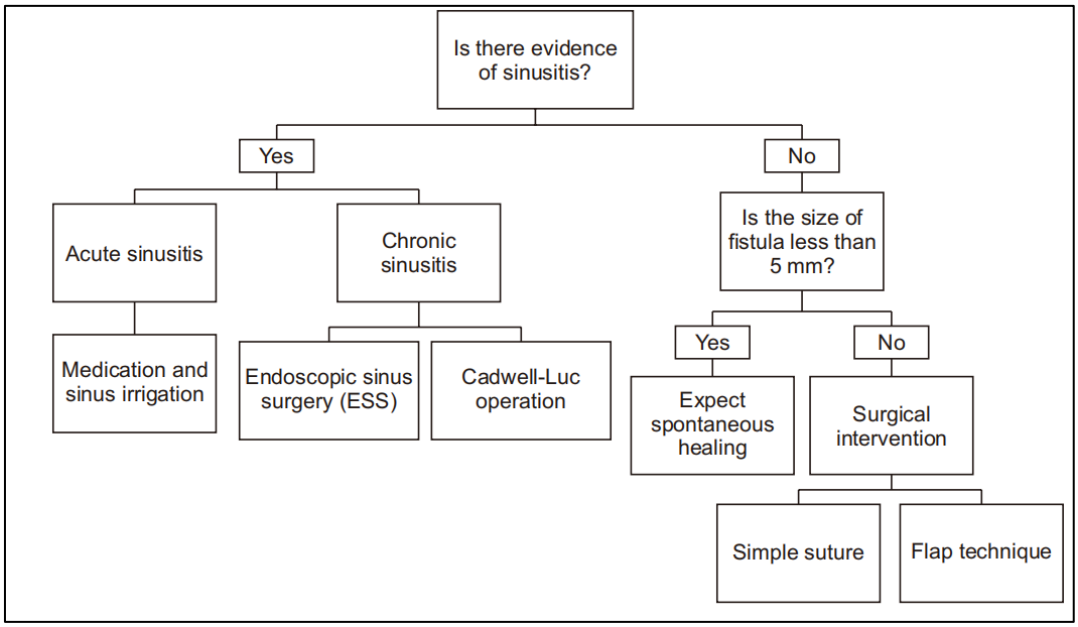


Fig. 4. Approach algorithm for the treatment of oroantral fistula(2)

X. Surgical techniques

10.1 Buccal advancement (Rehrmann) flap

The buccal advancement flap is the oldest and most commonly used local flap technique. Rehrmann described the classic approach in 1936. A broad-based trapezoidal mucoperiosteal flap is raised with vertical releasing incisions, advanced over the defect and sutured to the palatal/recipient tissue. Its proximity to the defect, reliable vascularity and technical simplicity make it an excellent option for many small-to-moderate accessible OAFs. [2,3,9]

Its principal disadvantage is reduction in vestibular depth, which can compromise denture retention and may complicate later implant/prosthetic rehabilitation. Buccal sliding modifications can reduce the effect on vestibular depth but require greater dentogingival mobilization and may increase periodontal morbidity. [2,3]
The classic literature includes Killey and Kay's series of 362 surgically closed OAFs, while later comparative and clinical studies have continued to support the buccal flap as a dependable workhorse technique. [9–11]

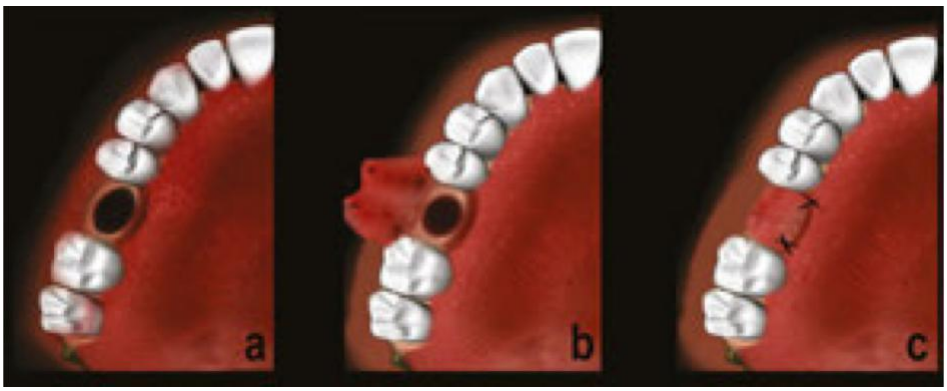


Fig. 5. Demonstration of buccal advanced flap technique [4]

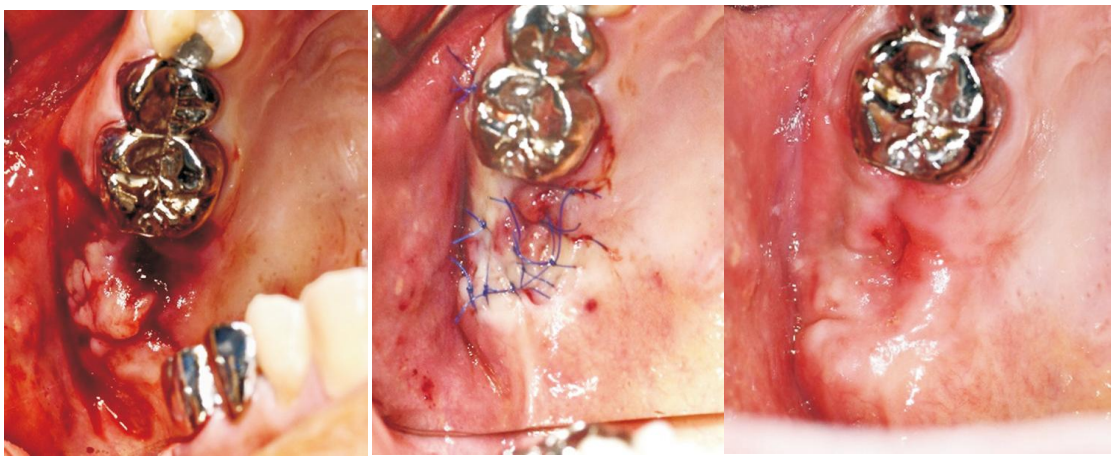


Fig. 6. Clinical example of a buccal sliding flap and healing. Reproduced from the user-provided open-access local-flap review (Kwon et al., 2020), which illustrates flap coverage and healing. □

10.2 Pedicled buccal fat pad (BFP) flap

The BFP is a lobulated, vascularized fat pad with contributions from branches of the maxillary, superficial temporal and facial arterial systems. It can be mobilized through a posterior vestibular/tuberosity approach and advanced into the defect. Its major advantages are excellent vascularity, proximity to posterior maxillary defects, minimal donor-site morbidity and relative preservation of vestibular depth. [3]

Stajcić reported successful use in 56 cases, and subsequent literature has established the BFP as a versatile option for posterior oral defects. The BFP can epithelialize after exposure, but many contemporary techniques cover it with oral mucosa, particularly for larger defects, creating a double-layer closure. [12–15]

Careful handling is essential because excessive traction can compromise the pedicle. Previous head-and-neck radiotherapy may reduce BFP volume and mobility, making alternative tissue or a modified strategy preferable. [3]

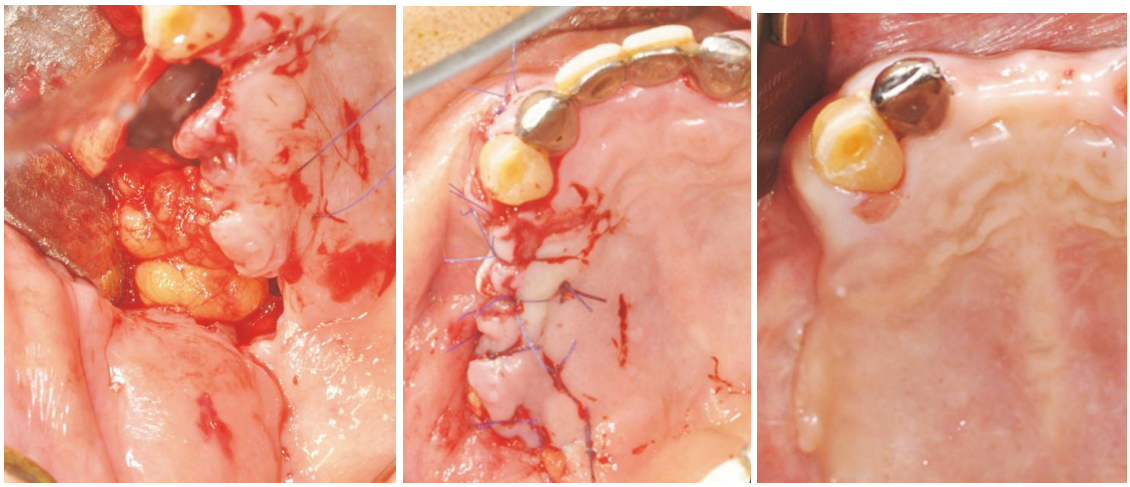


Fig. 7. Pedicled BFP used for closure of a large posterior maxillary defect, with mucosal coverage and subsequent healing. Reproduced from Kwon et al. (2020)

10.3 Palatal rotational flap

The palatal rotational flap is particularly useful when preservation of vestibular depth is important or when the defect is palatal/large. A full-thickness mucoperiosteal flap based on the greater palatine artery provides thick, keratinized, highly vascular tissue. The donor site heals by secondary epithelialization. [3,16,17]

The flap is relatively stiff and its thickness can restrict rotation. Subepithelial dissection in the rotating segment can improve mobility and reduce tension while protecting the greater palatine artery. Published reviews particularly consider palatal rotation for larger defects, including defects >10 mm in selected cases. [2,3]

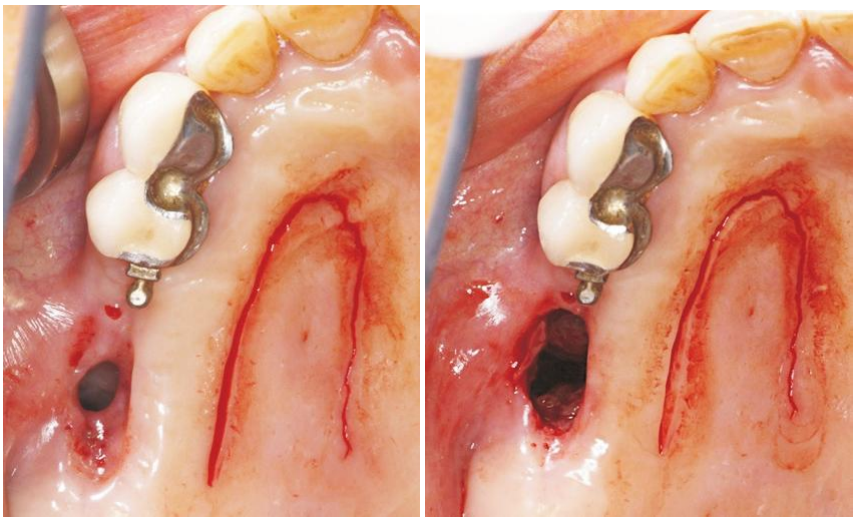


Fig. 8. Palatal rotational flap: excision of the fistula tract, full-thickness harvest including the greater palatine artery, rotation and inset, followed by donor-site healing. Reproduced from Kwon et al. (2020)

10.4 Other local and distant flaps

Other described options include palatal advancement, hinged or island palatal flaps, connective-tissue grafts, tongue flaps, temporalis muscle flaps and other distant reconstructions. These are generally reserved for defects in which conventional local flaps are unavailable, have failed, or cannot provide adequate reach and vascularity. [1–4]

A tongue flap provides robust vascularity and flexibility but usually requires staged surgery and, in many cases, general anesthesia. It is therefore a salvage or selected reconstruction rather than a first-line technique for routine small OAFs. [1,3]

XI. Bone grafts, membranes and biologic materials

Soft-tissue closure alone may restore separation but does not necessarily recreate the alveolar bone lost around a chronic fistula. This becomes important when future implant rehabilitation is planned or when the bony defect is extensive. The Parvini reviews describe autogenous bone grafts, allografts, xenografts, synthetic materials, guided tissue regeneration (GTR), collagen/fibrin materials and PRF as adjunctive or alternative strategies. [1,4]

Autogenous bone may be harvested from intraoral sites or extraoral donor sites depending on defect requirements. Its limitations include donor-site morbidity, resorption and increased operative burden. Membrane-based approaches can be attractive where simultaneous soft- and hard-tissue reconstruction is desired. [4]

PRF has been described as a biologically active membrane/clot that can be used without a separate donor site. The evidence base remains heterogeneous, and it should be considered an adjunct in appropriately selected cases rather than a universal replacement for vascularized flap closure. [4,18]

XII. Flap selection: postgraduate practical guide

Clinical factor	Preferred consideration	Why
Small, accessible alveolar OAF; vestibular depth not critical	Buccal advancement/sliding flap	Simple, nearby tissue; broad vascular base.
Posterior defect; desire to preserve vestibular depth	Pedicled BFP ± mucosal coverage	Excellent reach and vascularity; minimal donor-site morbidity.
Large/palatal defect; keratinized tissue desirable	Palatal rotational flap	Thick, vascular tissue based on greater palatine artery.
Very large defect or failed local flap	Combined flap / distant flap / bone reconstruction	Provides additional tissue or structural support.
Future implant placement	BFP or palatal flap, GTR/bone graft where indicated	Preserves/reconstructs tissue while avoiding unnecessary vestibular loss.
Previous radiotherapy	Individualized plan; consider alternative to BFP if atrophic or poorly mobile	Radiation may compromise tissue quality and vascularity.
Chronic sinusitis	Sinus surgery/ENT management before definitive closure when indicated	Closure should not trap uncontrolled sinus disease.

XIII. Common causes of failure

- Failure to recognize or treat associated sinusitis.
- Closure performed over an infected or poorly drained sinus.
- Inadequate excision of the epithelialized tract or diseased tissue.
- Flap tension, inadequate vascular base or excessive pedicle manipulation.
- Insufficient flap size or poor adaptation to intact recipient tissue.
- Persistent pressure changes from nose blowing, forceful sneezing, smoking or strenuous activity.
- Poor oral hygiene or mechanical trauma to the surgical site.
- Unrecognized foreign body, root fragment or implant within the sinus.
- Poor tissue quality caused by prior radiation, systemic disease or repeated surgery.
- Failure to account for future prosthetic/implant requirements, particularly loss of vestibular depth.

XIV. Postoperative care

- Soft diet and avoidance of direct chewing trauma over the repair.
- Avoid nose blowing and forceful closed-mouth sneezing; sneeze with the mouth open.
- Avoid straws, smoking and activities that markedly increase sinus pressure during early healing.
- Maintain gentle oral hygiene and use prescribed saline rinses when appropriate.
- Use analgesics and other medications according to patient-specific requirements.
- Continue appropriate sinus-directed therapy when indicated.
- Review the wound for flap dehiscence, infection, recurrent nasal regurgitation or persistent air passage.
- Confirm closure clinically before proceeding with definitive implant or prosthetic rehabilitation.

The exact medication regimen should be individualized to the patient's infection status, allergies, renal/hepatic function, local antimicrobial policy and microbiology when available.

XV. Complications

Complication	Likely mechanism	Management principle
Flap dehiscence	Tension, infection, poor vascularity, trauma	Control infection; small defects may granulate, larger failures may need re-closure.
Flap necrosis	Pedicle injury, excessive tension, compromised tissue	Debride nonviable tissue after demarcation; reassess sinus and reconstruct.
Persistent/recurrent OAF	Uncontrolled sinusitis, residual epithelium, inadequate closure	Re-image, treat sinus, revise with a more robust/alternative flap.
Chronic sinusitis	Persistent oral contamination or impaired drainage	ENT/sinus evaluation and definitive sinus treatment.
Reduced vestibular depth	Buccal advancement flap	Plan alternative flap or secondary vestibuloplasty if rehabilitation requires.
BFP necrosis	Excessive traction or inadequate coverage	Meticulous pedicle preservation; mucosal coverage for larger defects.
Palatal donor-site morbidity	Exposed bone, pain, delayed epithelialization	Protect donor site; collagen sponge/palatal splint may be used in selected cases.

XVI. Evidence synthesis and current perspective

The available literature supports the reliability of vascularized local tissue closure but does not establish one universally superior technique. Visscher et al. highlighted the heterogeneity of the evidence, while Parvini et al. emphasized that treatment selection should integrate defect size, time, infection, tissue quality, location and future implant requirements. [1,5]

Clinical studies support the long-standing role of buccal advancement flaps and the BFP. Killey and Kay reported on 362 closures using the buccal flap, while Stajcić reported a 56-case experience with BFP. Yalçın et al. subsequently reported 23 chronic OAFs managed with buccal advancement or palatal island flaps, reinforcing the importance of individualized selection rather than a single universal technique. [9,12,19]

More recent reviews continue to emphasize that closure is a combined oral-sinus problem. The 2021 review by Bhalla, Sun and Dym summarizes contemporary management across soft- and hard-tissue approaches, while clinical reviews continue to stress early treatment and sinus control. [20,21]

XVII. Conclusion

Oroantral communication and fistula remain important complications in dentoalveolar and implant surgery. The most transferable principle for postgraduate practice is that successful closure depends on more

than the size of the opening: sinus health, timing, epithelialization, defect location, tissue quality, flap vascularity, tension, systemic risk and future rehabilitation all matter. Early recognition and appropriate sinus management reduce chronicity. For many small-to-moderate accessible defects, the buccal advancement flap remains a dependable workhorse; the pedicled BFP is particularly valuable for posterior defects and for preserving vestibular depth; and the palatal rotational flap provides thick, vascularized keratinized tissue for larger or palatal defects. Complex or recurrent defects may require combined soft-tissue and bony reconstruction, GTR, PRF or distant flaps.

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