Palatal rotation-advancement flap for delayed repair of oroantral fistula: A retrospective evaluation of 63 cases

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Objective. To review our 17-year clinical experience with delayed oroantral fistula repair by palatal rotation-advancement flap, and to report its advantages, disadvantages, and complications.

Study design. The records of 63 patients with late oroantral fistula treated by palatal rotation-advancement flap from 1984 to 2002 were reviewed. Eleven had undergone unsuccessful closure with a buccal flap. Data recorded were patient age and sex, cause of fistula, signs and symptoms, interval from appearance of fistula to repair, fistula size, radiographic appearance, method of repair, and immediate and late complications.

Results. There were 35 women and 28 men aged 21 to 71 years (mean 50.3 years). Surgery was performed 3 months to 20 years after injury (mean 1.8 years). Twenty-four patients had acute maxillary sinusitis and 39 had chronic sinusitis. The main causes of oroantral fistula were extraction of the second and first molars and pathological lesions within the sinus. Average fistula size was 2.3 cm × 1.6 cm. Fifty-one repairs were preceded by Caldwell-Luc operation. All fistulas were successfully closed with the palatal rotation-advancement flap, with minimal complications on long-term follow-up.

Conclusion. The palatal rotation-advancement flap is recommended for the late repair of oroantral fistula owing to its good vascularization, excellent thickness and tissue bulk, and easy accessibility; it also allows for the maintenance of the vestibular-sulcus depth. It is particularly indicated in cases of unsuccessful buccal flap closure.


Oroantral fistula (OAF) most commonly occurs as a complication of maxillary molar or premolar extraction.1-4 The primary reason is the anatomic proximity of the root apices to the sinus floor or projection of the roots within the maxillary sinus. Other causes of OAF include dentoalveolar infections,4,6 destruction of a portion of the sinus by cysts or benign or malignant tumors,4,7,8 Paget’s disease,9 trauma,10 complication of Caldwell-Luc procedure,11 and dentoalveolar or implant surgery. Oroantral communications (OAC) of less than 2 mm in diameter tend to close spontaneously, whereas those larger than 3 mm or accompanied by inflammation of the sinus, alveolus or, periodontal regions require surgical closure.3,12

Various flaps have been reported in the literature for closure of OAFs. Each has advantages and disadvantages. The aim of the present study was to describe our 17-year clinical experience with the local palatal rotation-advancement flap for delayed repair of OAF and to highlight its advantages, disadvantages, and complications.

PATIENTS AND METHODS

The files of 63 patients with late OAF who were treated by palatal rotation-advancement (R-A) flap at the Department of Oral and Maxillofacial Surgery of Rabin Medical Center between 1984 and 2002 were reviewed. Eleven of the patients were referred from other institutions after failed attempts to close the fistula by buccal flap. All underwent preoperative and postoperative evaluation by one of the authors (a senior surgeon). The data recorded included patient age and sex, etiology of OAF, presenting signs and symptoms, interval from OAF appearance to repair, fistula size, radiographic appearance, method of repair, and short- and long-term complications. Good repair was defined as a complete closure of the OAF without recurrence of the fistula. In all cases, odontogenic and periodontal sources of infection were eliminated by root canal therapy and initial periodontal treatment was administered before surgery.

SURGICAL TECHNIQUE

Acute infections of the maxillary sinus were treated preoperatively with amoxicillin/clavulanate 1 × 3 g/d IV combined with antral irrigations with chlorhexidine gluconate 0.2% × 3/d through the fistula to drain pus
and mucus (Figs 1 and 2). If passage to the sinus was insufficient, the fistulous tract was enlarged by excision of the epithelial and granulomatous tissue. A Waters view radiograph was taken 1-2 weeks later to monitor progress.

The full-thickness mucoperiosteal palatal R-A flap is designed on the basis of the greater palatine vessels (Fig 3 A,B). The anterior extension of the flap is determined by measuring the distance of the arc of flap rotation, ie, the distance from the greater palatine foramen to the lateral-anterior bony fistular border. About 1-cm length of additional flap is taken to achieve tension-free closure of the fistula on the buccal bony base. The width of the flap is determined by the bony defect and angle of rotation. The medial border of the flap is 2-3 mm lateral to the mid-palatal raphe. At the lateral border, a strip of about 5 mm of palatal marginal gingiva beside the teeth is left in order to avoid periodontal damage. The ratio of flap length to width is 1.5-2.0:1.0. The alveolar bone is smoothed, and the palatal R-A flap is rotated, advanced, and sutured to the buccal tissue with vertical and simple mattress vicryl 3-0 or silk sutures (Fig 4).

In cases of maxillary sinus pathology, a Caldwell-Luc operation (CLO) is performed, which includes sinus polyposis excision and inferior meatal nasal antrostomy. The sinus is then packed with a balloon of Foley (Bard Limited, UK) urethral catheter, which is inflated with minimal pressure on the sinus walls. The balloon is removed after 3 days, and Coe-Pack (GC America, Alsip, Ill) periodontal dressing is applied to the exposed palatal bony donor site for about a week.

All our patients who underwent a CLO received intraoperative and postoperative antimicrobial treatment with amoxicillin/clavulanate, 1 × 3 g/d IV for 5 days, and 875 mg × 2/d po for 5 more days. The other patients received ampicillin 1 g IV intraoperatively and amoxicillin 0.5 × 3 g/d po for 7 days. Postoperatively, patients applied nasal drops containing phenylephrine HCl and chlorhexidine gluconate 0.2% for 2 weeks, together with saline mouth rinses. Nonsteroidal antiinflammatory drugs (NSAIDS) were prescribed for pain control. Soft diet restrictions were advised.

**RESULTS**

**Background data**

The study group consisted of 35 (55.6%) women and 28 (44.4%) men aged 21 to 71 years (mean 50.3 years). Nine patients had hypertension, 7 diabetes mellitus, 3 hypertension and diabetes mellitus concomitantly, 5 cardiopathy, 2 asthma, 1 psoriasis, 1 rheumatoid arthritis, and 1 familial Mediterranean fever. In addition, 1 patient was after a cerebrovascular accident and 1 patient was immunocompromised, with a history of drug addiction and hepatitis. The interval from fistula development to repair was 3 months to 20 years (mean 1.8 years).
Clinical presentation

Twenty-four patients presented with acute maxillary sinusitis and 39 had chronic sinusitis. Symptoms of acute sinusitis included fever, fatigue and malaise, facial swelling, and pain that increased upon bending forward. Five patients with acute sinusitis also had swelling of the periorbital tissues, and all 24 had a purulent yellow-to-green discharge from the fistula; 1 patient had symptoms of ethmoidal, frontal, and sphenoid sinusitis, including headaches and infraorbital anesthesia. Various symptoms of chronic sinusitis included postnasal drainage of the secretions causing pooling and coughing, nausea, popping of the ears, muffled hearing, nasal congestion and halitosis, referred pain to the upper teeth, and reduced senses of taste and smell.

Etiology

Tooth extraction or residual root in the sinus was the most frequent cause of OAF (n = 54, 85.7%; Fig 5). The involved tooth was either the second molar (n = 28, 44.4%) or the first molar (n = 25, 39.7%); only in 1 patient (1.6%) was the first premolar extracted. Other causes were pathological lesions within the sinus—either odontogenic cysts (n = 5, 7.9%) or central odontogenic fibroma (n = 1, 1.6%)—and dental implants that were pushed into the sinus (n = 2, 3.2%). In 1 patient (1.6%), OAF developed after removal of a blade implant.

Fistula size

Fistula width ranged from 0.3 to 2.0 cm, and length from 0.3 to 4.0 cm (mean 1.6 cm × 2.3 cm). In 1 patient after second molar extraction in the presence of an odontogenic cyst in the maxillary sinus, the soft tissue defect measured 2.0 cm × 4.0 cm. Surgical inspection revealed that, in many cases, the actual bony defect was larger than the soft tissue fistula.

Imaging

Panoramic and Waters view radiographs were taken preoperatively and, in some cases, computed tomography was also performed to determine antral pathology, such as inflammatory polyposis or granulations and tumors, and the presence or location of dental roots or implants that may have been pushed into the antrum. Total cloudiness and opacification of the maxillary sinus was observed in 49 (77.8%) patients.
Treatment
Fifty-one repairs (81%, all 39 patients with chronic sinusitis and 12 with initial acute sinusitis) were treated by palatal R-A flap and CLO, and 12 (19%) by palatal R-A flap only (Table 1). Good repair was noted in all cases, with no long-term loss of vitality of the palatal flap or recurrence of the fistula. There was no diminution in vestibular sulcus height or need for secondary preprosthetic surgery (Fig 6).

Complications
Epithelialization of the palatal bone donor site was completed after 3-4 weeks, with minimal discomfort. After healing, 59 (93.7%) patients showed no alteration in anatomy and only a minimal color change in the local palatal mucosa; in the other 4 (6.3%), bulging of the palatal flap region was noted at the 1-year follow-up. Five (7.9%) patients, all with acute sinusitis, had fluid and air leakage from beneath the medial side of the palatal flap, which stopped spontaneously within 1-2 months; in 3 (4.8%) patients, the lower teeth impinged on the flap necessitating lower crown height reduction (Table II). Two patients who underwent a CLO developed acute sinusitis at 4 months and 5 months after surgery, which was treated successfully with irrigation through the nasal antrostomy and antibiotics. In these patients, there was no fluid or air leakage after surgery. In 1 (1.6%) patient, severe primary herpes simplex infection of the perioral dermal region and lips and palate developed 10 days after surgery and was treated successfully with IV acyclovir 400 mg × 3/d for 7 days.

One patient reported infraorbital anesthesia preoperatively, which was found to be due to acute sinusitis. Sensation completely recovered 2 months after CLO with OAF closure. Two patients complained of infraorbital neuropathy postoperatively, most probably due to aggressive stripping of the antral mucosa of the orbital floor or excessive trauma from pressure or traction on the infraorbital nerve at surgery. In the first patient, the symptoms disappeared spontaneously 4 weeks after surgery. The second patient was treated with local injections of bupivacaine 0.5% 2 cc twice weekly for 3 weeks and carbamazepine tabs 300 mg daily for 6 months. The symptoms subsided gradually, with complete recovery at the 3-year follow-up.

DISCUSSION
The most common methods used today for closure of OAF are buccal and palatal flaps. The classic buccal mucoperiosteal flap was originally described in the 1930s in the European medical literature by Rehr-
The buccinator myomucosal vascularized tissue, such as the temporal parietal fascia, has been described. Although lauded for their ease of performance and good blood supply, buccal flaps require careful manipulation, as they may be very thin, and they need periosteal incisions at their base to improve mobility. When there is scarring from previous operations in the areas where the flap has to be raised, mobility may be impaired and healing poor. The flap may also result in a very shallow vestibular sulcus, which can interfere with prostodontic rehabilitation and maintenance of oral hygiene.

To overcome these obstacles, Moczair and Haan-aes and Pedersen shifted the flap 1 tooth distally, leaving the donor site for secondary epithelialization. However, this technique necessitated a great amount of gingival detachment and did not completely resolve the vestibular reduction, and it was therefore limited to edentulous patients.

Schuchardt used a transversal flap in edentulous patients, but again, flap mobility was limited. The pedicled buccal fat pad, introduced in 1977 by Egyedi for closure of oroantral and oronasal communications, has lately gained popularity because of its rich blood supply from the maxillary, superficial temporal, and facial arteries, quick epithelialization, and high success rate. However, it tends to undergo variable degrees of partial necrosis, fibrosis, shrinkage, retraction, and distortion, with fistular recurrences and some reduction of the vestibular sulcus depth. Flaps employing other vascularized tissue, such as the temporal parietal fascia flap, the buccinator myomucosal flap, and the buccinator myomucosal island pedicle flap, have also been described.

The palatal flap is an axial flap. It receives its blood supply from the greater palatine artery, which passes from the greater palatine foramen at the level of the second molars anteriorly to the ipsilateral palatal mucoperiosteum to the border of the premaxilla, ie, between the first premolar and the canine. The terminal branches of the greater palatine artery pass anteriorly upward through the incisive foramen to anastomose with the nasopalatine branch of the sphenopalatine artery. These anastomosing branches allow for extension of the flap, if necessary, to the incisive foramen.

Various methods of palatal flap harvesting have been reported. Palatal flaps can be classified by thickness, namely, mucoperiosteal or connective tissue flap, or by the direction of movement, namely, straight-advancement flap, rotation-advancement flap, pedicled island flap, anteriorly based flap (which serves as a lateral transposition flap for the closure of large defects at the tuberosity area), submucosal connective tissue pedicle flap, and submucosal island flap. Some authors have tried combined buccal-palatal flaps for larger defects. These techniques are effective, but they require 2 donor sites, with an increase in denuded surface area and a decrease in the vestibular sulcus.

Distant flaps and anteriorly or posteriorly based lateral tongue flaps have been found difficult to use due to problems with tissue transport, fixation, and bulk. Other studies describe grafting with cancellous bone or with alloplastic materials such as gold foil (which prolonged healing), polymethylmetacrylate (which increased risk of infection), Tissucol lyophilized fibrin glue (which ran the risk of transmitting serum-related diseases), and hydroxyapatite. Guided tissue regeneration using absorbable gelatine membrane has also been reported.

Some authors claim that buccal flap techniques are preferable for closure of small and immediate OAC, and palatal flaps are better for large bony defects or long-standing OAFs. Ashley recommended palatal flaps to close OAFs, and Herbert suggested the palatal mucoperiosteum as the tissue of choice for large fistulas.

When the fistula appears buccally in the depth of the vestibule or in dentulous patients in whom the fistula developed during surgical extractions and the buccal flap was already raised, it is easier to pass a buccal rather than a palatal flap over the defect between the neighboring teeth. The patients will not require denture reconstruction or suffer loss of vestibular depth due to the mobilization and advancement of the flap.

As the variable success rate of the buccal flap is due to its failure to provide a bony base, we believe that when used for OAF closure, the flap margins should be supported by underlying bone, without any tension.

In our study, the palatal R-A flap was used for late closure (mean 1.8 years) of OAFs in 63 patients. The flap was selected for its thickness and width, which make it adaptable for the masticatory mucosa, and its abundant blood supply from the greater palatine vessels. It is also easily accessible, mobile, versatile, and

Table II. Immediate and late complications

<table>
<thead>
<tr>
<th>Complications</th>
<th>Palatal R-A flap with CLO, n (%)</th>
<th>Palatal R-A flap only, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air and fluid escape</td>
<td>3 (4.8)</td>
<td>2 (3.2)</td>
</tr>
<tr>
<td>Infraorbital sensory disturbance</td>
<td>3 (4.8)</td>
<td></td>
</tr>
<tr>
<td>Teeth impingement on the flap</td>
<td>11(1.6)</td>
<td>2 (3.2)</td>
</tr>
<tr>
<td>Severe herpes simplex infection</td>
<td>1 (1.6)</td>
<td></td>
</tr>
<tr>
<td>Late</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulging of the flap</td>
<td>3 (4.8)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Late acute sinusitis</td>
<td>2 (3.2)</td>
<td></td>
</tr>
</tbody>
</table>

R-A = rotation-advancement

Anavi et al
elastic; can be rotated without tension; and allows for the preservation of the maxillary vestibular sulcus depth. The technique was successful in all cases. Epithelialization of the palate was excellent, with no necrosis or folding of the palatal mucosa.

The palatal R-A flap is known to have 2 potential drawbacks. First, tissue bunching can occur at the base and rotation of the flap, sometimes causing kinking or “dog-ear,” which may compromise the vascular supply, predispose the patient to venous congestion, and impair closure at the most distal part of the flap. Kruger suggested that a V-shaped section excision be made at the area of the greatest bend of the flap to prevent folding and wrinkling.

There is also a possibility of liquid passage beneath and alongside the flap, especially at the palatal region, because the flap cannot be compressed against the bone. We encountered only the latter problem and only in 5 patients, in whom it resolved spontaneously with time. We therefore believe that there is no need for a palatal split to adapt the mucosal upper layer to the palatal bone, as suggested by Yamazaki et al., as it could compromise the vascular supply of the flap.

CLO is the classic recommended surgery in cases of chronic maxillary sinusitis with OAF. CLO and removal of the inflammatory tissue, including the sinus mucosa, are necessary when the mucosa is irreversibly diseased and mucociliary function has been lost. These patients are poor candidates for endoscopic surgery, which precludes stripping of the diseased mucosa. The use of endoscopic middle meatus antrostomy with CLO, a procedure termed “anterior antrostomy with natural ostium fenestration,” remains controversial. This approach may conserve mucociliary function through the ostium, which exists even after inferior antrostomy. However, Ballenger and Snow advocated the formation of inferior turbinate nasoantral windows at the time of OAF repair to prevent a recurrence of the maxillary sinusitis that could cause a breakdown of the flap.

Primary closure of OAFs within 48 hours is associated with success rates of 90%-95%, whereas the success rate for late secondary closure is reportedly 67%. The most common cause of failure is insufficient control of maxillary sinusitis, followed by thickness, immobility, and poor vascularity of the scarred tissue; insufficient length or width of the flap causing extensive tension and impaired blood supply; and inadequate trimming of the traumatized flap. All the patients in the present study presented with a delayed OAF, which fostered the development of acute and chronic maxillary sinusitis. Most required early fistula enlargement to facilitate irrigation, followed by CLO. The antral necrotic bone, granulomatous soft tissue and polyps, pathological lesions, roots, and implants were completely removed, and the epithelium bridging the defect from the oral cavity to the maxillary sinus was debrided. Nasal antrostomy and packing the sinus with a Foley catheter were performed in order to prevent bleeding and hematoma formation and secondary infections within the sinus. Foley catheter balloon was used, and not gauze packing, because the gauze absorbs blood and tends to harden and is more painful at removal. An additional advantage of the Foley catheter balloon is the easy control of balloon inflation, which prevents excessive pressure on the infraorbital nerve and subsequent postoperative neuropathies.

With the use of the appropriate treatment protocol and meticulous surgery (with CLO when indicated), all OAFs closed, at the most, after 2 months. Outcome was not affected by patient age or sex, etiology of the OAF, interval from OAF appearance to repair, fistula size, or radiological appearance.

Immediate air and fluid escape did not affect the long-term closure of the OAF, though it caused some short-term inconvenience to the patients. We assume that in those patients where the palatal vault is high, the medial adherence of the flap to the bone may be more difficult and the healing time prolonged. No study of the relationship of the height of the palatal vault to the short- or long-term repair of OAF has been conducted to date.

Post-CLO infraorbital sensory disturbances may be avoided by cautious stripping of the antral mucosa of the orbital floor and gentle retraction of the overlying tissues during surgery. However, other postoperative complications, such as teeth impingement on the flaps, viral infection, and bulging of the flap seem to be unavoidable. The 2 patients who developed late sinusitis were from the CLO group and neither had immediate air or fluid escape. We could not determine the reason for this late complication.

In our series, 10 patients had diabetes mellitus, which causes microangiopathy. The R-A palatal flap was successful in all these patients, probably owing to the excellent axial blood supply of the flap.

On the basis of our experience, we also recommend using the palatal R-A flap for closure of secondary OAFs in cases of long-standing sinus disease and when a Caldwell-Luc procedure with nasal antrostomy is necessary. It is particularly indicated after unsuccessful attempts to close an OAF by a buccal flap. It is also recommended for large OAFs that develop during extraction and for OAFs located in the third molar region, when coverage of the osseous oroantral defect is necessary. During this procedure, the buccal mucosa is also elevated to some extent to facilitate suturing of the flap.
However, it is not useful for large alveolar defects created by ablation of large, benign, or malignant tumors, or significant maxillofacial trauma caused, for example, from gunshot wounds.

The problem of adequate tension-free tissue coverage becomes more significant with an increase in the size of the defect. In agreement with other studies, we found that the osseous defect surrounding the fistula was always much larger than the clinically apparent tissue deformity.

In conclusion, the palatal R-A flap is an excellent technique for closure of delayed OAFs created by extractions or failed dental implants in the alveolar ridge and the maxillary vestibule, as it can be well placed in the specified position without tension. The mucosa in the buccal site of the alveolar crest can be maintained as attached gingiva at an appropriate height, without obliteration of the vestibule.

REFERENCES


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