Surgical Management of Oroantral Fistula: Locoregional Flaps and Evaluation of Closure Outcomes

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Abstract

Aim: To evaluate surgical techniques used for oroantral fistula (OAF) repair in an otolaryngology setting and to assess closure success in relation to etiologic, demographic, and operative factors.

Methods: This retrospective cohort study included patients who underwent surgical repair of OAF at a tertiary otolaryngology unit between 2007 and 2024. Clinical records were reviewed for demographic, etiologic, and operative variables and OAF closure success. A significance threshold of p< .05 was applied for group comparisons.

Results: Thirty-six patients underwent 40 OAF repair procedures. Odontogenic causes accounted for 77.5% of cases, whereas tumor-related etiologies represented 17.5%. Concomitant maxillary sinusitis treated with simultaneous functional endoscopic sinus surgery (FESS) was present in 42.5% of cases. Overall, successful closure was achieved in 35 of 40 procedures (87.5%), including three of five initial failures after revision surgery. Among procedures using a single flap, buccal advancement and palatal flaps yielded similar success rates (80.0% vs 93.8%; p=.333). Success rates did not differ between single and combined flap techniques (89.3% vs 83.3%; p=1.000), between procedures with and without grafts (90.0% vs 86.7%; p=1.000), or between cases managed with or without FESS (82.4% vs 91.3%; p=.634). Age, sex, and smoking were not associated with closure failure.

Conclusions: OAF repair in an otolaryngology setting achieved high success rates. When sinus disease is controlled and flap selection is tailored to defect characteristics and patient factors, both buccal and palatal approaches provide reliable closure. These findings support multidisciplinary management and close collaboration between dental clinicians and otolaryngologists.

Keywords: *oroantral fistula; buccal flap; palatal flap; buccal fat pad; maxillary sinusitis*

1. Introduction

An oroantral communication (OAC) is a pathological condition characterized by the development of an abnormal passage between the oral cavity and the maxillary sinus. Prompt management within 24 to 48 hours is advised to prevent the development of sinusitis and maximize closure success.[1] Failure of spontaneous or treatment-induced closure may result in an oroantral fistula (OAF), characterized by tract epithelialization and substantially lower closure success rates compared with acute OAC repair.[2] Although OAFs usually occur following extraction of maxillary molar teeth, they may also arise due to maxillofacial trauma, odontogenic cysts or tumors; iatrogenic injuries during endoscopic sinus surgery or Caldwell-Luc procedures, and chronic infections such as osteomyelitis.[3-5]

Patients with OAF may present with symptoms such as purulent discharge from the nasal cavity into the mouth, escape of fluid or air into the nose, halitosis, loss of smell or taste, or changes in phonation.[5,6] If an OAC is left untreated, symptoms may worsen rapidly, with sinusitis developing in about 50% of cases within days and up to 90% within two weeks.[7]

Previous studies indicate that oroantral defects smaller than 3–5 mm may heal spontaneously, whereas those larger than 5 mm usually necessitate surgical repair.[8,9] Various surgical techniques have been described for the repair of OAF, including primary closure, local advancement and rotational flaps, or combined approaches. Many factors such as location and size of the fistula, anatomical changes due to the underlying etiology, and the surgeon's experience help decide on the appropriate surgical approach.[10]

In this study, we aimed to evaluate the surgical techniques used in the repair of OAF and assess their success rates, in light of demographic and etiologic factors.

2. Materials and Methods

A single-center retrospective cohort study was conducted. This study was approved by the Clinical Research Ethics Committee of Istanbul University, Istanbul Faculty of Medicine (Approval No: 2025/654). Patients who underwent surgical repair for an OAF at

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our tertiary-level hospital between 2007 and 2024 were included. Inclusion criteria were a diagnosis of OAF based on clinical evaluation and, when necessary, radiological imaging; surgery performed at our hospital; and a minimum postoperative follow-up period of 6 months. Two patients were excluded from the study; one patient with an iatrogenic OAC which was repaired during the same operation, and another patient whose data could not be fully obtained from the medical records.

Electronic medical records and surgical notes were reviewed to collect data on patient age, sex, type of anesthesia (general or local), smoking history, whether the repair was primary or revision surgery, etiology of OAF, repair method used (primary closure or locoregional flap), the type of flap applied, whether functional endoscopic sinus surgery (FESS) including maxillary antrostomy was performed intraoperatively, the side and localization of the fistula, the success status of the repair, and the duration of postoperative follow-up.

The diagnosis of OAF was established through clinical findings—including air or blood leakage on the Valsalva maneuver, physical examination, and endoscopic assessments supported by patient history, symptoms, and radiologic imaging (panoramic X-ray or computed tomography).

In all cases, the OAF tract was excised completely and the mucosa around the OAF was freshened to induce epithelial regrowth. Primary closure or locoregional flap techniques were selected depending on the size and localization of the defect. The flap techniques were buccal advancement flap (BAF), palatal advancement / rotation flap, combined use of BAF and buccal fat pad (BFP), and combined use of BAF and palatal flap (PF).

The BAF technique involves making two vertical incisions adjacent to fistula margins, elevating the flap in the subperiosteal plane, advancing it over the fistula and suturing it to the defect margins. The PF consists of elevating a posterior-based mucoperiosteal flap supplied by the greater palatine artery, from the hard palate, advancing and/or rotating it to cover the defect, and securing it with sutures. The BFP technique involves accessing the fat pad through a mucosal incision, mobilizing it via blunt dissection, and then positioning it over the fistula.

Use of cartilage or bone grafts may be required in large defects, and these were used to reconstruct the sinus floor prior to repair with flap techniques. Cartilage grafts were harvested from the nasal septum or the auricle, and bone grafts were obtained from the hard palate. Endoscopic maxillary antrostomy was performed for chronic maxillary sinusitis for sinus clearance and drainage, or for removal of foreign bodies, such as displaced tooth roots, dental implants or filling materials. Routine postoperative examinations were conducted at the 1st week, 1st month, and 3rd month, followed by additional follow-up visits extending to at least 9 months. Treatment success was defined as the absence of an OAC on clinical examination and the absence of any symptoms related to OAF during routine postoperative visits and self-referral visits.

2.1. Statistical Analysis

All statistical analyses were performed using SPSS Statistics for Windows, version 30.0 (IBM Corp., Armonk, NY, USA). The Shapiro–Wilk test and Q–Q plots were used to assess the normality of continuous variables. Data were reported as mean ± standard deviation (SD) or median (interquartile range [IQR]), depending on the distribution. Between-group comparisons were conducted using the Student's t-test or the Mann–Whitney U test, according to data normality. Categorical variables were presented as counts (percentages) and compared using the chi-square test or Fisher's exact test when appropriate. A p-value < .05 was considered statistically significant.

3. Results

In total, 36 patients with OAF were included. Because three patients required a second operation due to persistent fistula and one patient underwent bilateral repair in the same operation following bilateral tooth extraction, a total of 40 surgical procedures were performed for OAF repair. Among smokers, the mean pack-year was 20.6 ± 15.3. Patient demographics are summarized in Table 1.

Table 1

Demographics

Number of patients, n		36
Sex, n (%)		
	Male	24 (66.7)
	Female	12 (33.3)
Age, mean (SD) [min-max]		42.3 (14.8) [16-73]
Smoking, n (%)		
	Yes	11 (30.6)
	No	25 (69.4)
Follow-up, median (IQR) [min-max], months		58.5 (29-87.5) [9-104]

Abbreviations: IQR, interquartile range; SD, standard deviation.

Among the odontogenic etiologies, 24 fistulas developed after tooth extraction, 5 were associated with odontogenic cysts, and 2 occurred following dental implant surgery. In the tumor group, the underlying maxillary lesions included 2 squamous cell carcinomas, 2 ameloblastomas, 1 osteoma, and 2 tumors for which the exact histopathological diagnosis could not be retrieved from the medical records. The remaining etiologies consisted of 1 spontaneous OAF and 1 case secondary to medication-related maxillary osteonecrosis.

Overall, OAF closure was achieved in 35 of 40 procedures (87.5%). Operative characteristics and closure outcomes are presented in Table 2. Closure success was 71.4% for tumor-related etiologies and 90.9% for non-tumor etiologies; however, this difference was not statistically significant (p = .204). Among the cases treated exclusively with BAF or PF, closure success did not differ significantly between the two flaps (80.0% vs. 93.8%; p = .333). When flap techniques were dichotomized as single advancement flaps versus combined flaps, closure success did not differ between groups (89.3% vs. 83.3%; p = 1.000). Closure success did not differ between procedures performed with versus without cartilage or bone grafts (90.0% vs. 86.7%; p = 1.000). Donor site (septal vs. auricular or palatal) also showed no significant difference in closure outcomes (83.3% vs. 100.0%; p = 1.000). In addition, performing a concomitant FESS did not significantly influence closure success (82.4% vs. 91.3%; p = .634).

Comparisons between patients with successful and unsuccessful closure showed no significant associations for sex, age, or smoking status (p = .627, .146, and 1.000, respectively).

Five patients (13.9%) experienced unsuccessful fistula closure after the primary operation. Their individual demographic and operative characteristics, along with details of the subsequent revision procedures in 3 cases, are summarized in Table 3. Successful OAF closure was achieved after revision surgery in these 3 cases.

Table 2

Operative Characteristics and Closure Outcomes

Parameters		n (%)	Closure Success (%)	*p*
Number of surgeries		40	87.5	
Etiology[a]				.204
	Odontogenic	31 (77.5)	90.3	
	Tumor	7 (17.5)	71.4	
	Others	2 (5.0)	100.0	
Side				1.000
	Right	19 (47.5)	89.5	
	Left	21 (52.5)	85.7	
Anatomic localization[b]				.427
	Posterior	36 (90.0)	88.9	
	Anterior	4 (10.0)	75.0	
Type of anesthesia				.237
	General anesthesia	38 (95.0)	89.5	
	Local anesthesia	2 (5.0)	50.0	
Type of surgery				1.000
	Primary	36 (90.0)	86.1	
	Revision	4 (10.0)	100.0	
Closure method				1.000
	Primary closure	6 (15.0)	83.3	
	Flap closure	34 (85.0)	88.2	
Flap type[c]				.559
	BAF	12 (35.3)	83.3	
	PF	16 (47.1)	93.8	
	BAF + PF	3 (8.8)	100.0	
	BFP + BAF	3 (8.8)	66.7	
Cartilage / bone graft				1.000
	No	30 (75.0)	86.7	
	Yes	10 (25.0)	90.0	
Cartilage / bone donor site[d]				1.000
	Septal	6 (60.0)	83.3	
	Auricular	2 (20.0)	100.0	
	Palatal	2 (20.0)	100.0	
Concomitant endoscopic antrostomy				.634
	No	23 (57.5)	91.3	
	Yes	17 (42.5)	82.4	

Abbreviations: BAF, buccal advancement flap; BFP, buccal fat pad; PF, palatal flap. ***a*** *Comparison between tumor and nontumor etiologies; Fisher's exact test.* ***b*** *Posterior localization refers to fistulas located in the premolar–molar region (2 in the first premolar, 5 in the second premolar, 9 in the first molar, 15 in the second molar, 1 in the third molar, and 4 extending across the premolar–molar area), whereas anterior localization refers to those in the canine–incisor region (3 in the canine region and 1 in the lateral incisor region).* ***c*** *Percentages for flap type are calculated among the 34 procedures in which a flap technique was used. Comparison between single advancement flaps and combined flaps; Fisher's exact test.* ***d*** *Percentages for graft donor site are calculated only for procedures in which a graft was used. Comparison between septal and other donor sites; Fisher's exact test.*

Table 3

Characteristics of Patients with Unsuccessful Fistula Closure and Their Revision Surgeries

Patient no.	Sex / Age	Smoking (p/y)	Etiology	Side / Localization	Anesthesia	Surgery	FESS	Follow-up (mo)
1	♂ / 44	+ (25)	IS	R / M2	GA	BAF (+SC)	+	12[a]
2	♂ / 62	+ (25)	Tm	L / P1	GA	BAF	-	1[a]
3	♂ / 72	-	Tm	R / C	LA	PC	-	8[a]
4	♀ / 26	-	TE	L / P1	GA	BFP + BAF	+	95
5	♀ / 64	-	TE	L / M2	GA	PF	+	88
Revision surgeries								
1					GA	PF	-	80
2					GA	PF	-	56
3					LA	PC	-	31

Abbreviations: BAF, buccal advancement flap; BFP, buccal fat pad; C, canine; FESS, functional endoscopic sinus surgery; GA, general anesthesia; IS, implant surgery; LA, local anesthesia; L, left; M, molar; ♂, male; ♀, female; P, premolar; p/y, pack/year; PC, primary closure; PF, palatal flap; R, right; SC, septal cartilage; TE, tooth extraction; Tm, tumor. a Refers to the time until revision surgery.

4. Discussion

In this cohort, the overall rate of successful OAF closure was 87.5%. Five patients (13.9%) had persistent fistulas after the primary procedure, and successful closure was subsequently achieved in the three cases that underwent revision surgery. All patients in this series presented with persistent OAFs, as at least three weeks had elapsed since the onset of the initial OAC. Several factors have been shown to influence the success of closure, including the timing of intervention, defect localization and size, the presence of maxillary sinusitis, the type of surgical flap and closure technique, control of the underlying pathology, patient-related risk factors, and adherence to postoperative care. The literature reports a 90–95% success rate for OAC closure when treated within the first 24–48 hours, whereas the success of secondary OAF repair has been documented to decrease to approximately 67%.[1,11,12]

Successful OAF closure relies primarily on two factors: eliminating any associated chronic maxillary sinusitis and ensuring coverage with a well-vascularized, tension-free flap over healthy bone.[13]

In patients presenting with active infection, initial management consisted of oral antibiotics and topical decongestants, with topical irrigation and intranasal steroids added in case of concurrent chronic infection. OAF closure was planned only after sufficient control of the acute or ongoing sinus infection. This strategy aligns with previous findings indicating that, in selected patients with chronic OAF–associated rhinosinusitis, nonsurgical management with antibiotics and local decongestion therapy can lead to symptomatic improvement and spontaneous fistula closure in most cases.[14]

In our study, 42.5% of patients had concomitant chronic maxillary sinusitis identified intraoperatively, for which FESS was performed along with OAF closure. No significant difference in closure success was observed between patients who underwent FESS and those who did not. Previous reports have shown that patients with OAC and sinusitis who received simultaneous FESS or mini-Caldwell–Luc along with fistula closure achieved complete resolution of both the fistula and sinusitis.[15,16] Another study demonstrated that combining FESS with either BAF or BFP provided highly predictable outcomes in cases of chronic sinusitis with persistent OAC/OAF.[17,18] Moreover, the postoperative follow-up period is critical, as the presence of maxillary sinusitis at follow-up has been associated with a nearly 15-fold increase in recurrence risk.[11]

In most cases (85.0%), OAFs were closed using a flap-based technique, whereas a smaller proportion of patients (15.0%) underwent primary closure without the use of a flap or graft. No significant difference in closure success was observed between the two groups. Among flap procedures, single flaps—BAF for posterior defects and PF for palatal-side or vestibule-sparing cases—were most commonly used, whereas larger defects or patients with additional risk factors required combined advancement flaps or BAF plus BFP. In line with previous reports describing a “buccal fat pad–covering” technique, in our series the BFP was routinely used as a pedicled interpositional layer and was partially covered by a BAF in all three cases in which this combination was applied, thereby reinforcing the closure and facilitating rapid mucosalization of the defect.[19,20]

Within this cohort, no significant differences in closure success were observed between BAF and PF. Consistent with our findings, a recent meta-analysis reported comparable success rates for BAF and PF, while identifying BFP as the more successful technique among the three.[19] Similarly, another study demonstrated that BFP achieved the highest success rate (98.3%), followed by BAF (89.8%) and PF (85.7%), with BFP performing significantly better than PF.[21] Moreover, a recent systematic review highlighted BFP as the most reliable option for large (>5 mm) oroantral defects and for recurrent cases, particularly in patients with comorbidities such as diabetes or smoking. In contrast, PF was recommended for small to medium defects due to its favorable healing characteristics, whereas BAF showed lower success and higher recurrence rates in larger defects.[22] BFP was used in only three patients in this cohort, all in combination with BAF. Although one of these cases resulted in failure, the limited number of patients requires cautious interpretation and comparison with the existing literature.

In this cohort, no significant differences in closure success were observed between single and combined flaps. Several studies suggest that two-layer closure, although more invasive and time-consuming, may be more effective than single-flap techniques.[23,24] However, one report found no significant difference between approaches: the BAF technique achieved an 86.6% success rate, while the combined BAF + BFP method reached 93.3%.[25]

In this series, one of the unsuccessful cases had undergone primary closure, whereas the remaining four were treated with flap-based techniques (two with BAF, one with BFP + BAF, and one with PF). The patient who initially received primary closure underwent repeat primary repair, while the two patients previously treated with BAF were successfully managed with PF during revision. In the remaining two cases, the patients declined further surgery due to reduction in fistula size and improvement in symptoms, and were therefore managed conservatively with follow-up.

When selecting the appropriate flap technique, several parameters should be considered, including defect size and localization, whether the case represents a primary or revision repair, the presence of comorbid conditions, and the inherent advantages and limitations of each flap. BAF has been reported as the most commonly used surgical flap in the literature, although its main limitation is the potential for postoperative restriction in mouth opening.[19,21,26-28] Additionally, Von Wowern showed that the decrease in vestibular depth following the Rehrmann method may persist in up to half of cases, and while the buccal sulcus often returns to its original form within 4–8 weeks, lifelong vestibular shortening can occur in as many as 40% of patients.[19,29]

A full-thickness palatal flap provides strong, well-vascularized coverage and preserves the buccal vestibule; however, exposure of the palatal bone is common and may result in postoperative pain and surface irregularities as secondary epithelialization occurs over the following 2–3 months.[26,27] The BFP provides a thick, well-vascularized pedicled tissue that is particularly useful for large or recurrent defects and in patients with compromised local tissues or systemic risk factors; however, its use is limited by the available fat volume and the difficulty in reaching anterior defects, and reported complications include usually transient limitation in mouth opening, cheek swelling, and, rarely, contour changes or partial flap necrosis.[26-28]

In selected cases, alternative techniques such as tongue flaps for larger defects and biomaterials like PRF may also be used as primary or adjunctive methods for defect closure.[30,31]

Cartilage or bone grafts were used in 25.0% of all procedures and in 29.4% of flap-based surgeries in our cohort. Septal cartilage was the most frequently used donor material, followed by auricular cartilage and palatal bone. No significant difference in closure success was observed between cases with and without graft use. In the literature, donor sites such as mandibular bone, auricular cartilage, and septal cartilage have been reported to enhance closure success in cases with large defects and in selected situations.[32-34]

Postoperative management plays a crucial role in achieving successful healing of OAC/OAF. Patients are advised to maintain meticulous oral hygiene, follow a soft diet regimen, and use prescribed analgesics—typically non-steroidal anti-inflammatory drugs—and nasal decongestants to reduce discomfort and congestion. To prevent increased pressure across the repair site, nose blowing, sneezing with the mouth closed, using straws, and engaging in vigorous physical activity should be strictly avoided. These measures help protect the surgical closure, minimize the risk of sinus contamination, and promote uneventful healing.[12,13]

Most patients in this cohort underwent surgery for odontogenic causes (77.5%), followed by tumor-related etiologies (17.5%). Although the success rate was lower in the tumor group compared with the non-tumor group, this difference was not statistically significant. Consistent with our findings, previous reports indicate that the majority of OAC/OAF cases are odontogenic in origin, with upper molar or premolar extraction being the most common cause.[35,36] A systematic review similarly reported that OAC/OAF surgery was most frequently performed after dental extraction (76.3%), followed by cystectomy (12%), implant failure (6%), and tumor resection (2.2%).[19]

In our study, neither age nor smoking was associated with an increased risk of OAF closure failure. Although both factors could theoretically impair wound healing and negatively influence closure outcomes, existing literature similarly indicates that their impact has not been demonstrated statistically, likely due to limited sample sizes and the overall high success rates reported in most series.[11,22,37] Our cohort included only a small number of tumor-related cases, and none of the patients had a history of maxillary radiotherapy; therefore, the effect of these high-risk conditions could not be assessed in this study.

Although OAC is most often encountered initially by dental practitioners, otolaryngology consultation and intervention may be essential in selected cases. The presence of concomitant sinusitis requiring FESS, as well as the need for combined or advanced flap techniques, are the primary reasons for multidisciplinary involvement. Therefore, our findings underscore the importance of close collaboration between otolaryngologists and dental clinicians in the management of OAC/OAF.

This study has several strengths. It includes a clearly defined cohort of patients with persistent OAF, all with adequate follow-up. The evaluation of multiple surgical techniques—including BAF, PF, BFP, grafting, and concomitant FESS—provides a comprehensive overview of management strategies in an otolaryngology setting. The systematic comparison of demographic, etiologic, and operative factors adds further value. Nevertheless, several limitations should be acknowledged. Its retrospective, single-center design and relatively small sample size limit the statistical power and generalizability of the findings. In particular, the high overall success rate resulted in a very small number of failure cases, which restricts the ability to detect potential differences between subgroups and increases the risk of type II error. Accurate, objective measurements of fistula size were not consistently available, preventing quantitative evaluation of defect dimensions as a prognostic factor. Additionally, patient-reported outcomes were not assessed using standardized scales.

5. Conclusion

In this cohort of patients with OAF, surgical repair achieved a high overall success rate of 87.5%. Once sinus infection was adequately controlled, commonly used flap techniques—such as BAF and PF—showed similar closure outcomes. Likewise, single-flap and combined-flap approaches demonstrated comparable success rates, underscoring that when patients are appropriately evaluated and the correct surgical technique is selected, reliable and predictable results can be achieved with different methods. Cartilage or bone grafts and concomitant FESS were valuable in selected complex cases. Overall, our findings highlight the importance of individualized decision-making guided by defect characteristics, sinus condition, and patient comorbidities, and emphasize the need for close collaboration between dental clinicians and otolaryngologists in the multidisciplinary management of OAF.

Statement of ethics

The study received approval from the Istanbul University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee on (09/02.05.2025).

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Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

This Data and materials are available to the researchers.

Author contributions

CS, SS, BB: conceptualization, methodology, investigation, and writing – original draft.

CS, OO, VEA: resources, formal analysis, and writing – review and editing.

CS, SS, BB, OO, VEA: conceptualization, methodology, and writing – review and editing. All authors read and approved the final version of the manuscript.

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ChatGPT-5.1 was used to assist with writing editing, spelling, and language editing. The entire content of the manuscript was originally prepared, reviewed, and approved by all of the authors.

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