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OROANTRAL COMMUNICATION FOLLOWING MAXILLARY TOOTH EXTRACTION: DIAGNOSIS, PREVENTION, AND CONTEMPORARY MANAGEMENT – A NARRATIVE REVIEW

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ABSTRACT

Oroantral communication (OAC) is one of the most common complications associated with the extraction of maxillary posterior teeth and may lead to chronic oroantral fistula (OAF) formation and odontogenic maxillary sinusitis if not diagnosed and treated promptly. Early recognition and appropriate management are essential to prevent persistent communication, sinus infection, and long-term morbidity. This narrative review aims to summarize current concepts in the diagnosis and management of OAC, with particular emphasis on evidence-based clinical decision-making and recent advances in surgical treatment. The review discusses the etiology and risk factors associated with OAC, contemporary diagnostic methods, including the role of cone-beam computed tomography (CBCT), and strategies for preventing this complication during maxillary tooth extraction. Furthermore, current management options are presented, ranging from conservative treatment of small communications to various surgical techniques, including buccal advancement flaps, palatal flaps, pedicled buccal fat pad, and regenerative approaches using platelet-rich fibrin (PRF). The importance of controlling maxillary sinus infection, selecting an appropriate surgical technique based on defect characteristics, and providing adequate postoperative care is also highlighted. Recent evidence supports an individualized treatment approach that considers the size and duration of the defect, the presence of sinus pathology, and patient-specific factors. Advances in regenerative techniques and minimally invasive procedures have expanded the therapeutic options available to clinicians and have contributed to improved clinical outcomes. A comprehensive understanding of current diagnostic and therapeutic principles is essential for achieving predictable closure of OAC and minimizing postoperative complications.

KEYWORDS

Oroantral Communication, Oroantral Fistula, Maxillary Sinus, Tooth Extraction, Cone-beam Computed Tomography, Surgical Management, Buccal Fat Pad, Platelet-rich Fibrin

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Introduction

Oroantral communication (OAC) is a pathological connection between the oral cavity and the maxillary sinus, most frequently occurring as a complication of maxillary posterior tooth extraction due to the close anatomical relationship between the roots of these teeth and the maxillary sinus floor [1,3]. Although OAC may also arise following implant surgery, endodontic procedures, cyst or tumor removal, facial trauma, or medication-related osteonecrosis of the jaws, dental extraction remains the leading cause in clinical practice [1,3,7].

When left untreated, an oroantral communication may become epithelialized, resulting in the formation of an oroantral fistula (OAF). This persistent communication facilitates bacterial contamination of the maxillary sinus and may subsequently lead to chronic odontogenic maxillary sinusitis, prolonged patient discomfort, impaired oral function, and increased surgical complexity [1,2,10]. Consequently, early diagnosis and appropriate management are essential to prevent chronic infection and improve treatment outcomes [1,7].

The likelihood of OAC development depends on multiple anatomical and clinical factors. Maxillary first and second molars are associated with the highest risk because of their close proximity to the sinus floor, particularly in patients with extensive maxillary sinus pneumatization or divergent root morphology [3,4]. Additional risk factors include advanced periodontal destruction, large periapical lesions, previous surgical interventions, patient age, and traumatic or technically difficult extractions [3,4,7]. Recent evidence also suggests that careful preoperative evaluation of clinical and radiographic findings may help identify patients at increased risk, allowing clinicians to implement preventive surgical strategies before extraction [4].

Accurate diagnosis is based on a combination of clinical examination and radiographic assessment. While clinical tests remain useful for detecting the presence of an oroantral communication, cone-beam computed tomography (CBCT) has become the imaging modality of choice because it provides three-dimensional visualization of the defect, evaluates the integrity of the maxillary sinus floor, and identifies associated sinus pathology with greater diagnostic accuracy than conventional two-dimensional imaging [1,3,4].

Management of OAC has evolved considerably over recent decades. Current treatment strategies emphasize individualized decision-making based on defect size, duration of communication, sinus health, surrounding soft tissue quality, and patient-related factors. Small defects without sinus involvement may heal spontaneously or respond to conservative management, whereas larger or persistent communications generally require surgical closure using local flap techniques or regenerative procedures [1,2,5,6]. Among the most frequently applied methods are the buccal advancement flap, palatal rotational flap, pedicled buccal fat pad flap, and, more recently, biologically enhanced techniques involving platelet-rich fibrin (PRF) and other regenerative materials [5,6,11–13]. Advances in surgical techniques and a better understanding of maxillary sinus pathology have significantly improved the predictability of treatment and reduced postoperative complications [1,2].

The aim of this narrative review is to present current evidence regarding the etiology, diagnosis, prevention, and management of oroantral communication, with particular emphasis on evidence-based clinical decision-making and contemporary surgical approaches that optimize clinical outcomes.

Etiology and Risk Factors

Oroantral communication most commonly develops following the extraction of maxillary posterior teeth and accounts for the majority of acquired communications between the oral cavity and the maxillary sinus [1,3,7]. The close anatomical relationship between the roots of maxillary premolars and molars and the floor of the maxillary sinus is considered the principal predisposing factor. The risk is particularly high for the first and second molars, whose root apices may be separated from the sinus by only a thin layer of cortical bone or, in some individuals, may protrude directly into the sinus cavity [3,7].

The incidence of OAC is influenced by a complex interaction of anatomical, pathological, and surgical factors. Anatomically, extensive maxillary sinus pneumatization, reduced residual alveolar bone height, divergent or elongated root morphology, and thin sinus floor increase the probability of sinus perforation during extraction [1,3,4]. These anatomical variations should be carefully evaluated during preoperative planning, particularly in patients undergoing surgical extraction of maxillary posterior teeth.

Pathological conditions affecting the involved tooth or surrounding tissues further increase the risk of communication. Large periapical lesions, chronic apical periodontitis, advanced periodontal disease, odontogenic cysts, and chronic inflammatory changes may result in progressive destruction of the alveolar

bone separating the oral cavity from the maxillary sinus, thereby predisposing patients to OAC formation [3,7]. Similarly, teeth requiring surgical removal because of extensive caries, root fractures, or failed endodontic treatment are often associated with greater procedural difficulty and an increased likelihood of sinus perforation [1].

In addition to anatomical and pathological factors, surgical technique plays a decisive role in the development of OAC. Excessive force during extraction, inappropriate use of elevators, uncontrolled removal of surrounding bone, or accidental displacement of roots or teeth into the maxillary sinus significantly increase the risk of creating an oroantral communication [1,5,7]. These findings emphasize the importance of meticulous surgical planning, atraumatic extraction techniques, and adequate operator experience to minimize intraoperative complications.

Recent evidence has highlighted the value of preoperative risk assessment in preventing OAC. Jurásek et al. demonstrated that several clinical and radiographic findings—including intimate root-to-sinus relationship, interruption of the cortical outline of the sinus floor, sinus floor projection between the roots, and advanced sinus pneumatization—are reliable warning signs associated with an increased probability of oroantral communication following maxillary tooth extraction [4]. Recognition of these predictors allows clinicians to modify the surgical approach, prepare appropriate instruments, and anticipate the need for immediate closure if communication occurs.

Patient-related factors may also influence both the occurrence of OAC and subsequent healing. Advanced age, reduced bone quality, smoking, systemic diseases that impair wound healing, previous surgical procedures involving the maxillary sinus, and untreated maxillary sinus infection have all been associated with less favorable outcomes following oroantral communication [1,2]. Although these factors alone rarely cause OAC, they should be considered during treatment planning because they may affect both the risk of communication and the success of surgical closure.

Overall, the current literature supports a multifactorial etiology of OAC in which anatomical characteristics, local pathology, surgical technique, and patient-related variables collectively determine the likelihood of communication development. Consequently, comprehensive preoperative evaluation combining detailed clinical examination with appropriate radiographic imaging is essential for identifying high-risk patients and implementing preventive strategies aimed at reducing the incidence of this complication [1–4].

Diagnosis

The diagnosis of oroantral communication should be established immediately after the suspected injury to ensure prompt management and to reduce the risk of chronic oroantral fistula formation and odontogenic maxillary sinusitis [1,2]. Accurate diagnosis relies on a combination of clinical examination and radiographic assessment, as neither approach alone is sufficient in all clinical situations [1,3].

Clinical examination remains the first step in the diagnostic process. Patients with OAC may present with the passage of fluids from the oral cavity into the nose, altered nasal airflow, a whistling sound during speech, unilateral nasal discharge, or an unpleasant taste resulting from communication between the oral cavity and the maxillary sinus [1,3,7]. However, immediately after tooth extraction, many patients remain asymptomatic, making careful clinical inspection of the extraction socket essential, particularly when preoperative risk factors have been identified [3,4].

Direct visualization of the extraction socket may reveal a visible communication or exposed sinus membrane. Gentle probing of the socket has historically been described as a diagnostic method; however, current evidence discourages routine probing because it may enlarge the defect, disrupt the blood clot, or introduce microorganisms into the maxillary sinus [1,3]. Therefore, careful visual inspection combined with appropriate imaging is preferred whenever OAC is suspected.

The Valsalva maneuver has traditionally been used to assess the presence of oroantral communication by asking the patient to gently exhale while keeping the nostrils closed. The appearance of air bubbles or air leakage through the extraction socket may indicate communication with the maxillary sinus [3,7]. Nevertheless, contemporary literature recommends interpreting this test with caution. A negative Valsalva test does not exclude a small communication, whereas excessive positive pressure may dislodge the blood clot or enlarge an existing defect. Consequently, the maneuver should be performed gently, if at all, and should never be considered the sole diagnostic criterion [1,3].

Radiographic evaluation plays a pivotal role in confirming the diagnosis and planning treatment. Conventional periapical and panoramic radiographs may demonstrate discontinuity of the sinus floor,

displaced root fragments, foreign bodies, or opacification of the maxillary sinus, but their two-dimensional nature limits diagnostic accuracy [3]. For this reason, cone-beam computed tomography (CBCT) is currently regarded as the imaging modality of choice whenever OAC is suspected or when clinical findings are inconclusive [1,3,4].

CBCT provides high-resolution three-dimensional visualization of the communication, allowing accurate assessment of defect size, residual alveolar bone, sinus floor integrity, root position, and the presence of associated sinus pathology such as mucosal thickening, retained root fragments, or fluid accumulation [1,3]. Compared with conventional radiography, CBCT facilitates more precise treatment planning and enables clinicians to select the most appropriate surgical approach according to the anatomical characteristics of each case [1].

Recent studies have also emphasized the importance of identifying radiographic warning signs before tooth extraction. Jurásek et al. demonstrated that interruption of the cortical outline of the sinus floor, intimate root-to-sinus relationship, sinus floor projection between the roots, and marked maxillary sinus pneumatization significantly increase the likelihood of postoperative OAC [4]. Recognition of these findings allows clinicians to classify patients as high risk and to adopt preventive surgical strategies before extraction.

Overall, contemporary diagnosis of OAC should be based on the integration of clinical findings with advanced radiographic imaging. While clinical examination remains indispensable, CBCT has become the current diagnostic gold standard in complex or uncertain cases because it provides comprehensive anatomical information that directly influences treatment planning and improves clinical outcomes [1,3,4].

Prevention During Tooth Extraction

Preventing oroantral communication begins with meticulous preoperative assessment and careful surgical planning. Identification of patients at increased risk allows clinicians to adopt preventive measures that minimize the likelihood of maxillary sinus perforation during tooth extraction [1,4]. A comprehensive evaluation should include both clinical examination and radiographic assessment, with particular attention to the anatomical relationship between the roots of the maxillary posterior teeth and the floor of the maxillary sinus [1,3].

Preoperative imaging plays a fundamental role in risk assessment. While panoramic radiography may provide an initial overview of the anatomical structures, cone-beam computed tomography (CBCT) offers superior visualization of the root–sinus relationship, residual alveolar bone, sinus floor morphology, and the presence of periapical pathology [1,3]. Contemporary evidence suggests that CBCT should be considered in patients presenting with radiographic warning signs or when conventional imaging does not provide sufficient anatomical information for safe surgical planning [1,4].

Several clinical and radiographic factors have been identified as predictors of OAC. These include extensive maxillary sinus pneumatization, close proximity or protrusion of tooth roots into the sinus, interruption of the cortical outline of the sinus floor, large periapical lesions, advanced periodontal bone loss, and previous surgical interventions involving the posterior maxilla [3,4]. Recognition of these findings enables clinicians to anticipate potential complications and modify the surgical approach accordingly [4].

The surgical technique itself is a critical determinant in preventing OAC. Atraumatic extraction should always be the primary objective, particularly in high-risk cases. Excessive force, uncontrolled use of elevators, and unnecessary removal of alveolar bone may increase the risk of sinus floor perforation and should therefore be avoided [1,5]. When surgical extraction is required, careful tooth sectioning and controlled root separation are often preferable to excessive luxation forces, as these techniques reduce mechanical stress on the surrounding bone and sinus floor [5,7].

In situations where the risk of OAC is considered particularly high, clinicians should be prepared to perform immediate closure if communication occurs during surgery. Early recognition and prompt management are associated with significantly higher success rates than delayed treatment after epithelialization or secondary infection has developed [1,2]. Therefore, appropriate surgical instruments and soft tissue flap techniques should be available whenever complex extractions of maxillary posterior teeth are planned.

Prevention also extends beyond the surgical procedure itself. Patients should receive clear postoperative instructions to avoid actions that increase pressure within the maxillary sinus during the initial healing period, including forceful nose blowing, sneezing with a closed mouth, smoking, and the use of straws [1,7]. These recommendations help maintain blood clot stability, reduce the risk of communication enlargement, and promote uneventful healing.

Current evidence indicates that successful prevention of OAC relies on a combination of accurate preoperative risk assessment, appropriate imaging, atraumatic surgical technique, and immediate intraoperative recognition of sinus perforation. Rather than depending on a single preventive measure, clinicians should adopt a comprehensive and individualized approach tailored to each patient's anatomical characteristics and surgical complexity [1–5].

Contemporary Management

The management of oroantral communication has evolved from the routine use of a limited number of local flap techniques to a more individualized, evidence-based approach. Contemporary treatment is based on several key factors, including the size of the communication, the time elapsed since its occurrence, the condition of the maxillary sinus, the quality of the surrounding soft tissues, and patient-related systemic factors. The primary objectives of treatment are to achieve complete closure of the communication, restore separation between the oral cavity and the maxillary sinus, eliminate infection, and prevent recurrence or progression to oroantral fistula formation [1,2,7].

The decision between conservative and surgical treatment largely depends on the size of the defect and the presence of sinus pathology. Small communications, generally measuring less than 2 mm in diameter, may heal spontaneously when the Schneiderian membrane remains intact, the maxillary sinus is free of infection, and a stable blood clot is preserved within the extraction socket [1,5]. Defects measuring approximately 2–5 mm require careful clinical evaluation, as spontaneous healing is less predictable and depends on local anatomical conditions, soft tissue integrity, and the absence of active sinus disease [1,7]. Communications larger than 5 mm or those associated with persistent symptoms, epithelialization, or maxillary sinus infection generally require surgical intervention to achieve predictable closure [1,2].

Successful management begins with appropriate assessment of the maxillary sinus. Before attempting surgical closure, clinicians should exclude or adequately treat active sinus infection, since closure of an infected communication is associated with an increased risk of treatment failure and recurrence [1,2,10]. Management of odontogenic maxillary sinusitis may include antimicrobial therapy, nasal decongestants, saline irrigation, and, in selected cases, collaboration with an otorhinolaryngologist for functional endoscopic sinus surgery (FESS) when conservative treatment is insufficient [10,11].

Immediate closure is generally associated with superior clinical outcomes compared with delayed intervention. Fresh communications identified during or immediately after tooth extraction demonstrate higher healing rates because soft tissues remain viable and epithelialization has not yet occurred [1,2]. In contrast, delayed treatment often requires excision of the epithelial tract, debridement of inflamed tissues, and management of chronic sinus disease before definitive closure can be performed [5,6].

Selection of the surgical technique should be individualized according to defect characteristics and local tissue availability rather than relying on a single universal procedure [1,2]. The buccal advancement flap remains one of the most frequently performed techniques because of its simplicity, predictable vascular supply, and high success rate in closing small- to medium-sized communications [5,6]. Nevertheless, advancement of the buccal flap inevitably reduces vestibular depth, which may compromise future prosthetic rehabilitation or implant placement, particularly in partially edentulous patients [5,6].

The palatal rotational flap represents an alternative for selected defects, particularly those located in the premolar region. Owing to its robust vascularization supplied by the greater palatine artery, the flap provides reliable tissue coverage and preserves the buccal vestibule [5,6]. However, flap rotation is technically more demanding, donor-site healing occurs by secondary intention, and postoperative discomfort may be greater than with buccal flap techniques [5].

Among contemporary reconstructive options, the pedicled buccal fat pad has gained widespread acceptance for the management of medium- and large-sized oroantral communications. The flap is characterized by excellent vascularity, rapid epithelialization, minimal donor-site morbidity, and high clinical success rates. Furthermore, its anatomical proximity to the surgical site enables tension-free closure while preserving vestibular depth, making it particularly valuable for posterior maxillary defects and recurrent oroantral fistulas [2,6,12,13].

Recent years have also seen increasing interest in regenerative approaches designed to enhance tissue healing. Platelet-rich fibrin (PRF) has been proposed as an adjunctive or, in selected small defects, standalone treatment because of its ability to promote angiogenesis, stimulate soft tissue regeneration, and stabilize the blood clot through the sustained release of growth factors [1,12]. Although current evidence suggests

promising clinical outcomes, available studies remain limited by relatively small sample sizes and methodological heterogeneity. Consequently, PRF should currently be regarded as a valuable adjunct rather than a replacement for established surgical techniques [1,2,12].

Overall, no single surgical technique has been demonstrated to be universally superior for all clinical situations. Recent systematic reviews consistently emphasize that successful treatment depends primarily on appropriate case selection, adequate management of sinus pathology, meticulous surgical technique, and tension-free soft tissue closure rather than on the choice of flap alone [1,2]. Therefore, contemporary management of OAC should be individualized, integrating defect characteristics, patient-specific factors, and surgeon experience to achieve predictable long-term outcomes.

Postoperative Care

Appropriate postoperative care is essential for successful healing following the closure of an oroantral communication. Even technically successful surgical procedures may fail if excessive pressure is applied to the surgical site or if postoperative infection develops during the early healing phase. Therefore, postoperative management should focus on maintaining wound stability, preventing maxillary sinus contamination, controlling pain and inflammation, and promoting optimal soft tissue healing [1,2,7].

Patients should receive detailed postoperative instructions immediately after treatment. Activities that increase intra-sinus pressure should be avoided for at least 10–14 days, including forceful nose blowing, sneezing with the mouth closed, drinking through a straw, smoking, playing wind instruments, and vigorous physical activity [1,5,7]. If sneezing is unavoidable, patients should be instructed to keep their mouth open in order to reduce pressure within the maxillary sinus and minimize stress on the surgical closure [1].

Maintenance of adequate oral hygiene is equally important for preventing postoperative infection. Gentle tooth brushing should be continued while avoiding direct trauma to the surgical site. Chlorhexidine mouth rinses are commonly recommended during the early healing period to reduce bacterial load and support wound healing, although vigorous rinsing should be avoided during the first 24 hours to prevent disruption of the blood clot [1,7].

Pharmacological management should be tailored to the individual clinical situation. Analgesics are routinely prescribed to control postoperative pain, whereas antibiotics may be indicated in patients with established oroantral communication, signs of sinus contamination, or concomitant odontogenic infection [1,2]. In addition, many authors recommend short-term use of nasal decongestants to improve drainage and ventilation of the maxillary sinus, thereby reducing intranasal pressure and facilitating mucosal recovery [1,7]. Saline nasal irrigation may also be beneficial in selected patients, particularly when mild inflammatory changes within the maxillary sinus are present [10].

Regular postoperative follow-up is essential for evaluating wound healing and detecting early signs of treatment failure. Clinical assessment should confirm complete soft tissue closure, absence of fluid leakage between the oral cavity and the nose, resolution of pain, and the absence of clinical symptoms suggestive of maxillary sinusitis [1,3]. Persistent nasal discharge, recurrent passage of fluids into the nasal cavity, foul taste, or delayed wound healing should prompt immediate re-evaluation and, when indicated, additional radiographic assessment using cone-beam computed tomography [1,3].

Healing is influenced not only by surgical technique but also by patient-related factors such as smoking, uncontrolled diabetes mellitus, poor oral hygiene, and reduced compliance with postoperative recommendations [1,2]. Consequently, patient education should be considered an integral component of treatment rather than merely supportive care. Ensuring that patients understand the rationale behind postoperative restrictions may significantly improve adherence and contribute to more predictable clinical outcomes.

Current evidence indicates that successful postoperative management requires a multidisciplinary approach combining meticulous patient education, appropriate pharmacological support, maintenance of oral and nasal hygiene, and regular clinical follow-up. Adherence to these principles minimizes the risk of wound dehiscence, recurrent communication, and postoperative maxillary sinus infection, thereby improving the long-term success of OAC treatment [1,2].

Management of Oroantral Fistula

Oroantral fistula (OAF) represents a chronic stage of oroantral communication in which the pathological connection between the oral cavity and the maxillary sinus becomes epithelialized. In contrast to an acute OAC, which may occasionally heal spontaneously when the defect is small and the maxillary sinus is healthy, an established OAF usually requires surgical intervention because epithelialization prevents spontaneous closure and maintains persistent contamination of the maxillary sinus [1,2,7]. The transition from OAC to OAF is clinically significant, as chronic fistulas are frequently associated with recurrent or persistent odontogenic maxillary sinusitis, mucosal inflammation, and impaired sinus drainage [3,10].

The management of OAF should begin with a detailed assessment of the fistulous tract, surrounding soft tissues, residual alveolar bone, and the condition of the maxillary sinus. Clinical symptoms may include fluid leakage from the oral cavity into the nose, unilateral nasal discharge, foul taste, halitosis, altered speech, and recurrent episodes of maxillary sinusitis [3,7]. However, the severity of symptoms does not always correlate with the size of the defect, and radiographic evaluation is essential for treatment planning [1,3]. Cone-beam computed tomography is particularly useful in chronic cases because it allows three-dimensional visualization of the bony defect, identifies retained root fragments or foreign bodies, and demonstrates sinus mucosal thickening or fluid accumulation [1,3,10].

Successful treatment of OAF requires not only closure of the oral defect but also elimination of the epithelial tract and control of any associated sinus disease. Surgical closure without adequate management of chronic maxillary sinusitis may lead to recurrence, wound dehiscence, or persistent sinonasal symptoms [1,2,10]. Therefore, active infection should be treated before or in conjunction with definitive closure. This may include systemic antibiotics, nasal decongestants, saline irrigation, and, in selected patients, referral to an otorhinolaryngologist for endoscopic sinus evaluation or functional endoscopic sinus surgery [10,11].

Before flap closure, the epithelialized fistulous tract should be completely excised, and inflamed or nonviable tissue should be removed to create fresh wound margins capable of healing by primary intention [4,5,6]. This step differentiates OAF management from the treatment of fresh OAC, where immediate closure may be performed without the need for extensive tract excision. In chronic cases, proper debridement is essential because residual epithelial tissue may compromise soft tissue integration and contribute to recurrence [4,5].

The choice of surgical technique depends on the size and location of the fistula, the amount and quality of available soft tissue, vestibular depth, prosthetic considerations, and whether previous closure attempts have failed [1,2,4]. Buccal advancement flap remains one of the most commonly used techniques because it is simple, reliable, and provides well-vascularized tissue coverage for small- and medium-sized defects [4,5]. However, its main disadvantage is reduction of the buccal vestibule, which may negatively affect future prosthetic rehabilitation, especially in partially edentulous patients [4,5,6].

Palatal rotational flap may be preferred in selected cases, particularly when preservation of vestibular depth is important. The flap has a robust blood supply from the greater palatine artery and provides thick keratinized tissue for closure [4,5]. Nevertheless, the technique is more demanding, and the donor site heals by secondary intention, which may increase postoperative discomfort [4,6]. For this reason, palatal flaps are often reserved for cases in which buccal tissue is insufficient or when prosthetic considerations make vestibular preservation clinically relevant [4,5].

The pedicled buccal fat pad is particularly valuable in the management of larger posterior defects, recurrent fistulas, and cases with compromised local mucosa. Its anatomical proximity to the posterior maxilla, excellent vascularity, and rapid epithelialization make it a reliable option for OAF closure [2,4,5,13,14]. Compared with buccal advancement flap alone, the buccal fat pad may better preserve vestibular depth and provide additional soft tissue volume, which is advantageous in larger communications or revision surgery [2,4,13]. However, careful handling is necessary to avoid excessive traction, flap perforation, or postoperative necrosis [4,5].

In chronic OAF associated with odontogenic maxillary sinusitis, combined oral and endoscopic management may be required. Galli et al. emphasized the importance of classifying odontogenic sinusitis and oroantral fistula according to the extent of sinus involvement and the underlying dental cause in order to select the most appropriate surgical strategy [10]. Similarly, Andrić et al. reported that functional endoscopic sinus surgery may serve as an effective adjunctive treatment in patients with persistent sinus disease requiring simultaneous restoration of sinus drainage and closure of the fistula [11]. These findings support a multidisciplinary approach in complex or recurrent cases.

Overall, contemporary management of OAF is based on a staged and individualized approach. The clinician must identify and eliminate the underlying cause, control maxillary sinus infection, excise the epithelial tract, and select a closure technique that provides tension-free, well-vascularized soft tissue coverage [1,2,4,10]. Compared with acute OAC, treatment of OAF is more complex and less predictable, which highlights the importance of early recognition and immediate management of fresh communications before chronic fistula formation occurs [1,2,7].

Complications

Untreated or inadequately managed oroantral communication may lead to several local and sinonasal complications. The most important clinical consequence is the transformation of an acute oroantral communication into a chronic oroantral fistula, which occurs when the communication becomes epithelialized and fails to close spontaneously [1,2,7]. Once epithelialization develops, spontaneous healing is unlikely, and surgical intervention becomes necessary to remove the fistulous tract and restore separation between the oral cavity and the maxillary sinus [4,5].

One of the most frequent and clinically relevant complications of OAC and OAF is odontogenic maxillary sinusitis. Persistent communication allows oral bacteria, saliva, food debris, and inflammatory mediators to enter the maxillary sinus, leading to mucosal inflammation, impaired sinus ventilation, and secondary infection [1,3,10]. Patients may present with unilateral nasal obstruction, purulent nasal discharge, facial pressure, foul taste, halitosis, and recurrent episodes of sinusitis [3,7,10]. In chronic cases, mucosal thickening, fluid accumulation, and obstruction of sinus drainage pathways may be visible on radiographic examination, particularly on cone-beam computed tomography or computed tomography [1,3,10].

The presence of active maxillary sinus infection significantly complicates treatment. Surgical closure performed in the setting of uncontrolled sinusitis has a higher risk of failure because persistent infection may impair wound healing, increase tissue inflammation, and contribute to wound dehiscence or recurrence of the communication [1,2,10]. For this reason, contemporary management emphasizes that infection control should precede or accompany definitive surgical closure, especially in chronic OAF or recurrent cases [1,10,11].

Wound dehiscence and recurrence are among the most important postoperative complications following surgical closure of OAC or OAF. These complications may result from excessive flap tension, inadequate blood supply, persistent infection, insufficient debridement of epithelialized tissue, poor patient compliance, smoking, or traumatic postoperative pressure changes within the maxillary sinus [1,2,4,5]. Recurrence is particularly more likely in chronic fistulas, large defects, previously failed closures, and cases associated with untreated odontogenic sinusitis [1,10].

Foreign body displacement into the maxillary sinus represents another relevant complication, particularly during extraction of maxillary posterior teeth or implant-related procedures. Root fragments, teeth, dental implants, grafting materials, or other foreign bodies may be displaced into the sinus, resulting in mucosal irritation, infection, persistent oroantral communication, or chronic sinusitis [3,7,13]. Radiographic assessment is essential in such cases, as retained foreign material must be identified and removed before or during definitive closure to reduce the risk of persistent inflammation and treatment failure [1,3].

Complications may also affect future prosthetic and implant rehabilitation. Some closure techniques, particularly buccal advancement flap, may reduce vestibular depth and alter the anatomy of the edentulous ridge, potentially complicating denture stability, hygiene access, or implant placement [4,5,6]. Although this does not represent a failure of OAC closure itself, it may have important functional consequences, particularly in partially edentulous patients requiring long-term prosthetic treatment [4,5].

Postoperative morbidity varies depending on the selected surgical technique. Buccal advancement flaps may be associated with vestibular shortening, swelling, and temporary limitation of oral function, whereas palatal rotational flaps may cause donor-site discomfort due to secondary intention healing [4,5,6]. Pedicled buccal fat pad flaps generally show favorable healing, but potential complications include partial necrosis, excessive traction, hematoma, or limited mouth opening if the flap is improperly mobilized [4,5,13,14]. These risks underline the importance of careful technique selection and tension-free closure.

Overall, complications of OAC and OAF are largely preventable when communication is recognized early, sinus infection is adequately controlled, and appropriate surgical principles are followed. The literature consistently indicates that delayed diagnosis, persistent sinus pathology, poor flap design, and inadequate postoperative care are major contributors to treatment failure [1,2,7,10]. Therefore, prevention of complications depends on early diagnosis, individualized treatment planning, meticulous surgical technique, and close postoperative follow-up [1,2,7].

Clinical Decision-Making Algorithm

Clinical decision-making in oroantral communication should be based on a structured assessment of defect size, time elapsed since occurrence, presence of maxillary sinus infection, soft tissue condition, and patient-related risk factors. Contemporary management emphasizes that treatment should not rely on a single universal technique, but rather on an individualized approach adapted to the clinical situation [1,2,7].

The first step is immediate recognition of the communication. When OAC is suspected during or after extraction of a maxillary posterior tooth, careful clinical examination should be performed without aggressive probing of the socket, as unnecessary manipulation may enlarge the defect or disrupt the blood clot [1,3,7]. If the diagnosis is uncertain or if the anatomical situation is complex, cone-beam computed tomography should be considered to evaluate the size of the defect, the integrity of the sinus floor, the presence of retained root fragments, and possible sinus pathology [1,3,8].

Small acute communications, particularly those less than 2 mm in diameter and not associated with maxillary sinus infection, may be managed conservatively. In such cases, preservation of the blood clot, avoidance of increased sinus pressure, maintenance of oral hygiene, and close postoperative follow-up are essential [1,7]. However, even small communications require careful monitoring, because persistent fluid passage, nasal symptoms, or delayed healing may indicate failure of spontaneous closure and the need for surgical intervention [1,3].

Defects between 2 and 5 mm require individualized evaluation. Some may heal with conservative management if the sinus is healthy and the soft tissues are stable, whereas others may require early surgical closure, particularly when the defect is located in a high-risk anatomical area or when patient compliance is uncertain [1,2,7]. In this intermediate group, the clinician should consider local tissue quality, the degree of sinus floor disruption, and the presence of pre-existing inflammatory changes before selecting the treatment strategy [1,3,8].

Large communications, usually exceeding 5 mm, persistent defects, and communications associated with sinus symptoms should generally be treated surgically. Immediate closure is preferred whenever possible because fresh wounds have better vascularity, no epithelialized tract, and lower risk of chronic infection than delayed defects [1,2,7]. The choice of surgical technique should depend on the size and location of the defect, vestibular depth, prosthetic needs, and the availability of local soft tissues [1,2,4].

When a chronic oroantral fistula is present, management becomes more complex. In such cases, the epithelialized tract should be excised, inflamed tissues should be debrided, and sinus infection should be controlled before or during definitive closure [4,5,10]. Closure of a fistula without addressing odontogenic maxillary sinusitis increases the risk of recurrence, wound dehiscence, and persistent sinonasal symptoms [1,10,11].

For small- and medium-sized defects with adequate buccal mucosa, buccal advancement flap remains a reliable and frequently used technique. Its advantages include simplicity, accessibility, and predictable vascularity, although reduction of vestibular depth must be considered, especially in patients requiring future prosthetic or implant rehabilitation [4,5,6]. In selected cases where preservation of vestibular depth is important, palatal rotational flap may be preferred because of its robust blood supply and use of keratinized tissue [4,5].

For larger posterior defects, recurrent fistulas, or cases with insufficient local mucosa, pedicled buccal fat pad flap represents a valuable reconstructive option. Its excellent vascularity, anatomical proximity to the posterior maxilla, and rapid epithelialization make it particularly useful in complex cases [2,4,13,14]. Regenerative approaches such as platelet-rich fibrin may be considered as an adjunct in selected situations, especially to enhance healing and support soft tissue regeneration, although current evidence does not justify replacing established flap techniques with PRF alone in larger or chronic defects [1,2,12].

A practical clinical algorithm should therefore distinguish between acute and chronic communications, small and large defects, and healthy versus infected sinuses. Acute small defects may be managed conservatively, acute large defects usually require immediate surgical closure, and chronic fistulas require excision of the epithelial tract combined with management of associated sinus pathology [1,2,7,10]. This structured approach improves treatment predictability and reduces the risk of recurrence, sinusitis, and long-term functional complications [1,2].

Future Perspectives

Future developments in the diagnosis and management of oroantral communication are likely to focus on earlier risk identification, more precise treatment planning, biologically enhanced healing, and closer interdisciplinary cooperation. Although traditional surgical techniques remain effective, recent literature emphasizes the need for individualized decision-making based on defect characteristics, sinus health, and patient-specific risk factors rather than a uniform approach for all cases [1,2,7].

One of the most important directions for future clinical practice is the improvement of preoperative risk assessment. The identification of radiographic warning signs, such as close root-to-sinus relationship, interruption of the sinus floor cortical outline, extensive maxillary sinus pneumatization, and sinus floor projection between roots, may allow clinicians to recognize high-risk patients before extraction [3,8]. Wider use of cone-beam computed tomography in selected cases may help reduce unexpected intraoperative sinus perforation by improving visualization of the posterior maxilla and supporting more accurate surgical planning [1,3,8].

Another important area of development is the standardization of clinical decision-making algorithms. Current literature provides general recommendations regarding conservative treatment, immediate surgical closure, local flap selection, and management of chronic oroantral fistula; however, treatment protocols still vary among clinicians and institutions [1,2,7]. Future studies should aim to define clearer thresholds for conservative versus surgical management, particularly in intermediate-sized defects where spontaneous healing is less predictable [1,2]. More consistent classification systems may also improve comparison between studies and strengthen evidence-based recommendations.

Regenerative techniques represent a promising field in OAC management. Platelet-rich fibrin has been proposed as an adjunctive material that may enhance wound healing, support angiogenesis, stabilize the blood clot, and promote soft tissue regeneration [1,12]. Nevertheless, current evidence remains limited by small clinical samples, heterogeneous techniques, and inconsistent follow-up periods [1,2,12]. Therefore, future randomized clinical studies are needed to determine whether PRF and other biologically active materials can reliably improve outcomes when compared with established flap techniques or when used in combination with them [1,2].

The role of the pedicled buccal fat pad is also expected to remain significant, particularly in larger posterior defects, recurrent oroantral fistulas, and cases with insufficient local mucosa. Its favorable vascularity, anatomical proximity, and rapid epithelialization make it a valuable reconstructive option [2,4,13,14]. However, future research should better define its indications, long-term functional outcomes, and comparative effectiveness against other surgical techniques in different defect categories [2,4].

Interdisciplinary management will likely become increasingly important, especially in patients with chronic odontogenic maxillary sinusitis or recurrent oroantral fistula. Combined treatment involving oral and maxillofacial surgeons, dental practitioners, and otorhinolaryngologists may improve outcomes when sinus disease is extensive or when restoration of sinus drainage is required [10,11]. The integration of dental treatment with endoscopic sinus surgery in selected cases reflects a more comprehensive approach to the management of odontogenic sinus pathology associated with OAF [10,11].

Overall, future progress in OAC management will depend on combining advanced imaging, preventive risk assessment, evidence-based surgical algorithms, regenerative strategies, and multidisciplinary care. Although current techniques provide predictable outcomes in many cases, stronger clinical evidence is still needed to determine the optimal treatment for different defect sizes, chronicity stages, and sinus conditions [1,2,9]. A more standardized and biologically oriented approach may further improve closure success, reduce recurrence, and minimize postoperative morbidity.

Conclusions

Oroantral communication remains a clinically relevant complication of maxillary posterior tooth extraction and other surgical procedures involving the posterior maxilla. Although small acute communications may occasionally heal spontaneously under favorable conditions, delayed diagnosis or inadequate management may lead to epithelialization, oroantral fistula formation, and chronic odontogenic maxillary sinusitis [1,2,7]. Therefore, early recognition and appropriate treatment are essential for preventing long-term complications.

Contemporary management of OAC is based on individualized clinical decision-making rather than a single universal treatment approach. The most important factors influencing treatment selection include the size and duration of the defect, the presence or absence of maxillary sinus infection, the quality of surrounding

soft tissues, patient-related risk factors, and future prosthetic or implant rehabilitation needs [1,2,4,7]. Cone-beam computed tomography plays an increasingly important role in diagnosis and treatment planning, particularly in complex cases, recurrent fistulas, or when conventional imaging does not provide sufficient anatomical detail [1,3,8].

Surgical closure remains the standard of care for large, persistent, or chronically epithelialized defects. Buccal advancement flap, palatal rotational flap, and pedicled buccal fat pad flap continue to be reliable techniques, each with specific advantages and limitations [4–6]. The pedicled buccal fat pad is particularly valuable in posterior, large, or recurrent defects because of its excellent vascularity and anatomical proximity to the maxillary sinus [2,4,13,14]. Regenerative approaches, including platelet-rich fibrin, appear promising as adjunctive methods, although stronger clinical evidence is required before they can replace established surgical techniques [1,2,12].

Successful treatment depends not only on the selected closure method but also on proper control of sinus infection, elimination of epithelialized tissue in chronic fistulas, tension-free flap adaptation, and strict postoperative care [1,2,10]. In patients with chronic odontogenic maxillary sinusitis or recurrent OAF, interdisciplinary cooperation with otorhinolaryngologists and, when indicated, functional endoscopic sinus surgery may improve treatment outcomes [10,11].

In conclusion, predictable management of oroantral communication requires a comprehensive approach combining prevention, early diagnosis, appropriate imaging, individualized surgical planning, and careful postoperative monitoring. Future research should focus on standardized treatment algorithms, comparative evaluation of surgical techniques, and high-quality clinical studies assessing regenerative materials and minimally invasive approaches [1,2,9].

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