

Review

OROANTRAL COMMUNICATION, ITS CAUSES, COMPLICATIONS, TREATMENTS AND RADIOGRAPHIC FEATURES: A PICTORIAL REVIEW

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ABSTRACT

The term oroantral communication is used indiscriminately in literature as a synonym for 'oro-antral perforation', 'antro-oral communication' (OAC), 'oroantral fistula' (OAF), 'antro-alveolar fistula'. Although these terms are synonyms, OAF develops when the OAC does not close spontaneously, remains manifest, and becomes epithelialized. The development of this epithelialized tissue represents a pathological pathway for bacteria and is generally thought to be generated soon, at least 48/72 h from the creation of the communication. The aim of this review was to provide a pictorial review of incidence and treatment for oroantral communications and fistulas and to avoid the risk of recurrence. By conducting an electronic search on the MEDLINE bibliographic database (Pubmed), 63 articles with a period from 1994 to 2021 were selected using the following algorithm: "sinus lift" OR "sinus augmentation" OR "sinus graft" OR "maxillary sinus floor elevation" OR "sinus floor augmentation" AND "oro-antral communication" OR "antro-oral communication" OR "oroantral communication" OR "oro-antral fistula" OR "oroantral fistula" OR "oro-sinus communication" OR "antro-alveolar fistula" OR "fistula" OR "oro-sinus fistula" OR "sinus-oral fistula" OR "sinus communication" OR "OAF". The electronic search yielded 63 articles. No language restrictions were applied, and only cohort studies were considered, excluding case series, case reports, RCTs, and CCTs. Titles and abstracts were examined using the previously defined inclusion and exclusion criteria. After thorough analysis, 21 articles were excluded, and 3 studies were included in the qualitative and quantitative data synthesis. The incidence of AOC, regardless of the technique used, appears to be a relatively rare complication. The surgical protocols used, the surgeon's experience, implant management, and intra-operative complications could play an active role in post-operative complications. Further studies are needed to establish a comparison between the techniques.

KEYWORDS: *oroantral communication, sinus augmentation, sinus lift, sinus graft, maxillary sinus, floor elevation*

INTRODUCTION

An oroantral communication (OAC) is defined as a pathological pathway that is created between the maxillary sinus and the oral cavity as a complication of dental extraction surgery, trauma, sinus surgery, implant failures (i.e., peri-

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implantitis, infection of the graft material, migration of the implant into the sinus), osteomyelitis or removal of neoplasms involving the posterior areas of the upper jaw (1).

The term oroantral communication is used indiscriminately in literature as a synonym for 'oro-antral perforation', 'antro-oral communication', 'oroantral fistula' (OAF), 'antro-alveolar fistula'. Although these terms are synonyms, OAF develops when the OAC does not close spontaneously, remains manifest, and becomes epithelialized.

The development of this epithelialized tissue represents a pathological pathway for bacteria and is generally thought to be generated soon, at least 48/72 h from the creation of the communication (2, 3). Symptoms are variable and can occur even after a long time. Most commonly, epistaxis passage of fluid between the oral and nasal cavities, pain, postnasal drip, altered vocal resonance, and difficulty in sucking or puffing out the cheeks are reported (4). In addition, if left untreated, such preferential pathways can lead to numerous complications, such as secondary sinus infection with sinusitis (acute or chronic) along with pseudopolyp formation or herniation of the sinus mucosa through communication.

Diagnosis represents a critical issue, especially in doubtful cases. Parvini et al. (5) illustrated a pragmatic and useful decision-making process, i.e., the Valsalva maneuver, compressing the patient's nostrils and blowing out air, could be useful (6). The increase in endosinus pressure leads to the formation of bubbles at the level of the communication, unmasking the condition. However, a negative test does not automatically exclude the presence of an OAC. At the same time, a check-blowing test with a hissing sound could be helpful for the diagnosis, even if the risk of spreading the infection into the sinus is reported. The same risk is present when a probe is inserted into the communication to assess the dimensions of the AOC.

Radiologically, 2D-dimensional imaging with a gutta-percha cone inserted inside the communication can highlight the interruption and discontinuity in the floor of the maxillary sinus, indicating the presence of the communication. Coronal sections of CT and CBCT are adjunctive diagnostic tools with particular care for sinus abnormalities (7).

Multiple factors are to be considered while treating an OAC, i.e., the size of the perforation, the time of diagnosis, the presence of inflammation, and the clinician's experience, all of which have a critical role in managing these complications. In the absence of sinus infections and limited lesions ($\leq 2\text{mm}$), the clot formation could lead to closure of the OAC and spontaneous healing. During sinus infection and when extensive communication with epithelialized tissue is present, flap mobilization surgery (buccal flap, palatal flap, buccal pad) associated with previous treatment for the sinus pathology is mandatory for the complete healing of the condition (8, 9).

Immediate intervention generally has a very high success rate (around 95%), but if the condition is improperly treated, 50% of patients will develop sinusitis only 48h later. In addition, if not detected, sinusitis will develop in almost 90% of patients after only 2 weeks since the AOC creation (9). Some nontrasfusional hemocomponents are an effective therapeutic option (10), especially when mechanical factors are considered for the closure of the communication and flap management (11). Sinus augmentation techniques are widely used to increase the height of the residual bone ridge for implant placement in the posterolateral areas of the upper jaw.

Implant insertion strictly depends on the bone amount between the sinus floor and the residual ridge. It can be performed at the same time (one-stage technique) or delayed (two-stage technique) to ensure the primary stability necessary for a successful osteointegration (12).

Sinus augmentation techniques, first developed in the late 1970s and later revised by Summers in the 1990s, have undergone numerous modifications in terms of protocols and surgical instrumentation (Cosci&Luccioli, MISE, CAS, Intralift, Reamer-Mediated TSFE, minimally invasive osteotome SFE, Sinus balloon technique). These techniques are considered safe and predictable, and the most common intra-operative complication reported in the literature is perforation of the Schneiderian membrane.

Some postoperative complications are reported, including sub-antral artery bleeding, hematoma, dehiscence, epistaxis, nasal congestion, infraorbital neurovascular bundle injury, implant migration into the sinus, fistulae, and sinusitis. In the literature, postoperative complications of sinus augmentation surgery appear to be relatively rare compared to intraoperative complications (13).

Perforation of the Schneiderian membrane has been investigated in numerous studies as a factor influencing implant stability. Still, such analyses and evaluations would appear to be much more complex when examining postoperative complications with more limited casuistry (14-16). This short review aims to define the incidence of OACs secondary to sinus augmentation surgery and to define the technique associated with the highest incidence.

MATERIALS AND METHODS

Search strategy

The following short review attempts to answer the questions: "What is the incidence of oroantral communications secondary to sinus lift surgery? Which technique appears to be associated with the greatest risk of this complication?"

By conducting an electronic search on the MEDLINE bibliographic database (Pubmed), 63 articles with a time span from 1994 to 2021 were selected using the following algorithm: "sinus lift " OR "sinus augmentation " OR "sinus graft" OR "maxillary sinus floor elevation" OR "sinus floor augmentation" AND "oro-antral communication" OR "antro-oral communication" OR "oroantral communication" OR "oro-antral fistula" OR "oroantral fistula" OR "oro-sinusal communication" OR "antro-alveolar fistula" OR "fistula" OR "oro-sinusal fistula" OR "sinus-oral fistula" OR "sinus communication" OR "OAF".

Titles and abstracts of the articles were subjected to an initial selection process considering relevance, type of study, and population considered. A hand search was conducted for the resulting studies by analyzing the complete articles and their relevance and adherence to the inclusion and exclusion criteria.

Selection Of Studies

The choice of studies considered fell on cohort studies. Having different purposes than RCTs, CCTs, case series, and case reports, cohort studies provide a direct quantitative measure of the possible complications associated with the interventions examined.

Here we investigated the incidence of postoperative complications during different sinus lift techniques. Specifically, the incidence of oroantral communication was considered. No restrictions were placed on the surgical technique used. The following inclusion criteria were applied for the selection of studies:

- studies reporting data on the incidence of OAC after sinus lift surgery (at least 1 OAC);
- number of patients considered > 10;
- post-operative follow-up;
- absence of systemic and pre-operative sinus pathologies.

In the same way, the following exclusion criteria were applied:

- systemic pathologies contraindicating surgery or preoperative sinus conditions;
- number of patients \leq 10;
- absence of data on postoperative complications (incomplete clinical and/or radiographic documentation) concerning AOC;
- no antibiotic treatment prescribed.

Data extraction

The following data were extracted from the selected studies: 1) year of publication, 2) study design, 3) sample size, 4) mean age, 5) number of sinuses treated, 6) technique used, and 7) number of AOC recorded during follow-up.

Risk assessment bias

The Newcastle-Ottawa Scale (NOS) for cohort studies was used to assess the risk of bias in the individual studies considered. This scale includes a questionnaire divided into three categories: selection, comparability, and outcome. The included studies were classified as good, fair, or poor quality.

Data and statistical analysis

The individual incidence was considered to assess the overall incidence of complications and compare the techniques. The overall incidence was calculated by the sum of the total number of complications and patients for each technique. Then the hypothesis test for difference in proportions was applied to determine whether there was a significant difference between techniques. The null hypothesis was that there was no significant difference between the techniques. An alpha significance level of 0.05 was adopted to establish the threshold for statistical significance, and the value of the Z test statistic was obtained.

RESULTS

Description of studies

The electronic search yielded 63 articles. No language restrictions were applied, and only cohort studies were considered, excluding case series, case reports, RCTs, and CCTs. Titles and abstracts were examined using the previously defined inclusion and exclusion criteria.

After thorough analysis, 21 articles were excluded, and 3 studies were included in the qualitative and quantitative data synthesis. The flow chart in Fig. 1 summarizes the study selection process (17-40).

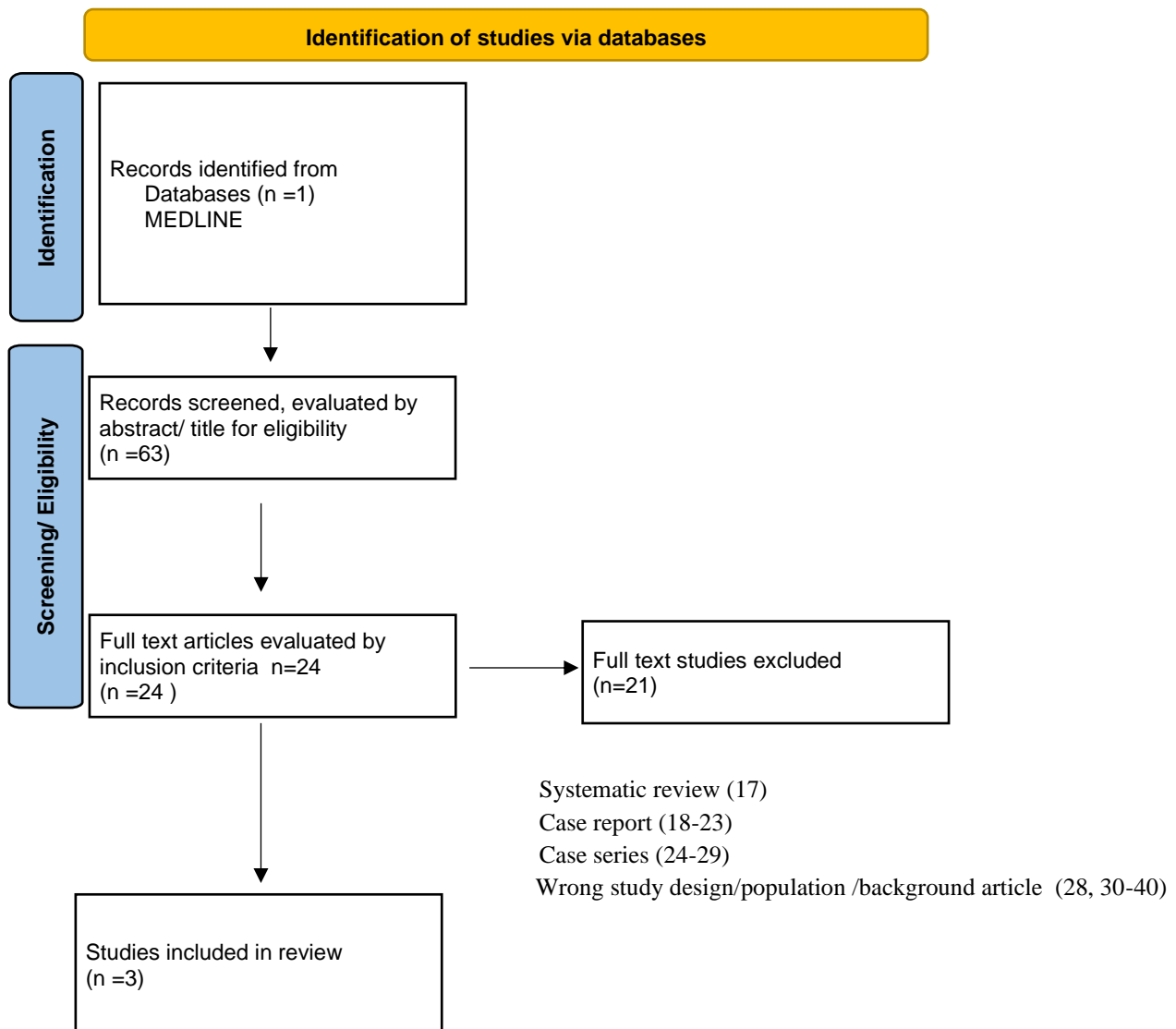


Fig. 1. Summary of the study selection process.

One of the studies (40), although falling within the inclusion criteria, was not considered due to a probable bias related to the biomaterial utilized (natural polysaccharides polymers-coated bovine bone, PBB) that could affect the accurate estimation of the incidence of AOC. After the selection process, therefore, 2 studies (38, 39) were analyzed.

Population

The sample size of the studies considered ranged from 116 to a maximum of 430 patients. The total number of patients treated was 546 (283 M and 263 F). The average overall age was 51.9 years. The age ranged from 26 to 84 years. The total number of sinuses treated was 580.

Operative techniques

The sinus augmentation techniques considered in the two studies involved lateral and crestal approaches. In the first study (39), a one-stage lateral elevation technique was performed on patients with 5/3 mm residual alveolar bone height and 6 mm thickness in the bucco-palatal direction. A crestal incision, a vertical release incision at the level of the

canine, and a distal incision at the level of the second/third molar were made, and a full-thickness flap was performed, which, when flipped over, allowed access to the anterolateral wall of the upper jaw.

An osteotomy was performed using low-speed burs with copious sterile saline irrigation. The sinus membrane and the anterolateral and medial walls of the maxillary sinus were carefully lifted from the floor using dedicated curettes. After membrane elevation, the implant sites were then prepared with calibrated low-speed burs specific to the implant system used. The graft material was inserted under the sinus membrane, and the implants were inserted with a torque value of 30 to 50 N/cm.

The graft materials used were a combination of heterologous, homologous, or alloplastic grafts, and the implant diameters ranged from 3.75 to 5.5 mm with lengths from 10 to 13 mm. A total of 81 patients were treated with unilateral techniques, in 35 patients, the operation involved both sinuses.

The second study under analysis considered a unilateral crestal approach in patients with residual bone height \leq 5mm with contextual insertion of a single implant (38). Sinus access was performed with subtractive techniques using specific drills (Cosci&Luccioli) or by bone compaction using osteotomes (Smart lift technique, Summers' technique). Antibiotic therapy was conducted before and after surgery, and patients were monitored over time at the various follow-ups considered in the studies.

Incidence Of OAC

In the study involving lateral techniques with a total of 151 sinuses and 116 patients, the complication was reported only once with an incidence of 0.8 % (0.6 % based on the number of sinuses treated). Even for crestal techniques for a total of 430 patients and 430 sinuses treated, the presence of an oroantral communication was reported in only one patient, with an incidence of 0.2%.

Risk of bias in included studies

The NOS scores were considered as a rough indicator of the methodological quality of the studies along with other factors, such as the completeness of the reported data. Studies with higher scores were considered to be of good quality, while those with lower scores indicated a potential risk of bias. The two studies were considered both of fair quality.

DISCUSSION

OAC is a pathological pathway connecting the oral cavity and maxillary sinus. Patients with AOC and a developed OAF are prone to acute or chronic sinus infection. OAC complications may occur early after implant placement but rarely long after, and they seldom concern osseointegrated implants (7, 41, 42). It was observed that implant perforation of the Schneiderian membrane is not associated with sinus complications or pathologies, regardless of the extension of the implant protrusion into the sinus (43). There is a lack of clear and defined data in the literature regarding sinus lift procedures.

In the sinus lift group with the lateral approach, the postoperative incidence occurred in only one patient, corresponding to an incidence of 0.8%. In the crestal approach group, on the other hand, there was again only one case of complication, with an incidence of 0.2%. The hypothesis test for difference in proportions was used to determine whether there was a significant difference between the two incidences. The test produced a value of $Z = -0.699$. Considering a significance level $\alpha = 0.05$, the value of Z did not reach the critical threshold to reject the null hypothesis. Consequently, the assumption that one sinus-lift technique has a significantly different incidence than the other is not supported. Considering the two techniques and the reported incidences, the overall incidence calculated taking into account complications and total patients is 0.3%.

Limits

This systematic review has several limitations, particularly the presence of confounding factors that could play a substantial role in the development of the complications examined (i.e., patient age, surgeon experience, contextual or delayed insertion of implants, and biological complications).

The search strategy may also have introduced a potential selection bias into the studies, leading to an overestimation of the overall incidences observed, excluding from the search articles that did not explicitly mention AOC as a possible post-operative complication or articles in which no post-operative complications were reported. Limiting the bibliographic coverage to one database (Medline) similarly could affect the representativeness of the review.

CONCLUSIONS

The incidence of AOC, regardless of the technique used, appears to be a relatively rare complication. Depending on the type of technique considered, the incidence ranges reported in the literature vary from 0.2% to 0.8%. However, the trend of greater incidence observed in the lateral approach does not seem statistically supported. The lack of statistical significance could be influenced by various factors and limitations of the present short review, including the sample size. The actual rarity of this complication would necessitate a larger sample size to determine a direct comparison between the techniques. Furthermore, the surgical protocols used, the surgeon's experience, implant management, and intra-operative complications could play an active role in the occurrence of post-operative complications. Further studies are needed to establish a comparison between the techniques.

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