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ORIGINAL PAPER

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The epidemiological pattern of oroantral communication – a retrospective study

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ABSTRACT

Introduction. Oroantral communication (OAC) between the maxillary sinus and the oral cavity is an infrequent post-surgical complication occurring most commonly after extraction of posterior maxillary teeth.

Aim. To present the characteristics of OAC and predisposing factors as well as evaluate postoperative pharmacological therapy and complications in patients with an OAC.

Material and methods. In this retrospective study, medical records of 63 patients with diagnosed OAC between 2011 and 2018 were analyzed.

Results. The most frequent causes for tooth extraction leading to an OAC were periodontitis (n=34; 54%), carious destruction of the tooth (n=14; 22.2%), and tooth impaction (n=10; 16%). First molars (n=28; 44.4%), second molars (n=14; 22.2%) and third molars (n= 13; 20.6%) were the most frequently related teeth to OACs. The majority of OACs appeared in the fourth (n=22; 35%) and third (n=20; 31.7%) decades of life.

Conclusion. OACs are rarely seen on an everyday basis by general practitioners; however, if left untreated, they may lead to further serious complications. Proper postoperative precautions must be taken in order to prevent further complications, and thus the evaluation of predisposing factors is of great importance.

Keywords. maxillary sinus, oroantral communication, tooth extraction

Introduction

Oroantral communication (OAC) is a rare surgical complication that occurs when an opening is created between the maxillary sinus and the oral cavity. If left untreated, an OAC can lead to further complications, such as the formation of an oroantral fistula (OAF) or an infection of the maxillary sinus.[1] There are a variety of factors that may cause or lead to an OAC, including trauma, tumors, cysts and other pathological entities. Nevertheless, the most frequent cause of OACs is the extraction of maxillary posterior teeth, which can be the result of a close association of maxillary premolars and molars root apices to the maxillary sinus floor.[1-3] This relationship between the root apices and the maxillary si-

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nus floor makes it much easier for complications such as an OAC to occur during an extraction. The occurrence of OACs varies depending on the maxillary tooth being extracted.[2,4,5] OACs may be an iatrogenic complication associated with inadequate surgical technique and therefore it is important to have a proper preoperative plan as well as select the appropriate procedure in the case of maxillary posterior tooth extraction. Such procedures may include preoperative radiographs to assess the location of the roots and state of the maxillary sinus as well as a change in the surgical technique used. Management of OACs is predominantly dependent on the size of the communication between the maxillary sinus and the oral cavity, as well as the overall health status of the patient. In patients with healthy sinuses and an OAC less than 5 mm in size, the communication tends to close spontaneously after the development of a blood clot in the socket. If the communication is between 2 and 6 mm, management includes the placement of a collagen plug into the socket and figure-of-eight sutures. In cases where OACs are larger in size, surgical intervention is required to close the opening.[6,7] Once patients undergo surgical intervention and OAC closure, it is important to follow postoperative sinus precautions to avoid further complications, such as sinusitis or the formation of an OAF. Studies show that if an OAC is maintained open for 48 hours or more, chronic inflammation of the sinus membrane may occur and permanent epithelization of the buccosinusal fistula may form, greatly increasing the risk of sinusitis.[8] The most important issue is to quickly and correctly diagnose OACs to counteract these complications and choose the best method of treatment. Postoperative precautions include the use of decongestants and antibiotics such as penicillin or clindamycin for 7 to 10 days.[9] It seems reasonable to develop a process for the extraction of posterior maxillary teeth, which will minimize the risk and incidence of OAC and associated complications.

Aim

The aim of this retrospective study is to present the characteristics of OAC and predisposing factors as well as evaluate postoperative pharmacological therapy and complications in patients with an OAC.

Material and methods

For this retrospective study, the medical records of 82 patients with documented diagnosis of OAC who were treated between January 2011 and March 2018 at the Department of Oral Surgery and Periodontology and the Emergency Department, Poznan University of Medical Sciences, Poland were reviewed. Initially, this study included 82 patients, however, eighteen patients were excluded from further analysis due to incomplete data. The final study sample included 63 patients, including 33 women (52.4%) and 30 men (47.6%) aged 15 -91 (mean age: 40). In all cases, OAC was diagnosed using the nose-blowing test right after tooth extraction. The comprehensive dental and medical history was taken from all patients in the Department of Oral Surgery and Periodontology and the Emergency Department, Poznan University of Medical Sciences, Poland. The data recorded for each patient included sex, age, tooth number, right or left side involvement, reason for tooth extraction, anesthetic used, prescribed postoperative antibiotics, supplementary drugs, and short-term complications. Anesthesia was performed before the surgical procedure and a buccal flap or a Wassmund flap with Borusiewicz modification was performed for OAC closure. Sutures were removed 6-10 days postoperatively. Antibiotics, either clindamycin or amoxicillin were prescribed to patients postoperatively, as well as nasal decongestants and nonsteroidal anti-inflammatory drugs (NSAIDs). The patients were instructed to avoid nose blowing and sneezing with a closed mouth for 2 weeks, strenuous physical activities, smoking, use of straw as well as rolling their tongue over the wound with sutures.

This data was then analyzed and evaluated using descriptive statistical methods using IBM SPSS Statistics software (v. 23.0, Chicago, IL). P values lower than 0.05 were considered as statistically significant.

Before any study procedure was carried out, written informed consent was obtained from every subject. The study was carried out in accordance with the ethical standards set by the World Association Declaration of Helsinki.

Results

The most common diagnosis for tooth extraction that later led to an OAC was periodontitis (54%), followed by carious destruction of the tooth (22.2%), impaction of third molars (16%) and chronic OAC from previous extractions (7.9%). The distribution of diagnosis for tooth extraction was demonstrated in Table 1. There was a statistically significant difference between the diagnosis for tooth extraction and the age of the patient (p=0.007). A significant correlation was found between the diagnosis for extraction and the tooth number (p<0.05).

The majority of OACs appeared in the fourth and third decades of life (Table 2). The teeth related to the highest occurrence of OAC were the first molars (44.4%), followed by the second molars (22.2%) and third molars (20.6%) (Table 3). A statistically significant difference was observed between the age of the patient and the extracted tooth (p=0.007). In addition, statistical significance was reported between the third molars and the canine (p=0.036), as well as the third molars and the second molars (p=0.019). Conversely, there was no statistical significance between the age of the patient and the postoperative complications.

Table 1. Distribution of diagnosis for tooth extraction that later led to an OAC

Diagnosis	Frequency (n)	Percentage (%)
Periodontitis		
– Acute	8	12.7
– Chronic	26	41.3
Caries	14	22.2
Impaction of third molars	10	15.9
OAC from previous extraction	5	7.9
Total (n)	63	100

Table 2. Distribution of patients with OAC according to decade of life and tooth

Age group	Canine	First premolar	Second premolar	First molar	Second molar	Third molar	Total number of OACs
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
21 – 30	0 (0.0)	2 (3.1)	1 (1.6)	8 (12.7)	1 (1.6)	8 (12.7)	20 (31.7)
31 – 40	0 (0.0)	1 (1.6)	0 (0.0)	11 (17.5)	7 (11.1)	3 (4.8)	22 (35.0)
41 – 50	0 (0.0)	0 (0.0)	1 (1.6)	4 (6.5)	0 (0.0)	1 (1.6)	6 (9.7)
51 – 60	0 (0.0)	1 (1.6)	0 (0.0)	1 (1.6)	2 (3.1)	1 (1.6)	5 (7.9)
61 – 70	0 (0.0)	0 (0.0)	0 (0.0)	2 (3.1)	3 (4.8)	0 (0.0)	5 (7.9)
71 – 80	1 (1.6)	0 (0.0)	0 (0.0)	1 (1.6)	1 (1.6)	0 (0.0)	3 (4.8)
81 – 90	1 (1.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.6)
91 – 100	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.6)	0 (0.0)	0 (0.0)	1 (1.6)

Frequency (n). *P* value =0.007.

Table 3. Incidence of OACs related to tooth and side involvement

Tooth	Right		Left	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Canine	2	3.2	0	0.0
First premolar	3	4.8	1	1.6
Second premolar	2	3.2	0	0.0
First molar	14	22.2	14	22.2
Second molar	10	15.9	4	6.3
Third molar	7	11.1	6	9.5
Total (n)	38	60.4	25	39.6

Table 4. Incidence of postoperative complications

Complication	Frequency (n)	Percentage (%)
Trismus	7	11.11
Fever	2	3.17
Pain	9	14.29
Swelling	9	14.29
Total (n)	27	42.86

The right side of the face was more commonly involved with OAC (Table 3). Additionally, no correlation was observed between the sex of the patient and the diagnosis for tooth extraction, as well as between the sex of the patient and tooth number. The occurrence of OAC was higher in females (52.4%) than in males (47.6%). No statistically significant difference was seen between the sex of the patient and postoperative complications.

Clindamycin was prescribed to 70% of patients, and the remaining 30% received amoxicillin. Nasal decongestants were prescribed in most cases (73%), as well as NSAIDs (60%). The anesthetic most commonly used was articaine 4% with 1:200 000 epinephrine (71.43%), followed by mepivacaine 3% (27%). There was a statistically significant difference between the age of the patient and the anesthetic used ($p<0.05$). A statistically significant correlation was observed between the diagnosis given for tooth extraction and the postoperative use of nasal decongestants ($p=0.012$). Postoperative complications were observed in 42.86% of cases (Table 4). Though, there was no statistically significant difference

between postoperative complications and tooth number, nor between postoperative complications and age of the patient. There was a lack of statistical significance between the use of antibiotics and the incidence of postoperative complications. Moreover, OAF and maxillary sinusitis were not documented complications in follow-up appointments. No significant correlation was observed between the age of the patient and the antibiotics prescribed.

Discussion

OAC is considered a rare complication of oral surgery, with studies reporting various incidence rates, ranging from 0.31% to 13%, and with the occurrence of OAC differing depending on the type of tooth being removed.[2,5,10,11] In the present study, the most common causes of tooth extraction that led to OACs were periodontitis, carious destruction of the tooth, and impaction. Punwutikorn et al., also observed these diagnoses for extractions that led to OAC, but they were less common than OACs caused by dentoalveolar abscess.[10] We observed a significant difference between the diagnosis of periodontitis and impaction. The high frequency of OAC due to periodontitis may be associated with the presence of periapical lesions and narrowing of the periodontal space, which could result in a more difficult extraction and higher risk of OAC.[12] Impaction is most commonly seen in third molars, and are therefore increasingly more difficult to extract.[9] Expansion of the sinus is usually completed after the eruption of permanent teeth, but occasionally, the sinus is further pneumatized, particularly after the removal of one or more posterior maxillary teeth, to occupy the remaining alveolar process.[9] However, our results show that the maxillary first molar was the most important causative tooth of OAC. We concur with various authors who assert extraction of the first molar most often leads to such pathology.[10,13,14] As molar extractions were only observed in 20.6% of cases, our results are in contrast to Wachter et al., who attributed OAC being the most common complication in the maxilla due to the close proximity of the third molars to the maxillary sinus.[15] The main causative teeth of OAC are the last four maxillary, but most often tooth involvement is variable and depends on the consulted sample.[11,16-19]

There is no consensus among various authors concerning the frequency of left side or right side involvement. OAC was found to be as frequent on the left side as on the right by both Del Rey et al. and Punwutikorn et al,.[3,10] The current study showed 60.3% of OACs occurred during extractions performed on the right side of the face. However, Jones et al., found that roots were displaced into the left antrum more frequently than the right antrum.[20] Different degrees of pneumatization may be due to developmental variations during tooth eruption, which could lead to asymmetrical development of the maxillary sinuses, or as stated earlier, due to the removal of one or more posterior maxillary teeth.[9,21] Additionally, previous infections of the sinuses and upper respiratory tract may disturb or change sinus development or cause anatomical anomalies, for example from nasal septum deviation.[22] Hypertrophy of the nasal turbinates and tonsils could also interfere with symmetrical development of the sinuses.[21] Finally, surgical ergonomics will play a role in the performance of an extraction. The position of the dentist will affect the amount of force applied during the extraction, which can vary depending on their position for the side involved, as is determined by their preference to extract in a sitting or standing position, and left or right hand dominance.[9] Other factors, such as how wide the patient can open their mouth, the resiliency of the cheeks, perioral musculature, exaggerated gag reflex, airway liability, and overall patient cooperation may affect the overall performance of the extraction.[9]

Additionally, the literature shows conflicting results with respect to the variable of age and the occurrence of OAC. The risk of OAC increases after the third decade of life, which marks the completion of maxillary sinus development and thus the greatest size.[10] The risk of an OAC occurring in children is minimal due to the smaller size of the maxillary sinus.[3,10,13,16] The age of patients in our study ranged from 21 to 91 years, with a predilection for the group of 30-40 years of age, and a mean of 40 years old. The fourth and third decade of life showed the most frequent occurrences of OAC. Comparably, other authors observe a greater number of OAC in the third, fourth and fifth decades of life.[8,11,13,16,23] Guven justified the increased incidence in the fourth decade of life to the pneumatization of the maxillary sinus from loss of posterior maxillary teeth.[13] However, Del Rey et al., based their study on the appearance of OAC in the extraction of the third molar, and obtained an average of 21 years of age.[3] This is similar in respect to our results, which showed that OACs after third molar extractions occurred most often within the age group of 21-30 years. In a study by Abuabara et al., the average age obtained was 31.2 years old, basing this finding on the overall higher incidence of third molar extractions.[18] Conversely, Punwutikorn et al., found the greatest incidence of OAC occurred as of the sixth decade of life.[10] A higher risk of OAC may result from previous loss of adjacent teeth and increased pneumatization of the sinus, as well as sclerosis of the bone in the elderly, or periodontitis, which makes extraction difficult.[9,12]

In this study, a slight predominance of OAC was found among females. This finding is not in agreement with those reported by other studies, who attributed a greater frequency among males due to a more frequent indication of third molar extraction and increased tech-

nical difficulties than in women.[2,13] With respect to this variable, other studies do not report a difference.[8,3,10,16]

There is no clear decision among authors with respect to antibiotics prescription in patients who are diagnosed with OAC. The present study showed all 63 patients were prescribed antibiotics, with Clindamycin 0,6 given to 44 patients (70%). Nasal decongestants, NSAIDs, or a combination of both were also prescribed to patients. Studies show nasal decongestants are used because they facilitate shrinking of the nasal mucosa, keeping the antral opening patent, and NSAIDs are prescribed for pain control.[1,24] In patients without confirmed penicillin allergy, it is recommended to prescribe amoxicillin with or without clavulanic acid due to better absorption and reduced risk of side effects.[25] However, due to an increased risk of antibiotic resistance, such prescriptions given by dentists should be limited to certain oral bacterial infections with signs of spreading or systemic involvement, or to febrile or immunocompromised patients.[26-29] In our study, the justification for antibiotic prescription was not reported by dental practitioners in patient medical records. It has been shown that generally 30-50% of prescribed antibiotics are unnecessarily or not optimally prescribed.[30] Several authors agree on the recommendation of antibiotic prophylaxis in the postoperative treatment of OACs.[8,13,31] However, depending on the country, antibiotics are not always prescribed after simple extraction with OACs. For example, in the Netherlands, antibiotics and decongestants are only recommended in OACs existing longer than 24 hours or in OACs with evident non-purulent antral infection.[25] Our results showed that there was no significant difference between the drugs used, which leads us to believe that surgical technique is the most important factor contributing to OAC formation.

The present study showed 15.9% of patients reported symptoms of pain, swelling, trismus, and fever after OAC closure procedure. Such symptoms are known possible adverse effects of tooth extraction. We attribute these results to the extraction procedure itself rather than to the postoperative complications of OAC.[9] OACs cause microbial contamination from the oral cavity to the maxillary sinus.[16] If left untreated, an OAC may lead to further complications, including OAF formation, which can further lead to maxillary sinusitis. Previous studies show a sinusitis rate of 60% after the fourth day post-OAC, while others observed a sinusitis rate of 50% by the third day after the occurrence of OAC.[1] The need to confirm diagnosis of OAC within 24 hours is of great importance to ensure successful treatment, and thus eliminating the risk of further complications, such as maxillary sinusitis, from arising.

Infiltration anesthesia was most frequently performed using 4% articaine with 1:200 000 epinephrine, followed by 3% mepivacaine hydrochloride without epinephrine. There are several known benefits of vasoconstrictor addition to local anesthesia, including: reduced peak plasma concentration of the pharmacological agent, increased quality of anesthesia, prolonged duration, reduction of the minimum concentration of anesthetic required, and decreased blood loss during surgical procedures.[32] Articaine is considered advantageous because of its low toxicity, and ability to achieve excellent bone penetration.[33] There was statistical significance observed between the type of anesthesia used versus the age of the patient. We attribute the use of mepivacaine without epinephrine to the fact that with increasing age there is greater likelihood patients will present with existing chronic conditions, which could be contraindications for the use of vasoconstrictor. Such contraindicated conditions may include cardiovascular diseases, stroke, and hyperthyroidism, to name a few.[34]

Our study is the first Polish epidemiological description of OAC incidence during simple tooth extraction. One of the limitations of this study includes a small sample size. It would be beneficial to compare our research with other Polish medical centers to establish specific Polish epidemiological and population features. Other limitations include a lack of evaluation of the difficulty of each tooth extraction, a lack of longer postoperative control of patients, as well as a lack of radiographic control of the affected maxillary sinuses. Furthermore, there was limited general medical data available regarding sinus and respiratory tract disorders. Our study could not take into account the reason for the antibiotic prescriptions given to patients. This shows the importance of the need to further standardize these practices, as we emphasize the need for establishing protocols to prevent the occurrence of OAC.

Conclusion

This study attempted to determine the incidence of OACs that occurred after simple tooth extraction in a Polish general population. Extraction of a posterior maxillary tooth can be a difficult task even for the most experienced dentist and therefore the surgical techniques as well as the dentist's surgical skills are of great importance when it comes to avoiding postoperative complications such as OACs. Since the extraction of maxillary first, second and third molars most commonly leads to an OAC, it is essential to provide dentists with a proper guide for maxillary extractions and postoperative management. Imperative measures that could be useful in the prevention of OAC during routine extractions include proper radiological evaluation before routine extractions, especially in cases of diagnosed periodontitis and tooth impaction in the predisposed age group, ensuring medical history is taken of previous

sinus conditions, and adapting to appropriate surgical techniques after radiological evaluation. Furthermore, prevention of OAC which lead to further complications can be achieved by rapid and appropriate diagnosis after each extraction performed in the posterior region, and following proper postoperative precautions. These factors combined may greatly improve treatment success.

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