

Review Paper: The Prevalence, Etiology & Management of Oroantral Fistula



Ashkan Salari¹, Rasoul Tabari Khomeiran², Vanousheh Norouzi^{3*}

¹ Assistant professor, Dental Sciences Research Center, Department of Periodontics, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran

² Associate professor, Social Determinants of Health Research Center, Guilan University of Medical Sciences, Rasht, Iran

³ Postgraduate of student, Department of Periodontics, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran



Citation Salari A, Tabari Khomeiran R, Norouzi V. The Prevalence, Etiology & Management of Oroantral Fistula . Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2023; 12(3):7-12.

 <http://dx.doi.org/10.32592/3dj.12.3.7>

ABSTRACT



Article info:

Received: 27 Aug 2023

Accepted: 22 Oct 2023

Available Online: 28 Oct 2023

Oroantral Fistula (OAF) is a pathologic and epithelialized path between the oral cavity and the maxillary sinus. Various reasons can lead to its development, the most common of which is the extrusion of upper molar teeth. Any condition that leads to traumatized tooth extraction or conditions that make tooth extraction more difficult, such as: improper use of a dental elevator, teeth with long roots near the sinus, dental infections, etc., increase the probability of this problem. The most common age of occurrence of OAF is between 30 & 60 years old. Most studies suggest that smaller fistulas have a chance of healing spontaneously, but larger types and those that persist for a longer period of time usually do not heal without intervention. It can lead to uncomfortable side effects such as pain, sinusitis, air escaping from the mouth to the nose, and even a change in the person's voice and overall discomfort in the patient. Various surgical and non-surgical treatments have been proposed for the management of OAF. Non-surgical treatments include blocking the area by placing different materials inside defect, and surgical treatments include closing the area with local and regional flaps or in combination with Autografts and Allografts, etc. The purpose of this review article is to investigate the etiology factors of OAF, the prevalence rate and the ways of its management by various surgical and non-surgical treatments.

Keywords:

Oroantral Fistula
Maxillary Sinus
Adipose Tissue
Surgical Flaps
Practice Management Denta

* Corresponding Authors:

Vanousheh Norouzi

Address: Postgraduate of student, Department of Periodontics, School of Dentistry, Guilan University of Medical Sciences, Rasht, Iran

Tel: +9813 33486418

E-mail: dr.vanorouziiii@gmail.com

1. Introduction

Oroantral Communication (OAC), it is a pathological and epithelialized path between the oral cavity and the maxillary sinus. In articles under other titles such as Oroantral

or Oroantral connection, it is also called Oroantral or Orosinusual Fistula (OAF). Most studies use the terms OAC and OAF as synonyms. (1,2)

In Manuel's study, when an OAC is not identified or attempts to close it fail, the condition progresses to OAF,

and when this communicating duct is epithelialized, it is called OAF. In this study, the causes of OAF are called similar to the causes of OAC and it is stated that if there is a problem such as sinusitis, fungal infections, antral pathology that reduce the amount of OAC repair, the lesion will progress to OAF.(3) The most common etiological factor of OAF is the extraction of maxillary molar teeth with an incidence between 0.3% and 4.7% and similar prevalence between the right and left sides.(1) Teeth with long roots, so that are close to the floor of the sinus, high density of alveolar bone that leads to difficulty in tooth extraction, incorrect use of dental elevators to remove the remaining roots, teeth with apical pathology leading to loss of sinus floor bone, they increase the chances of creating an OAC following the extraction of maxillary posterior teeth. (3) Other etiological factors regarding OAC include: dental infection, trauma, radiotherapy, osteomyelitis, orthognathic surgery(2), cysts, tumors, osteonecrosis, failure of implant treatment, dehiscence following failure in posterior of atrophic maxilla(1), progressive sinus pneumatization with increasing age, especially in molars that were only placed in the arch, teeth with unusual anatomy such as dilation, hypercementosis, ankylosis, in cases where the patient dose not follow the instructions after tooth extraction or when the clot formed after tooth extraction in incomplete or dislodged, failed sinus lift treatment and peri-implantitis are cases that increase the chance of creating an OAC.(3) Most authors stated that the most common area of OAF occurrence is the first molar.(1) While other people, such as Güven's study, state the second molar as the most common area.(4) According to Eberhardt's study, the closest distance from the sinus floor belongs to the mesiobuccal root of the maxillary second molar, and the longest distance from the sinus floor was the maxillary palatal premolar.(5) In Elshamaa's study, the highest prevalence of OAF is expressed in the following order: second molars, third molars, first molars, and the lowest in first premolars.(6) The most common age of OAF is between 30 and 60 years old. Due to the fact that the possibility of losing teeth increase with age and the maxillary sinus reaches its largest size in the third decade of life, the probability of developing OAF increases in this age range, and it is less likely to occur in children and adolescents.(7) In terms of gender prevalence between men and women in the studies , different opinions have been raised so that in some studies, the incidence of OAF is higher in men with the justification that the overall rate of traumatic tooth extraction is more common in men than in women.(6-10) some studies reported the incidence of OAF to be equal in both sexes. (11-14) In a study also raises the risk of OAF in women due to the possibility of having larger sinuses.(15)

The present review aims to investigate the etiology factors of OAF, the prevalence rate and the ways of its management by various surgical and non-surgical treatments.

2. Discussion

Most studies believe that fistulas with dimensions less than 5 mm will have a chance to heal spontaneously without intervention, but types larger than 5 mm or those that remain for more than 3 weeks need intervention to close. (2,4,11,16)

Quinzi's study states that fistulas less than 2 mm will close spontaneously, and defects larger than 3 mm or those with evidence of Antrum inflammation will require surgical intervention.(7)

The goal of OAF management is to prevent sinus infection, repair the defect, and restore the integrity of the sinus and oral cavity. (2)

Because remaining OAF can lead to complications such as Pain, sinusitis, air escaping from the mouth to the nose, fluid coming out of the nose, purulent discharge, discharge from the back of the nose and antral polyps into the mouth (17), voice change due to resonance, bad taste or saltiness in the mouth, the patient's inability to blow air cheek and generally feel discomfort in the patient.(4)

To confirm the presence of OAF, several methods can be used, such as the Cotton wisp test or Butterfly test, in which a piece of cotton wisp is kept at the OAF site, while the patient's nose is closed, the patient is asked to blow his nose, because the air flow passes through OAF, Cotton wisp trembles.

Another method is to hold a mouth mirror close to the OAF, which fogs up the mirror due to the passage of airflow, or to place a suction nozzle at the OAF, making a sound like blowing with the mouth into an empty bottle.(3)

Management of OAF includes surgical and non-surgical treatments.

In situations where surgical treatment is difficult due to the patient's general condition, non-surgical treatment is used.

Non-surgical treatment is the creation of a mechanical barrier by placing different materials inside the defect; Such as: acrylic splints, fibrin glue, absorbable implants, etc. (19)

Logan & Coates, in their study, reported a case of non-surgical treatment in a patient with HIV, which OAF was blocked by a palatal plate made of acrylic resin, and after 8 weeks, complete healing occurred. (20)

Surgical treatment of OAF

Surgical treatment should be performed as early as possible.

In 50% of patients who had untreated OAF, they developed sinusitis after 48 hours, and 90% of them showed signs of sinus congestion within 2 weeks during radiological examination. (16)

According to Visscher's study, 10% of OAF closures required reoperation, which increases the risk of recurrence by 15 times in those with sinusitis. (21)

Before surgical treatment, the area should be clinically examined. In cases where the defect has rounded edges and no signs of inflammation, OAF can be closed through surgery. However, if we see signs of traumatized tooth extraction, such that the edges of the lesion are uneven or have signs of inflammation, edema, and tenderness, the conditions are not suitable for surgery. It is necessary to wait a few weeks for improvement in the edges of the defect, then proceed to surgery, because if you have the above conditions, the chance of treatment failure increase. (3)

The types of surgical methods described in the articles include: local flaps, regional flaps, or in combination with Autografts, Allografts, etc. (3)

First Axhausen in 1930 proposed the use of buccal flap for the management of OAF. (7)

Currently, the most popular and common OAF closing surgery is the Buccal Advancement Flap (BAF). Also known as Rehrmann flap, and introduced by Rehrmann in 1963. Currently it is still the most accepted method in the management of OAF. (6)

BAF, It is also known under other titles such as Berger flap and Moczaire flap. The Berger flap, like the Rehrmann flap, is a mucoperiosteal flap that is advanced straight. But the Moczaire flap is a sliding trapezoidal flap. (3)

BAF, It has a wide base to provide sufficient blood supply. A parallel incision in the periosteum at the base of the flap is used to mobilize the flap. Due to the relative simplicity of this technique, it is a suitable method for closing small OAFs. (1)

BAF has a success rate of 93%. (16)

The main disadvantage of this technique is the reduction of vestibular depth, which may require an additional surgery within 6 months after OAF closure in order to increase the vestibular depth. Also, causing pain and edema after work is another disadvantage of this method. (16)

The buccal fat pad(BFP), is an anatomical structure recognized by Heister in 1732 and described by Bichat in 1801 as its fatty nature, also called Bichat Fat Pad.(1)

This anatomical structure is placed in the form of a fat ball between the masticatory muscles and is supplied with blood by three arterial trunks including the maxillary, facial and superficial temporal arteries. The size of this fat ball is constant regardless of people's weight. (16)

The use of this anatomical structure in the management of OAF was first introduced by Egyedi in 1977. (22)

This structure is exposed through an incision in the periosteum in the posterior region of the maxilla in front of the tuberosity. (16)

Advantages of this method: harvesting and easy mobilization, due to the pedicle and rich blood supply, it has constant blood supply, it is adjacent to the surgical area and reduces the surgery time. (17)

It has minimal donor site morbidity, is a potential source of stem cells, and if properly isolated, provides a pedicle graft up to 3x4x7 cm in size.(1)

The average thickness of the BFP is about 6 mm. (18)

Regarding the time required for the epithelialization of this fat tissue, some studies stated a period of 2 weeks (16), some 2-4 weeks after surgery (1) and some more than a period of 2-3 weeks. (17)

One study states that if this adipose tissue is resected with the proper technique, it provides a 3x5x6 cm graft that easily covers an area of 10 cm². (18)

Regarding the main limitation of this technique in one study, the size of the defect is stated, because defects larger than 3x4x4 cm increase the probability of dehiscence. (2)

But in another study, the possibility of harvesting the BFP only once is stated as the main disadvantage of this technique, which may cause a depression in the cheek area. Of course, it is mentioned that there is no need to remove the fat tissue on the opposite side, because it does not create significant asymmetry. (1)

This method does not reduce the depth of the vestibule and as a result does not require secondary surgery (vestibuloplasty) before oral reconstruction, which is superior to the BAF method.

Compared to BAF, more pain and edema were observed with this method, but not significantly.

In general, this method has a higher morbidity compared to BAF. But the patient is able to tolerate it well. (17)

The use of BFP is recommended for the management of medium-sized OAFs, i.e., between 1 and 4 cm. (1)

Another study found BFP to be suitable for closing small- and medium-sized OAFs. (16)

Although the amount of this fat tissue is constant regardless of people's weight, the amount of fat obtained with this technique is different. According to Visscher's study, it depends on the clinical experience of the operator. (23)

Due to the possibility of necrosis of BFP when placed in the oral cavity, it is recommended to be covered by a buccal advancement flap as much as possible. (16)

Shukla's study compared BFP with BAF in the management of OAF and finally stated that BFP is a better choice for OAF closure despite higher morbidity. (17)

Considering that the closure of OAF by soft tissue covering techniques, especially in conditions where the bone defect is extensive, has a high recurrence rate and may require reconstruction by dental implants in the future, some studies suggested the use of hard tissue for the management of OAF. (4, 18, 24)

In 1969, the use of bone grafts in the management of large OAFs was first proposed by Proctor. Which used autogenous iliac bone. (18)

Degheidy's study used a chin bone graft to manage OAF closure. As in 11 of the 20 patients included in the study, OAF was exposed without signs of infection and dehiscens wound was closed. The defect was filled by autogenous chin corticocancellous graft and PRF membrane. It was then covered by an advanced buccal flap. Patients were followed up at 1, 2 weeks, 1, 3, and 6 months in terms of fistula closure and control of possible complications.

CBCT radiographs were used to monitor bone formation immediately after surgery and 6 months later.

Adding a PRF membrane to an autogenous bone graft enhances the possibility of new bone growth. It is effective in closing the mucous membrane of the sinus floor. (7)

In Sharma's study, which was conducted as a case report, a 3-layer method was used including: the use of autogenous chin bone graft, BFP and BAF to close the OAF. The patient was a 45-year-old male, a chronic smoker, with an asymptomatic OAF defect. The patient's only complaint was fluid leakage from the nose while drinking.

For bone grafting from the cortical bone of the chin, it was harvested according to the size of the defect. Inside the OAF defect, it was pressed as a press fit, without the

need for screw fixation.

Then, BFP and BAF were used to cover the bone graft. The defect was closed in 3 layers in order to reconstruct the hard and soft tissue. (18)

The closure of three layers of OAF was confirmed by studies such as Er et al. (25) and Weinstock (26). Er's study showed the superiority of the three-layer method by stating a 20% incidence of wound dehiscence after two-layer OAF closure. (25)

George, in his study used BFP and BAF and an L-PRF membrane and coined the term triple-layer closure. (27)

Agarwal's study investigated the effectiveness of using collagen membrane in the management of OAF. In this study, a Bio-Gide collagen membrane (GTR/GBR Collagen Membrane) was used inside the socket for 10 patients (5 women and 5 men), And connected to the adjacent gum with a suture. Patients were followed up at intervals of 1, 3, 6 week and 3 months.

In all samples, the soft tissue was completely epithelialized, and no relapse was observed in any of the samples during the 3-month follow-up. There was no significant difference in vestibular height before and after treatment. Finally, it was concluded that the collagen membrane is optimally able to close the OAF. And due to its porous structure, which is placed on the side of the bone, it allows the growth of osteoblastic cells and leads to the formation of lost bone in the floor of the maxillary sinus. The rate of bone formation was seen in 90% of patients at 8-week intervals, which is statistically significant, and this rate increased in the 16th week. The collagen membrane will be completely absorbed within 24 weeks. (11)

Various materials have been used in studies to close OAF, such as hydroxyapatite blocks in Zida's study (28) and gold foil in Goldman's study (29).

Elshamaa's study compared two techniques of BFP combined with BAF with Rotational Palatal Flap (RPF) in OAF closure. This study was conducted on 76 patients. All patients were evaluated clinically by Valsalva test at one week and 4 weeks after surgery. And the surgical area was examined for OAF closure and epithelialization. Finally, no significant difference was observed in terms of clinical results between the two methods. This study recommends that the RPF technique is contraindicated and should not be used in cases where the OAF site is very posterior and related to the tuberosity due to the possibility of excessive rotation of the flap leading to the risk of blood supply. (6)

Amin's study compared the two methods of RPF and

BAF in the treatment of OAF. In this RCT study, 120 patients were studied. Both methods showed equal success in OAF closure. It was also concluded that BAF is the most appropriate technique in the management of small fistulas, but PRF alone or in combination with buccal flap is suitable for large fistulas. (10)

One of the rare causes of OAF is periodontal destruction and maxillary sinus infection, which can lead to fistula if it progresses and is not treated.

In Özden's study, a rare case with advanced periodontitis and maxillary sinusitis leading to OAF was introduced. The patient was a 46-year-old man with grade 2 furcation involvement related to tooth #17, which was extracted and the area covered by BFP. (19)

Franco Carro, in his study, stated that only 0.93% of patients had OAF due to periodontal problems. (30)

Another treatment method proposed in the management of OAF is the use of Low Level Laser Therapy (LLLT).

Janas Gresiak-Janias, in his study, used a 30 mw continuous mode laser with a wavelength of 830 nm to manage OAF. At the rate of 3 cycles intraoral and extraoral in a period of 4 days. But the unpredictability and high cost of this method is one of its disadvantages. (31)

Kitagawa, in his study, considered the use of auto transplantation of the third molar to close OAF to be successful. (32)

Currently, there is no agreement on the best method of treatment and management of OAF in studies. Each technique has advantages and disadvantages, and the best method should be chosen according to the conditions. According to Visscher (23), the ideal treatment for the management of OAF should be simple and safe, cost-effective, and ultimately lead to good bone and mucosal healing.

References

1. Quinzi V, Gallusi G, Cannatelli M, et al. Comparison Between Buccal Fat Pad Flap and Buccal Advancement Flap for Closure of Oroantral Fistula: A Systematic Review. Research Square. 2022. [DOI: 10.21203/rs.3.rs-1807441/v1]
2. Arana-Fernández B, Santamaría-Gadea A, Almeida-Parra F, Mariño-Sánchez F. Oroantral Fistula Closure Using Double-Layered Flap: Greater Palatine Artery Flap and Buccal Fat Pad. Laryngoscope. 2023;133(8):1824-27. [DOI: 10.1002/lary.30458] [PMID]
3. Manuel S. OroAntral Communications and OroAntral Fistula. Oral and Maxillofacial Surgery for the Clinician. Springer. 2021:491-512. [DOI: 10.1007/978-981-15-1346-6_24]
4. Güven O. A clinical study on oroantral fistulae. J Craniomaxillofac Surg. 1998;26(4):267-71. [DOI: 10.1016/s1010-5182(98)80024-3]
5. Eberhardt JA. A computed tomographic study of the distances between the maxillary sinus floor and the apices of the maxillary posterior teeth. Oral Surg Oral Med Oral Pathol. 1992;73(3):345-6. [DOI:10.1016/0030-4220(92)90133-B]
6. Elshamaa MM, Elborolsy SA, Mahran H. Buccal Fat Pad Reinforce Buccal Advancement Flap Vs Rotational Palatal Flap in Chronic Oroantral Fistula Treatment. Egyptian Dent J. 2021;67(4):3013-21. [DOI:10.21608/edj.2021.82426.1691]
7. Degheidy S, Al-shareef A, Khalifa M, Saad M. Simultaneous Oroantral Fistula Closure and Sinus lining Repair Using Core Chin Bone Grafting. Egyptian Dental Journal. 2022;68(2):1401-11. [DOI: 10.21608/edj.2022.120780.1975]
8. Delgado Galindez B, Gonzalez Sanchez OJ, Villalpando Carrcon M, Albores Zuniga D. Surgical correction of oroantral fistulae with integration of mandibular bone. Rev Med Inst Mex Seguro Soc. 2005;43:167-72. [PMID]
9. Hirata Y, Kino K, Nagaoka S, Miyamoto R, Yoshi-masu.H,

3. Conclusion

It can be concluded from the present review study that, OAF can be caused by various causes, the most common of which is the traumatic extraction of posterior maxillary teeth. There are a variety of surgical and non-surgical methods for the management of OAF, each with advantages and disadvantages, and there is no agreement on the best method so far in studies. The best method is chosen according to the patient's condition and the ability of the clinician. Failure to treat OAF can cause various complication and discomfort in the patient.

Ethical Considerations

Compliance with ethical guidelines

Not applicable.

Funding

None.

Authors' contributions

AS initiated, conceptualized, and supervised the review work. VN performed data collection. AS and VN wrote the manuscript. All authors read and approved the final manuscript.

Conflict of Interests

The authors declare no conflict of interest.

Availability of data and material

The data used to support the findings of this study are available from the corresponding author upon request.

Acknowledgments

None.

- Amagasa T. A clinical investigation of oro-maxillary sinus perforation due to tooth extraction. *Kokubyo Gkizasshi*. 2001;68:249-53. [DOI:10.5357/koubyou.68.249] [PMID]
10. Amin S, Tayyab TF, Jamal M, Akram MA. Comparison of palatal rotational flap with buccal advancement flap for the treatment of oroantral fistula. *Annals of PIMS-Shaheed Zulfiqar Ali Bhutto Medical University*. 2020;16(2):73-7. [DOI:10.48036/apims.v16i2.314]
 11. Agarwal A, Choudhary A, Verma U. Evaluation of the Effectiveness of Collagen Membrane in the Management of Oro-Antral Fistula/Communication-A Clinical Study. *J Dental Health Oral Res*. 2023;4(1):1-8. [DOI:10.46889/JDHOR.2023.4101]
 12. Punwutikorn J, Waikakul A, Pairuchvej V. Clinically significant oroantral communications-a study of incidence and site. *Int J OralMaxillofacSurg*. 1994;23:1921. [DOI:10.1016/s0901-5027(05)80320-0]
 13. Von Wowern N. Closure of oroantral fistula with buccal flap: Rehrmann versus Móczár. *Int J Oral Surg*. 1982;11(3):156-65. [DOI:10.1016/s0300-9785(82)80003-3]
 14. Abramoff MM, Lopes NN, Lopes LA, Dib LL, Guilherme A, Caran EM, et al. Low-level laser therapy in the prevention and treatment of chemotherapy-induced oral mucositis in young patients. *Photomed Laser Surg*. 2008;26(4):393-400. [DOI:10.1089/pho.2007.2144]
 15. Ogunsalu C. A new surgical management for oro-antral communication: the resorbable guided tissue regeneration membrane-bone substitute sandwich technique. *West Indian Med J*. 2005;54(4):261-3. [Link]
 16. Konate M, Sarfi D, El Bouhairi M, Benyahya I. Management of Oroantral Fistulae and Communications: Our Recommendations for Routine Practice. *Case Reports in Dentistry*. 2021;2021. [DOI:10.1155/2021/7592253]
 17. Shukla B, Singh G, Mishra M, Das G, Singh A. Closure of oroantral fistula: Comparison between buccal fat pad and buccal advancement flap: A clinical study. *National Journal of Maxillofacial Surgery*. 2021;12(3):404. [DOI:10.4103/njms.njms_323_21]
 18. Sharma SP. Three-layered closure of persistent oroantral fistula using chin graft, buccal fat pad, and buccal advancement flap: a case report with review of literature. *Case Reports in Dentistry*. 2019;2019. [DOI:10.1155/2019/8450749]
 19. Özden FO, Özden B, KÖSE Hİ, Demir E, Çelenk P. Oroantral Fistula Associated with Destructive Periodontitis. *Open Dent J*. 2016; 2(2): 45-50. [Link]
 20. Logan RM, Coates EA. Non-surgical management of an oro-antral fistula in a patient with HIV infection. *Australian Dental Journal* 2003;48:(4): 255-258. [DOI:10.1111/j.1834-7819.2003.tb00040.x]
 21. Visscher SH, van Roon MR, Sluiter WJ, van Minnen B, Bos RR. Retrospective study on the treatment outcome of surgical closure of oroantral communications. *J Oral Maxillofac Surg*. 2011;69(12):2956-61. <https://doi.org/10.1016/j.joms.2011.02.102>
 22. Egyedi P. Utilization of the buccal fat pad for closure of oro-antral and/or oro-nasal communications. *J Maxillofac Surg*. 1977; 5(4):241-4. [DOI:10.1016/S0301-0503(77)80117-3]
 23. Visscher SH, van Minnen B, Bos RR. Closure of oroantral communications: a review of the literature. *Journal of oral and maxillofacial surgery*. 2010;68(6):1384-91. [DOI: 10.1016/j.joms.2009.07.044]
 24. Haas R, Watzak G, Baron M, Tepper G, Mailath G, Watzek G. A preliminary study of monocortical bone grafts for oroantral fistula closure. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2003;96(3):263-6. [DOI:10.1016/s1079-2104(03)00375-5]
 25. N. Er, H. Y. Tuncer, Ç. Karaca, and S. Çopuroğlu. Treatment of oroantral fistulas using bony press-fit technique. *Journal of Oral and Maxillofacial Surgery*. 2013;71(4): 659-66. [DOI:10.1016/j.joms.2012.12.010]
 26. Weinstock RJ, Nikoyan L, Dym H. Composite three-layer closure of oral antral communication with 10 months follow-up—a case study. *Journal of Oral and Maxillofacial Surgery*. 2014;72(2):266-e1. [DOI:10.1016/j.joms.2013.09.022]
 27. George E. Triple-layered closure of an oroantral fistula: a case report. *Int J Oral Maxillofac Implants*. 2018; 33:33-6. [DOI:10.11607/jomi.5725]
 28. Zide MF, Karas ND. Hydroxylapatite block Closure of oroantral fistulas: Report of cases. *J Oral Maxillofac Surg*. 1992;50:71-5. [DOI:10.1016/0278-2391(92)90201-a]
 29. Goldman EH, Stratigos GT, Arthur AL. Treatment of oroantral fistula by gold foil closure: Report of a case. *J Oral Surg*. 1969;27:875-7. [PMID]
 30. Franco-Carro B, Barona-Dorado C, Martínez-González MJS, Rubio-Alonso LJ, Martínez-González JM. Meta-analytic study on the frequency and treatment of oral antral communications. *Med Oral Patol Oral Cir Bucal*. 2011;16 (5):682-7. [DOI:10.4317/medoral.17058] [PMID]
 31. Grzesiak-Janias GY, Janias A. Conservative closure of antro-oral communication stimulated with laser light. *Journal of Clinical Laser Medicine & Surgery*. 2001;19(4):181-4. [DOI:10.1089/104454701316918934]
 32. Kitagawa Y. Use of third molar transplantation for closure of the oroantral communication after tooth extraction: a report of 2 cases. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2003; 95(4):409-15. [DOI:10.1067/moe.2003.122]