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The Effectiveness of Different Surgical Techniques in the Management of Oro-Antral Communication and Fistula

(Graduation Project)

A project submitted to the Scientific Committee of the Department of Oral & Maxillofacial Surgery, College of Dentistry / University of Baghdad, in partial fulfillment of requirements for the BDS Degree

By

Hussein Mahmoud Tufah
Hussein Muhannad Abd-Alhussein

Supervised by:
Lecturer. Dr. Firas A. Jamil
BDS, MSc
Oral and Maxillofacial Surgery

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بسم الله الرحمن الرحيم

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صدق الله العظيم

سورة الاسراء

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Declaration

I certify that this project was prepared by the undergraduate students **Hussein Mahmoud Tufah & Hussein Muhannad Abd-Alhussein** under my supervision at the College of Dentistry / University of Baghdad in partial fulfillment of requirements for the degree of Bachelor in Dental Surgery (BDS).

Signature

Lecturer. Dr. Firas A. Jamil

BDS, MSc (Oral and Maxillofacial Surgery)

College of Dentistry, University of Baghdad

Supervisor

Dedication

We dedicate it to our families for their unlimited support throughout all these years and our appreciations and thanks to every one taught us a letter from our childhood until today.

Acknowledgment

First and foremost, We would like to express our utmost gratitude to **Allah** for giving us the strength, endurance and patience to achieve this difficult project.

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We consider it an honor to work with our supervisor **Lecturer. Dr. Firas A. Jamil**. His guidance was greatly beneficial for us in all the time of research and writing of this project.

Abstract

BACKGROUND: Oro-antral communication acts as a pathological pathway for bacteria and can cause infection of the antrum, which further obstructs the healing process as it is an unnatural communication between the oral cavity and the maxillary sinus.

AIMS: This project aimed to review etiologic factors and complications of Oro-antral communication (OAC) and compare the most common techniques employed in surgical closure of oroantral fistula (OAF), explaining both the advantages and disadvantages of each.

MATERIALS & METHODS: A systemic search was conducted in the electronic databases of Google Scholar and MEDLINE (PubMed). Two reviewers independently assessed the articles. The key terms were anatomy and embryology of maxillary sinus, oro-antral communication and fistula, signs and symptoms of OAC and OAF, etiologic factors of OAC and OAF, management of OAC and OAF, indications and contraindications of different surgical flaps and complications of OAC and OAF. Articles that were not related to the purpose of this study were excluded from further evaluation.

RESULTS: The initial search revealed **75** papers (Google Scholar = **43**, PubMed = **32**), of which **46** were excluded since they were irrelevant. The included articles and text books (**29**) were entirely read. They were categorized with respect to their context into five main groups. The results derived from the review process were described under several different topic headings to give readers a clear overview of the literature.

CONCLUSIONS: Repairing oro-antral defects like OAC/OAF is one of the most challenging and difficult procedures in the field of oral and maxillofacial surgery. Particular emphasis should be made in choosing the most appropriate method and each having both advantages and disadvantages.

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List of Abbreviations

Abbreviation	Complete words
No.	Number
&	And
%	Percent
BFP	Buccal Pad of Fat Flap
Fig.	Figure
FESS	Functional endoscopic sinus surgery
GTR	Guided tissue regeneration
L-PRF	leucocytes-platelet-rich fibrin
MS	maxillary sinuses
NSAIDS	Non-steroidal anti-inflammatory drugs
OAC	Oro-antral communication
OAF	Oro-antral fistula
PSAA	posterior superior alveolar artery
PRF	Platelet-rich fibrin
PTFE	Polytetrafluoroethylene

Introduction

Oro-antral communications and fistulas are complications frequently encountered by oral and maxillofacial surgeons. Oro-antral communication is an unnatural communication between the oral cavity and the maxillary sinus **(Hassan et al, 2012**)**.**

Oroantral communication acts as a pathological pathway for bacteria and can cause infection of the antrum, which further obstructs the healing process as it is an unnatural communication between the oral cavity and the maxillary sinus **(Logan & Coates, 2003).**

Oroantral fistula is an epithelialized communication between the oral cavity and the maxillary sinus which has its origin from extraction of upper molar as the most common etiologic factor **(Abuabara et al, 2006).** The term oroantral fistula is used to indicate a canal lined by epithelium that may be filled with granulation tissue or polyposis of the sinus membrane **(Borgonovo et al, 2012).** Oroantral fistulas are common between the ages of 30 and 60 **(Yilmaz et al, 2013).**

OACs may close spontaneously especially when the defect has a size smaller than 5mm. Nevertheless to our knowledge, it has never been actually proven that small OACs(-5mm) will heal by themselves. Also, it is difficult to determine the size of the OAC clinically. To prevent chronic sinusitis and the development of fistulas, it is generally accepted that all of these defects should be closed within 24 to 48 hours **(Visscher et al., 2010).**

The present review compares between different surgical techniques employed in closure of oroantral fistulas regarding advantages, disadvantages, indications, and contraindications. Furthermore, it highlights the possible complications that are associated with each of them.

Aims

1. To review the complication of Oro-antral communications and etiologic factors of OAC/OAF/chronic OAF.
2. To compare the most common techniques employed in surgical closure of oroantral fistulas, explaining both the advantages and disadvantages of each.
3. To describe the indications and contraindications of different surgical techniques.
4. To clarify the limitations of use for all techniques.

Chapter One

MATERIALS & METHODS

Materials and Methods

1.1 Sample Selection

An electronic search of English articles was conducted on Google Scholar and MEDLINE (PubMed). Two reviewers independently assessed the articles. The key terms were anatomy and embryology of maxillary sinus, oroantral communication and fistula, signs and symptoms of OAC and OAF, etiologic factors of OAC and OAF, management of OAC and OAF, indications and contraindications of different surgical flaps and complications of OAC and OAF.

Titles and abstracts were reviewed and the full text was assessed for an appropriate analysis. Clinical trials, classical studies, multicenter studies, case reports, textbooks, and reviews of the literature were included in this review. Articles that were not related to the purpose of this study were excluded from further evaluation.

Chapter Two

Results

Results

2.1 Descriptive Statistics

The initial search revealed **75** papers (Google Scholar = **43**, PubMed = **32**), of which **46** were excluded since they were irrelevant. The included articles and text books (**29**) were entirely read. They were categorized with respect to their context into five main groups as clearly shown in **table 2-1**. The results derived from the review process were described under several different topic headings to give readers a clear overview of the literature.

Table (2-1): Descriptive statistics of the included papers regarding different groups.

Group	No. of articls & text books	%
Anatomy and Embryology	2	6.9
Oro-antral communication and Fistula	11	37.9
Surgical Techniques	8	27.6
Indications and Contraindications of Different Procedures	5	17.2
Complications of Surgical Maneuver	3	10.3
Total	**29**	**100**

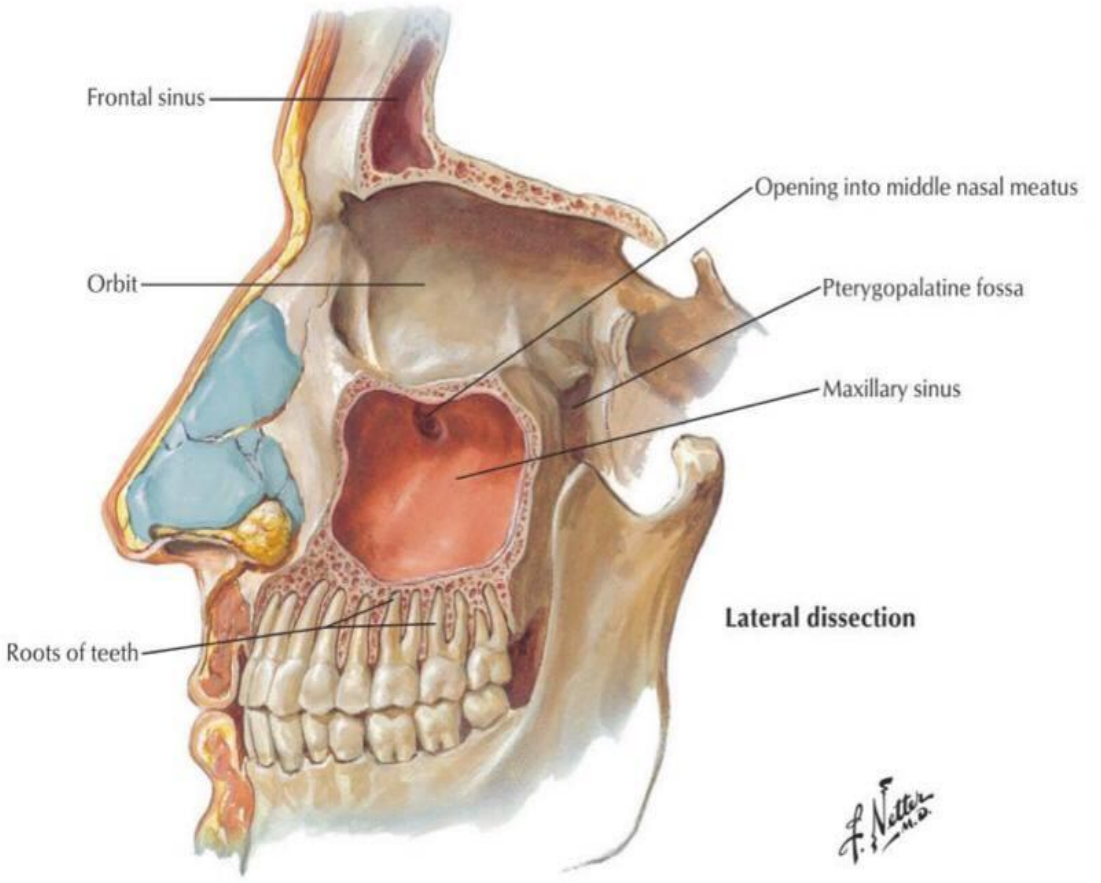
Chapter Three

Review of literature

Review of literature

3.1 Anatomy & Embryology

There are four pairs of paranasal sinuses: the maxillary, ethmoid, frontal and sphenoid. They are air-filled, mucosa-lined spaces within the maxillofacial region and skull centred on and communicating with the nasal cavity. The maxillary sinuses were first illustrated and described by Leonardo da Vinci in 1489 and later documented by the English anatomist Nathaniel Highmore in 1651. The maxillary sinus, or antrum of Highmore **(Fig. 3.1)**, lies within the body of the maxillary bone and is the largest and first to develop of the paranasal sinuses. The alveolar process of the maxilla supports the dentition and forms the inferior boundary of the sinus **(Whyte & Boeddinghaus, 2019).**



(Fig. 3.1): Maxillary sinus lateral dissection. **(Hansen, 2014)**

The maxillary sinuses (MS) begins to form during the 10th week of development. These invaginations fuse during the 11th week of development, giving rise to a single cavity representing the primordium of the maxillary sinuses. The primordial shape of the sinus is characterized as an oval cavity with smooth walls. Rapid growth of the maxillary sinuses has been observed during two periods of development: from the 17th to the 20th week and from the 25th to the 28th week **(Nuñez-Castruita, 2012).** The floor of the sinus is related to the roots of the first premolar teeth at age 4 years and the second molar teeth at age five years, and may extend to the third molar teeth and/or to the first premolar teeth, and sometimes to the canine teeth **(Standring, 2015).**

3.1.1 Structure

The anterior wall of the MS is formed by the facial surface of the maxilla and is internally grooved by the canalis sinuosus (which houses the anterior superior alveolar nerve and vessels).The anterior wall as three major landmarks: **(Standring, 2015).**

(1) the thin canine fossa;

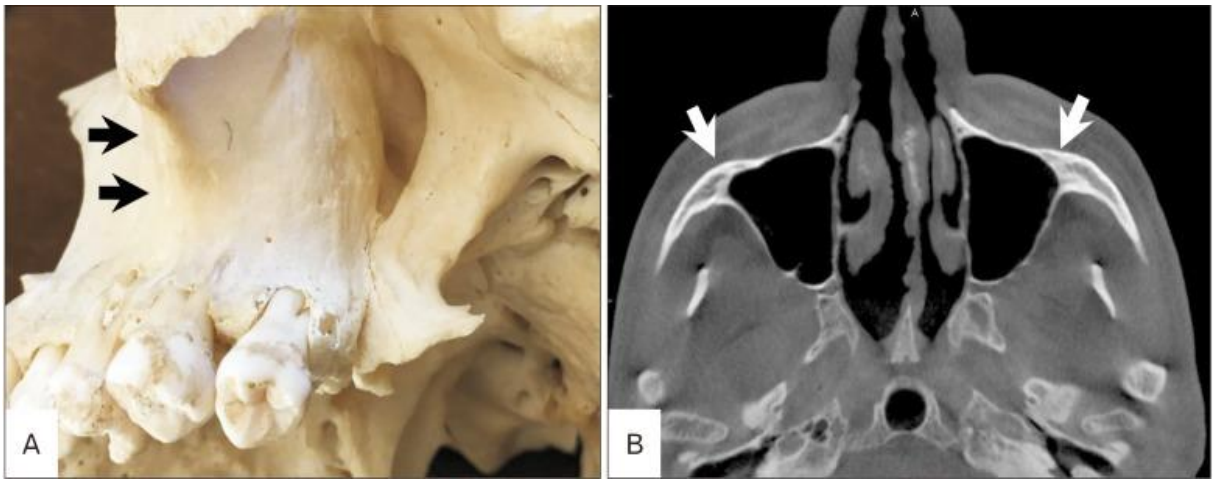
(2) the infraorbital foramen located in the midsuperior region.

(3) the infraorbital groove.

The posterior wall is formed by the infratemporal surface of the maxilla **(Standring, 2015).** It forms the anterior border of the pterygopalatine fossa **(Duncavage, 2011).** The superior wall is formed by the fragile, triangular orbit floor, with the infraorbital groove running through it. **(Standring, 2015).**

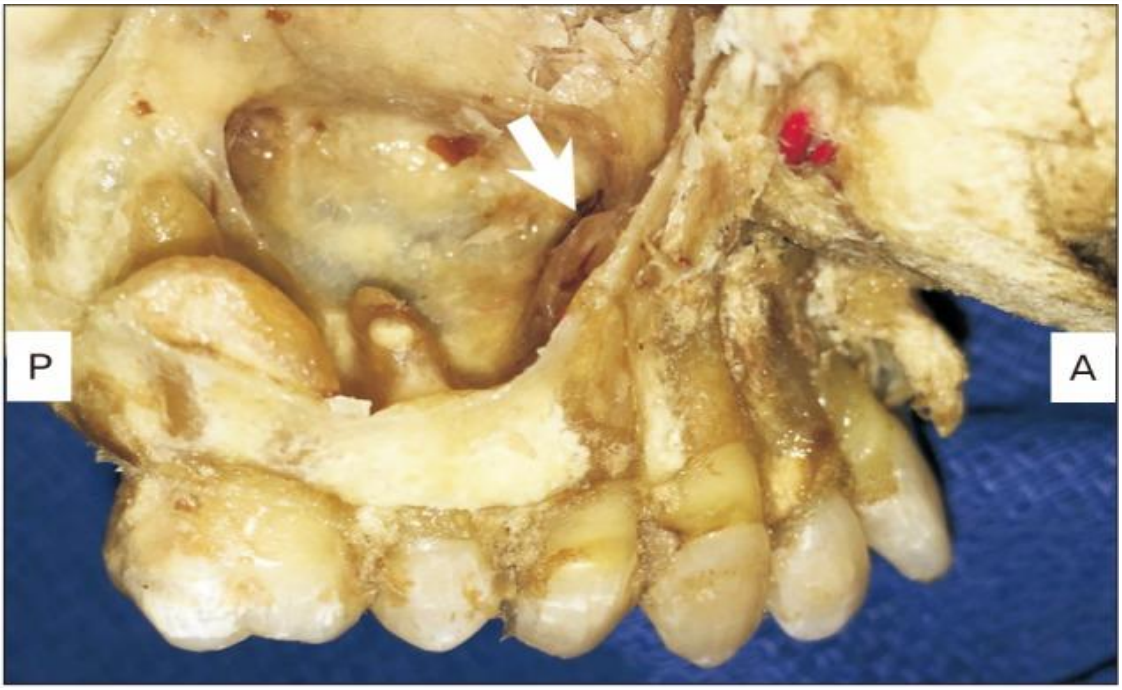
The roof of the sinus thickens toward the orbital margin, with a mean thickness of 0.4 mm medial to the infraorbital canal and 0.5 mm thick lateral to it **(Lang, 1989).**

The medial wall of the MS separates the sinus from the nasal cavity. It is smooth on the sinus side and carries the inferior nasal conchae on the nasal side. The medial wall is rectangular in shape and is slightly deficient at the maxillary hiatus. The lateral apex of the MS extends into the zygomatic process of the maxilla **(Fig. 3.2),** and can reach the zygomatic bone therefore forming the zygomatic recess **(Standring, 2015).**



(Fig. 3.2): The maxillary sinus extending into the zygomatic process (arrows). (A) Dry skull (inferolateral view). (B) Computed tomography (axial image). **(Standring, 2015)**

The floor of the sinus is formed by the alveolar and palatine processes of the maxilla and lies below the nasal cavity, which is usually located from the mesial part of the first premolar to the distal part of the third molar with the lowest at the first and second molar (**Fig. 3.3)**. The floor of the sinus is separated from molar dentition by a thin layer of compact bone **(Duncavage, 2011).**



(Fig. 3.3): Relationship between teeth and maxillary sinus (right side). Note the root of the first premolar (arrow) is located most medially. **(Duncavage, 2011)**

3.1.2 Blood supply

Vascular supply to the maxillary sinus is derived primarily from branches of the maxillary artery: the posterior superior alveolar artery (PSAA), the infraorbital artery, and the posterior lateral nasal artery. The PSAA can course along the medial wall of the sinus. The infraorbital artery passes along the infraorbital groove and canal, under the orbit, and finally through the infraorbital foramen on the facial surface of the maxilla **(Flanagan, 2005).** The PSAA and the infraorbital artery anastomose along the anterolateral wall of the sinus, supplying the mucous membrane of the nasal chambers. An extraosseous anastomosis often exists between these two arteries **(Standring, 2015).**

The posterior lateral nasal artery branches from the sphenopalatine artery and passes through the sphenopalatine foramen to enter the nasal cavity and can be found within the medial wall of the sinus. As it continues anteriorly, theposterior lateral nasal artery begins to branch, supplying blood to the posterior and medial wall of the sinus **(Flanagan, 2005).**

3.1.3 Innervation

The maxillary sinus receives general sensation innervation from the infraorbital and anterior, middle, and posterior superior alveolar branches of the maxillary nerve (V2) **(Standring, 2015).** Most sensory innervation is provided by the posterior superior alveolar branch, which usually has two to three branches**(Duncavage, 2011).** The anterior superior alveolar branch innervates the anterior portion of the maxillary sinus, whereas the middle superior alveolar branch contributes secondary mucosal innervation. The ostium of the maxilla is innervated by the greater palatine nerve while the infundibulum is innervated by the anterior ethmoidal branch of the ophthalmic nerve (V1) **(Iwanaga et al, 2019).** Parasympathetic secretomotor fibers originate from the nervus intermedius of the facial nerve, synapsing in the pterygopalatine ganglion and proceeding to the sinus mucosa via the trigeminal sensory branches **(Duncavage, 2011).**

3.2 Oroantral Communication and fistula

Oro-antral communication is an unnatural communication between the oral cavity and the maxillary sinus **(Hassan et al, 2012).**

Oroantral fistula is an epithelialized communication between the oral cavity and the maxillary sinus which has its origin from extraction of upper molar as the most common etiologic factor **(Fig. 3.4) (Abuabara et al, 2006).**

These complications occur most commonly during extraction of upper molar and premolar teeth (48%). The major reason is the anatomic proximity or projection of the roots within the maxillary sinus **(Khandelwal &Hajira, 2017).**

(Fig. 3.4): Oro-antral fistula**. (Moore et al, 2011)**

3.2.1 Sign and Symptoms

Symptoms have been classified based on whether the OAC is acute or chronic (OAF) **(Malik, 2008).**

Acute OAC

- Epistaxis
- Escape of fluid from mouth to nose
- Excruciating pain in and around the region of affected sinus
- Escape of air from mouth to nose on sucking, inhaling or puffing the cheeks
- Enhanced column of air causing alteration in vocal resonance and subsequently change in the voice

Chronic OAC

- Negligible pain as the fistula becomes established and allows the free escape of fluids

- Development of an antral polyp seen as a bluish red lump extruding through the fistula
- Postnasal drip accompanied by unpleasant taste, nocturnal cough, hoarseness of voice, ear ache or catarrhal deafness
- Persistent mucopurulent, foul, unilateral nasal discharge from the affected nostril especially when head is lowered

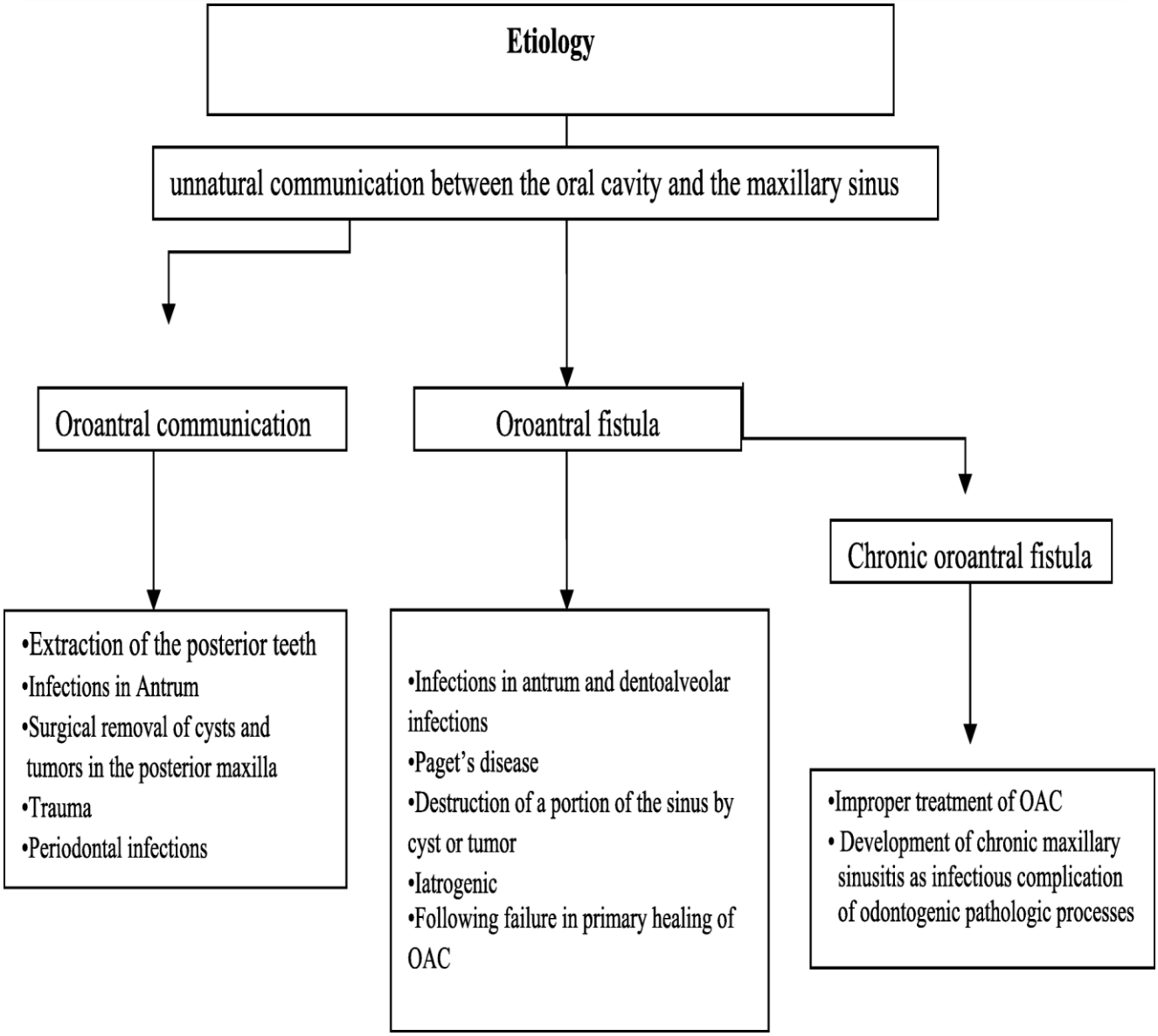
3.2.2 Etiologic factors of OAC/OAF/chronic OAF

These complications occur most commonly during extraction of upper molar and premolar teeth (48%). The major reason is the anatomic proximity or projection of the roots within the maxillary sinus **(Hassan et al, 2012**).

Maxillary second molar extractions cause 45% of OACs, third molars cause 30%, first molars cause 27.2%, and first premolars cause 5.3% **(Parvini, 2019).**

Due to the close relationship of the roots to the antrum and partially very thin maxillary sinus floor, the extraction of the upper molars and premolars, especially the extraction of the first molars, is considered the most common etiology of OAC **(Hirata et al, 2001).**

Other causes of OAC/OAF (**Fig. 3.5)** include tuberosity fracture, dentoalveolar/periapical infections of molars, implant dislodgement into maxillary sinus, trauma (7.5%), presence of maxillary cysts or tumors (18.5%), osteoradionecrosis, flap necrosis, dehiscence following implant failure **(Scattarella et al, 2010).**



(Fig. 3.5) : Illustrates the etiologic factors of OAC/OAF/chronic OAF. **(Parvini, 2019)**

3.2.3 Complications of OAC

Chronic communication between oral cavity and maxillary sinus can act as a pathway for further bacterial and fungal penetration **(Borgonovo et al, 2012).**

Sinusitis has been reported to occur in 60% of cases on the fourth day after sinus exposure **(Watzak et al, 2005).**

Long-standing OAF can cause a general systemic toxaemic condition leading to fever, malaise, morning anorexia, frontal and parietal headache, anosmia and cacosmia **(Malik, 2008).**

Further complications of OAC may result from the removal of cysts or tumors, implant placement, and pathological procedures like osteomyelitis. In addition to the size of the defect, possible maxillary sinusitis, odontogenic infections, cysts, tumors, foreign bodies in the maxillary sinus, and osteitis and osteomyelitis changes also likely play a crucial role in the formation of a chronic oroantral fistula. Furthermore, improper treatment of OAC can produce maxillary sinusitis and become chronic **(Mehra & Jeong, 2009).**

3.2.4 Diagnosis

Patient usually complains of nasal regurgitation of liquid, altered nasal resonance, difficulty in sucking through straw, unilateral nasal discharge, bad taste in the mouth and whistling sound while speaking. Pain may be present at malar region. At later stage, there is formation of antral polyp which is visible through the defect intra-orally. However, some patients may be asymptomatic. Clinically, a large fistula is easily seen on inspection. However, diagnosis of small defect scan be made by the nose blowing test. The patient is asked to close his nostrils and blow gently down the nose with the mouth open **(Scattarella et al, 2010).**

Presence of OAF appears as a whistling sound as air passes down the fistula into the oral cavity. It can also be seen as air bubbles, blood or mucoid secretion around the orifice. The escape of air through the nostril can be tested by placing a cotton wisp near the orifice. A mouth mirror placed at oroantral fistula causes fogging of the mirror. Probing (the introduction of a probe into the antrum through the fistula) should never be attempted. Panoramic radiograph gives an accurate estimation of the dimension of the bony defect of

the fistula and also reveals about the presence and location of dental roots or implants or any foreign body that may have been dislodged into the antrum. Computed tomography can be done to rule out the presence of maxillary sinusitis **(Scattarella et al, 2010).**

3.2.5 Prevention of OAC/OAF formation

Where the risk of OAC formation is anticipated, the patient should be warned preoperatively and steps should be taken to avoid this complication. Surgical exodontia is preferable to forceps extraction because it allows more control over bone removal and by tooth division, enables individual roots to be delivered away from the thin antral floor. If a mucoperiosteal flap is raised its design should allow it to be adapted for OAC repair if necessary **(Pedlar & Frame, 2007).**

3.3. Management of OAC and OAF

The objective of the management of OAC/OAF is the closure of the defect and prevention of oral bacteria and food debris penetrating the sinus. Oroantral communication can cause sinus contamination leading to infection, impeded healing, and chronic sinusitis **(Borgonovo et al, 2012).**

It is possible that a small OAC of less than 2 mm in diameter, without epithelialization and in the absence of sinus infection, can heal spontaneously after a blood clot is formed **(Liversedge & Wong, 2002).** However, defects that are larger than 5 mm in diameter or those that present for more than 3 weeks rarely heal spontaneously and typically will require surgical intervention **(Kraut & Smith, 2000).**

Technical choice of professionals for the closure of oroantral fistula can be influenced by the clinical aspects of each defect (location and size), further prosthetic treatment, and experience of surgeons **(Yalcin et al, 2011).** Unilateral odontogenic sinus infection is treated and cured by drainage and

removal of the odontogenic cause. Further factor is the outcome desired like the choice for bone or bone substitute grafting technique if the dental implant has to be placed in the near future. Moreover, in relation of OAC to adjacent teeth, the height of the alveolar ridge, duration of OAC, existence of inflamed sinus, and the general health of the patient should be taken into consideration **(Guven ,1998).**

Many techniques have been described for the closure of oroantral fistula, including local and soft tissue flaps. Other techniques include grafts, allogenous, xenografts, alloplastic materials, and other methods like guided tissue regeneration (GTR) or immediate implantation of a dental implant **(Parvini, 2019).**

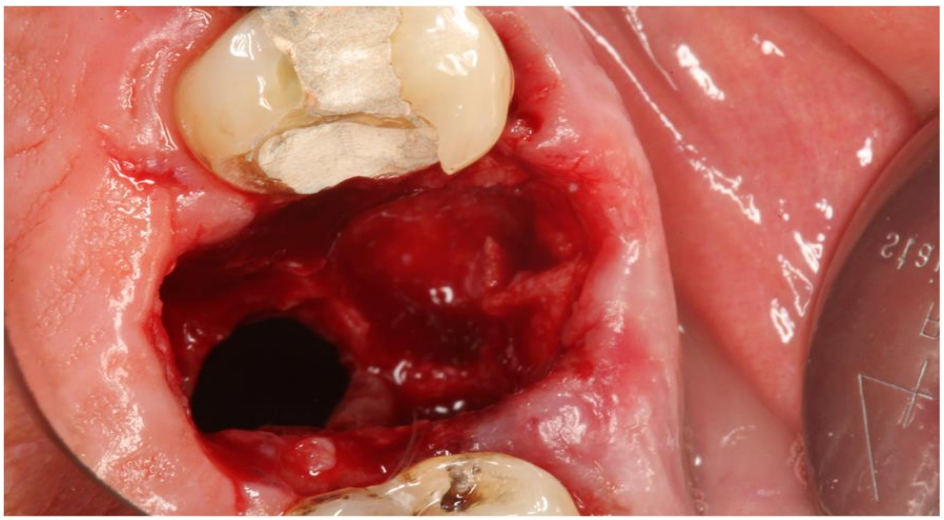
The OAC must be closed within 24–48 h as its persistence increase the possibility of maxillary sinusitis **(Poeschl et al, 2009).** Therefore, a confirmatory and early diagnosis of OACs is mandatory to permit successful closure. Also, management of oro-antral communication to promote closure should be done within 24 hours. If left untreated, an OAC can develop into an OAF or chronic sinus disease. In cases with larger oro-antral communications and in patients with history of any sinus disease, surgical closure is indicated **(Haas et al, 2003).**

Decision on how to treat an OAC should be based on the size of communication ,time of diagnosis, and presence of an infection. Furthermore, the selection of treatment strategy is influenced by the amount and condition of tissue available for repair and the possible placement of dental implantas in the future **(Watzak et al., 2005).**

They are their own advantages and disadvantages depending on the cases and the size of the defects occurred. Most of them rely on mobilizing the tissue and advancing the resultants flap into defect **(Ahmed & Askar, 2011).**

3.3.1 Intraoral examination

The large OAC (**Fig. 3.6) ;** is easily seen on the investigation. At a later stage, the antral polyp is seen through the defect **(Parvini, 2019).**



(Fig. 3.6): Clinical OAC after the extraction of a molar. **(Parvini, 2019)**

3.3.1.1 Valsalva test

The patient is instructed to try to exhale through a blocked nasal airway. However, a negative test does not exclude the possibility of antral perforation. It is worth noting that the detection of small perforations is not always possible **(Kretzschmar & Kretzschmar, 2003).**

3.3.1.2 Cheek-blowing test

The patient is asked to blow air into the cheeks against a closed mouth. This test is considered a risk of antral complications due to the spread of microorganisms from the oral cavity into the maxillary sinus **(Parvini, 2019).**

3.3.1.3 Exploration of the perforation with probing

Attempt of probing the fistula is likely to result in sinusitis or widening of the fistula due to pushing of foreign bodies or bacteria into the maxillary sinus.

Furthermore, probing may lead to laceration of the sinus membrane, which may sometimes be intact **(Khandelwal &Hajira, 2017).**

3.3.2 Radiographic Features of OAC and OAF

Radiological investigation of the site of OAC and OAF is required to validate the clinical findings and to investigate the presence of foreign body within the antrum. From an anatomical point of view, several different radiographic investigations are required to show all areas of the antral anatomy well because of the complexity of its anatomy **(Whaites, 2002).**

Radiologically, bone discontinuity of the floor of the maxillary sinus is evident. Patients with OAF are most susceptible to sinus infections. Therefore, radiological investigation of the maxillary sinus is recommended. Periapical film or panoramic radiography can provide an idea about the bony defect size of the OAC and OAF. Radiologically, they reveal the disruption of the border of sinus. Periapical radiograph provides detailed information about the bony radiographic changes owing to its inherent technique quality. Moreover, it confirms the presence and location of the foreign body that may have been dislodged into the antrum **Koenig, (2017); Nah, (2008).**

The maxillary sinus and the trajectory of the communication can be visualized by occipitomental and panoramic radiography. However, periapical film and panoramic radiography techniques give only a two-dimensional view of complicated three-dimensional (3D) structures. In addition, the structures are superimposed **(Parvini, 2019).**

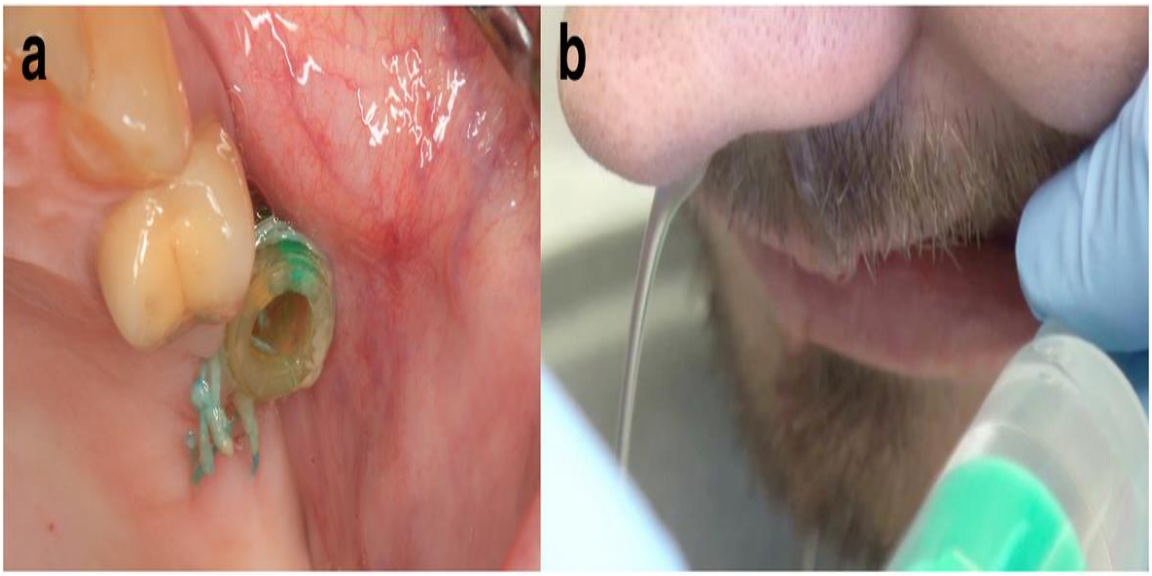
3.3.3 Medical history

Medical history serves to identify patients who have a higher risk to develop complications during or after closure of OAC. Cardiovascular disease, diabetes, renal dysfunction, and hematological disorders may increase the risk

of complications such as bleeding, infections, and delayed tissue healing **(Renton et al, 2013).**

3.3.4 Perioperative Management

Preoperatively, drainage and irrigation with saline through the OAC of the affected maxillary sinus should be achieved in cases with sinus infection and degenerated mucosa **(Fig. 3.7)**. This procedure should be performed until the lavage fluid is clear and no longer contains inflammatory exudates. Nasal decongestants shrink the nasal mucosa and keep the antral opening patent for drainage **(del Rey-Santamaria et al, 2006).**



(Fig. 3.7): a Drainage through the OAC. b Irrigation with saline through the OAC. **(Parvini, 2019)**

3.3.5 Operative Management

The size of the OAC and opening duration are crucial prognosis factors in treatment. However, primary suturing the gingiva with a figure-of-eight suture closes the communication effectively. When this does not provide adequate closure, a soft tissue closure using a buccal or palatal flap is indicated **(Visscher et al, 2010).**

It is also possible to close the OAC simultaneous with an immediate implant or to perform an external sinus elevation **(Doobrow et al, 2008).**

3.3.6 Postoperative Management

The patients should be instructed not to eat hard food items. They should eat soft food items and drink fluid from the opposite side to avoid trauma to operated site. Strenuous physical activities which can increase the intra-sinusoidal pressure should be avoided until healing occurs. Nose blowing and sneezing with a closed mouth is prohibited for 2 weeks. Patient should open mouth while coughing or sneezing. Patients should not roll tongue over suture line or the flap for 07 days after surgery. The wound should be kept clean with warm saline mouth rinses. Use of straw or smoking is prohibited. Use of steam inhalations such as menthol or benzoin 6 hourly moistens the airway and stimulates serous gland activity preventing crusting of blood and mucous **(Waldrop & Semba, 1993).**

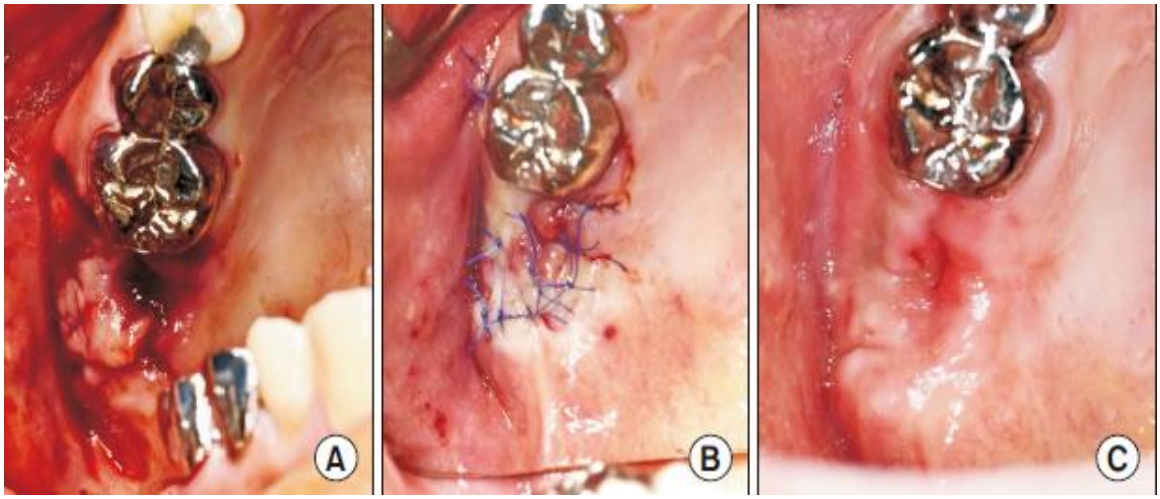
All patients should receive amoxicillin plus clavulanic acid (Augmentin/Amoxyclav), 1 g twice daily, or clindamycin, 300 mg 3 times daily for at least 5 days, and a decongestant nasal drops (Otrivin 0.05%).Nasal decongestants shrink the nasal mucosa and keep the antral opening patent for drainage. Non-steroidal anti-inflammatory drugs (NSAIDS) should be prescribed for pain control **(Scattarella et al, 2010).**

3.4 Surgical techniques

3.4.1 Local Soft Tissue Closure

3.4.1.1 Buccal flaps

In 1930, Axhausen first described the use of a buccal flap with a thin layer of buccinator muscle for closure of an oro-antral defect **(Fickling, 1957).** Later, Berger advocated a buccal sliding flap technique for closure of small to medium sized (< 1 cm) fistulas which are located either laterally or at center of the alveolar process **(Berger, 1939).** Buccal flaps are among the most commonly used techniques for the OAC closure. This is due to the simplicity of the technique **(Lazow, 1999).** This procedure involves the design of a broad-based trapezoid mucoperiosteal flap and its placement over the defect followed by sutures **(Fig. 3.8) (Min-Soo Kwon et al, 2020).**



(Fig. 3.8): A. shows a fistula the size of a single tooth on the second premolar region of the maxilla. B. The buccal sliding flap covering over the fistula and sutured with the palatal mucosa can be seen. C. Complete healing was obtained at three weeks after the surgery. **(Min-Soo Kwon et al, 2020)**

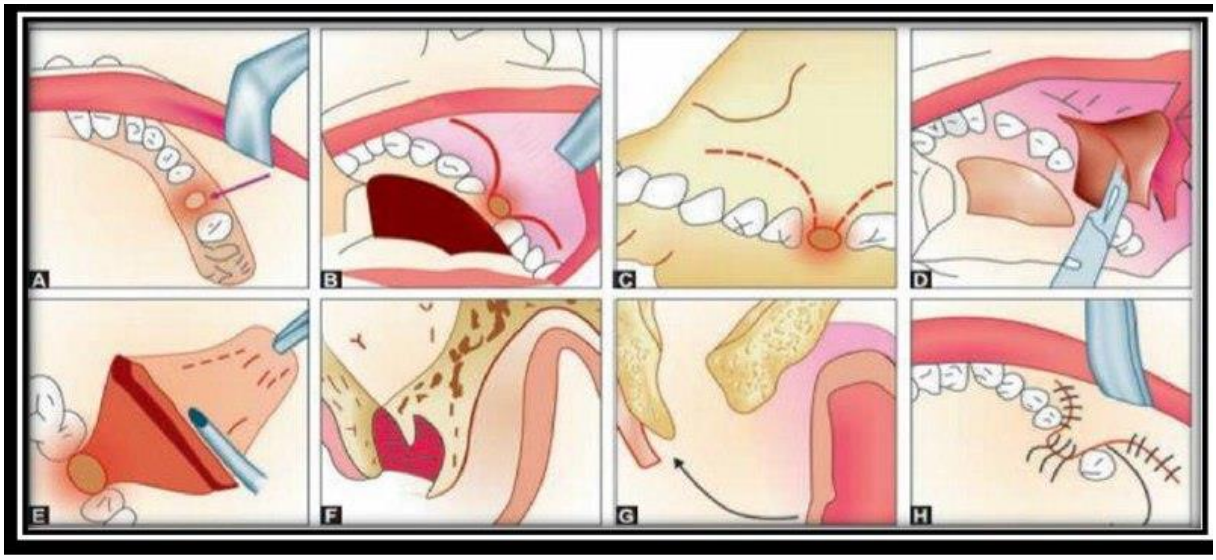
After excising the epithelialized margins, two vertical release incisions are given to develop a flap with adequate dimensions for closure of the oro-antral defect. Epithelial lining of the palatal mucosa behind the communication is also excised. This trapezoidal flap consists of both epithelium and connective

tissue. The flap is then placed over the defect and sutured using horizontal mattress sutures from the buccal mucosa to the palatal mucosa. The advantage of the buccal flap technique is that this method can be used when the alveolar ridge height is very low and the fistula is located in a more mesial area. However, the loss of the vestibular depth represents a major disadvantage requiring an additional vestibuloplasty in patients wearing removable dentures **(Borgonovo et al, 2012).**

3.4.1.2 Modified Rehrmann's Buccal Advancement and Môczáir Flap

Rehrman's flap and Môczár flap are the two most commonly used buccal advancement flaps. These two flaps may also have disadvantages when compared to simple suturing, because the reflection of a mucoperiosteal flap may result in swelling, and also requires the dentist to have proper training to perform this operation. Another disadvantage of the buccal advancement flap is the risk of losing the depth of the vestibular sulcus, even though the Môczár flap results in less vestibular sulcus flattening **(Dergin et al, 2016).**

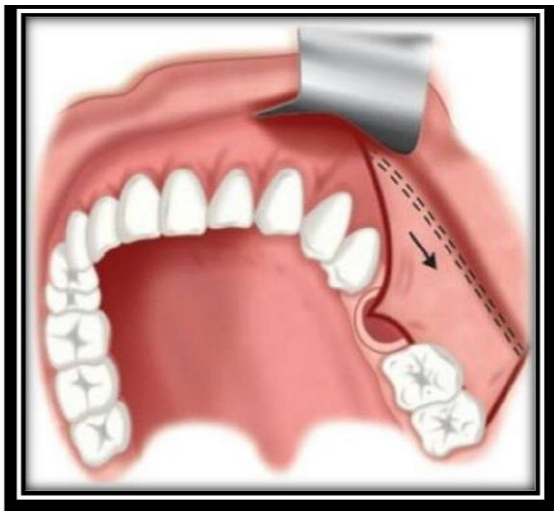
Buccal advancement flaps **(Fig. 3.9),** can be safely preferred in dentate patients with no alveolar resorption and a bony defect of less than 5 mm size in the sinus floor for the immediate closure of the OAC. Buccal flaps can be used in edentulous patient also if the fistula is on the buccal side of the alveolar crest **(Yalçın et al, 2011).**



(Fig. 3.9): Diagram of oroantral fistula closure by buccal advancement flap,Modified Rehrmann's procedure. **(Malik, 2012)**

In Môcz**á**ir Flap**,** Described by **Môcz**á**ir (1930),** closure of alveolar fistulas is usually performed by the buccal sliding flap (**Fig. 3.10)** shifting the flap one tooth distally. This technique produces only a negligible change in the depth of the buccal vestibule **(Parvini et al, 2018).**

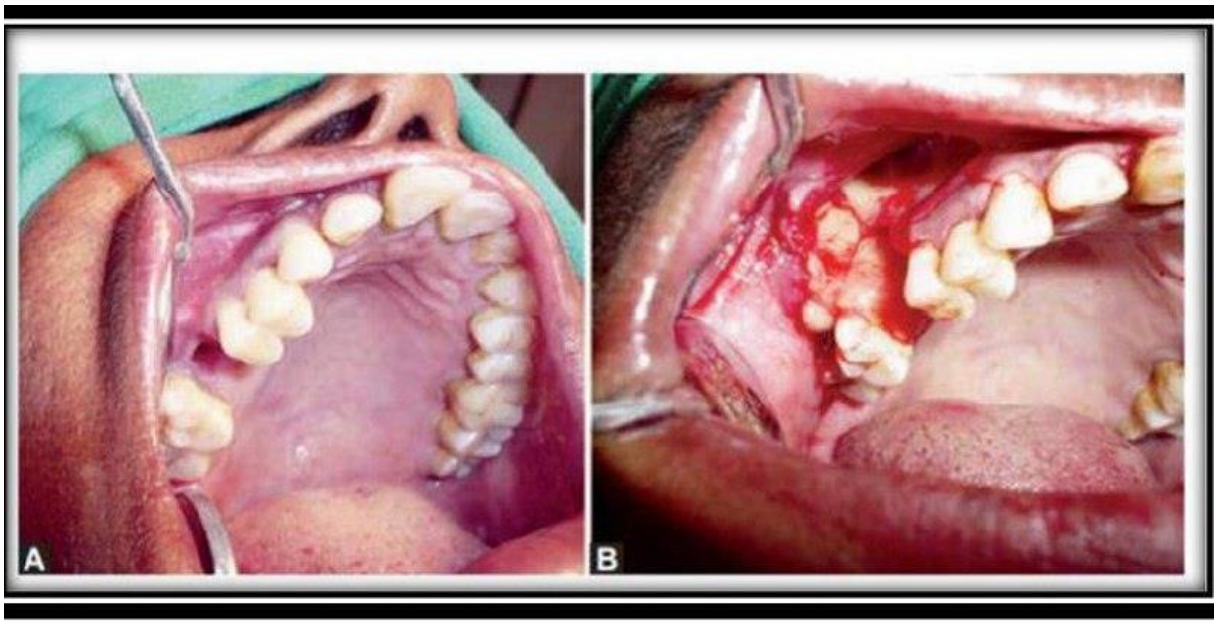
This flap technique has the advantage of that the influence of buccal sulcus depth is minimal. However, it may provoke the onset of periodontal disease and gingival recession because of its need for a significant amount of dentogingival detachment **(Kwon et al, 2020).**



(Fig. 3.10): Moczair's flap**. (Borle, 2014)**

3.4.1.3 Buccal Pad of Fat Flap (BFP)

The technique was first described by Egyedi in the late 1970s **(Egyedi, 1977).** According to Egyedi and Hao, BFP flap is a satisfactory method to close the oro-antral defects **(Fig. 3.11).** Rapid epithelialization of the uncovered fat is a peculiar feature of the BFP flap stalk. An incision is made in posterior mucosa in the area of the zygomatic buttress, followed by a periosteal incision. Fascia enveloping the buccal pad of fat is incised then. A gentle dissection with fine curved artery forceps is done to expose the yellowish-colored buccal fat. The pedicled buccal fat pad flap is used most commonly for the closure of the OAF. The reason for favourability of using BFP is anatomically favourable location; ease of harvesting and minimal dissection required to harvest and to mobilize the flap The advantages of this technique include good epithelialization and a high rate of success. The disadvantages include decrease in the vestibular height **(Borgonovo et al, 2012).**



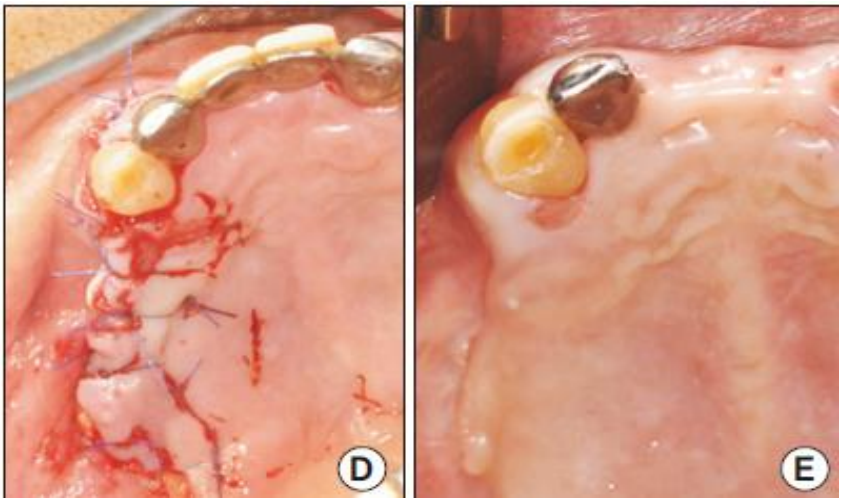
(Fig. 3.11): A and B: Use of buccal fat pad for the closure of OAF**. (Borle, 2014)**

The advantages of using the BFP as a graft material include the great ability of utilization, nourishing blood supply, and negligible donor-site morbidity **(Baumann & Ewers, 2000).**

The fat pad is approachable through the oral cavity, and the buccal and temporal branches of the maxillary artery, facial artery, and superficial temporal artery perfuse it sufficiently, which make it a good choice as a material to close medium-sized defects of the maxilla **(Dergin et al, 2016).**

The aforementioned rich blood supply enables the uncovered fat to epithelize by itself within two weeks after the surgery **(Yang et al, 2018).**

In a recent study, the use of double-layered suturing with the BFP and oral mucosa is recommended to minimize the chance of postoperative complications **(Fig. 3.12) (Tideman et al, 1986).**



(Fig. 3.12): D. The defect was covered with the BFP and oral mucosa by doublelayered suture. E. Complete healing was observed, and no signs of complications were noted at 11 weeks after the surgery. **(Min-Soo Kwon et al, 2020)**

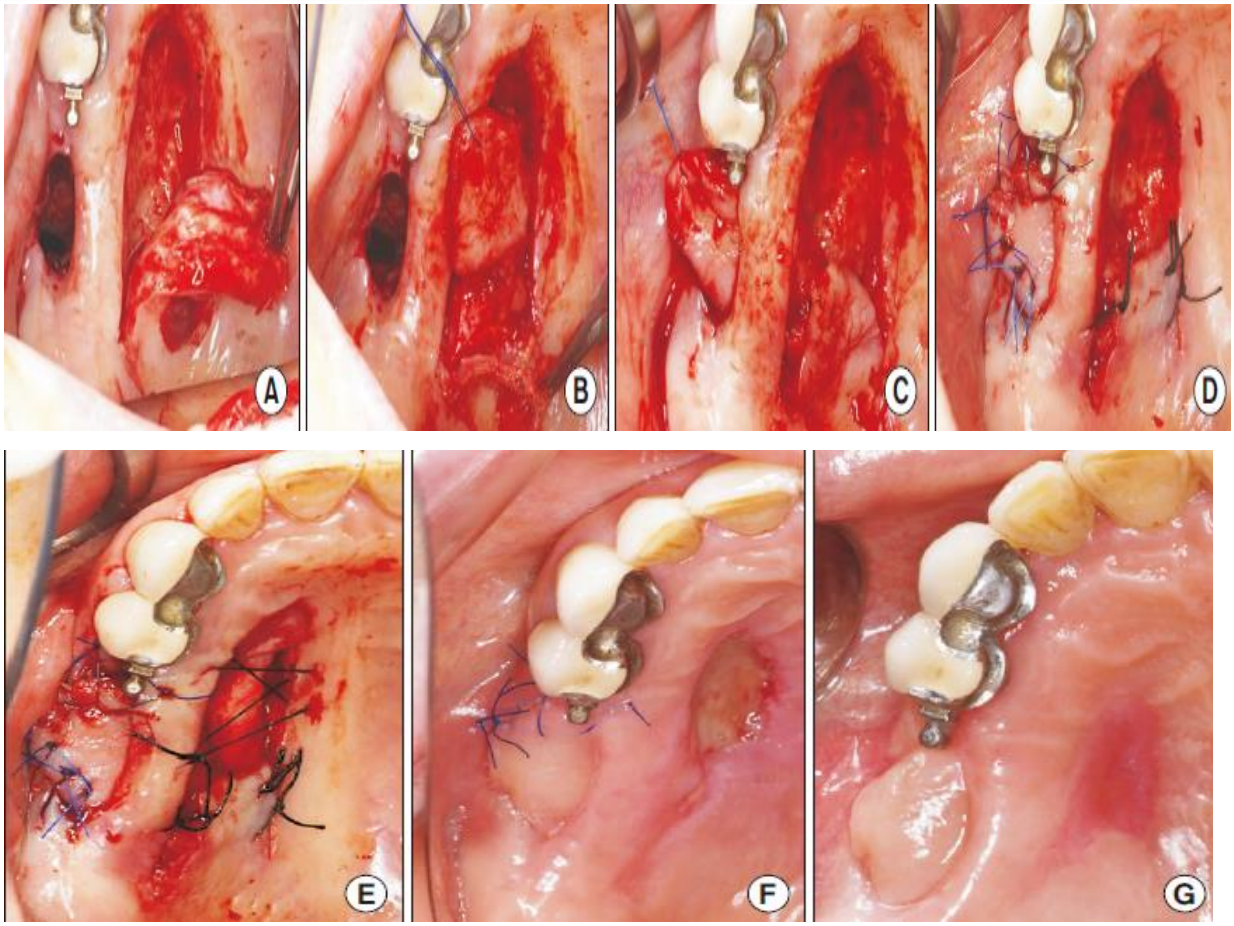
3.4.1.4 Palatal flaps

The palatal flap has different forms that can be classified as straight-advancement, rotation-advancement, hinged, pedicle island, anteriorly based, submucosal connective tissue pedicle, and submucosal island flaps **(Anavi et al, 2003).** Another well-known and widely used procedure for the closure of large OAFs is the palatal-based rotational flap **(Wells & Capes, 2000).** Yamazaki and coworkers further improved this technique by adding to the connective tissue island a flap of mucosa to cover the raw area of palatal bone **(Sokler et al,**

2002). OAFs larger than 10 mm or that are undergo-ing late repair usually require full-thickness mucoperiosteal rotating palatal flaps **(Anavi et al, 2003).** This procedure may necessitate that a circular excision of the fistula tract is established as it is often larger than it appears at the entrance . essential to include the greater palatine artery for sufficient blood supply during the flap harvesting step **(Jamali, 2014).** Secondary wound healing (epithelialization) is expected to occur at the exposedpalatal bone of the donor site within two weeks **(Kwon et al, 2020).**

The bone is covered and the island flap retains excellent mobility without causing bunching of the mucosa of the hard palate and recipient site. Moreover this method allows replacement of the denture a short time after the wound healing. The bone surface is preserved since the periosteum is not involved. Using flaps of partial thickness avoids the occurrence of necrosis even in the case of wide OAFs caused by removal of large cysts or tumors. The first step consists in excising the epithelium from its edges and in cutting the palatal fibro-mucosa so as to create a flap having an axial stalk with a posterior base, supplied by the greater palatine artery. The palatal flap with its total thickness laterally rotated must have a large base to include the greater palatine artery at the site of its exit from the foramen. The anterior extension of the flap must exceed the diameter of the bony defect and have a length sufficient to allow its lateral rotation and the replacement and the suture without exerting tension on the vestibular mucosa **(Borgonovo et al, 2012).**

Therefore, conducting subepithelial dissection of the connective tissue on the rotating region is advised to release the tension, avoid the twist of the artery, and limit possible necrosis of the flap **(Fig. 3.13) (Kwon et al, 2020).**



(Fig. 3.13): A. Full-thickness palatal harvest includes the greater palatine artery. B. Subepithelial dissection of the rotating region of the flap. C. The flap was rotated and placed through the fistula tract underneath the tunnel. D. The flap was sutured to the remaining buccal mucosa and, also, the rotated area of the flap was sutured to limit undesired movement of the flap during the healingperiod. E. The collage sponge was used to cover the denuded donor site. F. The secondary wound healing of the donor site can be seen. G. Complete healing without complications was observed at two months of follow-up. **(Min-Soo Kwon et al, 2020)**

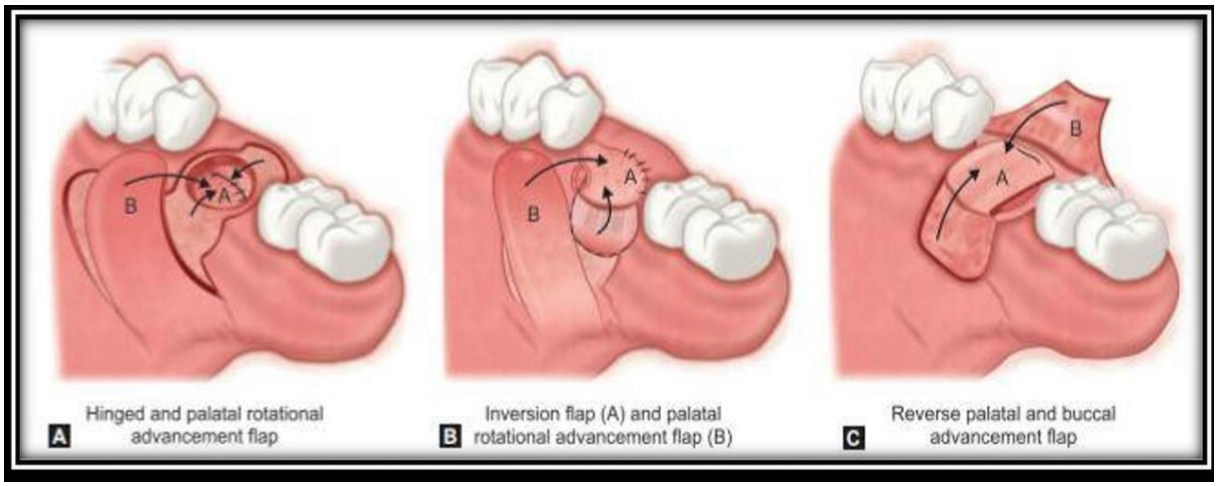
However this type of flap is only indicated for closing fistulas in the premolar area since an excessive rotation required when operating in the molar region could cause ischemia of the flap due to the palatal artery occlusion and necrosis. Advantages of the palatal flap include good vascularization, adequate thickness and optimal tissue quality **(Borgonovo et al, 2012).**

However as a consequence of this technique, exposure of the bony palatal surface, pain and later surface irregularities of the surgical area due to secondary

epithelialization two or three months later, are often observed. The most important disadvantage is the necrosis of the palatal flap that can occur following excessive rotation of the flap **(Borgonovo et al, 2012).**

3.4.1.5 Combined Local Flaps

These include the combination of inversion and rotational-advancement flapsdoubled overlapping hinged flaps, doubled island flaps and superimposition of reverse palatal and buccal flaps **(Fig. 3.14).** All these procedures preserve the buccal vestibular height **(Borle, 2014).**



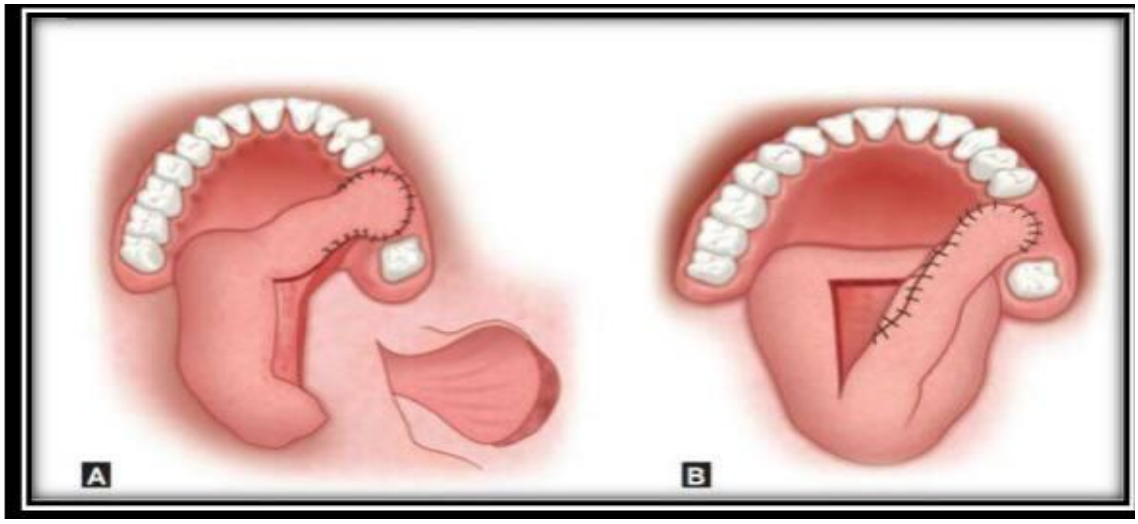
(Fig. 3.14): Combined Local Flaps. **(Borle, 2014)**

3.4.2 Distant flaps

3.4.2.1 Tongue flap

Tongue flap are suitable for reconstruction in various areas including lip, cheek, and palatal or oroantral fistulas **(Fig. 3.15)**, because they offer rich blood supply and pliability **(El Hakim &El Fakharany, 1999).** Tongue flaps can be created from the ventral،dorsal, or lateral part of the tongue **(Kim et al, 1998).** The surgical design of the flap is dictated by the location of the defect, A lateral tongue flap has been described as a suitable method for the closure of large

OAF, used a full-thickness pedicled flap from the lateral border of the tongue to close a large OAC after partial maxillectomy **(Siegel et al, 1977).**

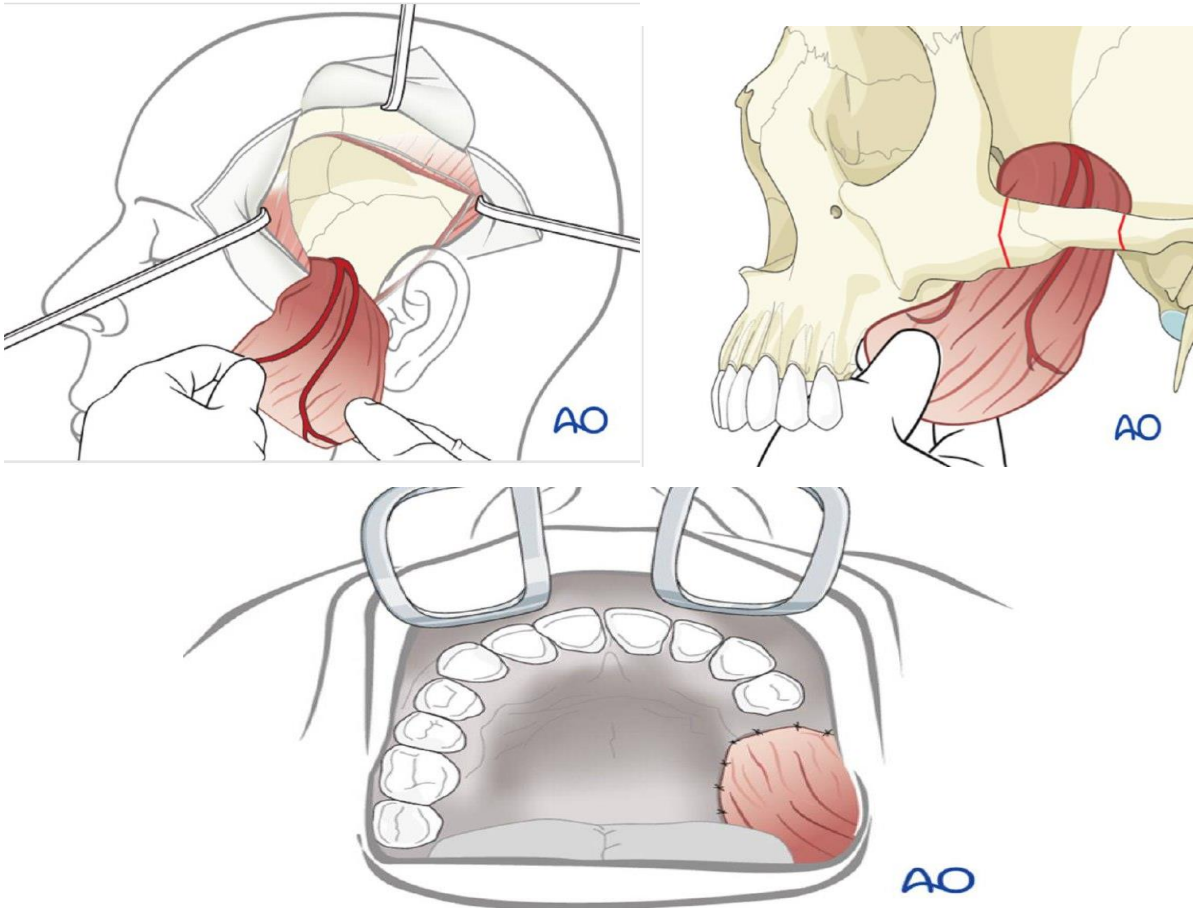


(Fig. 3.15): A and B: Posteriorly and anteriorly based tongue flaps. **(Borle, 2014)**

General disadvantages of the tongue flaps include hematoma formation that can compress the pedicle leading to necrosis of the flap, wound dehiscence, and temporary loss of tongue sensation and, also requirements for general anesthesia and multiple operations **(Buchbinder & Hilaire , 2003).**

3.4.2.2 Temporalis muscle flap

Temporalis muscle flaps are another distant flap **(Fig. 3.16)**, which can be used for closure of orofacial region defects, It has been indicated for one-stage closure of large oroantral communications ,The temporalis muscle flap is less bulky, well-vascularized, and more pliable, with minimal functional and esthetic sequelae, and in closer proximity to the oral cavity. The temporalis fascia is sectioned above the arch to permit flap rotation. It is then brought into the oroantral fistula through a tunnel created in the infratemporal fossa **(Pourdanesh et al, 2013).**



(Fig. 3.16): Temporalis muscle flap. **(Hanasono et al, 2001)**

3.4.3 Bone grafts

Bone autografts harvested from the extraction socket, retromolar area, chin, zygomatic process, or distant sites like the iliac crest have been used for repairing the bony defect in maxilla **(Haas et al, 2003).** Bone grafting for closure of OACs has the disadvantage of requiring a second surgical procedure for bone harvesting ,The second procedure elongates surgical time and increases patient morbidity **(Visscher et al, 2010).**

3.4.3.1 Retromolar bone

For press fitted closure of OACs After placing the bone graft, soft tissue closure was realized by a Rehrmann buccal flap, in most cases only a small amount of bone will be needed for closure of OACs **(Watzak et al, 2005).**

A limiting factor of the retromolar donor area is the confined amount of bone available **(Nkenke et al, 2002).**

3.4.3.2 Chin bone

In a study conducted by **Haas et al (2003)**, 5 patients were included. In 3 patients, a stable press-fit of the bone graft in the OAC was accomplished. In 2 patients, additional plates and screws were used to obtain a rigid fixation of the graft. A Rehrmann flap was used in all patients for soft tissue closure. Wound dehiscence occurred in 1 patient, but the sinus remained unaffected. The use of monocortical bone grafts harvested at a chin site block for closure of an OAF is recommended for patients affected by maxillary atrophy requiring sinus augmentation before implant placement **(Haas et al, 2003).**

3.4.3.3 Zygomatic bone

Is a suitable donor site for OAF closure, The technique is indicated when a modest amount of bone needed **(Kainulainen et al, 2002).** This technique offers the advantage of the proximity of the donor area to the recipient area, which minimizes surgical time and patient discomfort, as in retromolar bone grafts, limited bone is obtainable from the zygomatic process, Furthermore, accidental sinus membrane perforation may occur **(Peñarrocha-Diago et al, 2007).**

3.4.3.4 Iliac crest

Closure of OAF with a bone graft harvested from the iliac crest should be indicated for large defects because of the significant inherent donor site morbidity prolonged postoperative pain, and possible sensory disturbance **(Joshi & Kostakis, 2004).**

3.4.4 Auricular cartilage graft

Auricular cartilage can be used for the closure of oro-antral fistulas. Auricular cartilage is biocompatible, highly resistant to infection, easy to harvest and manipulate, non-resorbable and cost-effective. This graft does not require vascularisation for the integration to the recipient site. This characteristic feature decreases the failure rate of the graft. There is no scar or defect formation at the donor site. Auricular cartilage graft act as a barrier between the sinus membrane and the oral mucosa which allows successful healing. The only requirement for this technique is that the auricular graft must be supported by primary closure **(Isler et al, 2011).**

A disadvantage of this procedure is the potential formation of a defect donor site **(Parvini et al, 2018).**

3.4.5 Allogenous materials

Multiple techniques have been described for the closure of OAFs using lyophilized fibrin glue of human origin In this technique, the fibrin glue is prepared and injected into the socket, together with the collagen sheet. The technique is simple with few postoperative complaints, no need to raise flaps and the intraoral anatomy remains intact. According to the manufacturer, the major disadvantages of the procedure are the risk of transmitting viral hepatitis and the preparation time required for the fibrin glue **(Stajčić et al, 1985).**
lyophilized dura used to treat OACs, the sterilized dura is placed in a saline solution to regain its flexibility, then it is cut to size to make it cover the bony margins of the defect and Sutures are placed at the corners of the graft after which it is covered with a plastic plate for protection, the dura is exfoliated after 2 week,this technique is simple and non-surgical approach make it an attractive option for OAF closures. The risk of transmitting pathogens is a main disadvantage **(Kinner &Frenkel, 1990).**

3.4.6 Xenografts

3.4.6.1 Lyophilized porcine dermis

Used for closure of OAFs has been described in the literature, the technique reported good results when the porcine graft was either exposed to the oral environment or covered with buccal and palatal sliding flaps. The main advantage of the collagen is potential incorporation into the granulation tissue, and no need to remove it prior to complete healing **(Mitchell &Lamb, 1984).**

3.4.6.2 Bio-Oss-Bio-Gide Sandwich technique

Has yielded excellent results for OAF closure. The technique achieves both bony and soft tissue closure, by contrast with only soft tissue closure obtained by local flaps **(Batra et al, 2010).**

This technique offers the unique advantage that no donor site surgery is necessary, saving time, cost, and less discomfort to the patient during and after surgery the disadvantage is the need for a mucoperiosteal flap to cover the sandwich **(Ogunsalu, 2005).**

3.4.7 Synthetic closure

3.4.7.1 Titanium plate

Closure of OAFs by titanium plate with transalveolar wiring fixation was documented as an excellent technique for closure of OAF as it is quick, safe straightforward, well tolerated by patients, has low costs, and results in good bony and soft tissue healing with a low complication rate **(Ahmed, 2015).**

3.4.7.2 Aluminum plates

Among the various synthetic materials, use of Aluminum plates OAF closures, 36 gauge pure aluminum plate is used as a protective plate to aid in closure, sutures are placed only for approximation of the buccal and palatal tissues, the aluminum plate is therefore visible at all times. After several weeks, the aluminum plate is removed from its initial position as a result of formation

reparative tissue underneath. Advantages of the aluminum are malleability, smoothness and inexpensive **(Steine et al, 2008).**

3.4.7.3 Functional endoscopic sinus surgery and titanium mesh

Recently, a dual otorhinolaryngological/oral approach was described in a patient with an OAF complicated by maxillary sinusitis **(Procacci et al, 2016).** The investigators used the functional endoscopic sinus surgery (FESS) technique in combination with a titanium mesh to obtain optimal reconstruction and stabilization of soft tissu, full-thickness vestibular flap was elevated and the titanium mesh was fixed on the defect, then Mesh removal was conducted after 6 to 18 months of healing based on clinic and radiographic evidence of OAF closure Advantages of this technique predictable healing, mechanic scaffolding, and tissue stability. Whereas disadvantage is the second surgery needed to remove the mesh **(Procacci et al, 2016).**

3.4.8 Other Techniques

3.4.8.1 Platelet-rich fibrin (PRF)

PRF was used as a clot and a membrane for the closure of OAFs. PRF was prepared by taking blood samples into glass-coated plastic tubes without anticoagulant, The samples were centrifuged immediately, Then when fibrin clot formed separat it from other acellular plasma and red blood cells. Then one third of the fibrin cut off and inserted gently into the OAF two thirds of the clot pressed gently with sterile dry gauze to drive out the fluids and form the membrane, OAF site sutured to the gingival margins. PRF as a membrane and grafting material facilitates formation of mineralized tissue due to osteoinductive properties possibly inherent in PRF **(Assad et al, 2017).**

Plasma-rich fibrin technique is a simple and effective method, which can be used in the treatment of OACs with a diameter of 5 mm or less with a low risk of complications **(Demetoglu et al, 2018).**

3.4.8.2 Autogenous third molar transplantation

Using for treatment OACs is a simple and excellent treatment option to close small OACs following tooth extraction, A mucoperiosteal flap was reflected to expose the donor tooth,Small amount of bone overlying the crown portion of the tooth was removed, the donor tooth was extracted atraumatically and placed at the 1st molar site tight interdental suturing was done to closely adapt the gingiva around the tooth, the donor tooth it was splinted using composite resin and stainless steel wire with the adjacent teeth. Tooth transplantations, have some limitations: requirement of sufficiently developed third molar of appropriate shape and size, risk of ankylosis and root resorption if not carried out with proper technique and the need for root canal treatment in developed donor teeth **(Nagori et al, 2018).**

3.4.8.3 Triple-layered closure of an oroantral fistula

More recently, triple-layered to repair an oroantral fistula ,this technique uses leucocytes-platelet-rich fibrin (L-PRF) membrane concomitantly with the buccal advancement flap and buccal fat pad, the platelet-rich fibrin membrane is placed over the buccal fat pad and completely covered by a buccal advancement flap. The positive feature of the L-PRF membrane is expediting the healing process by producing growth factors and leucocytes (**George, 2018).**

3.4.8.4 Polytetrafluoroethylene (PTFE) membrane

More recently, a high-density polytetrafluoroethylene (PTFE) membrane is used to close an OAC. This technique showed a complete closure of the OAF due to the good regeneration of the soft tissues directly over the OAC **(Lee, 2016).**

3.4.8.5 Laser light

Laser light for closure of OAFs was suggested by **Grzesiak Janas and Janas (2001).** In this study, 61 patients were subjected to 3 cycles of extraoral and intraoral irradiation with a CTL 1106 biostimulative laser of 30-mW power

with a tip-emitting light of 830-nm wavelength for 10.5 min and for four consecutive days; the researchers demonstrated a complete closure of OAFs. This technique eliminates the need for a surgical procedure. The technique has the disadvantage of being expensive and requires many visits to accomplish complete closure.

3.4.8.6 Palatal splint

Logan and Coates (2003) described a procedure that provided closure of OAF in immunocompromised patients. The oroantral fistula was de-epithelialized under local anesthesia, and the patient wore an acrylic surgical splint continuously for an 8-week period.the acrylic surgical splint covered the fistula and the edentulous area including the hard palate. The investigators reported complete healing of the oroantral fistula after 8 weeks. Moreover, an acrylic surgical splint can be used successfully when a surgical intervention is contraindicated because of immunosuppression**.**

3.4.8.7 Caldwell-Luc Approach

The modified Caldwell-Luc Approach is a satisfactory method to close oroantral defects. In this approach, the bone graft can be harvested from the bone of the anterior wall of the maxillary sinus by accessing the surgical entry tract. The positive features of the technique include the use of autogenous grafts, easy and adequate harvesting of the graft along the surgical route, and no need for a flap, whereas disadvantages are that it requires endoscopic surgical equipment and experience **(Aladag et al, 2018).**

3.4.8.8 Dental implant

A new technique in which a dental implant was the ultimate therapy for the treatment of an oroantral communication (OAC) that was created subsequent to the extraction of a maxillary first molar is described **(Ogunsalu, 2005).**

3.5 Indications & Contraindications of Surgical Flaps

Clinically, the well-perfused flap demonstrates a wider base and is well vascularized. The site of anastomosis should be free of tension and situated over the intact alveolar bone leaving at least 5 mm from the margin of fistula **(Borgonovo et al, 2012).**

The buccal flap combined with displacement of the buccal fat pad is appropriate for fistulae located in the third molar area **(Borgonovo et al, 2012).**

Borgonovo et al. proposed the use of the buccal flap for the closure of oroantral fistulae of moderate size, provided that not too posteriorly located; the palatal flap is best used in the case of fistulae located in the premolar teeth area; and the buccal flap combined with displacement of the buccal fat pad is appropriate for fistulae located in the third molar area **(Borgonovo et al, 2012).**

Ideally, a combination of BFP with buccal advancement flap technique can be used to cover BFP and as additional tissue in cases of deficient BFP for closure **(Batra et al, 2010).** Given the limitations of local flaps option for closure OAF, distant flaps and bone grafts can be used with success in the closure of large defects or in cases where local flaps have failed **(Awang,1988).** Application of alloplastic, biological material, or immediate implantation for the closure of OAC is usually indicated in the closer of OAC with a diameter of 3–4 mm provided that the maxillary sinus is uninfected or no foreign body is within the antrum **(Buric et al, 2012).** Among the various synthetic materials, Bio-Oss-Bio-Gide Sandwich technique has yielded excellent results for OAF closure. The technique achieves both bony and soft tissue closure, by contrast with only soft tissue closure obtained by local flaps **(Batra et al, 2010).**

Collagen and fibrin materials have received considerable attention for these are biologically competent and easy to use **(Awang, 1988).** Regarding autogenous bone grafts as the technique of choice for closure large OAF, donor

site morbidity, anatomic and structural problems, and increased level of bone resorption during healing should be considered **(Visscher et al, 2010).** However, bone grafts are recommended for the closure of chronic OAF when soft tissue flap closure fails **(Kiran, 2018).** It is recommended to use resorbable guided tissue regeneration membrane when endosseous implant with bone graft is considered **(Ogunsalu, 2005).** Non-surgical closure of OAC with absorbable polyglactin/polydioxanon implant can be applied in higher risk patients with blood disorders **(Buric et al, 2012).** Moreover, an acrylic surgical splint can be used successfully when a surgical intervention is contraindicated because of immunosuppression **(Logan & Coates 2003).** The most common methods used for closure of OAF are the buccal flap and the palatal pedicled flap techniques **(Scattarella et al, 2010).**

Chapter Four

Conclusion

Conclusion

Repairing oro-antral defects like OAC/OAF is one of the most challenging and difficult procedures in the field of oral and maxillofacial surgery. In selecting the surgical approach to close an oro-antral fistula, different criteria must be taken into consideration, like location of defect, size of defect, height of the alveolar ridge, vestibular depth, persistence of defect, sinus inflammation or infection and general health of patient. Particular emphasis should be made in choosing the most appropriate method and each having both advantages and disadvantages. A comprehensive clinical and radiographic examination and consideration of the patient history serve to assess the severity of the OAC and the patient's treatment needs. Treatment modalities to repair the oro-antral defects include local or free soft tissue flaps, with or without autografts or alloplastic materials. The buccal flap is suitable for closure of small and mesial fistulas; the palatal flap is a feasible option for repairing OACs, more likely for defects in the premolar area. The BFP is suitable for the closure of large posterior OAC/OAFs.

References

(A)

- Abuabara A, Cortez AL, Passeri LA, De Moraes M, Moreira RW. Evaluation Of Different Treatments For Oroantral/Oronasal Communications: Experience Of 112 Cases. *Int J Oral Maxillofac Surg*. 2006;35:155–8.
- Ahmed MS, Askar NA. Combined Bony Closure Of Oroantral Fistula And Sinus Lift With Mandibular Bone Grafts For Ssubsequent Dental Implant Placement. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2011;111:E8–14
- Ahmed WM. Closure of oroantral fistula using titanium plate with transalveolar wiring. J Maxillofac Oral Surg. 2015;14(1):121–5
- Anavi Y, Gal G, Sifen R, Calderon S, Tsikva Petah et al. Palatal rotation-advancement flap for delayed repair of oroantral fistula: a retrospective evaluation of 63 cases. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2003 Nov;96(5):527–34.

(B)

- Borgonovo AE, Berardinelli FV, Favale M, Maiorana C. Surgical Options in Oro-antral Fistula Treatment. *Open Dent J*. 2012;6:94–8.
- Baumann A, Ewers R. Application of the buccal fat pad in oral reconstruction. J Oral Maxillofac Surg 2000;58:389-92; discussion 392-3.
- Berger A. Oroantral openings and their surgical corrections. *Arch Otolaryngol*. 1939;130:400–2.
- Buric N, Jovanovic G, Krasic D, Tijanic M, Buric M, Tarana S, et al. The use of absorbable polyglactin/polydioxanon implant (Ethisorb((R))) in non-surgical closure of oro-antral communication. J Craniomaxillofac Surg. 2012;40(1):71–7

References

- Batra H, Jindal G, Kaur S. Evaluation of different treatment modalities for closure of oro-antral communications and formulation of a rational approach. J Maxillofac Oral Surg. 2010;9(1):13–8.
- Borle, R.M., Aakash, A. Pranali V, N. Diseases of Maxillary Sinus. In Textbook of Oral and Maxillofacial Surgery. 1st ed. New Delhi: Jaypee Brothers Medical Publishers, 2014, Inc. pp. 281-285.

(D)

- Duncavage J. The maxillary sinus: medical and surgical management. New York: Thieme Medical Publishers;2011.
- Dym H, Wolf JC. Oroantral Communication. Oral Maxillofac Surg Clin North Am 2012; 24: 239-47
- del Rey-Santamaria M, Valmaseda Castellon E, Berini Aytes L, Gay EC. Incidence of oral sinus communications in 389 upper third molar extraction. Med Oral Patol Oral Cir Bucal. 2006;11(4):E334–8.
- Doobrow JH, Leite RS, Hirsch HZ. Concomitant oroantral communication repair and immediate implant placement: a five-year case report. Implant Dent. 2008;17(2):176–81.
- Demetoglu U, Ocak H, Bilge S. Closure of oroantral communication with plasma-rich fibrin membrane. J Craniofac Surg. 2018 Jun 1;29(4):e367-70.
- Dergin G, Emes Y, Delilbası C, Gurler G. Management of the Oroantral Fistula. InA Textbook of Advanced Oral and Maxillofacial Surgery Volume 3 2016 Aug 31. IntechOpen.

(E)

- Egyedi P. Utilization of the buccal fat pad for closure of oroantral communication. J Maxillofac Surg. 1977 Nov;5(4):241–4.

(F)

- Fickling BW. Oral surgery involving the maxillary sinus. *Ann R Coll Surg Engl.* 1957;20:13–35
- Flanagan D. Arterial supply of maxillary sinus and potential for bleeding complication during lateral approach sinus elevation. Implant Dent. 2005; 14:336–338.

(G)

- Guven O. A clinical study on oroantral fistulae. J Craniomaxillofac Surg. 1998;26(4):267–71

(H)

- 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;96:263–6
- Hassan O, Shoukry T, Raouf AA, Wahba H. Combined Palatal And Buccal Flaps In Oroantral Fistula Repair. *Egypt J Ear, Nose, Throat Allied Sci.* 2012;13:77–81.
- Hirata Y, Kino K, Nagaoka S, Miyamoto R, Yoshimasu H, Amagasa T. A clinical investigation of oro-maxillary sinus-perforation due to tooth extraction. Kokubyo Gakkai Zasshi. 2001;68(3):249–53
- Hanasono MM, Utley DS, Goode RL. The temporalis muscle flap for reconstruction after head and neck oncologic surgery. Laryngoscope. 2001 Oct;111(10):1719-25.
- Hansen JT: Netter's Clinical Anatomy, 3rd edition. E-Book with Online Access. Elsevier Health Sciences, 2014.

References

(I)

- Isler SC, Demircan S, Cansiz E. Closure of oroantral fistula using auricular cartilage: a new method to repair an oroantral fistula. *Br J Oral Maxillofac Surg.* 2011;49:e86–e87.
- Iwanaga J, Wilson C, Lachkar S, Tomaszewski KA, Walocha JA, Tubbs RS. Clinical anatomy of the maxillary sinus: application to sinus floor augmentation. Anatomy & Cell Biology. 2019 Mar 1;52(1):17-24.

(J)

- Jamali JA. Palatal flap. Oral Maxillofac Surg Clin North Am 2014;26:305-11.

(K)

- Kretzschmar DP, Kretzschmar JL. Rhinosinusitis: review from a dental perspective. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2003;96(2):128–35
- Koenig LT, D.; grace, C. Diagnostic Imaging: Oral and Maxillofacial 2nd ed: Elsevier; 2017. 1072 p
- Khandelwal P, Hajira N. Management of oro-antral communication and fistula: various surgical options. World J Plast Surg. 2017;6(1):3–8
- Kiran Kumar Krishanappa S, Eachempati P, Kumbargere Nagraj S, Shetty NY, Moe S, Aggarwal H, et al. Interventions for treating oro-antral communications and fistulae due to dental procedures. Cochrane Database Syst Rev. 2018;8:CD011784.
- Kapustecki M, Niedzielska I, Borgiel-Marek H, Rozanowski B. Alternative method to treat oroantral communication and fistula with autogenous bone graft and platelet rich fibrin. Med Oral Patol Oral Cir Bucal. 2016;21(5):e608–13

References

- Kraut RA, Smith RV. Team approach for closure of oroantral and oronasal fistulae. Atlas Oral Maxillofac Surg Clin North Am. 2000;8(1):55–75
- Kim MK, Han W, Kim SG. The use of the buccal fat pad flap for oral reconstruction. Maxillofac Plast Reconstr Surg. 2017;39(1):5
- Kwon MS, Lee BS, Choi BJ, Lee JW, Ohe JY, Jung JH, Hwang BY, Kwon YD. Closure of oroantral fistula: a review of local flap techniques. J Korean Assoc Oral Maxillofac Surg. 2020 Feb 1;46(1):58-65.

(L)

- Lazow SK. Surgical management of the oroantral fistula: flap procedures. Oper Tech Otolaryngol Head Neck Surg. 1999 Jun;10(2):148.
- Logan RM, Coates EA. Non-surgical management of an oro-antral fistula in a patient with HIV infection. Aust Dent J. 2003;48(4):255–8
- Lee C. Use of a non-Resorbable DPTFE membrane to close an oroantral communication of the posterior maxilla after tooth extraction: a case report. Ann Otolaryngol Rhinol. 2016;3:1133
- Liversedge RL, Wong K. Use of the buccal fat pad in maxillary and sinus grafting of the severely atrophic maxilla preparatory to implant reconstruction of the partially or completely edentulous patient: technical note. Int J Oral Maxillofac Implants. 2002;17(3):424–8.
- Lang J. Clinical anatomy of the nose, nasal cavity, and paranasal sinuses. New York: Thieme Medical Publishers;1989.

(M)

- Min-Soo Kwon et al: Closure of oroantral fistula: a review of local flap techniques. J Korean Assoc Oral Maxillofac Surg 2020.
- Malik NA. Textbook of Oral and Maxillofacial Surgery. Second Edition. New Delhi: Jaypee Brothers Medical Publishers, 2008.

References

- Mehra P, Jeong D. Maxillary sinusitis of odontogenic origin. Curr Allergy Asthma Rep. 2009;9(3):238–43
- Moore UJ. Principles of oral and maxillofacial surgery. John Wiley & Sons; 2011 Jan 31, p 161.
- Malik NA.Textbook of Oral and Maxillofacial Surgery.3rd ed. New Delhi,India: Jaypee Brothers Medical Publishers, 2012,Inc. 635-654.

(N)

- Nah KS. The ability of panoramic radiography in assessing maxillary sinus inflammatory diseases. Korean J Oral Maxillofac Radiol. 2008;38:209–13
- Nuñez-Castruita A, López-Serna N, Guzmán-López S. Prenatal development of the maxillary sinus: a perspective for paranasal sinus surgery. Otolaryngol Head Neck Surg. 2012; 146:997–1003.

(O)

- 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

(P)

- Parvini P, Obreja K, Sader R, Becker J, Schwarz F, Salti L. Surgical options in oroantral fistula management: a narrative review. Int J Implant Dent. 2018 Dec;4(1):1-3.
- Poeschl PW, Baumann A, Russmueller G, Poeschl E, Klug C, Ewers R. Closure of oroantral communications with Bichat's buccal fat pad. J Oral Maxillofac Surg. 2009;67(7):1460–6
- Parvini P, Obreja K, Begic A, Schwarz F, Becker J, Sader R, Salti L. Decision-making in closure of oroantral communication and fistula. Int J Implant Dent. 2019 Dec;5(1):1-1

References

- Pedlar J, Frame JW, editors. Oral and Maxillofacial Surgery E-Book: An Objective-Based Textbook. Elsevier Health Sciences; 2007 Jul 30.PP. 219-220.
- Parvini P, Obreja K, Begic A, Schwarz F, Becker J, Sader R, Et Al. Decision-Making In Closure Of Oroantral Communication And Fistula. Int J Implant Dent 2019; 5: 13

(R)

- Renton T, Woolcombe S, Taylor T, Hill CM. Oral surgery: part 1. Introduction and the management of the medically compromised patient. Br Dent J. 2013;215(5):213–23.

(S)

- Standring S. Gray's anatomy: the anatomical basis of clinical practice. 41st ed. London: Elsevier Health Sciences;2015.
- Scattarella A, Ballini A, Grassi FR, Carbonara A, Ciccolella F, Dituri A Et Al. Treatment Of Oroantral Fistula With Autologous Bone Graft And Application Of A Non-Reabsorbable Membrane. Int J Med Sci. 2010;7:267–71
- Sokler K, Vuksan V, Lauc T. Treatment of oroantral fistula. *Acta Stomat Croat.* 2002;36:135–40.

(T)

- Tideman H, Bosanquet A, Scott J. Use of the buccal fat pad as a pedicled graft. J Oral Maxillofac Surg 1986;44:435-40.

(V)

- Visscher, S.H., von Minnen, B., & Bos, R.R.Closure of oroantral communications: a review of the literature. J Oral Maxillofac Surg. (2010);68(6),1384-1391.

(W)

- Wells DL, Capes JO. Complications of dentoalveolar surgery. In: Fonseca RJ, ed. Oral and maxillofacial surgery. Philadelphia: WB Saunders; 2000:432.
- Waldrop TC, Semba SE. Closure of oroantral communication using guided tissue regeneration and an absorbable gelatin membrane. J Periodontol. 1993;64:1061–6
- Watzak, G., Tepper ,G., Zechner, W., Monov, G., Busenlechner, D., & Watzek G. Bony Press-Fit Closure of Oro-Antral Fistulas: a technique for pre-sinus lift repair and secondary closure. J Oral Maxillofac Surg. (2005);63(9), 1288-1294
- Whaites E. Essentials of Dental Radiography and Radiology. 3rd Edition ed: Churchill Livingstone; 2002. 488 p
- Whyte A, Boeddinghaus R. The maxillary sinus: physiology, development and imaging anatomy. Dentomaxillofac Radiol. 2019 Dec;48(8):20190205

(Y)

- Yilmaz T, Suslu AE, Gursel B. Treatment of oroantral fistula: experience with 27 cases. *Am J Otolaryngol*. 2003;24:221–223
- Yalcin S, Oncu B, Emes Y, Atalay B, Aktas I. Surgical treatment of oroantral fistulas: a clinical study of 23 cases. J Oral Maxillofac Surg. 2011;69(2):333–9
- Yang S, Jee YJ, Ryu DM. Reconstruction of large oroantral defects using a pedicled buccal fat pad. Maxillofac Plast Reconstr Surg 2018;40:7.