Surgical Treatment of Oroantral Communications

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Background: Oroantral communication (OAC) can be defined as a pathologic space created between the maxillary sinus and the oral cavity.

This communication and subsequent formation of a chronic oroantral fistula is a common complication often encountered by oral and maxillofacial surgeons.

Although various techniques have been proposed in published studies, long-term successful closure of oroantral fistulas is still one of the most difficult problems confronting the surgeon working in the oral and maxillofacial region.

The decision of which treatment modality to use is influenced by many factors, such as the amount and condition of tissue available for repair, the size and location of the defect, the presence of infection, the time to the diagnosis of the fistula.

Objective: To evaluate an alternative technique for the treatment of oro-antral fistula, using a combined therapeutic ear nose and throat/intraoral approach.

Methods: Twelve consecutive patients affected by complicated OAC were included in this study.

The protocol consisted of: clinical, endoscopic, and radiological preoperative evaluation (panoramic tomogram and computed tomography); systemic antibiotic and steroid therapy for 2 weeks before surgery; one-stage surgical procedure consisting of Functional Endoscopic Sinus Surgery technique associated with the closure of the OAC by a titanium mesh and a mucoperiosteal flap; postoperative antibiotic and cortisone-based therapy.

A titanium mesh was used to obtain an optimal support and stabilization of soft tissues.

Follow-up consisted of weekly clinical evaluation during the first month, a clinical evaluation at 1, 3, 6, 12, 24 months and a nasal endoscopy at 3, 8, 24 weeks after surgery. A second surgical step took place to remove the mesh, after a period of healing, which went from 6 to 18 months. Samples were harvested from the surgical site after mesh removal for histological analysis.

Results: At 1 month follow-up, in 10 patients of 12, the Valsalva manoeuvre was negative, same result at the 3rd month follow-up, although in 11 of 12 patients. In 5 of 12 patients, the mesh was exposed. The histological analysis confirmed the formation of a pseudo-periosteum layer.

One patient failed because the mesh lost its stability. The patient was operated again 8 months later and new mesh was fixed into place.

Conclusion: The current study showed that one-stage, combined endoscopic and intraoral approach represents a feasible and minimally invasive procedure for the long-term effective treatment of chronic complicated OACs.

The main advantage of the use of a titanium mesh to guide the regeneration is that it assures a predictable healing, mechanic scaffold, tissues stability and allows a possible following oral rehabilitation.

Key Words: Histology, intraoral wound, oroantral, sinusitis

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Chronic maxillary sinusitis frequently developed as an infectious complication of odontogenic pathologic processes, such as periapical abscess, periodontal disease, extraction of posterior teeth with projecting roots, maxillary cystic lesions or foreign bodies (endodontic materials, dental implants). Oroantral communications (OACs) are complex defects that involve the soft and hard tissue layers.[1–3]

In the absence of sinus infection, most small acute OACs, 1 to 2 mm in diameter, will heal spontaneously after the formation of a blood clot and secondary healing. However, larger oroantral defects that are not diagnosed or are left untreated rarely heal, and subsequent formation of an OAC becomes inevitable.[4]

When an OAC develops, the presence of maxillary sinusitis, epithelialization of the fistula tract, dental apical abscess, osteitis or osteomyelitis on the communication's margins, dental cysts, foreign bodies, or tumors will prevent spontaneous healing and result in chronic fistula formation.

Thus, elimination of the maxillary sinus pathologic features is essential for successful treatment.[5,6]

Drainage and adequate aeration of the sinus should be achieved, and foreign bodies, infected and degenerated polypoid mucosa, and infected bone should be immediately removed, and the defect should be surgically closed.

Functional endoscopic sinus surgery (FESS) has proven effective and safer in the treatment of chronic sinusitis than the conventional intraoral surgical approach (Caldwell–Luc procedure).[7]

Functional endoscopic sinus surgery allows the preservation of the sinusal mucosa and the restoration of a physiological drainage, through a minimally invasive approach to the sinus cavity.[8]

Immediate closure of acute oroantral defects has a high success rate, approaching 95%, but the success rate of secondary closure of OACs has been reported to be as low as 67%.[6,9,10] Unless the problem is properly treated, approximately 50% of patients will

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experience sinusitis 48 hours later, and 90% of patients will develop sinusitis after 2 weeks of no treatment. Therefore, management of communications is recommended within 24 hours.[10]

Several methods of surgical repair of OACs have been described, but only a few have gained wide acceptance.[11]

Different flap designs to cover these defects have been reported, including local soft tissue flap techniques such as buccal and palatal flaps and their modifications and distant soft tissue flaps such as tongue and temporalis flaps.[11]

In addition to these methods, the use of alloplastic materials has also been reported and has ranged from autogenous bone grafts to gold foil. The use of graft materials combined with guided bone regeneration/guided tissue regeneration is more dangerous, because primary closure to cover the membranes is still difficult and could cause problems. Furthermore, the graft materials could be easily dislocated into the sinus.[10,11]

The use of nonporous hydroxyapatite blocks, bioabsorbable root analogs and transplanted natural third molars have also been used to close perforations. Although none of these methods has been proved to be preferable to others, certain advantages and disadvantages exist among them.

The most common methods involving the soft tissue are the buccal flap technique and the palatal pedicle flap technique. However, this method is connected with a significant risk of morbidity of the donor site, infections, avascular flap necrosis, impossibility to repeat the surgical technique after clinical failure and patient discomfort.[11]

The possibility of limiting the surgical trauma and, consequently, the overall discomfort for the patient, has raised the interest in flapless surgical techniques, which are less complex and more conservative, but their efficacy has still to be ascertained.[8]

This can be particularly relevant in patient of small-sized noncomplicated OACSs following tooth extraction, in which flap-based surgical techniques might constitute an overtreatment.

The flapless techniques for OACs closure already described in the literature are found on positioning a material that stabilizes the blood clot into the fresh extraction socket.[8]

Some examples are the thermally molded poly acid-coated porous beta-tricalcium phosphate, the biodegradable polyurethane foam, and the resorbable haemostatic gauze composed of reconstituted oxidazed cellulose.

The decision of which treatment modality to use is influenced by many factors, such as the amount and condition of tissue available for repair, the size and location of the defect, the presence of infection, the time of the diagnosis of the fistula.[6,8–11]

The aim of this study is to evaluate an alternative technique for the treatment of OACs, using a combined therapeutic otorhinolaryngological/intraoral approach. A titanium mesh was used to obtain an optimal reconstruction and stabilization of soft tissues.

METHODS

Ethical Guidelines

The study design followed guidelines established in the Declaration of Helsinki (revised 2002 version) for research involving human subjects. Each patient gave his or her informed consent to take part in the study.

Exclusion Criteria

Exclusion criteria were established before the study commenced and were as follows: patients with a history of microvascular or macrovascular complications arising from diabetes, metabolic bone disorders, a history of renal failure, radiation treatment to the head or neck region, current chemotherapy, pregnancy, drug or alcohol abuse, poor oral hygiene, periodontal disease, a bleeding index >20% and smokers.

INCLUSION CRITERIA

The inclusion criteria were:

(1) Oroantral communication with composed tridimensional bone defect: vestibular and/or crestal cortical bone loss both in intercalary and terminal edentulism.
(2) Signs and symptoms of maxillary sinusitis.
(3) Failure of previous closure attempts.

A total of 12 patients with a chronic OAF were treated at the Department of Oral Surgery and Otorhinolarylgology of Azienda Ospedaliero Universitaria Careggi (AOUC), Florence, from 2008 to 2012.

The data recorded included sex, age, fistula location, fistula size, smoke habit, and complications.

The criteria for success was complete closure of the communication and maxillary sinus health.

Of the 12 patients, 9 were women and 3 were men.

Their age ranged was from 36 to 62.

The smokers were 6.

Of the 12 OACs, 5 were in the right side and 7 in the left side of the maxilla.

OAC dimensions were variables from 6 to 24 mm from 11 to 22 mm.

At the first examination the patient's medical, clinical, and dental history was collected.

Data about major of minor symptoms of sinus infection, such as a pain located in the anterior aspect of the maxilla, headache, nasal obstruction, nasal and intraoral purulent or mucoid discharge, and olfactory disturbance were collected.

The oral cavity was inspected for signs of dental or periodontal disease, and for the presence of oroantral fistula.

All subjects enrolled, underwent a nasal endoscopy with flexible fiberopticendoscope, a digital panoramic radiograph, and a computed tomography for diagnosis confirmation.

In particular, major endoscopic physical findings, such as mucosal erythema, swelling, and mucoid /purulent discharge from the middle meatus were assessed. Preoperative coronal and axial sinus computed tomography (CT) scans were evaluated for the presence of mucosal thickening, opacification or swelling of the maxillary mucosa, and obstruction of the osteomeatal complex.

Moreover, information obtained by the CT scan was correlated with the endoscopic findings for the preoperative planning.

Clinical Protocol

The protocol consisted of: clinical, endoscopic and radiological preoperative evaluation (panoramic tomogram and computed tomography); systemic antibiotic and steroid therapy 2 weeks before surgery; one-stage surgical procedure consisting in FESS technique associated with the closure of the OAC by a titanium mesh and a mucoperiosteal flap; postoperative antibiotic and cortisone-based therapy.

A titanium mesh was used to obtain an optimal reconstruction and stabilization of soft tissues.

Surgical Procedure

Endonasal surgery according to the FESS technique:

- General anesthesia with oral-tracheal intubation
- Ischemia of the nasal mucosa was ischemized using topic vasoconstrictors

- Nasal septa and turbinatesdysmorphia were corrected
- Caudal uncinectomia and medial antrostomy
- Sinusal mucosa toilet/debridement

Intraoral surgical phase:

(1) The defect was analyzed through diagnostic radiology and stereo-lithographic or plaster model.
(2) The mesh was premodeled on the stereo-lithographic or plaster model and afterward sterilized.
(3) A full-thickness vestibular flap with mesial and distal release incisions was elevated (Fig. 1).
(4) The ridge was skeletonized and fistula cleaned from granulation and epithelial tissue (Fig. 2).
(5) A mesh was fixed on the defect with osteosynthesis screws (Fig. 3).
(6) The flap was released by performing periosteal horizontal incision to achieve closure without tensions (Fig. 4).
(7) The flap was sutured with Vycril.

Postsurgical Procedure

Amoxicillin + clavulanic acid (1 g every 12 hours for 15 days) was administered. Mouthwashes with 0.2% clorhexidine were prescribed for 15 days.

Follow-up examinations were performed at 1, 2 weeks, 1, 3, 6, 12 months and every 6 months by the otorhinolaryngologist and the oral surgeon to study possible signs and symptoms of sinusitis or OAC.

Mesh Removal

Mesh removal was conducted after 6 to18 months of healing on clinic and radiographic evidence of OAC closure (Fig. 5).

Meshes used had 2 different designs: pore and net (Fig. 6). They had a width between 0.1 and 0.3 mm allowing dimensional stability and flexibility enabling adequate modulation. The pores had dimensions between 1.2 and 2 mm. The pores allowed neo-formed tissue to grow through the mesh from one side to the other to receive nourishment from the mucosal and periosteal part of the flap. This may help increase thickness and quality of tissues.

Samples were harvested from the surgical site after mesh removal for histological analysis.

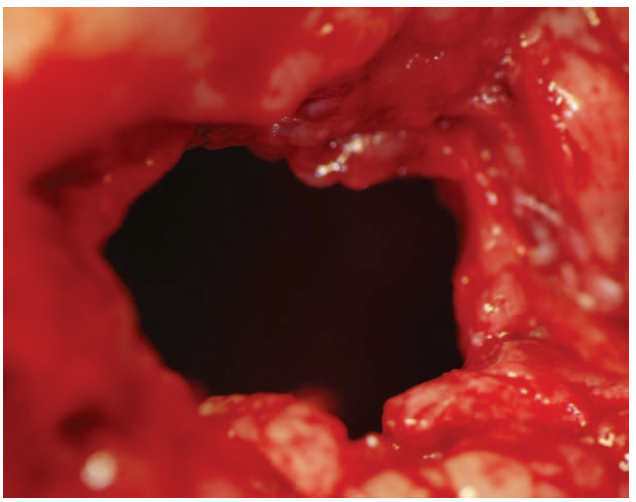

FIGURE 1. Full-thickness flap elevation.

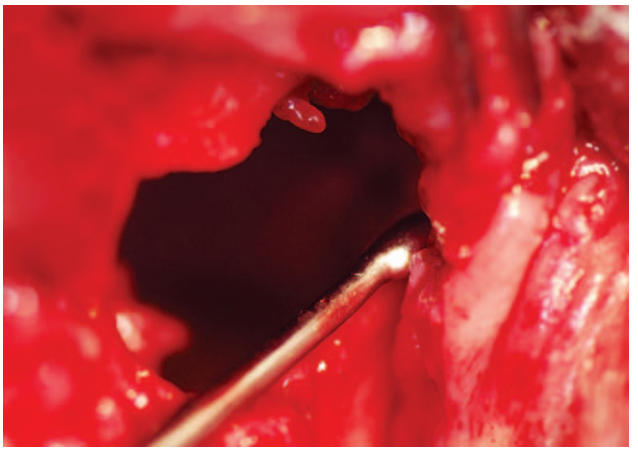

FIGURE 2. Skeletonization of the ridge and removal of the granulation and epithelial tissue from the fistula.

RESULTS

In 10 patients of 12, at 1 month follow-up, the Valsalva manoeuvre was negative, same result at the 3rd month follow-up, although in 11 of 12 patients. In 5 of 12 patients, the mesh was exposed. The histological analysis confirmed the formation of a pseudo-periosteum layer (Fig. 7). Results were confirmed by radiological and three-dimensional analyses (Figs. 8 and 9).

One patient failed because the mesh lost its stability. The patient was reoperated 8 months later and new mesh was fixed into place.

Rhinosinusitis recovered in all patients, with the exception of the patient who needed a second surgery. In this patient, sinusitis appeared after 6 months probably due to drainage possibility that delayed recurrence.

Results are summarized in Table 1.

Due to the small sample, a statistical analysis was not possible.

Histological Analysis

Samples of tissue were taken from the surgical site after mesh removal. The sampling method was standardized, taking the tissue from the interface between mesh and surrounding connective tissue. Spatial references were: vestibular surface (V), palatal surface (P), mesial surface (M), distal surface (D), coronal surface (C), apical surface (A). The specimen was cut in the VP direction to study

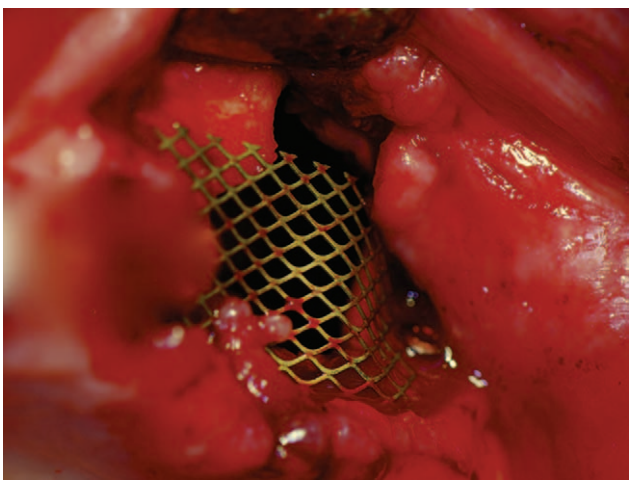

FIGURE 3. Fixation of the mesh.

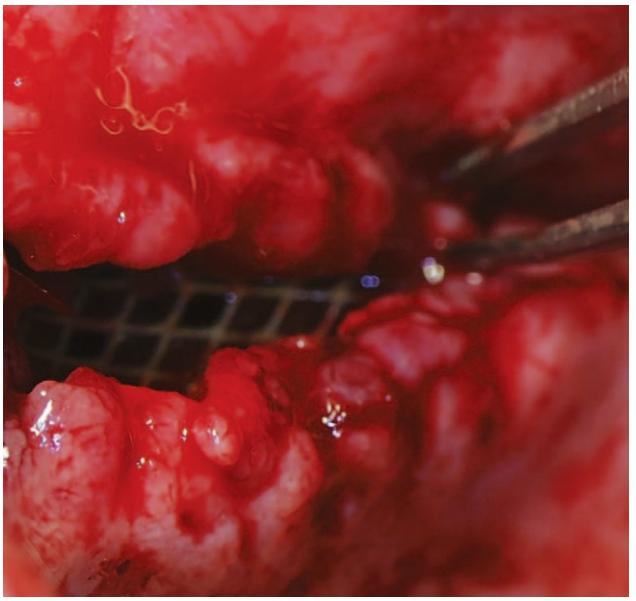

FIGURE 4. Releasing of the flap to obtain the first intension closure without tension.

different cellular layers. The samples were sent for histological analysis; hence, they were fixed in formalin and later included in paraffin. The paraffin block was cut with a microtome in 6-μm sections and later colored with hematoxylin-eosin.

Initial epithelial proliferation and inflammatory tissue zone were evident. The inflammatory tissue zone was probably present before surgery. Initial epithelial proliferation and inflammatory tissue zone were found in the CA direction in the specimen. Also a thick layer of fibrous connective tissue was found, which was attached to the inner aspect of the mesh. The fibrous tissue could represent an appropriate background for osteogenic cells, colonization, and bone formation.

DISCUSSION

Oroantral communication is a condition characterized by a pathologic space between oral cavity and maxillary sinus, caused by soft and hard tissue loss.[8,11]

Predisposition and trigger factors of the OAC's multifactorial etiology are responsible for its onset.

It is an immediate or tardive complication, of a maxillary surgical act or a destructive pathology that discontinues the antral mucosa, enabling the transit of air and/or liquids.

If not treated it will lead to infection of the maxillary sinus.

Different parameters identify the OAC:

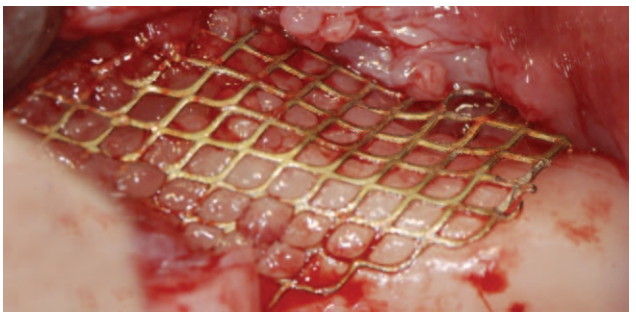

FIGURE 5. Removal of the mesh after 6 to 18 months.

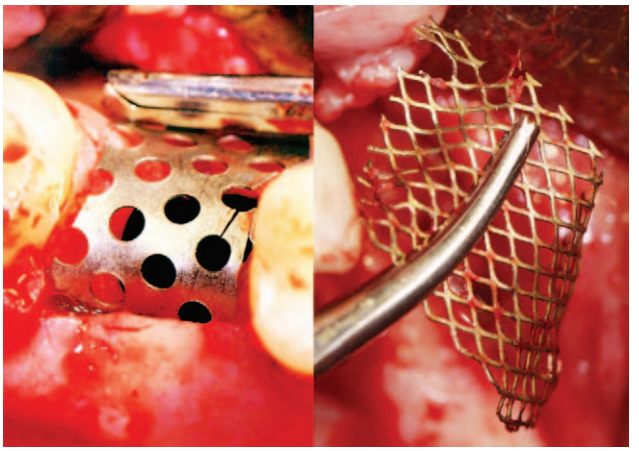

FIGURE 6. Different types of meshes.

(1) Etiology: extractive complications, implant or sinus lift failures, dysplastic processes, osteomyelitis, other.
(2) Onset: early or delayed OAC.
(3) Interested site: intercalary edentulism or terminal edentulism.
(4) Dimension: small or wide diameter if referred to an extracted tooth, diverse configuration referred to crestal and/ or vestibular damage.
(5) Adjacent tissue conditions: alveolar bone thickness, alveolar bone density, alveolar soft tissue inflammatory conditions.
(6) Restorative tissue strength: related to patients parameters such as age, smoker or non and biotype.

The main cause of OAC is the upper molar and premolar extraction. Other causes are iatrogenic dysplastic and neoplastic processes. A rapid closure of the OAC is recommended to prevent complications. However, reports state that nontreated OACs, within 24 to 48 hours, tend to become infected with bacteria that diffuse from the oral cavity to the maxillary sinus.[12]

The clinical aspect of the OAC is fundamental for choosing a proper therapy. A crucial prognosis factor is the size of the OAC. An OAC of large dimension does not heal spontaneously. Method of defining a small OAC from a large one has not yet been determined;

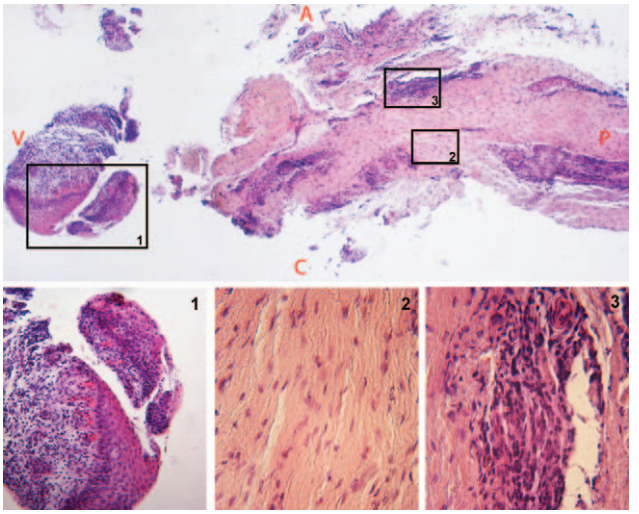

FIGURE 7. Histological analysis: new bone formation is observable, with no inflammatory tissue.

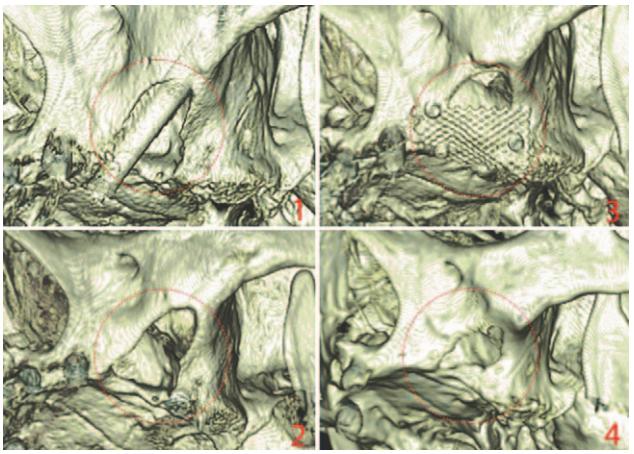

FIGURE 8. Three-dimensional evaluation of the defect.

however, a defect can be defined, standardized, when a medium diameter of the upper molars and premolars, which is approximately 5 to 8 mm, is used as a reference.[13]

In OAC, soft tissue covers the real bony defect, which will always be larger than it appears during clinical examination. The dimension must be related to the tridimensional morphology of the defect. We can distinguish simple OACs from composed OACs. In simple OACs, there is only a crestal defect, in composed OACs the crestal defect is associated with loss of vestibular and/or palatal bone walls.[10]

The location of the defect is another important parameter. In intercalary edentulism, the 4 bone walls normally delimit the OAC and the alveolus is preserved. In terminal edentulism there is no support of adjacent teeth. In the second patient, an OAC has normally larger dimensions and reduced bone walls and this condition represents a restrictive vital and restorative capacity of the area.[14]

Also, the quality of hard and soft tissues can affect the prognosis. Bone quality and quantity decrease physiologically after the extraction. The event reduces the vitality of the zone causing a slower restorative process.

FIGURE 9. Computed tomographic control after the mesh removal confirms the clinical results.

Bone cells and periantral periosteum promote the regrowth and consequent obliteration of the defect. This process is the only way to ensure an OAC closure.

Bone density should be evaluated according to the restorative possibilities of each patient. These may be affected by systemic diseases (eg, osteoporosis), chronic intake of drugs (eg, cortisone, bisphosphonate), or smoking that interferes with the bone metabolism and the wound-healing process.[10]

Immediate or delayed OAC, especially if complicated by chronic sinusitis, must be surgically treated to obtain full recovery. Healing is possible when bone/fibrous tissue formation fills communication and sustains antral mucosa. Clot stability is essential during the healing process.[10]

Current reports state that immediate closure within 48 hours is the preferred treatment.[15] In this patient, healing is almost 95%, but it decreases to 65% if surgery is done when sinus damage is chronic and associated with sinusitis. Clinical signs of OACs healing are negative to the Valsalva Manoeuvre (no air and fluid flow), nasal-sinus homeostasis is restored with no signs or symptoms of sinusitis. Healing is then possible when removing all inflammatory obstacles occluding the metal ostium, normal aeration, and mucosal secretions are reestablished.

In patient of OAC complicated by maxillary sinusitis, a dual otorhinolaryngological/oral approach is essential. The endonasal surgery, using the FESS technique, allows the access to the maxillary sinus through the antralostium. The antrostomy enlarges the semilunar hiatus, facilitating access to the antral cavity that will be inspected and cleaned by using a dedicated rigid optics at 0° and 30° along with debridement instruments. This type of endoscopic surgery allows a functional recovery when a correct ventilation of the sinus cavity and the physiological muco-ciliar is reactivated.[16]

Oral surgery performed in contemporary to the FESS causes some advantages. In fact, it allows surgical revision of the maxillary sinus part not accessible with the FESS technique and fistula removal, which is a source of infection.[16]

Various techniques are described; to treat an OAC, vestibular and palatal flap surgery seem to be the gold standard. However, patients in whom delayed and complex OACs associated with chronic infection of the maxillary sinus, flap stabilization is difficult; therefore, flap support with possible complications in the healing process is not sufficient.[10]

Various OAC treatment techniques are described in different reports. A review by Visscher et al[10] analyzes different (treatment) techniques: autogenous technique (soft tissue flaps, bone grafts); allogenous technique (fibrin glue, dura); xenografts technique (collagen, Bioss-Bioguide); alloplastics technique (gold, aluminum, soft polymethilmathacrylate disk, PTFE membranes, hydroxylapatite); alternative techniques (GBR, interseptalalveolotomy). All these techniques aim at the closure of the OAC with regenerated and stable tissue. This tissue must be supported by a prothesis or a dental implant, although soft tissue flaps represent the most diffused treatment.

The method described uses a vestibular flap associated with a titanium mesh. Meshes were introduced in oral surgery to avoid dislocation of soft tissues and work as a space maintainer in regenerative maxillary surgery. Titanium is a resistant and flexible material, easy to work with, inert to biological fluids, stable on hard and soft tissues. Meshes have 0.1 to 0.3 mm thickness and have a porous or net design which can be easily shaped to the geometry of the defects.[17,18]

Using mesh to treat an OAC gives some advantages: it has the function of a scaffold and it enables bony growth avoiding migration of soft tissues from the flap inside of the OAC; it determines a protective effect for the healing process because it is fixed by screws; it guarantees blood clot stability, in order for,

TABLE 1. Summary of the Demographic Data and the Follow-Up Results of the Examined Patients

Patient	Age	Sex	Smoker	OAC Site	OAC Dimensions (mm)	Mesh Exposition (1–12 mo)	Valsalva Maneuver (1–12 mo)	Mesh Permanence in Mouth
1	61	F	No	R-2 pM	8 × 14	No	Negative	8 mo
2	49	F	Yes	L-1 pM	7 × 15	No	Negative	10 mo
3	62	F	No	R-1/2 pM	14 × 16	3, 6, 12 mo	Negative	16 mo
4	60	F	Yes	L-1/2 pM	13 × 11	No	Negative	11 mo
5	42	F	Yes	R-1 pM	6 × 12	1 mo	1 mo	10 mo
6	36	F	Yes	L-1/2 M	24 × 19	6, 12 mo	Negative	18 mo
7	54	M	No	L-1 M	12 × 10	No	Negative	9 mo
8	43	M	No	R-1/2 M	21 × 15	No	Negative	14 mo
9	50	M	Yes	L-1/2 M	17 × 21	3, 6, 12 mo	Negative	16 mo
10	50	F	No	L-1/2 M	22 × 19	1, 3, 6 mo	1, 3, 6 mo	16 mo
11	48	F	Yes	L-1/2 M	18 × 17	No	Negative	12 mo
12	62	F	No	R-1/2 M	18 × 22	No	Negative	15 mo

OAC, oroantral communication.

fibroblasts and osteoblasts can migrate through a stable tissue to repair the defect; it works as an anchor for the flap that is externally fixed; it has a semipermeable action: pores allow perfusion and nutrition exchange between the 2 sides, improving the regenerative process; and it enables sinus exudate to flow during the first 48 hours after surgery and avoids gathering and stagnation in the maxillary sinus.[17–19]

We do not add a graft to cover the OAC, to avoid the risk that the graft may migrate inside the sinus. In that patient, the graft will not find sufficient nutrition due to the reduced vascularization. Titanium is a biocompatible material that does not represent an obstacle to the regeneration process and will allow a connective tissue layer of 1 to 2 mm to be formed under the mesh. This newly formed tissue can partially become bone.

The healing process of the OAC needs several months, depending on the dimensions of OAC, its geometry (simple or complicated), and its acute or chronic inflammatory state.[17] During these months the mesh can become partially exposed. It is due to thinness of the vestibular flap and the masticatory function that determine the traction of the flap. The healing process can be compromised if a dehiscence of the flap occurs during the first month postsurgery, when clot stability must be guaranteed. Delayed mesh exposure does not jeopardize the success rate; on the contrary, a delayed exposure of the mesh, without signs and symptoms of sinusitis, is the evidence that a new stable connective tissue has been formed under the mesh.[18]

The major disadvantage of this technique is the second surgery needed to remove the mesh. Before removing the mesh, the growth of the stable tissue was evaluated with a radiographic examination (OPT or CT). After 6 to 9 months the remaining tissue on mesh removal is a, "pseudo-periosteum," as indicated in the histologic analysis.

In our experience, we treated 12 OACs complicated by chronic rhino-sinusitis, reporting 1 failure of the technique. Patients received a second intervention and healed uneventfully. The mesh was removed between the sixth and eighteenth month periods, enabling stable fibrous tissue to form. The number of patients is limited, due to the extreme clinical situation, but it is significant both for the dimension of OACs as for the chronic sinusitis. The FESS helps recover the norm-aeration of the sinus. Further studies, with perspective design, are needed to validate and analyze the variables of this technique.

CONCLUSIONS

The current study showed that 1-stage, combined endoscopic and intraoral approach represents a feasible and minimally invasive procedure for the long-term effective treatment of chronic complicated OACs.

The main advantage of the use of a titanium mesh to guide the regeneration is that it assures a predictable healing, mechanic scaffold, tissues stability and allows a possible following oral rehabilitation.

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