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Management of Oroantral Communications using Platelet-Rich Fibrin: our experience

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ABSTRACT

Aims Oroantral communication (OAC) represents an opening between the maxillary sinus and the oral cavity most commonly caused by the extraction of maxillary posterior teeth (80%). The aim of the present study was to evaluate the efficacy and reliability of treating OACs using plasma-rich fibrin (PRF). Also, the most significant recent papers on the topic are briefly summarized in order to compare the surgical procedure and results

Materials and methods A retrospective study was conducted in the Maxillofacial Surgery Unit of the Federico II University of Naples from April 2017 to December 2020. A total of 102 OAC patients with a lesion of a diameter of 5 mm or more were enrolled in the study and surgically treated, 63 patients were treated with PRF alone; 39 patients were treated with a buccal flap or buccal fat pad.

Results Locoregional healing of the surgical area was observed between 3 and 4 weeks in all patients, no recurrences were recorded. At 6 months the mucous membrane of the maxillary sinus is completely regenerated and resumes normal muco-ciliary functions.

Conclusion Surgical treatment of OAC with PRF is a less invasive surgical technique than using mucous flaps or buccal fat pad. PRF is an autologous material that contains growth factors and allows to preserve the height of the vestibular sulcus. The results of our study showed that PRF can be easily performed and guarantees excellent results in the treatment of OACs with a diameter equal to or greater than 5 mm with a low risk of complications.

KEYWORDS Fistula, Oroantral communication, Platelet-Rich Fibrin (PRF), Oral surgery, Sinus surgery, Maxillofacial surgery.

INTRODUCTION

Oroantral communication (OAC) represents the opening between the maxillary sinus and the oral cavity, a complication of oral surgery (1) with the highest incidence in the population of 31-40 years age range (2). The most common cause is the extraction of the posterior maxillary teeth (80%), due to the close anatomical relationship between the sinus floor and the root apexes of the premolar and molar teeth (2). Other etiological factors are trauma (2-5%), benign or malignant tumors (5-10%) and maxillary cysts (10-15%) (3). Failure to treat an OAC can cause the fusion of the Schneiderian membrane with the oral mucosa leading to the formation of an oroantral fistula (OAF). In accordance with the literature the closure of the OAC is recommended within 48 hours to avoid the onset of sinus infections and complications. The occurrence of maxillary sinusitis in patients not treated with OAC within 48 hours is 50% reaching up to 90% in patients not treated within two weeks (1).

Lesions with a diameter of less than 3 mm can spontaneously close (4). Cases with a defect with a diameter of 3-5 mm, can only be treated with PRF membranes (5). If the OAC has a diameter greater than 5 mm there are several surgical options such as the buccal flap; palatal rotation-advancement flap; flap of buccal fat pad. Recent alternatives have been described in the literature, such as third molar transplantation; bone replacement sandwich techniques (6). Direct suture is the most frequently used technique (60%), followed by buccal fat flap (28%), buccal flap (9%), palatal flap (2%) and single tooth transplantation (1%) (7).

In this study we evaluate the efficacy and reliability of the use of PRF in the treatment of OACs. PRF, owing to its autogenic nature, does not induce any immunological reaction. Its composition is rich in growth factor, so it can increase loco-regional vascularization; it can be prepared quickly and is biocompatible, reducing the risk of infection for the patient. Thanks to its content

of leukocyte cytokines, PRF suppresses inflammation and infection, reduces bleeding at the operating site by promoting vascular hemostasis, stimulates the recovery of soft tissues, reduces local pain and consequently the intake of analgesics (6-7).
Thanks to these characteristics, PRF in recent years is a widely used method in the surgical treatment of drug-related osteonecrosis of the jaws, lichen planus and tooth extraction (8-10).

MATERIALS AND METHODS

A retrospective study was conducted in the Maxillofacial Surgery Unit of the Federico II University of Naples (Italy) from April 2017 to December 2020.
Since the work was a retrospective study ethical approval was not necessary. Informed consent had been obtained by all patients before undergoing the surgical procedure.
A total of 102 patients with OAC with a diameter of 5 mm or more were included in the study. In 81 patients OAC was caused by tooth extraction in the upper jaw, 12 had a maxillary odontogenic cyst and 9 patients developed oroantral communication after trauma.
This presurgical evaluation was performed for the survey by means of Valsalva maneuver, orthopantomography and cone beam CT scan, used to evaluate the OAC. A panoramic X-ray was requested as a first-level study to visualize the OAC and the location of the dental root. A Cone-Beam CT scan was requested as a second-level study to better visualize the maxillary sinus and the integrity and thickness of the maxillary cortical bone.
Being PRF rich in angiogenic growth factors, the exclusion criteria in our study were benign and malignant tumors of the jaw and keratocysts.
In cases with oroantral fistula with associated maxillary sinusitis (33 cases out of 102), a preoperative aerosol protocol with antibiotic and corticosteroid solution was implemented. During the operation, an endoscopic approach was associated with antrostomy of the maxillary sinus to ensure the drainage of any infectious secretions and to restore the physiological clearance. The aerosol protocol was then implemented in the post-operative period for 2 weeks.
For the PRF preparation, about 30-40 ml of blood is needed, which is taken from the patient intraoperatively. The blood in the tubes is centrifuged (1500 rpm for 12 minutes) until 3 layers are obtained. The top layer consists of platelet-free plasma, the middle layer contains PRF, and the bottom layer contains erythrocytes. The insulated PRF is collected using a sterile buffer and is shaped until a membrane is obtained. The obtained PRF membranes were inserted to fill the residual cavity in order to cover the OAC. The membranes were fixed in place by sutures to the surrounding tissue to prevent dislocation (Fig. 1).
The 102 patients were divided in two groups as follows.
- Group A: 63 patients in whom PRF only was used.
- Group B: 39 patients in whom a buccal flap or buccal fat pad or an association of these flaps were used.

All patients were prescribed antibiotic agents (amoxicillin / clavulanic acid 1000 mg), analgesics (paracetamol) and oral rinsing (0.2% chlorhexidine digluconate).
Post-operative evaluation was performed after one week, 1 month and 6 months with endoscopic vision and CT imaging.
A visual analogue scale (VAS) was used to assess pain (0 mm: no pain - 100 mm: severe pain) and the dose of analgesics administered was recorded (8).
The measurements were carried out in the first 24 hours after surgery, in the total of 3 days of hospitalization and 7 days during the outpatient check-up. To standardize the data, paracetamol 1000 mg was used as an analgesic for all patients. In case of allergy to paracetamol, patients were excluded.

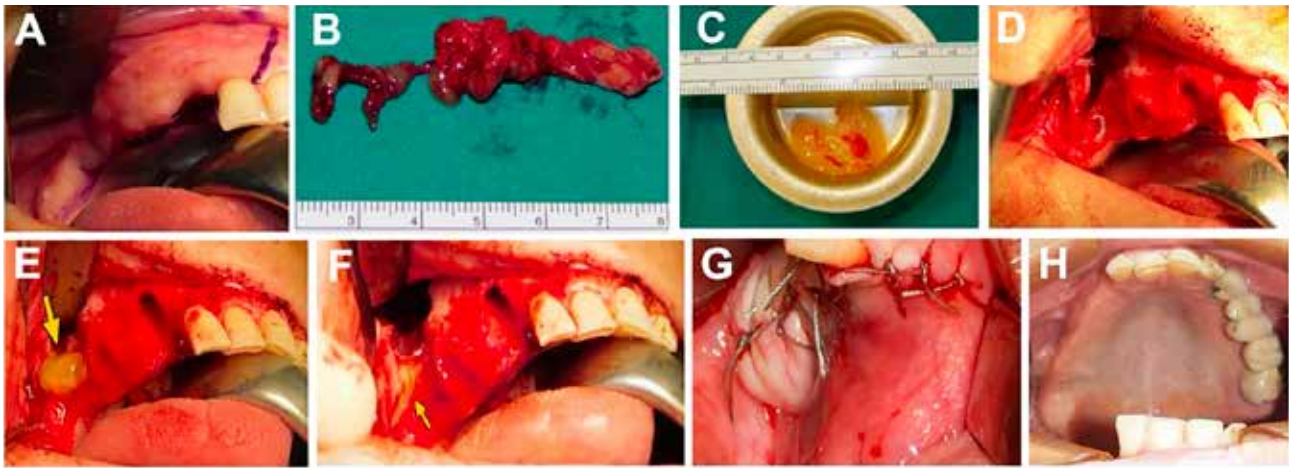

FIG. 1 Drawing of the surgical incision (A), fistulectomy (B), PRF membranes produced (C), view of oroantral communication OAC (D), PRF lied on OAC (E), PRF manipulated and adapted on OAC (F), suture of surgical site(G), post-operative after 3 Months (H).

Statistical analysis

Statistical analyses were performed with Microsoft Excel for Mac (Version 16.16.27) using independent t-test samples (t), to compare the average values of 2 independent groups for the two variables.
Statistical significance was defined at $P < 0.05$.

RESULTS

A sample of 102 patients, 57 males and 45 females, aged from 19 to 43 years the males, and from 25 to 37 years the females, underwent OAC closure.
In the male population the smallest OAC was 7 mm large and the largest 16 mm, with average measurement of 10.9 mm. In the female population the smallest defect was 6 mm and the largest 14 mm, with average measurement of 8.7 mm. All patients had no or little comorbidities such as a well-controlled hypertension. The 80% (81 patients) of OACs were caused by upper molar tooth extraction. In details, 51 patients after the extraction of the first molar, 15 patients after the extraction of the second molar, 9 patients after the extraction of the third molar, and 6 patients after the extraction of the second primary molar. The remaining 12 patients (11%) developed the OAC as a result of a periapical cyst of the upper jaw, and 9 patients (9%) as a result of trauma and fractures of the maxilla.
In total, 59% (60 of the 102) of OACs were caused by acute sinus membrane perforation, 42 cases had chronic oroantral fistula, and in these cases fistulectomy was performed before treating the OACs.
The patients were divided in two groups:
- Group A: 63 patients treated by using PRF only for OAC closure;
- Group B: 39 patients treated by buccal flap or buccal fat pad for OAC closure.

In both groups the soft tissue recovery was completed without any complications. In all 102 patients a healthy granulation tissue was observed at 7-10 days. Locoregional healing of the surgical area was observed between 3 to 4 weeks in all patients. After three months, radiologic findings, such as radio-opacity, was observed over the entire defect.
At 6 months post-surgical evaluation with CBCT imaging and endoscopic view was conducted: the maxillary sinus mucosa was completely regenerated in all patients and resumed normal muco-ciliary functions with the exclusion of scars; the fistula was obliterated and no recurrences of OAC were found (Fig. 2).
VAS pain values were significantly higher ($P < 0.5$) in group B (buccal flap) compared to group A (PRF) ($P=0.003$) in the first 24 hours, but there was no significant difference ($P > 0.5$) on the days 3 and 7 (Table 1). The total dose of analgesic taken in the first 24 hours was significantly lower ($P<0.5$) in the PRF group than buccal flap group. Although there was no significant difference at 3 days in the VAS score, the total paracetamol dose taken in group B was significantly higher ($P < 0.005$) than in group A. However, there was no significant difference ($P>0.5$) at day 7 (Table 2).

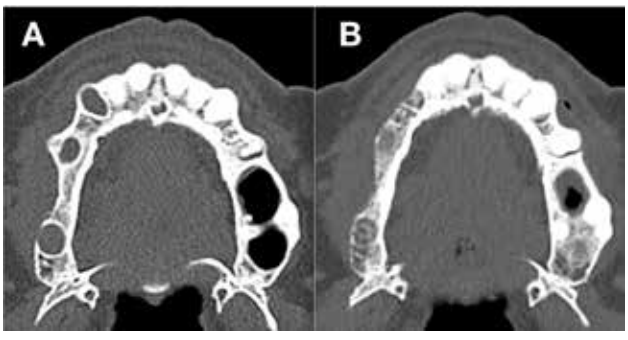

FIG. 2 CT Cone-Beam comparison in axial sections between pre- and post-surgery after 6 months, the fistula was obliterated and the cortical bone thickness has grown with new bone formation.

DISCUSSION

The treatment of OACs is still widely debated. In the literature, the most established technique is the buccal sliding flap technique (12) for its reliability, effectiveness and predictability.
Despite being an established technique, it has disadvantages such as reduction of the depth of the vestibular sulcus, post-operative edema due to soft tissue detachment and post-operative pain (13). In some cases, a second surgery may be necessary to expand the depth

VAS score	PRF group (n° 63) Mean ± SD	Buccal flap/fat pad group (n° 39) Mean ± SD	P value
First 24 hours	43.6 ± 12.1	55,6 ± 12	P=0.003
3 days	25.8 ± 6.4	44 ± 8,2	P=1.058
7 days	0.0 ± 0.0	0.0 ± 0.0	/

TABLE 1 VAS (visual analog scale) score results in the two groups.

Analgesics doses	PRF group (n° 56) Mean ± SD	Buccal flap/fat pad group (n° 34) Mean ± SD	P value
First 24 hours	1523.8 ± 601.6	2571.4 ± 507.1	P=0.004
3 days	2857,1 ± 727	6476.2 ± 872.9	P=0.003
7 days	0.0 ± 0.0	0.0 ± 0.0	/

TABLE 2 Distribution of the demand for analgesics in PRF group and buccal flap/ fat pad group.

Author/Year	Type of study	N° cases	Treatment of OAC	Follow – up/Complications
Demetoglu 2018 [5]	Observational Retrospective	21	21 PRF clots	All patients: 7-10 day: healthy granulation tissue 3-5 weeks: epithelialization oral mucosa
Procacci 2016 [21]	Observational Retrospective	12	12 Titanium Mesh + Buccal flap	1-3 months: total epithelialization oral mucosa 5/12 patients: mesh exposure 1/12 patient: mesh loss 1/12 patient: complication of sinusitis
Bilginaylar 2018 [23]	Observational Retrospective	21	21 PRF clots	All patients: 7 day: healthy granulation tissue 3 weeks: epithelialization oral mucosa
Bilginaylar 2019 [24]	Observational Retrospective	36	21 PRF clots 15 Buccal flap	In each group all patients: - 7 day: healthy granulation tissue - 3 weeks: epithelialization oral mucosa PRF Group: less pain and sweeling; less administered analgesics
Gülsen 2016 [25]	Observational Retrospective	20	20 PRF clots	All patients: 7 day: healthy granulation tissue 3 weeks: epithelialization oral mucosa
Kapustecki 2016 [29]	Observational Retrospective	20	20 Autologous Bone graft + PRF Clots	After 2 weeks: 18/20 patients: complete healing of site 2/20 patients: exposure of bone stabilization screw After 3 months: 3/20 patients: mobility of aggregating elements
Krishanappa 2018 [30]	Review	20	10 buccal flap 10 buccal fat pad flap	In each group all patients: - 7-10 day: healthy granulation tissue - 4 weeks: epithelialization oral mucosa Buccal flap: less pain and sweeling; less administered analgesics
Kwon 2020 [31]	Review	/	-Buccal Flap -Buccal Fat Pad -Palatal Flap	-> periodontal disease; gingival recession -> graft necrosis; atrophy; higher rate of relapse -> limited rotation, slow healing of the donor site
Pandikanda 2019 [32]	Technical note/ Case series	3	3 PRF clots	All patients: 7 day: healthy granulation tissue 3 weeks: epithelialization oral mucosa
Patel 2019 [33]	Case Report	1	1 Buccal flap	- 7-10 day: healthy granulation tissue - 4 weeks: epithelialization oral mucosa Disadvantages: other surgical site, more pain and swelling

TABLE 3 Summary of the most recent literature (last 5 years) regarding the results obtained using different surgical techniques for the treatment of OACs.

of the vestibular sulcus. Using PRF it is not necessary to set mucous flaps to close the OAC, so the depth of the vestibular groove is preserved.

In the treatment of small and medium-sized OAC, the buccal fat pad technique is used, ensuring good results and few complications. Despite this, partial or total necrosis of the flap may occur post-operatively, and in patients with large defects an alteration of the facial contour may occur as a result of the mobilization of the adipose pad (14).

Another treatment option for OAC is the use of monocortical bone grafting (15). The autologous graft is taken and adapted to fill the remaining space and stabilized with mini-screws. Although the method is invasive with greater morbidity for the patient, it offers the advantage of greater filling of the defect site with the possibility of early implant rehabilitation.

In literature the possibility of repairing large OAC (>5 mm) using collagen membranes is also described (16). The membrane is positioned on the defect helping the stability of the clot and ensuring greater protection from external agents favoring the development of epithelialization of the oral mucosa. A further advantage is represented by the possibility of primary closure of the OAC without the

Technique	Advantages	Disadvantages
Buccal flap	Simple execution Possibility to close large defects	Vestibular archway reduction
Palatal flap	Good vascularity Thickness of the flap	Second palatal bone healing Pedicle rotation limit
Buccal fat pad	Simple execution Tissue abundance	General anesthesia Necrosis / tissue resorption
Third molar transplantation	Good closure of the defect	Failure to take root Nerve injuries
Granular bone sandwich	Adaptable to every defect	Limited availability Expensive
PRF-membrane	Low cost Repeatable Autologous	Availability of the patient to take blood Systemic diseases

TABLE 4 Main features of the different surgical techniques.

need for mucous flaps, in fact a spontaneous closure of the gingiva has been demonstrated in the uncovered part of the membrane within 14 days. However, this method has the disadvantage of having higher costs for the patient.

PRF is a second-generation platelet concentrate of autologous origin first described by Choukron et al. in 2000 (17). PRF is compatible with tissues and does not contain alloplastic materials and therefore does not cause foreign body reactions. The main advantages of this method are easy implementation, low cost, properties that accelerate the healing of soft tissues, preservation of the depth of the vestibular sulcus.

PRF is constituted of three components: platelets and their activated growth factors that are substantially embedded into the fibrin matrix during the natural polymerization process; leucocytes and their cytokines that contribute to anti-infectious action and immune regulation in the healing process; the density and complex organization of the fibrin matrix architecture produced by a natural polymerization (15). The strong fibrin architecture distinguishes it from other platelets concentrates, such as platelet-rich plasma (PRP). This fibrin matrix is responsible for the slow release of growth factors during the proliferation stage of wound healing, over a period of 7–14 days, and it is composed of thin fibers with micropores that can serve as a scaffold for cell migration and differentiation. PRF is also an important reservoir of numerous growth factors to promote angiogenesis, such as transforming growth factor b (TGF-β) and vascular endothelial growth factor (VEGF). There are still large amounts of platelet-derived growth factors (PDGFs) in platelet α-granules, which act as an essential regulator for collagen production and mesenchymal cell migration and proliferation (19,20).

When the OAC is closed with conventional procedures, the scar coat generally is not provided of a mucociliary epithelium, so it does not support maxillary sinus physiological clearance. Furthermore, this depressed area is configured as a mucus accumulation area, representing a risk of sinusitis (21-23). By using the PRF it is possible to avoid this by practicing a sort of "sinus lift" in the scar site, so the mucus does not stagnate. PRF is superimposable to biocompatible heterologous materials without the risk of inflammation and can be obtained at low cost.

The association of PRF with the endoscopic technique allows a minimally invasive and extremely effective approach. Through antrostomy of the maxillary sinus, it is easier to drain secretions that could affect the rooting of the flaps (24).

The combined endoscopic and intraoral approach represents a valid minimally invasive technique for the treatment of OACs, especially when they are associated with maxillary sinusitis (25).

We summarized in table 3 the the results of the most recent literature (last 5 years) obtained using different surgical techniques in the treatment of OACs. The main concept emerged from this review is that a good surgical result in terms of epithelialization of the oral mucosa is achieved with all the different techniques (PRF clots, buccal flap and buccal fat pad). PRF surgery is better in terms of postoperative pain and swelling as well as in terms of the total dose of analgesics administered. The analysis of the main features of the different surgical techniques is summarized in table 4.

The data of our work are in perfect agreement with the data obtained from recent literature. Statistical analyses showed that in PRF group less pain was experienced in the first 24 hours compared to buccal flap group; the patients treated with PRF (group A) used significantly fewer analgesics compared to those of group B (buccal flap). The only limit of this procedure is the patients availability to supply blood samples for the treatment and the absence of concomitant systemic disorders that can compromise the structure of the PRF (24).

CONCLUSION

In conclusion, closure of OAC with a PRF membrane

is a less invasive technique than buccal sliding flap or buccal fat pad technique, maintaining the vestibular sulcus depth. It is also autogeneous and includes growth factors.

The study results showed that PRF technique is a simple and effective method, which can be used in the treatment of OACs with a diameter of 5 mm or more with a low risk of complications.

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Ethical statement

The study was conducted according to the guidelines of the Declaration of Helsinki.

Informed consent statement

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

Conflicts of interest

The authors declare no conflict of interest.

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