Effect of Surgical Repair of Chronic Oroantral Fistula Using PRF with Tailored 3D Printed Mesh

Dr. Ibraheem A. Mahdy Nama[1*], Dr. Marwan Ghanim[2]

[1*]B.D.S, Resident Maxillofacial Surgont, Al-Wasity Teaching Hospital, Maxillofacial Surgont. E-mail: drnihadkhalawe@gmail.com

[2]B.D.S., F.I.B.M.S, Consultant Maxillofacial Surgery.

Abstract

Background: Oro-antral fistula may emerge following the removal of maxillary cysts or tumors, facial trauma, dentoalveolar or implant surgery, and infection or may even be iatrogenic in nature. Spontaneous healing can happen in a less than 2mm defect, but larger fistulas need prompt attention and immediate treatment, so as to avoid PRF gaining increased attention in various regenerative medical clinical fields due to its accessibility, natural autologous origins, and promising regenerative capacity. PRF can be gained from patients' own peripheral blood by single-step centrifugation. **The Aim of the Study:** assess the effect of surgical repair using PRF with tailored 3D printed mesh on patients with chronic oroantral fistula. **Materials and Methods:** This prospective study included (16) patients whose ages ranged from (16- 68) years, suffering from chronic oroantral fistula, and underwent surgical repair using PRF with tailored 3D printed mesh at AL-Wasity Teaching Hospital from (March-2020 to August-2021). **Results:** the highest proportion of the study patients in both the PRF and mesh groups were within the age group (<60) years (87.5% and 62.5% respectively). In this study, half of the study patients in both groups (50%) were smokers. The most common cause of fistula in both groups was trauma during dental extraction (37.5% in both groups). Regarding size of fistula, it was (<20) mm in (50%) of the PRF group and in (75%) of the mesh group, and (50%) of the patients in the mesh group showed healing compared to (37.5%) of patients in the PRF group. **Conclusions:** The majority of OAF cases treated with PRF in our study occurred among the older ages, with equal number of males and females. No major complications were encountered in this study. It was shown that half number of the patients in the mesh group showed healing.

Keywords: Surgical Repair, Chronic Oroantral Fistula, PRF, Tailored 3D Printed Mesh.

DOI: 10.47750/pnr.2022.13.S03.096

INTRODUCTION

Bone and soft tissue regeneration may be indicated for managing defects subsequent from several conditions, such as congenital defects (cleft lip and palate), alveolar bone resorption, periodontal defects (recession coverage and furcation defects), cystic cavities, bone infection (osteomyelitis) and traumatic bone destruction [1].

Nowadays, the current clinical approaches have several limitations, namely limited self-renewal capacity and/or limited donor supply, risk of immune response, operative time, and costs, and donor site morbidity. As a consequence, new biomaterials have been developed to modulate inflammation and enhance the healing process[2].

The aim of the study: This study aimed to assess the effect of surgical repair using PRF with tailored 3D printed mesh on patients with chronic oroantral fistula.

Patients and Methods

The study was approved by the Scientific council of maxillofacial surgery number (30220).

The patients were divided into two groups: the PRF group, which included (8) patients (7 males and 1 female) who were treated by using PRF with tailored 3D printed mesh, and the mesh group, which included (8) patients (5 males and 3 females) who were treated by using only tailored 3D printed mesh without PRF.

This study was designed as a prospective observational clinical study.

The diagnosis of the chronic oroantral fistula was performed by taking history, and clinical and radiographical examination in Al-Wasity teaching Hospital.

Clinical Examination

A. **General examination:** A full examination of patients was carried out so as to recognize the presence of any other more serious disorders or injuries elsewhere in the body.
B. **Local examination:** Extraoral examination of the patient was initiated by careful inspection for any sign of inability to close or open the mouth or limitation of mouth opening. The jaws were carefully examined by

palpation for the whole regions and the temporomandibular joint, with special attention to areas of point tenderness, as well as signs of any neurosensory deficit such as anesthesia or paresthesia of the lower lip or mental region.

C. **Radiographical examination:** In order to confirm the diagnosis of oroantral fistula, radiographical investigation was requested. For all the patients included in this study, a conventional preoperative (OPG) and occipitomental view were obtained. The computed tomography (CT) and panoramic radiography were used for radiological inspection of the fistula sites.

Case reports from our study

Case No.1

A-62-year-old male un control diabetic patient suffers from a chronic OAF. OAF results from traumatic tooth extraction. Refeed by GP dentist after multiple failures Operation to OAF closure. The process of closing his fistula was carried out using the PCL mesh in a way with advancement buccal flap under local anesthesia. After a follow-up for three weeks, the operation was found to be unsuccessful and part of the prominent mesh was removed. After 6 months, the patient was followed up. We found that the opening was completely closed and the patient recovered completely.

Case No.2

A-68-year-old male un control diabetic patient suffers from a chronic OAF. Fistula results after removal of necrotic bone of Mucormycosis fungal infection post COVID-19 infection. The process closing of fistula was carried out under local anesthesia using the PCL mesh in a way with advancement buccal flap. After a follow-up for three weeks, the operation was found to be unsuccessful and size of fistula became small, part of the prominent mesh was removed. After 4 months, the patient was followed up. We found that the opening was completely healed and the patient recovered completely.

Case No.3

A-18-year-old male patient suffers from loss part of the alveolar bone and surrounding tissues as a result of exposure to smoke bomb, which leads to a chronic opening between oral cavity and maxillary sinus. Operation was done at Al-Wasity Hospital/Maxillofacial department under general anesthesia with advancement buccal flap and PCL mesh with PRF. After the follow-up, the operation was successful and the fistula completely healed.

Case No.4

A-34-year-old female patient was referred by a GP dentist with OAF at the right side with displaced root of 1st molar to maxillary sinus, resulting from a traumatic extraction of the tooth, at Al-Waisty Hospital/Maxillofacial department. The surgical removal of root from sinus and OAF treated with buccal flap advancement, PCL mesh, PRF. After one week follow up, flap was partially dehiscence with exposed part of mesh, one complications of surgical treatment of OAF with buccal flap advancement with tension. After that, the exposed mesh was removed and wound was left to heal with secondary intention healing. After 3 weeks of follow up, the OAF completely healed.

Complicated cases of OAF after buccal flap seal

A 32-year-old male patient referred by a GP dentist with a big pathological cyst at dentoaleovlar to maxillary sinus at the left side. After surgical removal of the cyst, OAF was created to him. The patient underwent surgical management at Al-Wasity Hospital/Maxillofacial department with buccal flap advancement, PCL mesh, PRF. After one week follow up, dehiscence of flap with exposed mesh occurred, and this was one of the complications of surgical management of OAF with buccal flap advancement with big size defect. It was shown that the failure of fistula seal was because of contamination.

Statistical analysis

The statistical package for social sciences (SPSS-26) was used for statistical analysis of the data in this study. The two-tailed independent t-test was used for comparing continuous variables. Chi square test was used to assess the association between categorical information, while Fisher exact test was used instead when the expected frequency was (< 5). A ($P< 0.05$) value was regarded as significant.

RESULTS

In the current study, (16) patients were included. All of them were diagnosed with chronic oroantral fistula and were divided into two groups (1): The PRF group which included (8) patients treated by using PRF with tailored 3D printed mesh, and (2): the mesh group which included (8) patients treated by using only tailored 3D printed mesh without PRF.

General characteristics

Regarding the age and gender of the study group, it was observed that there were no significant differences ($P \geq 0.05$) in age and gender between the study groups as shown in table (1).

The age of the study patients was ranging from (20–68) years with a mean of (41.43) years and a standard deviation (SD) of (±15.6) years. The highest proportion of the study patients in both the PRF and mesh groups was within the age group (<60) years (87.5% and 62.5% respectively).

Table (2) showed the distribution of study groups according to the clinical information. In this study, half of the study patients in both groups (50%) were smokers. The most

common cause of fistula in both groups was trauma during dental extraction (37.5% in both groups).

Regarding size of fistula, it was (<20) mm in (50%) of the PRF group and in (75%) of the mesh group.

Results in the table (3) showed that (50%) of the patients in the mesh group showed healing compared to (37.5%) of patients in the PRF group, however, this difference was statistically not significant (P = 0.5).

There were no significant differences (P ≥ 0.05) in age and size between the patients who showed healing and those who didn't heal as shown in table (4).

No significant differences (P ≥ 0.05) were observed in gender and smoking between patients who showed healing and those who didn't heal as shown in table (5).

Discussion

Oroantral communication (OAC) and subsequent development of an oroantral fistula (OAF) is a common post-extraction complication of the upper posterior teeth or surgical operations within the maxilla. If the patient has a healthy sinus, an OAC less than 4 to 5 mm in diameter will most likely heal spontaneously[3].

Oroantral fistula is "a pathological condition in which the oral cavity and sinus have permanent communication through fibrous connective tissues lined by epithelium"[4]. Oroantral fistula is most commonly caused by extraction of teeth that related to maxillary antrum that can lead to contamination of the maxillary antrum by bacteria, causing a chronic sinusitis[4].

In this study, the total number of patients included was (16). All of them were diagnosed with chronic oroantral fistula and were divided into two groups (1): The PRF group which included (8) patients treated by using PRF with tailored 3D printed mesh, and (2): the mesh group which included (8) patients treated by using only tailored 3D printed mesh without PRF.

The age of the study patients was ranging from (20–68) years with a mean of (41.43) years and a standard deviation (SD) of (±15.6) years. The highest proportion of the study patients in both the PRF and mesh groups was within the age group (<60) years (87.5% and 62.5% respectively).

It seems from our results that the highest proportion of the study patients in both PRF and mesh groups was among the older ages, and this result didn't agree with the studies of [108,109] who analyzed the PRF network pattern and found a decrease in the density of network as age advances, while Miron *et al.,* (2018) [7]., conducted a study to determine the effect of age and found a larger PRF membrane in older age patients compared to younger ones, and they stated that this difference may be due to the alterations in hematocrit value. We can add that the small number of patients enrolled in our study could not give a sufficient impression about age distribution of patients because of statistical purposes, the greater the number of patients in the research, the greater the statistical significance will be.

Results of our study revealed that there was no significant difference between males and females among patients with oroantral fistula who underwent surgical repair of chronic oroantral fistula using PRF with tailored 3D printed mesh.

Comparing the gender and PRF network, the studies conducted by[5]. demonstrated that males showed predominantly dense fibrin network than females. This observation was not consistent with our findings concerning gender, while[8] found a larger PRF membrane in females than males. Both the studies above were not consistent with our findings concerning gender, and this result may also be attributed to the small size of our samples, which can't show true statistical variations between males and females.

The distribution of study groups according to the clinical information in this study showed that half of the study patients in both groups (50%) were smokers. The most common cause of fistula in both groups was trauma during dental extraction (37.5% in both groups).

Regarding size of fistula, it was less than 20 mm in (50%) of the PRF group and in (75%) of the mesh group.

Although smoking did not cause delay of healing to most of our smoker patients, smoking seems to impair wound healing in plastic and orthopedic surgeries. It is suggested several mechanisms by which smoking interferes with wound healing processes including inadequate perfusion and tissue ischemia, poor neovascularization, reduced proliferation of red blood cells, macrophages and fibroblasts, impaired leukocyte chemotaxis and phagocytosis, impaired osteoblastic activity and disruption of bone remodeling[9].

Trauma, dental infections, radiotherapy, osteomyelitis and tooth extraction are possible causes of chronic OAF, which is a pathological communication between the epithelium of the oral cavity and that of the maxillary sinus, which may have different origins. The sizes of fistula of our patients were mostly small (less than 20 mm), and this helped them to heal rapidly without complications, and this was supported by[10] who stated that if the patient has a healthy sinus, an OAF less than 4 to 5 mm, then he will most likely heal spontaneously.

Method of closing oroantral communications using PRF membrane and autogenous bone graft can establish an interesting alternative to the traditional single- and bilayer procedures to close oroantral communication. It provides numerous benefits related to prosthetic and implant treatment. It allows the alveolar shape to be maintained and even to increase its vertical dimension. The average reduction in the value of H v-p dimension for the alveolar without a graft was 4.4 mm, which constitutes a significant difference in comparison to the one observed in own studies and studies conducted by different authors[11].

A well-profiled graft functions as a plug formation, securing from pressure alterations in paranasal sinuses. The graft is covered by the PRF membrane, while its contents of the above-mentioned components have positive influence on its

integrations. The majority of authors of publications regarding this issue use resorbable collagen membranes or non-resorbable membranes separating the graft from the maxillary sinuses[12]. Thus, this technique may turn out to another way for single-stage closure of the oroantral communication and to alveolar augmentation.

Recently, the platelet rich fibrin (PRF) became widely used in different dentistry fields. It is composed of fibrin matrix including platelet growth factors and cytokines. These constituents can be freed and function as resorbable membranes. Choukroun and his co-workers[13] were the pioneers in applying the PRF protocols for oral and maxillofacial surgery to improve bone healing in implantology. At present time, PRF is believed and regarded to be a healing biomaterial[14]. There is a possibility that the inflammatory regulation observed on surgical sites treated with PRF results from the impacts of cytokines trapped in fibrin networks and released during the initial remodeling phase[13].

The platelet rich fibrin (PRF) is a patient blood-derived and autogenous living biomaterial which is increasingly globally inspected and used by clinicians as an adjunctive autologous biomaterial to promote bone and soft tissue healings and regenerations. The gold standard for in vivo tissue regeneration and healing needs mutual interaction between scaffold (fibrin matrix), platelet, growth factor, leukocyte and stem cell[15].

No current studies that investigate the impact of A-PRF which is a new-generation platelet concentrate, on bone defect healing[16].

PRF contains about 97% of blood platelets and >50% of blood leukocytes[17]. Among these cells, macrophages may immediately improve osteogenesis, which is associated with the nuclear factor Kappa[18]. Macrophages may also help in bone formation activity via maintaining local availability of mesenchymal stromal/progenitor cells when apoptotic osteoblasts are recognized and removed to activate the paracrine loops[19].

Fibrin membrane (FM) is a natural biopolymer with an important capacity for the regeneration of several injured tissues[20]. The adhesive FM, when arranged on the wound bed, changes its configuration and mechanical properties over time because of the fibrin matrix retraction and expression of the secretome mostly containing the vital signaling molecules. The FM can be combined with secondary dressings, including alginates, hydrocolloids, and gauze, enhancing the action of the biomaterial[21]. Therefore, the PRF-based dressings accelerate the healing of hard and soft tissues and can be used in the treatment of different types of lesions[21].

CONCLUSIONS

1. The majority of OAF cases treated with PRF in our study occurred among the older ages, both males and females were almost equal, with no significant difference, and there was no significant difference between the number of smokers and non-smokers in our study group (equal number).
2. No major complications were encountered in this study, so Regarding the size of the fistula, it was less than 20 mm in (50%) of the PRF group and in (75%) of the mesh group, and It was shown that (50%) of the patients in the mesh group showed healing compared to (37.5%) of patients in the PRF group with no significant difference.

REFERENCES

Crisci A, Marotta G, Licito A, Serra E, Benincasa G, Crisci M. Use of leukocyte platelet (l-prf) rich fibrin in diabetic foot ulcer with osteomyelitis (three clinical cases report). Diseases 2018, 6, 30.

Zumarán, C.C.; Parra, M.V.; Olate, S.A.; Fernández, E.G.; Muñoz, F.T.; Haidar, Z.S. The 3 R's for platelet-rich fibrin: A "super" tri-dimensional biomaterial for contemporary naturally-guided oro-maxillo-facial soft and hard tissue repair, reconstruction and regeneration. Materials 2018, 11, 1293.

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(2): 155-58.

Leonardo Gomes de Lima, Ana Larisse Carneiro Pereira, Jefferson David Melo de Matos, et al. Treatment techniques for oroantral communications and fistulas. Int J Adv Res., 2018; 6:634-648.

Samy Amroun, Yassine Zouari, Ayman Bouattour. Closure of an oroantral fistula by bone autograft: A case report. J Oral Med Oral Surg., 2018; 24: 143-148.

Yajamanya, S.R., Chatterjee, A., Babu, C.N. and Karunanithi, D. Fibrin network pattern changes of platelet-rich fibrin in young versus old age group of individuals: A cell block cytology study. Journal of Indian Society of Periodontology. 2016, 20(2), p.151.

Miron RJ, Choukroun J, Ghanaati S. Necessity for standardization of relative centrifugal force values in studies on platelet rich fibrin; response to letter to the editor. J Periodontol., 2018; 90: 122–5.

Miron, R.J.; Zucchelli, G.; Pikos, M.A.; Salama, M.; Lee, S.; Guillemette, V.; Fujioka-Kobayashi, M.; Bishara, M.; Zhang, Y.; Wang, H.L.; et al. Use of platelet-rich fibrin in regenerative dentistry: A systematic review. Clin. Oral Investig., 2017, 21, 1913–1927.

Sørensen L.T. Wound healing and infection in surgery. The clinical impact of smoking and smoking cessation: A systematic review and meta-analysis. Arch. Surg., 2012; 147: 373–383.

Shokri A, Lari S, Yousef F, Hashemi L. Assessment of the relationship between the maxillary sinus floor and maxillary posterior teeth roots using cone beam computed tomography. J Contemp Dent Pract., 2014, 15(5): 618-22, 2014.

Thompson DM, Rohrer MD, Prasad HS. Comparison of bone grafting materiale in human extraction sockets: clinical, histologic, and histomorphometric evaluation. Implant Dent. 2006, 15: 89-94.

Peleg M, Garg AK, Misch CM, Mazor Z. Maxillary sinus and ridge augmentations using a surface-derived autogenous bone graft. J Oral Maxillofac Surg., 2004, 62: 1535-44.

Naik, B.; Karunakar, P.; Jayadev, M.; Marshal, V.R. Role of Platelet rich fibrin in wound healing: A critical review. J. Conserv. Dent., 2013, 16, 284–293.

Ghanaati, P. Booms, A. Orlowska, A. Kubesch, J. Lorenz, J. Rutkowski, C. Landes, R. Sader, C. Kirkpatrick, and J. Choukroun, Advanced platelet-rich fibrin: A new concept for cell-based tissue engineering by means of inflammatory cells. J. Oral Implantol., 2014, 40, 679.

Kawase T, Kamiya M, Kobayashi M, Tanaka T, Okuda K, Wolff LF,

Yoshie H. The heat-compression technique for the conversion of platelet-rich fibrin preparation to a barrier membrane with a reduced rate of biodegradation. J Biomed Mater Res B Appl Biomater., 2015; 103: 825–31.

Ozgul, F. Senses, N. Er, U. Tekin, H. H. Tuz, A. Alkan, I.D. Kocyigit, and F. Atıl, Efficacy of platelet rich fibrin in the reduc-tion of the pain and swelling after impacted third molar surgery: Randomized multicenter split-mouth clinical trial. Head Face Med., 2015, 11, 37.

Dohan D, Ehrenfest, M. Del Corso, A. Diss, J. Mouhyi, and J.-B. Charrier, "Three-dimensional architecture and cell composition of a Choukroun's platelet-rich fibrin clot and membrane," Journal of Periodontology, 2010, vol. 81, no. 4, pp. 546–555.

Mise-Omata S, N. Alles, T. Fukazawa et al., "NF-κB RELA-deficient bone marrow macrophages fail to support bone formation and to maintain the hematopoietic niche after lethal irradiation and stem cell transplantation," International Immunology. 2014, vol. 26, no.11, pp. 607-618.

Castro A, S. Cortellini, A. Temmerman et al., "Characterization of the leukocyte- and platelet-rich fibrin block: release of growth factors, cellular content, and structure," The International Journal of Oral & Maxillofacial Implants. 2019, vol. 34.

Lourenco P.A., Mourão C.F.A.B., Leite P.E.C., Granjeiro J.M., Calasans-Maia M.D., Alves G.G. The in vitro release of cytokines and growth factors from fibrin membrane. Produced through horizontal centrifugation. J. Biomed. Mater. Res., 2019, 106: 1373–1380. no. 4, pp. 855–864.

Del Amo C., Perez-Valle A., Perez-Zabala E., Perez-del-Pecho K., Larrazabal A., Basterretxea A., Bully P., Andia I. Wound dressing selection is critical to enhance platelet-rich fibrin activities in wound care settings. Int. J. Mol. Sci. 2020, 21: 624.

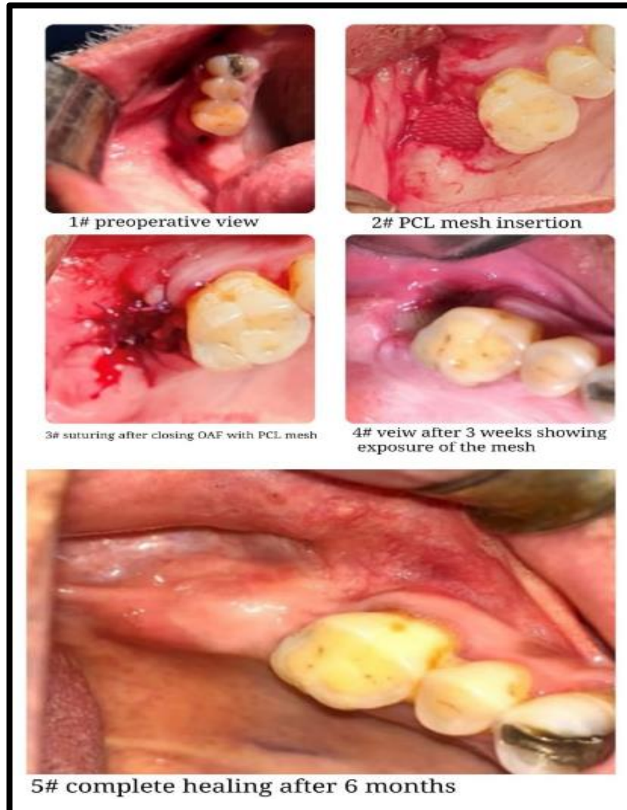

Figure (1): Pictures show step by step procedure of case No.1.

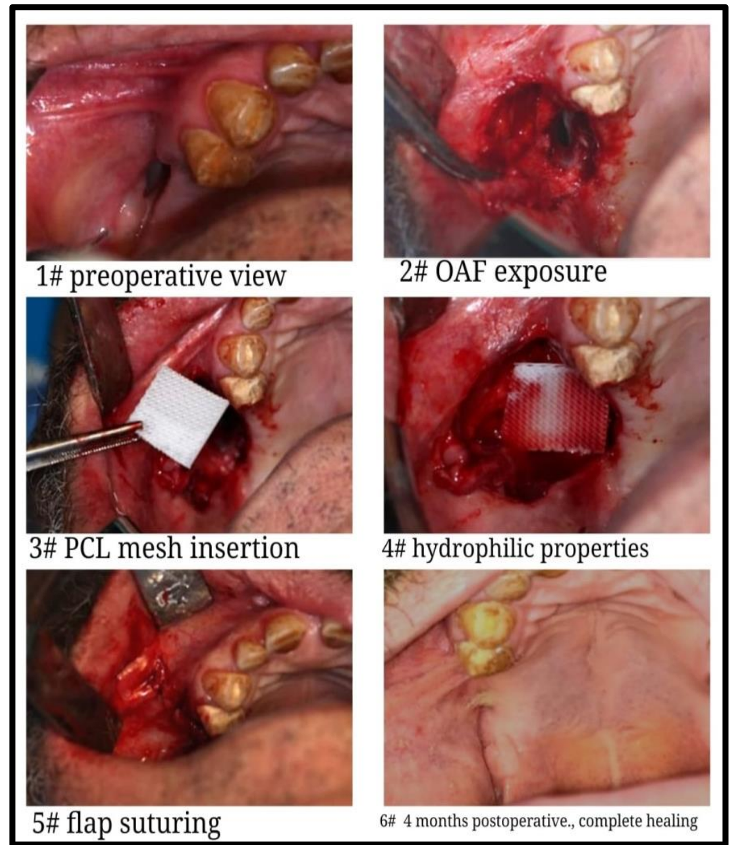

Figure (2): Pictures show step by step procedure of case No.2.

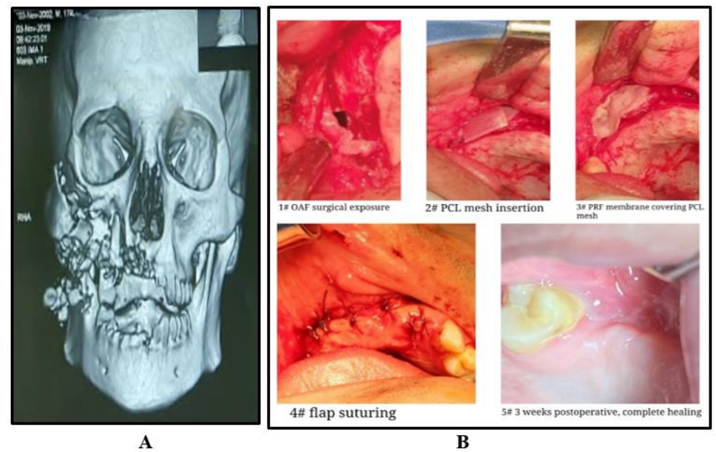

Figure (3): A. 3D CT scan B. Pictures show step-by-step procedure of case No. 3.

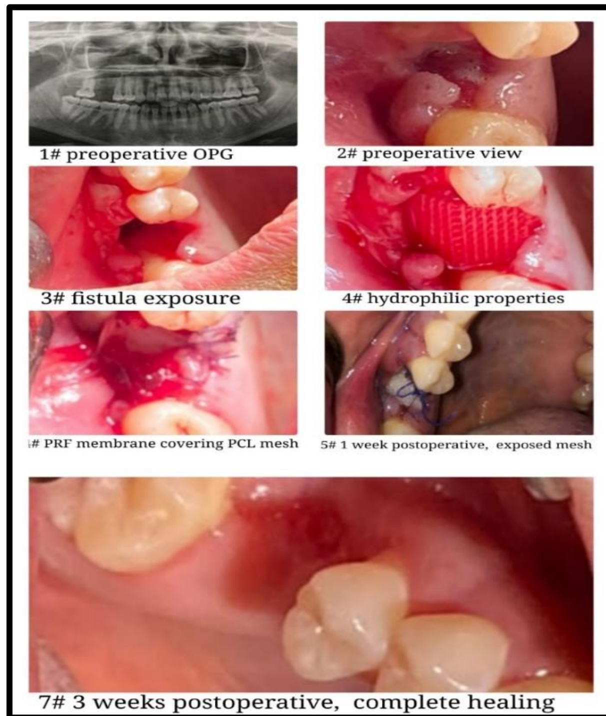

Figure (4): Pictures show step by step procedure of case No. 4.

Table (1): Distribution of study groups according to age and gender

Variable	Study group		Total (%) n = 16	P- Value
	PRF n = 8	Mesh n = 8		
Gender				
Male	7 (87.5)	5 (62.5)	12 (75.0)	**0.248**
Female	1 (12.5)	3 (37.5)	4 (25.0)	
	mean ± SD	mean ± SD		
Age (Year)	34.0 ± 12.8	48.87 ± 15.3		**0.054**

Table (2): Distribution of the study groups according to clinical information

Variable	Study group		Total (%) n= 16
	PRF n= 8	Mesh n= 8	
Smoking			
Yes	4 (50.0)	4 (50.0)	8 (50.0)
No	4 (50.0)	4 (50.0)	8 (50.0)
Cause of fistula			
Trauma during dental extraction	3 (37.5)	3 (37.5)	6 (37.5)
Trauma due to tear bomb	3 (37.5)	0 (0)	3 (18.8)
After surgical remove of pathological cyst	1 (12.5)	1 (12.5)	2 (12.5)
Trauma with displace root to sinus	1 (12.5)	2 (25.0)	3 (18.8)
After surgical removal of necrotic bone	0 (0)	1 (12.5)	1 (6.3)
Trauma due to sharp edge of denture	0 (0)	1 (12.5)	1 (6.3)
Site of fistula			
Upper right 1st molar	1 (12.5)	3 (37.5)	4 (25.0)
Upper right 2nd molar	1 (12.5)	1 (12.5)	2 (12.5)
Upper left 1st molar	1 (12.5)	1 (12.5)	2 (12.5)
Upper right quadrant	2 (25.0)	1 (12.5)	3 (18.8)
Upper left 2nd molar	2 (25.0)	2 (25.0)	4 (25.0)
Upper left quadrant	1 (12.5)	0 (0)	1 (6.3)
Size of fistula (mm)			
< 20	4 (50.0)	6 (75.0)	10 (67.5)
≥ 20	4 (50.0)	2 (25.0)	6 (32.5)

Table (3): Distribution of the study groups according to outcome results

Outcome result	Study group		Total (%) n= 16	P- Value
	PRF n = 8	**Mesh n = 8**		
Healed	3 (37.5)	4 (50.0)	7 (43.8)	**0.5**
Not healed	5 (62.5)	4 (50.0)	9 (56.2)	

Table (4): Relationship between the age of patients and size of fistula and outcome result

Variable	Outcome result		P- Value
	Healed Mean ± SD	**Not healed Mean ± SD**	
Age (Year)	48.14 ± 16.8	36.22 ± 13.3	**0.151**
Size (mm)	1.57 ± 0.83	1.66 ± 0.82	**0.824**

Table (5): Relationship between the gender of patients and smoking and outcome result

Variable	Outcome result		Total (%) n = 16	P-Value
	Healed n = 7	**Not healed n = 9**		
Gender				
Male	5 (41.7)	7 (58.3)	12 (75.0)	**0.771**
Female	2 (50.0)	2 (50.0)	4 (25.0)	
Smoking				
Yes	2 (25.0)	6 (75.0)	8 (50.0)	**0.315**
No	5 (62.5)	3 (37.5)	8 (50.0)	