Volume 04, Issue 01 (January-February 2021), PP 16-24 **www.ijmsdr.org**
ISSN: 2581-902X

International Journal of Medical Science and Dental Research

Efficacy of three-layered closure of oroantralfistula using block graft, buccal fat pad, and buccal advancement flap (Prospective clinical and radiographic study)

Mohammed Ali Hassan[1], Mansour Mohammed Hussien[2], Abdel Aziz Baiomy Abdullah[3]

[1] *Department of Oral and Maxillofacial Surgery, Faculty of dental medicine / Al-Azhar University (Assiut Branch), Egypt.*
[2] *Department of Oral and Maxillofacial Surgery, Faculty of dental medicine / Al-Azhar University (Cairo Boys), Egypt.*
[3] *Department of Oral and Maxillofacial Surgery, Faculty of dental medicine / Al-Azhar University (Assiut Branch), Egypt.*

Abstract:*This study was designed to evaluate the efficacy of three layered (bone block graft (BBG), buccal fat pad (BFP) and buccal advancement flap(BAF)closure of oroantral fistula(OAF) and replacing the missing alveolar bone.* ***Patients and Methods:*** *Twenty patients suffered from an OAFwere underwent to pre-operative clinical, and radiological examinations to estimate location and size of the fistulaby computerized tomography (CT). OAF in all patients were closed by three layered (BBG, BFP, andBAF) closure. The postoperative clinical evaluation includedcheek dimensions, graft rejection and intensity of pain in the periods 1 week, 3 weeks, 6 weeks, 3 months. The radiological evaluation by cone beam computerized tomography (CBCT) was done to measure the density and height of the bone in the periods 3 ,6, 9 months. All data were collected and underwent to statistical analysis.****Results:****The estimated level of pain intensity and cheek dimensions gradually decreased during postoperative intervals with statistically significantdifference ($p \leq 0.05$). Thepostoperative radiographic evaluation showed statistically significant increase in bone density measurements during follow-up periods ($p \leq 0.05$). While the average measurements of bone height decreased at all postoperative intervals with statistically significant difference ($p \leq 0.05$) between3- and 6-monthperiodsonly.****Conclusion:*** *Closure of OAF with BBG covered by BFP and BAF is a promising modality togive proper anatomical closure for OAF with excellent soft tissue healing allowing for future implant placement in OAF region.*

KeyWords: *bone block, buccal advancement flap, buccal fat pad, oroantral fistula.*

I. INTRODUCTION

An oroantral fistula can develop as a sequel of dental extractions, infection, maxillary cyst/tumor excision, persistent infection/abscess, or radiotherapy [1-2]. A small oroantral fistula < 3 mm can close spontaneously or by simple figure of eight suture, but large fistulae > 5 mm need more complicated surgical management [3-5]. It is shown that about 50% of patients with unattended oroantral communications will develop maxillary sinus symptoms in 48 hours, and within 2 weeks, 90% will have maxillary sinusitis [6]. Therefore, early detection and management are advised to avoid further complications.

Many techniques have been proposed for the closure of OAF, including raising the local or distant flap and advancing into the defect, for example, buccal flaps, palatal flaps, tongue flap, and nasolabial flaps [2-5]. The

preferred technique may vary from one clinician to another and case selection moreover all these methods have their own advantages and disadvantages.

The first clinical application of buccal fat pad was described by Egyedi[7] in 1977 where he used it for reconstruction of palatal defect following tumor excision. In recent years, buccal fat pad has been used successfully for closing oral defects due to its reliability and easy harvesting. It can provide a 6 × 5 × 3 cm graft which can cover an area of 10 cm^2. The mean thickness is about 6 mm. Care should be taken while harvesting to avoid injury to the parotid duct and facial nerve branches [8-9].

Regarding underlying bony defect, simultaneous use of bone graft in closure of oroantral communications is recommended to facilitate good prosthetic treatment. Bone grafts from different sites have been used. In 1969, Proctor [10] reported the use of iliac crest graft for large oroantral fistula closure. The chin area, retromolar area, tuberosity, and ramus of mandible and zygomatic bone are also reported as alternative donor sites [11].

Although, autogenous bone graft considered the gold standard for grafting, the disadvantage of a separate surgical procedure associated with unacceptable donor site morbidities sometimes could be a limitation [12]. Authors showed favorable results with the coverage of bone graft with buccal mucoperiosteal flap [13]. In a 10-month follow-up case, Weinstock et al. [14] demonstrated the additional benefit of the three-layer closure with bone graft, buccal fat, and buccal advancement flap. The two layers over the graft not only provide added support but also give a well vascularized bed for the success of the graft. So, the present study was performed to evaluate the effectiveness of xenogenic block graft covered with buccal fat pad and closure with buccal advancement flapin OAF closure.

II. PATIENTS AND METHODS

The present prospective study was carried on 20 patients (12 male- 8 female), aged 28-55year (mean = 41.5 year). They were selected from Oral and Maxillofacial Surgery Outpatient Clinic, Faculty of Dentistry, Al-Azhar University, Assiut branch, Egypt. Each patient was informed of the objectives and nature of the study, including benefits and risks, and was required to sign informed consent before participation in the study. The clinical study extended from 2018 till 2020 year. The study was conducted in accordance with the declaration of Helsinki, and ethics committee approval was obtained from Al-Azhar University.

1, Selection criteria:

Study carried out on patients with OAF of more than 5 mm in diameter. All the patients were free from any local or systemic condition that may interfere with healing process. While, patients with previously operated OAF, patients with chronic infections, and patients with allergy of bone graft were excluded from our study.

2, Preoperative examination:

2.1, Clinical examination:
Patients were examined if they have had one or more of these signs and symptoms; (regurgitation of fluids from the nose on the affected side, inability to blow out the cheeks and alteration in the vocal resonance). Patients were examined clinically to assess the OAF by propping it with a blunt prop, or with Valsalva test (fig.1a).

2.2, Radiographic examination:

Radiographic examination was done using CT to define the underlying bony defect and also to rule out any foreign body inside maxillary sinus (Fig1b).

Figure 1: (a) Clinical intraoral photograph showing OAF. (b) CT cut showing position and size of OAF.

3, Preoperative preparation:

All the patients were prepared preoperatively with irrigation of sinus with normal saline and no evidence of maxillary sinusitis was ensured before surgery. One day before surgery, all patients received amoxicillin/clavulanic acid, 1 gm q12h (Augmentin; GlaxoSmithKline) and metronidazole, 500 mg q8h (Flagyl; Sanofi Aventis), NSAID (Brufen, 400 mg q8h), nasal decongestant; Xylometazoline hydrochloride (Otrivin 0.1% Nasal Drops; Dawaya), and 2 % chlorhexidine mouth wash (Hexitol, Adco, Egypt) 3 times daily for one day prior surgery.

4, Surgical procedures:

After administration of local anesthesia using 4% Articaine / adrenaline 1:100,000 1.8ml (3M™ ESPE™ Ubistesin™ Forte) 3M Germany), a circular incision with a 2-mm margin was made around the OAF and the epithelial tract and pathological lesions within the opening was completely excised. Two divergent cuts were made from each end of the circular incision extending into the vestibule. The trapezoidal buccal mucoperiosteal flap was reflected from the alveolar process and the lateral wall of the maxilla(fig.2a). Bony defect was curetted by bone curette to removal any necrotic tissue. Then the mesiodistal and bucco- lingual dimensions of the bony defect were measured.

Bio-Oss bone block (Geistlich Bio-Oss Collagen®, Wolhusen, Switzerland) was trimmed to the suitable size and press fitted to the bony defect. TheBFP was exposed through a 1cm long vertical incision in the reflected periosteum posterior to the zygomatic buttress(fig.2b). The BFP was gently advanced into the bony defect and secured to the palatal mucosa without tension with 4-0 vicryl sutures. Finally, the mucoperiosteal flap was replaced in its original position and sutured with 3-0 black silk sutures(fig.2c&d).

5, Postoperative care:

Routine postoperative instructions including application of ice compresses to minimize edema, soft diet, maintaining good oral hygiene were instructed to the patients. The patients were instructed to avoid strenuous physical activities (nose blowing, sneezing, using suction tubes for drinking, vigorous sports) that might raise the pressure within the paranasal sinuses. Every patient was instructed to continue the preoperative medication for 10 days after surgery. The sutures were removed after 10 days from surgery.

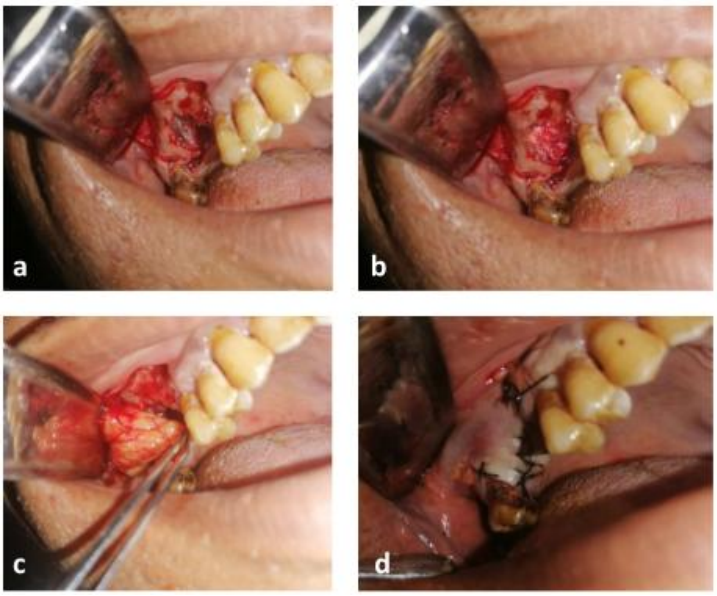

Figure 2: (a) OAF defect after reflection of trapezoidal buccal mucoperiosteal flap. (b) BBG was press fitted to the bony defect. (c)BFP was gently advanced into the bony defect. (d) Wound closure

6, Postoperative follow up and evaluation:
6.1, Clinical follow up:

The patients were examined after 1, 2, 4, and 12 weeks to inspect the following:

- Healing of the surgical wound, local allergic or inflammatory reaction, relapse of the oroantral communication, any signs or symptoms of maxillary sinusitis, graft rejectionand any undesired results that occurred.
- Postoperative pain was assessed using visual analogue scale (VAS) of 10 units: 0; no pain, 1-2; mild pain, 3-6; moderate pain, 7-9; severe pain, and 10; inconsolable pain.
- Postoperative edema was assessed using a flexible tape after four points on side of face were marked and the (AC+AD+BE) three planes were measured in millimeter (Fig.3). Where, AC- the most posterior point on the tragus to the lateral point on the corner of mouth, AD- the most posterior point on the tragus to the soft tissue pogonion, and BE- the lateral canthus of the eye to the most inferior point on the angle of the mandible. The sum of AC+AD+HE was considered as the postoperative cheek dimension value.

6.2, Radiographic follow up:
Quality (bone density) and height of bone formation were assessed using cone beam computed tomography (CBCT) at 3,6 and 9 months. Follow up CT scans using PlanmecaPromax 3D® (Planmeca Oy, Finland). The scanning conditions were tube voltage 84kV, tube current 12 mA, and slice thickness 1 mm. CT images were stored in DICOM format.

Bone density:

By using CBCT software, the changes in bone density were calculated in Hounsfield units (HU). The thickness of slices was constant in all examinations. This process was repeated at each interval of postoperative follow up (immediate, 3, 6, and 9 months)

Bone height:

The reference-plane for bone height measurement was determined by the bone-level crestal plane CBCT.

6.3, Statical analysis:
Data were collected and tabulated for statistical analysis. The statistical analysis was done using Statistical Package for Social Sciences (SPSS) Version 20 statistical analysis software at level of significant 5%. Graphs were performed using the Microsoft Excel 2019 program.

III. RESULTS

1, Clinical observations**:**

Successful closure of the OAF was achieved in all cases. None of the cases reported recurrence of the OAF or any postoperative undesired complications such as wound dehiscence, infection**,** rejection of the graft. Except, one patient had soft tissue dehiscence at 1-week follow-up. Which healed spontaneously by secondary intention after using chlorhexidine mouth wash.

Regarding pain level after surgical procedures, our study showed ahigh statistically significant decrease ($p<0.001$) in means of VAS measurements at postoperativeintervals. Also, astatistical analysis showed high statistically significant difference ($p<0.001$) between means of VAS measurements at one week (mean± SD = 7.14 ± 0.69) and 6 weeks (mean+ SD = 1.0 ± 0.82) and 3 months (mean+ SD = 0.43 ± 0.53) without any statistically significant difference ($p > 0.05$) with 3 weeksinterval (mean+ SD = 3.29 ± 0.76) (table 1).

Regards to postoperative swelling (edema), there was a high statistically significant decrease ($p<0.001$) in means of cheek dimensions measurements at postoperative intervals. Also, Post Hoc Test showed a high statistically significant increase ($p<0.001$) in means of cheek dimensions measurements at one week (mean+ SD = 11.09 ± 0.49) when it compared with preoperative mean of cheek dimensions measurements (mean+ SD = 10.13 ± 0.55). Also, there were a statistically significant decrease ($p<0.005$) in means of cheek dimensions measurements at 6 weeks (mean+ SD = 9.83 ± 0.52) and 3 months (mean+ SD = 9.83 ± 0.52) intervals compared with preoperative values and values of 3 weeks interval (mean+ SD = 10.31 ± 0.48). In the opposite site, there was not any statistical significant difference ($p > 0.05$) between values of 3 weeks interval and preoperative values (Table1).

Table 1: Comparison between the different time periods according to visual analog scale and swelling (edema)

	After 1 week (Mean + SD)	**After 3weeks** (Mean + SD)	**After 6weeks** (Mean + SD)	**After 3months** (Mean +SD)	**Fr**	**p**
Visual analog scale (VAS)	7.14 ± 0.69	3.29 ± 0.76	1.0 ± 0.82	0.43 ± 0.53	19.853*	<0.001*
	Sig. bet. Periods					
	1 vs 3 weeks	**1 vs 6 weeks**	**1 week vs 3 months**			
	0.147	0.001*	<0.001*			
	After 1 week (Mean + SD)	**After 3weeks** (Mean + SD)	**After 6weeks** (Mean + SD)	**After 3months** (Mean +SD)	**Fr**	**p**

swelling (edema)	11.09 ± 0.49	10.31 ± 0.48	9.83 ± 0.52	9.83 ± 0.52	198.91*	<0.001*
	Sig. bet. periods					
	1 vs 3 weeks	**1 vs 6 weeks**	**1 week vs 3 months**			
	<0.001*	0.153	0.002*			

Fr: Friedman test, Sig. bet. Periods was done using Post Hoc Test (Dunn's)
p: p value for comparing between the studied periods.
*: Statistically significant at $p \leq 0.05$

2, Radiographic observations:

Regarding means of bone density, means values with SD immediately ,3,6,9 monthsintervals were (590.0 ± 30.24, 629.9 ± 28.72, 666.1 ± 21.01,683.3 ± 16.59) respectively. Statistical analysis showed a statistically a significant increase in mean bone density measurements at 3 and 6 and9 months (p<0.001, p<0.001,0.004) in the same sequence when compared with preoperative values(fig.3a&c)

The current study presented that means values of bone height at immediately ,3,6,9 months intervals were (8.97 ± 0.33, 8.75 ± 0.30 , 8.31 ± 0.40, 7.90 ± 0.70)respectively. The statistical analysis showed a statistically significant decrease in mean bone height measurements at 3 and 6 and 9 months (p<0.001, p<0.001, 0.004) in the same sequence when compared with preoperative values. Moreover, there was a high statistically significant difference between mean values of 3 and 6 months intervals (p<0.001) and statistically nonsignificant difference between mean values of 6 and 9 months intervals (p> 0.005) (fig.3b&d).

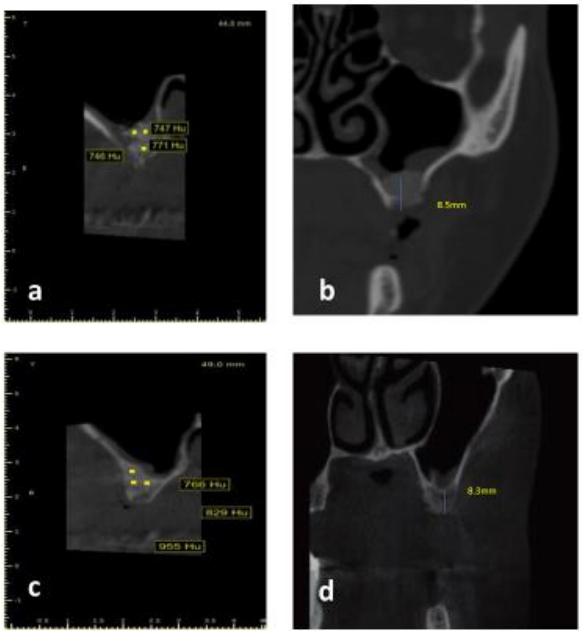

Figure 3: CBCT showing measurement of (a)Immediately postoperative bone density. (b)Immediately postoperative bone height (c) postoperative bone density after 9 month (d)postoperative bone height after 9 months

IV. DISCUSSION

Oroantral fistula is pathologic communication between oral cavity and maxillary sinus, usually localized between antrum and buccal vestibule. Persisting OAF always causes chronic maxillary sinusitis [1]. So many causes can lead to fistulas which can involve the nasal and antral cavities or even both. They may result from

various entities such as pathological ones or secondary to removal of tumors or maxillary cysts. However, the main cause of oroantral fistula is the extraction of a maxillary molar or premolar. Frequencies of such occurrences have been reported to be between 0.31% and 4.7% [15].

Several techniques have been utilized for OAF closure, such as the use of mucoperiosteal flap techniques (vestibular, palatine, lingual or combined), or buccal fat pad grafts [2-7]. These techniques have main shortfall that is only soft tissue closure is achieved; hence the need of complex hard tissue (bone) grafting when endosseous implant is considered [16].

The present study describes a new technique for closure of the OAF, in which both hard (bone) and soft tissue closure was achieved for prosthetic rehabilitation purpose. The technique included xenograft bone block graft for closure of OAF defect then covered by BPF graft to support bony graft and ensure soft tissue closure.

In our study, successful closure of the OAF was achieved in all cases. This can be explained by that grafting the bony defect by suitable bone graft not only reduces the bone resorption expected, but also it protects and supports the soft tissue closure as discussed by Haas et al[17].

Tidemanet al.[18] have shown that BFP was capable of self-epithelialization within 3-4 weeks of its inset. Nevertheless, covering the BFP might be essential in cases of large defects and where the amount of BFP may be inadequate. In such cases, buccal advancement flap is the best option. This combination technique provides more stability and provides additional tissue for cover. [7,18]

In our case, this layered closure was needed to provide support to the bone graft and to maintain a well vascularized environment for the graft take up. This was in the same direction with study of Er et al. [19] who reported wound dehiscence in 20% of cases after two-layered closure. Also, Weinstock et al. [14] demonstrated additional benefit of the buccal flap covering the BFP over the graft in a study with a 10-month follow-up.

The bone substitute that was used for our study is the an-organic bovine bone. Various authors have reported the material to be suitable for sinus augmentation [20-21]. The most commonly used product that has been reported in literature comes under the proprietary name of Bio-Oss ®tlich Pharma Switzerland) which is a highly biocompatible and osteoconductive material which leads to appropriate osseointegration of dental implants [22].

Regarding pain level after surgical procedures, our study showed gradually decrease in means of VAS measurements at postoperative intervals. Where, there was a high statistically significant difference between values at one week and other intervals. Moreover, there was nonsignificant difference between 6weeks and 3 months intervals.

The present study used CBCT to follow the qualitative (bone density) and quantitive (bone height) changes in the augmented defect in agreement with the studies concluded that CBCT is a reliable technique with less effort, both for the investigator and for the patient, as it is noninvasive and technically supported for assessment of the graft after augmentation [23-24].

Regards to radiological evaluation, all patients showed a highly statistically significant radiologic evidence of bone formation at 3,6 and 9 month interval. The bony defects showed marked increase in the bone mineral density with minimal loss of bone height after three months and continued till last time of study which denoted accelerated healing and rapid degradation of the graft. These results are in agreement with animal studies and clinical trials published by Zitzmann et al [25], Slotte et al [26], Norton et al. [27] which reported Bio-Oss® exhibited good osteoconductive potential.

V. CONCLUSION

Despite of our study is lacks control, itsresults proved that combined use of BBGcovered by double layers (BPF graft and buccal advanced flap) was a very simple, easy and helpful technique in closure of OAFs. The technique not only improved the bone healing and reduced vertical alveolar bone loss, but it also increased the success rate of closure of the OAFs through minimizing the chance of graft resorption or wound dehiscence.

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