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CLINICAL PAPER

Surgical Management of Oro-Antral Communications Using Resorbable GTR Membrane and FDMB Sandwich Technique: A Clinical Study

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Abstract The paper describes a new technique for closure of the oro-antral communication, in which both hard (bone) and soft tissue closure was achieved. The technique uses a Guided Tissue Regeeration (GTR) membrane and Freez Dried Mineralized Bone (FDMB) allograft for closure of the defect. Aim of the study was to assess the advantages of the surgical management of oro-antral communications using resorbable GTR membrane and FDMB sandwich technique.

A total 10 patients were selected in whom dental extractions were complicated by formation of oro-antral communication (OAC). The resorbable guided tissue regeneration membrane (PERIOCOL-GTR) and freeze dried mineralized bone allograft material was used. Some cancellous granules of freeze dried bone allograft was sandwiched between sheaths of appropriately trimmed collagen membrane which was previously sutured together on three sides using 3/0 resorbable polyglycolic acid suture (vicryl). The fourth side was then adequately closed using the same suture after the bone graft had been inserted, thus creating a closed sandwich. The prepared sandwich was then tucked into the OAC in such a way that it formed a convexity towards the sinus and a concavity towards the alveolar bone. The rough surface of the sandwich is faced to the alveolar bone and additional bone graft is filled into this concavity. Suturing done without tension. Post-operative orthopantomogram was taken to radiologically quantify the amount of bone grafting/augmentation and closure of oro-antral fistula.

There was an average of 11.84 mm bone formation after 6 months, the average width preserved and obtained was 6.9 mm. By the end of 4 months there was evidence of bone formation in 7 subjects and in three subjects bony trabeculae formed was almost similar to the adjacent bone. By the end of 6 months follow-up of 7 subjects showed trabeculae indistinguishable from the adjacent bone.

The study was done in 10 patients with a follow-up period of 6 months and found to be excellent in the formation of new bone. The technique is simple and excellent for closure of the oro-antral communications especially when subsequent placement of end osseous implant is considered without the need of donor site surgery for bone grafting.

Keywords Oro-antral fistula · Bone allograft · Buccal sliding flap

Introduction

Oro-antral Communications (OAC) are pathological conditions characterized by the existence of a communication between the oral cavity and the maxillary sinus, as the result of loss of the soft and hard tissues which normally separate both compartments which may progress to the formation of Oro-antral fistula (OAF) [1].

Although perforations with a diameter of less than 2 mm may heal spontaneously after formation of the blood clot

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and secondary healing [2], larger orifices require closure of the defect to avoid infection and fistula formation [3]. Many techniques have been proposed to seal the socket from the oral environment but all of them describe the soft tissue closure only.

Achieving both hard and soft tissue closure will not only repair the OACs but also facilitate prosthetic rehabilitation of patient through the placement of an endosseous implant [1]. The technique has been first described by Ogunsalu [1]. The present study was conducted on 10 patients with 6 months follow up, and aims at achieving both soft and hard tissue closure of the OACs with use of resorbable GTR membrane and bone substitute. The bone grafting material utilized in this study was human freez dried mineralised bone allograft. The main aim of the present study was to assess (a) the new technique for successful closure of the OAC in terms of both hard tissue and soft tissue. (b) the quality and quantity of the bone regenerated by the new technique. (c) the newly regenerated bone, for the possibility of endosseous implant placement.

Materials and Method

Ten patients were selected in whom dental extractions were complicated by formation of OAC. Patients with sinus pathology and systemic diseases were excluded. Sinus perforation greater than or equal to 2 mm in diameter were selected. Systemically healthy subjects with no clinical or radiological signs of acute or chronic sinusitis were selected. Smokers were not selected.

The resorbable guided tissue regeneration membrane (PERIOCOL-GTR) was used. It is an orange brown Type I collagen membrane derived from fish sources and available in various dimensions. It is gamma sterilized and supplied in individual blister packing. It is non toxic, non allergenic, and non immunogenic and over-all bio-compatible. The porous surface facing the bone wall allow the ingrowth of the bone forming cells. The dense surface facing the soft tissue will prevent the in-growth of fibrous connective tissue into the bony defect. It will resorb in 24 weeks.

Freeze dried mineralized bone allograft material was obtained from Tata Memorial Hospital, Mumbai. It is prepared by following standard protocol and is highly successful in the formation of new bone.

A detailed clinical and radiological data of each patient was recorded in a standard case history performa. The OAC was assessed, diagnosed and confirmed by both clinical and radiological assessment. Clinical visibility on inspection was checked. Nose blowing test and cotton wisp test were performed to confirm OAC and its diameter measured using modified ball burnisher of different sizes. Radiologically an orthopantomogram was taken with gutta-percha points inside the socket in all cases prior to any surgical procedure to assess the OAC (Fig. 1). An IOPAR was taken in a similar manner (Fig. 2).

The length of the root of the extracted tooth was measured. If the root was not available the depth of the socket was measured.

Vestibular depth was noted using probe and scale. The closure was carried out the same day or as soon as possible.

Surgical Technique

After adequately anesthetizing the area with LA, extraction socket was irrigated and curetted gently to remove any debris or granulation tissue if present. Inter-radicular bone was partially removed and any sharp bony projections smoothened. Some cancellous granules of freeze dried bone allograft was sandwiched between sheaths of appropriately trimmed collagen membrane which was previously sutured together on three sides using 3/0 resorbable polyglycolic acid suture (vycril). The fourth side was then adequately closed using the same suture after the bone graft had been inserted, thus creating a closed sandwich (Fig. 3). The sandwich was prepared in such a way that it has a smooth side which is marked with “up” and a rough side. The prepared sandwich was then tucked into the OAC in such a way that it formed a convexity towards the sinus and a concavity towards the alveolar bone. The rough surface of the sandwich faced the alveolar bone and additional bone graft was filled into this concavity (Fig. 4).

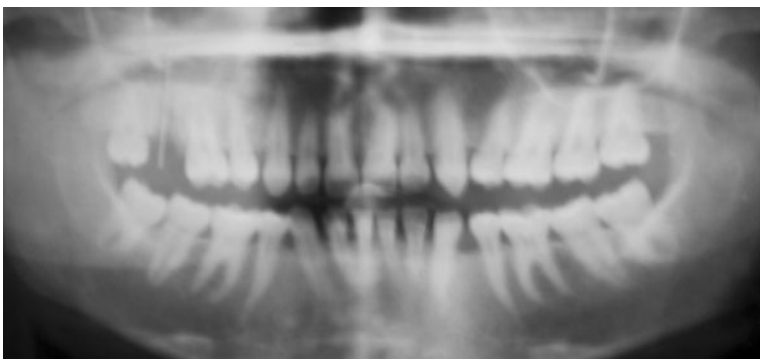

Fig. 1 OPG with GP points inside the socket

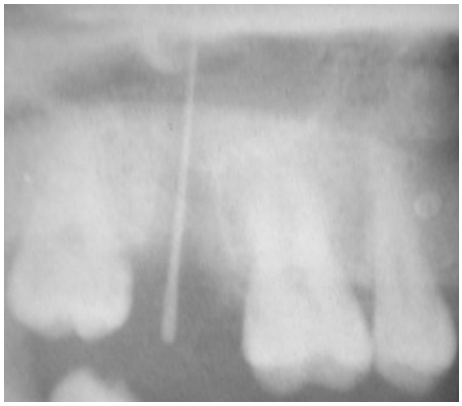

Fig. 2 IOPAR with GP points inside the extraction socket

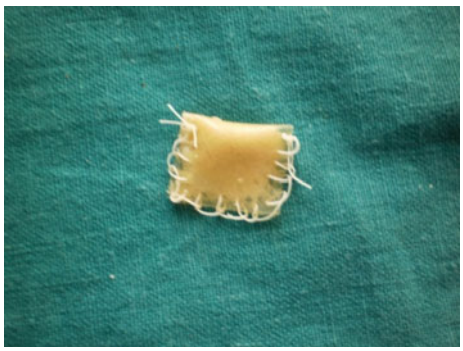

Fig. 3 Sandwich of FDBA in collagen membrane

Fig. 4 Sandwich of FDBA in collagen membrane tucked into the socket

The mucoperiosteum was raised both buccally and lingually, and the height of the alveolar ridge was reduced at the site of the opening substantially. Edges of the soft tissue to be approximated were freshened so that raw surfaces will be in contact with each other. Releasing incisions were made. Buccal flap was raised if soft tissue closure was not adequate. Suturing was done without tension. The edges were drawn together with mattress sutures and reinforced with multiple, interrupted black silk sutures. Prefabricated protective splint was placed post-operatively (Fig. 5). Routine standard post-operative instructions were given to all patients.

Results

The sample consisted of 10 patients, 5 males and 5 females whose age ranged from 19 to 42 years (mean age, 29.6 years).

Upper right 2nd molar was the most frequently involved tooth. The cause for extraction of the offending tooth being dental caries with periapical involvement in 4 cases, gross decay in 3 cases and dental caries with acute pulpitis in 3 cases. Diameter of the defect varied from 3 to 7 mm (average-4.3 mm, SD-1.25 mm). Length of the extracted socket varied from 10 to 17 mm (average-12.93 mm, SD-2.92 mm). All the cases required advancement of buccal flap for primary closure but extent of advancement towards palate varied drastically. Immediate complications were checked on 1st, 3rd, 5th and 7th day—significant post-operative pain was present only in 3 patients, swelling was present in 4 patients which gradually subsided by the end of 7th day, epistaxis was present in one patient on 1st post operative day. There was no evidence of any significant bleeding from socket neither was there any incidence of loss of graft, infection, or any evidence of sinusitis or wound gaping in any of the cases. Delayed complications were checked at 2nd week, 3rd week and 4th week—there was no evidence of infection, wound gaping, fistula formation, loss of graft or sinusitis.

Long-term variables, checked on 2nd and 4th month, showed satisfactory soft tissue clinical healing. There was an average of loss of sulcus depth of 3.1 mm.

Fig. 5 Closure

There was an average of 11.84 mm bone formation after 6 months, the average width preserved and obtained was 6.9 mm.

Quality of bone formation

By the end of 4 months there was an evidence of bone formation in 7 subjects and in three subjects bony trabaculae formed was almost similar to the adjacent bone. By the end of 6 months follow up 7 subjects showed trabaculae indistinguishable with the adjacent bone (Figs. 6, 7).

Discussion

The treatment of oro-antral communications relies on the establishment of a good physicochemical barrier that allows uneventful healing and prevents infection. Whereas small oro-antral communications with a diameter of less than 2 mm usually heal spontaneously, larger defects rarely heal spontaneously without adequate closure [3].

When the OAC persists for more than 3 weeks, the fistulous trajectory between the maxillary sinus and oral cavity begins to undergo epithelization—thereby precluding spontaneous closure [4].

The most frequent cause underlying OAC is surgical extraction of the second premolar and of the first and second molars of the upper jaw (the latter also being referred to as "antral teeth") [5]. They are called antral teeth due to the proximity between the apices of these teeth and the maxillary sinus [6, 7], with a distance of 1–7 mm or to root protrusion into the floor of the maxillary sinus secondary to its pneumatization [7].

In the present study the incidence of age ranged from 19 to 42 years (mean age. 29.6 years). Male–female ratio was equal. Upper right 2nd molar was the most frequently involved tooth. The only cause for extraction of the offending tooth was dental caries.

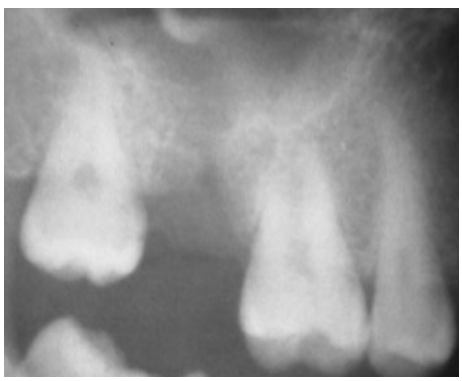

Fig. 6 IOPAR after a period of 6 months

The intraoperative diagnosis of OAC is usually based on the Valsalva maneuver [7], which offers a sensitivity of 52 % [8]. Penetration of a blunt-edged Bowman probe to assess perforations of the maxillary sinus floor is also valid for diagnosing OAC [9, 10], with a sensitivity of 98 % [8] hence both these methods were utilised in our study.

The size of the communication varied from 3 to 7 mm (average 4.3 mm SD-1.25 mm). and length of extracted socket varied from 10 to 17 mm (average 12.93 mm, SD-2.92 mm). These sizes are close to the sample utilized for comparative study conducted by Hariram and Mohammad [11]. The loss of sulcus depth in our method was an average of 3.1 mm SD:1.2 mm. This is mainly due to an attempt to achieve primary closure over the graft, the final vestibular depth was still sufficient enough for prosthetic rehabilitation in all cases.

Intra-oral periapical x-rays are useful for diagnosing OAC, but the usual approach is to employ extraoral projections (e.g., orthopantomography and the Waters projection) which can visualize the oral cavity, the maxillary sinus and the trajectory of the communication. Computed axial tomography in turn can assess the size of the fistula, the characteristics of the bone and mucosa surrounding the perforation, and the nature of the sinus mucosal lesion [9, 10, 12]. Nevertheless, computed axial tomography has certain limitations and is unable to detect fine bone laminas—as a result of which the diameter of the fistula may be overestimated. In our present study we have used both IOPA radiographs and OPGs for confirmation of OACs.

The sandwich technique is fast and easy, it shows good clinical healing and integration into the hard and soft tissues. Post-operative pain and swelling are markedly reduced and the vestibular architecture is maintained [1].

In the present study, post-operative wound healing was uneventful. Of 10 only 4 patients had significant post op pain during follow-up. Only 3 patients presented with swelling which gradually subsided within 7 days. One patient reported with epistaxis which was present on first post-operative day but was not significant hence needed no intervention. None of the patients had bleeding from the socket, loss of graft, signs of sinusitis or infection or wound gaping. This finding is agreeable to the study conducted by Hariram and Mohammad [11]. Radiological evidence of bone formation was seen after 4 months of graft placement. Cases in which the bone opacity was clearly far lower than the native bone were marked (−). Cases in which the bone opacity was close to that of the native bone but still lower were marked (+). And cases of bone in which the radiopacity is equal or nearly equal to adjacent native bone was marked as (++) [13] (Table 1).

Four months post surgery 30 % of patients showed good bone quality of (++) score while rest 70 % showed bone opacity that was close to the native bone but still lower;

Table 1 Post operative findings after 6 months follow up

Case no.	Width of the bone formed	Depth of the bone formed	Depth of Sulcus	Loss of sulcus depth	Quality of bone formation	Clinical healing
1	6	11	11	2	++	+
2	7	9	14	3	++	+
3	7	12.5	13	3	++	+
4	6	8.4	13	2	+	+
5	8	15.5	12	5	++	+
6	6	9.5	11	2	+	+
7	8	15.3	12	5	++	+
8	6	15	13	3	++	+
9	7	13.2	13	2	++	+
10	8	9	11	4	+	+
Average	6.9	11.84	12.3	3.1		
SD	0.88	2.82	1.06	1.2		

whereas by the end of 6 months follow-up, 70 % of patients showed bone quality with trabeculae indistinguishable with adjacent bone (Table 1; Figs. 6, 7).

The width of the bone was measured with the help of caliper [14] after the tissues were thoroughly anesthetized; it ranged from 6 to 8 mm with an average of 6.9 mm (SD 0.88) after 6 months post operatively (Table 1). In any circumstances for the placement of an endosseous implant the minimum requirement is 5 mm [15]. Our study indicated an average of 6.9 mm of bone preservation and formation which is more than sufficient for an implant placement.

The depth of the bone was measured 6 months postoperatively. As per the method, magnification error was thoroughly taken care of as mentioned. The average depth of bone formation was 11.84 mm with SD 2.82 (Table 1). As per the statistical analysis for hard tissue healing the amount of bone formation is greater than 6 mm. Hence it is evident that hard tissue healing is far superior to an uncomplicated exodontias in that region (average amount of bone remaining in an edentulous or partially edentulous patient is only 6 mm as per study conducted by Shahbazian et al. [16]).

The sandwich technique in the closure of oro-antral communication/fistula is new and promising [1]. Ogunsalu et al. first used this technique in 2000 in the reconstruction of the maxillary sinus floor and alveolus post excision of a bone destroying lesion without the need of bone graft donor site. In their classic papers [17, 18], the authors suggested other possible applications of this technique to include reconstruction of orbital floor, closure of oro-antral fistula, reconstruction of bony cleft defects and mastoid ablation. As no donor site surgery is necessary, this is an advantageous technique in terms of time saving, cost and more importantly, less discomfort to the patient during and after surgery. Furthermore, both bony (hard tissue) and soft tissue closure is achieved for oro-antral communication in contrast to only soft tissue closure obtained by buccal sliding flap and palatal flaps. The reconstructed bony tissue regenerated from this technique will also be able to receive an endosseous implant [1]. In our study all patients showed not only excellent soft tissue closure of the OAC but also good bone tissue formation.

Our observation of bone regeneration in 6 months when FDBA was used through remodelling is consistent with Minichetti [19] who did a histologic analysis of grafted site with FDBA and concluded that formation and remodelling of bone was present. Feuille et al. [20] did a histomorphometric analysis of grafted site of FDBA and revealed a range of new bones from 42.9 to 70.5 %, with a mean of 47.6 %. All these studies indicate adequate osseointegration,

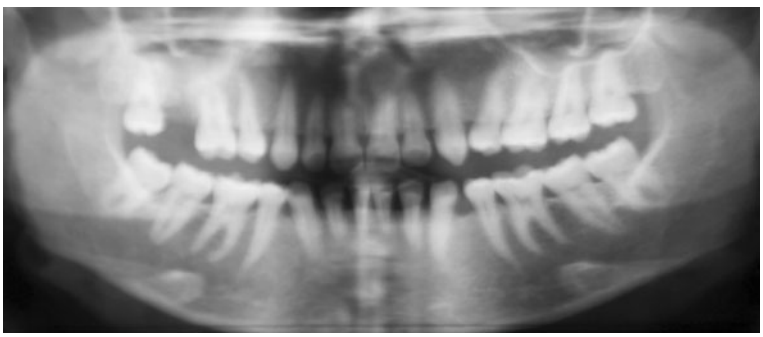

Fig. 7 OPG after a period of 6 months

followed by replacement resorption of FDBA along with preservation of ridge. Thus, human freeze dried bone allograft is an excellent bone grafting material especially when an implant placement has to be considered.

The sandwich technique thus offers a promising approach to replacement of lost bone without the limitations seen with other techniques. This technique can also be used successfully in the closure of oro-antral fistula [1].

Conclusion

This study indicates that the closure of OAC by this "New surgical management for oro-antral communication the resorbable guided tissue regeneration membrane—bone substitute sandwich technique" is very reliable. The results clearly indicate that the new technique is successful in not only achieving closure of OAC in terms of both hard and soft tissues but also helps to preserve and obtain a good quality of bone. The ultimate width and depth of the bone achieved was sufficient to place an endosseous implant.

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