

Case Report

Use of Fibrin Sealant in Guided Tissue Regeneration of Intrabony Defect

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Abstract

Background: The treatment of periodontal intrabony defect can be a challenge to clinicians especially with the use of barrier membrane in guided tissue regeneration (GTR). The mechanical and biological regenerative potential of barrier membrane could be enhanced with the use of fibrin sealant. The purpose of this case report was to describe a surgical procedure achieving regeneration with fibrin sealant application in combination with guided tissue regeneration (GTR) to eliminate intrabony defect.

Methods: A 21 year old systemically healthy female had the complaint of swelling and bleeding from gingiva in maxillary anterior region since 6 months. On clinical examination, there was a high frenal attachment penetrating deep into the palatine papilla leading to midline diastema. The papilla caused opening of the gingival margin in the palatine region leading to pocket formation in mesial side of 7 mm and 5 mm in relation to 21, 12. Radiographic examination revealed an intrabony defect in the same region. Due to persistence of pocket after frenum excision, surgical treatment for GTR was planned with use of bio-resorbable collagen membrane and fibrin sealant application.

Results: The patient was followed for 9 months post-operatively. Reduction in probing depth was observed in 6 month and radiographic bone fill at 9 months. The probing depth was reduced to 3 mm in relation to 21 and 12. The gingival tissues appeared healthy with no bleeding on probing or gingival recession.

Conclusion: This case report shows the possibility of achieving periodontal regeneration over a localized intrabony defect with the combined use of GTR membrane and fibrin sealant. An adjunctive regenerative technique is presented that allowed space making, stabilization of membrane, early wound healing as well as local taxis of growth factors for regeneration of periodontal tissues.

Clinical implication: The use of fibrin sealant boosted the regenerative potential of barrier membrane showing potential of new bone formation and early wound healing.

Keywords: Alveolar bone loss; Bone regeneration; Fibrin tissue adhesive; Guided tissue regeneration; Periodontal pocket

Introduction

The basic concept of conventional periodontal regenerative treatment is reduction or elimination of tissue inflammation induced by bacterial plaque and its by-products, correction of defects or anatomical problems caused by the disease process, and regeneration of lost periodontal tissues as a consequence of disease destruction [1]. Guided tissue regeneration (GTR) has been widely used for this purpose as it has a "space making effect", leading to regeneration of periodontium [2]. The rationale of GTR is to place a barrier membrane over the denuded root surface and the debrided periodontal defect to exclude epithelial growth and allow periodontal ligament and alveolar bone cells to repopulate the isolated space [2]. Biodegradable collagen membranes, both synthetic and natural are popular and have been used by several authors [3,4]. The results have not been consistent with the use of these membrane, some have shown regeneration while others have found no difference when compared against open flap debridement [5,6]. The varied results seen among them could be explained by lack in expression of biologic potential for regeneration by the barrier membranes [7].

The major problem with the use of GTR membrane is the deficiency in maintenance of space and stability, early exposure and resorption of barrier membrane, and this overall influences the healing process [8,9]. Over the last two decades several methods have been used to enhance the regenerative capacity of membranes. Different biomaterials and products include bone graft and amelogenin to prevent collapse of membrane, wound healing modifier or biologic response modifiers like growth factor and root biomodifier to enhance the existing regenerative potential and promote early wound healing [3,10-12].

Fibrin sealants (FS) are biologically derived substance with fibrinogen and thrombin being its major constituent mimicking the final leg of clotting cascade [13]. Tal et al. [14] treated fenestration defects with collagen membranes and showed that the submembraneous blood clot was sufficient for the regeneration of cementum, periodontal ligament and bone. Similarly FS provides an artificial clot that persists longer than the natural clot because of presence of aprotinin, an anti-fibrinolytic agent [15]. The clot formed by fibrin sealant would provide stability and maintain space underneath the membrane and additionally increase the overall regenerative and healing potential. Previous studies have showed enhanced regeneration and early wound healing with use of fibrin sealant [7,15-18]. Therefore FS could be used to enhance and overcome the drawbacks of barrier membrane for the treatment of deep intrabony defect. In this case report we used a combination of resorbable barrier membrane and fibrin sealant system for the treatment of intrabony defect.

Case description

A 21 year old, female patient reported to the Department of

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Received: September 12, 2014; **Accepted:** October 30, 2014; **Published:** November 3, 2014

Citation: Pulikkotil SJ, Nath S (2015) Use of Fibrin Sealant in Guided Tissue Regeneration of Intrabony Defect. J Interdiscipl Med Dent Sci 3: 158. doi: 10.4172/2376-032X.1000158

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Periodontology, Chhattisgarh Dental College and Research Institute, Rajnandgaon, in January 2013. Her complaint was of swelling and bleeding from gingiva in maxillary anterior region since 6 months, which was “increasing over time”. The patient had a non-significant medical history. Intra-oral examination revealed presence of high frenal attachment of papilla penetrating type and spacing between central incisors (Figure 1). A blanch test was performed by stretching of the upper lips and observing the location of alveolar attachment while exerting intermittent pressure on the frenum. The test was considered positive as the band of tissue with a broad fan like base was attached to the palatine papilla and blanching was produced in the area.

Moderate plaque accumulation was seen in maxillary anterior region with a score of 1.2 [19]. The gingiva was inflamed with respect to 11, 21, and was soft in consistency. Probing evoked bleeding from the same region. Periodontal pocket detected in relation to the labial aspect of 11, 21 was 4 mm and 6mm; while 7 mm and 5 mm on the palatal aspect (Figure 2). No mobility or recession was noted in any of the involved teeth. The periodontal status of all the remaining teeth was healthy. Radiographic examination presented with angular bone loss extending middle half of the tooth root in the maxillary anterior region along the mesial aspect of 21 (Figure 3). Based on these findings a diagnosis of localized chronic periodontitis was made.

Treatment plan

Proper plaque control methods were reinforced and scaling and root planing was performed. Frenectomy was done for maxillary labial frenum after one week and reevaluation was done 4 weeks after the procedure (Figure 4). Persistence of periodontal pockets was detected in relation to mesial aspect of 11 and 21. Following consultation with the patient, the decision was made to perform regenerative periodontal surgery with the use of fibrin sealant and GTR membrane.

Surgical periodontal therapy

Prior to surgery, the patient rinsed for 60 seconds with a 0.2% chlorhexidine mouthrinse. The maxillary anterior quadrant extending from distal of right lateral incisor to distal surface of lateral incisor underwent conventional flap surgery. Following local anesthesia using 2% Lignocaine with adrenaline (1:200000), transgingival probing was done to determine the bone defect. Sulcular incision was given and a full thickness mucoperiosteal flap was raised on buccal and palatal surfaces. Granulation tissue was removed and root instrumentation performed. A large two-walled bone defect was observed in relation to 21 which measured to 9 mm in height and 2 mm in width (Figure 5). A tin foil was used as template and the GTR membrane was trimmed accordingly to an H-shape. With fibrin sealant (Tisseel® Baxter Healthcare, Deerfield, IL, USA) as the adhesive, bio-absorbable collagen membrane (Periocol GTR®, Eucare Pharmaceuticals P. Ltd., India) was used to cover the bony defect (Figures 6 and 7). The reconstitution of fibrin sealant was done as per manufacturer’s instruction. The flaps were then coronally repositioned and approximated using 5-0 bioabsorbable vicryl suture (Johnson, Ethicon, USA). Horizontal mattress sutures and a non eugenol periodontal dressing (Coe-Pak®, GC America, Alsip, IL.) was given (Figure 8).

Postoperative procedures

Postoperatively, 600 mg ibuprofen, three times/ day for 5 days and 500 mg amoxicillin, three times/day for 7 days were prescribed. The patient was instructed not to brush the surgical site for three weeks and to rinse with chlorhexidine digluconate 0.2% during this period for two minutes twice daily. The area was redressed every week for three weeks.

Professional oral prophylaxis was performed every week during the first postoperative month and every other week in the next two month.

Local tissue reaction and membrane exposure was also evaluated at every visit. Patient was assessed for potential side effects of fibrin sealant like hypersensitivity to bovine aprotinin, which could lead to severe bleeding. During the 7 days following surgery, patients filled out a questionnaire to evaluate the experience of post operative complaints.



Figure 1: High frenal attachment of papilla



Figure 2: Periodontal pocket

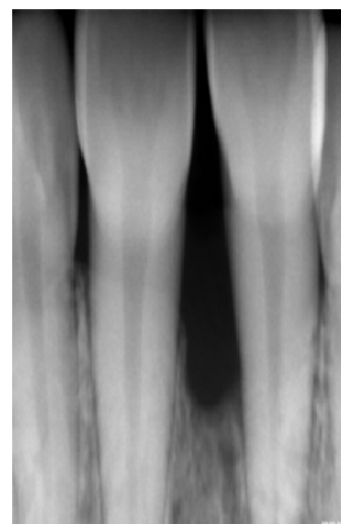


Figure 3: Radiographic examination



Figure 4: Frenectomy of maxillary labial frenum



Figure 5: Two-walled bone defect in relation to 21



Figure 6: Bony defect-1



Figure 7: Bony defect-2



Figure 8: Horizontal mattress sutures and a non-eugenol periodontal dressing

Questions relating to experienced pain, type of pain, use of analgesics, increase of pain or discomfort during brushing and eating, and swelling and bleeding of the gingival area were filled in by the patient. For the recording of the experienced pain and discomfort, a visual analogue scale (VAS) was used. For clinical and radiographic evaluation the patient was recalled at 3, 6, and 9 months.

Result

No soft tissue reaction or exposure of membrane was observed during the follow-up visits. No other adverse reactions or side effects were noted. After 7 days of post operative healing minimal pain and discomfort was noted with VAS score of 3 and 4. Three months after surgery clinical examination was performed. Plaque accumulation was minimal with a score of 0.8. The gingival tissues were healthy with no signs of inflammation and bleeding on probing. Periodontal probing was performed only after 6 months, revealing the probing depth was reduced to 3 mm (Figure 9). The periodontal tissue appeared healthy

with absence of bleeding and gingival recession. The plaque score was 0.5, indicating the patient was maintaining good oral hygiene. After 9 months the probing measurement remained same with good healing of gingival tissues. The radiographic examination revealed bone fill of the intra-bony defect (Figure 10).

Discussion

The case presented here highlights the combination use of resorbable collagen membrane and fibrin sealant in the treatment of deep intra-bony defect. The localized periodontal defect in the maxillary anterior was caused by the presence of papillary penetrating type frenal attachment. The frenum pull caused opening of marginal gingiva in palatal region leading to increase in plaque accumulation and calculus deposition. As its presence precluded maintenance of good oral hygiene and therefore leading to progression of periodontal disease [20]. Therefore after frenectomy, regenerative therapy was planned for the treatment of intra-bony defect between the maxillary teeth.

Various methods and technique have been developed following two distinctive paths for the regeneration of intra-bony defect. One is novel surgical techniques and other is use of regenerative materials. Former includes clinical innovation in flap design and handling. The recent flap techniques used are simplified papilla preservation flap, minimally invasive technique (MIST) and modified MIST [21]. While in the area of regenerative material, three different regenerative concepts have been explored: barrier membrane, grafts and wound healing modifiers and a combination of these materials. In our study we planned for combination of two different materials, fibrin sealant and GTR membrane [10-12].



Figure 9: Periodontal probing revealing probing depth

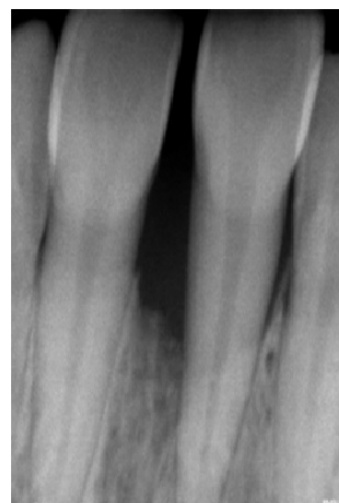


Figure 10: Radiographic examination revealed bone fill

Guided tissue regeneration is the procedure based on prevention of migration of the epithelial periodontal tissues into the osseous defect, allowing time for bone and other attachment tissues to heal [1]. Melcher suggested that certain cells residing in the periodontium have the potential to create cementum, alveolar bone and periodontal ligament and coordination between these three tissues is essential for regeneration [2]. It was hypothesized that such condition arises when epithelial cells or fibroblasts are excluded from the wound space and periodontal ligament cells are allowed to migrate coronally [22]. Hence forth the placement of a barrier membrane would thus ensure that the detached root surface becomes repopulated with cells from periodontal ligaments capable of forming bone, periodontal ligament and cementum [23]. The two types of membrane available are non resorbable and resorbable. Non resorbable membrane retain their build and form in the tissue but require a second surgical procedure for their removal causing increased patient visit, discomfort, duration, cost and disrupts initial healing [2]. To overcome these drawbacks, resorbable membranes were used. Resorbable membranes are of two types, natural and synthetic [3]. In our report we decided to use natural resorbable collagen membrane derived from fish. Collagen attracts and activates periodontal ligament and gingival fibroblast cells; in addition it is haemostatic and biocompatible. Collagen membrane showed inconsistent results due to insufficient stability and lowered space maintenance due to collapse and early resorption, all leading to compromised healing and regeneration [5]. An ideal GTR membrane should have the following property; cell exclusion, biocompatibility, space maintenance, tissue integration and ease of use [5]. In addition the membrane should be biologically active but till now there are no membrane fulfils all the above criteria. To overcome these shortcomings fibrin sealant was used in addition to resorbable collagen membrane to boost its regenerative potential.

Fibrin sealant is a two component system which on combination forms fibrin clot which is having adhesive and haemostatic property [13,15,16,24]. In several experiments fibrin sealant was used to fix flaps and grafts and after 1 week found it to have superior healing than conventional suturing [15,16]. In our study the additional use of a fibrin sealant material provided superior results with regeneration of bone. It resulted in probing depth reduction and gain in hard tissue probing and better clinical healing. Similar finding was also seen by several authors using FS and GTR procedures in humans [25,26] and in animals [7,27].

We placed fibrin sealant in between the root surface and membrane. Fibrin sealant allowed; cell exclusion, space maintenance tissue integration, regeneration and easy handling. Cell exclusion property requires the membrane to separate gingival flap from the coagulum in the wound space. Fibrin sealant promotes clot formation and increase clot strength by forming cross links with fibrin which further prevents its proteolytic cleavage. Early clot adhesion to the root surface promotes periodontal regeneration and serves as a barrier to the apical migration of junctional epithelium [25]. The next property is space maintenance; the membrane should withstand masticatory forces, flap tissue tension and prevent collapse of soft tissues or reduction of the wound space. The clot formed from FS between the membrane and root surface provides space for bone regeneration and also gives stability to the overlying membrane. FS provided high compatibility and good mechanical strength to the barrier membrane [7]. The third essential property is tissue integration. Tissue integration property ensures wound stabilization and inhibition of epithelial migration, resulting in gain of attachment level. In our report reduction in probing was achieved with the use of FS.

Fibrin sealant promotes new attachment and bone regrowth when placed over denuded root surface and similar effect was seen in our case report [28-31]. Fibrin sealant promotes regeneration by three mechanisms; osteoblasts proliferation, clot stabilization and presence of fibronectin and growth factor. Bosch et al. [32] have shown that fibrin sealant produced an early enhancement of bone repair in rabbits. The physical properties of the bony callus seemed to be enhanced by its use [33]. Although Caton et al. [34] contradicted these results. Isogai et al. [35] reported that fibrin clots support growth, adhesion, migration, and differentiation of osteoblasts in vitro. In addition FS contains several factors which can promote regeneration such fibrinogen, fibronectin, Factor XIII and platelet derived growth factor (PDGF). Fibrin and factor XIII are known to promote fibroblast adhesion and multiplication [15]. Fibronectin enhances wound healing by promoting new attachment by the growth of fibroblast and their attachment to root surfaces and forms covalent linkages with fibrin and collagen [29]. PDGF is a polypeptide, which enhances fibroblast reduplication and helps in periodontal regeneration and repair [15]. Therefore, the FS may act like osteoconductive materials on bone healing. Fibrin sealant has been as vehicle for delivery of mesenchymal stem cells and growth factors and BMPs for bone regeneration [36,37].

Lastly, the membrane should be easy to handle and manipulate allowing the clinician to conduct the surgical procedure without undue difficulty. Fibrin sealant made the membrane much easier to handle than suturing. Fibrin glues may have antibacterial properties as an undefined mechanism, evidenced by studies on skin grafts in infected sites [15]. This property would be beneficial as resorbable membranes have the drawback of getting exposed, which could lead to infection and delayed wound healing.

Conclusion

In conclusion, this study shows that combination use of fibrin glue and resorbable collagen fibrin supports bone formation. Therefore, placing fibrin glue provides adequate space and stability increased support and improved handling of the GTR membrane.

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