Original Article

Collagen Membrane And Leukocyte Platelet Rich Fibrin For Periodontal Regeneration In An Infrabony Defect: A Case Report

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Abstract

Aim: To demonstrate a case with clinical and functional improvement of a molar with advanced mobility following the application of Leukocyte- rich Platelet Rich Fibrin in an infrabony defect and coverage with collagen membrane.
Methods: A 26 years old female presenting with masticatory problem associated with edentulous areas and mobility in some of the remaining dentition. The case was diagnosed as generalized
Periodontitis Stage IV Grade C, the surgical phase comprised open flap debridement of the maxillary second premolar as well as simultaneous application of L-PRF within an infrabony defect affecting the adjacent first molar. Collagen membrane was used to cover the L-PRF before wound closure. The patient was enrolled in a meticulous supportive care during the study period of 6 months.
Results: Baseline data revealed a grade III mobility with a 5 mm clinical attachment level (CAL) that is associated with a pocket probing depth (PPD) of 6 mm, clinical bone defect depth of 7 mm on the mesial surface of the tooth, and radiographic base of defect depth (BD) of 7.9 mm. At 6 months following surgery, recorded parameters for the CAL, PPD were 4, and 2 mm respectively. The mobility regressed to grade I and the radiographic BD lessened to 6.7 mm.
Conclusion: The presented case demonstrated the promising outcomes of using collagen membranes with L-PRF in the treatment of infrabony pockets with advanced periodontal loss in stage IV grade C periodontitis.

KEYWORDS Periodontal Pocket, Periodontal debridement, Guided Tissue Regeneration, Platelet-Rich Fibrin, Tooth Mobility.

INTRODUCTION:

One detrimental effect of periodontal disease that deteriorates the quality of life is the consequent progression of masticatory dysfunction. The latter in specific discriminates exclusively stage IVperiodontitis from the other stages (Tonetti,

M. S., Greenwell, H., & Kornman, 2018). Several signs may exist to identify a masticatory dysfunction; other than missing teeth and ridge collapse and advanced mobility, correlation analysis in one study revealed a statistically significant

relationship between the patient reported objective masticatory efficiency and tooth mobility. (Barbe et al., 2020)

Periodontal regeneration carries the hope for salvaging teeth affected by periodontitis especially those with unfavorable prognosis. Regenerative therapy is a multifactorial process consisting of a well-orchestrated biological event that are sequentially dependent. Such events include cytological adhesion, migration, proliferation and differentiation. Thanks to

the role of growth factors and signaling molecules, the whole processes of wound healing and regeneration are managed in a sophisticated order (Giannobile, 1996).

To date, the initial phases of treatment planning are centered around biofilm control and cessation of local inflammation. In other words, utilizing scaling and root planing in the cause related phase of the plan targets termination of disease activity, restoration of a clinically healthy periodontium, and resolution of symptoms but is unable to restore the lost periodontal attachment. (Kwon, T., Lamster, I.B. and Levin, 2021)For that reason, the surgical phase come into play under the name of regenerative procedures. However, despite guided tissue regeneration (GTR) and bone grafts have been developed to regenerate periodontal tissue, their clinical outcomes are inconsistent and unpredictable. Consequently, research focuses on developing alternative regenerative strategies to counteract the drawbacks of the existing methods. The recognition of signaling molecules, cellular elements, and delivery vehicles (e.g. platelet concentrates and recombinant formulas) for example, elevated our expectations for better regenerative outcomes and widened the scope of use of the classical biomaterials. (Liang et al., 2020)

The literature demonstrates the successful potential of growth factors for accelerating and promoting hard and soft tissue regeneration. (Darby & Morris, 2013) Platelet concentrates, specifically the second generation Platelet-rich fibrin (PRF) not only provide a concentrated source of signaling molecules but also possess the an appropriate scaffold comprising a mechanically rigid fibrin meshwork that traps the cellular elements and growth factors while ensuring sufficient distribution of biological elements within the wound site. (Choukroun et al., 2000)

The case reported in the present article was diagnosed with stage IV grade C periodontitis and suffered advanced mobility and infrabony defect associated with a first molar tooth. Surgical phase included the use of GTR membrane to cover a multilayered L-PRF inserted within the defect.

CASE REPORT:

Patient information: A 23 years old female was referred to the outpatient clinic of faculty of dentistry, Ain Shams University for periodontal treatment. The patient complained of compromised chewing and food impaction related to multiple missing teeth. The dental history revealed multiple uncomplicated extractions performed throughout the past year due to teeth looseness. In addition, the referring dentist's letter mentioned performing supra and subgingival scaling seven months prior to referral. Contrary to the medical history, which was noncontributory, the family history revealed a similar pattern of mobile teeth loss at early age for her father.

Clinical Findings and diagnostic assessment: On initial presentation of the patient, the periodontal examination revealed a CAL of 6 mm, PPD of 8 mm on the mesial surface of the left maxillary first molar. Moreover, the same molar suffered a grade III mobility with vertical tooth displacement as well as a 4 mm recession depth (REC). Sounding for bone topography showed the presence of two- wall vertical defects on the mesial and distal interproximal surfaces. Periapical radiograph showed severe bone loss reaching 90% of the mesial root surface and approximating the apical foramen. Despite showing normal pulp response with vitality test, proximal caries was evident on the distal surface of the tooth. Supra eruption was noted in addition to the distal half of the crown forming plunger cusps with the opposing molars. The neighboring second premolar demonstrated a PPD of 6 mm, CAL of 2 mm, grade I mobility, and favorable crown/ root ratio. Teeth previously extracted due to periodontal disease were the mandibular incisors, right mandibular first molar, and right maxillary first premolar (Figure 1). The extent of attachment loss, deep pocket depths, and masticatory dysfunction related to extractions lead to the diagnosis of stage IV periodontitis. Grade C was assigned to the patient diagnosis since the momentum of bone loss calculated reached 3.91. For a single tooth prognosis, the data for the left maxillary first molar clarified a hopeless prognosis contrary to the neighboring second premolar which was favorable.

Figure 1: Intraoral initial occlusal view of the maxillary teeth.

Therapeutic intervention: An informed consent from the patient was obtained including a surgical phase section that suggested open flap debridement for the upper left second premolar and application of collagen membrane over L-PRF membrane condensed in the infrabony defect of the neighboring first molar. Phase I therapy was initiated with full mouth supra and subgingival debridement using ultrasonic tips P1D1 and mini five curettes2 followed by elimination of carious lesions and root canal treatment of the left maxillary first molar which had a pathologically exposed pulp space. After 8 weeks, the mesio- buccal surface of the right maxillary first molar showed a baseline PPD of 6mm (Figure 2), CAL of 5 mm. Marginal tissue shrinkage occurred after repair of phase I therapy with a resultant REC of 5 mm in the mid buccal surface. The radiographic BD, measured from the cemento enamel junction (CEJ) to the most apical level of the defect, measured 7.9 mm whereas the CEJ to alveolar crest (AC) was 1.8 mm. The plaque score and gingival index were 0 and the gingiva demonstrated no bleeding on probing. These measurements were recorded as baseline data.

Figure 2: Clinical appearance of the involved area at baseline showing a PPD of 6 mm.

Surgical procedure: Before surgical intervention, L-PRF membrane preparation was initiated by withdrawing a 10 ml intravenous blood in a silica coated plastic tube using a vacutainer holder. Immediate centrifugation of the blood sample was performed at 2700 rpm for 12 minutes3. The L-PRF harvest was retrieved from the tube and the erythrocytic face of the membrane was separated and discarded using a pliar and surgical scissors. In a special PRF metal box4, the membrane

1 NSK / Nakanishi inc., Japan.

2 Hu-Friedy Mfg. Co., LLC., USA.

3 IntraSpin™ Centrifuge; Intra-Lock International. USA.

4 Salvin Dental Specialties, Inc., USA.

was placed and folding it over itself was performed followed by the application of mild pressure to form a single layered L-PRF membrane of 1 mm thickness and enhanced mechanical properties of its fibrin meshwork.

Following administration of an adequate local anesthesia (2% lignocaine hydrochloric acid with epinephrine (1:100,000)), the surgical procedure began with an intrasulcular incision extending from the mesial aspect of the right maxillary first premolar to the distal line angle of the second molar. Mucoperiosteal flap reflection was then performed exposing the periodontal lesion adequately as shown in figure 3. Gross debridement of the defect and local factors on the root surface was then performed using the mini curettes followed by an accurate morphological assessment of the bony lesion which revealed a vertical defect with remaining buccal and mesial walls and had a depth of 10 mm measured from the CEJ to the apical base of the defect (Figure 4). The prepared L-PRF membrane was applied within and on top of the defect up to the level of the coronal alveolar crest(Figure 5).

Figure 3: A full thickness flap was elevated to expose the periodontal lesion.

Figure 4: Following defect and root surface debridement, anatomical features of the mesial and distal defects were assessed.

Resorbable collagen membrane5 was trimmed to adapt to the defect site configuration so that the entire defect and a 2 mm of the surrounding alveolar bone are covered (Figure 6). The membrane was extended supracrestally just 1 mm apical to the CEJ to allow for maximum volume of gingival connective tissue involvement in supracrestal wound healing. Membrane fixation was not needed as the primary adhesion of the membrane to root, and alveolar bone surfaces was sufficient for the L-PRF harvest retention. Flap closure was then performed using independent internal vertical mattress sutures (6-

5 TUTOPATCH®MED&CARE Sp. z o.o., ul. Mławska 13, 81-204 Gdynia, Poland.

Figure 5: The multilayered L-PRF membrane was condensed in the mesial bone defect.

0 polypropylene sutures) at every interproximal area (Figure 7). For the post-operative pain, non-steroidal anti-inflammatory drugs (Ibuprofen 600 mg thrice daily)[6] was prescribed after the surgery. As well, systemic antibiotics (Amoxicillin trihydrate 500 mg thrice daily for 7 days)[7] were prescribed every 12 hours, for one week. The patient received the post operative instruction verbal and in a written form making sure to avoid mechanical cleansing of the operated site while making sure to rinse with 10 mL of 0.2% chlorhexidine gluconate mouth-rinse[8] twice daily for two weeks, and attend at the clinic every other day for professional polishing of the same area. After 7 days, the sutures were removed, and the patient was instructed to start using an ultrasoft toothbrush.

Figure 6: The trimmed collagen membrane was applied on the L-PRF filled defect to cover the buccal and palatal aspects.

Figure 7: The flap was repositioned with internal vertical mattress sutures.

Results: Throughout a 6 month period, patient recall occurred every 2 months for periodontal maintenance and oral hygiene reinforcement. The overall condition of the operated site was stable with visible signs of clinical health through the follow up period. At the third follow up visit (6 months post operative), a CAL of 4 mm and a PPD of 2 mm were recorded on the mesial surface of the tooth (Figure 8). On the mesio buccal aspect of the tooth, REC value of 3 mm was measured. The periapical radiograph showed reduction in the depth of the defect (BD) from 7.9 to 6.7 mm, whereas alveolar crest resorption was evident as the AC dimension increased from 1.8 to 2 mm (Figure 9). Mobility was significantly reduced from grade III to I with absence of vertical tooth displacement. Clinical and radiographic measurements are shown in Table 1. Patient centered outcomes focused on questioning for the patient's masticatory efficiency. The improvement in clinical and radiographic findings were consistent with the patient reported improvement in masticatory function on the left side.

[6]Brufen 400 mg; Kahira Pharm. & Chem. Ind. Co., Under license from: Abbott Laboratories.
[7]Floxamo 500 mg; Amoun Pharmaceutical Company S.A.E. Cairo – Egypt
[8]Hexitol; Kahera Pharmaceutical, Cairo, Egypt

Figure 8: Follow up at 6 months showing PPD of 2 mm.

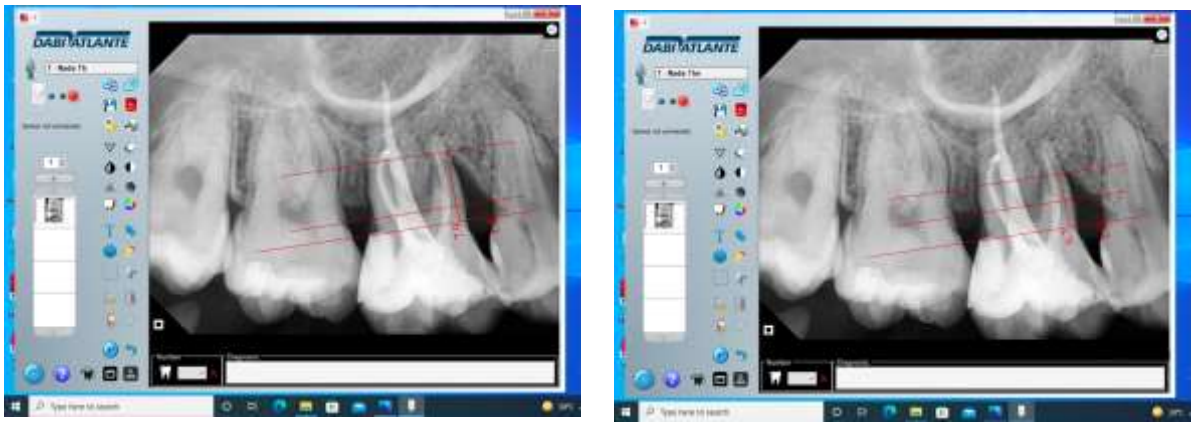

Figure 9: Radiographic measurements at (a) baseline and (b) 6 months postoperative showing hard tissue fill at the BD and AC resorption on the mesial aspect of the treated tooth.

Table1: Clinical and radiographic measurements of the treated tooth in millimeters (mm)

	Clinical measurements (mm)			Radiographic measurements mesial (mm)
	Mesio-buccal	Mid buccal	Disto buccal	
Baseline				
PD	6	3	5	
CAL	5	8	8	
REC	0	5	3	
Mobility	Grade III			

Intra-operatory					
CEJ- BD	10			CEJ- BD	7.9
CEJ- AC	2			CEJ- AC	1.8
6 months					
PD	2	1	3	CEJ- BD	6,7
CAL	4	7	6	CEJ- AC	2
REC	2	6	3		
Mobility	Grade I				

DISCUSSION:

The reported case presented with a severe interproximal periodontal defect with advanced mobility that rendered the tooth prognosis unfavorable. At 6 months of treatment, evidence of hard tissue fill and improvement in periodontal parameters coincided with the patient reported improvement in masticatory function. The bio- exclusion of epithelial ingrowth by the barrier membrane combined with the supra- physiologic levels of growth factors offered by the L-PRF were responsible for the gain in periodontal support and regressed tooth mobility.

It should be emphasized that the lack of significant regeneration with the use of guided tissue regeneration membranes reported in some studies (Petsos H, Ratka-Krüger P, Neukranz E, Raetzke P, Eickholz P, 2019) oppose the general consensus for their positive contribution in regenerative therapy especially in well selected defects with favorable morphology (Nibali L, Sultan D, Arena C, Pelekos G, Lin GH, 2021). Consequently, the use of collagen membrane on top of the defect might have provided the base of the periodontal lesion the time privilege for hard tissue formation on the expense of the unfavorable gingival cells. Applying the treatment protocol for the present case might have been successful owing to a favorable defect selection (deep two walled defect). Further knowledge about the role of signaling molecules in wound healing have expanded the field of regeneration to include the use of different sources of growth factors and scaffolding materials rather than the mere restriction of unfavorable cells. (Liang, Y., Luan, X. and Liu, 2020). In particular, L-PRF preparations have been studied amply in the literature and their superiority over open flap debridement was matched with the positive outcomes of bone grafts in managing infrabony defects. (Miron, R.J., Moraschini, V., Fujioka-Kobayashi, M., Zhang, Y., Kawase, T., Cosgarea, R., Jepsen, S., Bishara, M., Canullo, L., Shirakata, Y. and Gruber, 2021)

The present case demonstrated a dual antagonistic zone of biologic foundation versus lack of knowledge. The biologic foundation zone comprises the GTR theory and the role of barrier membrane in gingival cells' exclusion and periodontal tissue predilection for regeneration. Moreover, the positive influence of platelet concentrates (regardless their type) as local delivery means for growth factors and their contribution in regeneration of infrabony defects cannot be denied. (Reshma, A.P., Varghese, S.S. and Pampadykandathil, 2022) In contrast, the lack of knowledge stands initially on the questionable effect of collagen membranes on the release profile of growth factors from L-PRF harvests. Wether the occurrence of marginal tissue recession was the result of using conventional flap rather than papilla preservation or the effect of the biomaterials used was not investigated. The influence of membrane folding on growth factors' release rate, and the absence of a long lasting osteoconductive scaffold material may add up to the zone of knowledge gap that might contributed to the incomplete hard tissue fill of the infrabony defect.

There are some limitations to this report. First, the lack of any possible histological assessment was an obstacle for us to determine the nature of hard tissue fill at the base of the defect. Being a case report it is not possible to conclude whether

the increased tooth stability and hard tissue fill result from the collagen membrane effect, L-PRF effect, or the synergistic effect of both. Additionally, the follow up period of 6 months is an insufficient time frame to draw definitive conclusions about the effectiveness of the intervention. In regard to the growth factors' concentrations, the claimed higher physiologic level of growth factors in L-PRF loaded wounds was not biochemically evaluated in the present case. It is possible that the use of collagen membrane has retained the concentration of growth factors released from the L-PRF for longer period of time however, such hypothesis was not tested. Last but not least, the use of a splinting wire on the same day of the surgery could have helped further in post therapeutic tooth stability but unfortunately retention failure occurred to the applied wire on the same day of surgical intervention.

In conclusion, this case have introduced the idea of using collagen membranes to protect autologous L-PRF in regeneration of infabony defects. The successful outcomes of radiographic hard tissue formation as well as the improvement in the masticatory efficiency, vitalize recommending future prospective research with long follow up periods for comparing such a protocol with other biomaterials.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTION

Ramy Mubarak Hussein: Concept/Design, Data collection /interpretation, drafting article; Doaa Adel-Khattab: Concept/Design, Data analysis/interpretation, Drafting article, Approval of article; Ahmed Youssef Gamal: Concept/Design, Critical revision of article, Approval of article.

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