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Research Report

The treatment of gingival recession with coronally advanced flap with platelet-rich fibrin

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ABSTRACT

Background: *Of the various techniques developed for the treatment of gum recession, the current innovation in the use of platelet rich fibrin (PRF) has been applied to the treatment of root-end closure procedures.* ***Purpose:*** *This study analyzed the effect of the coronally advanced flap (CAF) in combination with PRF during treatment of gingival recession.* ***Methods:*** *This research constituted an experimental study incorporating a split-mouth design which was conducted on eight participants (with 16 recession defects) who were divided into two groups consisting of the CAF group with PRF and another CAF group without PRF. Clinical parameters consisting of gingival recession (GR), keratinized gingival width (KGW), recession width (RW) and clinical attachment level (CAL) were measured both before and 21 days after surgery).* ***Results:*** *The average differences between clinical parameters in the test group were as follows: GR (2.25 ± 0.27), KGW (1.81 ± 0.75), RW (3.44 ± 1.35), and CAL (2.56 ± 0.50); while in the control group they were as follows: GR (2.00 ± 0.71), KGW (1.94 ± 0.78), RW (3.50 ± 1.91) and CAL (2.00 ± 0.76). There were significant differences in the GR and CAL between the test and control groups ($p \leq 0.05$).* ***Conclusion:*** *A combination of the CAF procedure and PRF was proven to be more effective in covering GR and increasing CAL.*

Keywords: *coronally advanced flap; gingival recession; platelet-rich fibrin*

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INTRODUCTION

Gum recession constitutes a clinical condition during which the gingival margin is in a more apical location than the cementoenamel junction (CEJ), causing part of the radicular surface to be opened.[1] Gingival recession can be present in healthy periodontal tissue and appears as wedge shaped lesions on the buccal surface of the teeth, especially in association with hard toothbrush use, whereas in individuals with poor oral hygiene it can be present on any tooth surface. Risk factors in gingival recession include: tooth malposition, inadequate oral hygiene, alveolar bone dehiscence, muscle attachment, frenulum traction, periodontal disease and restorative iatrogenic treatment.[1,2] Gingival recession often causes aesthetic problems, root caries and tooth abrasion, with patients usually complaining of hypersensitive teeth.[1,2]

Various types of gingival recession treatments comprise: laterally positioned flaps (LPF), coronally advanced flap (CAF) and connective tissue graft (CTG) with a success rate of 65% to 98%.[3,4] The choice of technique depends on the extent of recession defect, the location of the required aesthetic improvement and the need for additional gingival tissue (graft). The CAF technique is popular because of its simple procedure and excellent post-surgical healing.[4]

The first platelet rich fibrin (PRF) was developed in France and utilized in the field of oral and maxillofacial surgery. PRF was a second generation platelet concentrate, consisting of platelets and growth factors in the form of fibrin membranes derived from the blood of the patient which is free of various anticoagulants.[5,6] PRF improves wound healing and regeneration. Multiple studies confirmed more rapid wound healing resulting from the use of PRF.[6] The PRF fabrication process is easier, cheaper, more effective

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and does not require any bovine thrombin or anticoagulants, therefore, rendering regenerative membranes more easily formed. The use of PRF in the field of periodontics has rendered it one of the most frequently used materials in regenerative surgical procedures.[5,7]

PRF has a dense fibrin matrix with leukocytes, cytokines, glycoprotein structures as well as growth factors, for example transforming growth factor β1, platelet-derived growth factor, vascular endothelial growth factor and glycoprotein such as thrombospondin-1.[8] Leukocytes concentrated in PRF play an essential role in releasing growth factors, regulating immune response, inducing anti-infective activity and remodeling matrix during wound healing.[5,8] Combination techniques using autogenous or allograft and guided tissue regeneration membranes were subsequently developed to correct the mucogingival defect.[9] This study was intended to analyze the effect of a combination of CAF and PRF in the treatment of gingival recession.

MATERIALS AND METHODS

This research constituted experimental research incorporating split-mouth, pre-test and post-test designs. The study was conducted at the Department of Periodontics, Faculty of Dentistry, Universitas Padjadjaran using a protocol and research design previously approved by the Health Research Ethics Committee. All participants completed an informed Helsinki Declaration consent form containing information about the research protocol (No. 284/UN6.C2.1.2/KEPK/PN/2013).

The total number of participants consisted of eight individuals (two men and six women) who attended the periodontics clinic chiefly complaining of hypersensitive teeth or gum recession. The criteria for inclusion as a research subject comprised: (1) Males or females above the age of 18 and free of active periodontal disease. (2) Class I Miller gum recession, recession defects > 1 mm in the buccal/labial incisors and premolars. (3) The patient enjoyed sound systemic health free of any medical condition contraindicated for periodontal surgery. (4) The tooth was not endodontically treated and had not undergone buccal or interproximal restoration. (5) The patient was not using antibiotics, corticosteroid, chemotherapeutic, immune modulator or any other medication that could potentially modify oral tissue. (6) The patients were exclusively non-smokers.

The autologous PRF for use in this study was extracted from the blood of the patients prior to surgery. All blood samples were inserted in the 10ml glass-coated plastic tube of a table centrifuge without an anticoagulant and subjected to centrifugation at 3,000 rpm for 10 minutes.[5,10] A fibrin clot formed in the middle section, with a cellular plasma present in the upper part and red corpuscles in the lower section. The fibrin clot was subsequently extracted with sterile tweezers and prepared using the PRF preparation kit in order to obtain the PRF membrane.[11] The length of time between blood collection and the centrifugation process is crucial to the clinical results and success of this procedure. Protracted management of the blood centrifugation process will result in diffuse polymerization, leading to the formation of small blood clots with irregular consistency.[5,8]

The measurement of initial clinical parameters was performed prior to surgery. Random selection of members of the test group (CAF + PRF) and control group (CAF only) was made on the result of a coin toss and with the same operator working on both groups. The administering of oral antiseptic was performed using the 0.2 chlorhexidine digluconate, a local anesthetic containing 2% lidocaine hydrochloric acid with adrenaline by means of an infiltration technique. Prior to incision, a blood sample was taken for preparation of PRF membrane. An intrasulcular incision was made around the tooth with recession defect and two vertical incisions were made on each adjacent tooth with the interdental papilla being maintained (Figure 1). Full-thickness flap and split-thickness techniques were performed on the apical section to enable repositioning of the coronal flap without pressure. The papilla was epithelialized to produce a connective tissue bearing-scaling, while root planning was performed on the radicular surface by means of a curette. Tetracycline HCl was applied for three minutes to the radicular surface which was then rinsed with water. In the test group (CAF + PRF), the PRF membrane was positioned on the recession defect at the level of CEJ (Figure 2). The margin of the gingival flap was repositioned on the enamel in both the test and control groups and held in that position with horizontal sling sutures and vertical incisions with interrupted sutures using non-resorbable threads (5-0 nylon, Ailee®) (Figure 3). The placement of periodontal packs was performed by means of non-eugenol dressing (Coe-Pack™, GC America Inc., USA). After surgery, the patient was given 500mg of amoxicillin cap three times a day and 50mg of Cataflam™ twice a day for four days. The patient was instructed to rinse his/her mouth with 0.2% cumulative chlorhexidine medication, with the periodontal dressing and sutures being opened on the 10th day. On the 21st postoperative day, the patient was examined for clinical parameters, including: gingival recession (GR), keratinised gingival width (KGW), recession width (RW) and clinical attachment level (CAL).

The GR is the distance from the CEJ to the gingival margin measured in millimeters using a periodontal probe (Osung™ UNC-15, Korea). The examination was performed on the mid-buccal side of the treated tooth. The KGW is the distance from the gingival edge to the MGJ measured by a probe on the mid-buccal side. The RW is the distance between points placed on the CEJ, at the mesial-most and distal-most ends. The CAL is the distance from the CEJ border to the sulcus base. The values were represented in terms of their means ± standard deviation. The significance of the difference within and between groups before and after treatment was evaluated by means of a paired t-test and Mann-Whitney test. Differences were considered statistically significant at $P \leq 0.05$.

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RESULTS

In this study, the gender composition of the respondents was 75% male to 25% female. There were 16 sites of class I Miller recession defects which were divided into two groups, namely; the test group (CAF + PRF) and the control group (CAF only). The average RG, KGW, RW and CAL showed significant differences between the pre-treatment situation and after 21 days of treatment in both groups (p = 0.000) (Table 1). The average difference of the RG and CAL in the test and control groups was significant ($p \leq 0.05$) (Table 2), indicating that the test group presented superior closure in the radicular of the gingival recession than the control group. In other words, the use of PRF played a significant role in achieving the closure of gum recession. Improvement in the CAL was also more marked

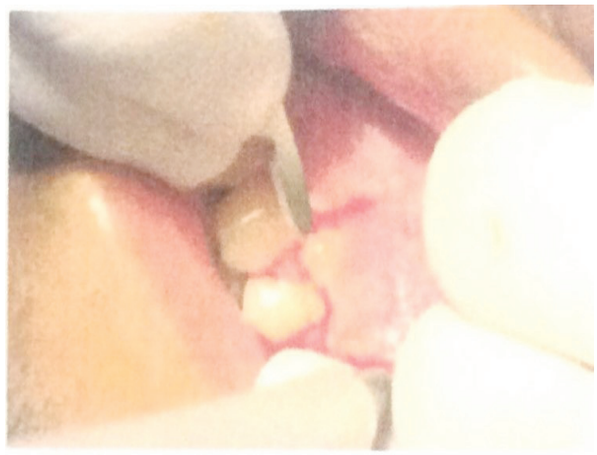

Figure 1. Incision design.

Figure 2. PRF membrane on recession defects.

Figure 3. Flap sutures.

Table 1. Assessment of the average GR, KGW, RW and CAL, before and after treatment in the test and control groups.

Clinical parameters	Test group Mean ± SD	Control group Mean ± SD	p-value
GR baseline	2.75 ± 0.53	2.50 ± 0.75	0.558
GR after 21 days	0.50 ± 0.70	0.5 ± 0.59	1.000
	(p = 0.000)*	(p = 0.000)*	
KGW baseline	4.12 ± 0.51	4.37 ± 0.91	0.513
KGW after 21 days	5.93 ± 0.56	6.31 ± 0.53	0.192
	(p = 0.000)*	(p = 0.000)*	
RW baseline	4.56 ± 0.97	4.68 ± 1.28	0.830
RW after 21 days	2.12 ± 1.27	1.18 ± 1.41	0.927
	(p = 0.000)*	(p = 0.000)*	
CAL baseline	3.81 ± 0.65	3.43 ± 0.90	0.357
CAL after 21 days	1.25 ± 0.59	1.43 ± 0.56	0.529
	(p = 0.000)*	(p = 0.000)*	

Note:
GR = Gingival Recession; KGW = Keratinized Gingival Width; RW = Recession Width; CAL = Clinical Attachment Level

Table 2. Differences of the average GR, KGW, RW and CAL, before and after treatment in the test and control groups.

Variable	Test group Mean ± SD	Control group Mean ± SD	p-value
GR	2.25 ± 0.27	2.00 ± 0.71	0.05*
KGW	1.81 ± 0.75	1.94 ± 0.78	0.37
RW	3.44 ± 1.35	3.50 ± 1.91	0.47
CAL	2.56 ± 0.50	2.00 ± 0.76	0.05*

Note:
GR = Gingival Recession; KGW = Keratinized Gingival Width; RW = Recession Width; CAL = Clinical Attachment Level

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in the test group than the control group. The KGW and RW parameters did not show significant differences between the two groups since application of PRF did not affect the KGW and RW.

DISCUSSION

This study was intended to evaluate the effectiveness of PRF with CAP in the treatment of gum recession. The research subjects consisted of eight individuals aged between 29 and 39 years-old who presented identical Bilateral Miller's class I gingival recession. The split-mouth design helped to avoid variations in characteristics between patients. CAF is a predictable procedure to treat Miller's class I mucogingival defects. Gingival thickness was the most significant factor associated with complete root coverage identified by analyzing factors such as GR, the KGW, RW and CAL measured at the time that the baseline was established and 21 days after the operation had been conducted on the test and control groups.

Platelet-rich fibrin has been claimed to enhance soft tissue healing, promote initial stabilization and the revascularization of flaps and grafts in root coverage.[12] Platelets play an essential role in wound healing by accelerating it after periodontal treatment. The wound healing process begins with the formation of blood clots and platelet attachment. Moreover, the substances released by platelets can stimulate tissue repair, angiogenesis, inflammation and immune responses. PRF is rich in platelets, growth factors and cytokines, all of which have the potential to improve wound healing in both hard and soft tissue.[13] PRF stimulates the expression of phosphorylated extracellular signal-regulated protein kinase (p-ERK) and production of osteoprotegerin (OPG) which play important roles in osteoblast proliferation.[14] FRF fibrin matrix, in addition to directly stimulating the angiogenesis process, contains platelets, growth factors and cytokines that may enhance the healing potential of both bone and soft tissues.[15] PRF membranes release various growth factors such as platelet-derived growth factor (PDGF), transforming growth factor (TGF), vascular endothelial growth factor (VEGF) and epidermal growth factor (EGF) for between seven and 28 days. This indicates that the PRF membrane stimulates the healing process during tissue re-modelling. Natural fibrin matrix plays a direct role in increasing angiogenesis. Fibrin constitutes a natural support to immunity which impedes the inflammatory process.[6]

In this study, the use of PRF as a membrane during the CAF procedure produced superior root coverage and a decrease in clinical attachment loss compared to the CAF procedure alone. The results of this study were consistent with those of research conducted by Padma *et al.* (2013),[16] which posited that the addition of PRF membrane with CAF provides superior root coverage with the extra benefits of an increase in the CAL and KGW six months after the operation. Another investigation reported inferior recession coverage using PRF membrane when compared with CAF only in multiple recession defects.[12] The average PPD reduction and CAL gain in CAF only-treated gingival recession defect were 0.35 mm and 2.60 mm respectively, while the difference was statistically significant ($p < 0.05$).[17] Improvement in CAL occurred due to the recession coverage as a result of the coronal shift of attachment apparatus during CAF procedures.[18]

In this study, the KGW and RW did not show significant differences between the CAF with PRF group and the CAF-only group, a finding in contrast to the research that reported a long-term increase in the keratinized gingiva width associated with an apical shift of the mucogingival junction.[19] This might be due to the evaluation not having been performed over a more extended period. The average recession coverage in this study was 80% using the CAF-only procedure, whereas in the treatment with PRF combination it was 81.8%. Previous studies conducted by Aroca *et al.*(2009),[12] and Jankovic *et al.*(2012),[20] which reported root coverage as high as 80.7% and 88.7% respectively. The treatment of gum recession with the combination of PRF resulted in perfect root coverage with satisfactory tissue contour and color. It also had several advantages, including: minimal bleeding, faster healing time and minimal postoperative pain.[9]

The use of PRF was also employed during other periodontal treatment such as that relating to periodontal bone defects. Various studies have indicated the effectiveness of PRF in the treatment of periodontal defects, an improved clinical attachment and radiographic height elevation with treatment using PRF.[21] Thorat *et al.* (2011), investigated the clinical and radiological effectiveness of autologous PRF in the treatment of intrabony defect of chronic periodontitis patients. They reported a greater reduction in pocket depth, more gain in clinical attachment level and greater intrabony defect fill at sites treated with PRF than those treated with open flap debridement alone.[21] It evaluated the effectiveness of PRF with demineralized freeze-dried bone allograft (DFDBA) material in the treatment of intrabony defects. The study concluded that a combination of PRF and DFDBA produced superior results in reducing bleeding at the probing depth and clinical attachment level compared to DFDBA alone in the treatment of intrabony defects.[22]

Further studies with larger sample sizes and longer follow-up periods are required to determine the advantages of using PRF in CAF technique for root coverage. Factors such as PRF consistency and platelet concentration not being tested in this study may have affected the final clinical outcome.

It is concluded that CAF procedure is a predictable treatment for isolated Miller's Class I recession defects. A combination of the CAF procedure with PRF was proven to be more effective in the coverage of the GR and in increasing the CAL.

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