Comparative Evaluation of Coronally Advanced Flap with and without Bioactive Glass Putty in the Management of Gingival Recession Defects: A Randomized Controlled Clinical Trial

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Abstract

Background: The need-of-the-hour is a material that can support coronally advanced flap (CAF) procedures in treatment of gingival recession. Recent literature shows that various bone substitutes are being used for this procedure. This study clinically evaluates the outcomes of CAF with and without bioactive glass putty (NovaBone®) in terms of root coverage, gains in keratinized tissue height, and root coverage esthetic score in multiple gingival recession defects.

Methods: Ten healthy patients (age range 18-45 years) with multiple bilateral (n = 40: test 20, control 20) and comparable Miller's Class I or Class II gingival recession defects were selected. The defects were randomly assigned by a computer-generated list to either test (CAF + bioactive glass putty) or control (CAF alone) groups. Clinical parameters included gingival recession (GR), probing pocket depth (PPD), clinical attachment level (CAL), keratinized tissue height (KTH) and root coverage esthetic score (RES) evaluated at baseline and at 6 months post-surgery CAF with or without bioactive glass putty.

Results: Six months post-surgery all clinical parameters showed significant reductions. Gingival recession showed significant reduction both in test and control groups (2.0 ± 0.47 mm and 2.3 ± 0.48 mm, respectively; $p < 0.05$) with no intergroup difference. The exposed root was covered by 72% (test) and 79% (control). CAL gain was also significant in both groups (test: 2.7 ± 0.67 mm; control: 2.8 ± 0.78 mm; $p < 0.05$) with no intergroup difference. Keratinized tissue height gain was significant in both the groups (test group: 1.2 ± 0.42 mm; control group: 0.9 ± 0.57 mm) with no intergroup difference. Also, the RES was significant for both the test and control groups (7.2 ± 2.78 and 7.7 ± 1.41 respectively) with no intergroup differences.

Conclusions: In isolated Class I/II GR defects, CAF associated with bioactive glass putty provided no significant difference in root coverage, CAL, KTH or RES compared to CAF alone. However, statistically significant gains were seen in all the parameters in both groups as compared to baseline. We refute the claims of the recent studies using a bone substitute for root coverage. Further long-term clinical trials are warranted to substantiate our results.

Key words: Periodontal flap, gingival recession, coronally advanced flap, bioactive glass putty, alveolar bone grafting, root coverage

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Introduction

Gingival recession is defined as the apical displacement of gingival margin in relation to the cementoenamel junction (Glossary of Periodontology Terms, 2001). According to the reports based on the Third National Health and Nutritional Examination Survey, an estimated 22.5% (approximately 24 million) people in the United States have one or more tooth surfaces with ≥ 3 mm of recession (Alabander, 1999). The problems associated with recession include compromised esthetics, hypersensitivity, higher incidence of root caries, and compromised plaque control. Recession is a frequent clinical finding in populations with both good and poor standards of oral hygiene. Generally, the development of gingival recession can be related to mechanical factors (such as toothbrush trauma), to localized plaque-induced inflammatory lesions, or to generalized forms of destructive periodontal disease. Untreated gingival recessions show poor esthetics and negative prognosis over time in spite of good patient motivation, while the esthetics and prognosis can be improved after carrying out mucogingival procedures (Agudio *et al.,* 2009; Miller, 1993). Many surgical techniques have been reported in the literature to perform root coverage, such as A) pedicle graft procedures, B) free soft tissue graft procedures, and C) additive treatments.

A. Pedicle graft procedures (depending on the direction of transfer) are:

1. Rotational flap [Patur, 1977; e.g., lateral sliding flap (Grupe and Warren, 1956); double papilla flap (Cohen and Ross, 1968); oblique rotated flap (Pennel *et al.*, 1968); transpositioned flap (Bahat *et al.,* 1990)].
2. Advanced flap procedures [(e.g., coronally repositioned flap, semilunar coronally repositioned flap; Tarnow, 1986); laterally moved and coronally advanced (Zucchelli and De Sanctis, 2000; Zucchelli, 2004)].
3. Regenerative procedures along with the use of barrier membranes using pedicle graft procedures are also included in this group

B. Free soft tissue graft procedures [e.g., free gingival graft (Bjorn, 1963); connective tissue graft (Harris *et al.,* 1999); subepithelial connective tissue graft (Langer and Langer, 1985)]. Free soft tissue graft procedures may include non-submerged graft techniques (single-stage or two-stage surgeries) and submerged graft techniques (using any free soft tissue graft and a pedicle technique or envelope technique).

C. Additive treatments (e.g., root surface modification agents; enamel matrix derivatives; guided tissue regeneration; platelet concentrates)

Various techniques have been tried. The subepithelial connective tissue graft (SECTG) is currently the most accepted and predictable technique to achieve root coverage. It has a high degree of esthetics (Carvalho *et al.*, 2006) and serves as the gold standard (Chambrone *et al.*, 2008).

Zucchelli's technique is another effective technique for the treatment of multiple adjacent recessions in terms of both root coverage and keratinized tissue gain, irrespective of the number of defects. Moreover, this technique does not require an additional surgical site as required in the gold standard SECTG (Bherwani *et al.*, 2014). However, Zucchelli's procedure is technique-sensitive and requires precision. Moreover, these procedures often result in healing with long junctional epithelium and limited connective tissue attachment (Caffesse *et al.*, 1986).

Zucchelli's technique is a new modification of the coronally advanced flap for treatment of multiple teeth recession. This technique mandates horizontal incisions comprised of oblique submarginal incisions placed in the interdental areas with the blade parallel to the long axis of the tooth in order to dissect the surgical papillae in a split thickness manner. These incisions are continued with the intrasulcular incision around the defects. Each surgical papilla is displaced with respect to the anatomic papilla by the oblique submarginal interdental incisions. The surgical papilla mesial to the flap midline is displaced apically and distally while the papilla distal to the midline is displaced more apically and mesially. The envelope flap should be raised in a split-full-split approach in the corono-apical direction; the surgical papillae is raised in a split thickness manner, the gingival tissue apical to the root exposure is raised in a full thickness manner to ensure adequate thickness for root coverage, and the most apical portion of the flap is elevated in a split thickness manner to facilitate coronal flap displacement. The advantages of this technique include the absence of vertical releasing incisions, a variable thickness, combining areas of split and full thickness and the coronal repositioning of the flap (Zucchelli and de Sanctis, 2000).

In the case of SECTG little or no new cementum is created (Majzoub *et al.*, 2001). The following limitations are often associated with these techniques: the need for a second surgical site, morbidity associated with harvesting donor grafts, post-surgical bleeding, patient discomfort, poor color matching between donor and recipient site, a limited quantity of donor tissue, and frequent need of multiple procedures to achieve optimal results. We reported a comparative study between Zucchelli's or the tunnel technique with SECTG in the treatment of multiple gingival recession (Bherwani *et al.,* 2014). Guided tissue regeneration (GTR)-based root coverage procedures have reported promising results.

However, creating and maintaining space underneath the membrane remains a challenge.

For these reasons, a variety of bone substitutes (Mahajan and Kedige, 2015) and biologic mediators (Cochran and Wozney, 1999) are being used with different clinical outcomes. However, with these materials, the main problem faced is the graft confinement because of the particulate nature of various materials, necessitating the placement of an additional membrane. In recession management, we need a material that can support the coronally advanced flap (CAF) and will stay in the same place for a considerable time period, just like the gold standard, the sub epithelial connective tissue graft (SECTG). Anorganic bovine-derived hydroxyapatite matrix/cell binding peptide (P-15) has been used successfully in the treatment of recession defects (Nazareth and Cury, 2011).

Recently bioactive glass was introduced in the putty form (NovaBone® putty) and the literature reports good confinement of the material. Bioactive glass has acquired interest because of two properties: osteoconduction and osteoproduction (Chan *et al.*, 2002). They have the ability to cause acceleration in acellular mineralization and bring about stimulation of cell responses by releasing ions such as calcium and silicon at proper doses (El-Fiqi *et al.*, 2015). Once the bioactive glass has been implanted, ions leach into the surrounding tissue as the sodium ions in the glass exchange with hydrogen ions in the tissue fluids. Following this, calcium and phosphorous ions leach out into the tissues, thus leaving a silica-gel layer. The action is much like that of the mineral phase of bone and the organic components such as collagen fibers (Katuri *et al.*, 2013).

NovaBone® putty is a next generation calcium phosphosilicate bone graft material built from a bioactive glass platform with additives that improve handling characteristics and performance (Allon *et al.*, 2014). Bioactive glass can bond directly to the bone through the development of a surface layer of carbonated hydroxyapatite *in situ*. This calcium phosphate-rich layer is thought to promote adsorption and concentration of osteoblast-derived proteins necessary for the mineralization of extracellular matrix (Reynolds and Reidy, 2010). Bioactive glass has been shown to significantly increase clinical attachment level and hard tissue fill when implanted in intrabony defects (Froum *et al.,* 1998)

Del Pizzo *et al.* (2005) assessed the ability of enamel matrix derivative (EMD) to improve root coverage with a CAF. The authors concluded that the additional use of EMD to CAF is not justified for clinical benefits of root coverage, but is an attempt of achieving periodontal regeneration rather than repair. Jespen *et al.* (2013) evaluated the clinical outcomes of the use of a xenogeneic collagen matrix (CM) in combination with the CAF in the treatment of localized recession defects. The results showed that CAF + CM was not superior with regard to root coverage, but there was enhanced gingival thickness and width of keratinized tissue when compared with CAF alone. For the coverage of larger defects, CAF + CM was more effective.

To our knowledge, no literature has reported the use of bioactive glass in the form of putty to manage gingival recession defects. Hence, this study was designed to clinically evaluate the efficacy of bioactive glass putty (NovaBone Putty, NovaBone Dental Putty®; Jacksonville, FL) for the management of isolated gingival recession defects and compare it to CAF alone.

Materials and methods

Patient selection and experimental design

A randomized controlled study was carried out in the Department of Periodontics and Oral Implantology of the Dr. D.Y Patil Dental College and Hospital, Dr. DY Patil Vidyapeeth, Pune, India. The research protocol was approved by the Institutional Ethical Committee and Review Board. Written informed consent was obtained from all those who agreed to participate voluntarily in the study. Ten subjects (6 males), age range 18 - 45 years, were enrolled in this randomized controlled trial. The inclusion criteria were: presence of multiple bilateral gingival recession defects classified as Miller's (Miller, 1985) Class I or Class II recession defect [n = 40 test 20 (Class I - 12 and Class II - 8), control 20 Class I - 13 and Class II - 7: ≥ 2 mm] involving maxillary canine and/or premolar teeth (*Figure 1A*). The cause of recession was either physiological (toothbrush trauma) or pathological (calculus deposit). Systemically healthy patients having only thick gingival biotype were included (thickness ranged between 1.6 - 2.4 mm, average 1.9 mm); patients were willing to comply with all study-related procedures and consented to follow-up. The exclusion criteria were the inability to maintain good oral hygiene; subjects on medications known to interfere with periodontal health or healing; tobacco in any form; pregnant or lactating mothers, recession defects associated with caries or restorations and teeth showing evidence of pulpal pathology were excluded.

The study protocol involved a screening consultation followed by initial therapy to establish optimal biofilm control and gingival health, surgical therapy, suture removal at 14 days, post-surgical consultations, recall visits at 1 and 3 months, and final evaluation after 6 months. One side of the mouth was given treatment and the other side was used as a control.

Initial therapy and clinical measurements

A detailed case history and clinical examination, along with complete hemogram, were evaluated. Thereafter all subjects received a session of oral prophylaxis (scaling and root planning were performed in a single day with the help of power-driven and hand-activated instruments such as ultrasonic scalars and curettes. Patients were instructed to maintain proper oral hygiene by brushing teeth twice daily and rinsing after every meal.

Modified Stillman's brushing technique was taught that minimized apically directed forces to the soft tissues. Surgery was scheduled after two weeks following initial therapy. The following clinical parameters were recorded at baseline and at 6 months post-surgery: plaque index (PI) – (Silness and Löe, 1964); gingival index (GI) – (Löe and Silness 1963); gingival recession (GR), measured from the cemento-enamel junction (CEJ) to the most apical extension of the gingival margin; probing pocket depth (PPD) was recorded from the crest of the gingival margin to the base of the gingival sulcus; keratinized tissue height (KTH) was measured from the gingival margin to the mucogingival junction (MGJ), CAL gain was measured by the difference between the pre- and post-treatment attachment levels. Baseline parameters were recorded two weeks after initial therapy (scaling and root planing) after the tissues had healed to better visualize and appreciate the measurements. Moreover, attached calculus and/or plaque would give a false negative reading.

All the pre- and post-treatment clinical parameters were assessed by two previously calibrated, experienced periodontists (AK (Guide and Secondary Investigator) and RK (Secondary Investigator) who performed all the pre- and post-treatment clinical assessments using a periodontal probe (UNC-15, Hu-Friedy, Chicago, IL) to ensure adequate intra-examiner reproducibility. These examiners were blinded to the type of treatment rendered. All the surgeries were performed by AB (postgraduate student). The examiner was considered calibrated once a statistically significant correlation and statistically non-significant differences between duplicate measurements were obtained (r = 0.89 for GR, r = 0.85 for CAL, r = 83 for PPD, r = 92 for KTH). The GR, PPD, CAL, and KTH values were estimated to the nearest millimeter.

Photographic analysis

Photographs were taken preoperatively, immediate post-operatively, and 6 months post-surgery.

The root coverage esthetic score (RES) system was used to evaluate five variables at 6-months post-surgery: the level of the gingival margin, marginal tissue contour, soft tissue texture, MGJ alignment, and gingival color. The best esthetic score was 10. A score of 0 was assigned when the final gingival margin position was equal to or apical to the previous recession depth (i.e., failure of the root coverage procedure) independent of color, the presence of scarring, the gingival margin, or MGJ (Cairo *et al.*, 2009).

Acrylic stents were fabricated for the selected sites. A groove was placed in the stent in the line of recession to have a constant reference for standardized measurements at baseline and 6 months post-surgery.

Surgical procedures

Following anesthesia with 2% lignocaine HCl containing 1:80,000 adrenaline, the exposed portion of the root was prepared by means of curettes, finishing burs, and ultrasonic devices as needed. The exposed root surface was then conditioned with tetracycline hydrochloride for 4 minutes with a light pressure burnishing technique. The root surface was then thoroughly rinsed.

All surgical procedures were performed by a single operator (AB). Flap design began with an intrasulcular incision on the vestibular aspect of the target teeth followed by two horizontal incisions (one mesial and one distal) starting at the CEJ level and extending to the center of the papilla. Two vertical releasing incisions starting at the end of the horizontal incisions and extending to the MGJ complemented the flap design (*Figure 1B*). A full mucoperiosteal flap was raised to the level of the MGJ, and a partial-thickness flap was elevated at the most apical portion of the flap to allow flap coronal movement without tension (*Figure 1C*). The vestibular epithelium of the interdental papillae was removed to provide a wound bed appropriate for flap reposition. Root surfaces were thoroughly instrumented with manual scalers to provide a flattened surface. After the flap elevation of left and right areas, the bilateral defects were randomly assigned by computer-generated list to the test group (CAF + NovaBone® putty) or to the control group (CAF). NovaBone® putty was used according to the manufacturer's instructions and was placed at the CEJ level covering the entire defect (*Figure 1D*). Finally, the flaps were positioned at the level of or slightly coronal to the CEJ and fixed with sling sutures (*Figure 1E*).

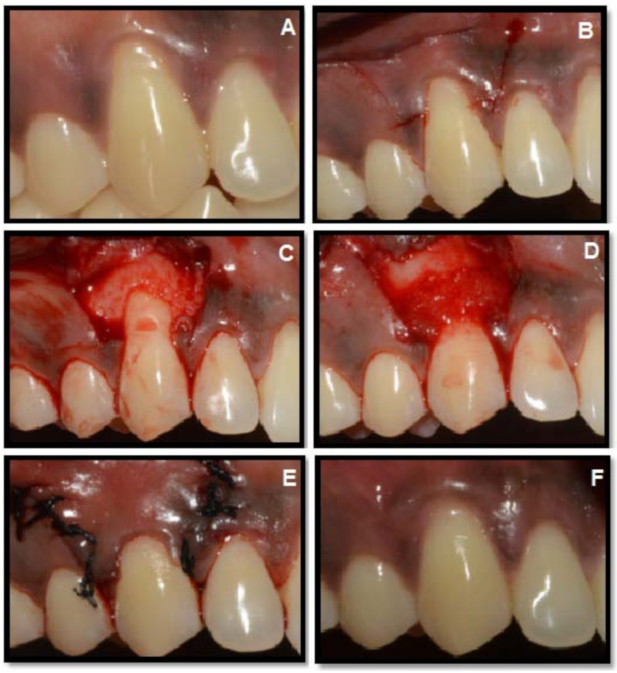

Figure 1. Complete surgical procedure: A) Miller's class I recession defects in canine. B) Crevicular incision and vertical releasing incisions adjacent to the defect. C) Full mucoperiosteal flap was raised to the level of the mucogingival junction, and a partial-thickness flap was elevated at the most apical portion of the flap. D) Defect was covered by NovaBone® putty biomaterial. E) Flap repositioned and suture placed. F) Post-operative healing at 6 months.

Post-surgical protocol

Post-operative instructions were given, the patient was advised to eat a soft diet for the first 24 hours and was prescribed antibiotics and analgesics Cap Novamox LB (amoxicillin + lactobacillus) 500 mg TID for 5 days and Tab. Zerodol (aceclofenac 100 mg) BID for 5 days. Patients were instructed to abstain from brushing and flossing around the surgical area until suture removal (14 days post-surgery). They were also instructed to avoid any other mechanical trauma to the treated sites. For 2 weeks, the patients used 0.2% chlorhexidine solution rinse for 30 seconds, twice a day. Patients were recalled at 1, 3 and 6 months, deposits if any were removed and oral hygiene instructions were reinforced. At the 6-month interval all clinical parameter measurements and photographic evaluations (*Figure 1F*) were performed.

Statistical analyses

Power calculations are made based on the formula $(1-\beta)$ 80% power of the study

$$\text{Mean} = \left(\frac{(Z_{1-\alpha} - Z_{\beta})\,6}{\delta}\right)^2$$

$$= \left(\frac{(1.96+0.84)\,0.18}{0.2}\right)$$

$$= 6.35 \text{ (Approximated to 7)}$$

$$= \text{Rounded off to } 10$$

A sample size of 10 subjects per treatment arm provides 80% power to detect a 20% difference between treatment and placebo. Descriptive statistics were expressed as mean ± standard deviation (SD) for each parameter at different time intervals. The difference between each pair of measurements was then calculated (baseline to 6 months). Data were analyzed using Student's *t*-test for paired and unpaired observations to assess changes obtained within and between groups. In the above tests, p values less than 0.05 ($p < 0.05$) were taken to be statistically significant. All analyses were performed using SPSS software version 20.

Results

All the base parameters (age, sex, sample size, type of defect) are tabulated in *Table 1*. The mean full mouth plaque and gingival scores at baseline were 1.22 ± 0.5 and 0.78 ± 0.36, respectively. At 6 months plaque and gingival scores reduced to 0.33 ± 0.26 and 0.29 ± 0.13, respectively. The plaque index and GI showed significant differences from baseline to 6 months post-therapy. However, as this was a split mouth study these parameters did not make any difference between the test and the control groups (*Table 2*).

All patients tolerated the surgical procedures well, experienced no post-operative complications, and complied with the study protocol. The reduction in GR was significant in both the test and control groups ($p < 0.05$), with no differences between groups. The exposed root was covered by 72% ± 15.81% in the test group, and by 79% ± 18.94% in the control group. Significant CAL gain and gain in KTH was observed in both groups ($p <$ 0.05), with no difference between groups. The decrease in PPD was significant only in the test group, with no difference between groups. The mean RES score for test group was 7.7 ± 1.41 mm and for the control group was 7.2 ± 2.78 mm. The difference between the scores was not statistically significant (*Table 3*).

Discussion

This study shows that in isolated Class I and Class II GR defects, CAF associated with NovaBone® putty provides no significant difference in root coverage and CAL gain compared to CAF alone. Although not clinically significant, a statistically significant increase in the KTH was observed in the NovaBone® putty group. The KTH gain should be correlated with tissue maturation following healing and with the fact that the mucogingival junction tends to be located at its genetically determined position (Ainamo *et al.*, 1992).

Table 1. Baseline parameters

Parameters	Value
Age Range (Mean)	18-45 years 38 years
Sex (M/F)	6/4
n = 40 (Test/control)	20/20
Recession Miller's Class I/II	Test 12/8 Control 13/7

Table 2. Comparison of gingival and plaque index at baseline and at six months

Parameters	Baseline	6 months	Difference	*p* value
Plaque index	1.22 ± 0.5	0.33 ± 0.26	0.89 ± 0.41	< 0.05
Gingival index	0.78 ± 0.36	0.29 ± 0.13	0.49 ± 0.3	< 0.05

Table 3. Comparison of various parameters between baseline and at 6 months for both groups

Parameter	**Value**	**Control (CAF) Mean ± standard deviation (mm)**	**Test (CAF + NovaBone® putty) Mean ± standard deviation (mm)**	**Difference (Control - Test) Mean ± standard deviation (mm)**
GR	Baseline	3.0 ± 0.67	2.8 ± 0.42	
	6 months	0.7 ± 0.68	0.8 ± 0.42	
	Difference	2.3 ± 0.48	2.0 ± 0.47	0.3 ± 0.21
	p value	$p < 0.05$	$p < 0.05$	$p > 0.05$
PPD	Baseline	1.6 ± 0.84	1.6 ± 0.52	
	6 months	1.1 ± 0.32	0.9 ± 0.32	
	Difference	0.5 ± 0.85	0.7 ± 0.48	0.2 ± 0.31
	p value	$p > 0.05$	$p < 0.05$	$p > 0.05$
CAL	Baseline	4.6 ± 1.2	4.4 ± 0.69	
	6 months	1.8 ± 0.79	1.7 ± 0.67	
	Difference	2.8 ± 0.78	2.7 ± 0.67	0.10 ± 0.33
	p value	$p < 0.05$	$p < 0.05$	$p > 0.05$
KTH	Baseline	3.4 ± 0.52	2.5 ± 0.53	
	6 months	4.3 ± 0.483	3.7 ± 0.48	
	Difference	-0.9 ± 0.57	-1.2 ± 0.42	0.3 ± 0.22
	p value	$p < 0.05$	$p < 0.05$	$p > 0.05$
Root coverage (%)	*p* value	79 ± 18.94	72 ± 15.81	7.5 ± 7.8 $p > 0.05$
RES		7.7 ± 1.41	7.2 ± 2.78	0.5 ± 0.98 p > 0.05

CAF, coronally advanced flap; CAL, clinical attachment level; GR, gingival recession; KTH, keratinized tissue height; PPD, probing pocket depth; RES, root coverage esthetic score

Another explanation of the KTH increase may be the granulation tissue formation derived from the periodontal ligament tissue, which forms a connective tissue with the potential to induce keratinization of the covering epithelium (Müller *et al.*, 1998). To our knowledge, this is the first description of the use of NovaBone® putty in the treatment of GR defects. The mean baseline recession in this study group was 4.4 ± 0.69 mm. In the 6-month follow-up, there was an average of 72% (2.8 mm) and 79% (2.7 mm) coverage of the roots in the test and control groups, respectively. These findings were in accord with recent studies, where the mean percentage of root coverage ranged from 72% - 76% in the test groups. The materials used in these studies included acellular dermal matrix allograft, subepithelial connective tissue graft, demineralized freeze-dried bone allograft and xenogeneic collagen matrix (Cortes *et al.*, 2004; Da Silva *et al.*, 2004; Kimble *et al.*, 2004; Jespen *et al.*, 2013) respectively. For all four treatments, there was significant increase in root coverage when compared to baseline. However, there was no statistical significance between the test and the control groups in terms of root coverage. The variation in the treatment outcome for the various procedures may be associated with the technique being assessed and with the thickness of the flap (Susin *et al.*, 2004), the flap tension (Manchala *et al.*, 2012), or differences in oral hygiene quality (Anarthe *et al.*, 2013). Furthermore, the procedures are operator sensitive and factors influencing the treatment outcome may not be completely known.

The present study showed that the mean probing pocket depth (PPD) was reduced from 1.6 mm ± 0.84 mm to 1.1 mm ± 0.32 mm, showing a reduction of 0.5 mm in the control group that was not statistically significant. These findings were in accordance with Zucchelli and de Sanctis (2000) and Modica *et al.* (2000). In the test group the mean PPD was reduced from 1.6 mm ± 0.52 mm to 0.9 mm ± 0.32 mm, showing a mean reduction of 0.7 mm ± 0.48 mm that was statistically significant. These findings were in accordance with Duval *et al.* (2000) and Dodge *et al.* (2000). This minimal decrease in PPD may suggest that the gain in CAL was associated with new connective tissue attachment. Histologic studies are needed to clarify such an outcome. In the present study, when probing pocket depths were compared between the control and the test group over a period of 6 months, no statistically significant difference was observed between them.

Significant CAL gain (around 2.8 mm) was observed in both groups, with no difference between groups. The amount of clinical attachment level obtained in our study was in accordance with studies reported by Nazareth and Curry (2011), Woodyard *et al.* (2004) and Huang *et al.* (2005).

Although only histological evaluation will confirm it, we assume that the clinical improvements in the test group may be because of true periodontal regeneration, and in the control group it might be because of long junctional epithelium. At this point, we cannot confirm and need histological studies to validate our assumption. The use of bioactive glass putty seems to avoid the apical downgrowth of epithelium and maintains the space necessary for periodontal regeneration, promoting true periodontal regeneration (Fetner *et al.*, 1994).

Treating gingival recessions to obtain complete root coverage is no longer sufficient for defining the complete success of treatment and it should always be associated with an optimal integration of the adjacent tissues. In our study, the RES as given by Cairo *et al.* (2009) was used to assess the treatment outcome. The root RES obtained in our study was 7.7 ± 1.41 mm in the control group. In the test group, the RES was 7.2 ± 2.78 mm when evaluated at 6 months. The difference between the test and control groups was not statistically significant. These findings were comparable to those reported by Pini-Prato *et al.*, 2011 where the mean RES score was 6.8 mm (range, 0 to 10) at the 1-year evaluation of a root coverage procedure. Cairo *et al.* (2012) reported RES scores of 7.6 ± 1.7 mm using CAF + CTG and 6.7 ± 1.5 mm with CAF alone, which is in agreement with the present study results.

Root coverage in the form of CAF has a predictable outcome; the addition of bioactive glass putty to CAF did not yield any significant differences compared to CAF alone. Small sample size could be a limitation of this study; larger sample sizes with long-term evaluations are warranted. Also, bioactive glass with different morsel size in putty or other consistency can be used in permutations and combinations to further investigate the efficacy of this material for root coverage.

Conclusions

The results of the present study indicate that both CAF and CAF + bioactive glass putty can be successfully used to treat Miller's Class I and Class II gingival recession defects. Both groups demonstrated an overall significant improvement in all the assessed clinical parameters. Although the result of this study found no significant difference between the two groups with regard to the outcome of the treatment, a trend towards greater improvement in KTH was seen in the bioactive glass putty group. Further studies are necessary to compare the results obtained by the proposed technique with other conventional reconstructive periodontal plastic surgeries, such as subepithelial connective tissue grafts and guided tissue regeneration.

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