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A Comparison between the Tunnel Technique with Autogenous Grafts and Coronally Advanced Flap for Root Coverage of Multiple Gingival Recessions: A Randomized Clinical Trial

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A B S T R A C T

Objectives: The purpose of this study was to compare the clinical performance of coronally advanced flap (CAF) with connective tissue graft (CTG) and vestibular incision subperiosteal tunnel access (VISTA).

Materials and Methods: The statistical population of this randomized clinical trial consisted of 24 healthy non-smokers with Miller Class I or II gingival recession (GR) defects, equally divided into two groups of 12 to receive either a CAF or the VISTA technique. Clinical parameters including the clinical attachment level (CAL), gingival biotype, pocket probing depth (PPD), recession height (RH), recession width (RW), root coverage (RC), and keratinized tissue width (KTW) were measured and compared between the two groups using ANCOVA, Fisher's exact test, independent samples t-test, Mann-Whitney U test, and repeated-measures ANOVA (alpha=0.05).

Results: The CAF group showed a significantly higher RC percentage (97.22%±9.62%) than the VISTA group (77.22%±24.28%%). Both techniques exhibited similar performance in terms of reducing the PPD and increasing the KTW and gingival attachment. However, the CAF group experienced a significantly greater reduction in CAL, RW, and RH than the VISTA group (P<0.05).

Conclusion: The VISTA and CAF groups showed a complete root coverage (CRC) percentage of 33.3% and 91.7%, respectively, indicating higher effectiveness of CAF than VISTA.

Keywords: Connective Tissue; Gingiva; Gingival Recession; Randomized Controlled Trial; Surgical Flaps

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INTRODUCTION

Gingival recession (GR) is the apical shift of the gingival margin in relation to the cementoenamel junction (CEJ) with concomitant root surface exposure in the oral cavity [1]. GR is becoming a more significant clinical problem due to its clinical complications [2]. Once exposed to the oral environment, denuded root surfaces increase the risk of dentin hypersensitivity, compromise esthetics, and can lead to dental caries in the majority of patients. It can also cause pulpal hyperemia, decrease attached gingiva, and complicate post-GR

reconstructive procedures [3]. According to the literature, the incidence of GR≥1mm in American adults over 30 years is approximately 58% [4, 5].

Several surgical approaches have been proposed for treatment of GR defects with variable success rates such as the coronally advanced flap (CAF) alone or in combination with a connective tissue graft (CTG), free gingival graft, and laterally positioned flap [6]. CTG is considered as the gold standard for root coverage (RC) treatment due to its reportedly optimal esthetic score and clinical attachment gain [2]. However, various GR treatment techniques have been proposed to be combined with the CTG, e.g., CAF, vestibular incision subperiosteal tunnel access (VISTA), tunnel technique (TUN), and modified TUN, the predictability of which increases significantly when combined with CTG [7].

CAF is one of the most widely used techniques for RC, which is based on coronal shift of the soft tissue apical to the exposed root surface [8, 9]. It can be employed alone or in conjunction with acellular dermal matrix, enamel matrix derivative, platelet-rich plasma, soft tissue grafts, and xenogeneic collagen matrix [10]. Among them, CAF+CTG and enamel matrix derivative increase the likelihood of acquiring complete root coverage (CRC) [11]. CAF+CTG is a modified version of CAF, which is one of the most effective methods for maximum root coverage (MRC) with a good esthetic score and optimal color match of the surgically treated area with the adjacent soft tissue [12].

The VISTA technique was created to circumvent the technical issues associated with the conventional intrasulcular TUN, chief among them being restricted access and potential gingival trauma [13]. The GR treatment outcomes largely depend on the flap design, among which split–full–split flaps are a popular option, especially in cases of single and multiple GR defects. A variety of factors, including variations in the composition of the applied CTG (e.g., depth differences in submucosa and lamina propria), can have an impact on the course of treatment. Furthermore, the success is influenced by the harvesting technique, which highlights the significance of access in dissection, graft stabilization, periosteal elevation, and visibility [14, 15].

Researchers disagree on the best treatment modality for GR and the efficacy of surgical approaches, and further research is required due to the scarcity of studies and conflicting results. Thus, the purpose of this study was to compare the clinical performance of CAF with a CTG and VISTA. The null hypothesis assumed that there would be no statistically significant difference between clinical parameters, including clinical attachment level (CAL), keratinized tissue width (KTW), pocket probing depth (PPD), recession height (RH), and recession width (RW).

MATERIALS AND METHODS

Trial design:

This 6-month single-center, double-blind randomized controlled clinical trial (registration number: IRCT20200804048305N1) was conducted following the guidelines of the Consolidated Standards of Reporting Trials. Ethical approval was obtained from the Local Research Ethics Committee (Institutional Review Board affiliated to Isfahan Medical University; No.: IR.MUI.RESEARCH.REC.1398.141). According to the Declaration of Helsinki, the patients were provided with the information about the potential research benefits and risks before obtaining their informed consent.

Primary and secondary outcomes:

The primary outcomes were the mean RC and CRC percentage, while the secondary outcomes were CAL, KTW, PPD, RH, and RW.

Sample size calculation:

The sample size was calculated assuming α=0.05, expected standard deviation=0.45mm, and power=80% for detecting an actual≥0.50mm mean difference between the two treatment groups. Accordingly, 12 patients per group were required to be treated for this study.

Eligibility criteria and settings:

The inclusion criteria were: multiple GR defects in the anterior mandible, systemically healthy patients with no contraindication for

periodontal surgery, presence of two or more adjacent Miller Class I or II GR defects (recession depth≥1mm), age between 18-65 years, no need for orthodontic treatment, and no dental restoration or caries.

The exclusion criteria were systemic diseases or conditions affecting periodontal health such as substance abuse, immunodeficiency disorders, pregnancy/lactation, uncontrolled diabetes mellitus, smoking, systemic/local bone diseases, and taking anticoagulants/immunosuppressants.

The study population consisted of twenty-four 18 to 65-year-old healthy non-smokers (divided equally into two groups of 12) with Miller Class I or II GR defects. They were all referred to the Department of Periodontology due to their esthetic problems and/or dentin hypersensitivity due to exposed root surfaces.

Interventions:

After obtaining written informed consent from the patients, root planing, professional cleaning, and scaling were performed after patients received oral hygiene instructions, which included non-traumatizing brushing method with a soft toothbrush. The Silness and Löe plaque index (PI) [16] was measured prior to treatment, and also after 3 and 6 months.

Clinical Measurements: A periodontal probe was used in the mid-buccal region of the recession zone for clinical measurements at baseline and 3 and 6 months after surgery. PPD was measured from the gingival margin to the bottom of the gingival sulcus. RH was measured from the CEJ to the gingival zenith. RW was the transverse distance between the two recession edges at the CEJ (i.e., the maximum area). KTW was measured from the gingival zenith to the mucogingival junction. CAL was measured from the CEJ to the bottom of the gingival sulcus. gingival biotype was also determined as thin, thick, and medium by inserting a probe into the gingival sulcus [17]. All clinical measurements were made by one blinded examiner (M.M.). The measurements were repeated by the same examiner twice within a 24-hour period. Calibration was accepted if 90% of the clinical measurements were reproducible with a maximum difference of 1mm.

Surgical Technique: Another examiner (A.F.) used a computer-generated randomization list to randomly assign the patients to a research group after clinical examination. Examiner M.M., who carried out the surgical procedure received the random allocation sequence on the day of surgery. One single skilled periodontist (J.Y.) performed all surgical procedures with the same professional team. A combination of 4% articaine hydrochloride and 1:200,000 epinephrine was used for local anesthesia of both the donor and recipient sites.

CAF: During the CAF procedure, two beveled 3-mm horizontal incisions were made distal and mesial to the recession defect using a small (#15c) scalpel blade. The split–full–split technique was then employed to elevate the obtained trapezoidal-shaped flap, leading to exposure of bone (3-4mm) to the bone dehiscence apically. Curettes were used to mechanically treat the root surface. The facial soft tissue of the anatomical interdental papillae coronal to the horizontal incisions underwent de-epithelialization. Double horizontal mattress sutures were applied to suture the recession area by means of 6.0 polypropylene suture at the buccal CEJ level. Soft tissue shrinkage was compensated by positioning the vestibular soft tissue 1mm coronal to the CEJ [18]. Surgical papillae were stabilized over the anatomical interdental papillae using sling sutures [12] (Fig. 1).

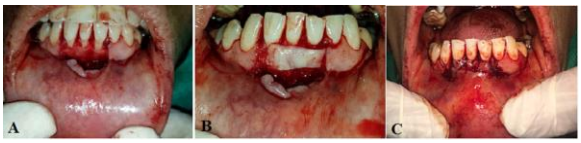

Fig 1. CAF+CTG; (A) bed preparation at the recipient site, (B) Insertion of the graft, (C) Coronalization of the flap and suturing

VISTA: The first step in the VISTA technique was to make a vestibular access incision with a #15c scalpel blade. To this end, two vertical incisions were placed 2mm beneath the gingival margin on either side of the recession area. The subperiosteal tunnel was created using a microsurgical periosteal elevator (VISTA 1), and access to interproximal areas and gingival sulcus was facilitated by Bayonet curved elevators (VISTA 2 and 3; Dowell

Dental Products). The papillae were gently separated from the underlying bone without tearing. Horizontal mattress sutures were applied to guide the CTG through the tunnel. Next, 6.0 polypropylene suture was utilized to coronally advance and stabilize the coronally anchored CTG [13]. A thin layer of flowable composite resin was applied over the knot to secure polypropylene sutures to the facial aspect of each tooth during the early healing stages to prevent apical relapse of the gingival margin. Next, multiple 5.0 polypropylene sutures were used to approximate and suture the vertical incisions (Fig. 2).

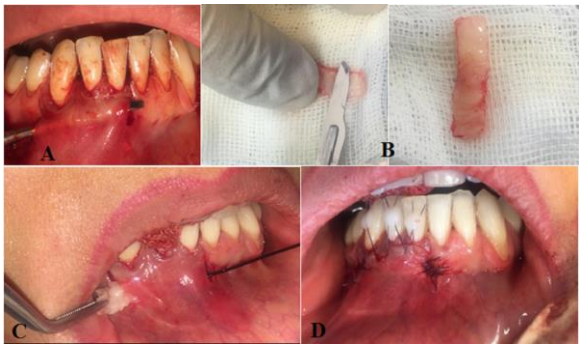

Fig 2. VISTA+CTG; (A) Tunneling, (B) Donor site preparation, (C) Insertion of the connective tissue, (D) Composite/suture

Donor site preparation: A palatal CTG (height: 5mm, thickness: 1.5mm) was harvested from the premolar area #31. A #15c scalpel blade was then utilized to remove any visible epithelium after CTG trimming [19] (Fig. 3).

Fig 3. Removal of the epithelial tissue using a scalpel

Post-operative protocol: After surgery, the patients received 500mg amoxicillin 3 times a day and 400mg ibuprofen 4 times a day for one week. Also, 0.2%w/v chlorhexidine digluconate mouthwash was prescribed twice a day for 2 weeks. Sutures were removed from the donor and the recipient sites 10 and 14 days after surgery. For one month, plaque removal at the surgical area was performed by using a cotton swab soaked in 0.2% chlorhexidine as part of routine oral hygiene.

Statistical analysis:

The collected data were analyzed using SPSS version 22. Descriptive statistics were reported as the percentage, frequency, mean, and standard deviation. ANCOVA, Fisher's exact test, independent samples t-test, Mann-Whitney U test, and repeated-measures ANOVA were employed for inferential statistics. A P value of less than 0.05 deemed significant in all analyses, which were conducted by a statistician blinded to the group allocations.

RESULTS

A total of 24 patients (equally divided into two groups of 12 in CAF and VISTA groups) were enrolled in the current study. The mean age of the patients was 46.86±6.51 years, and each group consisted of 4 males and 8 females. All 24 participants completed the study (Fig. 4). Table 1 summarizes the baseline and 3/6-month postoperative measurements of clinical parameters. Table 2 reports the 3/6-month postoperative clinical outcomes denoting variations in baseline clinical parameters. No significant difference was observed between the two groups regarding GR distribution at baseline (P=0.51). Class I and II GR defects had 50%/50% frequency, respectively in the CAF group and 66.7%/33.3% frequency, respectively in the VISTA group. However, the CAF group showed greater improvement at 3 and 6 months postoperatively than the VISTA group (P=0.02 and P=0.04, respectively). Three months postoperatively, 58.3% and 16.7% of patients recovered in the CAF and VISTA groups, respectively. Six months postoperatively, 91.7% and 60% of patients recovered in the CAF and VISTA groups, respectively. Meanwhile, class I GR defects remained in 8.3% and 41.7% of patients in the CAF and VISTA groups, respectively.

No significant difference was found between the two groups in terms of tissue biotype distribution at any time point (P>0.05). Prior to the intervention, a thin gingival biotype was seen in 75% and 66.6% of patients in the CAF and VISTA groups, respectively (P=0.63). No patient in either group had a thin gingival biotype 3 or 6 months postoperatively, indicating no significant difference between them (P>0.05).

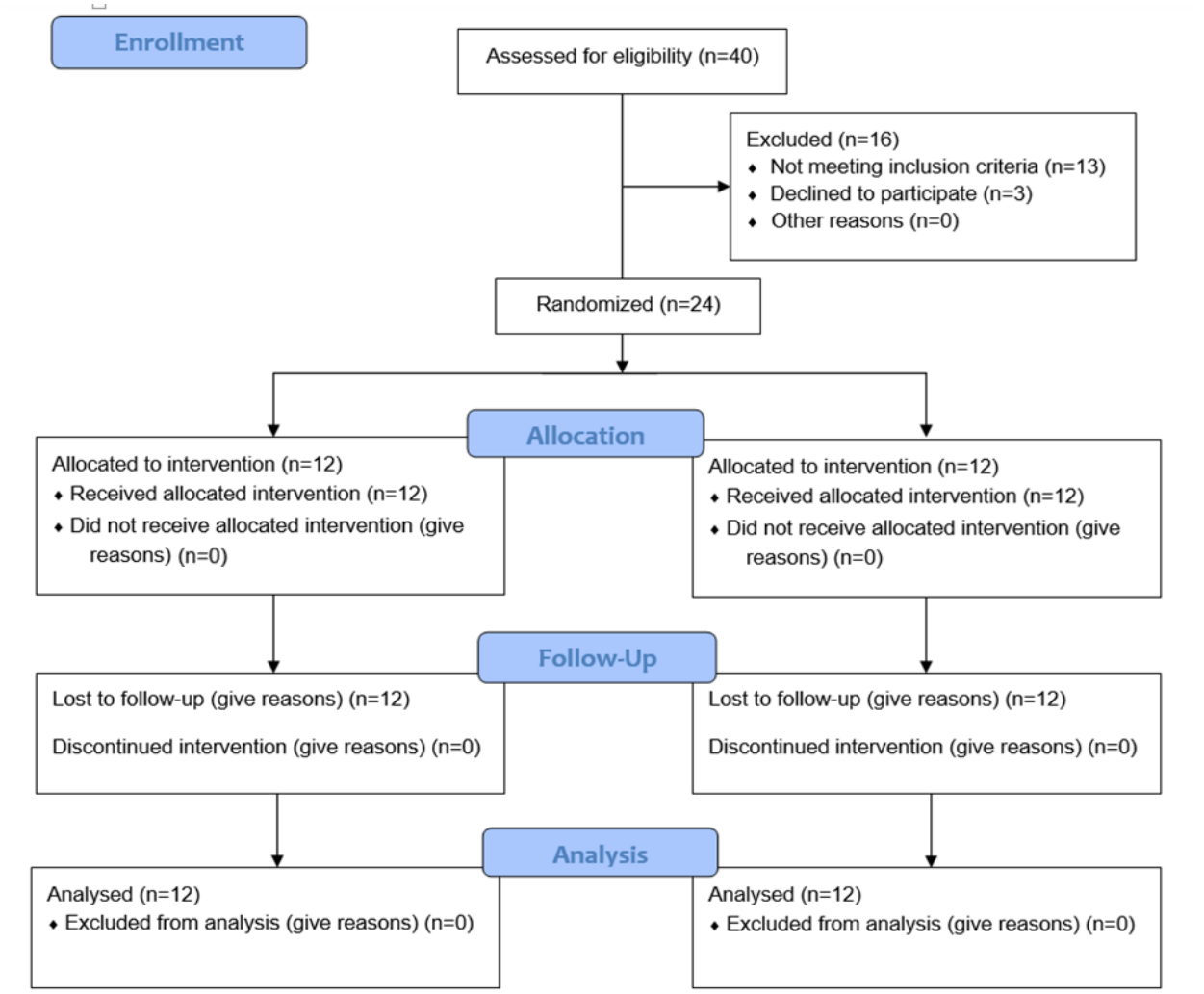

Fig 4. CONSORT 2010 flow diagram of patient selection and allocation

Table 1. Clinical outcomes

Variable	CAF	VISTA	P-value	Confidence interval
RC%	97.22±9.62	77.22±24.28	0.02	4.362-35.636
3 months				
Recession reduction (mm)	-1.92±0.66	-1.33±0.49	0.02	-1.080--0.086
KT gain (mm)	1.21±0.84	2±0.85	0.03	-1.507--0.075
6 months				
Recession reduction (mm)	-2.67±1.43	-2.08±1	0.26	-1.629-0.463
KT gain (mm)	1.96±1.05	2.58±1.08	0.17	-1.530-0.280

p<0.05 statistically significant; CAF, coronally advanced flap; VISTA, vestibular incision subperiosteal tunnel access; RC, root coverage; KT, keratinized tissue.

Table 2. Clinical parameters at baseline and 3 and 6 months postoperatively

Parameter	Group	Baseline	Three months postoperatively	Six months postoperatively	P-value	P-intervention
PPD	CAF	1.42±0.15	1.25±0.13	1±0	0.034	0.691
	VISTA	1.17±0.11	1.17±0.11	0.92±0.08	0.102	
	P-value	0.194	0.972	0.411		
RH	CAF	2.75±0.41	0.83±0.34	0.08±0.08	<0.001	0.224
	VISTA	2.83±0.37	1.50±0.31	0.75±0.25	<0.001	
	P-value	0.881	0.008	0.015		
RW	CAF	3.17±0.24	1.25±0.43	0.25±0.25	<0.001	0.070
	VISTA	2.67±0.14	1.67±0.28	0.92±0.29	<0.001	
	P-value	0.088	0.194	0.041		
KTW	CAF	3.96±0.28	5.17±0.17	5.92±0.26	<0.001	0.860
	VISTA	3.58±0.58	5.58±0.48	6.17±0.52	<0.001	
	P-value	0.570	0.027	0.216		
AG	CAF	2.58±0.31	4±0.17	4.92±0.26	<0.001	0.928
	VISTA	2.50±0.60	4.17±0.64	5±0.68	0.003	
	P-value	0.903	0.682	0.854		
CAL	CAF	3±0.43	1.08±0.42	0.25±0.18	<0.001	0.078
	VISTA	4±0.39	2.33±0.40	1.33±0.38	<0.001	
	P-value	0.097	0.181	0.057		

p<0.05 statistically significant; PPD, pocket probing depth; RH, recession height; RW, recession width; KTW, keratinized tissue width; AG, attachment gain; CAL, clinical attachment level

The CAF group exhibited a significantly higher mean percentage of MRC than the VISTA group (97.22±9.62% vs. 77.22±24.28%; P=0.02). Also, 91.7% and 50% of patients had CRC in the CAF and VISTA groups, respectively; this difference was statistically significant (P=0.03) according to the Fisher's exact test.

At baseline, no significant difference was seen between the two groups regarding the mean attached gingiva, CAL, KTW, PPD, RH, and RW, according to independent samples t-test (P>0.05). Nevertheless, 3 months postoperatively, while the two groups showed no significant difference in terms of the mean attached gingiva, CAL, PPD, and RW according to ANCOVA (P>0.05), they exhibited a significant difference regarding KTW and RH (P<0.05) and a greater reduction in these values was noted in the CAF group. On the other hand, 6 months postoperatively, the CAF group showed significantly reduced RH and RW values than the VISTA group. The mean reduction in CAL was also close to significant (P=0.057).

Changes in the parameters within each group were analyzed by repeated-measures ANOVA. The results indicated a significantly downward trend (P<0.05) for all parameters, except PPD, in the VISTA group (P=0.102). However, the two groups revealed no significant difference in parameter reductions (P>0.05).

The CAF group displayed a significantly higher mean recession reduction (P=0.02) than the VISTA group 3 months postoperatively. Six months postoperatively, however, no significant difference (P=0.26) was observed between them. Moreover, while the VISTA group showed a significantly higher mean keratinized tissue gain 3 months postoperatively than the CAF group (P=0.03), no significant difference (P=0.17) was found between them at 6 months postoperatively.

DISCUSSION

In this study, clinical performance of CTG was evaluated using two different techniques namely CAF and VISTA. CAF outperformed VISTA in terms of CRC. There was no significant difference between them in terms of enhancing keratinized and attached gingiva. After a 12-month follow-up, Gobbato et al. [20] observed no significant difference between CAF+ subepithelial connective tissue graft (SCTG) and TUN+SCTG in reduction of PPD and attached gingiva, which was consistent with the present findings. As in the current study, TUN+SCTG showed significantly increased

keratinized tissue compared with CAF+SCTG probably due to longer follow-up period. On the contrary, Mayta-Tovalino et al, [16] in their meta-analysis and systematic review did not reveal any significant difference in KTW, which was also consistent with the present findings. However, as opposed to the current outcomes, a randomized controlled clinical trial by González-Febles et al. [21] supported the TUN, indicating significantly increased KTW with unknown long-term sustainability. Likewise, Salem et al. [22] found that the pouch/TUN +CTG group experienced higher keratinized tissue gain than the CAF+CTG group. Although the current findings are consistent with their long-term results, Salem et al. [22] found that the thickness of the soft tissue in the pouch/TUN + CTG group increased unexpectedly over time, something that was not observed in the CAF + CTG group. These conflicting results highlight the subtle factors that CTG approaches must take into account and recommend that the results of different studies must be interpreted cautiously [21, 22].

Enhancing both tissue height and width is a top priority for surgeons treating GR defects. Herein, both groups showed significantly reduced RH and RW over the course of 6 months, which can be probably explained by using a combination of techniques or the measurement time [20]. Both groups also exhibited a significant reduction in CAL, which was in line with earlier studies indicating that CAF outperformed other techniques e.g., TUN+SCTG [20] or SCTG [23] in CAL. Moreover, the meta-analysis by Mayta-Tovalino et al. [15] did not show any significant difference in CAL, which further confirms the current findings.

Following a 6-month intervention, the two groups showed no evidence of a thin gingival biotype and exhibited only a medium or thick gingival biotype. While they did not show a statistically significant difference in biotype alteration, the VISTA group showed more prominent gingival thickening. In particular, while the CAF group only had one single patient with Class I GR defect, 41.7% of patients in the VISTA group had Class I GR and 10% of patients had Class II GR defects. Notably, the CAF group had a higher percentage of RC (97.22%) than the VISTA group (77.22%). In the study by Salem et al, [22] the gingival tissue gain significantly increased with both techniques. Remarkably, the test group showed an extra gingival tissue gain over time, while the gingival tissue remained unchanged in the control group.

In the study by Gobbato et al, [20] RC assessment after applying CAF/TUN+SCTG suggested that TUN+SCTG and CAF+SCTG groups achieved 50% and 60% CRC, respectively, revealing no significant difference between the two methods.

The MRC% was found to be 98.4% for the CAF group and 78.8% for the TUN group, according to a comparison between their RC efficacy. Also, CRC rates were 21.4% and 78.6% for the CAF and TUN groups, respectively, indicating the superiority of the latter in obtaining CRC [24]. The current study, however, showed that both groups had RC% higher than 70%, with CAF outperforming TUN in terms of overall RC%. Azaripour et al. [25] compared CAF and modified TUN outcomes for treatment of Miller Class I and II GR defects. The RC% was found to be 98.3% and 97.2% for the CAF and modified TUN groups, respectively, indicating their esthetic acceptability.

Several studies have reported optimal treatment outcomes and really successful surgical practices with/without CAF. For example, the reported RC rates vary from 55% to 99% and from 70% to 98% for CAF and CAF+CTG techniques, respectively [20, 24, 25]. Additional research indicates that using VISTA in conjunction with platelet rich fibrin membrane may be a promising option for treating Miller Class I and II adjacent multiple GR defects [26, 27].

Several researchers support TUN+SCTG, which entails exposing a portion of SCTG, possibly leading to total graft necrosis, to overcome particular restrictions concerning the tunnel preparation and flap advancement. Although TUN is a promising option for GR treatment, there are limitations to its clinical applicability, especially when it comes to managing deep recessions. Due to the limited flap mobility in these cases, a significant

amount of the graft must be left exposed, which could result in necrosis. Therefore, > 5 mm defects are considered inappropriate for this method [20, 25, 28]. In essence, prolonged duration of surgery corresponds to higher dosage of analgesics. The TUN is a more complex and time-consuming process than the CAF procedure because it requires specific attention and care, especially in patients with a thin gingival biotype. Moreover, in contrast to CAF, VISTA results in more postoperative edema and pain because the surgical area needs to extend beyond the recessed area by at least one distal and mesial tooth to ensure its effectiveness [20, 28].

It is important to recognize the limitations of this study even though it offers insightful information about the relative efficacy of the VISTA and CAF approaches for GR treatment. Evaluation of long-term results might have been hampered by the relatively brief 6-month follow-up period. Besides, the generalizability of the findings may be affected by the sample size. The conclusions would be more robust if more studies were conducted with longer follow-up periods and larger cohorts. Finally, even with strict methodology, variations in healing responses among individuals and possible operator-dependent factors may introduce inherent biases.

CONCLUSION

The findings revealed a significant difference in MRC% between the VISTA and CAF groups, with the latter showing a significantly higher MRC%. It should be noted that 91.7% and 33.3% of patients in the CAF and VISTA groups achieved CRC, respectively. An evaluation of clinical parameters also demonstrated that the two approaches performed similarly. Nonetheless, a significant difference was seen in RH/RW reduction, with the CAF group showing a much larger reduction than the VISTA group.

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CONFLICT OF INTEREST STATEMENT

None declared.

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