



## Guided Creeping Technique (GCT) as a Novel Minimally Invasive Approach in Treating Limited Gingival Recession – Case Series

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### Abstract

**Background:** Patients with limited gingival recessions may not justify treatment with extensive procedures such as coronally advanced flap with natural or synthetic grafting or even minimally invasive tunneling approaches. In an attempt to maximize patient acceptance, the present novel minimally invasive Guided Creeping Technique (GCT) is suggested.

**Methods:** Thirteen patients each contributed one or 2 adjacent Cairo RT1 GR defect of  $\leq 3$  mm in depth were treated by GCT and completed a 6-months follow up period. Micro-periosteal elevator was used to elevate vertical full thickness blind tunnel of 2 mm to 3 mm width starting apically from the horizontal incision and coronally up to the apical border of the junctional epithelium. Small pieces of collagen membrane (1 mm  $\times$  2 mm) were prepared and inserted through the apical tunnel aperture using blunt instrument supporting the coronal level of the displaced gingival margin. Single periosteal interrupted suture was placed in order to close the apical tunnel border. The following clinical parameters were assessed at baseline, 3 and 6 months: Gingival Index (GI), Plaque Index (PI), Probing Depth (PD), Clinical Attachment Loss (CAL), Gingival Recession (GR) at the mid-buccal aspect of the affected tooth, Keratinized Tissue Width (KTW) and Complete Root Coverage (CRC). On days 1, 3, 7 and 15, patients were asked to complete a visual analogue scale pain scoring.

**Results:** At 3 and 6 months, mean root coverage significantly reduced from  $3.41 \pm 1.03$  to  $0.43 \pm 0.52$  and  $0.17 \pm 0.41$  respectively ( $P=0.0001$  and  $0.0041$ ). The corresponding complete root coverage prevalence was 58.43% and 83.33%. Between baseline and 3 months statistically significant Keratinized Tissue Thickness (KTT) increase from  $0.650 \pm 0.187$  to  $1.283 \pm 0.392$  ( $P=0.0269$ ). Keratinized Tissue Width (KTW) was significantly increased from baseline to 3 and 6 months from  $2.50 \pm 0.84$  to  $3.17 \pm 0.98$  and  $3.33 \pm 0.82$  respectively.

**Conclusion:** Guided creeping technique in treating limited RT1 recession resulted in significant clinical improvements and provided a simple minimally invasive approach that could maintain maximum soft tissue support.

**Clinical Relevance:** Satisfactory minimally invasive approach is required in dealing with limited gingival recession. Developing a treatment option that is minimally invasive based on maximum maintenance of soft tissue support required in order to get a wide acceptance by our patients.

**Keywords:** Minimally invasive surgery; Tunneling techniques; Gingival recession; Creeping attachment

### Introduction

Gingival recession is developed as exposure of a part of the tooth root due to apical migration of the gingival margin [1]. It is mainly found in subjects with anatomical susceptibility factors, iatrogenic factors or deficient oral hygiene [2,3]. Localized or generalized recessions can be treated with periodontal plastic surgical procedures using various flaps and placing soft tissue grafts or graft substitutes to cover root surfaces to restore normal esthetics and reducing root sensitivity [4,5]. The current gold standards technique of choice Corronally Advanced Flap (CAF) with Connective Tissue Graft (CTG) showing a predictability in root coverage and long-term stability [6,7]. However, the use of CTG has limitations including second surgical site, postoperative discomfort and palatal volumetric changes [8]. To avoid donor site morbidity connective tissue alternatives have been

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proposed such as acellular dermal matrix [6] and porcine collagen [7] with a radicular coverage similar to that of the autologous grafting. However, systematic reviews reported higher keratinized tissue gain and complete root coverage with the use of CTG [4-9]. The coronally advanced tunnel technique is suggested as a minimally invasive flap design without releasing incisions and with the adjacent papillae left intact, favoring both flap and graft nutrition. The reported positive outcomes could be attributable to interproximal tissue preservation and minimum surgical manipulation of the tissues [10-12].

Patients with limited gingival recession may require specific simple minimally invasive surgical procedures with minimum soft tissue reflection. This limited recession may not compromise esthetic but causing root hypersensitivity which may make extensive surgeries unacceptable by the patient. Most studies only evaluated treatment of extensive gingival recession and limited information is available on simple specific treatment of minor gingival recession. Therefore, new specific clinical approaches are required to predictably treat minor gingival recession with minimum loss of soft tissue support that make it acceptable by the patient. In an attempt to maintain soft tissue support and to enhance graft stability and protection in treating limited recession the present novel minimally invasive Guided Creeping Technique (GCT) is suggested. This approach employed collagen to overfill a limited blind mucoperiosteal tunnel just under the recession defect which is supposed to support coronally repositioned gingival margin until the wound get a sufficient power of attachment to the root surface. In addition, a suggested spontaneous postsurgical coronal creeping of gingival margin and apical creeping of the junctional epithelium could aid into coverage of the denuded root surface [13-17]. Thus, the aim of this study is to evaluate the clinical outcomes and patients' satisfaction of GCT for the treatment of limited maxillary and mandibular gingival recession after 6 months follow-up period.

## Material and Methods

Thirteen subjects were selected from the outpatient clinic of periodontology department, October 6 and Al Azhar Universities, Cairo-Egypt to participate in this single arm open label study in a period between February 2021 and January 2022. Each subject contributed one or 2 adjacent maxillary or mandibular buccal GR in incisors, canine or premolar teeth. The detailed operation and follow up periods were clearly described in detail for all patients. All subjects were signed a written consent and agreed to participate in this clinical trial. Study protocol was approved by the Ethical Committee of October 6 University, Cairo-Egypt (code: 1509-2020) and registered in a Clinical Trial.gov Identifier: NCT05101642.

All participants met the following inclusion criteria, being over 18 years of age, systemically and periodontally healthy, presence of one or 2 adjacent buccal Cairo RT1 gingival recessions [18] of  $\leq 3$  mm in depth, an identifiable CEJ, affected vital teeth with at least 2 mm to 3 mm attached gingival width, agreed to participate and signed informed consent form. Study exclusion criteria included contraindications for periodontal surgery; patients with malpositioned teeth, smokers, pregnancy, using antiepileptic drugs or using antibiotics for at least 20 days before surgery.

The surgical procedure was explained to the patient and the informed consent was obtained. Elimination of all habits related to gingival recession development were performed. All patients received detailed oral hygiene instructions and a non-traumatic

tooth brushing technique using a soft toothbrush was recommended. Four weeks before surgery, all patients received a session of scaling and prophylaxis. Surgical treatment was not performed until the patient could demonstrate an adequate level of supragingival plaque control and gingival index score of 0 at the affected site. Prior to surgery, the following baseline data were reported: Gingival Index (GI) [19], Plaque Index (PI) [20], Probing Depth (PD), Clinical Attachment Loss (CAL), Gingival Recession (GR) at the mid-buccal aspect of the affected tooth and Keratinized Tissue Width (KTW). All measurements were undertaken using UNC graduated probe. Keratinized Tissue Thickness (KTT) was measured with a # 20 endodontic file across the gingival tissue perpendicularly 2 mm below the mid-gingival margin under local anesthesia, and then, the thickness was measured using a digital caliper (Truper). On days 1,3,7 and 15, patients were asked to complete a visual analogue scale in which they can rate subjective complaints of pain, burning sensation or discomfort at the surgical site on a scale from zero (none) to 10 (sever) [21].

All surgeries were performed by the same expert periodontist (AYG). Following local anesthesia using Articaine 4% and 1:200,000 epinephrine mechanical root surface debridement and treatment with EDTA 24% were applied for two minutes before surgery. Horizontal incision of 2 mm to 3 mm was performed using 15c blade at the mucogingival junction just lateral to the mesial or distal recession margin (Figure 1c). Micro-periosteal elevator was used to elevate vertical full thickness blind tunnel of 2 mm to 3 mm width starting apically from the horizontal incision and coronally up to the apical border of the junctional epithelium (Figure 1d). Coronal reflection extended up to one mm. apical to the base of the pocket guided by visualization of the shape and movement of the instruments through the gingival tissue. Micro-periosteal elevator was used to elevate the buccal aspect of both mesial and distal papillae of the affected tooth if required. Once dissection of the gingival fibers completed, the gingival margin was found free to be displaced coronally up to the level of the CEJ without junctional epithelial detachment. Small pieces of collagen membrane (1 mm  $\times$  2 mm) were prepared and inserted through the apical tunnel aperture using blunt instrument supporting the coronal level of the displaced gingival margin (Figure 1e). Collagen membrane fragments packed properly until junctional epithelium advancement was stabilized and a sufficient fullness in the gingival tissues for self-holding the mucogingival tissue complex was created. Every effort was made in order to avoid junctional epithelial detachment or collagen fragments overpressure on the junctional epithelium. Single periosteal interrupted suture was placed in order to close the apical tunnel border using polypropylene 5-0 (Figure 1f). No coronal suture or periodontal dressing was used.

All patients were instructed to avoid brushing in the surgical area, to rinse with antimicrobial for plaque control (0.12% chlorhexidine, twice daily) and to consume soft diet for two weeks. Postoperative follow-up was performed at fourteenth days for suture removal and then monthly to follow patients' compliance of their oral hygiene instructions and to report clinical data at 3 and 6 months. All clinical measurements were recorded by one calibrated examiner (M T D).

## Statistical analysis

The mean and standard deviation values were calculated for each group in each test. The primary outcome variable was gingival recession reduction. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, data showed

parametric (normal) distribution. The significance level was set at  $P \leq 0.05$ . Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows (Version 20.0. Armonk).

## Results

Fourteen patients fulfilling inclusion criteria treated with guided creeping technique consisted of nine women and five men ranging in age between 24 and 45 years (mean  $32.8 \pm 6.13$  years). Of these, 7 teeth were central incisors, 5 were canines and 2 first upper premolars. All patients completed the 6 months follow-up study except one patient who did not attend the 3-month evaluation appointment and was decided to be excluded from the study. Each patient shared a single recession except one case of 2 adjacent recessions. No unwanted complications such as bleeding, infections or loss of collagen fragments occurred. One case showed migration of collagen fragments below the mucogingival junction which appeared as a firm fibrous tissue nodule apical to the horizontal incision line one weeks following surgery and disappeared one week after. It was decided to move the apical horizontal incision laterally to start at the mesial or distal margin of the recession for the future operations (11 cases) in order to improve graft containment within the tunnel. One case showed rupture of the junctional epithelium and extrusion of collagen membrane. We decided to include these 2 cases in the study.

Periodontal clinical parameters (GI, PI, PD, CAL, GR reduction, KTW, KTT, Complete Root Coverage - CRC) at baseline, 3- and 6-months observation periods are reported in Table 1. Representative clinical steps and treatment outcomes at each time period are shown in Figure 1. Both Gingival Index (GI) and Plaque Index (PI) scores remained below 0.5 during the study period which indicated that all patients effectively comply with the oral hygiene instructions. The average baseline Gingival Recession (GR) was  $3.41 \pm 1.03$ . After 3 months, the GR mean value was  $0.43 \pm 0.52$  with a mean GR reduction of 2.98 mm ( $P=0.0001$ ) and a mean percentage of root coverage of 58.67%. At 6 months GR mean value was  $0.17 \pm 0.41$  ( $P=0.0041$ ) and complete root coverage CRC was 83.33% (10 sites). Between 3 and 6 months, additional root coverage (creeping attachment) was observed in 24.9%. The mean creeping attachment obtained in this period

was  $0.26 \pm 0.4$  ( $P=0.6109$ ). Although the amount of additional root coverage obtained was only  $0.26 \pm 0.4$ , it led to an additional 24.9% total root coverage at 6 months observation period. There was no statistically significant difference in pocket depth at both observation periods. At baseline CAL was  $4.80 \pm 0.84$  mm, which was significantly reduced to  $2.67 \pm 0.52$  and  $2.00 \pm 0.63$  at 3 and 6 months respectively. Between baseline and 3 months statistically significant increase in KTT from  $0.650 \pm 0.187$  to  $1.283 \pm 0.392$  ( $P=0.0269$ ) and  $1.033 \pm 0.082$  at 3 and 6 months respectively. No significant difference between 3- and 6-months observation periods. Keratinized tissue width was significantly increased from baseline to 3 and 6 months from  $2.50 \pm 0.84$  to  $3.17 \pm 0.98$  and  $3.33 \pm 0.82$  respectively. Postoperative morbidity was low since VAS scale showed a convenient record at day one ( $2.50 \pm 0.51$ ) which significantly reduced at days 3, 7 and 15 where at day 7 and 15 reported zero score (Figure 2).

## Discussion

The present case series is the first evaluation of a novel surgical technique that was specifically designed to keep the junctional epithelium while moving the mucogingival tissue complex coronally. Based on the current consensus, connective tissue graft-based procedures showed the best soft tissue root coverage to treat localized gingival recession [22,23]. However, the most important two unresolved problems which could negatively affect gingival recession treatment outcomes using either coronally advanced flaps with/without vertical incisions or tunneling techniques are, firstly, the graft stability which is affected by the extent of flap reflection and secondly, bacterial contamination of the grafted material due to the open defect nature. In addition, using such relatively extensive procedures in a limited recession defects may be psychologically unacceptable by the patients. The main objectives behind guided creeping technique are to provide maximum graft protection and stability through narrow blind tunnel reflection with its undetached coronal junctional epithelial seal and using of the collagen fragments to maintain coronal stability and enhance coronal and apical creeping attachment in treating limited recession defects. Such approach may increase patient acceptance to gingival recession treatment specially those unaware of the problem. The main differences between GCT



**Figure 1:** Showing 3 mm recession depth (a,b) related to upper left 1<sup>st</sup> premolar. (c) 2 mm horizontal incision lateral to the mesial border of the recession at the mucogingival junction, (d) 3 mm full thickness blind tunnel reflection up to the apical extent of the junctional epithelium (note the instrument shadow), (e) collagen fragment insertion supporting soft tissue coronally repositioned level, (f) simple interrupted suture closing the tunnel, (g) primary full recession coverage immediately following surgery (h) 6 month follow up period with complete coverage and apparent thick gingival phenotype.



**Table 1:** Clinical baseline and overtime data  $\pm$  standard deviation in mm. and degree of significance during different observation periods (n=13).

	GI	PI	PD	CAL	GR RED.	%RED	KTT	KTW	%CRC
<b>Base Line</b>	0.17 $\pm$ 0.41	0.33 $\pm$ 0.52	1.83 $\pm$ 0.41	4.80 $\pm$ 0.84 <sup>a,b</sup>	3.41 $\pm$ 1.03 <sup>c,d</sup>	-	0.650 $\pm$ 0.187 <sup>e,f</sup>	2.50 $\pm$ 0.84 <sup>g,h</sup>	-
<b>3 Months</b>	0	0	1.67 $\pm$ 0.52	2.67 $\pm$ 0.52 <sup>b</sup>	0.43 $\pm$ 0.52 <sup>c</sup>	85.67 $\pm$ 12.91	1.283 $\pm$ 0.392 <sup>e</sup>	3.17 $\pm$ 0.98 <sup>g</sup>	58.43%
<b>6 Months</b>	0	0	1.50 $\pm$ 0.55	2.00 $\pm$ 0.63 <sup>a</sup>	0.17 $\pm$ 0.41 <sup>d</sup>	96.33 $\pm$ 20.41	1.033 $\pm$ 0.082 <sup>f</sup>	3.33 $\pm$ 0.82 <sup>h</sup>	83.33%
<b>P-value</b>	0.3632	0.1747	0.3632	0.0001 <sup>a</sup>	0.0001 <sup>c</sup>	-	0.0269 <sup>e</sup>	0.025 <sup>g</sup>	-
<b>B-3</b>									
<b>P-value</b>	0.3632	0.1747	0.3632	0.006 <sup>b</sup>	0.0041 <sup>d</sup>	-	0.007 <sup>f</sup>	0.004 <sup>h</sup>	-
<b>B -6</b>									
<b>P-value</b>	0.2341	0.1132	0.6109	0.025	0.6109	0.712	0.1147	0.3632	0.033
<b>6-3</b>									

(Similar letters refer to significant difference – GI: Gingival Index; PI: Plaque Index; PD: Pocket Depth; CAL: Clinical Attachment Level; GR RED: Gingival Recession Reduction; KTT: Keratinized Tissue Thickness; KTW: Keratinized Tissue Width; %Red: Percentage Reduction, %CRC: Percentage Complete Root Coverage)

<sup>a</sup>Significant difference (p=0.0001) between (CAL baseline) and (CAL 3 months)

<sup>b</sup>Significant difference (p=0.0060) between (CAL baseline) and (CAL 6 months)

<sup>c</sup>Significant difference (p=0.0001) between (GR reduction baseline) and (GR reduction 3 months)

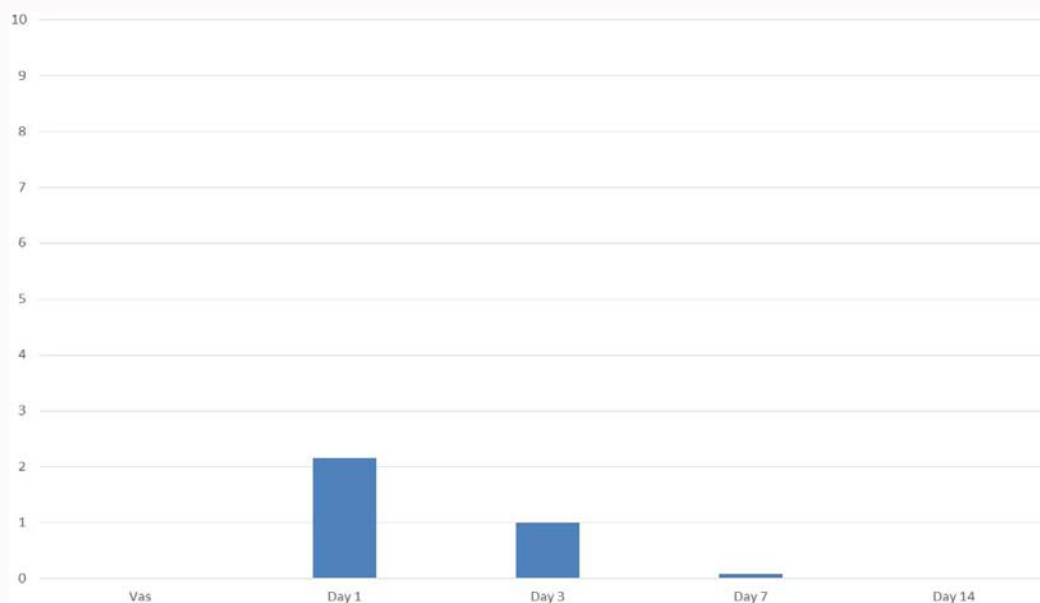
<sup>d</sup>Significant difference (p=0.0041) between (GR reduction baseline) and (GR reduction 6 months)

<sup>e</sup>Significant difference (p=0.0269) between (KTT baseline) and (KTT 3 months)

<sup>f</sup>Significant difference (p=0.0071) between (KTT baseline) and (KTT 6 months)

<sup>g</sup>Significant difference (p=0.0250) between (KTW baseline) and (KTW 3 months)

<sup>h</sup>Significant difference (p=0.0041) between (KTW baseline) and (KTW 6 months)

**Figure 2:** VAS scale levels during different observation periods.

and pinhole surgical technique introduced by Chao in 2012 are the limited reflection of soft tissue to be restricted only on tissues apical to the recession and the maintenance of the junctional epithelial seal with no intrasulcular incision. These makes such approach much more conservative maintaining maximum soft tissue support and graft protection [24].

The present case series was performed as an open-label non-controlled trial since introducing a novel approach require firstly proving its validity and potential before comparing the procedure with other techniques or control groups. Root surfaces were treated by 24% EDTA for 2 min in order to remove smear layer and expose root collagen. Evidence suggested that root surface demineralization enhanced the exposure of collagen fibrils of the cementum or dentin, and allowed integration of these fibrils with those in the covering gingival connective tissue, thus help in the formation of a new

fibrous attachment [25-29]. Otero-Cagide et al. [30] claimed that conditioning the cementum surface with tetracycline hydrochloride solution or citric acid might enhance creeping attachment. Apical horizontal incision was decided to be placed at the mesial or distal recession margin in order to avoid apical traction of the coronally displaced gingival tissue during suturing and to maintain collagen support within the tunnel. No coronal suturing was used since the blind tunnel is already biologically sealed coronally with the undetached junctional epithelium. Collagen fragments are used in order to avoid second surgery of getting connective tissue graft [9]. Every effort was made during surgery to avoid junctional epithelial detachment or collagen overpressure. Increases in pressure was reported to significantly suppressed the growth of epithelial cells [31].

The 6-month evaluation of these cases showed that GCT is able to promote a significant reduction in gingival recession and

improving CAL, KTW and KTT. The resultant clinical data appeared nearly comparable to many other studies used connective tissue graft and coronally advanced flap. Trombelli et al. [32] reported (81% Recession Coverage (RC) and 56.1% Attachment Gain (AG), Jepsen et al. [33] (91.1% RC and 62.1% AG), Zucchelli et al. [34] (93.5% RC and 69.1% AG), and Paolantonio et al. [35] (90% RC and 72% AG). This improvement could be attributed to maintenance of the coronal position of the dentogingival complex by the collagen filled blind tunnel. This could be also associated with enhanced creeping of the junctional epithelium coronally and apically by the combined action of EDTA biomodulated root surface and space created by reflected gingival connective tissue underneath the junctional epithelium. Migration of the junctional epithelium was reported to stop proliferation when it reaches connective tissue [36]. Reflecting gingival connective tissues underlying junctional epithelium could temporarily create space for the junctional epithelium to proliferate apically. This apical migration together with the epithelial coronal creeping supposed to maintain the coronal level of the repositioned gingival tissues.

Guided epithelial creeping could also biologically explained by Contact Inhibition of Proliferation (CIP), which is the ability of cells to stop proliferation once the tissue reaches confluence and cell establish cell to cell contact (sensing pressure increase) which is the main mechanism of proliferation control [37-41]. Reflecting gingival fibers beneath junctional epithelium create a space with subsequent pressure reduction that allow for rapid epithelial proliferation until it meets attached connective tissue to reestablish pressure increase and confluence with cell to cell contact inhibition. In addition, the contractile nature of fibroblasts claimed to induce coronal migration of the attachment apparatus (creeping). The fibroblasts contain intracellular microfilaments that give these cells some characteristics of smooth muscular fiber [42]. The movement of fibroblasts in the periodontium was reported to takes part in rats tooth eruption [43]. Another reported explanation is the possibility of an "over healing" process, that is, denuded surface is progressively hosted by proliferating cells of newly formed gingival tissue [44]. The resultant improvement of the keratinized tissue thickness following GCT could add positively in enhancing coronal creeping migration and maintenance of the gingival coronal position. Enhancing the gingival phenotype by collagen augmentation was reported to improve peripheral blood supply creating a more favorable environment for the creeping of gingival tissue [45]. Harris [17] treated 155 recession defects with a connective tissue graft and found that creeping attachment happened in 21 out of 22 defects. He reported that, although the amount of additional root coverage obtained was only 0.8mm, it led to full coverage of roots in 17 out of 22 defects.

Keeping soft tissue support around the minimally reflected blind tunnel and maintaining junctional epithelial adhesion could add more to the graft stability and protection. The present study passive coronal repositioning with no coronal suturing could be another explanation for the reported positive outcomes. The non-passive flap coronal positioning reported to cause marginal recession, shrinkage of the flap, or loss of epithelial connective tissue integrity at the flap margin [46]. Keeping junctional epithelial attachment could provide a biologic seal over grafted material and may also add to the rapid epithelial colonization of the exposed parts of the root surface owing to its reported high turnover rate [47,48]. Junctional epithelium has a simple extracellular matrix of internal basal lamina against the tooth surface [49]. The internal basal lamina does not contain any

basement membrane-forming proteins like laminin 111, laminin 511, type IV and VII collagens, and perlecan [50]. The main cell adhesion protein identified in the internal basal lamina is only laminin 332 [51,52]. This weak adhesion may explain the possibility of junctional epithelial gliding over the root surface without detachment during guided creeping technique. Guided creeping technique in the present study applied only for recession defects  $\leq 3$  mm, more recession depth may not allow for maintenance of the junctional epithelial adherence. Clinically we observed that in recession of  $>3$  mm the junctional epithelial seal detached gradually from the root surface.

## Conclusion

Within the limitations of the present study, it may be concluded that, guided creeping technique is a simple, effective, patient friendly, minimally invasive treatment option for root coverage and improvement of esthetic condition when used to treat single limited GRs. The use of this technique with CTG or other graft alternatives and its comparison with the gold standard coronally advanced flap and connective tissue graft is required. Longer observation periods are desirable to assess the stability of the results achieved by the employed techniques. Histologic evaluation for the mode of healing and dynamics of the junctional epithelial cell coronal or apical creeping following this procedure is also required.

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