Comparison of two techniques in gingival recession treatment: A randomized one-year clinical follow-up study

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Abstract

Background. Gingival recession (GR) is highly prevalent in the general population and represents a significant concern for patients and clinicians. Various surgical techniques have been proposed to treat gingival recession. Well-designed trials with clinician- and patient-based parameters, evaluating the envelope connective tissue graft (E-CTG) and semilunar coronally advanced flap (SCAF) techniques are still needed.

Objectives. The aim of this trial was to compare the effectiveness of E-CTG and SCAF in the treatment of GR during a 1-year follow-up.

Material and methods. A total of 42 patients with GR were treated with E-CTG ($n = 20$) or SCAF ($n = 22$). Clinician-based recordings of recession depth (RD), recession width (RW), probing depth (PD), clinical attachment level (CAL), keratinized tissue width (KTW), tissue thickness (TT), clinical attachment gain (CAG), root coverage (RC), keratinized tissue change (KTC), and wound healing index (WHI), as well as patient-based parameters of dentine hypersensitivity (DH), tissue appearance, patient expectations, and esthetics were collected at baseline (BL), 6 weeks (T_1), 6 months (T_2), and 1 year (T_3).

Results. After the treatment, E-CTG demonstrated better outcomes than SCAF in terms of CAG (50.70% vs. 33.33%), RC (85.60% vs. 35.60%) and KTC (1.70 ±1.49 mm vs. 0.36 ±0.96 mm) at T_3. Similar findings were detected in terms of WHI, tissue appearance, patient expectations, and esthetics. Although unpleasant surgical experience was recorded, better results were obtained after E-CTG in terms of DH and meeting the RC expectations.

Conclusions. Despite it being more uncomfortable surgical experience and the risk of keloid formation, E-CTG was superior to SCAF in terms of RC percentage, reducing DH and obtaining satisfactory RC. However, it is still necessary to improve patient comfort in the case of E-CTG.

Keywords: gingival recession, connective tissue, treatment outcomes, esthetics, patient-reported outcomes

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Introduction

A patient is considered a candidate for surgical gingival recession (GR) treatment when at least one of the following criteria is met: persistent gingival inflammation; progressive GR; or progressive attachment loss, following phase I periodontal therapy, or in case of planned orthodontic/restorative interventions.[1] In such cases, after the decision-making process, GR can be treated with various surgical techniques, including pedicle flaps, soft tissue grafts, guided tissue regeneration, and tissue substitutes, and their combinations.[2,3]

Connective tissue graft (CTG) is a predictable method with promising esthetic outcomes in GR treatment and is defined as the gold standard protocol for this purpose.[3,4] From among its overlying flap modifications, the envelope technique (E-CTG) consists in 2 horizontal incisions and the elevation of the split-thickness flap by undermining from the apical portion of GR. Envelope CTG is preferred in the treatment of shallow GR owing to its high gingival margin (GM) stability and less flap advancement needed.[5] This technique also has a high clinical success rate varying from 88.3% to 96.8% of root coverage (RC).[6–8] Besides its advantages, including the lack of vertical incisions and the preservation of the adjacent papillae, technical difficulties and the surgical impact on 2 different regions still make clinicians explore further alternatives.

From among the RC techniques, semilunar coronally advanced flap (SCAF), described by Tarnow,[9] consists in positioning the flap coronally by means of sulcular and horizontal apical incisions without disturbing the integration of the adjacent papillae. Moreover, the vestibule depth and the color match of the tissues can be maintained.[10] The RC% success of SCAF exhibits a wide range (41.8–90.1%).[6,7,11,12] Bittencourt et al. compared SCAF with E-CTG and both modalities exhibited successful RC% (89.3% vs. 96.3%), while E-CTG represented better patient-based outcomes in the treatment of GR as compared to SCAF.[7] Although SCAF is a practical procedure with a similar indication as in the case of E-CTG, only one study group compared the clinical outcomes obtained with SCAF and E-CTG in 2 relevant papers.[6,7] Taking this into account, further well-designed trials evaluating these 2 techniques by using clinician- and patient-based parameters are still required. Thus, the present study aimed to compare the E-CTG and SCAF techniques in Miller Class I GR treatment.

Material and methods

Study design

The present single-center, parallel-group clinical study, registered at https://www.clinicaltrials.gov/ (NCT04109794), was designed as a prospective, comparative, randomized, and single-blinded study. It was conducted between December 2012 and May 2014 with the permission of the Institutional Review Board at Kirikkale University, Turkey (protocol No. 12/12-3 of November, 12, 2012).

Individuals and randomization

From among 120 patients, 42 patients (37 females and 5 males), aged 20–54 years, with single Miller Class I GR defects ≤3 mm at their upper anterior or premolar teeth were chosen by considering the following inclusion criteria: systemically healthy patients; age >18 years; identifiable cemento-enamel junction (CEJ); and probing depth (PD) ≤3 mm. The exclusion criteria were as follows: periodontal surgery experience in the past 2 years; excessive contacts, mobility, caries, or a restoration in the relevant tooth; the loss of tooth vitality; smoking; and pregnancy. Written informed consent forms were completed by the individuals and necessary treatment was provided according to the current standards of health care. One investigator randomly assigned the patients, with a 1:1 allocation ratio, to the E-CTG and SCAF groups by using simple randomization without blocking (a computer-generated randomization scheme) (Fig. 1).

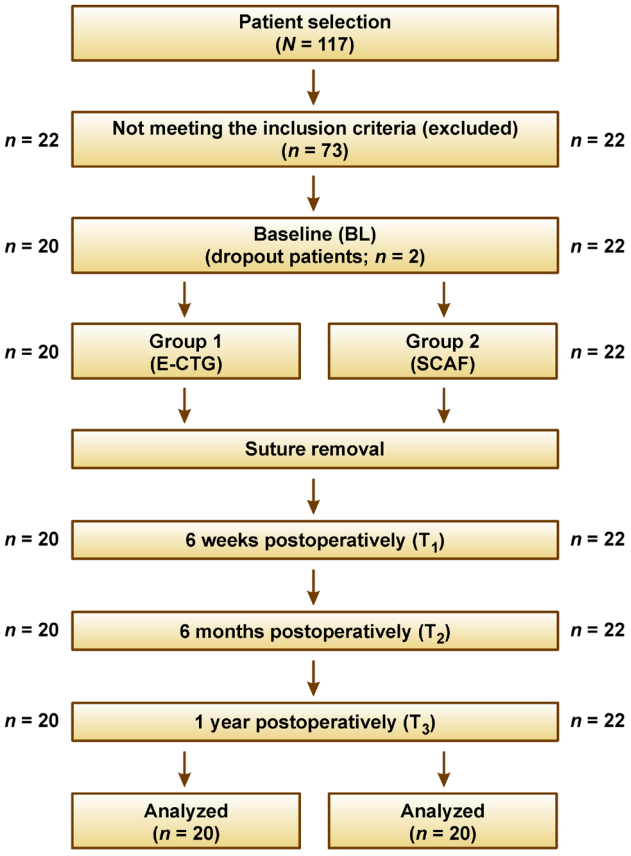

Fig. 1. Flow chart of the study

E-CTG – envelope connective tissue graft; SCAF – semilunar coronally advanced flap.

Allocation concealment and calibration

Number-labeled opaque envelopes that contained the name of the assigned method were used for concealing the allocation. A 90.7% (a coefficient value of 0.91) calibration level was achieved after measuring the distance from CEJ to GM, i.e., recession depth (RD), 3 times.

Phase I therapy

Personalized oral hygiene instructions focusing on the proper tooth brushing techniques (the roll technique directing to the coronal aspect of GR) were provided. A rubber cup with a non-abrading paste was used for professional prophylaxis, and if necessary, occlusal adjustments and/or bite guards were completed and delivered. The patients were not transferred to the surgical phase of the study until they achieved adequate hygiene and gingival health (the full-mouth plaque and bleeding scores <15%).[13]

Clinician-based variables

Periodontal variables

Another author blinded to the type of intervention measured the clinical variables at the mid-buccal locations of the treated teeth at baseline (BL), 6 weeks (T_1), 6 months (T_2), and 1 year (T_3) following the interventions by using a Michigan-O periodontal probe (Hu-Friedy, Chicago, USA), and the measurements were justified to the nearest 0.1 mm with a caliper (Kohdent Roland Kohler Medizintechnik, Stockach, Germany). The following variables were evaluated: gingival index (GI)[14]; plaque index (PI)[15]; RD as the distance between CEJ and GM; recession width (RW) as the horizontal distance between 2 recession borders at the CEJ level; PD as the distance between GM and the base of the gingival sulcus; clinical attachment level (CAL) as the distance between CEJ and the base of the gingival sulcus; and keratinized tissue width (KTW) as the distance between GM and the mucogingival junction (MGJ). Tissue thickness (TT) was measured after sticking a spreader (Technical & General Ltd., London, UK) into the gingiva 1.5 mm below GM, and then adjusting its silicon stopper.[16] Changes in the variables of RD, CAL and KTW were calculated to determine the clinical attachment gain (CAG), RC and keratinized tissue change (KTC) values. The number and proportion of defects, showing complete RC (CRC) were also calculated. Recession depth was the primary outcome measure, while the secondary variables included CAL, KTW and TT.

Wound healing index (WHI)[17]

The wound healing index was recorded 2 weeks after the surgery. The wound surface was visually inspected and the soft tissue healing was defined as 'uneventful' (score 1), 'slightly disturbed' (score 2) or 'poor' (score 3) based on the presence and severity of the following items: patient discomfort; erythema; edema; suppuration; and flap dehiscence.

Patient-based variables

Dentine hypersensitivity (DH)[18]

The evaporative air stimulus method was utilized at BL and T_2. After the placement of finger(s) for protecting the nearby teeth, the GR sites were subjected to an evaporative stimulus, which comprised a 1-second air blast from a distance of 1–3 mm by using an air spray of a pressure of 40–65 psi and a temperature of 19 ±5°C. After application, the individuals were requested to give a score of their DH between 0 (no pain) and 10 (extreme pain).

Tissue appearance[19]

The patients were asked to score the consistency, contour, color match, keloid formation degree, and contiguity of their treated sites at T_2. The scores were collected as points shown in parentheses. Consistency was assessed as firm (1 pt) or spongy (0 pt); contour as the presence (2 pt) or absence (0 pt) of knife-edged and scalloped GM; color match as excellent (3 pt), good (2 pt), adequate (1 pt), or unsatisfactory (0 pt); keloid formation degree as absent (1 pt) or present (0 pt); and contiguity as the presence (–1 pt) or absence (0 pt) of each perceptible incision mark.

Patient expectations[19]

The patients were requested to rate their treatment results at T_2 according to their expectations as satisfactory or not in terms of appearance, experience and the obtained RC.

Esthetics[19]

The level of esthetics was evaluated as excellent, good, fair, or poor.

Surgical interventions

The interventions were performed by one of the researchers, and are shown in Fig. 2 and Fig. 3. Before the surgery, a chlorhexidine gluconate mouth rinse (0.2%) (Klorhex®; Drogsan İlaçları, Ankara, Turkey) was given for intra-oral antisepsis. Articaine hydrochloride with epinephrine (1:100,000) (Ultracaine® D-S forte; Hoechst Marion Roussel, Frankfurt, Germany) was used to obtain anesthesia at the surgical region. Root planing was performed with hand instruments (Gracey curettes; Hu-Friedy), and if necessary, root convexity was eliminated by using fine-grain finishing burs (Hager & Meisinger, Düsseldorf, Germany). After planing and shaping, the surface was irrigated with sterile saline.

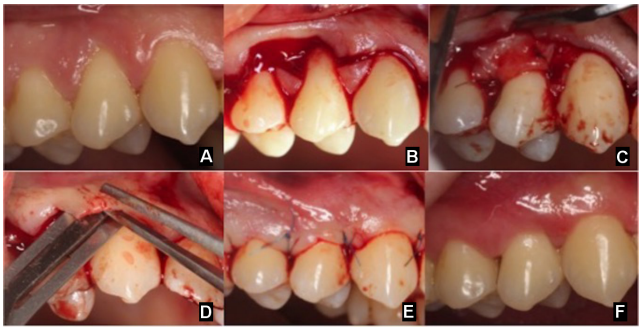

Fig. 2. Surgical interventions in the envelope connective tissue graft (E-CTG) group

A – preoperative clinical view; B – envelope incisions; C – flap elevation and CTG fixation; D – release of flap tension; E –wound closure; F – 1-year follow-up.

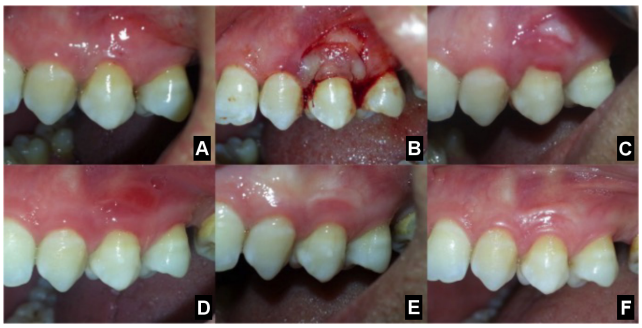

Fig. 3. Surgical interventions in the semilunar coronally advanced flap (SCAF) group

A – preoperative clinical view; B – postoperative clinical view; C – 10-day follow-up; D – 6-week follow-up; E – 6-month follow-up; F – 1-year follow-up.

E-CTG group[6]

Horizontal incisions were made from the base of the adjacent papilla triangles and connected with a sulcular incision extending to the MGJ level by uniformly undermining as split-thickness elevation. Connective tissue graft was taken from the premolar-molar region of the lateral palate with the use of the single-incision technique,[20] placed under the prepared envelope flap, secured with sling sutures (Ruschmed; İpek Plastik, Istanbul, Turkey), and covered by the positioning flap margin at CEJ with proximal sutures (Dogsan Tibbi Malzeme San, Trabzon, Turkey). The donor site was closed with continuous sutures (Dogsan Tibbi Malzeme San) (Fig. 2).

SCAF group[9]

A mesiodistally directed, curved incision, following the GM outline was made from the apical part of MGJ, sufficiently apical to place the apical end of the flap onto the alveolar bone, and was finished at least 2 mm under the tips of the adjacent papillae. The 2nd incision was started as a sulcular incision, continued as split-thickness dissection and finished by connecting it to the 1st incision. Then, the coronal margin of the elevated tissue was positioned at CEJ by gently sliding with wet gauze pressure. Care was taken to create an adequate amount of flap height in order to preserve blood supply. The flap was secured to the cervical region of the tooth with a sling suture (Ruschmed; İpek Plastik) for additional stabilization (Fig. 3).

Postsurgical period

For reducing pain and edema, extra-oral cold compress and analgesic anti-inflammatory medicines (Ibuprofen 100 mg; Sanovel Ilac, Istanbul, Turkey) were given. Oral hygiene activities were paused for 4 weeks, and a mouth rinse (0.2% chlorhexidine gluconate, Klorhex; Drogsan İlaçları) was prescribed instead. The patients were warned to watch out for traction or excessive trauma. The sutures were removed 2 weeks after the surgery, and the patients had recall appointments consisting of professional plaque control and hygiene instructions once a month.

Sample size calculation and statistical analysis

The sample size was determined by means of the NCSS PASS software, v. 11.0.8, assuming $\alpha = 0.05$, with the two-sided t test. Accordingly, 22 patients per group achieved a power of 81% to detect a difference of 0.6 ±0.7 mm in RD.[12]

The IBM SPSS Statistics for Windows software, v. 21.0 (IBM Corp., Armonk, USA), was used for statistical analysis and the significance level was set at $p < 0.05$. Quantitative variables were expressed as the mean and standard deviation ($M \pm SD$), and median and minimum–maximum (Me (min–max)) values. For nominal data, frequency and percentage (n (%)) were provided. The Shapiro–Wilk test was used to check the normality assumption. Nonparametric statistical tests were used, as the data did not conform to normal distribution. The intergroup comparisons of quantitative variables were made using the Mann–Whitney U test, whereas the Friedman test was used for repeated measures analysis. The distribution of qualitative variables among the study groups was analyzed with the Fisher–Freeman–Halton test and the χ^2 test.

To detect a difference of 0.6 mm with regard to the null hypothesis, the group sample sizes of 20 and 22 achieved a post hoc power of 59%. With a 0.05 significance level, using the two-sided two-sample t test and the Mann–Whitney U test, and assuming that the actual distribution was uniform, the mean difference in both groups was 1.3 mm; the alternative hypothesis was that the mean difference in the SCAF group would be 0.8 mm with the SD values of 0.9 mm and 0.8 mm for the E-CTG and SCAF groups, respectively.

Results

A satisfactory level of plaque control and satisfactory bleeding scores were obtained after phase I therapy. Two individuals from the E-CTG group did not attend

Table 1. Demographic information and the distribution of the recession sites

Variable		E-CTG (n = 20)	SCAF (n = 22)	Total (N = 42)	p-value
Age [years]	*M* ±*SD*	35.00 ±10.45	37.32 ±9.99	36.21 ±10.15	0.384
	Me (min–max)	34.0 (20–54)	35.5 (20–54)	34.5 (20–54)	
Gender *n* (%)	male	4 (20.0)	1 (4.5)	5 (11.9)	0.174
	female	16 (80.0)	21 (95.5)	37 (88.1)	
Tooth *n* (%)	incisor	4 (20.0)	3 (13.6)	7 (16.7)	0.692
	canine	2 (10.0)	6 (27.3)	8 (19.0)	
	premolar	14 (70.0)	13 (59.1)	27 (64.3)	

M – mean; *SD* – standard deviation; *Me* – median; min – minimum; max – maximum.

the intervention stage and the study was completed with 42 patients (Fig. 1). The trial ended after 1 year of patient follow-up. Demographics and GR site distribution (7 incisors, 8 canines and 27 premolars) are presented in Table 1. The mean age of the individuals was 36.21 ±10.15 years, and no intergroup difference was detected in terms of age or gender.

Clinician-based variables (Tables 2, 3)

Gingival index (GI)

In the beginning, the mean GI value was almost the same for both groups ($p > 0.05$) and after the surgery, a slight reduction was noticed. During the follow-up,

Table 2. Clinician-based variables

Variable	Time of assessment	E-CTG (n = 20)		SCAF (n = 22)		p-value
		M ±*SD*	*Me* (min–max)	*M* ±*SD*	*Me* (min–max)	
GI	BL	0.55 ±0.61	0.5 (0–2.0)	0.55 ±0.67	0 (0–2.0)	0.887
	T_1	0.35 ±0.49	0 (0–1.0)	0.43 ±0.50	0 (0–1.0)	0.567
	T_2	0.50 ±0.69	0 (0–2.0)	0.18 ±0.39	0 (0–1.0)	0.097
	T_3	0.40 ±0.50	0 (0–1.0)	0.09 ±0.29*	0 (0–1.0)	0.020‡
PI	BL	0.40 ±0.75	0 (0–3.0)	0.45 ±0.60	0 (0–2.0)	0.509
	T_1	0.15 ±0.37	0 (0–1.0)	0.36 ±0.49	0 (0–1.0)	0.120
	T_2	0.45 ±0.69	0 (0–2.0)	0.23 ±0.43	0 (0–1.0)	0.307
	T_3	0.45 ±0.60	0 (0–2.0)	0.14 ±0.35	0 (0–1.0)	0.050
RD [mm]	BL	1.54 ±0.91	1.8 (0.1–3.0)	1.58 ±0.96	1.5 (0.1–4.0)	0.948
	T_1	0.50 ±0.88**	0.3 (0–4.0)	1.33 ±1.00	1.3 (0–3.5)	0.001‡
	T_2	0.44 ±0.68**	0.3 (0–3.0)	1.07 ±0.92*	1.0 (0–3.5)	0.009‡
	T_3	0.21 ±0.48**	0 (0–2.0)	0.82 ±0.97**,†	0.5 (0–3.0)	0.074
RW [mm]	BL	2.89 ±1.43	3 (0.4–6.0)	2.89 ±1.69	3.0 (0.3–6.0)	0.758
	T_1	0.77 ±0.81**	0.6 (0–3.0)	1.96 ±1.48*	2.0 (0–5.0)	0.004‡
	T_2	0.72 ±0.78**	0.5 (0–2.5)	1.64 ±1.37*	1.5 (0–4.5)	0.027‡
	T_3	0.32 ±0.52**	0 (0–1.7)	1.11 ±1.29**	1.0 (0–4.0)	0.090
PD [mm]	BL	1.40 ±0.60	1.0 (1.0–3.0)	1.31 ±0.48	1.0 (1.0–2.0)	0.747
	T_1	1.20 ±0.41	1.0 (1.0–2.0)	1.22 ±0.43	1.0 (1.0–2.0)	0.832
	T_2	1.15 ±0.37	1.0 (1.0–2.0)	1.14 ±0.35	1.0 (1.0–2.0)	0.901
	T_3	1.05 ±0.22	1.0 (1.0–2.0)	1.13 ±0.35	1.0 (1.0–2.0)	0.347
CAL [mm]	BL	2.94 ±1.13	3.0 (1.1–5.0)	2.90 ±1.19	3.0 (1.1–6.0)	0.719
	T_1	1.70 ±1.10	1.5 (1.0–6.0)	2.56 ±1.15	2.5 (1.0–5.5)	0.004‡
	T_2	1.59 ±0.96*	1.3 (1.0–5.0)	2.20 ±1.09	2.0 (1.0–5.5)	0.021‡
	T_3	1.26 ±0.68**,†	1.0 (1.0–4.0)	1.95 ±1.01	1.5 (1.0–4.0)	0.042‡
KTW [mm]	BL	3.35 ±1.93	2.3 (1.5–8.0)	4.27 ±1.02	4.0 (2.0–7.0)	0.021‡
	T_1	4.93 ±1.56*	5.0 (3.0–9.0)	4.34 ±1.13	4.0 (2.5–7.0)	0.255
	T_2	4.95 ±1.36*	5.0 (3.0–8.0)	4.55 ±1.14	5.0 (2.0–6.0)	0.414
	T_3	5.05 ±1.23**	5.0 (3.0–8.0)	4.64 ±1.09	5.0 (2.0–6.0)	0.327
TT [mm]	BL	1.08 ±0.37	1.0 (0.5–1.5)	1.07 ±0.44	1.0 (0.5–2.0)	0.776
	T_1	1.83 ±0.29**	2.0 (1.0–2.0)	1.45 ±0.41*	1.5 (1.0–2.5)	0.001‡
	T_2	1.83 ±0.37**	2.0 (1.0–2.5)	1.52 ±0.39*	1.5 (1.0–2.0)	0.021‡
	T_3	1.88 ±0.39**	2.0 (1.5–2.5)	1.59 ±0.40**	1.5 (1.0–2.0)	0.054
WHI	2 weeks	1.65 ±0.67	2.0 (1.0–3.0)	1.95 ±0.89	2.0 (1.0–3.0)	0.280

GI – gingival index; PI – plaque index; RD – recession depth; RW – recession width; PD – probing depth; CAL – clinical attachment level; KTW – keratinized tissue width; TT – tissue thickness; WHI – wound healing index; BL – baseline; T_1 – 6 weeks postoperatively; T_2 – 6 months postoperatively; T_3 – 1 year postoperatively; * significantly different as compared to BL ($p < 0.05$); ** significantly different as compared to BL ($p < 0.001$); † significantly different as compared to T_1 ($p < 0.05$); ‡ significantly different between the groups.

Table 3. Clinical attachment gain (CAG), root coverage (RC) and keratinized tissue change (KTC) values

Variable	Time of assessment	E-CTG (n = 20)				SCAF (n = 22)				p-value	p-value (%)
		M ±*SD*	*Me* (min–max)	*M* ±*SD* (%)	*Me* (min–max) (%)	*M* ±*SD*	*Me* (min–max)	*M* ±*SD* (%)	*Me* (min–max) (%)		
CAG [mm]	T_1	1.19 ±1.30	1.05 (−3.0–2.8)	37.10 ±36.53	50.00 (−100.0–70.0)	0.34 ±0.80	0.50 (−2.0–2.0)	7.99 ±32.59	12.50 (−100.0–66.7)	0.001‡	<0.001‡
	T_2	1.30 ±1.31	1.05 (−2.0–3.5)	39.10 ±35.21	50.00 (−66.7–75.0)	0.69 ±0.97	0.50 (−1.5–2.5)	18.30 ±34.30	20.83 (−75.0–71.4)	0.065	0.020‡
	T_3	1.63 ±1.17	1.75 (−1.0–3.5)	50.70 ±28.01	57.50 (−33.3–75.0)	0.94 ±1.10	1.00 (−1.5–2.5)	26.41 ±39.36	33.33 (−75.0–71.4)	0.064	0.014‡
RC [mm]	T_1	1.04 ±1.07	1.00 (−2.0–2.8)	73.30 ±45.14	85.00 (−100.0–100.0)	0.25 ±0.75	0.50 (−2.0–2.0)	8.22 ±66.97	22.50 (−200.0–100.0)	0.001‡	<0.001‡
	T_2	1.10 ±0.93	1.00 (−1.0–2.9)	72.00 ±38.42	80.00 (−50.0–100.0)	0.50 ±0.77	0.50 (−1.5–2.0)	11.78 ±88.60	25.00 (−300.0–100.0)	0.030‡	0.001‡
	T_3	1.33 ±0.86	1.25 (0–2.9)	85.60 ±30.47	100.00 (0–100.0)	0.76 ±0.82	1.00 (−1.5–2.0)	35.60 ±113.91	77.50 (−400.0–100.0)	0.060	0.111
KTC [mm]	T_1	1.57 ±1.19	1.25 (1.0–4.0)	71.80 ±67.53	50.00 (16.7–233.3)	0.07 ±0.80	0 (−1.0–1.5)	3.13 ±19.37	0 (−33.3–33.3)	<0.001‡	<0.001‡
	T_2	1.60 ±1.30	1.25 (1.0–4.0)	75.10 ±71.27	55.00 (16.7–233.3)	0.27 ±0.99	0.50 (−2.0–2.0)	8.31 ±22.85	10.00 (−40.0–50.0)	0.002‡	<0.001‡
	T_3	1.70 ±1.49	1.75 (1.0–4.5)	82.70 ±82.14	63.30 (16.7–300.0)	0.36 ±0.96	0.25 (−2.0–2.0)	10.56 ±22.38	5.55 (−40.0–50.0)	0.003‡	0.001‡
CRC *n* (%)	T_1	7 (35.00)				2 (9.09)				0.041‡	
	T_2	6 (30.00)				2 (9.09)				0.084	
	T_3	12 (60.00)				10 (45.45)				0.345	

CRC – complete root coverage; ‡ statistically significant.

the reduction of GI continued in the SCAF group, and reached a statistically significant intra- (p = 0.047) and intergroup difference (p = 0.020) at T_3, also with the effect of a slight but not statistically significant rise in the E-CTG patients.

Plaque index (PI)

At BL, the PI values were 0.40 ±0.75 and 0.45 ±0.60 for the E-CTG and SCAF groups, respectively (p > 0.05). After the surgery, although not significantly, PI showed a reduction until T_1, and then turned back to its BL level in the E-CTG group. In the SCAF group, it showed a regular but not statistically significant reduction tendency, and did not reach a statistically significant difference as compared to the E-CTG group.

Recession depth (RD) and recession width (RW)

At BL, the RD and RW values were similar for both groups (p > 0.05). Although SCAF showed its effect later (T_3), both treatment modalities provided a statistically significant RD and RW reduction (p < 0.001). According to the intergroup comparison, the mean postsurgical RD and RW values were lower in the E-CTG group, and the differences were statistically significant at T_1 and T_2 (p < 0.05).

Probing depth (PD)

Probing depth did not show any time-dependent or intergroup differences during the study period (p > 0.05).

Clinical attachment level (CAL)

While the CAL values for both groups were similar at BL (p > 0.05), the E-CTG group demonstrated a higher CAL reduction after the surgery and the difference was maintained until the end of the follow-up period (p < 0.05).

Keratinized tissue width (KTW)

In the beginning, the SCAF group exhibited a higher mean KTW value (p = 0.021). After the treatment, an increase in KTW was detected only in the E-CTG group (p < 0.05) and the intergroup comparison of the KTW values showed statistical similarity at all follow-up visits (p > 0.05).

Tissue thickness (TT)

At BL, the number of individuals having TT ≥ 1 mm was 16 for the E-CTG group and 17 for the SCAF group. The mean TT values were similar at BL (p > 0.05) and increased after both surgery types (p < 0.05). However,

the increase was higher in the E-CTG group, and reached a statistically significant difference as compared to the SCAF group at T_1 and T_2 ($p < 0.05$).

Clinical attachment gain (CAG)

The millimetric values for CAG demonstrated an intergroup difference only at T_1 ($p = 0.001$), whereas CAG% was significantly higher in the E-CTG group at all follow-up visits ($p < 0.05$). At T_3, CAG was 50.70% and 33.33% in the E-CTG and SCAF groups, respectively.

Root coverage (RC)

Higher RC was detected in the E-CTG group at T_1 ($p < 0.001$) and T_2 ($p < 0.05$). At T_3, the E-CTG and SCAF groups showed mean RC values of 1.33 ±0.86 (85.60%) and 0.76 ±0.82 (35.60%), respectively, but the difference was not statistically significant. While the difference in the number of defects, showing CRC reached statistical significance at T_1 ($p = 0.041$), the differences between the groups at T_2 ($p = 0.084$) and T_3 ($p = 0.345$) were not statistically significant. Complete RC was 12/20 (60.00%) and 10/22 (45.45%) for the E-CTG and SCAF groups, respectively.

Keratinized tissue change (KTC)

While the mean KTC was 1.70 ±1.49 mm in the E-CTG, it was calculated as 0.36 ±0.96 mm in the SCAF group at T_3. Keratinized tissue change was statistically significantly higher for E-CTG at all measurement times ($p < 0.05$).

Wound healing index (WHI)

The mean WHI values were 1.65 ±0.67 and 1.95 ±0.89 in the E-CTG and SCAF groups, respectively, and the intergroup difference was not statistically significant.

Patient-based variables (Table 4)

Dentin hypersensitivity (DH)

In the beginning, DH was similar for both groups. After the treatment, a significant reduction in DH was noted for both groups ($p < 0.001$), whereas the E-CTG group showed a higher decrease ($p = 0.008$), demonstrating an analogy with the RC outcomes.

Tissue appearance

Except for keloid formation degree, none of the parameters related to tissue appearance showed a remarkable intergroup difference ($p > 0.05$). According to the analysis, the SCAF group revealed more keloid formation as compared to the E-CTG group ($p = 0.028$).

Patient expectations

Regarding their comments about the treatment results, the patients treated with SCAF perceived their surgical experience as better ($p = 0.006$), whereas the E-CTG patients were happier with their obtained RC outcomes ($p = 0.012$). However, both modalities created similar comments about tissue appearance ($p > 0.05$).

Table 4. Patient-based variables

Variable		Time of assessment	E-CTG ($n = 20$)	SCAF ($n = 22$)	Total ($N = 42$)	*p*-value
DH *M ±SD*		BL	6.20 ±1.79	5.54 ±1.59	5.85 ±1.70	0.133
		T_2	0.30 ±1.12	2.50 ±3.37	1.45 ±2.76	0.008‡
p-value			<0.001	<0.001	<0.001	–
Tissue appearance *M ±SD*	consistency	T_2	0.75 ±0.44	0.50 ±0.52	0.62 ±0.49	0.100
	contour		0.70 ±0.97	1.09 ±1.01	0.90 ±1.00	0.209
	color match		1.20 ±0.89	1.22 ±1.02	1.21 ±0.95	0.979
	keloid formation degree		0.75 ±0.44	0.40 ±0.50	0.57 ±0.50	0.028‡
	contiguity		–0.55 ±0.51	–0.45 ±0.51	–0.50 ±0.51	0.542
Patient expectations *M ±SD*	appearance	T_2	0.75 ±0.44	0.50 ±0.51	0.62 ±0.49	0.100
	experience		0.30 ±0.47	0.72 ±0.45	0.52 ±0.51	0.006‡
	obtained RC		0.90 ±0.30	0.54 ±0.51	0.71 ±0.46	0.012‡
Esthetics *n* (%)	excellent	T_2	15 (75.0)	13 (59.1)	28 (66.7)	0.500
	good		5 (25.0)	6 (27.3)	11 (26.2)	
	fair		0	2 (9.1)	2 (4.8)	
	poor		0	1 (4.5)	1 (2.4)	

DH – dentin hypersensitivity; ‡ statistically significant.

Esthetics

At T_2, no difference was detected regarding the patient-based esthetic evaluation ($p > 0.05$) and the esthetics values were predominantly assembled around the 'excellent' (66.7%) and 'good' (26.2%) levels.

Discussion

The study aimed to compare E-CTG and SCAF in Miller Class I GR treatment, and both modalities showed successful clinical outcomes. While E-CTG provided better clinician-based results with regard to CAG, RC and KTC, and patient-based results in terms of DH and keloid formation, SCAF caused less postsurgical discomfort. In the present study, the E-CTG group had a mean RC of 85.60% and this value is consistent with the results of the clinical studies regarding E-CTG (88.3–96.8%).[6,7,8] On the other hand, the SCAF group resulted in 35.60 RC% at 1 year. This result is slightly inferior to the lower limit of the RC% range (41.8–90.1%) in the randomized clinical trials (RCTs) which reported the short-term success rate of SCAF by comparing it with coronally advanced flap (CAF), CTG or SCAF + ethylenediaminetetraacetic acid (EDTA).[6,7,11,12] The relevant literature and the present results revealed that SCAF was a less predictable RC method in comparison with E-CTG.

At BL, in spite of randomization, the SCAF group showed a higher mean KTW as compared to E-CTG and this should be considered a limitation that might have masked the actual effects of the techniques. At T_3, E-CTG provided greater KTC and this result seems conceivable due to the well-known clinical influence of CTG on a KTC increase, associated with the biological concept of the characteristics of the surface epithelium determined by the information residing in the connective tissue.[21] The present results showing a tendency for higher TT enhancement in the E-CTG patients also seem to be related to this phenomenon.

An increase in TT after CTG has been reported by various authors,[22,23] and also confirmed by the present evaluations. Although TT is a valuable determinant for GR development and CRC, the possible occurrence of excessive marginal thickening and the loss of the scalloped form should not be overlooked. In the present study, the lower scores given by the patients from the E-CTG group to their GM morphology seemed to arise from these circumstances. Aichelmann-Reidy et al., who used the same subjective tissue contour evaluation after CTG and the utilization of acellular dermal matrices, also reported similar lower values in their CTG-treated patients, possibly due to the same phenomenon.[19]

In the present study, the patients' perception of tissue appearance (consistency, contour, color match, and contiguity) as well as esthetics were similar for both groups. This result can be attributed to the meticulously applied surgical protocols and the absence of the epithelialized graft which could result in unacceptable tissue contour and esthetics. On the other hand, DH was more effectively reduced by E-CTG, with more satisfactory RC and less keloid formation. In GR studies, the main reducing factor for DH is the success rate of RC, and the higher DH reduction in the E-CTG group in the present trial seems to be related to the higher CRC%. In 2013, Douglas de Oliveira et al. surveyed the literature on the efficacy of RC techniques at reducing DH and according to the analysis, a definitive conclusion could not be made due to the inadequate number of well-conducted clinical trials; 9 articles reported DH decreases between 55.6 and 100.0, and presented DH reduction rates (95.2 and 54.9 for the E-CTG and SCAF groups, respectively) that were within this range.[24] Contrarily, the SCAF group reported a more comfortable therapeutic course as compared to the E-CTG group in terms of surgical experience, possibly due to the absence of a second surgical site and the shorter duration of SCAF.

Soft tissue handling that consists of flap design, vertical incisions, split/full-thickness elevation, flap tension, and coronal positioning is the critical factor affecting clinical outcomes.[25] There are significant differences between the 2 techniques, and thus the study could not be designed in a controlled fashion. Envelope CTG is advantageous in terms of absence of mucosal incisions and less interrupted vascularization at the apical region, while SCAF provides less flap tension and more coronal positioning. Therefore, higher RC might be anticipated in the case of E-CTG, whereas keloid formation would be more probable after SCAF. At the end of the present trial, the clinician- and patient-based variables indicated outcomes parallel with these predictions.

To date, only a few studies have evaluated the patient-based outcomes following RC procedures as an additional outcome.[22] Data is heterogeneous and its amount is still insufficient to ascertain the truth about the correspondence of these procedures to patient expectations by performing a meta-analysis.[3,26] One of the powerful aspects of this study is the presence of such parameters, including DH, tissue appearance, patient expectations, and the esthetic evaluation. The main clinical indication for the E-CTG and SCAF techniques usually resides within the RD range of 1–3 mm,[5] and this range was considered as an inclusion criterion in the present study. However, it is difficult to achieve sufficient power for detecting statistical significance within this range. Even though a caliper that makes the measurements to the nearest 0.1 mm was used to overcome this limitation, the post hoc sample size should reach a power of 59% to detect a significant difference. Moreover, most of GR studies involve the criterion of RD ≥ 2 mm owing to the probability of spontaneous RC during the follow-up.[27] Therefore, although the adopted RD range did not affect intergroup comparisons, it may

be considered a limitation of the trial in combination with the effect of a relatively small sample size, and deserves attention while comparing the results of the present study with the relevant literature.

Conclusions

Every patient desires the most successful result with the easiest therapeutic technique. Therefore, the question of 'Can SCAF be the more comfortable alternative of CTG in the treatment of GR to obtain the same satisfactory outcome?' is justified. Although both techniques were similarly effective in meeting the esthetic expectations of the patients, the results of the present study suggest that the reality that 'better RC outcomes are accompanied by comparably worse surgical experience' could not satisfy the above equation. Within the limitations of this study, the following conclusions can be made:

– E-CTG is more predictable in shallow Miller Class I GR treatment;
– although SCAF has a more comfortable therapeutic course, it is not recommended due to its low RC values;
– although E-CTG showed better results in terms of DH and meeting the RC expectations, patient comfort still needs to be improved; and
– further clinical studies comparing E-CTG and other surgical techniques are needed to support the present findings.

Trial registration

The present study was registered at https://www.clinicaltrials.gov/ under the number NCT04109794.

Ethics approval and consent to participate

The study was approved by the Institutional Review Board at Kirikkale University, Turkey (protocol No. 12/12-3 of November, 12, 2012). All participants provided written informed consent prior to the investigations.

Data availability

All data generated and/or analyzed during this study is included in this published article.

Consent for publication

Not applicable.

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