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Comparative Clinical Outcomes of Connective Tissue Graft Procedures Harvested from the Palate, Before and After Recipient Site Preparation: A Randomized Controlled Trial

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Abstract

Objectives: This study aimed to compare the root coverage outcomes of connective tissue grafts (CTG) harvested from the palate before and after recipient site preparation.

Methods: Twenty single gingival recessions type 2 (RT2) at buccal sites of single-rooted teeth, randomized into two groups: graft harvested after (control) and before (test) site preparation. Clinical parameters and patient satisfaction were assessed at baseline and at three months, with follow-ups for complications at 1 week, 2 weeks, 1 month, and 3 months.

Results: At three months, recession reduction was 2.2±1.1 mm (control) and 2.5±0.7 mm (test), with root coverage percentages of 82.0±32.0% and 90.5±30.1%, respectively. No significant differences were observed in clinical outcomes, complications, or patient satisfaction between the two approaches.

Conclusions: These findings indicate that harvesting CTG prior to recipient site preparation can serve as a clinically effective and flexible alternative, especially in situations where anatomical limitations of the palate might complicate the traditional treatment sequence.

Keywords: gingival recession, recession reduction, root coverage

Introduction

Gingival recession is a significant issue that affects about 50-100% of the population.[1-4] This condition often causes patients to experience hypersensitivity and unpleasant esthetics. Several factors contribute to gingival recession, including tooth malalignment, traumatic tooth brushing technique, occlusal trauma, irritation from orthodontic appliances, and defective restoration or prosthesis.[4-7] The root coverage procedure is an effective treatment option for addressing gingival recession. Nowadays, a combination of connective tissue graft (CTG) and coronally advanced flap (CAF) is recognized as the gold standard for treating gingival recession.[8] This technique offers excellent esthetic results and a high success rate.[8] In the CTG technique, it is customary to prepare the recipient site prior to the preparation of the donor site.[9-12] This approach is grounded in the principle of minimizing the duration that the CTG is exposed to the external environment, as prolonged exposure may compromise the viability of the graft.[12-14]

The most frequent harvesting area is the hard palate because of its good dimension and blood supply.[15,16] However, in some cases, there are some anatomical limitations at the palate, such as exostosis, thin palatal gingiva, or shallow palatal vault.[17] These circumstances lead to inadequate graft harvesting for the recipient site, which has already undergone excessive preparation. Over-preparing the recipient site can cause additional tissue damage, increased vasodilation, and diffusion of inflammatory mediators and immune cells, all of which may lead to a higher risk of postoperative complications.[18-20] To address these concerns, some clinicians have proposed a modified technique in which the donor graft is harvested prior to recipient site preparation. This approach allows the clinician to adjust the flap design based on the actual size and shape of the harvested graft, potentially reducing the risk of over-preparation and limiting unnecessary flap exposure. However, scientific evidence to support this method is still lacking. The research question of this study was: Does the timing of harvesting CTG from the palate—either before or after the preparation of the recipient site—impact root coverage outcomes in the treatment of gingival recession? Therefore, the objective of this study was to evaluate and compare the root coverage outcomes of CTG harvested from the palate using two different approaches. We hypothesized that there was no significant difference in root coverage outcomes between CTG harvested before recipient site preparation and those harvested afterward.

Materials and Methods

All participating patients were recruited from the Periodontics Clinics at Mahidol University's Faculty of Dentistry between June 2023 and April 2024. The Faculty of Dentistry/Faculty of Pharmacy, Mahidol University Institutional Review Board approved the study protocol (Ethic number COA.No.MU-DT/PY-IRB 2023/024.0803). The inclusion criteria consisted of non-periodontitis patients aged 18 years or older with isolated gingival recession at buccal sites of single-rooted teeth, which were classified as recessions type 2 (RT2) by Cairo, 2011.[21] Full mouth bleeding on probing and plaque score were at or below 25%. The probing depth was at or below 4 mm at the site of interest, with no history of periodontal surgery at the recipient site. Patients were excluded from the study if they had any medical contraindications to periodontal surgery, a current or past history of smoking, or if they had used antibiotics or medications that could potentially impact periodontal healing within the last six months. Additionally, individuals exhibiting excessive tooth mobility or non-carious lesions deeper than 1 mm were also excluded.

The sample size was determined based on a statistical power of 80%, with an alpha error level set at 0.05. Anticipating a patient dropout rate of 10%, the calculations indicated that each group should comprise 10 recessions.[15] The investigator (K.T.) calibrated clinical measurements with an expert clinician (W.S.). The intraclass correlation coefficient was excellent for each clinical measurement.

The study was a prospective, parallel-group, randomized control trial registered in Thai Clinical Trials Registry no. TCTR20230826008, the protocol of which is presented in Figure 1. Following the recruitment process, patients participated in interviews, underwent clinical examinations, received oral hygiene instructions, and had full-mouth scaling performed. After this initial phase, patient allocation was performed using the nQuery Advisor program by K.T., with random assignment to either the control or test group. Patients were blinded to their group allocation. The random allocation sequence was concealed in sealed opaque envelopes and was not disclosed to the surgeon until immediately before the surgical procedure.

Patients were subsequently followed up at intervals of 1 week, 2 weeks, 1 month, and 3 months. A clinical examination was repeated at the 3-month mark. During each follow-up, patients were asked to report any pain at both the donor and recipient sites, using the Wong-Baker Faces Pain Rating Scale, which had a score of 1-10.[22] At the 3-month follow-up, patients were also requested to rate their satisfaction using a Patient Satisfaction Index (PSI), with scores ranging from 1 to 4. Score 1 means surgery met my expectations, score 2 means surgery improved my condition enough so that I would go through it again for the same outcome, score 3 means surgery helped me, but I would not go through it again for the same outcome, and score 4 means I am the same or worse compared to before surgery.[23]

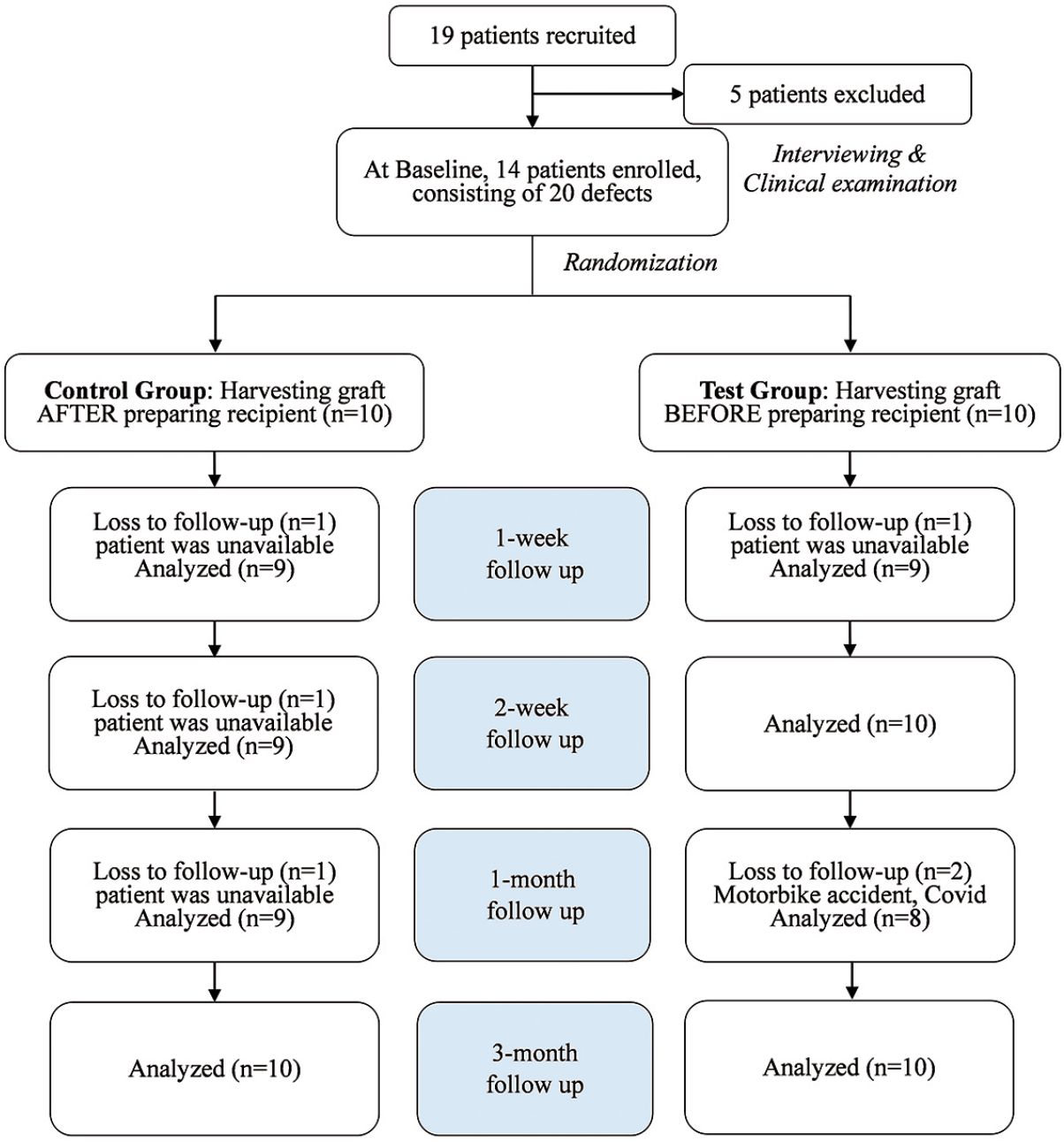

Figure 1: Study protocol.

Clinical parameter measurements: Clinical parameters were measured by K.T. before the surgery and at 3 months post-operation with a PCP-UNC-15 probe (Hu Friedy, Chicago, IL, USA) under a dental loupe (x2.5) as follows:

Probing depth (PD): the distance from the gingival margin to the bottom of the gingival sulcus.

Cementoenamel junction-gingival margin (CEJ-GM): distance from the gingival margin to the CEJ.

Clinical attachment level (CAL): calculation from probing depth plus CEJ-GM

Keratinized tissue width (KTW): the distance from the gingival margin to the mucogingival junction.

Plaque score: the percentage of plaque that was staining on the tooth surface.[24]

Bleeding on probing (BOP): present bleeding immediately after probing.

Gingival thickness: the periodontal probe shining through gingival tissue after being inserted in the gingival sulcus was defined as thin, and no periodontal probe shining was defined as thick.[25]

Recession reduction (RecRed): the difference of CEJ-GM at baseline and 3 months

The percentage of root coverage (RC): was calculated using the following formula: Percent of root coverage= (Initial gingival recession depth-Gingival recession depth at 3 months)/(Initial gingival recession depth) x 100

Surgical procedure: An expert clinician (W.S.) performed the surgical procedures, using local anesthesia of 2% mepivacaine with 1:100,000 epinephrine to anesthetize the donor and recipient sites.

Donor site: The donor site was prepared using a 2-parallel-incision technique modified from Bruno's technique.[10] The initial incision was made by positioning the blade perpendicular to the palatal gingiva, ensuring a distance of 2 mm from the gingival margin. A second incision was then created 2 mm apically and parallel to the first, with the blade angled to follow the contours of the palatal surface, achieving a depth of approximately 5 mm to secure adequate graft width. The third incision was initiated along the same line as the first and was performed by angling the blade parallel to the second incision, ensuring a consistent depth of 5 mm to achieve the desired graft width. Once the graft had been excised from the palate, the epithelial collar was carefully removed. The graft was harvested within 5 minutes and immediately placed in normal saline for hydration. Subsequently, the flap was sutured in place using 4-0 polyglactin 910 suture (VICRYL™) and protected with a non-eugenol periodontal dressing (COE-PAK™).

Recipient site: The recipient site was prepared using a modified Bruno's and Bernimoulin's technique.[10,26] Briefly, a horizontal incision was made at the base of the interdental papillae, positioned between the recessed tooth and the adjacent teeth. This created a new incision shaped like new papillae, located apical to the initial tips of the papillae. The tissue coronal to these horizontal incisions was de-epithelialized. A sulcular incision was then performed, allowing for the reflection of a partial-thickness flap. A minimal odontoplasty was performed to reduce the root contour if necessary. The graft was carefully adapted to the recipient site and secured with 5-0 polyglactin 910 sutures (VICRYL™). The donor and recipient site preparations are shown in Figure 2. At the surgical site, all the following parameters were measured by K.T. and W.S.

Surgical time (minutes): The duration from the initial incision to the final suture was documented. The time was also measured separately between the donor and the recipient site preparation. The donor preparation time starts from the first incision at the donor site until the graft is removed. The duration the graft remained extraorally was also recorded from when it is removed from the donor until it is placed at the recipient site. The recipient exposure time starts from the first incision at the recipient site to the time when the donor graft is in place.

Gingival thickness: The thickness was measured using an endodontic silicone disk affixed to a sterile needle, positioned at the mid-facial area 1.5 mm below the gingival margin of the recession site. The disk was secured with a flowable composite. Subsequently, the thickness was determined with a caliper accurate to the nearest 0.1 mm.

Alveolar bone dehiscence: A distance from the cementoenamel junction (CEJ) to the bottom of the dehiscence defect was measured using a periodontal probe.

Connective tissue graft size (mm): The width and height of the graft were measured utilizing a periodontal probe.

Post-operative care: The patient was prescribed 15 tablets of ibuprofen 400 mg and 15 tablets of paracetamol 500 mg. They were advised to take the medications as

needed for pain relief. Additionally, patients were instructed to avoid brushing their teeth in the surgical area for four weeks. They rinsed the area for 30 seconds with a 0.12% chlorhexidine solution twice daily for two weeks.

Statistical analysis: The main outcome of the study was the reduction of gingival recession. Secondary outcomes included various other clinical parameters as previously specified. Data were summarized using descriptive statistics, presenting means±standard deviations for quantitative variables and percentages for qualitative variables. To analyze differences in baseline data and outcomes between the two treatments, the Fisher exact test and Mann-Whitney U test were employed. A significance level of p=0.05 was set for rejecting the null hypothesis.

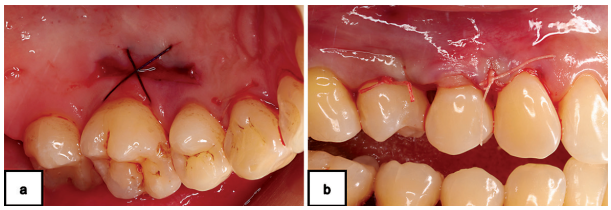

Figure 2: The donor site (a) and recipient site (b) preparation.

Results

Study population at baseline and surgical visit: A total of 19 patients were screened for the study, of which five did not meet the inclusion criteria, resulting in the recruitment of 14 patients (20 teeth). At the three-month follow-up, all subjects were successfully contacted. The mean age of participants was 36.7 years (±10.3), with ages ranging from 22 to 57 years. At baseline, there were no significant differences in the characteristics between the two groups. Most parameters assessed during surgical visits were also comparable, as shown in Table 1. However, two parameters differed significantly: the recipient site exposure time was shorter in the test group (p=0.015), while the extraoral graft duration was shorter in the control group (p=0.001)

Clinical Outcomes at Baseline and 3 months: The BOP, plaque score, KTW, PD, CEJ-GM, CAL, and gingival thickness did not differ between the two groups. However, when compared to the baseline, significant improvements were observed at three months, with notable gains in CAL, increased KTW, and enhanced gingival thickness. The RecRed measurements did not exhibit any differences between the two groups, with the control group showing 2.2±1.1 mm and the test group 2.5±0.7 mm. The clinical parameters assessed at baseline and three months are detailed in Table 2. At baseline, the CAL in the control and test groups was 4.3±1.0 mm and 4.5±1.1 mm, respectively. At the 3-month mark, CAL improved in both groups, showing increases of 1.9±1.0 mm in the control group and 1.8±0.9 mm in the test group. Additionally, the KTW at baseline was recorded at 1.7±1.6 mm for the control group and 1.2±1.2 mm for the test group. After 3 months, the KTW measurements in the control and test groups were 3.0±1.2 mm and 2.8±0.6 mm, respectively. The first premolars in both the control and test groups were followed up to three months, as illustrated in Figure 3.

Pain and patient satisfaction: Pain management was addressed only during the first week post-surgery. After that point, no pain or painkillers were utilized, with the exception of one patient in the test group who reported slight discomfort at the recipient site during the second week. All patients rated their experience with a score of 1, indicating that the surgery met their expectations. However, one patient in the control group provided a score of 2, suggesting that the surgery sufficiently improved their condition to the extent that they would undergo the procedure again for the same outcome. There was no significant difference in pain scores or patient satisfaction between the two groups.

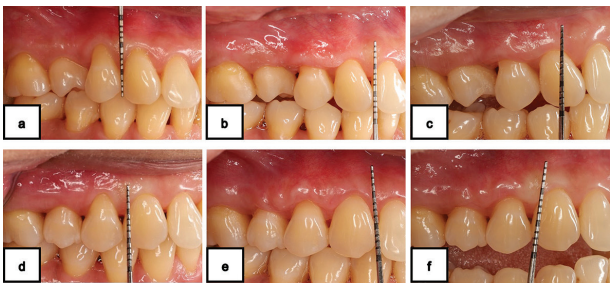

Figure 3: The first premolar of control group followed up at baseline (a), one month (b), and three months (c), the test group followed up at baseline (d), one month (e), and three months (f).

Discussions

Our research examined the outcomes of root coverage achieved using CTG harvested from the palate, both before and after the preparation of the recipient site. The

Table 1: Study population characteristics at baseline and parameters at surgical visit.

Parameter		Control (n=10)	Test (n=10)	*p*-value
Baseline				
Age (years): Mean±SD		36.5±10.6	36.8±10.6	0.970
BMI (kg/m^2): Mean±SD		22.5±1.9	23.7±3.8	0.643
Males: Females		4:6	5:5	1.000
Area of tooth:	Maxilla	6	6	1.000
	Mandible	4	4	
Tooth type:	Maxillary lateral incisor	2	1	-
	Maxillary canine	2	1	
	Maxillary premolar	2	4	
	Mandibular canine	2	1	
	Mandibular premolar	2	3	
Surgery visit				
Total Surgical time (mins)		49.0±16.6	53.7±10.2	0.174
Recipient exposure time (mins)		38.1±10.6	27.1±6.6	**0.015**
Donor preparation time (mins)		4.1±0.9	4.1±1.0	0.734
Graft remains extraorally (mins)		17.6±6.8	38.3±9.2	**0.001**
Gingival thickness (mm)		0.9±0.3	1.1±0.4	0.161
Alveolar bone dehiscence (mm)		5.9±1.8	6.0±1.7	0.760
Graft width (mm)		14.9±2.7	15.7±2.0	0.619
Graft height (mm)		4.1±0.6	4.4±0.8	0.395

Table 2: Clinical parameters outcomes compared between baseline and three months.

Parameter	Time points	Control (n=10)	Test (n=10)	*p*-value
Probing depth (mm)	Baseline	1.8±0.4	1.7±0.7	0.588
	3-months	1.6±1.0	1.6±0.5	1.000
	p-value	0.688	1.000	
Cementoenamel junction to gingival margin (mm)	Baseline	2.6±0.9	2.8±0.6	0.685
	3-months	0.5±0.8	0.4±0.8	0.693
	p-value	**0.000**	**0.000**	
Clinical attachment level (mm)	Baseline	4.3±1.0	4.5±1.1	0.587
	3-months	1.9±1.0	1.8±0.9	0.875
	p-value	**0.002**	**0.002**	
Keratinized tissue width (mm)	Baseline	1.7±1.6	1.2±1.2	0.507
	3-months	3.0±1.2	2.8±0.6	0.903
	p-value	**0.008**	**0.008**	
Plaque score (%)	Baseline	16.6±5.2	17.1±4.9	0.939
	3-months	21.9±11.7	18.8±5.6	0.650
	p-value	0.232	0.625	
Bleeding on probing (mm)	Baseline	10.9±9.4	9.7±6.4	0.850
	3-months	8.1±5.1	9.7±4.5	0.450
	p-value	0.492	0.695	
Gingival thickness (Number: Thin, thick)	Baseline	(10, 0)	(9, 1)	0.317
	3-months	(6, 4)	(6, 4)	0.383
	p-value	**0.046**	**0.025**	
Recession reduction (mm)	3-months	2.2±1.1	2.5±0.7	0.388
Percent of root coverage (%)	3-months	82.0±32.0	90.5±30.1	0.729

study demonstrated that both treatment methods yielded satisfactory clinical results, with comparable outcomes for both groups. Patients in both goups reported that pain subsided within two weeks postoperatively. Additionally, patients expressed a high level of satisfaction with the results of their treatments.

A two-parallel incision was employed for the donor site, while the modified Bruno's[10] and Bernimoulin's[26] techniques were utilized for the recipient site. This method avoids the need for vertical incisions, thereby minimizing trauma to the wound area, promoting quicker healing, and lessening post-operative complications.[10]

At baseline, the BOP and plaque scores were below 25%, indicating effective control of inflammation prior to the surgical procedure.[27] There was no significant difference in PD between the two treatment groups at different time points. This finding is consistent with previous studies conducted in Cairo (2012, 2016) and Zuhr (2014).[28-30] In contrast, Silva, 2004 reported a significant increase in PD from baseline to the 6-month mark.[31]

Gingival thickness exhibited significant improvement following surgical intervention. According to Zuhr (2021), an increase in soft tissue thickness was observed at the six-month mark post-surgery.[32] At baseline, the CAL was measured at 4.3±1.0 mm in the control group and 4.5±1.1 mm in the test group. After three months, the CAL values in the control and test groups were recorded as 1.9±1.0 mm and 1.8±0.9 mm, respectively. This indicated a significant gain in CAL of approximately 2 mm for both groups, which aligns with the findings of previous studies conducted by Cairo *et al*., in 2012 and 2016, as well as by Silva *et al*., in 2004.[28-31]

The keratinized tissue width (KTW) measurements were 1.7±1.6 mm for the control group and 1.2±1.2 mm for the test group at baseline. After three months, KTW values increased to 3.0±1.2 mm and 2.8±0.6 mm for the respective groups. The results indicated no significant difference between the two groups. The observed KTW gain aligns with findings from Cairo *et al*., (2012), where the initial KTW was recorded at 2.6±1.0 mm, rising to 3.7±0.9 mm after three months.[26] Additionally, Silva *et al*.,[31] reported a baseline KTW of 2.8±1.0 mm, with an increase to 3.4±0.7 mm at six months. This reflects a gain of approximately 1 mm in KTW, which was consistent with the results of our study.

At three months, the recession reduction (RecRed) was measured at 2.2±1.1 mm in the control group and 2.5±0.7 mm in the test group, findings that align with previous research. In a study by Zuhr *et al*.,[32] the gingival recession observed with the tunnel technique combined with CTG was reported to be 1.91±0.56 mm. The study by Cairo *et al*.,[28] on root coverage treatment used a coronally advanced flap, and CTG reported results of 2.4±0.6 mm at 3 months and 2.6±0.7 mm at 6 months, which aligns with our findings. It was important to recognize that the follow-up period for this research lasted only three months, which may not fully capture the complete healing and remodeling process of the connective tissue graft. Therefore, we recommend extending the observation period in future studies.

The present study compared root coverage outcomes between two harvesting sequences and found no significant differences in clinical outcomes, patient satisfaction, or complication rates. These findings suggested that both techniques were clinically effective, and the modified approach may serve as a practical alternative in anatomically challenging cases. This information can assist clinicians in selecting appropriate surgical protocols and may contribute to improving the success and predictability of root coverage procedures. However, the effect of grafts exposed to an extraoral environment on graft viability and shrinkage has not yet been studied. To date, research has only examined secondary graft shrinkage, which can occur for up to one year.[33,34] Future studies should focus on primary graft shrinkage occurring immediately after harvesting, within about 15 to 20 minutes and on graft viability extraorally after being harvested. Understanding these factors would lead to improved graft handling for better clinical outcomes. This modified technique, which involves harvesting the graft first, may also reduce prolonged exposure of the recipient site, which can enhance blood supply to the graft and improve wound healing ability.

To our knowledge, this was the first study comparing the clinical outcomes of root coverage using CTG based on the timing of graft harvesting in relation to recipient site preparation. A limitation of this study was its small sample size and the brief duration of observation. Additionally, two patients were lost to follow-up at one month, which may impact the statistical power of the results at that one-month time point. Following the randomization

process, the surgeon (W.S.) became aware of the treatment group prior to the surgery, which compromised the ability to blind the surgeon to the treatment protocol. Given the limited number of investigators involved, the examiner (K.T.) was responsible for conducting the randomization, gathering clinical parameters, and carrying out the statistical analysis. Another limitation is the lack of an acrylic stent to assist with probe placement during follow-up evaluations. While all measurements were carried out by a single examiner, who was calibrated with an expert periodontist and utilized a 2.5× surgical loupe along with consistent anatomical landmarks, the implementation of a stent might have further minimized variability in probing measurements. Future studies should involve a larger sample size and extended observation periods to validate the findings.

Conclusions

This study concluded that harvesting the graft prior to the preparation of the recipient site does not adversely affect clinical outcomes. There were no significant differences in clinical results, complications, or patient satisfaction between the two groups: those with grafts harvested before site preparation and those with grafts harvested afterward.

This research indicated that the clinical outcomes of the two surgical techniques were not significantly different. This information will aid surgeons in making decisions and selecting suitable cases for treatment, especially in scenarios involving large exostoses or thin palatal gingiva. Harvesting grafts prior to preparing the recipient site can serve as an effective alternative treatment option. Additionally, choosing the appropriate technique will contribute to improving the success rates of root coverage procedures.

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