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TITANIUM-PREPARED PLATELET RICH FIBRIN VERSUS CONNECTIVE TISSUE GRAFT FOR THE MANAGEMENT OF TYPE-2 GINGIVAL RECESSION (RT2) (RANDOMIZED CONTROLLED CLINICAL TRIAL)

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ABSTRACT

BACKGROUND: Gingival Recession is an apical migration of the marginal gingiva concerning the Cemento-Enamel Junction. Different techniques are used to manage GR, including Platelet-Rich Fibrin (PRF). The latter has several advantages: it does not require a second surgical site intervention, is completely autogenous, and contains numerous growth factors. However, contamination of PRF may happen from plastic or glass tubes. Therefore, Titanium prepared Platelet-Rich Fibrin (T-PRF) can be used to overcome this disadvantage.
Study objective: To assess the effect of using the T-PRF with Coronally Advanced Flap (CAF) in the management of Cairo gingival recession type-2 (RT2) and compare it to the use of Sub-Epithelial Connective Tissue Graft (SECTG).
MATERIALS AND METHODS: This randomized controlled clinical trial was conducted on 44 sites with Cairo RT2. After performing phase I therapy, sites were divided into two groups: Test group, included 22 defects managed by CAF in conjunction with T-PRF. Control group: included 22 defects managed by CAF in conjunction with SECTG. Clinical assessment was done immediately before surgery, at baseline, then three and six months postoperatively.
RESULTS: It showed that both SECTG and T-PRF with CAF could improve the PD, CAL, and RD from baseline to six months follow up, but SECTG + CAF showed superior results.
CONCLUSION: Within the limitations of this study, the results showed the superiority of autogenous CTG in root coverage (RC). However, T-PRF was a safe and effective choice for partial RC in RT2. However, it doesn't require a second surgical site intervention.
KEYWORDS: Coronally Advanced Flap, Gingival Recession Type 2, Titanium Prepared Platelet Rich Fibrin, Sub-Epithelial Connective Tissue Graft.
RUNNING TITLE: Root coverage using Titanium Prepared Platelet Rich Fibrin

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INTRODUCTION

Gingival recession (GR) is defined as apical migration of the marginal gingiva with respect to CEJ(1). It could lead to compromised esthetics, dentine hypersensitivity, and root caries. GR is considered a mucogingival deformity with multifactorial etiological factors. It may be a possible sequence for some conditions, such as thin periodontal biotype, improper oral hygiene, orthodontic treatment, tooth malposition, cervical lesions, and non-carious cervical lesions (NCCL)(2).

Other factors contributing to GR development include untreated gingival inflammation, shallow vestibular depth, and high frenal attachment(1). Classification of GR depends on some diagnostic considerations like recession depth, gingival thickness (GT), interdental clinical attachment level (CAL), and the amount of keratinized mucosa(3).
One of the most commonly used classifications is the one suggested by Cairo et al. (2011)(4). They classified GR based on interdental clinical

attachment level CAL into ***Recession type 1 (RT1)*** GR with no loss of interproximal attachment, and the CEJ is not detectable in both mesial and distal aspects of the tooth. ***Recession type 2 (RT2)*** GR is associated with interproximal attachment loss. The amount of interproximal attachment loss is equal to or less than the buccal attachment loss. ***Recession type 3 (RT3)***: gingival recession associated with interproximal attachment loss; the amount of interproximal attachment loss is more than the buccal attachment loss.

Several techniques(1,5-8) were proposed to manage either single or multiple GRs. These techniques included Lateral Positioned Flap (LPF), Double Papilla Flap (DPF), Free Gingival Autograft, SubEpithelial Connective Tissue Graft (SECTG), semilunar flap, Coronally Advanced Flap (CAF), Vestibular Incision Subperiosteal Tunnel Access technique (VISTA) and Pinhole Technique (PST), Zucchelli technique, together with the use of membranes, Platelet Rich Plasma (PRP), and Platelet Rich Fibrin (PRF) as well as others.

PRF was developed by Choukroun et al. (2001)(9). It contains platelet rich fibrin, leukocytes, and platelets, which play an important role in tissue healing by releasing numerous cytokines and growth factors that have multiple actions on different targeted cells(8). The main released growth factors are platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and transforming growth factor ß-1 (TGFß-1). These growth factors influence the regeneration and maturation of the soft tissue by inducing the recruitment of regenerative cells (mesenchymal cells, osteoblasts, fibroblasts, endothelial cells, and epithelial cells). Consequently, PRF can be used in conjunction with CAF to cover gingival recessions(8,10). There are many types of platelet rich plasma (PRP) and Platelet Rich Fibrin (PRF) preparations according to cell count (mostly leukocytes) and fibrin architecture as well as technique of preparation(8). These include Pure Platelet Rich Plasma (P-PRP), leukocyte platelet rich plasma (L-PRP), Pure Platelet Rich Fibrin (P-PRF), or leukocyte poor platelet rich fibrin, leukocyte platelet rich fibrin (L-PRF). The platelet rich fibrin family [PRF, L-PRF, Advanced-PRF, i-PRF, and Titanium-PRF(T-PRF)](8) is considered the second generation of platelet concentrates that do not require using anticoagulant nor bovine thrombin(11,12). Moreover, they have a strong fibrin matrix, which is good for handling and is long lasting when compared to PRP family(8,12).

When comparing Titanium and glass prepared PRF, Tunali et al. (2014)(13) demonstrated that both were clinically similar. However, T-PRF was found to be thicker and more prominent, with a more organized fibrin network between the cellular structures than L-PRF(14). Furthermore, titanium tubes are inert and more biocompatible than silica or glass tubes, both showing some contamination in the resultant blood samples(13).

The study aimed to evaluate the effectiveness of using T-PRF with CAF in the treatment of type-2 GR and compare it to the SECTG as a gold standard treatment. The null hypothesis of the study was that using T-PRF with CAF will be equally efficient to the use of SECTG with CAF in the management of type 2 GR.

MATERIALS AND METHODS

I. Materials

The research protocol was approved by the Research Ethics Committee of Alexandria University Faculty of Dentistry (IRB No. 001056-IORG 0008839) prior to any research-related activities. All research activities were conducted according to the regulations of the Modified Declaration of Helsinki 2013 and the ethical guidelines adopted by the Research Ethics Committee of Alexandria University, Faculty of Dentistry, on the conduct of clinical trials on human subjects(15).

Sample size estimation:

The sample size was estimated, assuming a 5% alpha error and 80% study power. The mean (SD) root coverage was 91.06% for T-PRF and 92.04% for CTG after 6 months postoperatively(16). Based on the difference between two independent means using SD=1.12(17), the minimum sample size was calculated to be 21 sites per group, and it was increased to 22 sites to make up for lost to follow-up cases. Total sample = number per group x number of groups= 22 x 2 = 44 sites.

Study Design and Subjects:

I-Study design

The study was a Randomized Controlled Clinical Trial (RCT).

II-Subjects

This study was conducted on eighteen patients of both sexes (4 males and 14 females), aged between 33 and 55 years old, with 44 sites of Cairo Type II GR. The patients were selected from the outpatient clinic of the Department of Oral Medicine, Periodontology, Diagnosis, and Oral Radiology at the Faculty of Dentistry, Alexandria University.

Eligibility criteria

The study included patients who met the following criteria: having type 2 gingival recession according to Cairo et al. (2011)(4), an adequate amount of attached gingiva (AG) (2 mm≤ AG)(3), an average age between 18-60 years, good oral hygiene (full mouth bleeding score of 0(18) and O'Leary index(19) less than ≤10% after complete phase I therapy), a clinically thick gingival biotype (1mm < gingival thickness)(3). Teeth in the esthetic zone.

Patients who did not meet these criteria were excluded from the study. Exclusion criteria included patients with gingival recession types 1 and 3, according to Cairo et al. (2011)(4), inadequate amount of attached gingiva (AG < 2 mm)(3), uncooperative patients, those who smoked more than ten cigarettes per day, and patients with known systemic conditions or taking medications that may affect soft tissue healing, also pregnant and lactating women, and patients with parafunctional habits.

Methods

Randomization and Patient Allocation

Allocation of patients was done randomly into control and test groups using a simple randomization procedure (computerized random number)(20).

Grouping

After selecting patients based on the previously mentioned criteria and performing phase I therapy, the patients were randomly divided into two groups, each comprising 22 sites or more with type 2 Cairo GR defects (based on clinical and radiographic criteria): ***Group 1 (Test group):*** 22 sites of GR from 12 patients were managed by CAF in conjunction with Titanium prepared PRF. In Group 2 (Control group), 22 sites of GR from 6 patients were managed by CAF in conjunction with SECTG.

Surgical intervention

Study participants received local anesthesia through buccal vestibular and palatal infiltration, using 4% Articaine hydrochloride and epinephrine (1/100000) (Septanest SP Articaine HCl 4%). The same operator performed all surgeries according to Zucchelli technique(1). An envelope flap was raised with a split-full-split approach in the apico-coronal direction and de-epithelization for the remaining inter-dental tissue (papilla) was performed, followed by sharp dissection of the vestibular mucosa by supra-periosteal split-thickness incisions, which were done by keeping the blade parallel to the bone plane (leaving the periosteum protected), and all muscle insertions were eliminated until it was possible to move the flap passively. It was done by keeping the blade submucosally. Mobilization of the flap was considered "appropriate" when the marginal gingiva of the flap was able to reach passively to (or coronal to) the level of CEJ.

However, to prepare the PRF for group I (test group, a certified nurse collected 20 ml of the patient's blood from the antecubital vein. The blood sample was obtained from the patient, conveyed into a titanium tube, and immediately centrifuged according to Choukroun et al. (2006)(12) at 2700 rpm for 12 mins at room temperature using fixed angle centrifuge (PRF Process, Tangkula800-1, China) /(Tangkula 800-1, Cord Company, China.). The fibrin clot was collected and placed in the PRF compression device (PRF GRF box) (OSUNG, 15020 West Drive, Houston, TX 77053, USA) and condensed to produce a uniform T-PRF membrane, which was inserted over the recession area and covered by the CAF(1).

In group II (control group), SECTG was obtained from the donor site (hard palate), placed into the recipient site and secured by sutures, then covered by a CAF(1). At the donor site, the approximate dimensions of the recipient bed (length and width) with an additional 1 mm in length and width were harvested from the palate by Bruno's technique(21). After the SECTG was removed from the palate, it was placed on a saline-soaked gauze and cleaned from the adipose tissue while the palatal wound was closed. The flap margins were approximated using horizontal crossed/parallel suspension Polypropylene (Prolene) Surgical Sutures (Atlas Medical, Greece), and the entirely undermined donor area was closed simultaneously.

Post-operative care

Post-operative instructions (both written and verbal) were given to study participants. Nonsteroidal anti-inflammatory (Ibuprofen 400 mg) (Manufactured by Kahira Pharmaceuticals & Chemical Industries Company Under License From ABBOTT Laboratories Limited – USA and its subsidiary in Pakistan) was prescribed to the participant two times a day for five days; in the case of a patient with a history of hypersensitivity to Ibuprofen, (Paracetamol 500 mg) (Paracetamol (El Nasr), Egypt) was prescribed three times a day for five days. Patients were instructed not to brush their teeth related to the operative site for at least 14 days and to use mouthwash to prevent plaque accumulation. Also, the participant was instructed to resume mechanical cleansing using a soft or extra-soft toothbrush, applying Charter's technique(22). They were also advised not to chew hard or sticky foods at the operative site. The sutures were removed after two weeks.

Evaluation

Clinical evaluation

Recession Depth (RD), Recession Width (RW), Probing Depth (PD), and clinical attachment level (CAL) were measured using a graduated periodontal probe (Nordent, USA) from CEJ until slight resistance in the pocket. A fabricated stent was used to ensure the accuracy of the measurements.

Statistical Analysis

Normality was tested for all variables using descriptive statistics, plots, and normality tests. All data showed normal distribution, so means and standard deviation (SD) were calculated, and parametric tests were used. Comparisons between the two study groups were performed using independent samples t-test with calculations of mean differences and 95% confidence intervals (CI). Comparisons between different timepoints within each group were performed using repeated measures ANOVA, followed by multiple pairwise comparisons using Bonferroni adjustment. Percent change was calculated using the following equation: $\frac{value\ at\ 6\ months - value\ at\ baseline}{value\ at\ baseline} \times 100$. Significance was set at p value <.05. Data were analyzed using IBM SPSS for Windows (Version 26.0).

RESULTS

Eighteen patients (with a total of 44 sites of type 2 GR) were selected from the outpatient's clinic of **the Department of Oral Medicine, Periodontology, Oral Diagnosis and Oral Radiology**, Faculty of Dentistry, Alexandria University. All enrolled participants were eligible and followed the inclusion criteria. Forty sites of GR were divided into two groups: 22 sites of GR were managed with CAF in conjunction with SECTG, and 22 sites of GR were managed with CAF in conjunction with T-PRF. Participants were randomly divided into 2 groups. The measurements were taken at three time points: preoperatively as

baseline, three months, and six months postoperatively.

Probing depth (PD) (*in mm*)

Intragroup analysis revealed a statistically significant decrease in mean PD in both T-PRF and SECTG groups from baseline to three months, then from three to six months (p<.001 and p<.001, respectively) compared to the preoperative study.

In the Titanium PRF Group:

Post Hoc Pairwise comparison revealed that the mean PD decreased three and six months postoperatively compared with preoperative values (p<.001 and p<.001, respectively). The decrease was statistically significant. In addition, mean PD showed a statistically significant decrease at six months when compared with three months values postoperatively (p<.001).

In the SECTG Group:

Post Hoc Pairwise comparison revealed that PD has significantly decreased between three and six months postoperatively compared with preoperative values (p<.001 and p<.001, respectively). In addition, PD has statistically significantly decreased six months compared with three months postoperatively (p<.001). **Table (1)**

When the two groups were compared to each other with respect to mean probing depth values, the following was observed:

At baseline, the T-PRF group [1.88 (±0.50)] showed a slight increase in mean PD compared to the SECTG group [1.80 (±0.51)]. This increase was statistically insignificant (*p*=.574).

Similarly, at three months, the T-PRF group [1.64 (±0.51)] showed a slight increase in mean PD compared to the SECTG group [1.42 (0.37)]. This increase was statistically insignificant (*p*=.124).

Furthermore, at six months, the T-PRF group [1.40 (0.56)] showed a slight increase in mean PD compared to the SECTG group [1.16 (±0.42)]. This increase was statistically insignificant (*p*=.091).

Table (1)

Clinical attachment level CAL (*in mm*)

Intra group analysis revealed that mean CAL decreased in both T-PRF and SECTG groups from baseline to three months and from three to six months. The decrease was statistically significant. (*p*<.001 and *p*<.001, respectively).

In the T-PRF Group:

Post Hoc Pairwise comparison revealed that CAL depicted a statistically significant decrease at three and six months postoperatively when compared to preoperative values (*p*<.001 and *p*<.001, respectively). In addition, mean CAL showed a statistically significant decrease at six months compared to three months postoperatively (*p*<.001).

In the SECTG Group:

Post Hoc Pairwise comparison revealed that CAL decreased three and six months postoperatively compared with preoperative (*p*<.001 and *p*<.001, respectively). In addition, mean CAL significantly decreased at six months when compared to three months values postoperatively (*p*<.001). **Table (2)**

When the two groups were compared to each other with respect to mean CAL values, the following was observed:

At the baseline, the T-PRF group [4.08 (±1.21)] showed a slight increase in CAL compared to the SECTG group [3.99 (±1.03)]. This increase was statistically insignificant (*p*=.811).

At three months, the T-PRF group [3.87 (±1.25)] showed a slight increase in CAL compared to the SECTG group [3.59 (±0.94)]. This increase was statistically insignificant (*p*=.415).

Furthermore, at six months, the T-PRF group was [3.66 (±1.28)], which showed a slight increase in mean CAL compared to that of the SECTG group [3.36 (±0.93)]. This increase was statistically insignificant (*p*=.376). **Table (2)**

Recession depth (RD) (*in mm*):

Intragroup analysis revealed that the RD had significantly decreased in both T-PRF and the SECTG groups at the different timepoints of the study (*p*<.001 and *p*<.001, respectively).

In the Titanium PRF Group:

The Post Hoc Pairwise comparison revealed that RD has statistically significant decreased three and six months postoperatively compared with preoperative (*p*<.001 and *p*<.001, respectively). In addition, RD has statistically significant decreased six months compared with three months postoperatively (*p*<.001).

In the SECTG Group:

The Post Hoc Pairwise comparison revealed that RD has statistically significant decreased three and six months postoperatively compared with preoperative (p<.001 and p<.001, respectively). In addition, RD has statistically significant decreased six months compared with three months postoperatively (*p*<.001). **Table (3)**

When the two groups were compared to each other with respect to mean RD values, the following was observed:

At the baseline, the T-PRF group [2.14 (±0.89)] showed a slight decrease in the mean of RD compared to the SECTG group [2.29 (±0.89)]. This decrease was statistically insignificant (*p*=.572).

At three months, the T-PRF group [1.95 (±0.90)] showed a slight decrease in the mean of RD compared to the SECTG group [1.99 (±0.86)]. This decrease was statistically insignificant (*p*=.889).

Furthermore, at six months, the T-PRF group [1.77 (±0.92)] showed a slight decrease in the mean of RD compared to the SECTG group [1.69 (±0.87)]. This decrease is statistically insignificant (*p*=.781).

Table (3)

Recession Width (RW) (in mm)

Intra group analysis revealed that mean RW decreased in both T-PRF and SECTG groups from

baseline to three months and from three to six months. The decrease was statistically significant. (p<.001 and p<.001, respectively).

In the T-PRF Group:

Post Hoc Pairwise comparison revealed that RW depicted a statistically significant decrease at three and six months postoperatively when compared to preoperative values (p<.001 and p<.001, respectively). In addition, mean RW showed a statistically significant decrease at six months compared to three months postoperatively (p<.001).

In the SECTG Group:

Post Hoc Pairwise comparison revealed that RW decreased at three and six months postoperatively compared with preoperative values (p<.001 and p<.001, respectively). In addition, mean RW significantly decreased at six months when compared to three months values postoperatively (p<.001). **Table (4)**

When the two groups were compared to each other with respect to mean RW values, the following was observed:

At the baseline, the T-PRF group [3.02 (±1.05)] showed a slight decrease in RW compared to the SECTG group [3.57 (±0.86)]. This decrease was statistically insignificant (p=.066).

At three months, the T-PRF group [2.75 (±1.07)] showed a slight decrease in RW compared to the SECTG group [3.16 (±0.77)]. This decrease was statistically insignificant (p=.148).

Furthermore, at six months, the T-PRF group was [2.43 (±1.12)], which showed a slight decrease in mean RW compared to that of the SECTG group [2.77 (±0.78)]. This decrease was statistically insignificant (p=.253).

Table (1): Comparison of the Probing Depth (mm) in the two studied groups.

	Group		Mean Difference 95% CI	Test of significance *p* value
	Titanium PRF	**SECTG**		
Probing Depth (mm) (preoperative)				
- n	22	22		
- Min – Max	1.20 – 2.90	1.20 – 3.00	Mean Diff=0.087	$t_{(df=42)}$=0.566
- Mean ± Std. Deviation	1.88 ± 0.50	1.80 ± 0.51	95% CI (0.226-	p=.574 NS
- 95% CI for mean	1.66 – 2.11	1.57 – 2.02	0.396)	
Probing Depth (mm) (3 months postoperative)				
- n	22	22		$t_{(df=42)}$=1.569
- Min – Max	0.94 – 2.64	1.02 – 2.38	Mean Diff=0.211	p=.124 NS
- Mean ± Std. Deviation	1.64 ± 0.51	1.42 ± 0.37	95% CI (0.060-	
- 95% CI for mean	1.41 – 1.86	1.26 – 1.59	0.483)	
Probing Depth (mm) (6 months postoperative)				
- N	22	22		$t_{(w)(df=35.533)}$=1.738
- Min – Max	0.63 – 2.51	0.67 – 1.96	Mean Diff=0.244	$p_{(w)}$=.091 NS
- Mean ± Std. Deviation	1.40 ± 0.56	1.16 ± 0.35	95% CI (0.041-	
- 95% CI for mean	1.16 – 1.65	1.00 – 1.32	0.528)	
Probing Depth Difference (3 months vs preoperative)				
- n	22	22		$t_{(w)(df=34.421)}$=2.901
- Min – Max	-0.47 – -0.12	-0.68 – -0.14	Mean Diff=0.429	$p_{(w)}$=.006*
- Mean ± Std. Deviation	-0.25 ± 0.10	-0.37 ± 0.17	95% CI (0.037-	
- 95% CI for mean	-0.29 – -0.20	-0.45 – -0.30	0.212)	
Probing Depth Difference (6 months vs preoperative)				
- N	22	22		$t_{(df=42)}$=3.071
- Min – Max	-0.77 – -0.30	-1.04 – -0.35	Mean Diff=0.157	p=.004*
- Mean ± Std. Deviation	-0.48 ± 0.14	-.64 ± 0.20	95% CI (0.054-	
- 95% CI for mean	-0.54 – -0.42	-0.72 – -0.55	0.260)	
Probing Depth Difference (6 months vs 3 months)				
- N	22	22		$t_{(df=42)}$=1.381
- Min – Max	-0.35 – -0.11	-0.42 – 0.02	Mean Diff=0.032	p=.174 NS
- Mean ± Std. Deviation	-0.23 ± 0.07	-0.26 ± 0.08	95% CI (0.148-	
- 95% CI for mean	-0.27 – -0.20	-0.30 – 0.23	0.079)	
Test of significance	$F_{(GG)(df=1)}$=218.018	$F_{(GG)(df=1)}$=283.637		
Partial Eta Squared	0.912	0.931		
Observed Power	100%	100%		
p value	p<.001*	p<.001*		
Post Hoc Pairwise comparison with Games-Howell				
3 months vs preoperative				
- **Difference**	-0.248		-0.373	
- **95% CI of Difference**	-0.306 – -0.191		0.468 – 0.277	
- ***p* value**	<.001		<.001	
6 months vs preoperative				
- **Difference**	-0.481		-0.637	
- **95% CI of Difference**	-0.557 – -0.404		0.745 – -0.529	
- ***p* value**	<.001		<.001	
6 months vs 3 months				
- **Difference**	-0.232		-0.265	
- **95% CI of Difference**	-0.274 – -0.191		-0.309 – -0.220	
- ***p* value**	<.001		<.001	

n : Number of patients
Min-Max: Minimum – Maximum
S.D.: Standard Deviation
CI: Confidence interval
(GG): Greenhouse-Geisser
df= degree of freedom
Mean Diff: mean difference

*: Statistically significant (p<.05) NS: Statistically not significant (p≥.05)

Table (2): Comparison of Clinical Attachments Level (in *mm*) in the two studied groups

	Group		Mean Difference 95% CI	Test of significance *p* value
	Titanium PRF	**SECTG**		
Clinical Attachments Level (mm) (preoperative)				
- n	22	22		
- Min – Max	2.50 – 6.50	2.20 – 5.86	Diff=0.082	$t_{(df=42)}$=0.241
- Mean ± Std. Deviation	4.08 ± 1.21	3.99 ± 1.03	95% CI (0.604-0.768)	p=.811 NS
- 95% CI for mean	3.54 – 4.62	3.54 – 4.45		
Clinical Attachments Level (mm) (3 months postoperative)				
- n	22	22		
- Min – Max	2.20 – 6.39	1.92 – 5.18	Diff=0.274	
- Mean ± Std. Deviation	3.87 ± 1.25	3.59 ± .94	95% CI (0.398-0.946)	$t_{(df=42)}$=0.823
- 95% CI for mean	3.32 – 4.42	3.18 – 4.01		p=.415 NS
Clinical Attachments Level (mm) (6 months postoperative)				
- n	22	22		
- Min – Max	1.90 – 6.27	1.63 – 4.87	Diff=0.302	$t_{(df=42)}$=0.894
- Mean ± Std. Deviation	3.66 ± 1.28	3.36 ± 0.93	95% CI (0.380-0.983)	p=.376 NS
- 95% CI for mean	3.09 – 4.23	2.95 – 3.77		
Clinical Attachments Level Difference (3 months vs preoperative)				
- n	22	22		
- Min – Max	-0.30 – -0.10	-1.14 – -0.10	Diff=0.192	$t_{(w)(df=23.417)}$=3.442
- Mean ± Std. Deviation	-0.21 ± 0.06	-0.40 ± 0.25	95% CI (0.077-0.308)	$p_{(w)}$=.002*
- 95% CI for mean	-0.24 – -0.18	-0.51 – -0.29		
Clinical Attachments Level Difference (6 months vs preoperative)				
- n	22	22		
- Min – Max	-0.6 – -0.2	-1.4 – 0.1	Diff=0.220	$t_{(w)(df=25.545)}$=2.649
- Mean ± Std. Deviation	-0.4 ± 0.1	-0.6 ± 0.4	95% CI (0.049-0.391)	$p_{(w)}$=.014*
- 95% CI for mean	-0.5 – -.4	-0.8 – -0.5		
Clinical Attachments Level Difference (6 months vs 3 months)				
- n	22	22		
- Min – Max	-0.30 – -0.10	-0.59 – 0.62	Diff=0.028	$t_{(df=42)}$=0.561
- Mean ± Std. Deviation	-0.21 ± 0.06	-0.24 ± 0.22	95% CI (0.724-0.128)	p=.578 NS
- 95% CI for mean	-0.24 – -0.18	-0.34 – -0.14		
Test of significance	$F_{(GG)(df=1)}$=211.961	$F_{(GG)(df=1)}$=211.961		
Partial Eta Squared	0.910	0.901		
Observed Power	100%	100%		
p value	p<.001*	p<.001*		
	Post Hoc Pairwise comparison with Games-Howell			
3 months vs preoperative				
- **Difference**	-0.208		-0.401	
- **95% CI of Difference**	-0.242 – -0.174		-0.541 – -0.259	
- ***p* value**	<.001		<.001	
6 months vs preoperative				
- **Difference**	-0.417		-0.637	
- **95% CI of Difference**	-0.485 – -0.349		-0.842 – -0.432	
- ***p* value**	<.001		<.001	
6 months vs 3 months				
- **Difference**	-0.208		-0.236	
- **95% CI of Difference**	-0.242 – -0.174		-0.361 – -0.112	
- ***p* value**	<.001		<.001	

n : Number of patients Min-Max: Minimum – Maximum
S.D.: Standard Deviation CI: Confidence interval
(GG): Greenhouse-Geisser df= degree of freedom
Diff: mean difference
*: Statistically significant (p<.05) NS: Statistically not significant (p≥.05)

Table (3): Comparison of the Recession Depth (in *mm*) in the two studied groups.

	Group		Mean Difference 95% CI	Test of significance *p* value
	Titanium PRF	**SECTG**		
Recession Depth (mm) (preoperative)				
- n	22	22		
- Min – Max	1.00 – 5.00	1.00 – 4.70	Diff=0.150	$t_{(df=42)}$=0.569
- Mean ± Std. Deviation	2.14 ± 0.89	2.29 ± 0.86	95% CI (0.682-0.382)	*p*=.572 NS
- 95% CI for mean	1.75 – 2.54	1.91 – 2.68		
Recession Depth (mm) (3 months postoperative)				
- n	22	22		
- Min – Max	0.75 – 4.83	0.60 – 4.25	Diff=0.037	$t_{(df=42)}$=0.140
- Mean ± Std. Deviation	1.95 ± 0.90	1.99 ± 0.86	95% CI (0.573-0.499)	*p*=.889 NS
- 95% CI for mean	1.56 – 2.35	1.61 – 2.37		
Recession Depth (mm) (6 months postoperative)				
- n	22	22		
- Min – Max	0.45 – 4.66	0.20 – 3.81	Diff=0.075	$t_{(df=42)}$=0.279
- Mean ± Std. Deviation	1.77 ± 0.92	1.69 ± 0.87	95% CI (0.470-0.620)	*p*=.781 NS
- 95% CI for mean	1.36 – 2.17	1.30 – 2.08		
Recession Depth Difference (3 months vs preoperative)				
- n	22	22		
- Min – Max	-0.30 – -0.10	-0.45 – -0.14	Diff=0.113	$t_{(w)(df=32.948)}$=4.395
- Mean ± Std. Deviation	-0.19 ± 0.06	-0.30 ± 0.11	95% CI (0.061-0.165)	$p_{(w)}$<00.1*
- 95% CI for mean	-0.21 – -0.16	-0.35 – -0.25		
Recession Depth Difference (6 months vs preoperative)				
- n	22	22		
- Min – Max	-0.60 – -0.20	-0.90 – -0.28	Diff=0.051	$t_{(w)(df=32.948)}$=4.395
- Mean ± Std. Deviation	-0.38 ± 0.12	-0.60 ± 0.21	95% CI (0.121-0.330)	$p_{(w)}$<00.1*
- 95% CI for mean	-0.43 – -0.32	-0.70 – -0.51		
Recession Depth Difference (6 months vs 3 months)				
- n	22	22		
- Min – Max	-0.30 – -0.10	-0.45 – -0.14	Diff=0.113	$t_{(w)(df=32.948)}$=4.395
- Mean ± Std. Deviation	-0.19 ± 0.06	-0.30 ± 0.11	95% CI (0.061-0.165)	$p_{(w)}$<00.1*
- 95% CI for mean	-0.21 – -0.16	-0.35 – -0.25		
Test of significance	$F_{(GG)(df=1)}$=103.511	$F_{(GG)(df=1)}$=117.909		
Partial Eta Squared	0.831	0.849		
Observed Power	100%	100%		
p value	*p*<.001*	*p*<.001*		
Post Hoc Pairwise comparison with Games-Howell				
3 months vs preoperative				
- **Difference**	-0.188		-0.301	
- **95% CI of Difference**	-0.221 – -0.156		0.243 – 0.359	
- ***p* value**	<.001		<.001	
6 months vs preoperative				
- **Difference**	-0.377		-0.602	
- **95% CI of Difference**	-0.442 – -0.312		0.719 – -0.486	
- ***p* value**	<.001		<.001	
6 months vs 3 months				
- **Difference**	-0.189		-0.301	
- **95% CI of Difference**	-0.221 – -0.156		-0.359 – -0.243	
- ***p* value**	<.001		<.001	

n : Number of patients
Min-Max: Minimum – Maximum
S.D.: Standard Deviation
CI: Confidence interval
(GG): Greenhouse-Geisser
df= degree of freedom
Diff: mean difference
*: Statistically significant ($p<.05$)
NS: Statistically not significant ($p\geq.05$)

Table (4): Comparison of the Recession Width (mm) in the two studied groups

	Group		Mean Difference 95% CI	Test of significance p value
	Titanium PRF	SECTG		
Recession Width (mm) (preoperative)				
- n	22	22		
- Min – Max	1.20 – 5.00	1.40 – 4.91	Mean Diff=0.545	$t_{(df=42)}$=1.885
- Mean ± Std. Deviation	3.02 ± 1.05	3.57 ± 0.86	95% CI (1.128-0.038)	*p*=.0.066 NS
- 95% CI for mean	2.56 – 3.49	3.19 – 3.95		
Recession Width (mm) (3 months postoperative)				
- n	22	22		
- Min – Max	0.97 – 4.86	1.14 – 4.58	Mean Diff=0.414	$t_{(df=42)}$=1.476
- Mean ± Std. Deviation	2.75 ± 1.07	3.16 ± 0.77	95% CI (0.979-0.152)	*p*=0.148 NS
- 95% CI for mean	2.27 – 3.22	2.82 – 3.50		
Recession Width (mm) (6 months postoperative)				
- n	22	22		
- Min – Max	0.73 – 4.72	1.02 – 4.35	Mean Diff=0.337	$t_{(df=42)}$=1.160
- Mean ± Std. Deviation	2.43 ± 1.12	2.77 ± 0.78	95% CI (0.923-0.249)	*p*=.253 NS
- 95% CI for mean	1.94 – 2.93	2.42 – 3.12		
Recession Width Difference (3 months vs preoperative)				
- n	22	22		
- Min – Max	-0.42 – -0.12	-0.74 – -0.14	Mean Diff=0.131	$t_{(w)(df=31.996)}$=2.836
- Mean ± Std. Deviation	-0.28 ± 0.10	-0.41 ± 0.19	95% CI (0.037-0.225)	$p_{(w)}$=.008*
- 95% CI for mean	-0.32 – -0.23	-0.49 – -0.32		
Recession Width Difference (6 months vs preoperative)				
- n	22	22		
- Min – Max	-1.04 – -0.24	-1.34 – -0.29	Mean Diff=0.208	$t_{(df=42)}$=2.481
- Mean ± Std. Deviation	-0.59 ± 0.23	-0.80 ± 0.32	95% CI (0.038-0.377)	*p*=.017 NS
- 95% CI for mean	-0.69 – -0.49	-0.94 – -0.66		
Recession Width Difference (6 months vs 3 months)				
- n	22	22		
- Min – Max	-0.62 – -0.12	-0.79 – -0.12	Mean Diff=0.077	$t_{(df=42)}$=1.481
- Mean ± Std. Deviation	-0.31 ± 0.15	-0.39 ± 0.19	95% CI (0.028-0.182)	*p*=.146 NS
- 95% CI for mean	-0.38 – -0.25	-0.48 – -0.31		
Test of significance	$F_{(GG)(df=1)}$=142.691	$F_{(GG)(df=1)}$=352.868		
- Partial Eta Squared	0.872	0.944		
- Observed Power	100%	100%		
- *p* value	*p*<.001*	*p*<.001*		
Post Hoc Pairwise comparison with Games-Howell				
3 months vs preoperative				
- Difference	-0.276		-0.407	
- 95% CI of Difference	-0.332 – -0.219		0.513 – 0.301	
- *p* value	<.001		<.001	
6 months vs preoperative				
- Difference	-0.590		-0.797	
- 95% CI of Difference	-0.719 – -0.460		0.972 – -0.622	
- *p* value	<.001		<.001	
6 months vs 3 months				
- Difference	-0.314		-0.391	
- 95% CI of Difference	-0.397 – -0.231		-0.497 – -0.284	
- *p* value	<.001		<.001	

n : Number of patients
Min-Max: Minimum – Maximum
S.D.: Standard Deviation
CI: Confidence interval
(GG): Greenhouse-Geisser
df= degree of freedom
Diff: mean difference
*: Statistically significant ($p<.05$)
NS: Statistically not significant ($p\geq.05$)

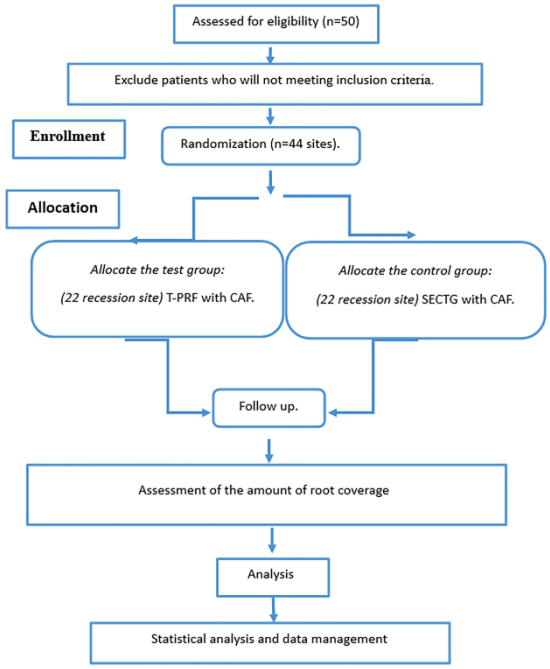

Figure 1: CONSORT 2010 Flow Diagram.

Figure 2: Surgical stages and follow up in a control group patient: (A, B, C) Pre-operative picture of upper left canine, first and second premolars with and without stent. (D, E) Surgical intervention with split full-split thickness flap according to the Zucchelli technique (F) Photographs of the donner site in the control case, trapdoor palatal donor site. (G) SECTG stabilization. (H) Immediately post operative. (I, J) Three months follow up with and without stent. (K, L) Six months follow-up.

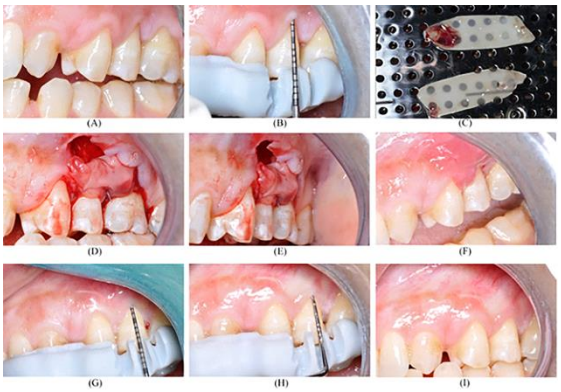

Figure 3: Surgical stages and follow up in a test group patients: (A, B) recession in upper left first and second premolars with and without stent. (C) T-PRF membrane prepared with the help of the PRF compression device (GRF box); (D, E) CAF and placement of the T-PRF membrane over the recession area; (F) a two weeks follow-up photograph. (G) a three month follow-up photograph. (H, I) a six month follow-up photograph with and without stent.

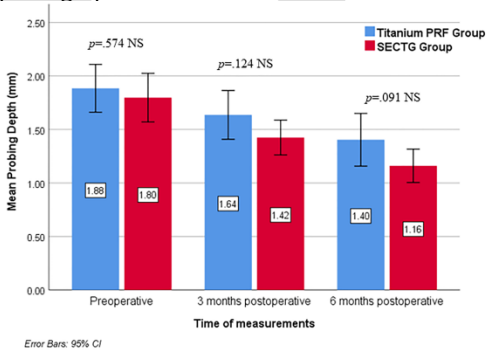

Figure 4: Clustered bar chart of mean Probing Depth (mm) in the two studied groups.

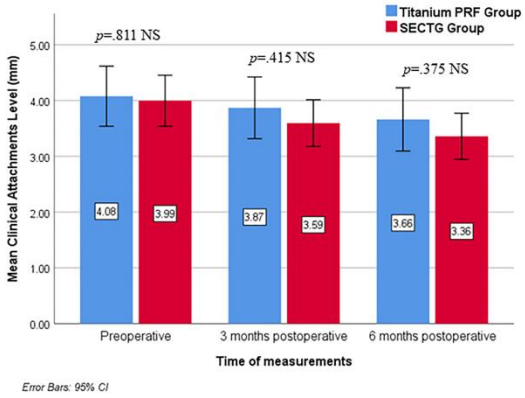

Figure 5: Clustered bar chart of mean Clinical Attachment Level (mm) in the studied groups.

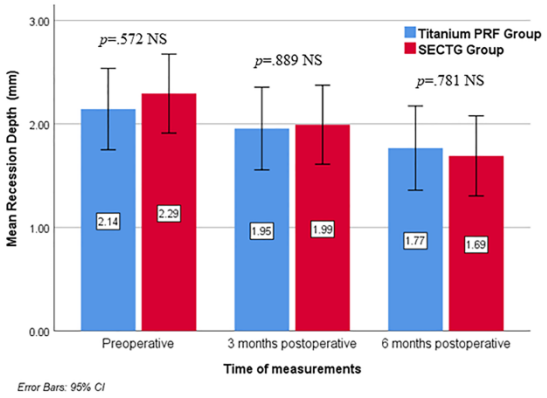

Figure 6: Clustered bar chart of mean Recession Depth (mm) in the studied groups.

DISCUSSION

Root coverage is a challenging procedure in periodontal treatment due to its high surgical morbidity and the need for expertise to obtain a large enough graft to ensure predictable outcomes. Multiple techniques have been proposed for the management of GR and modified over the years. Improvements have included approaches, instruments, and the nature of the used graft(1).

In the current study, CAF was standardized as the flap design to manage GR, and autogenous SECTG was used as the positive control as it is considered the gold standard and most predictable treatment option for root coverage(1).

The use of PRF in regenerative procedures has many advantages. In a histological study conducted by Sari et al. in 2020(23), PRF containing leukocyte (whether prepared by titanium tube or not) was shown to accelerate wound healing by prompting fibroblast activity and enhancing the capacity of fibroblasts to generate endothelial tissues.

Moreover, L-PRF enhanced angiogenesis by increasing the mitogenic activity of endothelial cells and stimulating the release of growth factors (GFs) at the wound site. These GFs are chemotactic for various cell types, (monocytes, fibroblasts, endothelial cells, stem cells, and fibroblasts) influencing the differentiation and proliferation of progenitor cells.(23,24)

Additionally, patients reported significantly less pain when L-PRF membranes were used to protect the palatal donor site. This was accompanied by less intake of analgesics during the early healing phase.(24)

To the best of our knowledge, this study is the first clinical trial to use a randomized controlled approach, testing T-PRF when used as a sole grafting material with CAF as an effective treatment option for RT2 defects, compared to CAF with SECTG.

The selection of T-PRF in the current study was based on the hypothesis that using a titanium tube would be better than the glass tube used in Chouckroun's PRF method(25). Furthermore, in a histological study conducted by **Tunali** et al., T-PRF was found to have a more organized fibrin network than other PRFs, and the T-PRF sample did not have any remnants from the silica glass tube in the PRF sample(14). The sample demonstrated a compact and thicker fibrin structure, which played a vital role in the prolongation of the time of fibrin resorption in the tissue and the amount of releasing growth factors over a more extended period(14).

Several studies have evaluated the safety and efficacy of using a T-PRF membrane with a CAF approach, but no previous study evaluated the use of a T-PRF membrane with a CAF approach in RT2(16,26). In line with the present study results, they concluded that it is safe and effective to use a T-PRF with CAF in treating Cairo RT1. Moreover, the use of T-PRF had the extra benefit of preventing donor site morbidity(16,26).

Interproximal attachment level is critical to determine the type of GR and the predictability of root coverage. Multiple studies used CAF with autogenous SECTG to manage RT2 defects, either by periodontist alone or with a multidisciplinary team(27-29).

The surgical management of RT2 defects is recognized as more complicated when compared to those of RT1, which is due to a partial loss of papilla and interdental bone, resulting in impairment of the recipient bed and blood supply to the grafted tissue. Moreover, larger recessions also have a less favorable prognosis. Full root coverage can be expected in RT1 GR. However, classes RT2 and RT3 have poor predictability when compared to RT1(30,31).

A systematic review and network meta-analysis by Cairo et al. (2020)(6) confirmed that SECTG provided better results than a soft tissue substitute (a biomaterial used as connective tissue replacements and should ideally shows certain properties, such as ease of adaptation and positioning at the level of the affected site, stabilization of the blood clot, integration with host tissues, and reduction in time and pain related to the removal of an autologous graft), as (acellular dermal matrix [taken form cadaver] and xenogeneic acellular matrix [taken from animals])(32) regarding some esthetic outcomes, which is consistent with our study findings. They suggested that the nature of the graft (like autogenous CTG and PRF) can influence the esthetic outcome, not the flap design. This fact was also highlighted by Tavelli et al. (2019) (33) when comparing CAF versus Tunnel Technique (TUN) in terms of esthetic score of the root coverage.

A group of researchers conducted a case series using SECTG with CAF to treat Miller's Class II and III GR in mandibular incisors. The study involved 10 patients with a total of 14 recession defects. After an average follow-up of 11.7 months,

the results showed that 90.22% ± 12.36% root coverage was achieved. The root coverage for Miller's Class II and III defects showed no significant difference. Out of the seven Miller's Class II sites, five (71.42%) achieved complete root coverage, while out of the seven Miller's Class III defects, three (42.85%) achieved complete root coverage. The findings are in accordance with our results indicating that utilizing the combination of SECTG + CAF is a successful approach in achieving root coverage. Furthermore, patients who underwent this procedure reported high levels of satisfaction with the esthetic outcome of the treated areas(34).

In the present study, T-PRF and SECTG groups showed a statistically significant reduction in mean PD. There was a statistically significant decrease in PD during follow-up periods when comparing the baseline to three months follow-up (p=.006) and from baseline to six months (p=0.004*), and a statistically insignificant difference from three to six months (p=.174). The comparison between both groups showed that this reduction was statistically significant, with better results for SECTG (p<.001).

In line with this observation, Katti et al. (2022)(35) found a statistically significant decrease in PD at the three- and six-month follow-ups in treating the RT2 with gingival unit grafts.

Also, the results in the study of Cairo et al., 2012, matched our findings. A statistically significant decrease in PD was found at three- and six-month follow-ups in a randomized controlled clinical trial in which fifteen patients were randomly assigned to CAF+CTG and fourteen patients were assigned to CAF alone(36).

In the present study, T-PRF and SECTG groups showed a statistically significant reduction in mean CAL. There was a statistically significant reduction in CAL during follow-up periods when comparing the baseline to three (p=*.002*) and from baseline to six-months follow-up (p=*.002*), and there was a statistically insignificant difference from three to six months (p=*.578*). The comparison between both groups showed that this reduction was statistically significant, with better results for SECTG (p<.001).

In accordance with this observation in the SECTG group, Ozcelik et al. (2011)(37) compared CAF procedure with or without orthodontic button application, the analysis of the mean differences of the clinical parameters between baseline and six months showed significant differences between groups for CAL (p<.001).

Also, Aroca et al. (2010)(38) were in line with our results. They compared the modified tunnel with CTG alone or with enamel matrix derivative (EMD) in the treatment of multiple recession RT2 with CAF. They observed that both groups showed significant post-surgical improvement in root coverage and CAL gain compared to baseline. In this randomized clinical trial, they considered all necessary clinical parameters. However, the influence of gingival phenotype in root coverage was not assessed.

In the present study, T-PRF and SECTG groups showed a statistically significant reduction in RD. There was a statistically significant reduction in RD for booth groups during follow-up periods when comparing the baseline to three months (p<.001), from the baseline to six months (p<.001), and from three to six months (p<.001). The RD in the two study groups showed statistically significant differences. The comparison between both groups showed that this reduction was statistically significant, with better results for SECTG (p<.001).

These results of the SECTG group were consistent with the findings of Aroca et al. (2010)(38) and (2018)(39). They showed a statistically significant post-surgical improvement in recession coverage using SECTG when compared to baseline.

In the present study, T-PRF and SECTG groups showed a statistically significant reduction in mean RW. There was a statistically significant decrease in RW during follow-up periods for both groups when comparing the baseline to three three-month follow-ups (p=.008) and from baseline to six six-month follow-ups (p= .017), and a statistically insignificant difference from three to six months (p=.146).

The comparison between both groups at three month follow up showed that this reduction was statistically insignificant, with better results for SECTG + CAF (p=.148), and at six month follow up showed that this reduction was statistically insignificant, with better results for SECTG + CAF (p=.253).

In line with the presented study, Abu-Ta'a (2023)(40) revealed that at six-months follow-up, a statistically significant reduction in RW was found between the two groups for RW (p=.045).

Also, in accordance with the presented study, Aroca et al. (2010)(39) showed statistically significant reductions in RW measurements from baseline to six-month and one-year data. That may be due to reduction in the RD together with increase of GT in the interproximal area.

It is important to note that this study has some limitations; the relatively small sample size and lack of information about the long-term stability of the results are other limitations. Moreover, one of the main limitations of this study was the lack of patient centered outcomes in the post operative evaluation.

CONCLUSION

Within the limitations of this study, the results showed that autogenous SECTG remains the gold standard for root coverage procedure. However, T-PRF is a safe and effective method for root coverage in RT2. It showed a positive effect in reducing PD, CAL, and RD. Therefore, this procedure can be recommended to treat GRs

without the need for additional surgery. Further RCTs with a larger sample size are essential to evaluate T-PRF efficacy in managing different types of GR with different approaches**.**

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CONFLICT OF INTEREST
There were no conflicts of interest.

REFERENCES

1. Zucchelli G, Mounssif I. Periodontal plastic surgery. Periodontol 2000. 2015;68:333-68.
2. Pecie R, Krejci I, Garcia-Godoy F, Bortolotto T. Noncarious cervical lesions--a clinical concept based on the literature review. Part 1: prevention. Am J Dent. 2011;24:49-56.
3. Cortellini P, Bissada NF. Mucogingival conditions in the natural dentition: Narrative review, case definitions, and diagnostic considerations. J Periodontol. 2018;89 Suppl 1:S204-s13.
4. Cairo F, Nieri M, Cincinelli S, Mervelt J, Pagliaro U. The interproximal clinical attachment level to classify gingival recessions and predict root coverage outcomes: an explorative and reliability study. J Clin Periodontol. 2011;38:661-6.
5. Zucchelli G, Marzadori M, Mounssif I, Mazzotti C, Stefanini M. Coronally advanced flap + connective tissue graft techniques for the treatment of deep gingival recession in the lower incisors. A controlled randomized clinical trial. J Clin Periodontol. 2014;41:806-13.
6. Cairo F, Barootchi S, Tavelli L, Barbato L, Wang HL, Rasperini G, et al. Aesthetic-And patient-related outcomes following root coverage procedures: A systematic review and network meta-analysis. J Clin Periodontol. 2020;47:1403-15.
7. Shepherd N, Greenwell H, Hill M, Vidal R, Scheetz JP. Root coverage using acellular dermal matrix and comparing a coronally positioned tunnel with and without platelet-rich plasma: a pilot study in humans. J Periodontol. 2009;80:397-404.
8. Ezzatt OM. Autologous Platelet Concentrate Preparations in Dentistry. Biomed J Sci Tech Res. 2018;8:6712-21.
9. Choukroun J. The role of platelet-rich fibrin (PRF) in periodontology. In: Choukroun J, (ed). An opportunity in perioimplantology: the PRF. French: Implantodontie; 2001. 55-62.
10. Eren G, Atilla G. Platelet-rich fibrin in the treatment of bilateral gingival recessions. Clin Adv Periodontics. 2012;2:154-60.
11. Ehrenfest DMD, Sammartino G, Shibli JA, Wang H-L, Zou D-R, Bernard J-P. Guidelines for the publication of articles related to platelet concentrates (Platelet-Rich Plasma-PRP, or Platelet-Rich Fibrin-PRF): the international classification of the POSEIDO. Poseido J. 2013;1:17-28.
12. Choukroun J, Diss A, Simonpieri A, Girard MO, Schoeffler C, Dohan SL, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part IV: clinical effects on tissue healing. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006;101:e56-60.
13. Tunalı M, Özdemir H, Küçükodacı Z, Akman S, Yaprak E, Toker H, et al. A novel platelet concentrate: titanium-prepared platelet-rich fibrin. Biomed Res Int. 2014;2014:209548.
14. Tunalı M, Özdemir H, Küçükodacı Z, Akman S, Fıratlı E. In vivo evaluation of titanium-prepared platelet-rich fibrin (T-PRF): a new platelet concentrate. Br J Oral Maxillofac Surg. 2013;51:438-43.
15. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. Jama. 2013;310:2191-4.
16. Uzun BC, Ercan E, Tunalı M. Effectiveness and predictability of titanium-prepared platelet-rich fibrin for the management of multiple gingival recessions. Clin Oral Investig. 2018;22:1345-54.
17. Rosner B. Fundamentals of Biostatistics. 7th ed. Boston: Cengage Learning; 2015.
18. Carter HG, Barnes GP. The Gingival Bleeding Index. J Periodontol. 1974;45:801-5.
19. Silberman SL, Le Jeune RC, Serio FG, Devidas M, Davidson L, Vernon K. A method for determining patient oral care skills: The University of Mississippi Oral Hygiene Index. J Periodontol. 1998;69:1176-80.
20. Saghaei M. Random allocation software for parallel group randomized trials. BMC Med Res Methodol. 2004;4:26.
21. Bruno JF. Connective tissue graft technique assuring wide root coverage. Int J Periodontics Restorative Dent. 1994;14:126-37.
22. Roth H, Thaller J, Alderman NE. The Charters Method of Toothbrush Massage: A Valuable Supplement in Periodontal Therapy. J Periodontol. 1956;27:309-12.
23. Sari R, Larasati GS, Kuncorowati NG, Syaify A. Platelet-rich fibrin (PRF) membranes accelerate open wound healing better than amniotic membranes: A histological study on the proliferation phase. Wound Medicine. 2020;31:100190.
24. Blanco J, García Alonso A, Hermida-Nogueira L, Castro AB. How to explain the beneficial effects of leukocyte-and platelet-rich fibrin. Periodontol 2000. 2024.
25. Özdemir H, Tunali M, Haydarpasa G, Akman S, Toker H, Firatli E. Titanium Prepared Platelet-Rich Fibrin for the Treatment of Gingival Recessions 2013.

26. Alaood O, Alasqah M, Alhomodi N, Alqahtani N, Gufran K, Shafiq S. Clinical Evaluation of the Efficacy of Coronally Advanced Flap in Combination with Platelet-Rich Fibrin Membrane in the Treatment of Miller Class I Gingival Recessions. Open Access Maced J Med Sci. 2020;8:7-13.
27. Lahham C, Ta'a MA. Clinical comparison between different surgical techniques used to manage advanced gingival recession (Miller's class III & IV). Heliyon. 2022;8:e10132.
28. Cairo F. Periodontal plastic surgery of gingival recessions at single and multiple teeth. Periodontol 2000. 2017;75:296-316.
29. Wessel JR, Tatakis DN. Patient outcomes following subepithelial connective tissue graft and free gingival graft procedures. J Periodontol. 2008;79:425-30.
30. Chan HL, Chun YH, MacEachern M, Oates TW. Does Gingival Recession Require Surgical Treatment? Dent Clin North Am. 2015;59:981-96.
31. Aroca S, Keglevich T, Nikolidakis D, Gera I, Nagy K, Azzi R, et al. Treatment of class III multiple gingival recessions: a randomized-clinical trial. J Clin Periodontol. 2010;37:88-97.
32. Rotundo R, Pancrazi GL, Grassi A, Ceresoli L, Di Domenico GL, Bonafede V. Soft Tissue Substitutes in Periodontal and Peri-Implant Soft Tissue Augmentation: A Systematic Review. Materials. 2024;17:1221.
33. Tavelli L, Ravidà A, Lin GH, Del Amo FS, Tattan M, Wang HL. Comparison between Subepithelial Connective Tissue Graft and De-epithelialized Gingival Graft: A systematic review and a meta-analysis. J Int Acad Periodontol. 2019;21:82-96.
34. Nart J, Valles C, Mareque S, Santos A, Sanz-Moliner J, Pascual A. Subepithelial connective tissue graft in combination with a coronally advanced flap for the treatment of Miller Class II and III gingival recessions in mandibular incisors: a case series. Int J Periodontics Restorative Dent. 2012;32:647-54.
35. Katti N, Mohanty D, Agrawal P, Raj SC, Pradhan SS, Baral D. Successful management of gingival recession with interdental attachment loss using gingival unit grafts. J Indian Soc Periodontol. 2022;26:373-7.
36. Cairo F, Cortellini P, Tonetti M, Nieri M, Mervelt J, Cincinelli S, et al. Coronally advanced flap with and without connective tissue graft for the treatment of single maxillary gingival recession with loss of inter-dental attachment. A randomized controlled clinical trial. J Clin Periodontol. 2012;39:760-8.
37. Ozcelik O, Haytac MC, Seydaoglu G. Treatment of multiple gingival recessions using a coronally advanced flap procedure combined with button application. J Clin Periodontol. 2011;38:572-80.
38. Aroca S, Keglevich T, Nikolidakis D, Gera I, Nagy K, Azzi R, et al. Treatment of class III multiple gingival recessions: a randomized-clinical trial. J Clin Periodontol. 2010;37:88-97.
39. Aroca S, Barbieri A, Clementini M, Renouard F, de Sanctis M. Treatment of class III multiple gingival recessions: Prognostic factors for achieving a complete root coverage. J Clin Periodontol. 2018;45:861-8.
40. Abu-Ta'a M. Advanced Platelet-Rich Fibrin and Connective Tissue Graft for Treating Marginal Tissue Recessions: A Randomized, Controlled Split-Mouth Study. Cureus. 2023;15:e35761.