Original Article

Comparison of Free Gingival Graft and Modified Apical Repositioned Flap Techniques to Create Attached Gingiva: Long-Term (2 Years) Retrospective Study

Yapışık Diş Eti Oluşturmak için Uygulanan Serbest Diş Eti Grefti ve Modifiye Apikale Repozisyone Flep Tekniklerinin Karşılaştırılması: Uzun Dönem (2 Yıl) Retrospektif Çalışma

[ID] Melis YILMAZ[1], [ID] Emrah TÜRKMEN[1], [ID] Nur BALCI[1], [ID] Hilal TOYGAR[1], [ID] Ali ÇEKİCİ[2]

[1]İstanbul Medipol University Faculty of Dentistry, Department of Periodontology, İstanbul, Türkiye
[2]İstanbul University Faculty of Dentistry, Department of Periodontology, İstanbul, Türkiye

ABSTRACT

Objective: An ideal anatomical component for maintaining gingival health is the attached gingiva. Increasing the width of the attached gingiva can be achieved using the predictable surgical methods of the modified apically repositioned flap (MARF) and the free gingival graft (FGG).

Methods: Fifteen (female) systemically and periodontally healthy patients were enrolled for this study. The treatment of a total of 21 teeth with recession in the lower jaw, absence of bone dehiscence, and attached gingiva ranging from a minimum of 0.5 mm to a maximum of 1.5 mm was conducted through FGG and modified apical positioned flap techniques. These procedures were randomly selected. Pocket depth on probing, gingival recession (GR), clinical attachment loss, bleeding index on probing, attached gingival width (AGW), keratinized tissue width and plaque index values were recorded before the surgical procedure and repeated at the 3rd month, 1st and 2nd years.

Results: The changes in GR levels at baseline, 3 months, first and second year in both the FGG and MARF groups were statistically significant (p=0.001; p<0.05). The changes observed in AGW levels at baseline, 3 months, first and second year in both MARF and FGG groups were statistically significant (p=0.001; p<0.05).

ÖZ

Amaç: Diş eti sağlığını korumak için ideal bir anatomik bileşen yapışık diş etidir. Yapışık diş eti bölgesinin artırılması, modifiye apikale repozisyone flep (MARF) ve serbest diş eti grefti (SDG) gibi öngörülebilir cerrahi yöntemler kullanılarak elde edilebilir.

Yöntemler: Bu çalışmaya sistemik ve periodontal açıdan sağlıklı 15 (kadın) hasta dahil edildi. Alt çenede diş eti çekilmesi bulunan, kemik dehisensi olmayan, yapışık diş eti minimum 0,5 mm ile maksimum 1,5 mm arasında değişen toplam 21 dişin tedavisi SDG ve MARF teknikleri ile gerçekleştirildi. Bu prosedürler rastgele seçilmiştir. Sondalamada cep derinliği, diş eti çekilmesi, klinik ataşman kaybı, sondalamada kanama indeksi, yapışık diş eti genişliği (YDG), keratinize doku genişliği ve plak indeksi değerleri cerrahi işlem öncesinde kaydedilerek 3. ay, 1. ve 2. yılda tekrarlandı.

Bulgular: Hem SDG hem de MARF gruplarında başlangıçta, 3. ayda, birinci ve ikinci yılda diş eti çekilme seviyelerindeki değişiklikler istatistiksel olarak anlamlıydı (p=0,001; p<0,05). Hem MARF hem de SDG gruplarında başlangıçta, 3 ayda, birinci ve ikinci yılda YDG düzeylerinde gözlenen değişiklikler istatistiksel olarak anlamlıydı (p=0,001; p<0,05).

ABSTRACT

Conclusion: Both techniques have been shown to result in a statistically significant increase in the width of keratinized tissue and the amount of attached gingiva in the long term.

Keywords: Free gingival graft, apically repositioned flap, attached gingiva

Clinical Trial Registration: The study was registered at ClinicalTrials.gov (NCT06253910).

ÖZ

Sonuç: Her iki tekniğin de uzun vadede keratinize doku genişliğinde ve yapışık diş eti miktarında istatistiksel olarak anlamlı bir artışa neden olduğu gösterilmiştir.

Anahtar Sözcükler: Serbest diş eti grefti, apikale repozisyone flep, yapışık diş eti

Klinik Araştırma Kaydı: Bu çalışma, "ClinicalTrials.gov" adresine kaydedilmiştir (NCT06253910).

Introduction

The attached gingiva serves to defend the periodontium from external harm, contributes to the stabilization of the gingival margin and prevents gingival recession (GR). It forms a strong barrier against physiological and friction forces with the thick collagen fibers attached to the bone (1). The dimensions of the attached gingiva differ based on the specific area within the oral cavity. In the consensus report published in 2015, it was reported that the width of the attached gingiva around the teeth should be at least 1 mm to maintain periodontal health (2). Adequate presence of attached gingiva facilitates enhanced efficacy in oral hygiene practices, thereby reducing the risk of periodontal inflammation (3).

The most widely accepted and implemented technique for addressing the deficiency of attached keratinized tissue is the free gingival graft (FGG). The FGG offers distinct advantages such as ample donor tissue availability and the capacity to address multiple teeth simultaneously (4). However, drawbacks associated with this technique encompass postoperative discomfort, unpredictability in color matching of tissues, and the necessity for an additional surgical procedure to obtain donor tissue (4). Carnio and Miller (5) described the modified apically repositioned flap (MARF) technique in 1999 as a method to increase the attached gingiva on multiple adjacent teeth. This surgical intervention employs a single horizontal incision at the designated site. The recognized advantages of employing the MARF technique include its surgical simplicity, ease of application, elimination of the requirement for a palatal donor site, reduced surgical duration, and a heightened predictability in achieving a harmonious color match of the tissues (5). Taking into consideration the advantages of the MARF technique, the authors suggest that it needs to be more widely implemented.

The aim of this study is to apply the frequently preferred FGG technique and the alternative MARF technique to areas with insufficient attached gingiva in order to establish attached gingiva. Furthermore, the objective is to assess changes in attached gingiva over the long-term period (baseline, 3rd month, 1st and 2nd year) resulting from the application of these techniques.

Methods

The present study was approved by the İstanbul Medipol Universitesi Non-Invasive Clinical Research Ethics Committee (decision no: 79, date: 18.01.2024) for the use and access of human subjects in research and was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2013. Fifteen (female) systemically and periodontally healthy patients were enrolled for this study. The general exclusion criteria were as follows: use of antibiotics and/or anti-inflammatory, non-steroidal anti-inflammatory drugs, steroids, immunosuppressants, beta-blockers, calcium channel blockers, anticoagulants, and hormonal contraceptives within 3 months preceding the study, smokers, surgical periodontal treatment (previous 12 mo.), having less than 15 natural teeth excluding third molar, diabetes, having systemic diseases such as rheumatoid arthritis and cardiovascular disorders. All participants gave oral informed consent.

The treatment of the total of 21 teeth with recession in the lower jaw, absence of bone dehiscence, and attached gingiva ranging from a minimum of 0.5 mm to a maximum of 1.5 mm, was conducted through FGG (FGG group, n=10; mean age of 39.5±5.85) and modified apical positioned flap (MARF group, n=11; mean age of 49.4±9.14) techniques. These procedures were randomly selected (coin toss) and applied by a single researcher.

Surgical methods were performed on a maximum of 2 teeth in the treated areas. At least 2 months before surgical procedures, patients received non-surgical periodontal treatment and oral hygiene practices were demonstrated. After applying surgical treatment to all patients, a simple numerical rating scale was used to assess postoperative comfort and pain approximately 10 days later. Patients were asked to provide a score between 0 (no pain) and 10 (unbearable pain) for the 10 days following the procedure.

Clinical Periodontal Parameters

To determine the periodontal status of the teeth to be treated, pocket depth on probing (PPD) (mm), GR (mm), clinical attachment loss (CAL) (mm), bleeding index on probing (BOP) (%), attached gingival width (AGW) (mm), keratinized tissue width (KTW) (mm) and plaque index (PI) values were recorded by 2 calibrated researchers. AGW was calculated by subtracting the PPD value from the KTW measurement value. Clinical periodontal parameters were recorded before surgical treatment (baseline) and repeated at third months, first and second years after treatment was completed.

Free Gingival Graft Technique

For the FGG surgery, a half-thickness flap was raised and expanded from approximately 0.5 mm coronal to the mucogingival border,

with a horizontal incision in the attached gingiva and two vertical incisions at the mesial and distal ends of the horizontal incision (6). Subsequently, donor tissue (10 mm x 5 mm) was harvested from the palatal region through a rectangular incision of 1-1.5 mm thickness (7). The wound bed that formed on the palate was promptly treated using local hemostatic measures. The tissue obtained from the palate was secured to the recipient site using 5-0 silk sutures, and a periodontal dressing was placed in the wound area. Immediately after the surgery, patients were instructed to avoid hot/acidic foods and beverages.

Modified Apically Repositioned Flap Technique

The MARF technique was implemented according to the previously established protocol by Carnio et al. (6). Following the administration of local anesthesia to the surgical area, a horizontal bevel incision was made from the mucogingival junction towards the attached gingiva, maintaining a distance of 0.5 mm with a no. 15 Bard-Parker scalpel. To avoid vertical relaxing incisions, a horizontal incision was extended mesiodistally to the buccal aspect of adjacent teeth parallel to the mucogingival attachment. The prepared half-thickness flap was secured apically to the periosteum using 5-0 silk sutures. To prevent dead space between the flap and the periosteal bed, gentle finger pressure was applied, and a periodontal dressing was placed in the wound area.

Statistical Analysis

The IBM SPSS Statistics 22 software was used for statistical analyses. The normal distribution of parameters was assessed using the Shapiro-Wilk test. For intergroup comparisons of parameters, the Mann-Whitney U test was utilized. Meanwhile, intragroup comparisons of parameters were conducted using the Friedman test and post hoc Wilcoxon signed-rank test. Significance was evaluated at the $p < 0.05$ level.

Results

The study was conducted with a total of 21 cases, ranging in age from 31 to 70. The mean age was 44.45±9.03 years.

Evaluation of periodontal parameters within and between groups is shown in Table 1 and Figure 1. Briefly, there was no statistically significant difference between the treatment groups in terms of PI, PPD, BOP, CAL, GR at baseline, 3 months, first and second years ($p > 0.05$). The changes in GR levels at baseline, 3 months, first and second years in both the FGG and MARF groups were statistically significant (p=0.001; p<0.05). The 3rd month, 1st year and 2nd year AGW level of the FGG group was statistically significantly higher than the MARF group (respectively: p=0.006; p=0.015; p=0.007; p<0.05). The changes observed in AGW levels at baseline, 3 months, first and second years in both MARF and FGG groups were statistically significant (p=0.001; p<0.05). The 3rd month and 2nd year KTW levels of the FGG group were statistically significantly higher than the MARF group (respectively: p=0.006; p=0.004; p<0.05). The changes in KTW levels at baseline, 3 months, 12 months, and 24 months in both the FGG and MARF groups were statistically significant (Table 1).

Table 1. Evaluation of periodontal parameters within and between groups

	FGG	MARF	
	Mean ± SD (median)	Mean ± SD (median)	[1]p-value
PI Baseline	0.68±0.65 (0.5)	1.03±0.7 (1.1)	0.192
3rd month	1±0.55 (1)	1.35±0.78 (1.6)	0.192
1st year	1.08±0.51 (1)	1.35±0.77 (1.5)	0.208
2nd year	0.78±0.72 (0.5)	1.13±0.6 (1.3)	0.220
[2]p	0.174	0.340	
PPD Baseline	1.3±0.4 (1.1)	1.23±0.32 (1.1)	0.806
3rd month	1.28±0.4 (1.1)	1.15±0.32 (1)	0.324
1st year	1.23±0.3 (1)	1.17±0.26 (1)	0.306
2nd year	1.26±0.4 (1.1)	1.15±0.3 (1)	0.320
[2]p	0.102	0.381	
BOP Baseline	12.5±17.68 (0)	7.5±16.87 (0)	0.399
3rd month	15±17.48 (12.5)	15±24.15 (0)	0.734
1st year	1.28±0.4 (1.1)	1.25±0.41 (1)	0.677
2nd year	1.35±0.52 (1)	1.4±0.43 (1.3)	0.425
[2]p	0.903	0.089	
GR Baseline	1.25±0.65 (1.1)	2.05±1.3 (1.5)	0.118
3rd month	1.20±0.66 (1)	1.83±0.95 (1.5)	0.102
1st year	1.08±0.61 (1)	1.70±0.95 (1.5)	0.099
2nd year	1.0±0.59 (1)	1.55±0.9 (1.5)	0.104
[2]p	0.001*	0.001*	
CAL Baseline	2.55±0.65 (2.5)	3.28±1.4 (2.6)	0.322
3rd month	2.48±0.66 (2.4)	2.98±0.82 (2.8)	0.148
1st year	2.35±0.63 (2.4)	2.95±0.79 (2.9)	0.072
2nd year	2.35±0.56 (2.3)	2.95±0.88 (2.9)	0.102
[2]p	0.141	0.314	
AGW Baseline	0.5±0.47 (0.5)	0.6±0.46 (0.8)	0.625
3rd month	4.3±1.16 (4)	2.8±0.79 (3)	0.006*
1st year	4.3±1.25 (5.5)	2.9±0.99 (4)	0.015*
2nd year	4.4±1.65 (5)	2.4±1.17 (3)	0.007*
[2]p	0.001*	0.001*	
KTW Baseline	1.7±0.63 (1.8)	1.6±0.46 (1.8)	0.840
3rd month	5.4±1.35 (5)	3.8±0.79 (4)	0.006*
1st year	5.38±1.72 (6)	3.76±1.15 (5)	0.005*
2nd year	5.27±1.57 (6)	3.06±1.17 (5)	0.004*
[2]p	0.001*	0.001*	

[1]Mann-Whitney U test, [2]Friedman test, *p<0.05
PPD: Pocket depth on probing, GR: Gingival recession, CAL: Clinical attachment loss, BOP: Bleeding index on probing, AGW: Attached gingival width, KTW: Keratinized tissue width, PI: Plaque index, FGG: Free gingival graft, MARF: Modified apically repositioned flap, KTW: Keratinized tissue width

The comparison of changes in the PI, PPD, BOP, GR, CAL, AGW, and KTW parameters of the treatment groups at baseline, 3rd month, 1st year, and 2nd year is presented in Table 2. Briefly, there was a statistically significant difference between the treatment groups in terms of the changes in BOP levels in the 24th month compared to the 12th month ($p=0.045$; $p<0.05$). The increase in AGW levels at 3 months, first and second years compared to baseline was statistically significantly higher in the FGG group than in the MARF group (respectively; $p=0.004$, $p=0.012$, $p=0.004$; $p<0.05$). The increase in KTW levels at 3 months, first and second years compared to baseline was statistically significantly higher in the FGG group than in the MARF group ($p=0.006$, $p=0.005$, $p=0.004$; $p<0.05$).

Patients reported a higher comfort score within the first 10 days after the FGG procedure compared to the MARF group, and this difference was statistically significant ($p=0.011$; $p<0.05$) (Table 3). The changes in representative cases for the FGG and MARF groups at baseline, 3rd month, 1st year, and 2nd year are showed in Figures 2 and 3.

Discussion

The main aim of this study is to evaluate the long-term changes in the formation of attached gingiva and keratinized tissue using the FGG and MARF methods. The width of attached gingiva and the amount of keratinized tissue increased significantly more with the FGG method compared to MARF, both techniques demonstrated a significant increase compared to the baseline.

Insufficient or lacking width of attached gingiva is a significant factor that increases susceptibility to periodontal disease and contributes to GR (1). For this purpose, various surgical techniques are being explored, and the FGG method is often preferred due to its successful outcomes (8-10). However, it has disadvantages such as the need for a donor site, the possibility of postoperative bleeding at the donor site, and color incompatibility at the recipient site (6). In order to eliminate the disadvantages of this technique, the MARF method was described in 1999 (5). With this technique, the need for a second surgical site and the problem of color incompatibility are eliminated.

To the best of our knowledge, there is only one study in the literature comparing MARF and FGG techniques in the long term (1 year) (6). Authors reported that, after 1 year, the FGG technique resulted in a greater amount of keratinized tissue and attached gingiva compared to the MARF technique. However, both methods resulted in a significant increase in AGW and KTW within their respective groups (6). In our results, similar to this study, the amounts of AGW and KTW at all time intervals (3rd month, 1st year, and 2nd year) were greater in the FGG technique compared to MARF. However, the increases in AGW and KTW amounts in both groups were statistically significant. The reason for this difference can be explained by the fact that in the FGG method, the recipient site is prepared more extensively compared to the MARF technique. In the FGG technique, the recipient site is prepared to be wider than the palatal tissue, considering postoperative shrinkage. In the MARF technique, it has been suggested that preparing the recipient site with a width of 4 mm in the apico-coronal direction is sufficient for the formation of an adequate width of attached gingiva after the procedure. Furthermore, Carnio et al. (6) reported that there was no difference between and within the groups in terms of PPD and GR after surgical procedures. In our study, in addition to PPD and GR, we also evaluated PI, BOP, and CAL levels. Similar to the previous study, while there was no statistically significant difference between groups and within groups in PD levels, GR levels showed a significant decrease within both groups (Table 1). The fact that clinical periodontal parameters (PI, BOP, PPD, GR,
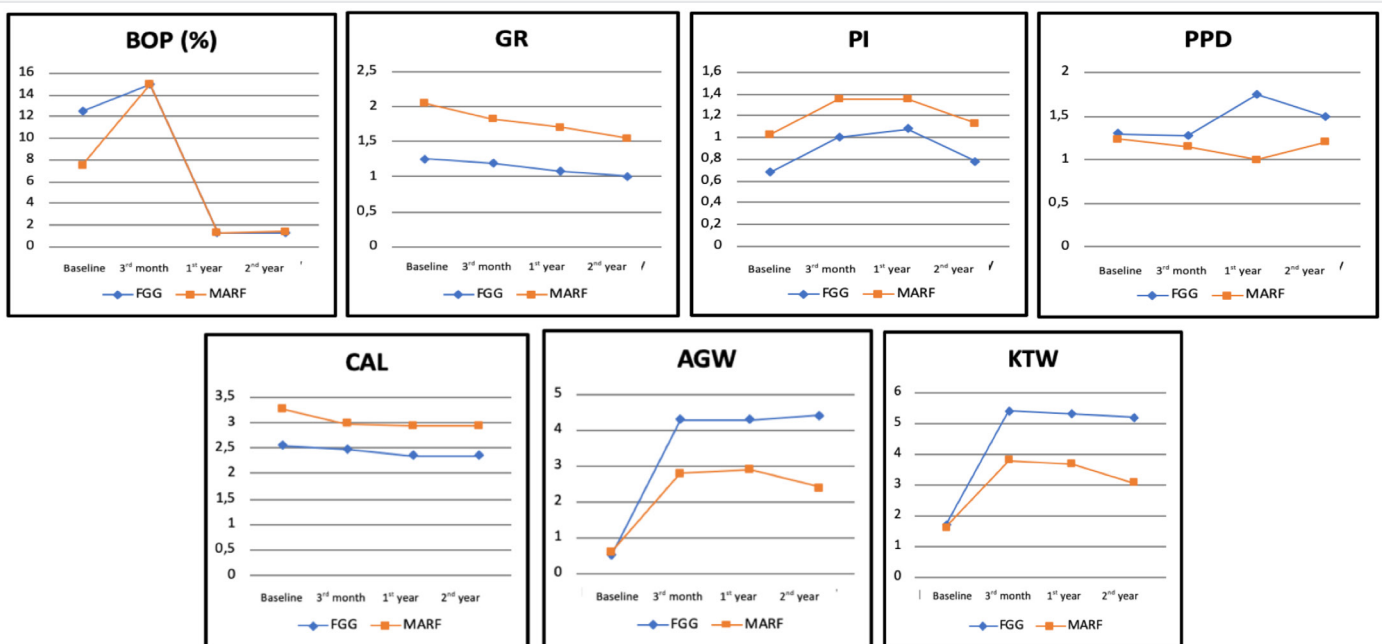

Figure 1. Evaluation of periodontal parameters within and between groups

Table 2. The comparison of changes in the PI, PPD, BOP, GR, CAL, AGW, and KTW parameters of the treatment groups at baseline, 3 months, 1 year, and 2 years

	FGG	MARF	
	Mean ± SD (median)	Mean ±SD (median)	p-value
PI 0-3	0.33±0.46 (0.1)	0.33±0.58 (0.4)	0.939
PI 0-12	0.4±0.49 (0.3)	0.33±0.66 (0.4)	0.819
PI 0-24	0.1±0.52 (0)	0.1±0.39 (0)	1.000
PI 3-12	0.08±0.17 (0)	0±0.12 (0)	0.304
PI 3-24	-0.23±0.64 (-0.1)	-0.23±0.65 (-0.4)	0.819
PI 12-24	-0.3±0.67 (-0.3)	-0.23±0.7 (-0.4)	0.939
PPD 0-3	-0.03±0.28 (0)	-0.08±0.17 (0)	0.233
PPD 0-12	-0.03±0.28 (0)	0.03±0.38 (0)	0.544
PPD 0-24	0.05±0.39 (0)	0.18±0.43 (0)	0.442
PPD 3-12	0±0 (0)	0.1±0.32 (0)	0.317
PPD 3-24	0.08±0.47 (0)	0.25±0.42 (0.1)	0.258
PPD 12-24	0.08±0.47 (0)	0.15±0.24 (0.1)	0.331
BOP 0-3	2.5±18.45 (0)	7.5±12.08 (0)	0.543
BOP 0-12	5±19.72 (0)	2.5±21.89 (0)	0.868
BOP 0-24	12.5±21.25 (12.5)	0±23.57 (0)	0.273
BOP 3-12	2.5±7.91 (0)	-5±25.82 (0)	0.584
BOP 3-24	10±12.91 (0)	-7.5±26.48 (0)	0.060
BOP 12-24	7.5±12.08 (0)	-2.5±7.91 (0)	0.045*
GR 0-3	-0.05±0.16 (0)	-0.23±0.43 (0)	0.486
GR 0-12	-0.18±0.21 (-0.1)	-0.35±0.41 (-0.3)	0.444
GR 0-24	-0.25±0.2 (-0.3)	-0.5±0.5 (-0.4)	0.311
GR 3-12	-0.13±0.18 (0)	-0.13±0.18 (0)	1.000
GR 3-24	-0.2±0.2 (-0.3)	-0.28±0.32 (-0.3)	0.748
GR 12-24	-0.08±0.17 (0)	-0.15±0.24 (0)	0.516
CAL 0-3	-0.08±0.43 (0)	-0.3±0.69 (0)	0.549
CAL 0-12	-0.2±0.4 (-0.1)	-0.33±0.77 (-0.1)	0.875
CAL 0-24	-0.2±0.47 (-0.3)	-0.33±0.76 (-0.3)	0.908
CAL 3-12	-0.13±0.18 (0)	-0.03±0.32 (0)	0.518
CAL 3-24	-0.13±0.57 (-0.1)	-0.03±0.42 (-0.1)	0.641
CAL 12-24	0±0.54 (0)	0±0.17 (0)	0.679
AGW 0-3	3.8±1.06 (3.8)	2.2±0.89 (2.5)	0.004*
AGW 0-12	4.1±1.21 (5.3)	3.1±1.03 (3.5)	0.012*
AGW 0-24	4.2±1.47 (4.8)	2.8±1.16 (3)	0.004*
AGW 3-12	1±0.47 (1)	1.1±0.57 (1)	0.654
AGW 3-24	1.1±0.88 (1)	0.6±0.97 (0,5)	0.249
AGW 12-24	0.1±0.88 (0)	-0.5±0.53 (-0,5)	0.104
KTW 0-3	3.4±1.09 (3.3)	2.2±0.89 (2.5)	0.006*
KTW 0-12	4.3±1.6 (4.8)	3.2±1.24 (3.8)	0.072
KTW 0-24	4.7±1.31 (4.8)	3±1.22 (3)	0.005*
KTW 3-12	1.1±0.74 (1)	1.2±0.79 (1)	0.744
KTW 3-24	1.3±0.95 (1)	0.8±1.03 (1)	0.324
KTW 12-24	0.2±0.92 (0.5)	-0.4±0.52 (0)	0.107

Mann-Whitney U test, *p<0.05
PPD: Pocket depth on probing, GR: Gingival recession, CAL: Clinical attachment loss, BOP: Bleeding index on probing, AGW: Attached gingival width, KTW: Keratinized tissue width, PI: Plaque index

Table 3. Discomfort score within the first 10 days after surgical procedures

	Discomfort score
	Mean ± SD (median)
FGG	7.0±0.82 (7)
MARF	5.2±1.55 (5)
p-value	0.011*

Mann-Whitney U test, FGG: Free gingival graft, MARF: Modified apically repositioned flap, SD: Standard deviation, *p<0.05

Figure 2. The changes in representative cases for the FGG: at baseline (a), after FGG procedure (b), at 3rd month (c), at 1st year (d), at 2nd year (e)

FGG: Free gingival graft

CAL) did not differ between the two groups at all time intervals showed that the MARF technique supported periodontal health at least as much as the FGG technique (Tables 1, 2).

Carnio et al. (11) reported an average increase of 3.6 mm in keratinized tissue and 2.21 mm in attached gingiva after following 21 teeth treated with the MARF technique for 1 to 11 years. In another study by Carnio et al. (12), where they evaluated the MARF technique over a period of 4 to 16 years, an average gain of 2.06 mm in keratinized tissue and an increase of 2.15 mm in attached gingiva width were reported. Moreover, both studies reported no significant differences in GR and PPD levels after the procedures (11,12). In a study with a 13-year case follow-up, it was reported that there was an average increase of 2.5 mm in attached gingiva and a 3 mm increase in keratinized gingival width compared to the baseline (13). In our study, an average increase of 2.2 mm in attached gingiva width was observed at the end of the third month compared to the baseline, 2.3 mm at the end of the first year and 1.8 mm at the end of the second year. The width of keratinized tissue increased by an average of 2.2 mm at the end of the third month compared to the baseline, 2.1 mm at the end of the first year, and 1.46 mm at the end of the second year. The results of our study are compatible with other clinical studies and case reports aiming to increase the amount of attached gingiva with the MARF technique (6,11-14).

In our study, post-op comfort was also evaluated and scored by the patients with a simple numerical scale (0-10). As a result, patients stated that MARF technique was more comfortable and caused less postoperative pain (Table 3). Parallel to our study, a study evaluating post-procedure comfort as more or less found the MARF method to be more comfortable.[6] These results suggest that the MARF method will be a more preferred method by patients in the future.

Study Limitations

The main limitation of this clinical study comparing MARF and FGG methods in the long term is the small sample size. Additionally, the measurement of keratinized and AGW using only a visual method can be identified as another limitation. In future studies, it is considered essential to increase the sample size, record the procedure duration and the correlation between duration and patient comfort should not be overlooked.

Conclusion

Both techniques have been shown to result in a statistically significant increase in the width of keratinized tissue and the amount of attached gingiva in the long term. However, MARF technique has many advantages, including not requiring a second surgical site, being technically simpler, providing more postoperative comfort for patients and achieving better tissue color match. Although it is not applicable for root coverage like FGG, the advantages of the MARF technique lead to the consideration of it as an alternative to FGG.

Ethics

Ethics Committee Approval: The present study was approved by the İstanbul Medipol University Non-Invasive Clinical Research Ethics Committee (decision no: 79, date: 18.01.2024) for the use and access of human subjects in research and was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2013.

Informed Consent: All participants gave oral informed consent.

Authorship Contributions

Surgical and Medical Practices: M.Y., N.B., H.T., Concept: E.T., A.Ç., Design: M.Y., E.T., Data Collection or Processing: H.T.,

Figure 3. The changes in representative cases for the MARF: at baseline (a), after FGG procedure (b), at 3rd month (c), at 1st year (d), at 2nd year (e)

FGG: Free gingival graft, MARF: Modified apically repositioned flap

Analysis or Interpretation: N.B., Literature Search: M.Y., E.T., A.Ç., Writing: M.Y.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Bartold PM, Narayanan AS. Molecular and cell biology of healthy and diseased periodontal tissues. Periodontol 2000. 2006;40:29-49.

2. Scheyer ET, Sanz M, Dibart S, Greenwell H, John V, Kim DM, et al. Periodontal soft tissue non-root coverage procedures: a consensus report from the AAP Regeneration Workshop. J Periodontol. 2015;86(2 Suppl):73-6.

3. Mehta P, Lim LP. The width of the attached gingiva--much ado about nothing? J Dent. 2010;38:517-25.

4. Cevallos CAR, de Resende DRB, Damante CA, Sant'Ana ACP, de Rezende MLR, Greghi SLA, et al. Free gingival graft and acellular dermal matrix for gingival augmentation: a 15-year clinical study. Clin Oral Investig. 2020;24:1197-203.

5. Carnio J, Miller PD Jr. Increasing the amount of attached gingiva using a modified apically repositioned flap. J Periodontol. 1999;70:1110-7.

6. Carnio J, Camargo PM, Pirih PQ. Surgical Techniques to Increase the Apicocoronal Dimension of the Attached Gingiva: A 1-Year Comparison Between the Free Gingival Graft and the Modified Apically Repositioned Flap. Int J Periodontics Restorative Dent. 2015;35:571-8.

7. Keceli HG, Aylikci BU, Koseoglu S, Dolgun A. Evaluation of palatal donor site haemostasis and wound healing after free gingival graft surgery. J Clin Periodontol. 2015;42:582-9.

8. Schmitt CM, Tudor C, Kiener K, Wehrhan F, Schmitt J, Eitner S, et al. Vestibuloplasty: porcine collagen matrix versus free gingival graft: a clinical and histologic study. J Periodontol. 2013;84:914-23.

9. Kothiwale S, Ajbani J. Innovative use of increasing the width of attached gingiva using chorion membrane along with platelet rich fibrin membrane. Cell Tissue Bank. 2021;22:389-98.

10. Wei PC, Laurell L, Geivelis M, Lingen MW, Maddalozzo D. Acellular dermal matrix allografts to achieve increased attached gingiva. Part 1. A clinical study. J Periodontol. 2000;71:1297-305.

11. Carnio J, Carnio AT, Pirih FQ, Cordero MG, Camargo PM. The Modified Apically Repositioned Flap Technique and Its Potential to Create Attached Gingiva in Areas with No Keratinized Tissue: A Long-Term (1 to 11 Years) Retrospective Case Series Study. Int J Periodontics Restorative Dent. 2020;40:103-9.

12. Carnio J, Camargo PM, Klokkevold PR, Pirih FQ. The Modified Apically Repositioned Flap Technique: A Long-Term (4 to 16 Years) Retrospective Study. Int J Periodontics Restorative Dent. 2018;38:519-24.

13. Carnio J, Camargo PM, Klokkevold PR, Lin YL, Pirih FQ. Use of the Modified Apically Repositioned Flap Technique to Create Attached Gingiva in Areas of No Keratinized Tissue: A Clinical and Histologic Evaluation. Int J Periodontics Restorative Dent. 2017;37:363-9.

14. Ughabharathy R, Balu P, Muthu J, Saravanakumar R, Vineela K, Karthikeyan I. Clinical Evaluation of Increase in the Width of Attached Gingiva using Modified Apically Repositioned Flap: A 9-Month Follow-up Study. Contemp Clin Dent. 2018;9:200-4.