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ORIGINAL ARTICLE

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Abstract

Objective: **The objective of this randomized clinical trial was to analyze the clinical outcomes of labial gingival tissue augmentation throughout stage II implant surgery in patients with thin gingival phenotype using the free subepithelial connective tissue graft (FSCTG) versus the omega roll envelope flap technique (OREF).**

Patients and methods: **Sixteen patients with thin gingival phenotype (<1.5 mm) got 20 implants in this 6-month follow-up randomized clinical trial and were split into two groups. Group I: eight patients got 10 implants in stage I surgery and got OREF for labial soft tissue augmentation in stage II surgery. Group II: eight patients got 10 implants in stage I surgery and FSCTG in stage II surgery. The clinical parameters of gingival thickness (GT), width of keratinized mucosa (KM), visual analog scale, and pink esthetic score were estimated at baseline, 1, 3, and 6-month follow-up intervals. Comparisons of GT and KM among groups and observation times were made suing repeated measures analysis of variance followed by Bonferroni test for multiple comparisons. For all tests, *P* value less than or equal to 0.05 was set as significant.**

Results: **Both groups' averages of GT and KM increased statistically significantly. Yet, over the course of the study's follow-up intervals, there was no significant difference in the means of GT among the two groups. The mean values of the pink esthetic score increased significantly within both groups. Means of visual analog scale of group II were statistically substantially more than those of group I at the 1- and 3-month follow-up intervals.**

Conclusion: **The OREF procedure is useful in enhancing the dimensions of thin facial gingival tissue surrounding dental implants. When compared with SCTG as a phenotype-modifying therapy surrounding dental implants, the OREF technique may be considered a novel and appropriate treatment option due to its convenience, good patient acceptance, and less postoperative discomfort. The choice between these two approaches may depend on the particular clinical situation, preferences of the patient, and the intended results of augmentation.**

Keywords: Gingival phenotype, Omega roll, Subepithelial connective tissue graft

Abbreviations: CBCT, cone beam computed tomography; FGG, free gingival graft; FSCTG, free subepithelial connective tissue graft; GP, gingival phenotype; GT, gingival thickness; KM, width of keratinized mucosa; OREF, omega roll envelope flap technique; PES, pink esthetic score; PMT, phenotype-modifying therapy; SCTG, subepithelial connective tissue graft; VAS, visual analog scale.

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Introduction

It places a strong emphasis on offering patients comprehensive restoration solutions that not only restore normal gingival contour, function, appearance, speech, and general health but also seamlessly integrating implants into the jawbone.[1]

Thanks to developments in both implant technology and surgical methods, physicians can now expect a successful osseointegration, which guarantees that implants are securely integrated with the jawbone. The main goals are to promote long-term dental health and restore complete oral health, including speech, appearance, and natural function. Ultimately, patient satisfaction is the key indicator of success in contemporary implant dentistry, highlighting the significance of attaining ideal functional and esthetic results.[2]

Among the variables impacting the outcome of restorative treatments in dental practice is thought to be periodontal phenotype. Three key characteristics are used to categorize periodontal phenotypes. Bone biotype, width of keratinized mucosa (KM), and gingival thickness (GT) are these three indicators. For keeping the health of the periodontium, each of these components is crucial.[3,4]

In certain instances, labial or buccal gingival tissue deficiency (i.e. width and thickness) surrounding the dental implant can negatively impact the esthetic results of the implant therapy. This is typically apparent in patients who fail to follow proper oral hygiene measures and exhibit significant levels of dental plaque deposition, as this is the primary cause of peri-implantitis.[5]

Furthermore, patients have an increased chance of gingival recession, which exposes metal to the oral environment and makes implants unsightly for the patients.[6] While bone morphotype and GT are known to affect the course of treatment, different periodontal phenotypes react differently to restorative and surgical approaches. Poor treatment outcomes following surgery are associated with a thin gingival phenotype (GP). In patients with thin GT, additional surgeries are usually necessary, but in those with thick GP, a simple approach can be used.[7,8]

Phenotype-modifying therapy (PMT) aims to improve the GT, KT, and bone biotype that make the entire GP. Improved stability and health of periodontal tissues, especially those surrounding dental implants, are the goals of this therapy. It has been demonstrated that PMT approaches, including the use of soft tissue grafts, collagen membrane, and acellular dermal matrix allograft, considerably enhance GT and KT around natural teeth; autogenous soft tissue grafts are optimal for both results.[9]

Subepithelial connective tissue graft (SCTG) used in PMT may prevent gingival recession and establish a stable environment for dental implants, hence promoting long-term peri-implant health.[10] Gingival recession surrounding implants may be lessened by surgically altering the soft tissue morphotype, which would be favorable for the healthy soft tissue surrounding implants.[11] Improving the soft tissue surrounding dental implants is a very important part of implant dentistry, with the goal of enhancing the implants' durability as well as their esthetic results. As a result, multiple surgical techniques for augmenting soft tissue were created to boost width and/or thickness of soft tissue and address crestal inadequacies. These methods include free gingival graft (FGG), SCTG, roll flap technique, and the modified roll flap technique.[12]

Concerning augmentation of soft tissue around the implant, the gold standard is SCTG. In terms of biology, SCTG can cause mesenchymal cells to differentiate into fibroblasts, which fosters the growth of epithelial cells and, as a result, aids in the regulation of the soft tissue phenotype. However, the main disadvantages of such an approach include the liability of patient discomfort at the second surgical site, limited availability of tissue, and postoperative donor-site morbidity.[13,14]

It has been demonstrated that the pouch roll technique effectively treats peri-implant mucosal deficiency, resulting in a GT of more than 3 mm and a 2–3-mm increase in the KT surrounding the implant without the need for sutures.[15]

The omega roll envelope flap (OREF) technique is suitable in both one-stage and two-stage implant-prosthetic techniques. It increases horizontal buccal soft tissue thickness using the supracrestal connective tissue at the implant site, and hence eliminating the need to harvest tissue from a donor site.[16]

As far as we are aware, no clinical trials have been suggested to compare or completely examine the impact of the OREF technique on peri-implant clinical parameters. Thus, the objective of this clinical research was to analyze the clinical results of augmenting the labial soft tissue during the second stage dental implant surgery in patients with thin periodontal phenotype using the OREF versus free subepithelial connective tissue graft (FSCTG). The null hypothesis for this research is that there is no difference among both techniques in improving the soft tissue profile surrounding dental implants and in patient satisfaction.

Patients and methods

Sixteen patients seeking implant placement in the esthetic zone of the maxilla were selected from the Department of Oral Medicine, Periodontology, Oral Diagnosis, Faculty of Dentistry, Mansoura University. Actual allocation started in May 2021 until February 2022.

Ethics information

The research proposal was accepted by the Ethics Committee of Mansoura University, Egypt (IRB Number: M02060721) according to the ethical guidelines of the Declaration of Helsinki.[17].

Study design

The patients were split into two equal groups: the study group (group I) and the control group (group II). All patients were seeking implant placement at the upper anterior or premolars area with thin GP (<1.5 mm). Group I included eight patients who received 10 implants at stage I and OREF for labial soft tissue augmentation at stage II of the implant surgery. Group II included eight patients who received 10 implants at stage I and FSCTG for labial soft tissue augmentation at stage II of implant surgery.

Patient population

All study patients had the same chief complaint of missing tooth or teeth in the esthetic zone. All participants were subjected to extraoral examination and intraoral examinations to confirm study patients' appropriateness to the study protocol.

Sample size calculation

The size of the sample was determined using G*Power program (University of Düsseldorf, Düsseldorf, Germany). Twenty cases (10 case per group) were enough to find out variations in clinical outcomes among groups, with an 80 % power of analysis at 5 % as a significance level.

Randomization

Patients were split into two groups in a random way as stated before. Random enrollment was done first by a nonstudy person. Study participants had numbers. One examiner randomly enrolled patients into each group with an allocation ratio of 1 : 1, using a computer program (Excel 2013 v15.0, Microsoft Windows, RAND function). The clinician and all patients were blinded to the used surgical procedures till the beginning of the procedure (Fig. 1).

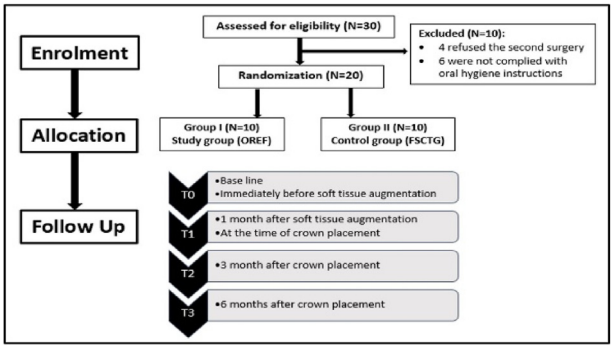

Fig. 1. Flowchart showing the 0 study design and follow-up intervals.

Inclusion criteria:

(1) Participants should be systemically healthy.[18]
(2) Age more than or equal to 21 years.[19]
(3) Single implant or more required in the esthetic zone.
(4) Facial GT less than 1.5 mm.[20]
(5) A buccolingual ridge width of at least 5.5 mm.[19]
(6) No significant hard or soft tissue loss.
(7) Minimal bone height of 10 mm.[21]

Exclusion criteria:

(1) Smoking more than 10 cigarettes per day.[19]
(2) Periodontitis and/or rampant caries.
(3) Medications that would affect postoperative healing and/or osseointegration.[21]
(4) Interocclusal space deficiency.
(5) Lack of patient compliance.

The study population signed informed consent forms after discussing the purpose of the study, both the treatment options used, and clarifying the possible postoperative complications.

Preoperative procedures

Complete medical and dental histories were taken from all patients before the beginning of any surgical procedures. Planned surgical sites were assessed for both mesiodistal dimensions and buccolingual dimensions of the surgical site, and the KM and GP either thin or thick gingiva were determined.[22] Preoperative photographs were taken using a digital camera (D5200, Nikkor, Medical Objective ring flash; Nikon Corporation, Tokyo, Japan) as a baseline record before beginning with the proposed treatment plan. Preoperative cone beam computed tomography using the i-CAT Next Generation Cone Beam 3D System by Imaging Sciences International, Hatfield, Pennsylvania, USA

was taken to assess the bone dimensions and the average relative bone density at the surgical site.

Surgical steps

All study participants had prophylactic antibiotic of 1 g Amoxicillin Clavulanate (Augmentin, tablets, 1 g; GlaxoSmithKline, Cairo, Egypt) 1 h before implant placement procedures and every 12 h for 5 days postoperatively. A solution of 0.1 % chlorohexidine gluconate mouthwash (Kahira Pharm. & Chem. Ind. Co, Cairo, Egypt) was prescribed for all patients for 1-min preoperatively. All surgical steps were performed after injection of local anesthesia (Articaine hydrochloride 4 % with 1 : 100.000 epinephrine; Septanest SP, Septodont Holdings, France).

Stage I (implant placement): surgical steps were done within the aseptic environment. Local anesthetic solution was injected buccally (1.5 ml) and palatally (0.3 ml). Using blade no. 15, horizontal incision was done over the crest of the alveolar bone slightly directed palatally within the KM for better vision and more secured flap approximation. At that point, a sulcular incision was directed mesially and distally to the adjacent teeth for better full thickness flap reflection and exposure of the alveolar bone to allow for easy drilling during implant placement procedures. The palatal flap was minimally raised to maintain blood supply to the bone. The site of osteotomy was prepared with a 2 mm pilot drill through the crest of the alveolar bone at the planned site of implant placement with saline irrigation during the whole surgical steps then parallel pins were used to verify that the desired angulations of the implants were correct. Subsequent drilling was done to prepare the site to receive the planned implant size. The implant (B&B Dental Implant Company – Via San Benedetto, San Pietro in Casale (BO), Italy) was placed with a minimum torque of 35–40 N-cm to ensure that primary stability is achieved. The implant was submerged under the margin of the crest by 1 mm, then a covering screw was inserted with a torque of 30 N-cm. A simple interrupted suture was done to close the flab using a 5-0 monofilament polypropylene suture (PROLENE Polypropylene Suture; Ethicon US, LLC. 2022 Route 22 West, Somerville, NJ 08876, United States). Postoperative instructions were explained to the patients. Sutures were removed 10 days postoperatively and the patients were advised to return to normal oral hygiene measures.

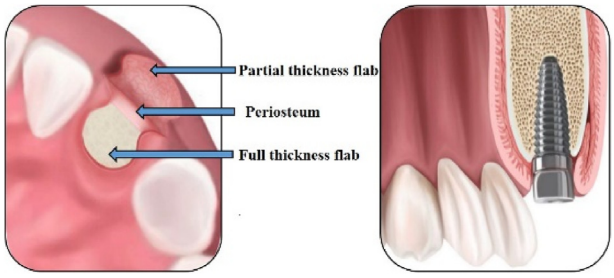

Fig. 2. Schematic diagram showing the whole procedure in group I (omega roll flap) (original).

Stage II surgery (4–6 months postoperatively)

Group I – omega roll envelope flap

The full-thickness para marginal incision extended adjacent to the mesial and distal teeth was done using a 15-c blade. The incision started from the buccal side of the flap and extended palatally in a semicircular pattern following the design of Greek letter omega (Ω) (Figs. 2 and 3). The minimum diameter of the palatal circular part of the flap is 3.4 mm.

The palatal semicircular part of the flap was de-epithelialized using a 15-c blade and elevated to full thickness with a microperiosteal elevator. In this way, the circular portion of the connective tissue above the central crest is exposed and enveloped gently with tissue forceps in the partial thickened vestibular portion of the flap. The healing abutment

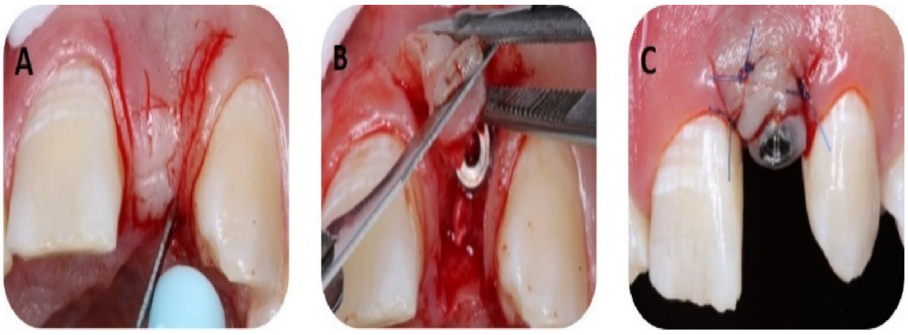

Fig. 3. (A) Full-thickness para marginal incision started from the buccal side of the flap and extended palatally in a semicircular pattern following the design of the Greek letter omega (Ω). (B) De-epithelialization of the circular part of the flap using a scalpel blade no.15-c. (C) Suture using the 5-0 polypropylene.

was customized by composite using a special index and screwed to the implant (Fig. 3).

The semicircular incision was extended buccally to facilitate the envelope of connective tissue to obtain a buccal connective tissue pedicle of minimum 2 mm depth. The connective tissue pedicle stabilized with a "U" stitch around the healing abutment using a 5-0 monofilament polypropylene nonabsorbable suture material to facilitate optimal wound healing (Fig. 4).[23]

Group II – free subepithelial connective tissue graft

A crestal incision was performed using a 15-c blade followed by partial thickness flab elevation in the buccal direction for placement of the FSCTG. Autogenous FGG was obtained from the palate, then the graft is ready for de-epithelization to obtain SCTG with copious irrigation to avoid necrosis of the graft. The palatal defect was filled with gel foam and sutured with 5-0 poly-propylene sutures (Fig. 5). The FSCTG was applied at the same side using a micro-mucoperiosteal elevator to allow adequate application of the soft tissue graft. Finally, a 5-0 poly-propylene suture was used to fix FSCTG to the mucoperiosteum to secure its stability through the time of healing. A suture was done for proper covering of the dental implant together with the graft placed around the healing abutment (Fig. 6).

Postoperative instructions

All study patients were informed to have Diclofenac potassium, 50 mg (Pharco, Alexandria, Egypt),

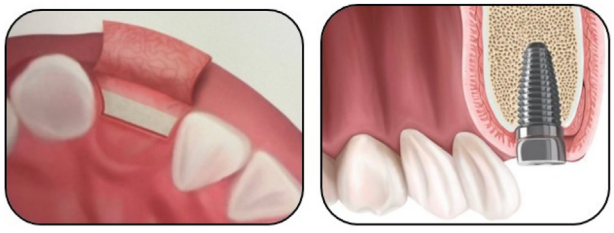

Fig. 4. Schematic diagram showing preparation of the recipient site in group II (connective tissue graft) (original).

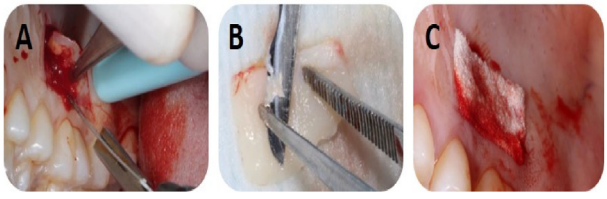

Fig. 5. (A) Harvesting free gingival graft using a 15-c blade. (B) De-epithelization of the free gingival graft. (C) Gel foam placed in the palatal defect.

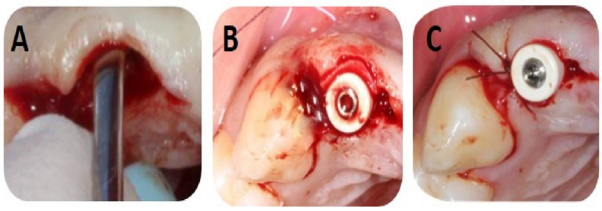

Fig. 6. (A) Preparing the recipient site in group II. (B) FSCTG placed at the recipient site. (C) Suturing using a 5-0 poly-propylene suture. FSCTG, free subepithelial connective tissue graft.

5–7 days, three times daily. Amoxicillin, 500 mg, 7 days, three times daily (Misr Co. for Pharmaceutical Industries, October Pharma S.A.E-Egypt) and chlorhexidine digluconate mouthwash (0.12 %) for 2 weeks (Kahira Pharma & Chem. Ino., Cairo, Egypt). All patients were advised to keep good oral hygiene, get only soft texture food, use ice bags for the first day, and then warm bags for the succeeding 2 days. Ten days after surgery, sutures were removed.

Prosthetic phase

Twenty-one days following stage II surgery, the gingival former was unscrewed and the scan body for MEDIT were screwed into fixtures, then the digital impression was taken using MEDIT scanner i500 (Medit Corp., South Korea) The digital impression was sent to the dental laboratory for making titanium custom abutment for the patient and CAD/CAM zircon crown according to the selected shade for the patient by EXO-CAD. The abutment was tried in the patient mouth and the try-in crown to ensure the crown and the custom abutment achieve all essential requirements from stability and retention and then the final prosthesis was inserted and cemented by glass ionomer cement.

Postoperative follow-up

Every 1 month after crown placement, the patients were followed up. At these visits, any prosthetic complications, or patient's discomforts were estimated. The general condition of the soft tissues and oral hygiene were also estimated and more directions were given when required. At the 6 month visit, all study participants were enquired about their satisfaction with cosmetic results of the implant treatment and any discrepancies in the gingival tissues around the implant.

Parameters assessment

Assessment was done by an autonomous examiner, who was unaware of the surgical technique

used. GT around the implant was estimated at the baseline (T0), 1 month following soft tissue augmentation (T1), 3 months following placement of fixed restoration (T2), and 6 months following placement of fixed restoration (T3) using an endodontic spreader and a digital caliper. Pink esthetic score (PES) compounded of seven values for an easy clinically practiced estimation with a 2–1–0 score rating system.[24] Estimation of this value was done at T0, T1, T2, and T3.

Gingival thickness

The facial gingiva was anesthetized using a topical lidocaine spray. The GT was assessed mid-buccally 4 mm apical to the free gingival margin using an endodontic spreader (size 20) fitted with a rubber stopper. The spreader was gently inserted to contact the underlying bone structure.[25] The soft tissue thickness was then measured on a digital caliper up to the 0.00 mm. Measurement errors were minimized by allowing only one person to perform the measurements three times for each area and the most frequently measured and recorded readings were selected as the final measurement (Fig. 7). GP was considered thin if the readings was less than 1.5 mm and considered thick if the readings was more than or equal to 1.5 mm.

Width of keratinized mucosa

The width of the KM was measured at the mid-buccal aspect of each implant to the nearest half millimeter using a UNC-15 periodontal probe. Each measurement was made from the gingival margin to the mucogingival junction. The mucogingival junction was identified by the rolling technique, where the mucosa was rolled until the nonmovable portion of the attached keratinized tissue was seen.[26]

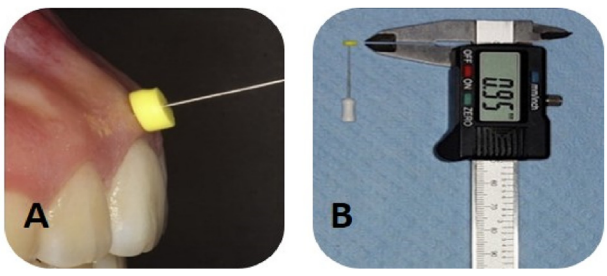

Fig. 7. (A) Size 20 endo-reamer with a stopper pierced in the buccal gingival tissue 4 mm apical to the free gingival margin. (B) The thickness measured on a digital ruler up to 0.00 mm.

Pink esthetic score

PES evaluates the esthetic outcome of the soft tissue around implant-supported single crowns in the anterior zone by awarding seven points based on seven variables (mesial and distal papilla, soft-tissue level, soft-tissue contour, soft-tissue color, soft-tissue texture, and alveolar process deficiency for a simple and clinically practiced evaluation with a 2–1–0 score rating system.[24]

Visual analog scale for pain

Pain assessment was performed using visual analog scale (VAS) to measure the intensity of pain experienced at T1 for both techniques. Pain intensity was assessed on the 0–10 scale with 0: no pain, 0.1–3: mild pain, 3.1–6: moderate pain, and 6.1–10: severe pain.[27]

Statistical analysis

The collected data was tabulated and analyzed using the Statistical Package for the Social Sciences (SPSS software, version 22; SPSS Inc., Chicago, Illinois, USA). Data were expressed as mean and SD. Comparison for VAS and PES between groups was made using the Mann–Whitney test. Comparison of VAS and PES between observation times was made using Friedman. Wilcoxon signed-rank test was then used for multiple comparisons. Comparisons of GT and KM among groups and time points were made using repeated measures analysis of variance. Bonferroni test was used for multiple comparisons. For all tests, *P* value less than or equal to 0.05 was set as significant.

Results

Twenty delayed implants placed in 16 patients were enrolled in this clinical research (Table 1). All the participants proclaimed edema and pain post-operatively for 3–5 days with an excellent reaction to ice application and analgesics. Peri-implant soft tissue healed and all implants functioned well and the patients completed the whole 6-months follow-up period of the study. Healing was typically monotonous and swelling was minimal. No signs of suppuration or peri-implant disease were regarded within the study time frame. All implants were firm and stable during the 6-months follow-up interval. The total participants of this trial were nine males and seven females with an age span of 21–50 years.

Regarding GP, a significant increase in the GT facially was recorded for both groups at T1, T2, and

Table 1. Demographic data of the study patients.

Study groups	Male	Female	Age (mean ± SD) (years)
Group I	2	6	26.6 ± 5.34
Group II	4	4	28.7 ± 5.77

T3 by compared to T0 ($P < 0.001$). Nevertheless, intragroup comparisons at all time intervals showed no statistically significant difference ($P > 0.05$) (Table 2).

Regarding the KM, group II exhibited statistically significantly greater width of KM than group I at T1, T2, and T3. The width of KM significantly changed through observation times for both groups ($P < 0.001$). KM increased between T0 and T1, and between T1 and T2 and then decreased from T2 to T3 among both groups. Comparisons between each of the two time points are conferred in the same table. Among the two groups, a significant difference among T0 and all other observations (T1, T2, and T3) was found. At the same time, no significant difference was noted between T1, T2, and T3 (Table 3).

There was no significant difference in VAS among either groups at T0 and T3 was observed. At T1 and T2, group II presented significantly greater VAS than group I ($P = 0.002$ at T1 and $P = 0.011$ at T2). Comparisons of VAS between observation times among groups are presented in Table 4. A significant difference was found in VAS scores among time points for either groups ($P < 0.001$ for group I and $P < 0.001$ for group II). For both groups VAS increased from T0 to T1, then decreased at T2 and T3. A significant difference between each of the two time points except between T0 and T3 was observed for either groups (Table 4).

Table 4. Comparison of visual analog scale between groups and observation times.

	T1	T2	T3	Freidman test (*P* value)
Group I				
Median	4.00[b]	0.00[c]	0.00[a]	<0.001
Minimum	3.00	0.00	0.00	
Maximum	5.00	1.00	0.00	
Group II				
Median	6.00[b]	1.00[c]	0.00[a]	<0.001
Minimum	4.00	0.00	0.00	
Maximum	8.00	2.00	0.00	
Mann–Whitney test (*P* value)	0.002	0.011	1.00	

P is significant at the 5 % level. Different letters in the same row indicate a significant difference between the two observation times (Wilcoxon signed-rank test, $P < 0.05$). Similar letters in the same row indicate nonsignificant difference between the two observation times (Wilcoxon signed-rank test, $P > 0.05$).

PES enhanced over the whole time frame of the research for either groups without significant difference. However, a significant difference was found in PES between the two time points for both groups except between T2 and T3 ($P < 0.001$) (Table 5).

Discussion

The current study compared the clinical outcomes of labial or buccal gingival tissue augmentation throughout stage II implant surgical procedures in patients with thin GP using the OREF versus FSCTG. Based on the current results, the null hypothesis was rejected as using the OREF technique resulted in a significant less pain and discomfort than the FSCTG technique. However, both methods are effective in improving the gingival tissue profile surrounding dental implants.

For the sake of enhancement of the patient satisfaction with respect to the esthetics, it is critical to

Table 2. Comparison of gingival thickness between both groups and observation times.

	T0	T1	T2	T3	*P* value
Group I	1.21[a]±0.15	2.29[b] ± 0.38	2.16[c]±0.37	2.14[c]±0.35	<0.001
Group II	1.18[a]±0.22	2.27[b] ± 0.36	2.14[c]±0.35	2.13[c]±0.37	<0.001
P value	0.727	0.904	0.903	0.951	

P is significant at the 5 % level. Different letters in the same row indicate a significant difference between the two observation times (Bonferroni *t* test, $P < 0.05$). Similar letters in the same row indicate nonsignificant difference between the two observation time (Bonferroni *t* test, $P > 0.05$).

Table 3. Comparison of width of keratinized mucosa between groups and observation times.

	T0	T1	T2	T3	*P* value
Group I	3.40 ± 1.17[a]	4.60 ± 0.84[b]	4.80 ± 0.63[b]	4.50 ± 0.85[b]	<0.001
Group II	3.90 ± 1.10[a]	5.90 ± 0.99[b]	5.90 ± 0.74[b]	5.70 ± 0.67[b]	<0.001
P value	0.339	0.006	0.002	0.003	

P is significant at the 5 % level. Different letters in the same row indicate a significant difference between the two observation times (Bonferroni *t* test, $P < 0.05$). Similar letters in the same row indicate nonsignificant difference between the two observation times (Bonferroni *t* test, $P > 0.05$).

Table 5. Comparison of pink esthetic score between groups and observation times.

	T0	T1	T2	T3	Freidman test (*P* value)
Group I					
M	0.00[a]	6.50[b]	8.00[c]	8.00[c]	<0.001
Min	0.00	6.00	7.00	7.00	
Max	0.00	8.00	9.00	9.00	
Group II					
M	0.00[a]	7.00[b]	7.50[c]	7.50[c]	<0.001
Min	0.00	6.00	7.00	7.00	
Max	0.00	8.00	9.00	9.00	
Mann–Whitney test *(P value)*	1.00	0.971	0.315	0.315	

M, median; max, maximum; min, minimum.
P is significant at the 5 % level. Different letters in the same row indicate a significant difference between the two observation times (Wilcoxon signed-rank test, $P < 0.05$). Similar letters in the same row indicate nonsignificant differences between the two observation times (Wilcoxon signed-rank test, $P > 0.05$).

fully recognize the significance of the periodontium phenotype and how it influences the results of restorative treatment.[28]

Evans and Chen[29] stated that patients having a thin GP are highly liable to have gingival recession. Because the GP influences the treatment's ultimate result, it should be given due consideration during planning the course of treatment. The thickness and contour of gingival soft tissue are crucial diagnostic variables that impact how an implant restoration will look.[30]

Research indicates that those with a thick GP have a higher success rate of dental implants inserted in the anterior cosmetic zone.[31] Furthermore, the occurrence of gingival recession after dental implant restoration is usual in patients with a thin GP.[32]

The literature listed a number of benefits of a thick GP, such as decreased gingival inflammation, enhanced soft tissue handling over thin tissue, resistance to recession and damage, and more predictable surgical results. The strength of thick soft tissue is credited to its high extracellular matrix, collagen amount, and improved vascularity.[33,34]

GT can be measured in a number of ways, but the simplest and commonly used approach is visual assessment, which involves using the transparency method or the trans-sulcular probing technique to observe the visibility of a periodontal probe.[35,36] The GP is a considered thick GP if the probe is invisible, and thin GP if it is visible through the gingiva. Despite its limitations, visual assessment is frequently applied to classify the GP for the primary diagnosis rather than offer an accurate measurement.

Another straightforward and precise method that can offer accurate GT measurements is transgingival probing, which involves the use of an endodontic spreader perpendicularly inserted with a rubber stopper into the anesthetized gingiva at the marked location, and then using a ruler to measure the distance between the tip of the spreader and the rubber stopper and approximated to the nearest millimeters.[37,38] The current study used an endodontic reamer with a rubber stopper and a digital caliper as the measuring tool for quantitative evaluation. Cone beam computed tomography or an ultrasonic device was not used in the study because the latter prompted concerns about radiation exposure and the former was not attainable.[39,40]

Numerous surgical approaches have been offered to increase the volume of the gingival tissue, particularly in the esthetic area surrounding dental implants. Many additional less invasive surgical procedures have been proposed, with SCTG being contemplated as the benchmark.[23,41,42]

The present study tested the OREF technique versus the FSCTG during stage II implant surgery and found that both techniques were successful in promoting the soft tissue surrounding dental implants through increasing the GT and KM and improving the esthetic outcomes measured by PES.

Soft tissue phenotype improvement surgical techniques might be applied before implant placement, concurrently with implant insertion, or throughout stage II surgery.[43,44] Bassetti *et al.*[45] reported effectiveness of performing soft tissue enhancement and abutment connection simultaneously with stage II implant surgery.

This study involved alterations of GP during implant stage II surgery, simultaneously with the insertion of the healing abutment. This is in agreement with the findings of Lin *et al.*[46] and Pandolf,[16] who found that improving the soft tissue phenotype during implant uncovering surgery had positive clinical outcomes.

The OREF technique is a modification of the central-crest incision and the roll envelope flap technique.[15,47] The peri-implant mucosa exhibits significant soft tissue healing and long-lasting esthetic enhancement when using the OREF approach. By minimizing the buccal soft tissue concavity and promoting faster wound healing, this approach minimizes postoperative pain and enhances esthetics.[16]

This study's findings showed that altering the soft tissue phenotype can successfully increase the thickness of the gingival tissue, which was 2.14 ± 0.35 mm for OREF and 2.13 ± 0.37 mm for FSCTG without significant difference among either groups. Simultaneously, we demonstrated a noteworthy rise in the average KM surrounding dental implants from T0 to T3, resulting in values of

4.50 ± 0.85 for OREF and 5.70 ± 0.67 for FSCTG. Furthermore, we observed a significant increase in the KM following the use of SCTG rather than the omega roll technique. This could be attributed to the fact that the connective tissue graft offers larger dimensions than the pedicle graft obtained through the OREF approach. However, the use of soft tissue phenotype tempering, either OREF or FSECTG, could gain GT and KM width in addition to obtaining the desired supracrestal tissue dimensions and the esthetically acceptable soft tissue profile surrounding implants for lengthy durability. That is consistent with many researchers who demonstrated that the goal of soft tissue phenotype improvement was to preserve stable marginal bone level, decrease soft tissue dehiscence, minimize periodontal pocket depth, and decrease the plaque score. All of these factors promote stability and healthiness surrounding implants.[48]

It was observed that for both groups, the majority of the volume increase of the gingival tissue happened in the first 3 months succeeding the surgery, and some loss happened by the end of the final observation, which was made 6 months after the procedure. It should be highlighted, although, that there was no significant difference among the two surgical approaches, and GT and KM were still more than the initial value (T0). This was the same found by Schmitt *et al.*[49] and Hadzik *et al.*,[50] who examined the volume of peri-implant KM that was regenerated using xenograft and either FGG or CTG. They discovered that the majority of the regenerated tissue's volume loss happened after 3 months from the surgery, and that it slowed down with time. Using the VAS, a significant difference in pain postsurgically was seen; during the various research follow-up time frame, the OREF group reported less pain and discomfort than the FSCTG group. This could be explained by the fact that, in contrast to FSCTG, which carried the risk of sloughing, delayed wound healing, and palatal pain, the OREF approach required no secondary donor surgical site and was comparatively atraumatic and minimally invasive. These outcomes are comparable to those of the study by Padhye *et al.*,[51] which examined the effects of buccally displaced flap technique and SCTG over a 1-year observation period. They noticed that while both techniques are useful in increasing the GT and KM surrounding implants, displacement of the flap buccally caused less discomfort to the patient and could be applied frequently to enhance the soft tissues profile surrounding implants.[52]

Certain amount of shrinkage of the newly improved KM is usually seen, whatever the soft tissue augmentation approach is used.[51,53] Yet tissue regeneration for the mucosa surrounding the implant to stabilize a new biologic width may be the cause of the change in the peri-implant tissue dimensions.[54]

In regions that are esthetically important, achieving a satisfactory esthetic result is crucial. As a result, for implant therapy to be successful, the soft tissue emergence profile should be adequately pleasant.[55] Within this context, the soft tissue level around the dental implant determines how implant-supported single-tooth restorations will appear. A method for consistently assessing the soft tissue esthetic quality surrounding single-tooth implant crowns is the PES.[24] Consequently, the esthetic outcomes with the clinical photos taken before treatment and throughout the follow-up period were assessed using the PES. According to the results published by Lai *et al.*,[56] PES means in the present trial increased significantly for both groups at 3 and 6 months postfinal restoration placement. However, no significant difference among both groups over the research time frame was found indicating that both techniques are effective in improving soft tissue esthetic outcomes. Limitation: the small size of the current sample may confine the extension of the results to a larger population.

Conclusion

Overall, within the findings of the current study, it was concluded that:

(1) The OREF procedure is useful in enhancing the dimensions of thin facial gingival tissue surrounding dental implants.
(2) When compared with SCTG as a PMT surrounding dental implants, the OREF technique may be considered a novel and appropriate treatment option due to its convenience, good patient acceptance, and less postoperative discomfort.
(3) The choice between these two approaches may depend on the particular clinical situation, preferences of the patient, and the intended results of the augmentation.

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Authorship contribution statement

Mohamed A.R. Al-Shahat, Eman M. Abdulhady, and Mohamed Ellayeh: revise and edit, supervise,

resources, project management, investigation, and concept development. Ahmed H. Fawzy: methodology writing, original draft, and data analysis.

Data availability

Materials and data are readily available on request.

Conflicts of interest

There are no conflicts of interest.

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