



## Volumetric Analysis After Modified Pedicle Roll Flap in Soft Tissue Ridge Augmentation in the Maxillary Esthetic Zone

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### Abstract

**Objective:** This randomized-controlled clinical trial aimed to assess modified pedicle roll flap for soft tissue ridge augmentation in the maxillary esthetic zone and compare it with deepithelialized connective tissue graft in the amount of volumetric changes, post-surgical pain, and patient satisfaction of both treatment modalities.

**Materials and Methods:** Twenty participants with one missing tooth in the maxillary esthetic zone with class I localized alveolar defect according to Seibert classification were included in the study for soft tissue augmentation procedure in the maxillary esthetic zone. They were divided into 2 equal groups; Group I (test group) included 10 patients who received modified pedicle roll flap (Long palatal connective tissue rolled pedicle graft), and Group II (control group) included 10 patients who received deepithelialized connective tissue graft for soft tissue ridge augmentation. Volumetric analysis using laser scanner was used to measure volumetric changes 3 months after soft tissue augmentation.

**Results:** Regarding the volume gained, the test group ( $36.80 \pm 5.81$ ) had a significantly higher value than the control group ( $30.20 \pm 5.83$ ) ( $p = 0.021$ ) after 3 months. Regarding pain (VAS) scores, the mean value of (VAS) scores in the control group was significantly higher than the test group after 10 days, 1 month, and 3 months post-operative. Regarding patient satisfaction, the control group had significantly more discomfort during the healing phase than the test group.

**Conclusion:** Within the limitations of the present study, it could be concluded that the quantitative volumetric analysis of the ridge in the maxillary esthetic zone revealed a more significant volume gain with the modified pedicle roll flap in comparison to the deepithelialized connective tissue graft 3 months after surgery. Modified pedicle roll flap is less painful and causes less discomfort than the deepithelialized connective tissue graft.

**Keywords:** Soft Tissue Augmentation; Connective Tissue Graft; Pedicle Graft; Pontic Site Development

### Introduction

The aesthetic appearance of soft tissue is a crucial factor in the overall attractiveness of a smile. Partially edentulous patients often experience localized alveolar ridge abnormalities, which can result in challenges related to esthetics, phonetics, and oral hygiene [1].

The aesthetic appearance of soft tissues is a matter of concern not only in relation to the design of a smile, but also in cases where there is a lack of gingival tissues around a tooth/implant or below a fixed prosthesis. A comprehensive aesthetic encompasses the harmonious integration of both white and pink aesthetics. The

achievement of successful prosthetic rehabilitation relies on the presence of a well-developed hard and soft tissue basis [2].

Various factors such as traumatic tooth extractions, advanced periodontal disease, periapical pathologies, endodontic failure, implant failure, developmental defects, external trauma, and tumors contribute to a reduction in the volume of bone and soft tissues within the alveolar process. Consequently, these factors give rise to localized alveolar ridge defects [1].

The appropriate management of a localized alveolar ridge deficiency is a common prosthetic obstacle from an aesthetic standpoint. These deficits can be addressed through the utilization of

prosthetic methods as well as other periodontal surgical treatments, specifically soft tissue augmentations [3].

The classification of tissues and materials used for soft tissue augmentation can be generically categorized as autologous, allograft, xenogeneic, and synthetic (alloplastic) materials. In addition, there is ongoing development of several novel tissue-engineered constructions intended for the purpose of augmenting soft tissue. An optimal material should possess characteristics such as texture, pliability, color, inertness towards the patient's own tissues, absence of disease transmission or causation, durability, and successful integration into the host tissues [4].

There exist significant limitations associated with augmentation procedures, notably the occurrence of morbidity and necrosis within the transplanted mucosa. The aforementioned limitations have prompted the exploration and utilization of other materials for augmentation purposes. The many alternative products can be categorized into distinct groups based on their source, namely allogeneic, xenogeneic, and synthetic (alloplastic) materials [5,6].

The notion of circumventing the need for a secondary donor surgical site holds significant appeal for materials that serve as substitutes for autogenous donor sites in soft tissue transplantation. While these recently developed materials do not exceed the established benchmark, they do offer patient satisfaction and aesthetic benefits, and are readily accessible in large quantities [7].

### Aim of the study

The aim of the present study was to assess

- Volumetric changes after the use of modified pedicle roll flap and deepithelialized connective tissue graft in soft tissue ridge augmentation in the maxillary esthetic zone as a primary outcome.
- Comparison between modified pedicle roll flap and deepithelialized connective tissue graft regarding post-surgical pain, and patient satisfaction of both treatment modalities in the maxillary esthetic zone as a secondary outcome.

## Materials and Methods

### Study design and patients' selection

This study was designed as a prospective randomized controlled clinical trial. Twenty patients with missing single tooth in the maxillary esthetic zone were recruited from the outpatient clinic of the Oral Medicine and Periodontology department, Faculty of Dentistry, Ain Shams University. The study was explained to the patients and informed consent was obtained from all of the patients. The study protocol was reviewed and approved by the Ethics Committee for clinical studies, Faculty of Dentistry, Ain Shams University (Approval number: FDASU-RecIM121902).

### Sample Size

A power analysis was designed to have adequate power to apply a statistical test of the null hypothesis that there is no difference between tested groups. By adopting an alpha ( $\alpha$ ) level of 0.05 (5%), a beta ( $\beta$ ) level of 0.2 (20%) (i.e., power = 80%), and an effect size ( $f$ ) of (0.585) calculated based on the results of a previous study [8], the predicted sample size ( $n$ ) was a total of (20) samples, i.e. (10) samples for each group. Sample size calculation was performed using G\*Power (version 3.1.9.7).

### Randomization and patient grouping:

Randomization was created via a computer-generated randomization tables ([www.randomizer.org](http://www.randomizer.org)) and was performed by another individual other than the investigator with a 1:1 allocation ratio. Randomization was performed before starting the surgery. Patients were randomly divided into two groups (each of 10 patients). Group I (Test group): received modified pedicle roll flap, Group II (Control group) received deepithelialized connective tissue graft.

### Inclusion criteria

Patients free from any systemic diseases, male or female with age range 20–50 years, having single missing tooth in the maxillary esthetic zone, edentulous from at least 3 months, and indicated for prosthetic rehabilitation by fixed prosthesis with class I ridge defect according to Seibert classification (buccolingual loss of the ridge contour) were included in the study.

### Exclusion criteria

Smokers, pregnant and breast feeding females, decisionally impaired individuals (mentally retarded patients, prisoners and handicapped patients), patients with periodontitis in the neighboring teeth, and patients with occlusal discrepancies were excluded.

### Presurgical preparation

Full mouth supra and subgingival debridement was performed. Teeth were examined for caries, periapical infection, and restorative procedure in order to be treated. Immediately prior to the surgery, Alginate impressions (Tropicalgin, Zhermack SpA, Italy) were taken and poured into cast models using an extra hard stone at the same time to minimize the amount of dimensional changes.

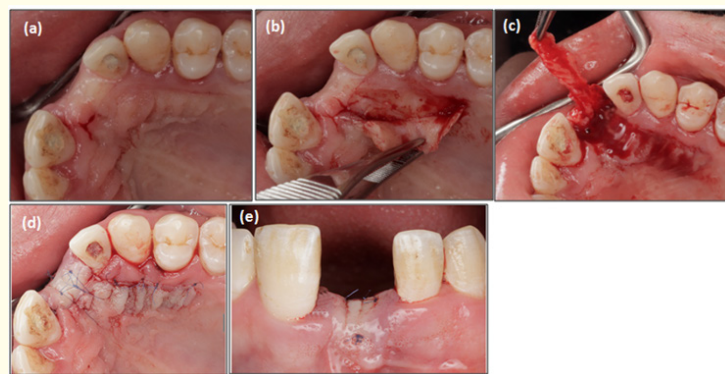
### Surgical procedure

For both groups, the following procedures were done

- Immediately prior to the surgical procedure, the patients were instructed to rinse for 30 sec with 0.125% chlorhexidine HCL mouthwash (Hexitol®: Chlorhexidine HCL mouthwash, The Arab Drug Company for pharmaceutical and CHEM. IND. CO. Cairo-Egypt).
- The area subjected to surgery was anesthetized by infiltration anesthesia using a local anesthetic solution of 4% articaine with 1:100,000 epinephrine (Artinibsa, Spain).

**Group I (Test group)**

- A partial thickness horizontal incision was made on the palatal aspect of the ridge. From the horizontal incision line, an oblique incision was placed toward the palate (L-shape) (Figure 1a).
- The partial thickness flap was reflected from the oblique incision line to expose the underlying connective tissue (Figure 1b).
- The palatal connective tissue pedicle graft was outlined by giving full thickness incision along the oblique incision line, and another parallel incision was done.
- A horizontal incision at the apical end joined these parallel incisions.
- The palatal connective tissue pedicle graft length was approximately two times more than the apico-coronal length of the ridge defect
- The palatal pedicle flap was reflected coronally up to the crest of the ridge defect. From the crest of the ridge defect, a partial thickness incision was made extending beyond the line angles of the adjacent teeth and mucogingival junction, leaving the periosteum on the bone (Figure 1c).
- The pedicle graft was rolled from the apical end and sutured by 6-0 polypropylene (6/0 polypropylene monofilament suture, Assut, Swiss) using horizontal mattress technique.
- Finally, the L-shaped incision was sutured by 6-0 polypropylene using a simple interrupted technique (Figure 1d and e).



**Figure 1:** (a) Intraoral occlusal photograph showing L-shape incision; (b) intraoral occlusal photograph showing flap reflection; (c) palatal pedicle flap elevation; (d,e) postoperative suturing.

**Group II (Control group):**

**Recipient site preparation:**

- A subepithelial pouch was created in the recipient site using a no.15c scalpel blade (Figure 2a).
- Partial thickness incision was done mid-crestally, extending deep to the mucogingival junction to permit coronal flap repositioning.
- Deepithelialized connective tissue graft harvested from the palate was placed in the pouch, and the flap was sutured using 6/0 polypropylene (Figure 2d,e)

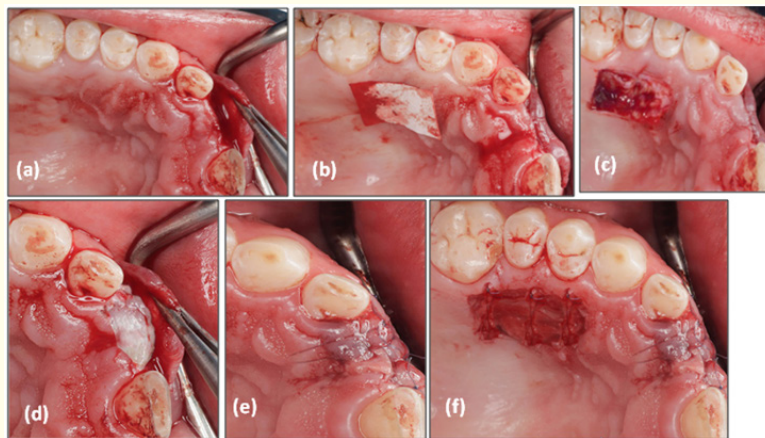
**Donor site preparation**

- The connective tissue graft was harvested from the palate from the maxillary premolar and molar region using de-epithelialization technique.
- The graft length was taken according to the length required at the recipient site measured by a sterile template (Figure 2b)
- A rectangular-shaped partial thickness incision was made (horizontal incision was made 1-2 mm apical to the gingival margin, and 2 vertical incisions connected by another horizontal one), keeping the periosteum intact.

- The graft was harvested by removal of free gingival graft and de-epithelialize it extraorally by scrapping technique using number 15c scalpel blade to obtain a uniform thickness of connective tissue graft and preserve the highly vascular connective tissue present immediately below the epithelium instead of the fatty connective tissue which is present deeply [9].
- The remaining connective tissue harvested was trimmed and adapted to the recipient site.
- Finally, platelet-rich fibrin (PRF) membrane was used to cover the donor site by cross-over sutures using 4/0 polypropylene (Figure 2f)

**PRF membrane preparation:**

- About 10 ml intravenous blood was obtained from the patient without anticoagulant and immediately centrifuged at 3000 rpm for 10 minutes.
- Coagulation started immediately, and 3 parts quickly appeared in the tube: packed red blood cells at the bottom, acellular plasma at the top, and the PRF clot between them.
- The PRF was gently removed from the tube, separated from the RBC base, and compressed between two sterile gauzes moistened with normal saline to get the membranes [10].



**Figure 2:** (a) Intraoral occlusal photograph showing the subepithelial pouch; (b) palatal template in place; (c) palatal graft removal; (d) CTG in pouch after deepithelialization; (e) pouch suturing; (f) PRF placed in palatal wound and sutured.

**Post-surgical management**

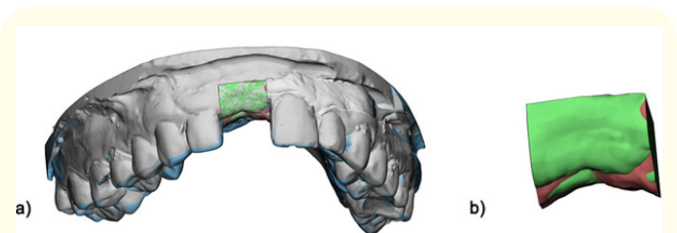
- Systemic antibiotics were prescribed (amoxicillin with clavulanic acid 1g orally twice daily for 5 days) (Hibiotic 1g manufactured by Amoun Pharmaceutical Company S.A.E), and analgesics (Ibuprofen 600mg tab twice daily for 3 days post surgically) (Brufen 600mg manufactured by Hamol limited, Reckitt for Abbott India Laboratories). Patients were instructed to rinse with 0.12% chlorhexidine HCL three times a day and to avoid any brushing and trauma to the surgical site for 2 weeks. Sutures were removed 10 days post-surgically.
- Patients were recalled after 10 days, 1 month, and 3 months for reevaluation.
- Three months after soft tissue ridge augmentation, another alginate impression was taken and poured into cast model; patients were recalled for the prosthetic fabrication.

**Methods of evaluation**

**Volumetric measurements**

- Cast models were obtained from alginate impressions to be used for comparison of tissue dimensions at baseline and at 3 months postoperative, and were digitized using a three-dimensional 3D laser scanner (Medit i700 Wireless) (Medit i700 Wireless, Seoul, South Korea).
- The STL files obtained from each model were subsequently transferred to digital shape sampling and processing software to re-elaborate 3D models from the 3D scan data (Materialise, Belgium).
- Presurgical and postsurgical models were superimposed for each patient based on a procedure that relies on best matching of manually selected surfaces. The area of the pontic site was defined by the mesial and distal surfaces of adjacent teeth, 5 mm buccal and palatal to the ridge crest. The software can then perform an automatic alignment and superimposition in one coordinate system of the two models based on the best match of these selections (Figure 3a and b).

- The marked superimposed pontic sites were isolated, and volumetric changes were done.



**Figure 3:** (a) Superimposition of STL files; (b) pontic site to be measured.

**Evaluation of post-surgical pain:**

- According to the American Pain Society guidelines for pain management, for postoperative pain, the most used scale is the Visual Analogue Scale (VAS) grading pain by no pain at 0 level to maximal pain at level 10 (11).
- The intensity of pain was evaluated and recorded at intervals of 10 days – 1 month and 3 months post-operatively.

**Evaluation of patient satisfaction**

- The questionnaire was used to determine the level of satisfaction which composed of 3 items (surgical time – discomfort – sequential visits) after 10 days from the surgery.
- Each item was constructed as an opinion statement and was administrated with a 4 point likert formate (strongly agree - agree -disagree - strongly disagree) (12).

**Statistical Analysis**

Ordinal and categorical data were presented as frequency and percentage values. Categorical data were analyzed using Fisher’s exact test. Numerical data were presented as mean and standard deviation values. They were analyzed for normality using Shapiro-Wilk’s test. Parametric data were analyzed using independent and paired t-tests for inter and intragroup comparisons respectively.



Non-parametric numerical data and ordinal data were analyzed using Mann-Whitney U test for intergroup comparisons and Friedman’s test followed by Nemenyi post hoc test for intragroup comparisons. The significance level was set at  $p < 0.05$  within all tests. Statistical analysis was performed with R statistical analysis software (version 4.3.0 for Windows).

**Results**

The study was conducted on 20 participants with single missing tooth and Class I ridge defect according to Seibert classification (i.e., 10 cases in each group). They were equally divided and randomly allocated to the test and the control groups. The test group received modified pedicle roll flap and the control group received deepithelialized connective tissue graft. All the patients underwent the study without complications, and no dropouts occurred.

**Demographic data**

There were 6(60.0%) males and 4(40.0%) females in the test group. There were 5(50.0%) males and 5(50.0%) females in the control group. The mean age of the cases in the test group was  $(35.00 \pm 4.08)$  years, while in the control group it was  $(35.90 \pm 2.42)$  years. There was no significant difference between different groups regarding gender and age ( $p > 0.05$ ) (Table 1).

Parameter	Value	Test	Control	P-value	
Gender	Male	n	6	5	0.653ns
		%	60.0%	50.0%	
	Female	n	4	5	
		%	40.0%	50.0%	
Age	(Mean $\pm$ SD) years	35.00 $\pm$ 4.08	35.90 $\pm$ 2.42	0.556ns	

**Table 1:** Intergroup comparisons and summary statistics for demographic data.

\*Significance ( $p < 0.05$ ) ns: Non-significant ( $p > 0.05$ )

**Volumetric measurements (mm<sup>3</sup>)**

Test group  $(36.80 \pm 5.81)$  had a significantly higher value than control group  $(30.20 \pm 5.83)$  ( $p = 0.021$ ) after 3 months (Table 2).

Volume gained (mm <sup>3</sup> ) (Mean $\pm$ SD)		P-value
Test	Control	0.021*
36.80 $\pm$ 5.81	30.20 $\pm$ 5.83	

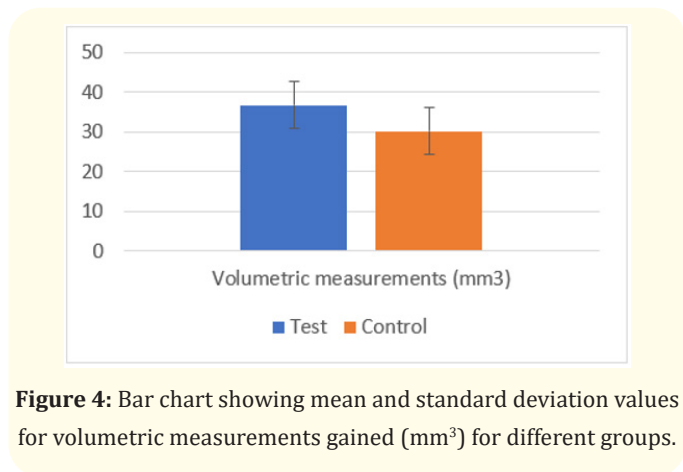
**Table 2:** Intergroup comparisons, mean and standard deviation (SD) values for volumetric measurements (mm<sup>3</sup>) for different groups.

\*Significance ( $p < 0.05$ ) ns: Non-significant ( $p > 0.05$ ).

**Post-surgical pain (VAS)**

At 10 days, control group  $(8.00 \pm 1.05)$  had a significantly higher value than test group  $(6.60 \pm 0.70)$  ( $p = 0.007$ ).

After 1 month, control group  $(5.30 \pm 0.82)$  had a significantly higher value than test group  $(2.70 \pm 0.95)$  ( $p < 0.001$ ).



**Figure 4:** Bar chart showing mean and standard deviation values for volumetric measurements gained (mm<sup>3</sup>) for different groups.

After 3 months, control group  $(1.30 \pm 0.82)$  had a significantly higher value than test group  $(0.40 \pm 0.52)$  ( $p = 0.017$ ) (Table 3).

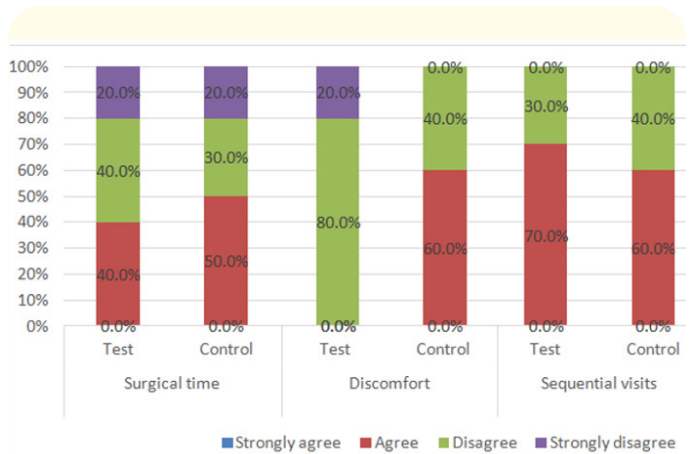
Time	VAS (Mean $\pm$ SD)		P-value
	Test	Control	
10 days	6.60 $\pm$ 0.70 <sup>A</sup>	8.00 $\pm$ 1.05 <sup>A</sup>	0.007*
1 month	2.70 $\pm$ 0.95 <sup>B</sup>	5.30 $\pm$ 0.82 <sup>B</sup>	<0.001*
3 months	0.40 $\pm$ 0.52 <sup>C</sup>	1.30 $\pm$ 0.82 <sup>C</sup>	0.017*
P-value	<0.001*	<0.001*	

**Table 3:** Inter and intragroup comparisons, mean and standard deviation (SD) values for VAS for different groups.

Values with different superscript letter within the same vertical column are significantly different \*Significance ( $p < 0.05$ ) ns: Non-significant ( $p > 0.05$ )

**Patient satisfaction**

For “Discomfort”, there was a significant difference in most of the cases of the control group choosing “Agree” (60%) and the majority of the cases in the test group choosing “Disagree” (80%) ( $p = 0.009$ ). For other domains, the difference was not statistically significant ( $p > 0.05$ ) (Figure 5).



**Figure 5:** Stacked bar chart showing percentage values for patient satisfaction.

## Discussion

Alveolar ridge deficiencies are frequently observed in patients with partial dentition, and they pose risks to the preservation of esthetics, speech, and oral hygiene. These anomalies have an impact on both osseous and non-osseous structures. The occurrence of these anomalies is more commonly observed in male patients of middle age. It is crucial to prioritize the augmentation of the deficient ridge prior to the placement of an implant or a fixed partial denture [13].

Numerous methodologies have been utilized for the purpose of rehabilitating the compromised ridge, including directed bone regeneration, bone grafting, implementation of bone substitutes, and augmentation of soft tissue in the ridge area. Various procedures are available for soft tissue ridge augmentation, including the epithelial connective tissue graft, onlay graft, subepithelial connective tissue graft, and roll pedicle graft technique [14].

This study was designed as a randomized, controlled clinical trial to compare two soft tissue augmentation techniques used to alter the contours of the alveolar ridge by quantifying dimensional volume changes before and 3 months after surgery. Moreover, it compares post-surgical pain and patient satisfaction of both treatment modalities in the maxillary esthetic zone.

Twenty patients with one missing tooth in the maxillary esthetic zone with class I localized alveolar defect according to Seibert classification were included in this study. The patients were divided into 2 equal groups; Group I (test group) included 10 patients who received modified pedicle roll flap for soft tissue ridge augmentation, and Group II (control group) included 10 patients who received deepithelialized connective tissue graft for soft tissue ridge augmentation.

Group I (test group) received modified pedicle roll flap (Long palatal connective tissue rolled pedicle graft), which is considered a modification of the roll flap. In the present technique, instead of the L-shaped incision proposed by Gasparini, *et al.* [2], an oblique incision was done from the line angle of the adjacent lateral incisor up to the second premolar. The oblique incision facilitates harvesting of the maximum possible length of pedicle graft; the length of the pedicle should be twice the defect depth [15].

Group II (control group) received deepithelialized connective tissue graft, which is considered the gold standard technique for soft tissue augmentation. It was harvested from the palate as a free gingival graft (FGG) with covering epithelium and de-epithelialized extra-orally. This harvesting technique can be used in very thin masticatory mucosa, and graft preparation can be performed superficially without violating blood vessels and nerve fibers in deeper layers. Moreover, this technique provides the high-quality tissue layer of highly vascularized lamina propria just beneath the epithelium, avoiding deep layer containing fatty or glandular tissues near the periosteum [9].

The results of the present study showed that in group I (test group), there was a significant increase in soft tissue volume after 3 months in cases with localized ridge defects, and the mean increase was  $(36.80 \pm 5.81\text{mm}^3)$ . In group II (control group), there was a significant increase in the mean soft tissue volume  $(30.20 \pm 5.83\text{mm}^3)$  after 3 months. There was a statistically significant difference between group I and group II volume values gained after 3 months ( $p < 0.035$ ).

In the present study, the modified pedicle roll flap in the test group offered soft tissue augmentation with connected blood supply, in contrast to the deepithelialized connective tissue graft (control group), which lost its blood supply after harvesting. Furthermore, the palatal wound in the test group is closed and sutured, offering healing by primary intention, resulting in decreased postoperative pain and discomfort in contrast to the deepithelialized connective tissue graft (control group), which heals by secondary intention [15].

Although both treatment modalities achieved volume gain after 3 months, the test group showed superior results. This may be attributed to the source of nutrition of the grafts; the pedicle graft had kept its connected blood supply, which maintained its volume throughout the maturation and remodeling phase, while the deepithelialized connective tissue graft had lost its blood supply, causing some volume shrinkage during the healing process.

To the best of the authors' knowledge, this is the first clinical trial that examined volume alterations after soft tissue augmentation using modified pedicle roll flap, "the long palatal connective tissue rolled pedicle graft" versus deepithelialized connective tissue graft technique; thus, it is tough to correlate our results. However, in some respects, the results of the present study could be correlated with the few studies that tackled the field of soft tissue augmentation in pontic site development or those in which volumetric changes after soft tissue grafting were assessed.

The results of the present study regarding group I (test group), which received modified pedicle roll flap, agreed with Reddy, *et al.* [15] as they treated three patients using long palatal connective tissue rolled pedicle graft. They used modified rolled palatal connective tissue pedicle graft with demineralized freeze-dried bone allografts (DFDBAs) plus platelet-rich fibrin (PRF) combination to correct Seibert class III localized maxillary anterior alveolar ridge defect. The use of modified pedicle roll flap with the combination of DFDBAs and PRF may be linked to the morphology of class III defects in which a combined vertical and horizontal bone loss is present, which require both hard and soft tissue augmentation to treat these types of defects.

The results of the present study disagreed with Abdelhameed, *et al.* [16], who conducted a study on twenty patients using two different techniques for soft tissue ridge augmentation in the maxillary esthetic zone in Seibert class I ridge defect. In the study group, a submucosal palatal island flap was performed, while in the con-

control group, a free SCTG, harvested from the palate by de-epithelialization technique, was used. The results showed that in group I (study group), there was a significant increase in soft tissue volume after 3 months, and this mean increase was ( $12.6 \pm 10.7 \text{ mm}^3$ ). In group II (control group), there was a significant increase in soft tissue volume ( $32 \pm 24.7 \text{ mm}^3$ ) after 3 months. The difference in the results may be attributed to the nature of the submucosal palatal island flap technique, which permits a more limited amount of graft harvesting than the modified pedicle roll flap technique.

Regarding the pain (VAS), the values recorded in group I (test group) after 10 days, 1 month and 3 months were ( $6.60 \pm 0.70$ ) ( $2.70 \pm 0.95$ ) ( $0.40 \pm 0.52$ ) respectively. There was a highly statistical significant difference in the pain VAS scores between 3 months and 1 month, between 3 months and 10 days, and between 1 month and 10 days ( $p < 0.001$ ). In group II (control group), the pain VAS values recorded after 10 days, 1 month, and 3 months were ( $8.00 \pm 1.05$ ) ( $5.30 \pm 0.82$ ) ( $1.30 \pm 0.82$ ) respectively. There was a highly statistical significant difference between 3 months and 1 month, between 3 months and 10 days, and between 1 month and 10 days ( $p < 0.001$ ). There was a highly statistical significant difference in the pain VAS between group I and group II. At 10 days postoperatively, the pain VAS was ( $6.60 \pm 0.70$  vs.  $8.00 \pm 1.05$ ); after 1 month was ( $2.70 \pm 0.95$  vs.  $5.30 \pm 0.82$ ) and at 3 months after surgery was ( $0.40 \pm 0.52$  vs.  $1.30 \pm 0.82$ ) ( $p < 0.001$ ).

The prolonged pain in the deepithelialized connective tissue graft group may be related to prolonged healing caused by the closure of the wound by secondary intention, while in the pedicle graft, healing was accelerated as it occurred by primary intention.

The present study was in agreement with Del Pizzo, *et al.* [17] study in which 24 patients were selected to compare early healing in the palatal donor area in the form of complete epithelialization and discomfort using two different surgical techniques to harvest a subepithelial connective tissue graft (free gingival graft (FGG) and single incision technique (SI)). Parameters were recorded at 1, 2, 3, 4, 6 and 8 weeks after surgery. Complete epithelialization of the palatal wound occurred in the FGG 4 weeks after surgery, while in the SI group, it occurred 2-3 weeks after surgery. There was a statistically significant difference between the SI and FGG groups. Rapid palatal healing results could be explained by primary closure of the palatal wound in single incision technique (SI), while in FGG, healing occurred by secondary intention. The discomfort was absent or minimal for SI groups in the first two postoperative weeks, while the FGG group reported more discomfort mainly in the first two postoperative weeks. In the SI group, discomfort recovery was statistically significant compared to the FGG procedure.

The results of the present study were in agreement with Abdelhameed, *et al.* [16], who conducted a study on twenty patients using two different techniques for soft tissue ridge augmentation in the maxillary esthetic zone in Seibert class I ridge defect. In the study group, a submucosal palatal island flap was performed, while in the control group, a free SCTG, harvested from the palate by de-

epithelialization technique, was used. The results showed that after 10 days, 1 month, and 3 months, the control group had a higher mean value for pain (VAS) than the study group.

Regarding patient satisfaction, there was a significant difference between both groups in most of the cases of the control group choosing "Agree" (60%) on feeling discomfort during the treatment phase and the majority of the cases in the test group choosing "Disagree" (80%) ( $p = 0.009$ ). This may be related to the prolonged pain and healing period in the deepithelialized connective tissue graft group caused by the closure of the wound by secondary intention, while in the pedicle graft, healing was accelerated as it occurred by primary intention.

This result was in accordance with Abdelhameed, *et al.* [16] as they compared the submucosal palatal island flap (a modification of the pedicle graft) with SCTG in soft tissue ridge augmentation. The results showed that half of the cases of the control group chose "Agree" (50%) on feeling discomfort during the treatment phase, and the majority of the cases in the test group chose "Disagree" (80%) ( $p = 0.021$ ), where there was a statistically significant difference between both groups.

The results of the present study showed that more volumetric soft tissue gain, less pain, and discomfort were encountered with the modified pedicle roll flap compared to the deepithelialized connective tissue graft.

## Conclusion

Within the limitations of the present study, it could be concluded that the quantitative volumetric analysis of the ridge in the maxillary esthetic zone revealed a significantly greater volume gain with the modified pedicle roll flap in comparison to the deepithelialized connective tissue graft 3 months after surgery. Modified pedicle roll flap is less painful and cause less discomfort than deepithelialized connective tissue graft.

## Conflict of Interest

The authors declare no conflict of interest.

## Data availability statement

The data sets used and analyzed during the current study are available from the corresponding author on reasonable request.

## Bibliography

- Gupta R, *et al.* "Surgical correction of alveolar ridge defect with subepithelial connective tissue graft: A Case report". *Journal of Advanced Clinical and Research Insights* 6.3 (2019): 91-93.
- Gasparini DO. "Double-fold connective tissue pedicle graft: a novel approach for ridge augmentation". *The International Journal of Periodontics and Restorative Dentistry* 24.3 (2004): 280-287.

3. Studer SP, *et al.* "Soft tissue correction of a single-tooth pontic space: a comparative quantitative volume assessment". *Journal of Prosthetic Dentistry* 83.4 (2000): 402-411.
4. Sclafani AP, *et al.* "Evaluation of acellular dermal graft in sheet (AlloDerm) and injectable (micronized AlloDerm) forms for soft tissue augmentation. Clinical observations and histological analysis". *Archives of Facial Plastic Surgery* 2.2 (2000): 130-136.
5. Wolff J, *et al.* "Soft tissue augmentation techniques and materials used in the oral cavity: An overview". *Implant Dentistry* 25.3 (2016): 427-434.
6. Ali AT, *et al.* "The influence of self-inflating soft tissue expander on the outcomes of horizontal alveolar ridge augmentation: A randomized controlled clinical and histological study". *Clinical Oral Implants Research* 34.5 (2023): 426-437.
7. Fu JH, *et al.* "Esthetic soft tissue management for teeth and implants". *Journal of Evidence-Based Dental Practice* 12.3 (2012): 129-142.
8. Akcali A, *et al.* "Soft tissue augmentation of ridge defects in the maxillary anterior area using two different methods: a randomized controlled clinical trial". *Clinical Oral Implants Research* 26.6 (2015): 688-695.
9. Zucchelli G, *et al.* "Patient morbidity and root coverage outcome after subepithelial connective tissue and de-epithelialized grafts: a comparative randomized-controlled clinical trial". *Journal of Clinical Periodontology* 37.8 (2010): 728-738.
10. Dohan DM, *et al.* "Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: technological concepts and evolution". *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* 101.3 (2006).
11. Price DD, *et al.* "The validation of visual analogue scales as ratio scale measures for chronic and experimental pain". *Pain* 17.1 (1983): 45-56.
12. Lee JM, *et al.* "Comparison between patient expectation before and satisfaction after periodontal surgical treatment". *Journal of Periodontology* 73.9 (2002): 1037-1042.
13. RA Koduganti, *et al.* "Ridge Augmentation Is a Prerequisite for Successful Implant Placement: A Literature Review". *Cureus* 14.1 (2022).
14. Deepak Grover and Gurpreet Kaur. "Soft tissue ridge augmentation using "roll technique" - A case report". *IAIM* 1.4 (2014): 80-85.
15. Reddy PK, *et al.* "Long palatal connective tissue rolled pedicle graft with demineralized freeze-dried bone allograft plus platelet-rich fibrin combination: A novel technique for ridge augmentation - Three case reports". *Journal of Indian Society of Periodontology* 19.2 (2015): 227-231.
16. Abdelhameed E, *et al.* "Volumetric Analysis Of Submucosal Palatal Island Flap In Soft Tissue Ridge Augmentation In The Maxillary Esthetic Zone: A Randomized Controlled Clinical Study". *Ain Shams Dental Journal* 16.4 (2019): 121-132.
17. Del Pizzo M, *et al.* "The connective tissue graft: a comparative clinical evaluation of wound healing at the palatal donor site. A preliminary study". *Journal of Clinical Periodontology* 29.9 (2002): r848-854.