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Buccal Pedicle (Modified Roll) Flap Technique Versus Connective Tissue Graft for Peri-implant Soft Tissue Augmentation (A 1-Year Follow-up Study)

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Aim: This study evaluated the role of buccal pedicle flap technique compared to connective tissue graft for peri-implant soft tissue augmentation.
Materials and Methods: This study was a randomized controlled clinical trial including 21 implants that were placed in partially edentulous sites and were randomized at the second stage surgery after 3 months of implant placement as follows: group I (buccal pedicle flap), group II (connective tissue graft) and group III (control group). Clinical parameters including gingival thickness, keratinized mucosa width, pink esthetic score, gingival, and plaque index were measured at baseline and after one year.
Results: Gingival thickness, keratinized mucosa width, and pink esthetic score increased significantly in group II after 1-year follow-up compared to the two other groups followed by group I, which showed a significant increase in gingival thickness. Gingival index and plaque index decreased in the three groups after 1 year.
Conclusion: The buccal pedicle flap showed an increase in gingival thickness, so it can be used for soft augmentation around the implant. It has the advantages of decreasing pain, morbidity, and the need for second surgical site, but connective tissue graft was superior to it in all clinical parameters measured.

Keywords: buccal pedicle flap, peri-implant mucosa, connective tissue graft, soft tissue augmentation

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Introduction

Dental implants have been regarded as a good option for decreasing crestal bone loss and maintaining a healthy mucosa with no significant damage to the adjacent natural teeth in partially edentulous patients. [1] Implant-retained prostheses have been regarded as a treatment modality associated with increased patient satisfaction in addition to, high success and survival rates.[2] A stable ridge dimension was guaranteed by delayed implants positioned after the ridge had fully healed. However, further augmentation procedures are needed because of the disadvantage of a longer healing period and bone resorption.[3]

Research has been undertaken for many years with the development of dental implants to determine the critical importance of soft tissue thickness in implant treatment. To prevent peri-implantitis and peri-implant mucositis which are peri-implant inflammatory diseases and to ensure a long-term, stable, and healthy implant survival, a biological seal by the soft tissue attachment surrounding the implant is considered to achieve this goal.[4]

It was found that it is crucial for dental implants to have adequate width and thickness of keratinized tissue.[5] Higher soft tissue inflammation, attachment loss, and mucosal recession can occur due to keratinized mucosa deficiency around implants which hinders patient oral hygiene.[6] Moreover, marginal bone loss can also be affected by the soft tissue thickness of the mucosa surrounding the implant.[5]

For peri-implant soft tissue augmentation, several techniques have been proposed including connective tissue grafts[7], which have been considered the gold standard[8], free gingival grafts[9], a combination of vestibuloplasty and grafting [10], allogenic soft tissue grafts[11], porcine collagen matrix[12], and the use of the buccal pedicle flap.[13]

Thoma et al. concluded that for maintaining peri-implant health, the most predictable technique is soft tissue augmentation using autogenous grafts by increasing keratinized tissue width (KTW) and thickness.[14] To have at least 2 mm of keratinized tissue width was found to have a protective effect on peri-implant health[15] as peri-implant biologic complications occur more in implants with < 2 mm of KTW..[16]

When the treatment outcomes are comparable, and according to Herfordet al., a one surgical site gingival augmentation procedure (the recipient) was preferable over two surgical sites procedure.[17] Also, obtaining an autologous soft tissue graft always has increased morbidity, the operative duration, needs additional preoperative planning, higher operative skills, and a second surgical site.[18]

So, evaluation of the role of the buccal pedicle flap technique compared to connective tissue graft for peri-implant soft tissue augmentation was the aim of this study.

Materials and methods

I-Patients selection

Patients with single or multiple edentulous sites seeking replacement of missing teeth by dental implants who attend the outpatient clinic of the Oral Medicine, Periodontology department at the Faculty of Dentistry, Mansoura University. The patients were provided with detailed information regarding the proposed procedures. A written informed consent regarding the purpose of the study was provided by all participants prior to their enrollment.

This study was a randomized controlled clinical trial with parallel arms. The present study was authorized by the research ethics committee of Faculty of Dentistry, Mansoura University with registration number A02060722, and registered with clinicaltrials.gov with registration number NCT06479733.

- Participants were enrolled according to these inclusion criteria: Patient aged between 18-50 years with single or multiple edentulous spaces, thin periodontal phenotype with healthy periodontium, patient with good oral hygiene measures and sufficient amount of basal bone.
- The exclusion criteria were as follows: Pregnancy and lactation, smokers, any pathological lesion or infection at the planned surgical site and any medication or disease that may compromise healing.

II- Sample size calculation

By using "Epi-info version 7.2.5.0" software and by considering the following assumptions; 95% two-sided confidence interval, with a power of 80% and an alpha error of 0.05, the minimum required sample size was calculated to get the most accurate significant results after considering the cases with inclusion criteria, as: (n) = 21 subjects, they were equally divided into three groups: (7 implants in each group).

III- Randomization

Eligible patients had a total number of 18 with 21 implant sites and were randomized at the second stage surgery 3 months after implant placement as follows:

Group 1: including 7 implant sites with soft tissue augmentation using buccal pedicle (modified roll) flap technique.

Group 2: including 7 implant sites with soft tissue augmentation using connective tissue graft.

Group 3: including 7 implant sites without soft tissue augmentation.

IV- Pre-surgical preparation

All patients received full mouth scaling and preoperative cone beam computed tomography was taken. 1 g of amoxicillin was given orally 1 hour before surgery (or 600 mg of clindamycin for penicillin-allergic patients), patients were instructed to rinse with a 0.2% chlorohexidine mouth wash for 1 min before surgery.

V- Surgical procedure

The implants were placed according to the standard implant placement protocol at the first stage surgery for all patients. Implant uncovering was performed after 3 months at the second stage surgery as follows:

For the first group (BPF), one horizontal and two small vertical incisions about 1 mm greater than the diameter of the cover screw mesially and distally were done, then de-epithelizing of the epithelium in between using a scalpel no 15c and with a small mucoperiosteal elevator, a full thickness flap was elevated containing the mini pedicle flap, after that a small buccal pouch was created, the mini buccal pedicle flap was rolled, inserted inside it and sutured with 5/0 vicryl suture as shown in Figure (1).

For the second group (CTG), the recipient site was prepared by making a crestal incision and a pouch was created buccally using appropriate tunneling instruments. For the donor site, the masticatory mucosa located on the hard palate between the palatal raphe and maxillary posterior teeth was the selected location. The graft was obtained as a free gingival graft, then it was de-epithelialized

using a scalpel no 15c. Then the donor site was compressed well, covered by gel foam, and protected by an acrylic stent. Graft was then sutured carefully under the buccal pouch as shown in Figure (2).

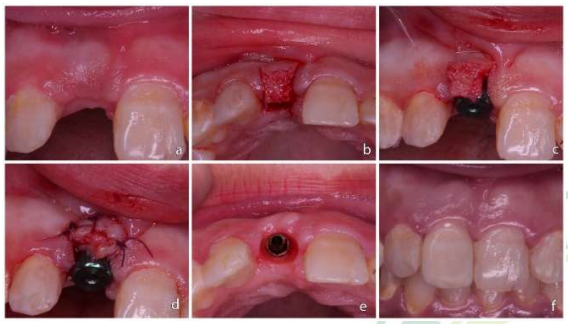

Figure 1: (a) Preoperative view, (b) Two vertical and one horizontal incision surrounding the cover screw with de-epithelialized tissue in between, (c) Rolled buccal pedicle flap with healing collar insertion, (d) Suturing of the buccal pedicle flap, (e) Healing after 2 weeks, (f) Final result after crown insertion.

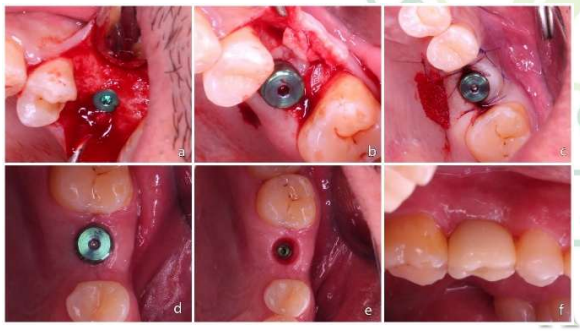

Figure 2: (a) First stage surgery of implant placement, (b) Buccal pouch with connective tissue graft inserted, (c) Suturing of the graft, recipient and donor site, (d) Soft tissue healing around the healing collar, (e) Emergence profile, (f) Final result after crown insertion.

Insertion of healing collars was done for all patients, postoperative medications including antibiotics and analgesics were prescribed, and instructions including consumption of soft food, rinsing twice a day with chlorhexidine 0.2% containing mouthwash were given to the patients. Open tray impression technique was used for impression taking after 1 month of the second stage surgery, and then prostheses were delivered to the patients.

VI- Clinical evaluation

Clinical parameters were assessed at baseline and after 1 year of the second stage surgery including:

1. Gingival thickness measurement using an endodontic spreader and a digital caliper.[19]
2. Keratinized mucosa width measurement using a periodontal probe.[20]
3. Pink esthetic score evaluation.[21]
4. Gingival index.[22]
5. Plaque index.[23]

VII- statistical analysis

The computer was fed with the data and IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp, released in 2011) used for data analysis. Percentages and numbers were used to represent categorical data. To compare between the three groups, the Chi-square test was applied. Alternatively, when more than 20% of the cells have an expected count of less than 5, the Fisher Exact correction test was applied. Shapiro-Wilk test was used for testing normality for continuous data. Mean and standard deviation were used to express quantitative data. For comparing the three studied groups for normally distributed quantitative variables, a one-way ANOVA test was used and then the Post Hoc test (Tukey) was used for pairwise comparison. For comparing between the two periods, the Paired t-test was used. Moreover, for comparing different groups for not normally distributed quantitative variables, the Kruskal Wallis test was used and then for pairwise comparison, the Post Hoc test (Dunn's for multiple comparisons test) was used. For comparing between the two periods, the Wilcoxon signed ranks test was used. At the 5% level, the significance of the obtained results was judged.

Results

A total of 21 implants were placed in 18 patients (10 females and 8 males), their age range was from (29 to 45) years.

After 3 months, all implants were uncovered; they all had a success rate of 100%, and all cases had primary wound closure with no adverse reactions or events.

1- Gingival thickness:

The gingival thickness was assessed in the three groups at baseline and after 1 year after the second stage surgery as shown in Table (1).

At baseline, there was no statistically significant difference between groups (p = 0.287) but it was statistically significant after 1 year (p <0.001*). There was a statistically significant increase in group II (CTG) from (1.59 ± 0.11) to (2.87 ± 0.50), followed by group I (BPF) which increased from (1.49 ± 0.16) to (2.19 ± 0.27) at 1-year follow-up, while group III showed a significant decrease from (1.47 ± 0.18) to (1.28 ± 0.25).

The amount of gain in gingival thickness from baseline to 1 year is shown in Figure (3).

2-Keratinized mucosa width:

The keratinized mucosa width was assessed at baseline and after 1 year as shown in Table (1).

At baseline, there was no statistically significant difference between groups (p=0.154), but it became significant after 1 year (p<0.001*).

By intragroup comparison, it increased significantly in group II (CTG) from baseline to 1 year (p p<0.001*), but there was no significant increase in the other two groups.

The amount of gain in keratinized mucosa width from baseline to 1year is shown in Figure (4).

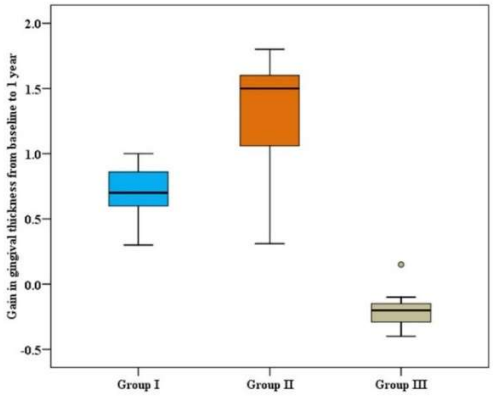

Figure 3: Comparison between the three studied groups according to gain in gingival thickness from baseline to 1 year

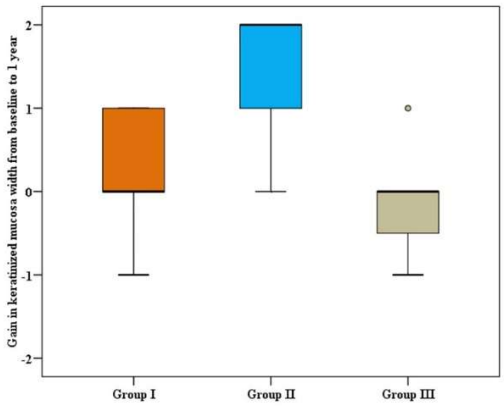

Figure 4: Comparison between the three studied groups according to gain in keratinized mucosa width from baseline to 1 year

3-Pink esthetic score:

The pink esthetic score was assessed at 2 month follow-up and after 1 year as shown in Table (2). There was a statistically significant increase in the three groups from 2 months to 1 year (p=0.004*, 0.011*, 0.008*) respectively. By intergroup comparison, group II (CTG) showed a statistically significant increase in pink esthetic score at 1-year follow-up followed by group I (BPF), and then the control group.

4- Gingival index and plaque index:

They were assessed at 2 month and after 1 year follow-up as shown in Table (2).

All groups showed a decrease in both indices after 1 year and an improvement in the gingival health status.

Table 1: Comparison between the three studied groups according to gingival thickness and keratinized mucosa width

		Group I	Group II	Group III	p
Gingival thickness	**Baseline**				
	Mean ± SD.	1.49 ± 0.16	1.59 ± 0.11	1.47 ± 0.18	0.287
	1year				
	Mean ± SD.	2.19 ± 0.27	2.87 ± 0.50	1.28 ± 0.25	<0.001*
	Sig. bet. grps.	p_1=0.006*,p_2<0.001*,p_3<0.001*			
	$^t p_4$	<0.001*	0.001*	0.030*	
Keratinized mucosa width	**Baseline**				
	Mean ± SD.	4.29 ± 1.11	4.14 ± 0.69	3.29 ± 1.11	0.154
	1year				
	Mean ± SD.	4.57 ± 0.79	6.57 ± 1.27	3.14 ± 0.90	<0.001*
	Sig. bet. grps.	p_1=0.004*,p_2=0.041*,p_3<0.001*			
	$^t p_4$	0.356	<0.001*	0.604	

p: p value for comparing between the studied groups, p_1: for comparing between **Group I** and **Group II,** p_2: for comparing between **Group I** and **Group III,** p_3: for comparing between **Group II** and **Group III,** p_4: for **Paired t-test** for comparing between **Baseline** and **1year** in each group, *: $p \leq 0.05$ is statistically significant.

Table 3: Comparison between the three studied groups according to different parameters

		Group I	Group II	Group III	p
Pink esthetic score	**2m** Mean ± SD.	10.86 ± 0.90	11.29 ± 1.50	9.71 ± 1.11	0.063
	1year Mean ± SD.	11.86 ± 0.69	13.14 ± 0.69	10.43 ± 0.98	<0.001*
	Sig. bet. grps.	p_1=0.019*,p_2=0.009*,p_3<0.001*			
	$^t p_4$	0.004*	0.011*	0.008*	
Gingival index	**2m** Mean ± SD.	1.07 ± 0.45	0.93 ± 0.31	1.11 ± 0.20	0.581
	1year Mean ± SD.	0.53 ± 0.26	0.40 ± 0.22	0.64 ± 0.32	0.085
	$^z p_4$	0.062	0.018*	0.027*	
Plaque index	**2m** Mean ± SD.	0.93 ± 0.28	0.93 ± 0.59	1.04 ± 0.65	0.963
	1year Mean ± SD.	0.55 ± 0.28	0.34 ± 0.25	0.69 ± 0.35	0.040*
	Sig. bet. grps.	p_1=0.153,p_2=0.72,p_3=0.011*			
	$^z p_4$	0.028*	0.043*	0.498	

Discussion

Achieving excellent soft tissue esthetics, healthy periodontal tissue, and hard tissue stability are the ultimate goals of dental implant tooth replacement. For a successful implant restoration, the peri-implant soft tissue properties are very crucial.[24] In addition to appropriate function, esthetics are highly important in dental implant treatments.[25]

This study evaluated the role of buccal pedicle or modified roll flap technique in increasing gingival thickness, keratinized mucosa width, pink esthetic score, and reducing gingival and plaque index compared to connective tissue graft.

According to our results, the gingival thickness increased significantly in group I (BPF) from baseline to one year but there was a statistically significant difference between group I and group II, also both groups showed a statistically significant difference to the control group.

This comes in line with Barakat et al[26] who evaluated the buccal pedicle flap or modified roll technique at 3 and 6 months follow-up and found a statistically significant difference in thickness between the study group and the control group at the 2 follow-up periods.

Multiple case series assessed the role of buccal pedicle flap in increasing soft tissue thickness and keratinized mucosa width[27-29], but the literature has a deficiency in comparing it with connective tissue graft or other augmentation techniques.

Regarding connective tissue graft, our results come in line with Thoma et al. who concluded that for maintaining peri-implant health the most predictable technique is soft tissue augmentation using autogenous grafts by increasing KTW and thickness.[14]Also wiesner et al.[30] who evaluated the CTG in means of increasing soft tissue thickness at 1-year follow-up and found that it was

(2.0±0.47), (2.05±0.50) at baseline then it became (3.20±0.42), (1.90±0.32) for the study and control group respectively.

Also Stefanini et al[31] in their case series evaluated the role of CTG inserted with transmucosal implant and found that buccal soft tissue thickness had increased significantly and vertical soft tissue level improved at 6 months, 1 year, and 3 years follow-ups. Also, Thoma et al[32] found that the soft tissue thickness in the CTG was 2.7 ± 0.4 at baseline and increased to 3.1 ± 1.3 after 1 year.

According to our results and regarding keratinized mucosa width, in group I (BPF), and group III (control) there was no statistically significant difference between baseline and 1 year but it was significant in group II (CTG).

This comes in accordance with Stefanini et al[31] who found a significant increase in keratinized tissue width at 3 years follow-up after connective tissue graft insertion with transmucosal implants, controversially Elbattawy et al[33], found that it increased from 4.17±1.17 at baseline, to 4.27±1.16 mm at 6 months follow-up in the group augmented by SCTG, which is a gradual non statistically significant increase.

This can be explained by two studies that utilized a connective tissue graft taken from the palatal most superficial layer as a free gingival graft and then de-epithelialized, showed a progressive increase in soft tissue thickness.[31, 34] Another study explained the increase in keratinized mucosa width as this type of superficial graft has the histological characteristics of keratinized mucosa, and a nature composed mainly of lamina propria with little glandular and adipose tissue.[35]

Regarding the pink esthetic score, there was a significant increase in all groups from 2-month follow-up to 1 year with favorable results in group II.

This comes in accordance with Arora & Ivanovski, who saw that PES values had a considerable improvement at the end of their follow-up[36], Wiesner et al.[30] found that PES for their study group (CTG) became (11.32±1.63) compared to (8.45±1.46) for the control group (no augmentation) at the end of 1 year follow-up, also Noelken et al. at their 1 year follow-up found that PES values had increased.[37]

This can be explained by Jung et al. who found that after implant placement, more expected abundant blood supply will occur in the case of thicker native hard and soft tissue, which in turn increases expectations about aesthetic success.[4]

Gingival and plaque index showed improvement from 2-month to 1-year follow-up at all groups, this came in line with systematic reviews and clinical studies, which showed that the quality and thickness of soft tissue played an important role in improving or maintaining peri-implant health.[38-40] which can also be explained by strong patient motivation toward oral hygiene that was supported by improved quality of keratinized tissue that formed a good peri-implant soft tissue seal.[40]

Conclusion

It can be concluded that and within the limitations of this study:

The buccal pedicle flap technique can improve peri-implant gingival thickness, and maintain the width of keratinized mucosa. It can be used for peri-implant soft tissue augmentation decreasing pain, morbidity, operation time, and second surgical site. But still, the connective tissue graft is the gold standard for soft tissue augmentation around implants.

Funding

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Data availability

Full data is available for anyone. It may be acquired by requesting it by email.

Ethics approval and consent to participate

The present study was authorized by the research ethics committee of the Faculty of Dentistry, Mansoura University with registration number A02060722 and all patients signed informed consents following an explanation of the whole procedure.

Competing interests

The authors have no conflicts of interest to declare.

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