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Comparison of bone tacks and sutures in free gingival graft procedures: a clinical study

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Abstract

Objective: The aim of the present study was to compare the efficacy of bone tacks and sutures in free gingival graft (FGG) stabilization during gingival augmentation procedures.

Materials and Methods: Twelve subjects participated in this study. One site in each subject was randomly assigned into each of the following experimental groups. In the test group, the FGG was stabilized with bone tacks, whereas FGG procedure with conventional sutures was performed in the control group. Clinical parameters assessed were the width of keratinized gingiva and plaque index (PI) scores at baseline, 1 month, and 3 months. Surface shrinkage (SS) was recorded at 15 days, 1 month, and 3 months. Early wound healing score (EHS) was recorded postoperatively, after an interval of 1 week.

Results: Bone tacks stabilized with FGG were effective in increasing the width of the keratinized gingiva, but did not show any added advantage over sutures, with no statistical difference between both groups (p=0.49). In both groups there was similar SS, EHS and PI scores, with no statistical significance difference between them (p=1.00).

Conclusion: This trial was conducted over a period of 3 months, and it was observed that bone tacks can be used to stabilize the FGG during mucogingival procedures.

Keywords: Bone tacks. Free gingival graft. Surface shrinkage.

Introduction

Gingival recession (GR) is a common mucogingival deformity, and is defined as the apical displacement of the gingival margin from the cementoenamel junction, leading to decreased keratinized tissue (KT), root exposure, esthetic concern and dentinal hypersensitivity (Caton *et al*., 2018; Lang *et al*., 1972). For maintaining overall esthetics to prevent periodontal recession, the presence of KT around natural dentition and implants is important (Schrott *et al*., 2009). Various surgical procedures have been proposed to increase the amount of KT and treat GR, with variable success rates. Free gingival graft (FGG) has been a popular procedure for gingival augmentation, which increases the amount of attached gingiva and tissue thickness, by restoring an adequate width of KT, hence correcting mucogingival deformities and improving esthetics (Zucchelli *et al*., 2015). Ample donor tissue availability, easy tissue handling and the ability to treat multiple teeth are the main advantages of FGG (Camargo *et al*., 2001).

FGG should be correctly positioned, along with proper immobilization, as any movement could compromise vascularization and impair healing. Improper stabilization may impair tissue revascularization, and subsequently lead to necrosis of tissue (Paknejad *et al*., 2004). Usually, interrupted sutures are used to stabilize FGG in the recipient site, although this has drawbacks, such as longer insertion times and a higher chance of crosshatched lines along the suture line. Another important factor to contemplate is not to compress the graft, by stretching or over-suturing. An expected clinical phenomenon is shrinkage of FGG, which occurs primarily during the healing period. Other factors influencing the FGG shrinkage are the periodontium phenotype, type of receptor bed, the graft thickness and suture. Grafts fixed on the periosteal bed showed less contraction, due to its potential to rapidly re-establish a blood supply to the graft, compared to grafts placed on the osseous bed. The use of silk suture avoids producing an inflammatory response in the tissue, which can interfere with graft shrinkage. Thicker grafts have greater primary contraction, due to the high amount of elastic lamina propria, but showed less secondary contraction (Kim *et al*., 2000: Barbosa *et al*., 2009).

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One possible approach involves the sutureless FGG technique (Hoexter *et al.*, 1979), which utilizes cyanoacrylates for stabilization of the graft, to avoid the use of sutures. Cyanoacrylates have advantages like strong bonding and biodegradability, but also presents side effects like retinal damage and skin burns upon contact (Singer *et al.*, 2008). Another method involves the use of acellular dermal matrix around dental implants, to increase keratinized mucosa, compared to FGG stabilized with sutures, resulting in reduced chair-side time and faster healing (Shi *et al.*, 2020). Thus, the present study aims to evaluate the impact of bone tacks on FGG stabilization and healing. By assessing the effectiveness of tacks in promoting graft stability and tissue regeneration, this study aims to contribute to improved treatment options for GR.

Methods

This study was approved by the ethics committee and the scientific committee of the institutional review board (IRB) (No: SVSIDS/Perio/2/2020), and the requirement for informed consent was waived.

A sample size of total 12 patients (6 for each group) was calculated for statistical power of 0.90, probability of error of 0.05 and effect size of 1.5. The study was conducted as a single blind, randomized controlled clinical trial, and subjects were selected from the Department of Periodontology of the outpatient section.

Male and female patients aged >18 years, systemically healthy, requiring gingival augmentation, with the following criteria, were included: incisor teeth, absence of keratinized gingiva/attached gingiva, Miller's Class I or Class II gingival recession without any bone loss. Medically compromised patients, subjects who underwent radiotherapy or chemotherapy, pregnant women, smokers and teeth with crown restorations were excluded from this study.

1. Measurements

a) Width of keratinized gingiva
The width of keratinized gingiva was measured from the free gingival margin to the mucogingival junction (MGJ) at the facial surface, using UNC 15 probe, at baseline, after 15 days, 1 month and 3 months. The MGJ was identified by the color contrast between the gingiva and the mucosa, and by moving the mucosa. The width of keratinized gingiva was measured in mm, at baseline, after 1 month and 3 months postoperatively.

b) Measurement of surface shrinkage
Measurement of surface shrinkage (SS) was performed using the formulas: surface area (SA) = width × length, and percent shrinkage = 100 × ([baseline dimension – postoperative dimension]/baseline dimension). Surface shrinkage was measured at 15 days, 1 month, and 3 months postoperatively (Cifcibasi *et al.*, 2015).

c) After 1 week postoperatively, soft tissue wound healing was recorded by using early wound healing score (EHS) (Marini *et al.*, 2018). The EHS scoring was based on the evaluation of clinical signs of hemostasis, re-epithelialization and inflammation. The sum of the scores for these parameters resulted in the EHS, which ranges between 0 to 10 points.

Full-mouth plaque index (PI) was recorded using Turesky modification of the Quigley Hein index, at baseline, after 1 month and 3 months. Score 0 = no plaque; 1 = isolated areas of plaque at gingival margin; 2 = thin band of plaque at gingival margin (≤1mm); 3 = plaque covering up to 1/3 of the tooth surface; 4 = plaque covering between 1/3 and 2/3 of the tooth surface; 5 = plaque covering 2/3 of the tooth surface.

2. Interventions

1) Pre-surgical protocol

Each patient was prepared for the surgery with initial phase-I therapy, including scaling and root planning, oral hygiene instructions and occlusal adjustment. One week after initial examination and phase-I therapy, the patients were reevaluated, for oral hygiene compliance. The patients were recalled for the surgical procedure after two weeks.

2) Study protocol

Patients were randomly allocated into test and control groups. In the test and control groups, free gingival graft was stabilized using bone tacks and sutures, respectively. All baseline (on the day of surgery) parameters were measured before the surgical procedure. The width of keratinized gingiva (wKG) and PI were recorded at the baseline, 1 and 3 months, and SS was recorded at 15 days, 1 month, and 3 months. EHS was recorded at 1 week postoperatively. Clinical parameters were assessed using a UNC #15 color-coded periodontal probe.

3. Surgical procedure

1) In test site

After rinsing with an antiseptic solution and administration of local anesthesia, the first horizontal incision was made coronally to the MGJ in the KT. Next, two vertical relaxing incisions were made to diverge apically, marking the mesiodistal length of the recipient site. To improve blood supply, de–epithelization of the recipient site was done. With the help of a mold made with sterile paper, the graft dimensions were replicated upon the palate, and, using a scalpel, the borders were outlined for the FGG to be resected using the 15C scalpel. After its removal, the graft was enfolded in gauze and placed in saline. The graft was then positioned to the recipient site by tacking into the bone. The tacks were removed at 30 days after the surgical procedure (Figs. 1 and 2).

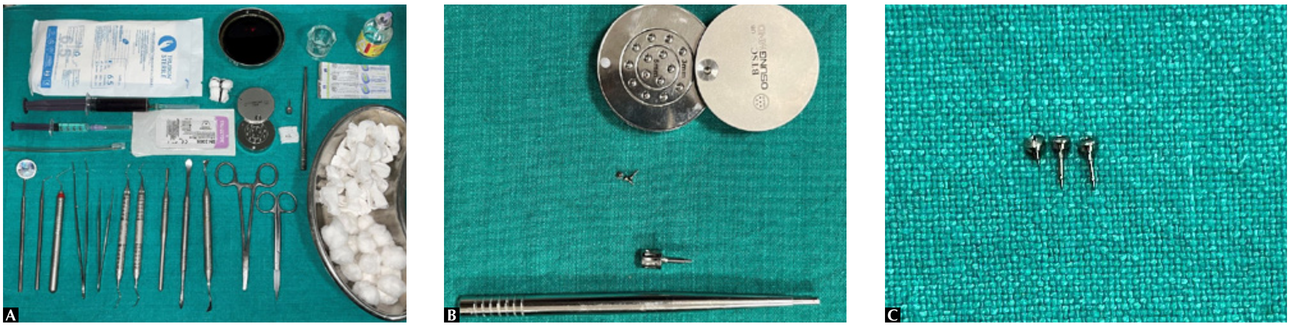

Figure 1. A) Armamentarium. B) Bone tack kit (BTSC OSUNG CE). C) Bone tacks (M0.75×3mm and M0.85×5mm).

Figure 2. A) Preoperative image of a class I gingival recession irt 14. B) De–epitheliazation of recipient site. C) Marking with template on donor site. D) FGG harvested. E) Suturing done on donor site after placing gel foam sponge. F) FGG stabilized with bone tacks. G) Obturator.

2) In control site

The same procedure was done for the control site, except for using bone tacks. FGG harvested from the palate under local anesthesia was adapted to the recipient site with single 4-0 vicryl sutures (Fig. 3).

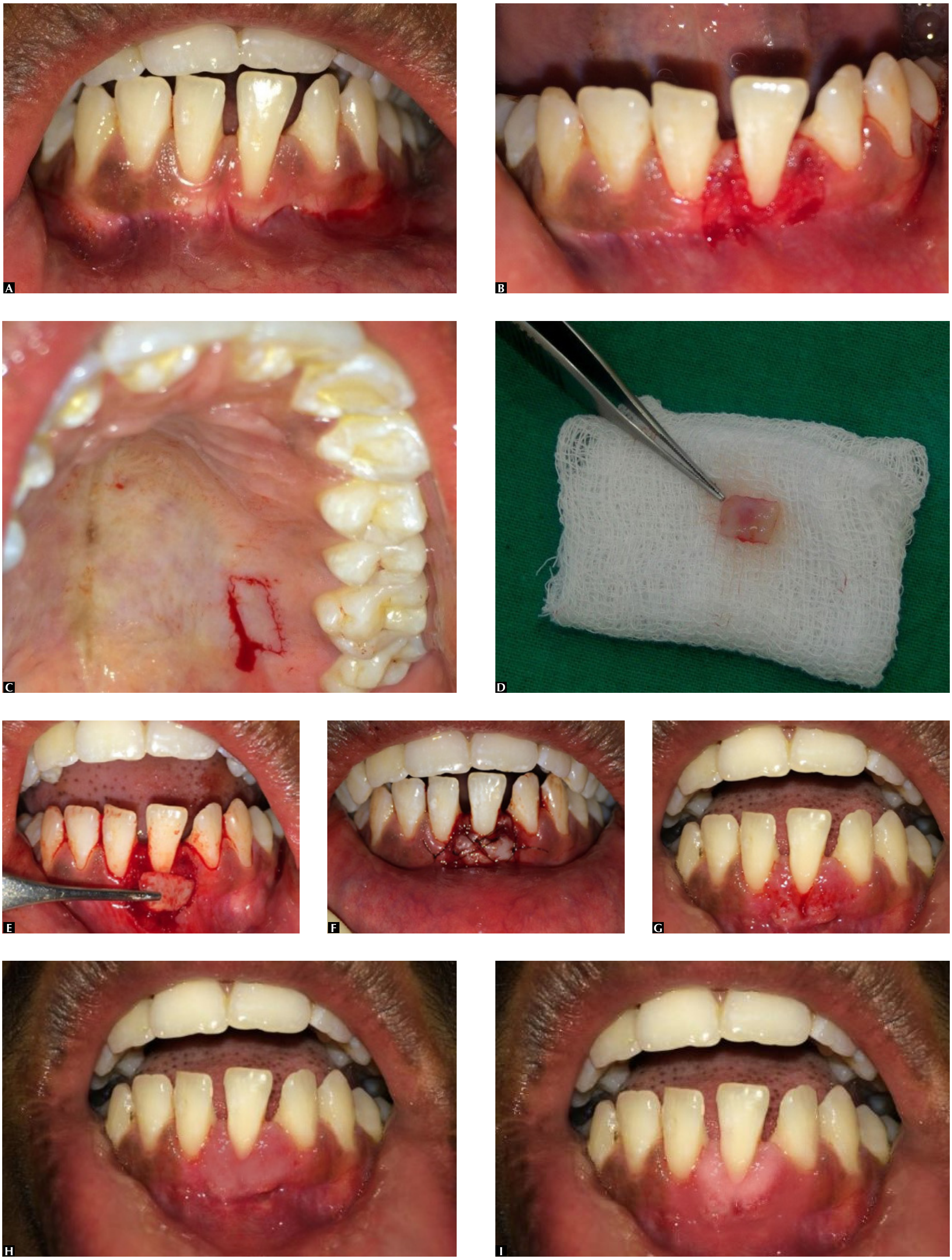

Figure 3. A) Pre–operative image of a class I gingival recession irt 31. B) De–epitheliazation of recipient site. C) Incisions marking on donor site. D) FGG harvested. E) Placement of FGG at recipient site. F) FGG stabilized with sutures. G) 15 days postoperative. H) 1 month postoperative.

4. Postsurgical care

For both groups, routine postoperative instructions were given and antibiotics were prescribed for 5 days (amoxicillin 500 mg t.i.d., metrogyl 400mg b.i.d.), analgesics for 2 weeks, and chlorhexidine digluconate mouth-rinse twice daily for 30 seconds. Palatal sutures were removed postoperatively after two weeks. Periodontal dressings and sutures were removed, and clinical measurements were recorded at baseline — patients were advised to gently brush the area with a soft-bristled toothbrush. Patients were then recalled at 1 and 3 months. At each visit, oral hygiene instructions were reinforced, and oral hygiene was reassessed.

5. Statistical analysis

The data was analyzed using IBM SPSS v. 20 (IBM Corp., Armonk, NY, USA). Friedman test was used to compare the parameters at the different intervals, Wilcoxon signed-rank test was used for intragroup comparisons, and Mann-Whitney u-test was used for the intergroup comparison of parameters. P-values < 0.05 were considered as significant and p-values < 0.001 were highly significant.

Results

This randomized clinical trial was carried out to determine the clinical efficacy of bone tacks over sutures in the stabilization of free gingival grafts (Marini *et al.*, 2018). Systemically healthy individuals, presenting with inadequate width of keratinized gingiva, were recruited. All patients demonstrated acceptable oral hygiene compliance following phase-I periodontal therapy. Satisfactory postoperative wound healing was observed, without any uneventful complications in all the treated sites. In addition, patients were followed up for 3 months after surgery, and no drop-outs occurred during the study period (Figs. 3 and 4).

Figure 4. A) Preoperative image of a class I gingival recession irt 14. B) 15 days postoperative. C) 1 month postoperative. D) 3 months postoperative.

1. Intergroup comparison

1) Width of keratinized tissue at different time intervals

On intergroup comparison, the width of keratinized gingiva at different time intervals revealed no significant differences between the test and control groups at baseline (p=1.00), and from baseline to 1 month and 3 months (p=0.575, p=0.49, respectively) (Table 1).

2) Surface shrinkage at different time intervals

On intergroup comparison, SS revealed a highly significant difference between the test and the control groups at 15 days (p=0.001), and from baseline to 1 month and 3 months (p=0.001, p=0.002, respectively) (Table 2).

3) Early wound healing score at different time intervals

On intergroup comparison with Mann-Whitney u-test, no significant differences were observed between the test and control groups for the EHS at 7 days (p=1.000) (Table 3).

4) Plaque index at different time intervals

On intergroup comparison with Mann-Whitney u-test, no significant differences were observed between the test and the control groups for the PI scores at baseline (p=1.000), and from baseline to 1 month and 3 months (p=1.000, p=0.52, respectively) (Table 4).

Table 1. Intergroup comparison of the width of keratinized gingiva between test and control.

GROUPS	*Baseline*	*1 month*	*3 months*
Test group	1.33±0.51	6.5±0.54	5.5±1.05
Control group	1.33±0.52	6.33±0.52	5.7±0.81
Mann-Whitney u-test	1.000 (NS)	0.575 (NS)	0.49 (NS)

* Significant for p < 0.05. NS = non-significant.

Table 2. Intergroup comparison of surface shrinkage among test (bone tacks) and control (sutures) groups.

Groups	*Baseline (at 15 days)*	*1 month*	*3 months*
Test group	8.90±0.96	18.17±1.68	30.3±4.43
Control group	10.1±1.49	19.6±2.62	30.47±6.52
Independent t-test	<0.001*	<0.001*	0.002*

* Significant for p < 0.05.

Table 3. Intergroup comparison of early wound healing scores (EHS) between test and control groups, post-operatively at an interval of 1 week.

Groups	*Mean±SD*	*U-value*	*p-value*
Test group	4.66±0.51	18.00	1.000 (NS)
Control group	4.66±0.51		

Mann-Whitney u-test. NS = non-significant.

Table 4. Intergroup comparison of plaque index (PI) scores between the test and control groups.

Groups	*Baseline (at SRP)*	*1 month*	*3 months*	*Friedman test p-value*
Test group	1.66±0.52	2.66±0.52	2.8±0.4	0.003*
Control group	1.66±0.52	2.66±0.52	2.66±0.52	0.016*
Mann-Whitney u-test	1.000 (NS)	1.000 (NS)	0.52 (NS)	

* Significant for p < 0.05. NS = non-significant. SRP = scaling and root planing.

Discussion

Although tacks have been used in guided tissue regeneration for stabilizing collagen membrane, to date no study has been done on usage of bone tacks for stabilizing FGG. The literature shows no evidence regarding the use of newly developed tacks instead of sutures. To the best of our knowledge, this is the first clinical study that evaluated the efficacy of bone tacks in the stabilization of FGG over sutures.

The technique used in the present study was found to be safe and effective. According to the manufacturer instructions, tacks can be used quickly. The advantages of using the tacks included: less time for stabilization of the graft, reduces trauma and graft contraction. Effective stabilization was demonstrated in the present study, since the graft position was the same after 30 postoperative days. However, care must be taken when adjusting or stabilizing the tacks, to avoid damaging the graft, by reducing the excessive compression of the soft tissues surrounding the head of the tacks.

The aim of the present randomized clinical trial was to evaluate the effect of bone tacks on FGG stabilization. The results of the present study indicate that using bone tacks in FGG procedure to increase KT dimensions is validated. On intergroup comparison with tacks and sutures in stabilization of FGG, in terms of gain in wKG, the present results showed no significant difference between both groups. But average gain of keratinized gingival was more than 5mm at the end of three months follow-up period in test group. This study is in accordance with the study done by Kang *et al.* (2021), who compared silk suture with a cyanoacrylate adhesive to stabilize FGG, using Er:YAG laser-assisted recipient site preparation. The width of the keratinized gingiva did not differ significantly between the groups ($p>0.05$), from baseline to 12 months. Additionally, the results showed that the cyanoacrylate group had more attached keratin layer than the suture group.

In this study, there was a 5.3-mm mean gain in keratinized gingiva with the use of bone tacks stabilized with FGG. A previous study also revealed similar gain in keratinized gingiva when different methods of suturing used for fixation of FGG were compared (Shammas *et al.*, 2020). Sutures and/or their remnants were removed after a period of 7-10 days. This promotes a plaque-free environment, as opposed to placing tacks, which have a potential to accumulate biofilm. This biofilm-free environment might have promoted creeping attachment, resulting in a higher gain of KT in suture-stabilized group. However, it may also be due to the heterogeneity of selection of recession cases in both groups.

Considering dimensional changes, it is possible to state that contraction of FGG occurs in two steps: first, during the formation of a net of blood vessels in the graft; and later, when graft adheres to the recipient site (Zingale *et al.*, 1974; Mormann *et al.*, 1981). In this study, it was decided to fix a graft on the periosteal bed due to its potential to rapidly renew a blood supply to the graft and also acts as a strong base to stabilize the graft (Oliver *et al.*, 1968).

On intergroup comparison of SS in FGG stabilized with bone tacks or sutures, findings revealed a highly significant difference between the test and the control groups at 1 and 3 months, respectively. Our study is in contrast with the study by Barbosa *et al.* (2009), who evaluated the dimensional changes in FGG fixed with cyanoacrylate or sutures. Their results showed that the dimensional changes in the healing of the grafts in the recipient site were influenced by the thickness of gingival graft tissue. In the present study, it was observed that graft shrinkage occurred more in control group than in test group, probably due to the trauma of the suture needle into the tissue. Sutures are bioactive, and must be engaged into the tissue at least six times to stabilize a graft. This interaction with the tissue can damage to the graft, and the probability of graft necrosis is increased (Gümüş *et al.*, 2014). The present results are similar to the study done by Shammas *et al.* (2020), who observed significant graft shrinkage. From the present study, it can be inferred that initial stabilization by bone tacks may have a significant effect in the maintenance of avascular plasmatic circulation, eventually resulting in less shrinkage, as stated by Sullivan *et al.* (1968) and Oliver *et al.* (1968). It can be observed that shrinkage of FGGs is a known clinical occurrence during wound healing in the early postoperative healing, as observed by Hatipoglu *et al.* (2007).

In the present study, intergroup comparison of EHS revealed no significant differences between the test and control groups. The present study is in accordance with Barbosa *et al.* (2009), who stated that the use of cyanoacrylate, when compared to conventional suturing, did not differ in regard to graft shrinkage, and had no impact on healing. Bissada *et al.* (1978) showed that FGG with perforation of cortical bone plate had significantly stronger attachment than those without perforation. Similarly, in the present study, grafts were stabilized by tacking into adjacent bone, which increase blood supply.

In the present study, EHS was recorded post-operatively at an interval of 1week, to understand the merging of graft with the adjacent site at two vertical incisions. Similar results for complete epithelization were observed in this study in the second week, demonstrating no significant difference.

In the present study, on intergroup comparison of PI scores between test and the control groups, no significant difference was observed from baseline to 3 months. These findings are similar to the study by Cifcibasi *et al.* (2015), who evaluated shrinkage of FGG and found no statistically difference from baseline to 3 months in the PI scores. The present findings are in agreement with the study done by Kang *et al.* (2021), who compared the silk suture to a cyanoacrylate adhesive to stabilize the FGG using Er:YAG laser. Their results revealed a non-significant difference in the PI scores at 3, 6, and 12 months within groups and in all treatment groups.

This study has the following limitations: histological assessment of the tissue was not performed; and the gingival phenotype was not assessed; shrinkage was not recorded by using optical scanner or any scanning software program (Barbosa *et al.*, 2009). Attention should be drawn from the present study about the methodological problems when assessing graft contraction (Soehren *et al.*, 1973). As contraction does not follow a fixed polygonal shape, there might be probability of error in evaluating dimensions between control and test group. Thickness of the graft harvested influenced primary and secondary contraction of the graft during healing, which was also not measured in the present study.

From this clinical trial conducted over a period of 3 months, it was concluded that bone tacks have the potential to stabilize free gingival grafts for gingival augmentation. Both bone tacks and sutures were effective in achieving a gain in the wKG. However, SS was higher for sutures, when compared to bone tacks. Further clinical and histological studies with a larger sample size are required to evaluate the efficacy of bone tacks in soft tissue augmentation.

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