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COMPARATIVE EVALUATION OF FREE GINGIVAL GRAFT AND VESTIBULOPLASTY WITH PERIOSTEAL FENESTRATION ON MUCOGINGIVAL JUNCTION STABILITY AND POSITION: A RANDOMIZED CLINICAL TRIAL

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ABSTRACT

Background: Adequate attached gingiva and a stable mucogingival junction (MGJ) are essential for periodontal health, particularly in the mandibular anterior region where shallow vestibule is common. Free gingival graft (FGG) and vestibuloplasty are routinely performed to increase keratinized tissue and vestibular depth; however, their comparative influence on MGJ stability remains unclear. This randomized clinical trial aimed to compare vestibuloplasty and FGG in the mandibular anterior region, focusing on changes in MGJ position and stability.

Materials and Methods: Thirty systemically healthy patients presenting with inadequate vestibular depth and/or insufficient attached gingiva in the mandibular anterior region were randomly allocated to either a vestibuloplasty group (n=15) or an FGG group (n=15). Clinical parameters including vestibular depth (VD), keratinized tissue width (KTW), and width of attached gingiva (WAG) were recorded at baseline, 3 months, and 6 months postoperatively. MGJ stability was assessed indirectly through the maintenance of postoperative gains in KTW and WAG and the absence of significant dimensional changes between 3 and 6 months.

Results: At 3 and 6 months postoperatively, the FGG group showed significantly greater improvements in all evaluated parameters compared to the vestibuloplasty group ($p < 0.001$). Mean VD was higher in the FGG group at 3 months (17.52 ± 1.06 mm) and 6 months (17.56 ± 1.01 mm). Greater gains in KTW (7.10 ± 0.97 mm) and WAG (4.48 ± 0.50 mm) were also observed at both follow-up intervals. The FGG group exhibited superior MGJ stability, evidenced by greater and more sustained apical displacement of the MGJ and maintenance of keratinized and attached gingival dimensions throughout the observation period.

Conclusion: Within the limitations of this study, both surgical approaches were effective, FGG resulted in significantly superior clinical outcomes in terms of vestibular depth, keratinized tissue width, and width of attached gingiva at postoperative follow-up. Therefore, FGG remains the preferred approach when long-term MGJ stability and mucogingival augmentation are primary treatment objectives.

Keywords: Vestibuloplasty, Periosteal Fenestration, Mucogingival Junction, Mucogingival Surgery, Keratinized Gingiva, Gingival Augmentation, Vestibular Depth

1. INTRODUCTION

The presence of a sufficient band of gingiva has been regarded as fundamental to maintain periodontal health.1,2 The mandibular anterior region is particularly prone to mucogingival problems due to a shallow vestibule, thin gingival biotype, and high muscle or frenum attachments.3 These anatomical limitations may compromise plaque control, contribute to gingival inflammation, and predispose to gingival recession. Reduced vestibular depth can further hinder effective oral hygiene measures and affect patient comfort.3,4 Various mucogingival surgical procedures have been proposed to augment keratinized tissue and deepen the vestibule. Free gingival grafting (FGG) is a well-established technique aimed at increasing the width of keratinized gingiva and enhancing tissue resilience.5,6,7 Vestibular deepening procedures, on the other hand, primarily focus on repositioning the mucosa apically to increase vestibular depth and reduce muscle pull. Both techniques are widely practiced in clinical periodontology.8 Although these procedures are effective in improving clinical parameters, their influence on the position and stability of the mucogingival junction (MGJ)

remains a subject of interest. The MGJ serves as a critical anatomical landmark and its displacement may reflect true gain in attached gingiva. Despite the widespread use of these techniques, comparative data regarding their specific influence on the stability and position of the mucogingival junction (MGJ) remain limited. The MGJ is a critical anatomical landmark; its stable displacement is a primary indicator of true gains in attached gingiva. This randomized clinical trial aimed to compare FGG and Vestibuloplasty regarding their impact on MGJ stability, vestibular depth, and keratinized tissue width in the mandibular anterior region.

2. MATERIALS AND METHODS

a. Ethical Considerations & Study Design

This investigation was designed as a parallel-arm randomized controlled clinical trial and conducted in the Department of Periodontics. The protocol received approval from the Institutional Scientific Review Board and the Institutional Ethics Committee, adhering strictly to the Declaration of Helsinki (2013 revision). Participants provided written informed consent prior to enrolment. Patients were assigned to study groups in a 1:1 allocation ratio using a computer-generated sequence. Allocation concealment was maintained through sequentially numbered, opaque, sealed envelopes.

b. Participant Selection

Thirty systemically healthy participants (aged 18 and above) were selected. Inclusion required the presence of inadequate vestibular depth and/or insufficient attached gingiva in the mandibular anterior region, specifically associated with a positive tension test of the mandibular labial frenum. Exclusion criteria included tobacco use in any form, pregnancy, or lactation, and systemic or metabolic conditions known to impair wound healing.

c. Clinical Parameters

After non-surgical periodontal therapy, Measurements were recorded by a single calibrated, blinded examiner at baseline, 3
months, and 6 months postoperatively using a UNC-15 periodontal probe (Hu-Friedy, USA). Parameters included:

- Keratinised Tissue Width (KTW): Distance from the gingival margin to the MGJ.
- Vestibular Depth (VD): Distance from the gingival margin to the deepest point of the vestibular fornix.
- Width of Attached Gingiva (WAG): Calculated by subtracting the probing depth from the KTW.

d. Surgical Protocols

A single experienced clinician performed all procedures under local anesthesia (2% lignocaine with 1:80,000 epinephrine).

- Vestibuloplasty Group (Group-1): A horizontal incision was placed 4–8 mm apical to the MGJ using a No. 15 Bard-Parker blade. Muscle fibers were detached from the periosteum via sharp dissection. The mucosal flap was repositioned apically and secured to the periosteum at the intended depth using 4-0 non-resorbable sutures.
- Free Gingival Graft (FGG) Group (Group-2): A recipient bed was prepared at the level of the MGJ via de-epithelialization using a No. 15 Bard-Parker blade. The required graft dimensions were determined using a sterile foil template adapted to the periosteal bed. A 1.5 mm thick graft was harvested from the palatal premolar-molar region using a No. 15C blade. A prefabricated Hawley's retainer was placed at the donor site to minimize postoperative discomfort. The graft was trimmed, positioned, and secured at the recipient site with 4-0 non-resorbable and 4-0 resorbable sutures.

e. Postoperative Care

Patients were prescribed Amoxicillin (500 mg, thrice daily) and Ibuprofen (400 mg, twice daily) for five days. A 0.2% chlorhexidine rinse was used twice daily for three weeks. Sutures and dressings (Coe-Pak) were removed at one week postoperatively. No postoperative complications, such as secondary hemorrhage or infection, were observed.

3. STATISTICAL ANALYSIS:

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) software, version 26.0 (IBM Corp., Armonk, NY, USA). Data normality for vestibular depth (VD), keratinized tissue width (KTW), and width of attached gingiva (WAG) was assessed using the Shapiro–Wilk test. Since all parameters demonstrated a statistically significant deviation from normal distribution ($p < 0.001$), non-parametric statistical tests were employed. Intragroup comparisons across baseline, 1-month, and 3-month follow-up periods were carried out using Friedman's test. When statistically significant differences were identified, post hoc pairwise comparisons were conducted using the Bonferroni correction. Intergroup comparisons between the Vestibuloplasty and free gingival graft (FGG) groups at each time point were performed using the Mann–Whitney U test. A p-value of ≤ 0.05 was considered statistically significant.

4. RESULTS

A total of 30 patients were included in the final analysis. Of these, 15 patients underwent vestibuloplasty and constituted the vestibuloplasty group, while the remaining 15 patients received free gingival grafting and formed the FGG group. All participants were followed up as per the study protocol, and no dropouts were recorded during the evaluation period.

Parameter	Group	Statistic	df	Sig.
VD	Vestibuloplasty	0.918	96	<0.001
	FGG	0.931	90	<0.001
KTW	Vestibuloplasty	0.901	96	<0.001
	FGG	0.874	90	<0.001
WAG	Vestibuloplasty	0.811	96	<0.001
	FGG	0.852	90	<0.001

Shapiro Wilk test

Table 1- Normality assessment

Table 1 presents the assessment of normality; the Shapiro–Wilk test indicated that vestibular depth (VD), keratinized tissue width (KTW), and width of attached gingiva (WAG) across both groups were not normally distributed ($p<0.001$). Consequently, non-parametric statistical methods were employed for all subsequent intragroup and intergroup analyses
Intragroup Analysis In the vestibuloplasty group, the Friedman's test revealed statistically significant improvements in VD, KTW, and WAG at all follow-up intervals ($p<0.001$). The mean VD increased from a baseline of 13.88±2.06 mm to 16.28±1.41 mm at 3 months, remaining stable at 6 months (16.36±1.41 mm). KTW also showed significant gains, rising from 2.96±0.95 mm at baseline to 4.67±0.93 mm at 3 months and 4.73±0.91 mm at 6 months. Similarly, WAG increased from 1.52±0.68 mm at baseline to 3.17±0.79 mm at 3 months and 3.30±0.80 mm at 6 months. (Table-2)
The FGG group exhibited a similar pattern of statistically significant intragroup improvement ($p<0.001$ for all parameters). VD increased from 13.63±1.54 mm at baseline to 17.52±1.06 mm at 3 months and remained stable at 17.56±1.01 mm by the 6-month evaluation. KTW demonstrated a marked rise from 3.12±1.03 mm at baseline to 7.10±0.97 mm at 3 months, with these values being fully preserved at 6 months. Likewise, WAG increased from 1.70±0.77 mm at baseline to 4.48±0.50 mm at 3 months, maintaining this level at the 6-month mark (Table-2)

Group	Parameter	Baseline	3 months	6 months	p-value
Vestibuloplasty	VD	13.88 ± 2.06	16.28 ± 1.41	16.36 ± 1.41	<0.001*
	KTW	2.96 ± 0.95	4.67 ± 0.93	4.73 ± 0.91	<0.001*
	WAG	1.52 ± 0.68	3.17 ± 0.79	3.30 ± 0.80	<0.001*
FGG	VD	13.63 ± 1.54	17.52 ± 1.06	17.56 ± 1.01	<0.001*
	KTW	3.12 ± 1.03	7.10 ± 0.97	7.10 ± 0.97	<0.001*
	WAG	1.70 ± 0.77	4.48 ± 0.50	4.48 ± 0.50	<0.001*

Friedman's test; * indicates a significant difference at $p \leq 0.05$

Table 2- Intragroup comparison of vestibular depth scores, keratinized tissue width, and width of attached gingiva at different follow-up periods in three groups

Post hoc Bonferroni analysis for both groups confirmed that significant clinical gains occurred between baseline and 3 months, as well as between baseline and 6 months ($p<0.001$). However, no significant differences were found between the 3-month and 6-month intervals for VD or KTW in either group ($p=1.000$), nor for WAG in the vestibuloplasty ($p=0.837$) or FGG ($p=1.000$) groups, indicating postoperative stability after the initial 3 months. (Table-3)

Group	Parameter	B vs 3m	B vs 6m	3m vs 6m
Vestibuloplasty	VD	<0.001*	<0.001*	1.000
	KTW	<0.001*	<0.001*	1.000
	WAG	<0.001*	<0.001*	0.937
FGG	VD	<0.001*	<0.001*	1.000
	KTW	<0.001*	<0.001*	1.000
	WAG	<0.001*	<0.001*	1.000

Post hoc Bonferroni test; * indicates a significant difference at p≤0.05

Table 3- Pairwise comparison of vestibular depth scores, keratinized tissue width, and width of attached gingiva at different follow-up periods in three groups

Intergroup Analysis At baseline, the Mann–Whitney U test showed no statistically significant differences between the two groups for VD, KTW, or WAG ($p>0.05$), confirming they were comparable prior to intervention.
At the 3-month and 6-month follow-up, the FGG group demonstrated significantly greater clinical gains compared to the vestibuloplasty group across all parameters ($p<0.001$). Specifically, the FGG group achieved higher mean VD values at 3 months (17.52±1.06 mm) and 6 months (17.56±1.01 mm) compared to the vestibuloplasty group (16.28±1.41 mm and 16.36±1.41 mm, respectively). Improvements in KTW and WAG were also markedly superior in the FGG group at both 3-month and 6-month intervals ($p<0.001$). These results indicate that while both surgical techniques are effective, FGG provides significantly superior outcomes in terms of increasing vestibular depth and augmenting keratinized and attached gingiva. (Table-4)

Parameter		Vestibuloplasty	FGG	p-value
VD	Baseline	13.88 ± 2.06	13.63 ± 1.54	0.175
	3 months	16.28 ± 1.41	17.52 ± 1.06	<0.001*
	6 months	16.36 ± 1.41	17.56 ± 1.01	<0.001*
KTW	Baseline	2.96 ± 0.95	3.12 ± 1.03	0.154
	3 months	4.67 ± 0.93	7.10 ± 0.97	<0.001*
	6 months	4.73 ± 0.91	7.10 ± 0.97	<0.001*
WAG	Baseline	1.52 ± 0.68	1.70 ± 0.77	0.135
	3 months	3.17 ± 0.79	4.48 ± 0.50	<0.001*
	6 months	3.30 ± 0.80	4.48 ± 0.50	<0.001*

Mann Whitney test; * indicates a significant difference at p≤0.05

Table 4- Intergroup comparison of vestibular depth scores, keratinized tissue width, and width of attached gingiva at different follow-up periods

Assessment of mucogingival junction (MGJ) stability demonstrated that both treatment modalities resulted in an apical displacement of the MGJ, reflected by significant increases in keratinized tissue width (KTW) and width of attached gingiva (WAG) from baseline to 3 and 6 months. However, the FGG group exhibited greater and more stable MGJ repositioning compared with the vestibuloplasty group. The absence of significant differences between the 3- and 6-month evaluations for KTW and WAG in the FGG group indicated maintenance of the surgically achieved MGJ position throughout the observation period. Although vestibuloplasty also produced significant improvements, the magnitude of gain was comparatively lower, suggesting a less pronounced and potentially less stable displacement of the MGJ. These findings indicate that free gingival grafting provides superior stability of the mucogingival junction and more predictable long-term maintenance of the augmented mucogingival complex.

5.DISCUSSION

This study compared vestibuloplasty and free gingival grafting (FGG) to evaluate changes in the position and stability of the mucogingival junction (MGJ), as well as improvements in vestibular depth and keratinized tissue width in the mandibular anterior region. The findings supported the initial hypothesis that different surgical approaches significantly

influence clinical outcomes. While both modalities successfully increased vestibular depth, the FGG group demonstrated significantly greater gains in vestibular depth, keratinized tissue height, and width of attached gingiva throughout the postoperative follow-up. These results suggest that while vestibuloplasty is a viable, less invasive option, FGG provides more predictable and superior enhancement of essential mucogingival parameters. The superior performance of FGG can be attributed to the transplantation of keratinized tissue with inherent dimensional stability, which effectively resists postoperative contraction and relapse. This direct augmentation results in a predictable increase in the width of attached gingiva and a stable repositioning of the MGJ. In contrast, vestibuloplasty showed more limited and less stable alterations in MGJ position. This is largely because vestibuloplasty relies on healing by secondary intention, which is frequently associated with greater tissue contraction during maturation. Furthermore, the lack of a grafted keratinized component in vestibuloplasty contributes to reduced long-term dimensional stability, especially in patients with a thin periodontal phenotype.

Our findings align with existing literature, such as the study by Basegmez et al. (2012)9, which reported that FGG remains a more predictable and stable technique for enhancing peri-implant attached mucosa compared to classic vestibuloplasty, showing reduced postoperative relapse and better tissue stability. However, it is important to consider procedural morbidity. Schmitt et al. (2013)10 noted that while FGG is effective, alternatives like porcine collagen matrices can offer comparable clinical and histologic outcomes with significantly reduced surgical time and morbidity by eliminating the need for a donor site. Similarly, Mohanty et al. (2025)11 observed that while FGG produces the greatest tissue augmentation, less invasive techniques like periosteal fenestration are associated with reduced postoperative pain and superior healing. Additionally, the consensus report from the 10th European Workshop on Periodontology led by Tonetti MS concluded that soft tissue augmentation procedures using autogenous grafts remain the gold standard for increasing keratinized tissue width due to their predictable outcomes and long-term stability.12 The present findings corroborate that consensus, particularly in the mandibular anterior region where anatomical challenges frequently compromise plaque control. The superior stability of the mucogingival junction observed in the present study following FGG further supports the concept that autogenous grafts provide greater resistance to postoperative tissue displacement and relapse, thereby ensuring more predictable long-term maintenance of the mucogingival complex.

The present findings are supported by the systematic review and meta-analysis by Kristina Bertl et al., which compared soft tissue substitutes (STSs) with autogenous free gingival grafts (FGGs) in non–root-coverage procedures.13 Their analysis demonstrated that FGG consistently produced significantly greater gains in keratinized tissue width and more reliably achieved postoperative widths ≥2 mm compared with STSs.

Although substitutes were associated with improved aesthetic outcomes and higher patient preference, autogenous grafts showed superior dimensional predictability. These observations align with the current results, further supporting FGG as the more reliable approach when stable and substantial keratinized tissue augmentation is the primary objective.

The systematic review by Daniel S Thoma et al. (2014)14 reported that multiple techniques can successfully increase keratinized mucosa (KM) at implant sites, predominantly based on an apically positioned flap or vestibuloplasty combined with autogenous grafts (FGG/SCTG) or soft tissue substitutes such as acellular dermal matrices or collagen matrices. While all approaches demonstrated short- to medium-term KM gain (up to 48 months), dimensional shrinkage was commonly observed, occasionally exceeding 50% within the early healing phase. For soft tissue volume augmentation, subepithelial connective tissue grafts were identified as the treatment of choice due to their predictable increase in tissue thickness at implant and partially edentulous sites.

From a clinical and patient-centered perspective, the choice between these procedures must be balanced. Vestibuloplasty offers the advantages of reduced surgical time and the avoidance of a secondary donor site, making it a less invasive alternative for some patients. Conversely, FGG is technique-sensitive and involves increased morbidity due to palatal harvesting. Therefore, the selection of the surgical modality should be tailored to individual patient requirements, including the degree of tissue deficiency, esthetic goals, and the patient's tolerance for surgical morbidity.

Limitations and Future Directions The primary limitations of this study include a relatively small sample size and a short follow-up period of six months. To fully assess the long-term stability of these outcomes and the potential for relapse, larger cohorts and extended study durations are required.

CONCLUSION

Within the study's limitations, both vestibuloplasty and FGG are effective at improving vestibular depth in the mandibular anterior region. However, free gingival grafting (FGG) is superior and more predictable regarding the stability of the mucogingival junction and sustained increases in keratinized tissue height and width. While vestibuloplasty serves as a less invasive option with acceptable results, FGG remains the more reliable method for stable modification of the mucogingival complex and enhancement of key periodontal parameters.

Clinical Photographs

Group 1 -Vestibuloplasty

Figure 1: Group 1 - Pre-surgical mandibular frontal view

Figure 2: Group 1 – Vestibuloplasty done

Figure 3: Group 1 – 3 month follow-up - mandibular frontal view

Figure 4: Group 1 – 6 month follow-up - mandibular frontal view

Group 2- Free Gingival Graft

Figure 1: Group 2 - Pre-surgical mandibular frontal view

Figure 2: Group 2 – Recipient site preparation mandibular frontal view

Figure 3: Group 2 – Free gingival graft secured over recipient bed with sutures

Figure 4: Group 2 – 3-month follow-up - mandibular frontal view

Figure 5: Group 2 – 6-month follow-up - mandibular frontal view

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