Clinical Evaluation of Increase in the Width of Attached Gingiva using Modified Apically Repositioned Flap: A 9-Month Follow-up Study

Abstract

Aim: The purpose of this study is to evaluate the increase in the width of attached gingiva (AG) in single/multiple adjacent teeth using variation of modified apically repositioned flap (MARF). **Materials and Methods:** A total of 20 systemically healthy controls with inadequate width of AG were recruited for the study based on inclusion and exclusion criteria. In all the individuals, variation of MARF technique was performed to increase the width of AG. Outcomes of the surgical techniques were measured in terms of probing pocket depth, clinical attachment level, width of AG, and width of keratinized gingiva (KG). The results were followed up at 3 months and continued till 9 months to confirm the stability of results. **Results:** Treatment with this procedure resulted in a significant increase in the width of the KG and AG. The increase in KG ranged from baseline (2.0 mm) to 3.85 mm at 3rd month and the results were stable till 9th month ($P < 0.001$), and the increase in AG ranged from baseline (1.0 mm) to 2.85 mm at 3rd month and the results were stable till 9th month ($P < 0.001$). **Conclusion:** MARF is an effective technique in increasing the width of the keratinized tissue and AG around teeth and also offers considerable advantages over other mucogingival surgery techniques.

Keywords: *Attached gingiva, esthetics, inadequate width, modified apically repositioned flap, mucogingival surgery*

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Introduction

The attached gingiva (AG) is that portion of gingiva that extends from the base of the gingival crevice to mucogingival junction. According to glossary of periodontal terms, AG is firm, resilient, and tightly bound to underlying periosteum of alveolar bone through connective tissue. Facial aspects of AG is demarcated from the movable alveolar mucosa by mucogingival junction.[1] To maintain optimal health of periodontium, an adequate zone of AG is essential. An inadequate width of AG can alter the periodontal health as it might facilitate subgingival plaque deposition resulting from movability of marginal gingival pull.[2] Hence, it is very essential to maintain an adequate width of AG around teeth.

A variety of surgical techniques has been introduced to increase the width of AG. The most commonly documented techniques are augmentation using free gingival grafts,[3] connective tissue gingival grafts,[4] and apically repositioned flap.[5] Though these techniques were predictable and successful, they were either technique sensitive or involved a second surgical site for procurement of donor tissue.[6] To overcome this, a modification in apically repositioned flap was given by Carnio and Miller in 1999.[7] In 2006 Carnio and Camargo, described a variation of modified apically repositioned flap (MARF).

The advantages of the variation of MARF technique is its simplicity as it involves only a single horizontal beveled incision in the recipient site. Other advantages include a shorter operative time, no necessity of palatal donor tissue, and enhanced color match between the treated and native gingival tissues.[8] Literature search revealed very few published research to evaluate the outcomes of this technique.[7-11]

In lieu with the above, the present study is done to evaluate whether MARF predictably increases the width of AG and whether results achieved are stable over a period of over 9 months.

Materials and Methods

The individuals for the study were recruited from the patient pool of Department of

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Periodontology, Indira Gandhi Institute of Dental Sciences, Puducherry. The individuals were informed about the purpose of the study, the surgical technique, and a written informed consent was obtained. This study was approved by Institutional Review Board IRB (IGIDSIRB 2014 NDPO2PGUKPAI) and Institutional Ethical Committee, IEC (IGIDSIEC 2014 NDPO2PGUKPAI) of the University of Sri Balaji Vidyapeeth.

Systemically healthy controls with <1 mm of AG, but with at least 0.5 mm of keratinized gingiva (KG) (Only at the buccal sites), with normal physiologic gingival sulcus were included for the study. Medically compromised patients, individuals with no KG, probing pocket depth (PPD) >3 mm at the surgical site, and the presence of thin periodontium were excluded from the study.

A total of 25 individuals were selected based on inclusion and exclusion criteria. Patients age ranged from 18 to 35 years (14 individuals were males, and 6 individuals were female).

At the first appointment, thorough oral prophylaxis and oral hygiene instructions were given to the individuals until a satisfactory level of plaque control was achieved. The patients were recalled after 1 month to assess their compliance with plaque control. Plaque index was used to measure oral hygiene compliance. Only individuals with performance index score 0.1–0.9, indicating good oral hygiene were recruited for the MARF procedure (*n* = 20).

The following periodontal parameters were measured: PPD, clinical attachment level (CAL), width of KG, and width of AG. Width of KG and AG were measured using Schiller's iodine solution [Figure 1]. A single calibrated examiner performed all measurements in the study.

Surgical technique

Local anesthesia was achieved by infiltration technique using lidocaine 1:200000 solution. Following local anesthesia, a beveled horizontal incision was made with a #15 blade, from 0.5 mm coronal to the mucogingival junction [Figure 2]. The gingiva coronal to the initial incision remained intact around the teeth. The mesiodistal extension of the initial horizontal incision extended at least one-half tooth in the mesial and distal directions of the teeth where gingival augmentation was desired. This extension will eliminate the need for vertical releasing incision to facilitate the apical repositioning of the flap. Carefully a split-thickness flap was elevated and was extended in the apical direction needed [Figure 3]. The flap was displaced apically and secured to the periosteum with simple interrupted bioabsorbable sutures [Figure 4]. Using a moist gauze pad, gentle digital pressure was applied to the surgical area for 3–5 min to maintain the flap in close contact with the underlying periosteum.

At the end of the surgical procedure, care was taken that a thin homogeneous layer of periosteum with no movable tissues was present over the underlying bone. The periodontal dressing was applied to the wound during the first postoperative week.

The patients were advised to take paracetamol, 500 mg every 6 h for the first 2 days for pain control. No antibiotics were prescribed. They were instructed not to brush or disturb the surgical site till suture removal. They were also advised to use 0.12% chlorhexidine rinse for 4 weeks. The dressing and sutures were removed at 1 week postoperatively. The surgical site was thoroughly irrigated with saline and healing was assessed. Mechanical oral hygiene measures were not initiated until the beginning of the fifth postoperative week.

The study individuals were followed up at 3rd month [Figure 5] and 9th month [Figure 6] postoperatively. If local or inflammation was present during the follow-up, prophylaxis was repeated. On each follow-up visits, the periodontal parameters were measured again and tabulated against the baseline measurements.

Figure 1: Measurement of attached gingiva and keratinized gingiva using Schiller's iodine

Figure 2: Horizontal incision given 0.5 mm coronal to mucogingival junction

Figure 3: Split-thickness flap elevated

Figure 4: Flap apically displaced and sutured to periosteum

Figure 5: Third-month postoperative measurement

Figure 6: Ninth-month postoperative measurement

Results

The mean PPD measurement of individuals was 1 mm at baseline. At the 3rd month postoperative, the mean pocket depth was 1 mm, and the same was maintained at 9th month postoperative. The mean CAL at baseline was (0.1 ± 0.38) mm, at 3rd month was (0.1 ± 0.38) mm, and at 9th month was (0.1 ± 0.308) mm. There was no mean difference in CAL from baseline to 9th month postoperative [Table 1].

Comparing the width of KG at baseline, 3rd month, and 9th month (2 ± 0, 3.85 ± 0.671 and 3.85 ± 0.671) mm, the mean difference was 1.850 mm and was statistically significant ($P < 0.001$). Comparing the width of KG at 3rd month and 9th month (3.85 ± 0.671 and 3.85 ± 0.671) mm, the mean difference was 0.000 mm and was not statistically significant (Wilcoxon signed rank test) [Table 2].

Comparing the width of AG at baseline, 3rd month, and 9th month (1 ± 0 2.85 ± 0.671 and 2.85 ± 0.671) mm, the mean difference was 1.850 mm and was statistically

significant ($P < 0.001$). Comparing the width of AG at 3rd month and 9th month (2.85 ± 0.671 and 2.85 ± 0.671) mm, the mean difference was 1.850 mm and was not statistically significant ($P < 0.001$) (Wilcoxon signed rank test) [Table 3].

Discussion

Bowers in 1963 and Ainamo and Löe in 1996 have suggested that the distance between mucogingival junction and projection on the external surface of the bottom of sulcus is the normal width of AG in clinical measurements.[1,12] Lang and Löe in 1972 in an effort to determine the adequate amount of AG studied the relationship between the inflammation and gingival width. Inflammation and exudates were present in 100% of teeth with <2 mm of KG.[13]

Miyasato *et al*. in 1977 reported that there is no relationship between inflammation and amount of AG irrespective of the presence or absence of plaque.[14] Gartrell and Mathews, Schmid in 1976 reported that a certain width of AG is always essential, especially for the maintenance

Table 1: Comparison of the probing pocket depth/clinical attachment level between different time intervals

Parameter	Mean±SD	Mean difference	P
PD (baseline)	1.0±0.000	0.000	NA
PD (9th month)	1.0±0.000		
CAL (baseline)	0.10±0.000	0.000	NA
CAL (9th month)	0.10±0.308	0.000	NA

NA: Not available; SD: Standard deviation; PD: Pocket depth; CAL: Clinical attachment level

Table 2: Comparison of the width of keratinized gingiva at different time intervals

KG	Mean±SD	Mean difference	P
KG (baseline)	2.00±0.000	−1.850	<0.001*
KG (3rd month)	3.85±0.671		
KG (baseline)	2.00±0.000	−1.850	<0.001*
KG (9th month)	3.85±0.671		
KG (3rd month)	3.85±0.671	0.000	NA
KG (9th month)	3.85±0.671		

*Statistically significant using Wilcoxon signed rank test. NA: Not available; SD: Standard deviation; KG: Keratinized gingiva

Table 3: Comparison of the width of attached gingiva at different time intervals

AG	Mean±SD	Mean difference	P
AG (baseline)	1.00±0.000	−1.850	<0.001*
AG (3rd month)	2.85±0.671		
AG (baseline)	1.00±0.000	−1.850	<0.001*
AG (9th month)	2.85±0.671		
AG (3rd month)	2.85±0.671	0.000	NA
AG (9th month)	2.85±0.671		

*Statistically significant using Wilcoxon signed rank test.
AG: Attached gingiva; NA: Not available; SD: Standard deviation

of gingival health, for the prevention of marginal gingival pull and gingival recession and also to prevent subgingival plaque formation. It also aids for the unaltered levels of the connective tissue attachment thereby facilitating good oral hygiene measures.[15,16]

Friedman *et al.* in 1993 stated that subgingival plaque formation is facilitated by an inadequate width of AG which is due to the improper pocket closure which results from the movability of the marginal tissue.[2] From this, it is inferred that minimum of 2 mm of KGl tissue is necessary to maintain good gingival health.

Increase in width of AG can be accomplished by numerous techniques such as free gingival graft,[3] connective tissue graft,[4] and apically repositioned flap.[5] Though these techniques have been used widely since introduction, they are technique sensitive and requires second surgical site for donor tissue and might be time-consuming.[6] To overcome this, Carnio and Miller in 1999 described the MARF. This technique was very similar to apically repositioned flap except the marginal tissue was left intact preventing

recession, but the disadvantage was the vertical incision that extended till the vestibular mucosa resulted in excessive bleeding. Since it has to extend to the vestibular depth, it was contraindicated in premolar and molar to prevent damage to the mental foramen.[7]

Taking this into consideration, Carnio and Camargo in 2006 described a variation of the MARF. The variant of MARF uses only a single horizontal incision and no vertical releasing incisions to achieve flap mobilization.[8]

The present study was undertaken to clinically evaluate the effectiveness of modified MARF technique in terms of increase in width of attached and KG. 20 individuals with an inadequate width of AG were included in the study as per inclusion criteria. All the individuals underwent phase 1 periodontal therapy. One month following this, all the patients was recalled, and a variant of MARF was done as an attempt to increase the width of AG. The patients were recalled at 3rd and 6th month postoperatively, and the parameters were recorded.

Clinical postoperative inspection of the surgical areas consistently revealed the presence of granulation tissue in the entire surgical site at the end of the 1st week. At 4 weeks postoperatively treated, areas were covered with tissue that had a clinical appearance very similar to the adjacent native gingival tissue.

With this variation of MARF technique, there was statistically significant increase in AG and KG from baseline to 3rd month, AG (1 ± 0 and 2.85 ± 0.671) mm and KG (2 ± 0 and 3.85 ± 0.671) mm. From 3rd month to 9th month, the results were not statistically significant, AG (2.85 ± 0.671 and 2.85 ± 0.671) mm and KG (3.85 ± 0.671 and 3.85 ± 0.671) mm. This show the results from this technique were stable as long as 9 months.

Similar results were obtained by Carnio *et al.* in 2007, published the case series using a variation of MARF technique. A total of 37 sites were treated, and they reported an adequate increase in width of AG with minimal postoperative discomfort and without increasing probing depth and marginal tissue recession.[9] They concluded that MARF is an effective technique in increasing the apicocoronal dimension of the keratinized tissue and AG. Carnio *et al.* in 2015 published the randomized study compared the free gingival graft (FGG) and the MARF in increasing the zone of AG in contralateral sides of 15 patients 1 year posttreatment. There was an increase in keratinized tissue and AG in both groups but the MARF surgical time was approximately half as long as that of the FGG. They concluded that both techniques are viable; however, the main advantages of the MARF were decreased surgical time and less postoperative discomfort.[11]

According to Karring *et al.*, the origin of the granulation cells that migrate over the wound determines the nature of the new tissues that develop over the exposed periosteum.

These cells migrate from the periosteal connective tissue, adjacent gingival and alveolar mucosa, periodontal ligament, and bone marrow spaces.[17-19] According to Carnio and Camargo, the surgical wound created by MARF is surrounded completely by keratinized tissue. This prevents migration of nonkeratinized epithelial cells from the oral mucosa proliferating onto the surgical area.[8]

The main advantages of variation of MARF over other techniques to increase the width of AG are that it does not include second surgical site, minimal tissue handling, simple technique, good color match, esthetics, and no postoperative recession.

A major limitation of the MARF technique needed >0.5 mm of AG to be present surgically. This is required to allow complete perimeter of the wound to be surrounded by keratinized tissue that aids in keratinized tissue formation. Another limitation of this technique is that it cannot be performed in the presence of bony dehiscence. If distance is >2.0 mm exists between the base of the pocket and the alveolar bone crest, when the flap is positioned, apically a root dehiscence is likely to be present, which enhances the probability of gingival recession.[9]

Conclusion

The predictable increase in the apicocoronal gingival dimension by variation of MARF with stable results over 9 months offers considerable advantage over other mucogingival surgery techniques. Furthermore, the steps involved in the MARF execution are simple, and the surgical procedure can be conducted expeditiously with limited chair time for the patient and the operator.

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Conflicts of interest

There are no conflicts of interest.

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