Assessment of Creeping Attachment after Free Gingival Graft in Treatment of Isolated Gingival Recession

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Abstract

Background: This longitudinal clinical study aimed to determine the amount of creeping attachment and its relation to baseline recession depth after placement of free gingival grafts (FGG) apical to class I, II, and III Miller's recession defects.

Materials and methods: Twenty subjects with Miller class I, II, and III gingival recession defects requiring FGG were recruited into this longitudinal clinical study. Site-specific clinical parameters (pocket depth, depth and width of gingival recession and width of keratinized gingiva apical to the recession) were recorded at baseline, 3 month and 6 month time points using a digital caliper. All subjects received motivation, oral hygiene instruction, full mouth scaling, and root surface debridement. FGG were placed using standard protocols for all subjects. Pearson correlation was used to determine the correlation between the amount of recession reduction at the six-month and baseline clinical parameters.

Results: Sixteen subjects completed the six-month follow-up. FGG resulted in significant improvements in all clinical parameters except pocket depth. Recession depth showed a significant reduction from 3.14±1.16mm at baseline to 1.87±0.92mm at the six-month time point (P= 0.001) and the amount of creeping attachment significantly correlated to the depth of recession at baseline (r= 0.66, P=0.01).

Conclusions: FGG placed apical to recession areas resulted in a significant decrease of recession depth by creeping attachment. The amount of creeping attachment was associated with baseline recession depth.

Keywords: Creeping attachment, Free gingival graft, Gingival recession

Introduction

Gingival recession is a challenging aesthetic problem that is recognized as denudation of soft tissue from the root surfaces due to a displacement of the marginal gingiva apical to the cementoenamel junction (CEJ). The condition may have numerous negative influences on dental and periodontal health such as root hypersensitivity, plaque accumulation, further periodontal destruction, root caries, and consequently tooth loss (Tugnait and Clerehugh, 2001; Kassab and Cohen, 2003; Addy, 2005).

Gingival recession is most likely the outcome of a combination of predisposing factors including plaque induced gingival inflammation, high muscle attachment and frenum pull, insufficient width of keratinized gingiva, bony dehiscence, and mal-positioned teeth. Furthermore, occlusal trauma and trauma from vigorous tooth brushing may initiate gingival recession (Kundapur *et al.,* 2009; Seong *et al*., 2018).

Iatrogenic dental procedures are also considered as potential etiologic elements in gingival recession. These include poor crown margins, poorly designed partial denture, orthodontic treatment and other operative procedures that might be a source of plaque accumulation and persistent

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gingival inflammation, such as open restoration margins, overhang restorations or using improper restorative materials (Tugnait and Clerehugh, 2001; Borghetti, 2008).

Although several studies have shown that the absence of keratinized gingiva might not disturb the maintenance of a healthy periodontium (Chapple *et al.,* 2018), mucogingival therapy should still be considered since a thin nonkeratinized gingiva might be less protective in the presence of inflammation (Müller and Heinecke, 2002).

Several surgical procedures have been proposed as functional procedures to obtainn coverage of denuded roots at sites of localized gingival recession, including direct covering with free gingival grafts (FGG), pedicle grafts, connective tissue graft and coronally repositioned flap (Alghamdi *et al.,* 2009). The success and survival for root surface coverage using free soft tissue grafts placed over a denuded root surface primarily rely on diffusion of blood from the recipient site. Furthermore, revascularization from the connective tissues bed surrounding the exposed root surfaces and arrangement of arterial circulation from neighboring vascular boundaries of the bed allow the healing phenomenon of "bridging" (Agudio *et al.*, 2017).

Healing of the FGG primarily depends on the restoration of collateral circulation from the periosteal and connective tissues bed, while a thin blood clot promotes tensile strength and stability of the graft. Wound stability and wound contraction are key factors for the healing cascade, which consequently affects the treatment outcome (Bouchard *et al.,* 2001).

Autogenous FGG is a periodontal plastic surgical procedure used when there is insufficient width of attached gingiva for preserving the health of the periodontium at specific sites. The procedure appears to be the most predictable method for augmentation and increasing the width of attached gingiva, stopping the progressive gingival recession and improving long term stability (Bertl *et al.*, 2017).

Although root coverage is not the key objective of FGG, root coverage may be achieved on narrow recessions of less than 3 mm in width by the bridging function (Agudio *et al.*, 2017). Additionally, root coverage may be achieved by a different healing process known as "creeping attachment". This phenomenon is observed as the postoperative migration of already retreated gingival marginal tissue in a coronal direction after releasing pulling forces exerted by aberrant frenum and/or high vestibular attachment of a shallow vestibular depth over a portion of a previously denuded root. The best creeping attachment results have been achieved on mandibular anterior teeth with narrow recession defects (Matter and Cimasoni, 1976; Chambrone and Chambrone, 2006). Full coverage on the mesial surface of the maxillary first molar has been reported as well (Otero-Cagide and Otero-Cagide, 2003).

Shrinkage of the graft is an expected phenomenon. Therefore, treatment outcomes, including a large amount of new keratinized tissue, may not be achieved (Silva *et al.*, 2010). Vertical shrinkage of FGG is a well-known clinical phenomenon that occurs mainly during the healing phase. Numerous studies that have investigated dimensional changes of FGG have reported average vertical shrinkage of 24.8% at 24 weeks and 43.25% at 52 weeks (Hatipoğlu *et al.,* 2007; Silva *et al.*, 2010; Cifcibasi *et al.*, 2015).

Creeping attachment has been documented following a number of surgical procedures including FGG, acellular dermal matrix grafts, and subepithelial connective tissue grafts (Matter and Cimasoni, 1976; Otero-Cagide and Otero-Cagide, 2003; Al-Rasheed, 2006). Creeping attachment is not an immediate occurrence and may occur after a long period of time after graft placement. However, it might also be present following the initial healing phase (Haeri and Parsell, 2000). Creeping attachment is not a predictable phenomenon and various factors such as the amount of attached gingiva, depth of the recession and oral hygiene status might have impact on the amount of creeping attachment after FGG. Thus, the aims of this longitudinal clinical study were to determine the amount of creeping attachment and its relation with baseline recession depth after FGG placed apical to class I, II, and class III Miller's recession.

Study design and patient population

The research design was a single-centered, prospective and controlled study. Twenty healthy subjects referred to the Periodontics Department, College of Dentistry, the University of Sulaimani complaining of persistent inflammation and hypersensitivtiy associated with exposed roots between June 2016 and May 2017 were invited to join the study. The ethical committee of the Faculty of Medicine, University of Sulaimani approved the study (ethical approval number: 334). All participants signed an informed consent form after receiving detailed information about the surgical procedure and its expected success rate. Inclusion criteria were: systematically healthy: −1 mm width of attached gingiva associated with lack of plaque control, gingival recession (Class I, II and III) (Miller, 1985) and absence of probing depth >3mm. Exclusion criteria were: smokers, pregnant women, and subjects with systemic disease and medication that might affect the surgical procedure.

Surgical procedure

Motivation and oral hygiene instruction were provided prior to surgical treatment to attain good plaque control using modified bass tooth brushing technique and interdental flossing. Additionally, scaling and polishing of the teeth were performed for all patients 3 weeks before the surgical procedure. Following this, the decision was made to perform surgery by FGG to increase the width of the keratinized gingiva and potentially to

achieve some root coverage by creeping attachment.

The donor and recipient sites of the surgery were infiltrated with (2% lidocaine with 1:100,000 epinephrine) local anesthetic agent and sequential steps were performed as shown in Figure 1. A partial thickness flap was elevated by horizontal incision (Blade no. 15) at the mucogingival junction including the teeth adjacent to the recession and then two vertical incisions were made at the end of the horizontal incision. A partial-thickness flap was separated from the underlying firm periosteal bed for the graft. The periosteal bed was covered with gauze moistened with saline until graft placement.

A tin foil plate customized according to the recipient site was placed over the palate between the first premolar and second molar and at least 2mm away from the gingival margin. A circumferential incision was made around the tin foil plate to outline the graft and the graft was carefully harvested by entering the blade between the epithelium and the connective tissue. The graft was slowly detached from the underlying connective tissue and after graft separation, the inner layer was inspected for irregularities and adipose tissue.

The graft was held firmly in the recipient area with gauze soaked in saline for 3 min to adapt the graft to the recipient site. The coronal part of a suture was placed at the mucogingival line and stabilized by a suture (Nylon 4-0 monofilament). Two or three knots were positioned between the graft and keratinized gingiva. No attempt was made to cover the recession area to enable the exact assessment of the creeping attachment effect. A periodontal dressing (Coe-Pack, GC America Inc, Illinois, USA) was used to cover the graft to protect the surgical area.

The patients were instructed to abstain from oral hygiene measures (brushing and flossing) until suture removal (7 days) and to use an antimicrobial mouth wash (0.12% chlorhexidine) twice daily for 4 weeks plus analgesics (400 mg ibuprofen bid). Antibiotics were prescribed (amoxicillin, 500 mg, four times daily) for 7 days to prevent possible postoperative infections (Matter and Cimasoni, 1976). The patients also advised to perform gingival massage and apart from checks at the study time points (3 months and 6 months) to measure the clinical parameters, weekly follow ups were scheduled for the first 3 weeks after suture removal to check the healing process at both donor and recipient sites.

Clinical measures

A single expert examiner collected all clinical measures and performed the surgical procedures, with 98% agreement of intra-examiner calibration. A digital caliper (0-150 mm) (Absolute, Mitutoyo Sul Americana, Suzano, Brazil) measuring 0.1 mm and Williams periodontal probe (Hu-Friedy, Chicago, IL, USA) were used to record the following parameters at the buccal aspect of the surgical site at baseline and 3 months and 6 months after surgery. The clinical parameters were: recession index using Miller's classification (Miller, 1985), recession depth (RD) from CEJ to the gingival margin at the mid buccal point, recession width (RW) gained by measuring the mesio-distal distance at the highest point of the recession, width of keratinized gingiva (KG) from the gingival margin to the mucogingival junction at the mid-buccal point, sulcus depth (SD) from the gingival margin to the bottom of the gingival sulcus, graft width (GW) and graft length (GL) in the middle of the graft and creeping attachment (CA) as determined by subtracting the RD at 3 months and 6 months from the base line RD.

Statistical analyses

All statistical analyses were undertaken with the consultation of an expert statistician. Only data from those subjects that completed the study were analyzed. The data were tested by Shapiro–Wilk test for normal distribution and

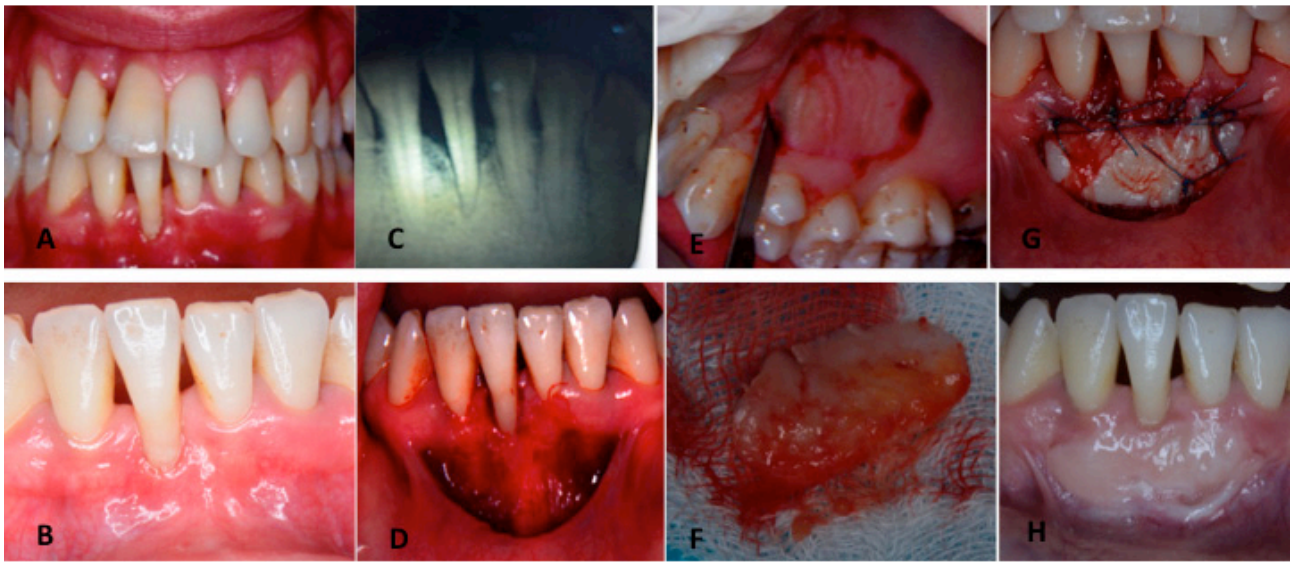

Figure 1. Surgical procedure details. (A) Preoperative. (B) Recession area (C) Radiograph to check bone loss. (D) Recipient bed. (E) Harvesting graft. (F) Graft after removal (G) Suturing of Graft. (H) Six month postoperative.

then subjected to appropriate parametric or non-parametric tests. One-way ANOVA was used to determine statistically significant differences in RD, RW, KG, and CA at the baseline, 3 months and 6 months time points. The statistically significant differences in SD, GW, and GL were determined by Kruskal–Wallis test. The correlation between RD and CA was determined by Pearson's correlation. Statistical significance was defined as $p \leq 0.05$. All calculations were performed using the SPSS software package (version 20; SPSS Inc., Chicago, IL, USA).

Results

Study Subjects' Demographics

Twenty-five patients that met the inclusion and exclusion criteria were invited to take part in the study: twenty agreed to participate, but four subjects failed to attend their 3 months and 6 months appointments. The mean age of the 16 remaining subjects (8 male and 8 female) was 28.2 ±6.1 years (aged between 21 and 36 years). None of the study subjects reported adverse effects such as graft rejection, paresthesia, bleeding or pain at 3-month and 6-month follow up.

Clinical Parameters

Four subjects were classified as Miller class I, 8 subjects as Miller class II and 4 subjects as Miller class III. The mean RD was 3.14±1.16 mm at baseline and this reduced to 2.52±0.91 3 months after FGG, however, the reduction was not significant (P= 0.1). A significant reduction was noticed 6 months after FGG (P = 0.001) (Figure 2). Comparison of RD at 3 months and 6 months identified no statistically significant difference (Table 1). Although RW decreased from 2.71±0.27mm at baseline to 2.54±0.31mm at 3 month follow up, this reduction was not statistically significant (P= 0.13). Further reduction to 2.22±0.39 mm at 6-month follow up resulted in statistically significant differences when compared to the baseline (P=0.0003) and 3-month (P= 0.01) time points (Table 1). Statistically significant increases in the width of KG were noted at both the 3-month and 6-month time point when compared to baseline, however, no significant difference was detected between the 3 and 6 months follow ups. Moreover, statistically significant increases of CA between all study time points were found (Table 1) and the amount of CA at the 6-month time point significantly correlated with the RD at baseline (r= 0.66, P= 0.01, confident interval = 0.4 to 0.9) (Figure 3).

Kruskal-Wallis test showed statistically significant differences in the median levels of SD, GW and GL at 3-month and 6-month follow up when compared to baseline, however, no significant differences were detected between the 3-month and 6-month time points (Table 2).

Discussion

A single-centered, randomized, prospective and controlled clinical study was conducted on 20 patients with single CL I, II and III Miller's recession on mandibular central incisors to assess the amount of creeping attachment after FGG placed apical to the recession at 3-month and 6-month postoperative time points.

In this study, patients were instructed how to perform gingival massage for the surgical sites and achieve meticulous plaque removal. Gingival massaging might increase capillary gingival microcirculation, thereby increasing oxygen sufficiency at the surgical site, plus efficient removal of dental plaque reduces inflammation, gingival proliferation and formation of dense bundles of connective tissue are attribute to creeping attachment (Horiuchi *et al.,* 2002; Aimetti *et al.,* 2005).

Figure 2. Preoperative recession (A, C and E) and creeping attachment after 6 month (B, D and F) respectively.

Table 1. Comparison of RD, RW, KG and CA at three study time points (n. 16).

Clinical Parameters	Baseline (mean ± SD) mm	3 month (mean ± SD) mm	6 month (mean ± SD) mm	P value (ANOVA test)		
				Baseline vs 3 month	Baseline vs 6 month	3 month vs 6 month
RD	3.14±1.16	2.52±0.91	1.87±0.92	0.1	0.001	0.057
RW	2.71**±0.27**	2.54**±0.31**	2.22**±0.39**	0.13	0.0003	0.01
KG	2.42**±1.1**	4.89±1.13	5.28±1.23	0.0001	0.0001	0.33
CA	-	0.62±0.54	1.27±0.67	0.001	0.0001	0.004

RD: recession depth, RW: recession width, KG: keratinized gingiva, CA: creeping attachment.

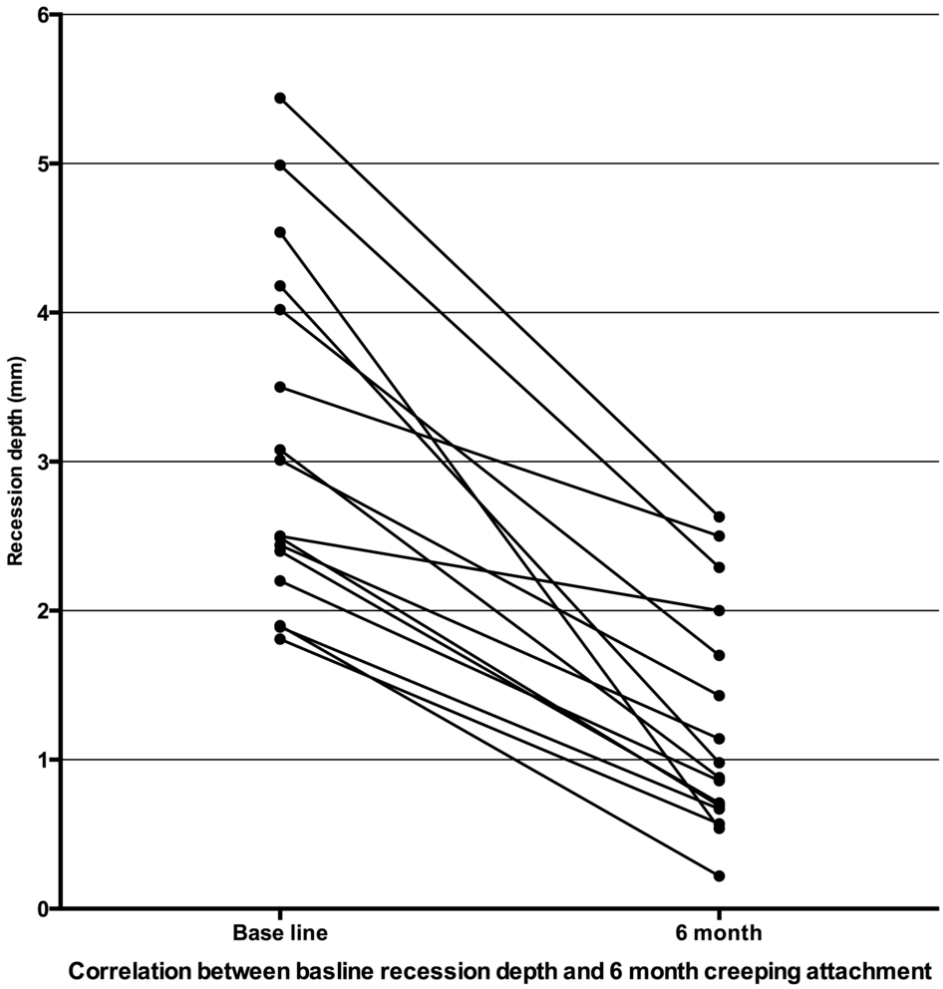

Figure 3. Correlation between baseline recession depth and 6 months creeping attachment.

Table 2. Comparison of SD, GW and GL at three study time points (n= 16).

Parameter	*Baseline median (iq* range) mm*	*3 month median (iq range) mm*	*6 month median (iq range) mm*	*P value (Kruskal-Wallis test)*		
				Baseline vs 3 month	*Baseline vs 6 month*	*3 month vs 6 month*
SD	1 (0.5-1)	0.5 (0.5-0.5)	0.5 (0.5-0.5)	**0.04**	**0.04**	0.9
GW	6.5 (6-8)	3.1 (2-4.9)	3.1 (1.9-4.8)	**0.0003**	**0.0001**	0.36
GL	21.5 (18- 24)	15 (8- 17)	14.7 (8-17)	**0.0001**	**0.0001**	0.61

* Interquartile range. SD: sulcus depth, GW: graft width, GL: graft length.

After three months of postoperative observation no significant differences in RD and RW were detected, however, significant increases were recorded in these two parameters after six months, indicating that improvement in the width and depth of recession after grafting apical to a recession is time related. It has been reported that further reduction in recession can be achieved after a year or more (Matter and Cimasoni, 1976). However, this was not achieved in this study as the sample size was not large enough and 4 subjects did not return for the six month follow-up. Creeping attachment was recorded in all cases, with an average of 1.27**±0.67** mm after six months' follow up. The gain of creeping attachment and reduction in the depth of recession were significant after six months compared to baseline. Time is considered to be a factor and further increase in creeping attachment could be expected after 6 months or a year (Matter and Cimasoni, 1976). Relief of pressure on the gingival margin from aberrant frenum or muscle pull of a shallow vestibule may lead to gradual ccreeping of the gingival margin in a coronal direction and this can take 6 months or more to occur. Matter and Cimasoni (1976) stated that creeping attachment typically occurs within 1-12 months after graft surgery and it might continue to progress even after the first post-operative year.

The amount of creeping attachment gained in this study was found to be proportional to the depth of the original recession defect. The deeper the recession the higher, the creeping attachment gain recorded and vice versa. The reason for that is not clear, although one can argue that deeper recession is usually associated with a narrow width of recession and this enhances further creeping as the blood supply at the deeper part is usually higher.

Creeping attachment is a significant clinical observation that results in further patient satisfaction when a free gingival graft is used for deepening the vestibular depth and adding an additional zone of keratinized gingiva for improving patients' plaque control measures. Several factors have been reported to have impact on amount of creeping attachment attained, such as width of recession, position of the graft in relation to the denuded root surface, position of the tooth in the arch, the level of interproximal bone height, and oral hygiene measures (Matter and Cimasoni, 1976). This is in line with our result as the higher creeping attachment results were gained in cases where the recession was classified as narrow (width of less than 3 mm).

In the present study a significant increase in the amount of keratinized gingiva was observed after 3 and 6 months compared to baseline (P= 0.0001), with no significant difference between 3 and 6 months recorded (Table 1) (P= 0.33). Furthermore, significant changes in the SD were recorded at 3 months and 6 months comparing to baseline, with no significant difference between three and six months detected (Table 2). This could be related to the fact that with time the mucogingival junction regains its original position after a gingival augmentation procedure (Pini Prato *et al.,* 2005; Agudio, *et al.,* 2008).

As a secondary aim, this study assessed the amount of FGG shrinkage after transplantation. Statistically significant differences (horizontally and vertically) were found after 3 and 6 months when compared to baseline. Shrinkage of FGGs is a well-known clinical phenomenon that usually occurs during wound healing in the first postoperative months and this is in line with our result as most of the shrinkage was identified at the 3-month time point and no significant difference was found between 3 and 6 months (Silva *et al.,* 2010; Cifcibasi *et al.*, 2015). Clinical reports have presented a broad range of values in the amount of shrinkage (12% to 49%) (Matter and Cimasoni, 1976).

This study found that FGG apical to recession area is an effective surgical procedure in halting the progression of recession in cases with an insufficient amount of attached gingiva. Gingival recession is reduced by creeping attachment and the amount of creeping attachment is significantly associated with baseline recession depth. The potential limitations of this longitudinal clinical study were the sample size and rate of dropout; however, 16 subjects is still a valid sample for a longitudinal clinical study that included surgical treatment and 6-month follow up. Further studies with larger sample size and longer follow up are necessary to validate the result of this study using FGG and different surgical procedures.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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