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Comparative Clinical Evaluation of Acellular Dermal Matrix Allograft and Connective Tissue Graft for the Treatment of Gingival Recession

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Abstract

Aims: "Gingival recession is a condition reported to occur due to abnormal periodontal anatomy, poor hygiene, excessive occlusal forces, toothbrush abrasion, and even iatrogenic or factitious causes. Though various surgical techniques are available to treat this problem, the most common is the palatal soft tissue autograft. Recently, an acellular dermal matrix allograft (ADMA) has been available as a substitute for the palatal tissue harvest. The aim of this study is to compare the ADMA with the conventional subepithelial connective tissue graft (SCTG) in the treatment of gingival recession."

Methods and Materials: Fourteen patients with 20 gingival recessions of Miller's grade I and II were selected and randomized in two groups of control (SCTG) and test (ADMA). In each group ten recession defects were treated. The following parameters were measured at baseline and then at six months post surgery: recession height (RH), recession width (RW), probing depth (PD), attached gingiva (AG), keratinized gingiva (KG), and clinical attachment level (CAL). All parameters were analyzed using the two-sample t-test. Data analysis was performed using SPSS (version 11) software.

Results: The following mean changes (mm) occurred in SCTG and ADMA, respectively: 2.60±0.97 and 2.90±0.81 decrease in RH; 1.70±1.01 and 1.65±0.67 decrease in RW; 2.50±0.97 and 2.95±0.69 increase in KG; 2.25±0.92 and 2.65±0.85 increase in AG; 2.60±1.08 and 2.75±0.92 decrease in CAL; and finally 0.05±0.50 and 0.10±0.46 decrease in PD for the SCTG and ADMA groups, respectively. The percentage of root coverage for the two groups was 70.12%±22.81% and 72.08%±14.12%, respectively. The changes from baseline to the six-month visit were significant for both groups in terms of all parameters but PD. However, the differences in mean changes were not significant between the two groups in any of the parameters.

Conclusion: These findings imply the ADMA and SCTG techniques could produce the same results when used for the successful treatment of gingival recessions. In addition the ADMA could be used as an adequate alternative treatment modality for conventional techniques.

Keywords: AlloDerm™, gingival graft, gingival recession, acellular dermal matrix allograft, subepithelial connective tissue graft

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Introduction

Gingival recession is one of the most common periodontal problems. Numerous studies have examined the relationship between periodontal health and the width of attached keratinized gingival tissue.[1] Lang and Loe[2] concluded 2 mm of keratinized gingival tissue with 1 mm of attached gingiva was sufficient to preserve periodontal health. Miasato et al.[3] and Detray and Bernimoulin[4] contrasted this idea of a minimal zone of keratinized tissue. This was possible only if the patient maintained ideal homecare or if the keratinized gingiva was augmented by soft tissue grafting techniques around teeth or dental implants. Different methods of gingival grafts have been recommended for treatment until now. They usually include the use of palatal masticatory mucosa as donor sites, which require two areas in the mouth to be operated upon. There is an increase of morbidity, such as pain, bleeding, and chair time. Recently a tissue processing technique has been developed that creates donor tissue (AlloDerm™) to obviate the problems associated with autogenous donor tissue.[1] AlloDerm™ is a dermal graft implant material from donated skin processed by the Lifecore Company, and it is strictly regulated by the U.S. Food and Drug Administration (FDA).

AlloDerm™ has been introduced as an acellular dermal matrix allograft alternative to the autogenous palatal mucosal graft in achieving increased width of attached gingiva. This allograft is a freeze-dried, cell free, dermal matrix comprised of structurally integrated basement membrane complex and extra cellular matrix, in which collagen bundles and elastic fibers are the main components.[5]

Shulman[6] described the periodontal use of an acellular dermal allograft to increase the zone of attached tissue. Harris[7] demonstrated acceptable results can be obtained by the connective tissue with a partial thickness double pedicle graft and the acellular dermal matrix combined with a coronally positioned pedicle, both clinically and histologically.

Fowler and Breault[8] used AlloDerm™ as an alternative to correct gingival defects negating the requirement for a second palatal surgical procedure.

Henderson et al.[9] treated Miller's class I or ll buccal recession defects with a coronally postioned flap plus AlloDerm™. Treatment with AlloDerm™ was an effective and predictable procedure for root coverage (RC). The orientation of the material did not affect the treatment outcome for any of the parameters tested.

Reidy et al.[10] reported 22 patients with gingival recession were treated by either a fitted acellular dermal connective tissue matrix (ADMA) or fitted connective tissue graft and covered by a coronally positioned flap, suggesting ADMA may be a useful substitute for autogenous connective tissue graft in root coverage procedures. There were no significant differences between treatments for any of the parameters.

Novaes, et al.[11] treated a total of 30 recessions by subepithelial connective tissue graft (SCTG) and ADMA. There were no statistically significant differences between the two groups in terms of recession reduction. Wasgshall et al.[12] utilized

ADMA to correct a mucogingival defect prior to orthodontic treatment of a child. The patient revealed good post-operative healing, tissue vascularization, and a healthy zone of attached gingiva at the six-month follow up visit.

AlloDerm™ has been used in many other types of dental surgeries. Fowler et al.[13] utilized ADMA and demineralized freeze-dried bone allograft (DFDBA) in two young patients who had a fracture in their upper incisors. After extraction, the defect was grafted with DFDBA, completely covered by ADMA, and flaps were closed. They concluded this technique increased keratinized tissue, while preserving and augmenting the alveolar ridge.

Fowler et al.[14] used ADMA as a barrier membrane with a DFDBA around an immediate endosseous implant. They demonstrated acceptable aesthetic results with virtually no loss of ridge height or width, and soft tissue dimensions were also preserved.

Batista et al.[15] reported ADMA may be a suitable material for the treatment of soft tissue ridge deformities due to its biocompatibility, color matching, and horizontal gain. Harris[16] placed ADMA on the bone around four implants to increase the amount of keratinized tissue. He increased the amount of keratinized tissue, but the patient's pain level and healing resembled those associated with a denudation procedure. Additionally, the histologic evaluation of the tissue that formed around the implants showed ADMA was not incorporated into the results; therefore, he does not recommend this technique.

Fowler and Breault[17] augmented a ridge utilizing an ADMA in lieu of an autograft and, thus, demonstrated an acceptable aesthetic result with a significant improvement in the bucco-lingual dimension of the dental ridge.

Novaes and Souza[18] used ADMA as a barrier membrane in case of guided bone regeneration for implantation. Healing progressed uneventfully with the formation of adequate new bone and increase in the width of keratinized tissue.

Batista and Batista[19] successfully placed ADMA as a dressing material to treat flap fenestrations in bone grafting surgery.

Novaes, et al.[20] used ADMA for elimination of gingival melanin pigmentation and compared the clinical results to the postoperative results of gingivoplasty in the same patient. Harris[21] found use of an acellular dermal matrix for soft tissue ridge augmentation is a clinically valuable technique.

ADMA has been successfully used in burn surgery since 1992 and in periodontal and plastic reconstructive surgery since 1994.[1]

Haim[22] used ADMA for the treatment of localized moderate gingival recession of the left mandibular canine. Eight-month observations and measurements showed more than 80% root coverage. Harris[23], in a comparative study of root coverage obtained with an acellular dermal matrix versus connective tissue graft, found there was no statistically significant difference in the mean root coverage obtained (95.8% AlloDerm™ vs. 96.2% connective tissue graft).

Wei et al.[5] in another study compared ADMA with free gingival graft (FGG) and after six months suggested: (1) the ADMA allograft was less effective and less predictable than the autogenous FGG in terms of increasing attached keratinized tissue due to considerable shrinkage and the inconsistent quality of the attached tissue gained and (2) the aesthetic results using the ADMA allograft might be better than those using the autogenous FGG.

Harris[24] evaluated the long-term stability of root coverage results obtained with an acellular dermal matrix. The mean root coverage at 12 weeks post operation was 91.7%, and at the final postoperative evaluation (mean 18.6 months) was 87.0%. The author reported these results were predictable and stable over time.

Wei et al.[25] histologically compared the microstructure of ADMA and FGG treated sites from the same group and suggested: (1) the resultant tissues of ADMA grafts were similar to "scar" tissue and (2) ADMA lacked the capability of directing cyto-differentiation of the covering epithelium.

Paolantonio et al.[26] clinically compared ADMA and autogenous connective tissue grafts in the treatment of Miller's class l or ll gingival recession.

The authors demonstrated both ADMA and SCTGs were similarly able to successfully treat gingival recession defects. However, the SCTG group demonstrated a significantly greater increase in keratinized tissue and showed quicker and more complete healing.

Haim et al.[27] found recession defects might be covered using ADMA or SCTG with no practical difference. However, SCTG results in significantly greater gain of keratinized gingiva.

"Because AlloDerm™ is available in various sizes, multiple sites can be treated during one surgery appointment. Conversely, conventional techniques to augment soft tissue are limited by the amount of tissue that can be harvested."

The manufacturer of AlloDerm™ claims it can be an alternative for free gingival graft which is taken from the palate. Therefore, the purpose of this study is the clinical evaluation of this ADMA product for treatment of gingival recession. Additional aims are to (1) compare results of this study with results obtained by the SCTG method and (2) determine the effect of the procedure on reduction of height and width of gingival recession, pocket depth, keratinized and attached gingival, and attachment level.

Methods and Materials

This study was approved by the Vice-Chancellor of Research, Mashhad University of Medical Sciences. The procedures were explained to patients through both verbal and written communication, and they were required to sign an informed consent form.

Study Population

Fourteen patients, eight males and six females, ranging from 23 to 62 years of age (mean=41.7) with twenty sites of gingival recession participated in this study. They were selected from a pool of patients seeking treatment at the Graduate Periodontics Clinic of the Mashhad School of Dentistry.

Patients met the following criteria: (1) no systemic disease; (2) non-smoker; (3) gingival recession (Miller's grade I, II) on the facial aspect of incisors or premolars; (4) no periodontal pockets; and (5) no restoration in the area to be treated.

Initial Therapy

Plaque index was achieved according to the O'Leary Plaque Index[28], in which the patients were chosen at an optimum plaque index of less than 15%. Moreover, oral hygiene instructions were conducted using the Modified Stilman Technique[29]; flossing, scaling, root planning, and polishing were done, if needed. The teeth were checked for premature-occlusal contacts; occlusal adjustments and restorative procedures were also done, if necessary. After two weeks, the patients were revaluated for gingival inflammation, bleeding on probing, plaque index, and oral hygiene instructions repeated. After one month, they were revaluated. Only the patients with good oral hygiene (plaque index<=15% O'Leary) were selected. After taking impressions and photographs, orthodontic brackets were fixed in the facial surfaces of their teeth. The following measurements were made at the facial aspect of each tooth along the defect before surgery: (1) probing depth (PD) using William's probe; (2) recession height (RH) measured from cementoenamel junction (CEJ) to free gingival margin; (3) recession width (RW) measured mesiodistally at CEJ level; (4) keratinized gingiva (KG); (5) attached gingiva (AG); and (6) clinical attachment level (CAL).

In a blind study, an examiner made pre and post surgical measurements.

Surgical Procedure

All patients were treated by the same surgeon. Surgery was performed when satisfactory plaque control was achieved. Six patients had two sites of recession in their mouths; therefore, each site was selected randomly by flipping a coin for ADMA (test) or SCGT (control) procedures. Other patients with one site of recession were also allocated randomly for ADMA or SCGT procedures through the flipping of a coin. (In fact the SCTG group is not a true control). Patients started rinsing with 0.2% chlorhexidine (CHX) solution, twice daily, two days before surgery. Under local anaesthetic injection, using 2% lidocaine with 1:100000 epinephrine, the surgical procedures were performed in each group as follows: in gingival papillae, on both sides of receded root, two small horizontal incisions were made with appropriate, sufficient distance from the top of the papillae and extending to half of the tooth width. The upper part of these papillae

was de-epithelialized. At the end of this point, two vertical incisions were made and extended epically 2 mm beyond mucogingival junction (MGJ). These incisions were trapezoid; therefore, the flap was wider at the base to provide enough circulation. The partial thickness flap was reflected enough by sharp dissection to be able to cover recession. The root was cleaned and planned with Gracy's 1⁄2 curettes. Muscles and loose connective fibers were thoroughly scraped to prevent subsequent graft mobility. Following bed preparation, the recipient site was randomly subjected to either ADMA (test) or SCTG (control) treatment.

Test Group

Patients in this group received an ADMA which had been rehydrated in sterile saline as the following procedure describes: the pouch was opened and the allograft was aseptically removed. Allograft has distinct upper and lower surfaces; therefore, to enable correct orientation, each piece contains an orientation slit that must not be trimmed before application. The allograft was placed with the attached backing in the first dish in the sterile field. Then the dish was filled with at least 50 ml of rehydration fluid (saline) to submerge and soak the allograft for five minutes. During this procedure the backing may float away from the tissue; then using sterile gloves or forceps, the backing was discarded. Next, the allograft was aseptically transferred to the second dish, which was filled with 50 ml saline, submerged completely, and allowed to soak for five minutes. Finally, the fully rehydrated membrane was ready for application to the wound bed. The membrane was trimmed wide enough to cover the recession area, positioned on the bed area, and sutured to the neighbour mucosa with 5.0 plain gut. The connective tissue side of ADMA was faced against the denuded roots as recommended by the manufacturer. Then the graft was covered with a coronally displaced flap. The flap was again sutured with 4.0 silk and was secured to a bracket to prevent apical displacement and covered with non-eugenol periodontal dressing (Coe-Pak) for protection. (Figures 1a-f).

Control Group

The bed in the control group was prepared in the same manner as the test group. Then it received an autogenous SCTG, harvested with #15 scalpel blades from one side of the hard palate, in the area of the second premolar to the first molar.

First, the size of the graft was obtained with a tinfoil model, wide enough to cover the recession area mesiodistally and coronoapically. This aluminium tinfoil was used to outline the graft. The longer side was positioned 5 mm apart and parallel to the gingival margin. One horizontal cut and two small vertical cuts on both ends of this cut were made. This split thickness flap was reflected and connective tissue with a thickness of 1.5 mm was harvested. The palatal flap was repositioned and compressed with wet spongy gauze for five minutes and sutured with 4.0 silk. The connective tissue was trimmed and the epithelial collar was removed from the CT graft; then it was positioned on the bed area and sutured to the neighbouring mucosa with 5.0 plain gut. Then the graft was covered with a coronally displaced flap. The flap was sutured with 4.0 silk and was secured to the bracket to prevent apical displacement. The donor sites and recipient sites were covered with non-eugenol periodontal dressing (Coe-Pak) for protection.

Statistical Analysis

Preliminary inspection of data revealed they were normally distributed. All parameters were analyzed using the 2-sample t test. Data analysis was performed using SPSS (version 11) software.

Results

The healing phase was uneventful. The study population was controlled for six months post-surgery, and during this time their oral hygiene was monitored. Tables 1 to 7 show the obtained results at baseline and after six months.

Table 1 shows the RH in which the amount of coverage in the control group (SCTG) was 2.60±0.97 mm (P-value <0.001) and in the test group it was 2.90±0.81 mm (P-value <0.001). The reduction in RH was statistically significant for both the control and test groups. Moreover, in comparison of the two groups there were no significant differences between the amount of RH after treatment (p=0.896) and in the amount of change (p=0.461).

Table 2 shows the RW was reduced to 1.70±1.01 mm in the control group and 1.65±0.67 mm in the test group, in which both show significant

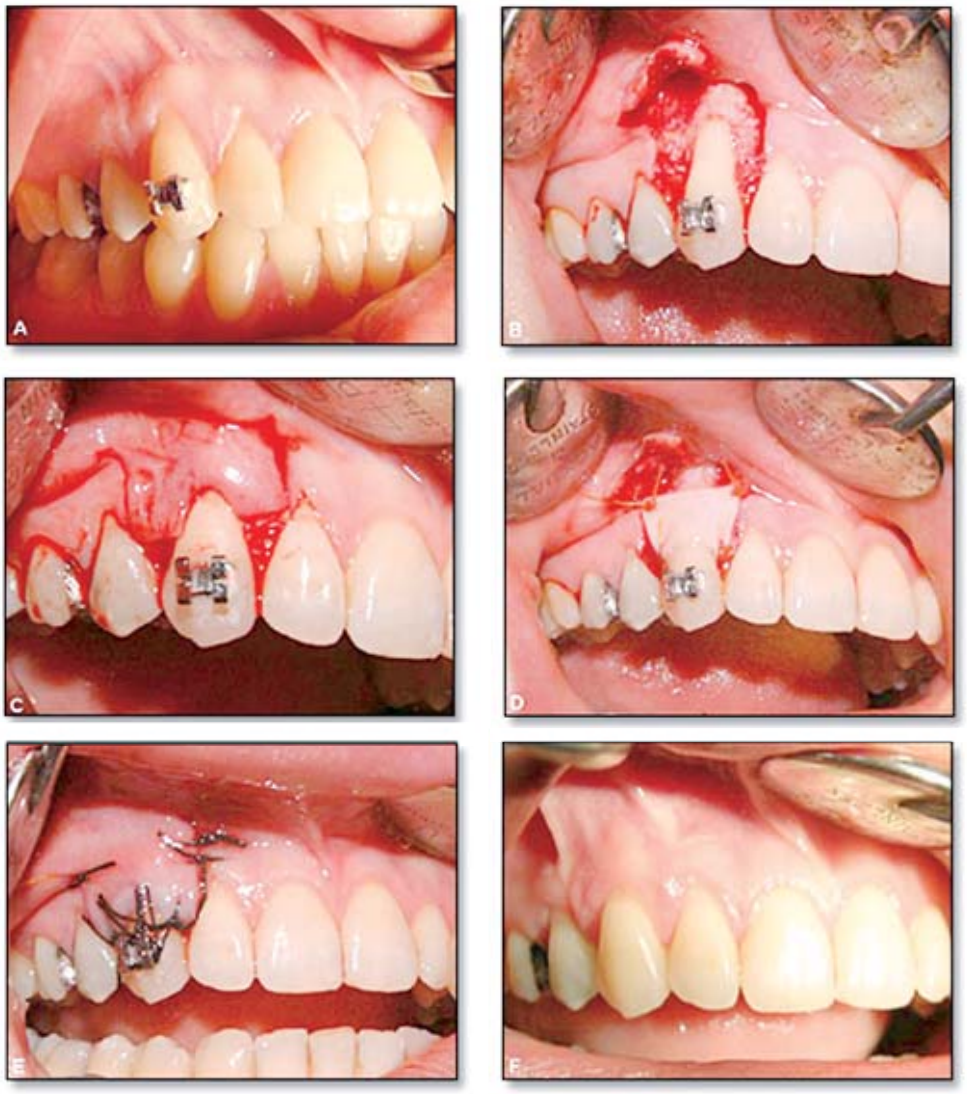

Figure 1. Root coverage with ADMA. **A.** Pre-treatment view. **B.** Horizontal and vertical incisions. **C.** Prepared bed. **D.** ADMA positioned and sutured. **E.** Coronally displaced flap covering the graft. **F.** The treated area six months post surgery.

Table 1. Recession height (RH) in mm before and after treatments and its change throughout the study.

Treatment type	Pre treatment	Post treatment	Change
SCTG (10 cases)	3.70±0.63	1.10±0.91	2.60±0.97*
ADMA (10 cases)	4.05±1.04	1.15±0.78	2.90±0.81**
P-value (2-sample t-test)	0.375	0.896	0.461

*P<0.001 (Pre vs. post treatment in control group)
**P<0.001 (Pre vs. post treatment in test group)

change (P value <0.001 and P value <0.001). Nevertheless, there was no significant difference between the groups in terms of the amount of RW after treatment (P=0.291) and in the difference in the amount of changes between the two groups (P=0.897).

Table 3 shows in terms of PD there was no statistically significant changes in the PD after treatment in the SCTG group (P=0.758) and in the ADMA group (P=0.509).

As Tables 4 and 5 show, the KG and attached gingiva significantly increased in both groups. However, there was no difference between the two groups in their ability to increase the KG and attached gingiva (P=0.247 and P=0.326, respectively).

Table 6 shows the CAL was significantly reduced in both groups (P<0.001). However, there was no difference between groups in the amounts of CAL gain (P=0.741).

Finally, as Table 7 shows, the mean percentage of root coverage in SCTG groups was 70.12%±22.80% and in ADMA groups was 72.08%±14.12%. The difference between the amount of obtained root coverage was insignificant (P=0.83).

Table 2. Recession width (RW) in mm before and after treatments and its change throughout the study.

Treatment type	Pre treatment	Post treatment	Change
SCTG (10 cases)	3.10±0.70	1.40±0.99	1.70±1.01*
ADMA (10 cases)	3.50±1.03	1.85±0.85	1.65±0.67**
P-value (2-sample t-test)	0.324	0.291	0.897

*P<0.001 (Pre vs. post treatment in control group)
**P<0.001 (Pre vs. post treatment in test group)

Table 3. Probing depth (PD) in mm before and after treatments and its change throughout the study.

Treatment type	Pre treatment	Post treatment	Change
SCTG (10 cases)	0.85±0.47	0.80±0.35	0.05±0.50*
ADMA (10 cases)	0.80±0.35	0.90±0.32	0.1±0.46**
P-value (2-sample t-test)	0.791	0.511	0.492

*P=0.758 (Pre vs. post treatment in control group)
**P=0.509 (Pre vs. post treatment in test group)

Table 4. Keratinized gingiva (KG) in mm before and after treatments and its change throughout the study.

Treatment type	Pre treatment	Post treatment	Change
SCTG (10 cases)	0.80±0.63	3.30±1.06	2.5±0.97*
ADMA (10 cases)	0.75±0.54	3.70±0.01	2.95±0.69**
P-value (2-sample t-test)	0.851	0.398	0.247

*P<0.001 (Pre vs. post treatment in control group)
**P<0.001 (Pre vs. post treatment in test group)

Table 5. Attached gingiva (AG) in mm before and after treatments and its change throughout the study.

Treatment type	Pre treatment	Post treatment	Change
SCTG (10 cases)	0.20±0.4	2.45±0.90	2.25±0.92*
ADMA (10 cases)	0.15±0.24	2.80±0.92	2.65±0.85**
P-value (2-sample t-test)	0.714	0.400	0.326

*P<0.001 (Pre vs. post treatment in control group)
**P<0.001 (Pre vs. post treatment in test group)

Table 6. Clinical attachment level (CAL) in mm before and after treatments and its change throughout the study.

Treatment type	Pre treatment	Post treatment	Change
SCTG (10 cases)	4.55±0.83	1.95±0.76	2.60±1.08*
ADMA (10 cases)	4.85±1.06	2.05±0.80	2.75±0.92**
P-value (2-sample t-test)	0.489	0.778	0.741

*P<0.001 (Pre vs. post treatment in control group)
**P<0.001 (Pre vs. post treatment in test group)

Table 7. Mean root coverage post treatment.

Treatment type	Root Coverage (mm)	Root Coverage (%)
SCTG (10 cases)	2.60±0.97	70.12±22.8%
ADMA (10 cases)	2.90±0.81	72.08±14.12%
P-value (2-sample t-test)	0.461	0.830

Discussion

The findings of this study revealed both groups (ADMA and SCTG) were successful in treatment of gingival recession according to Harris' criteria for root coverage.[30] In this study the percentage of root coverage was 72.08±14.12 for the test group and 70.12± 22.81 for the control group. There was no significant difference between them (P=0.830). In Harris' study[30] the mean root coverage of the patients was 97.4% with 80% of the samples having 100% root coverage. The surgical procedure used in our study is similar to Harris', and mean RH in our study was 3.7±0.63 mm, which is similar to his (3.6±1.1). In the Harris study RW had not been mentioned and the type of teeth treated was different from this study. Moreover, the majority of teeth in our study were premolars (55%), while in the Harris, study only 16% of teeth were premolars. Premolars are wider than mandibular centrals in mesio-distal width, necessitating wider graft and more blood supply. This could be a reason for the different results obtained by the two studies. Although other studies on teeth with different widths still obtained successful results[31], implying tooth width may not be such a critical factor. Piniprato et al.[32], who did the same surgical procedure as the SCTG group in our study, reported 72.73% root coverage. In that study mean RH was 2.52 mm but RW was not mentioned. Wennstrom and Zucchelli[33] did a study using the SCTG method and reported 98.9% mean root coverage after two years.

Several events take place during the healing and maturation of the tissue following placement of a free connective tissue graft under the coronally

advanced flap. According to Karring et al.[34], following the placement of a free connective tissue graft under the coronally advanced flap, connective tissue of the palatal masticatory mucosa possesses the ability to alter the differentiation of the epithelial cells of the thin covering flap to become keratinizing cells. Another factor which has been reported in many studies is creeping attachment, first described by Goldman as coronal movement of gingival margin toward denuded root after gingival graft placement.[35] A few studies[36,37,38] have indicated the onset of coronal movement after one month, lasting for at least one year. Piniprato et al.[39], Harris[38], Matter[36], and Fagan[40] reported 0.43 mm, 0.85 mm, 0.89 mm, and 0.8 mm creeping attachment after one year, respectively.

In the present study the mean RC was 72.08%±14.12% after six months for the test group. Other studies reported different results. Some reported only the success of treatment and did not mention the percentage of it.[1,5,6,7,8,11] Others indicated mean RC of between 80% and 95.8%.[9,10,22,23,24,26,27] Harris[23], in a research similar to this study, reported 95.8% root coverage for an ADMA group and 96.2% for a SCTG group after one year. Paolantonio et al.[26] did the same study on ADMA and SCTG and reported mean percentage 83.33±11.40 and 88.8±11.65 root coverage, respectively.

Harris[41] concluded an acellular dermal matrix and a subepithelial graft can produce similar amounts of root coverage in a short-term period. However, the results with an acellular dermal matrix tended to break down in the long-term, while the long-term results with a subepithelial graft tended to remain stable. In that study only 32% of the cases treated with ADMA demonstrated improved results or remained stable with time.

Henderson et al.[9] conducted a study to clarify which side of the ADMA membrane should be close to the root surface. In his study no difference was found between the two sides of the membrane and mean root coverage was reported to be 93%. In the present study, we made the connective tissue side of ADMA facing against denuded roots as recommended by the manufacturer. Although we did not measure the gingival thickness in our study design, a few investigators have brought up this issue. Woodyard et al.[42] found a coronally positioned flap plus an ADMA produced significantly greater mean coverage and gingival thickness than a coronally positioned flap alone. Cortes et al.[43] indicated acceptable root coverage can be achieved in class I gingival recession with or without the use of ADMA; however, a greater keratinized tissue thickness can be expected with ADMA.

Considering the insignificant difference in our study comparing ADMA and SCTG, use of the former one seems to be more logical due to the disadvantages of SCTG which includes two operating regions and more bleeding and pain. On the other hand, different sizes of ADMA make it simpler to use in different sized recession defects.

Conclusions

1. Both ADMA and SGCT procedures could be successful in the treatment of gingival recession.

2. Considering the disadvantages of SCTG, use of ADMA seems more reasonable.

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