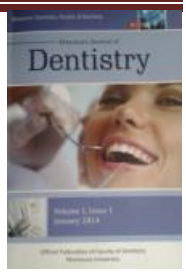
The Use of Acellular Dermal Matrix Allograft in the Treatment of Gingival Recession



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Abstract:
Objectives: Evaluate the effectiveness of acellular dermal matrix allograft (ADMA) in comparison to subepithelial connective tissue graft (SCTG) in the treatment of Miller's class I and II gingival recession.
Methods: A total of fourteen systemically healthy patients having Miller's Class I and II gingival recessionsaged between 22 to 42 years were selected to participate in the present study. Patients were randomly divided in two groups; test group (ADMA) and control group (SCTG). Clinical parameters including gingival index (GI), plaque index (PI), papillary bleeding index (PBI), probing depth (PD), clinical attachment level (CAL), gingival recession width (GRW),gingival recession length (GRL), width of keratinized gingiva (WKG), percentage of root coverage and patient satisfaction scores were recorded. All measurements were recorded at baseline and evaluated at 3 months postoperatively.
Results: There were no statistically significant in any of the parameters between both ADMA and SCTG groups postoperatively.The root coverage obtained with SCTG group was 83.3 % at 3 months, while for ADMA group was 80.2 % at 3 months.
Conclusions: ADMA may be suggested as an acceptable substitute for connective tissue graft to achieve predictable root coverage.

Keywords: *Gingival recession; acellular dermal matrix allograft; subpithelial connective tissue graft..*

Introduction

The exposed root surfaces of teeth pose a multitude of problems like root hypersensitivity, root surface caries along with a massive esthetic deficiency. The root surface coverage procedures are carried out to overcome these problems [1].

Esthetic root coverage has thus become an important part of periodontal therapy. The search for the perfect root coverage technique has taken many differing approaches. Several surgical procedures have been used to achieve root coverage, which include pedicle grafts (lateral sliding or double papillae) with or without connective tissue grafts, epithelialized autogenous grafts (free gingival graft), connective tissue grafts, coronally positioned flaps (CPF) alone, CPF preceded by a free gingival graft, and CPF with a simultaneous connective tissue graft. Each of these techniques results in varying degrees of success and offers a variety of treatments for such defects [2].

Subepithelial connective tissue graft (SCTG) is considered the most successful procedure for obtaining root coverage. However, its major drawback is donor site morbidity as it needs another surgery for palatal tissue harvest [3]. Many authors [4,5] have suggested that the gold standard for root coverage procedures is the SCTG technique, which requires a donor site and a recipient site, leading to greater patient discomfort and increased surgical time. The need for a second surgical procedure to harvest donor tissue is a disadvantage of the SCTG because only a limited amount of donor tissue is available for multiple recession defects. Thus, there has been a desire to find a substitute to replace the autogenous donor tissue.

Recently, acellular dermal matrix allograft (ADMA) tissue (AlloDerm, by LifeCell Corporation, NJ,USA) has been used successfully in soft tissue surgeries around the implants to increase the zone of keratinized tissue, for tissue augmentation, and also in root coverage. It is a human soft tissue, which is chemically processed to remove all the epidermal and the dermal cells (antigenic cells), while preserving the remaining bioactive dermal matrix. The intent of these procedures is principally to create a tissue barrier that is more resistant to further recession due to trauma. The ADMA acts as a scaffold for the vascular endothelial cells and fibroblasts to repopulate the connective tissue matrix and encourage the epithelial cells to migrate from the adjacent tissue margins [6]. In few case series and controlled studies, the healing process observed in the allograft is similar to that seen in autogenous grafts [7,8]. A human histologic case series [9] comparing SCTG and ADMA with 6-month healing indicated that the gingival attachment to the root surface was comparable in both SCTG and ADMA. The ADMA seemed well incorporated with new fibroblasts, vascular elements, and collagen, while retaining its elastic fibers throughout; it was apparent that equivalent attachment to the root surface was observed between SCTG and ADMA.

Acellular dermal allograft tissue (AlloDerm®) (ADMA), few years ago, was introduced as an allograft for root coverage in the treatment of gingival recession. The allograft retains the natural collagen matrix and mechanical properties of native dermis [10]. Acellualar dermal matrix allograft appears to have several significant advantages over other allograft materials. There are no dead cells within the dermal matrix that could contain class I and class II major histocompatibility complex (MHC) antigen, which pose the potential for inducing rejection. In addition, complete dead cell removal eliminates the almost nonexistent potential for viral disease transmission is a significant advantage in gaining patient and surgeon

acceptance [11]. With this goal in mind and the limitations of other surgical procedures, this study will be undertaken to evaluate the efficacy of acellular dermal matrix allograft in comparison to subepithelial connective tissue graft as a root coverage material.

The aim of the present study is to clinically evaluate the effectiveness of acellular dermal matrix allograft (ADMA) in comparison to subepithelial connective tissue graft (SCTG) in the treatment of Miller's class I and II gingival recession.

Patients and methods

Fourteen systemically healthy patients having Miller's Class I and II gingival recessions were randomly selected from the Department of Oral Medicine and Periodontology at the Faculty of Dentistry, Mansoura University.

All individuals enrolled in the study received phase I periodontal therapy principally through thorough scaling and root planing (SRP).They were educated and motivated for good oral hygiene control and divided into two groups**:**

ADMA group (Test group): Seven patients received acellular dermal matrix allograft (AlloDerm®) with partial thickness coronally advanced periodontal flap (Fig. 1).

SCTG group (Control group): Seven patients received subepithelial connective tissue graft harvested from the palate placed under partial thickness coronally advanced periodontal flap to act as positive control in the study (Fig. 2).

Inclusion Criteria

1) Presence of gingival recession defects on the labial or buccal surfaces of the teeth, either in maxillary or mandibular arch, classified as either Miller's Class I or II.
2) Presence of $\geq$ 2mm gingival recession.
3) Presence of $\geq$ 2mm width of keratinized gingival apical to recession.
4) Absence of bone loss interproximally in periapical x-ray film in the involved teeth.

Exclusion Criteria

1) Presence of systemic diseases such as Diabetes mellitus, blood diseases, immunodeficiency and hepatic patients.
2) Smokers.
3) Uncooperative patients.
4) History of periodontal surgery in selected gingival recession defects.

The following clinical parameters were measured for assessment of the results in all the selected cases preoperatively and after surgery: Gingival index (GI) [12], plaque index (PI) [13], papillary bleeding index (PBI) [14], probing depth (PD), clinical attachment level (CAL), gingival recession width (GRW), gingival recession length (GRL), width of keratinized gingiva (WKG), percentage of root coverage and finally patient satisfaction scores and total satisfaction percentage of all patients in both test and control groups under investigation. The patient was given score 2 if he/she was fully satisfied, given score 1 if he/she was just satisfied and given score 0 if he/she was unsatisfied. All patient scores were summated and divided by their numbers and calculated as percentage to give the total satisfaction percentage of SCTG and ADMA groups according to Mahajan et al. [15]. All probing measurements were recorded at maximum depth recession (Mid-facially per tooth); only on teeth to be treated at baseline and evaluated at 3 months postoperatively.

Both SCTG and ADMA patients received full mouth thorough scaling and root planing (SRP) using ultrasonic device and hand Gracey curettes two weeks before surgical intervention.

Surgical Technique for ADMA group of patients

The surgical area was prepared with adequate anesthesia using 2% Mepivacaine with 1/20000levonordefrin (Mepecaine-L, Alexandria Co. for pharmaceuticals & chemical industries Alex., Egypt.). Flap was designed using scalpel blades numbers 15 and 11. Intrasulcular incision was made at the labial aspect of the involved teeth. Two horizontal incisions were made at right angles to the adjacent interdental papillae at the level of cementoenamel junction without interfering with the gingival margin of the neighbouring teeth. In multiple teeth cases, additional horizontal incisions were made connecting the CEJ of the teeth with the recession. Two oblique vertical incisions were extended beyond the mucogingival junction and a trapezoidal mucoperiosteal flap was raised up to the mucogingival junction. After this point, a split thickness flap was extended apically, releasing the tension and favouring the coronal positioning of the flap. The epithelium on the adjacent papillae was deepithelized to create a connective tissue bed for flap adaptation.The root was thoroughly planed with Gracey's curettesand was washed with saline solution.Then, the root surfaces were conditioned with ethylenediaminetetra-acetic acid 19 % EDTA cream (MD-ChelCream™, 19% EDTA Cream made by Meta Biomed, KoreaMD-ChelCream™) for one minute to remove the smear layer. The exposed root surface was rinsed abundantly with sterile saline solution to remove all EDTA residues.5/0 Vicryl sutures (UNICRYL, UNICRYL sutures manufactured by UNIMED, kingdom of Saudi Arabia.) with round cutting needle was used for suturing with sling suturing technique.

AlloDerm preparation

The AlloDerm (ADMA) material was prepared according to the manufacturer's instructions. The foil bag was opened at the notch and the inner pouch was removed. The inner pouch was opened and the ADMA was taken with sterile forceps. It was submerged completely and soaked for 10 minutes in sterile saline or until the backing separates from the ADMA. Using a sterile forceps, the backing was removed and discarded once separated from the tissue. Then, it was transferred to a second sterile saline bath for another 10 minute lastly. When ADMA was fully rehydrated, it became soft and pliable. At this stage, it was ready for application to the surgical site. ADMA was trimmed to fit the defect site. Once the graft has been rehydrated, a drop of blood to both sides of the graft was added and rinsed with sterile saline solution. The dermal side had a bloody appearance; this side of the graft was placed toward the tooth and bone, whereas the basement membrane side did not retain blood inside; this side of the material was placed facing up towards the flap.

AlloDerm (ADMA) placement:

ADMA should be adapted to cover the exposed root area.The graft was trimmed in such a way that it was coronally located at CEJ and covered the alveolar bone apically up to at least 2 to 3 mm. The basement membrane side was placed adjacent to the bone and tooth and connective tissue side was placed facing the flap. The

coronal and lateral border of ADMA was sutured to the lingual gingival tissue with resorbable sutures 5/0 Vicryl sutures. The graft must be immobilized. Any movement interferes with healing. Avoid excess tension, which distorts the graft. Tissue forceps should be used delicately and minimum number of sutures used to avoid unnecessary tissue perforation.The flap was then coronally positioned and sutured to cover the ADMA, slightly coronal to CEJ and stabilized with simple interrupted 5/0 Vicryl sutures laterally and continuous sling sutures coronally. Finally periodontal dressing (Coe Pak, GC America, USA.) was placed over the surgical site.

Graft Harvesting for SCTG group of patients

After preparation of the recipient site, the donor area in the palate was anesthetized by block anesthesia of the greater palatine and nasopalatine nerve with 2% Mepivacaine and 1/20000 levonordefrin. Bleeding points were made corresponding to the required length of the graft. The technique described by Bruno(Bruno JF. 1994) was used to harvest the subepithelial connective tissue graft (SCTG) from the palate. The first incision was made perpendicular to the long axis of the teeth, approximately 2 to 3 mm apical to the gingival margin of maxillary teeth. The mesiodistal length of the incision was determined by the length of the graft necessary to cover the recipient site. The second incision was made parallel to the long axis of the teeth, 1 to 2 mm apical to the first incision, depending on the required thickness of the graft. The incision was carried far enough apically to provide a sufficient amount of connective tissue to cover the denuded root and the adjacent periosteum of the recipient site. The donor tissue was removed from the palate as atraumatically as possible; two small vertical incisions were placed to facilitate the atraumatic graft retrieval. The SCTG was placed on saline soaked gauze, while the palatal wound was closed. A horizontal mattress suture was used to stabilize the donor area.

SCTG placement

The epithelial collar was removed from the connective tissue graft and discarded. The SCTG was trimmed to the mesiodistal dimension and placed on the recipient site and secured in position with 5/0 vicryl sutures. Then the overlying full-partial thickness flap was positioned over the SCTG with no tension on the flap, using sling sutures into the mesial and distal papillae covering as much of the connective tissue graft as possible. Donor site was protected using periodontal pack (Coe Pak) for a week, and was repeated if necessary. The pack was retained by locking it through the interproximal spaces onto the lingual surface.

Postoperative Care for both ADMA and SCTG patients

After surgery, NSAID (Ibuprofen 400mg) and systemic antibiotic augmentin 1gram (Amoxicillin + clavulenic acid) twice dailywas prescribed for 5 days. Patients were instructed not to brush for 7 days after surgery and only to rinse with 0.2% Chlorhexidine gluconate (Hexitol) twice daily. The patients were instructed to clean the surgical area with a cotton pellet soaked in chlorhexidine gluconate solution twice a day for 30 days. After 14 days, the periodontal dressing and sutures were removed. All the patients were examined weekly for the first month and once in a month for next 3 months for supragingival scaling and oral hygiene motivation. Patients were recalled after 3 months to record clinical parameters assigned in the study.

Statistical analysis:

The collected data were tabulated and statistically analyzed. Appropriate tests were used to identify significant relationship between different variant in this study.

Statistical test used were**:** Statistical Package for Social Sciences (SPSS).

Results

Fourteen healthy individuals with Miller's classI and II gingival recession were selected from the out patients of the Department of Oral Medicine and Periodontology at Faculty of Dentistry, Mansoura University to participate in this study.

All patients received phase I periodontal therapy mainly by performing thorough scaling and root planing (SRP) and giving instructions for good oral hygiene at home. All individuals included in the study were non-smokers and had no systemic diseases.

They were divided randomly into two groups. Group A that consisted of seven patients who received acellular dermal matrix allograft (ADMA) under partial thickness coronally positioned flap and group B in which seven patients received subepithelial connective tissue graft (SCTG) in conjunction with partial thickness coronally positioned flap.

All selected subjects completed the study with uneventful healing and there were no drop-outs. No adverse effects were observed by any of the subjects to the materials used in the study.

The following clinical parameters were measured in all selected cases at baseline and after 3 months of surgical therapy:

- Plaque Index (PI).
- Gingival Index (GI).
- Papillary Bleeding Index (PBI).
- Probing Depth (PD).
- Clinical Attachment Level (CAL).
- Width of Keratinized Gingiva (WKG).
- Gingival Recession Length (GRL).
- Gingival Recession Width (GRW).
- Patient satisfaction score and total satisfaction percentage of patients in each group involved in the study.

The demographic data of all individuals enrolled in the current study are shown in Table 1. The age of the patients in SCTG group ranged from 23- 40 years with an average of 31.6 ± 5.9 years. Two of them were males and five were females. The age of the patients in ADMA group ranged from 22- 42 years with an average of 29.3 ± 6.9 years. Three of them were males and four were females.

Table 2 showed the mean values and standard deviations of plaque index (PI), gingival index (GI) and papillary bleeding index (PBI) in both SCTG and ADMA groups at baseline and after 3 months of surgical therapy. In the SCTG group, the average value and standard deviation of PI at baseline was 0.67 ±0.10, while 3 months after surgery, it was 0.79 ± 0.10. It was noted that there was a modest increase in the PI values; however, it was not statistically significant ($p > 0.05$). In the ADMA group; the baseline and after 3 months of treatment, PI values were 0.66 ± 0.12 and 0.81± 0.15, respectively. There was no

statistically significant difference between both values; however, there was a modest rise of PI value after therapy ($p > 0.05$). It was clear that there was also no significant difference between PI values of SCTG and ADMA groups at baseline and after treatment ($p > 0.05$).

With regards to GI values in SCTG group at baseline and after 3 months of therapy, the mean values and standard deviations were 0.22 ± 0.11 and 0.24 ± 0.13, respectively. In the ADMA group, the GI values were 0.23 ± 0.12 and 0.26 ± 0.11, respectively. However, there was modest elevation of GI values in both groups after therapy; it was statistically not significant compared to baseline values ($p > 0.05$). It was noticed that there was no statistically significant difference between GI values of SCTG and ADMA groups at baseline and after 3 months ($p > 0.05$).

The mean and standard deviation values of papillary bleeding index (PBI) of the SCTG group at baseline and 3 months after therapy were 0.65 ± 0.08 and 0.66 ± 0.16, respectively. While in the ADMA group, the baseline and after therapy values of PBI were 0.63 ± 0.10 and0.64±0.15, respectively. Noteworthy, there were no statistically significant differences between values at baseline compared to after therapy values in both groups ($p > 0.05$). Also, there was no significant difference between values after therapy in SCTG and ADMA groups ($p > 0.05$).

Table 3 showed the mean values and standard deviations of probing depth (PD) and clinical attachment level (CAL) measured in millimeter (mm) at baseline and after three months of complete healing of SCTG and ADMA patients. The mean value of probing depth in the SCTG at baseline was 0.57 ± 0.53 mm whereas its mean value at three months after therapy was 0.71 ± 0.49 mm. There was no statistically significant difference between both values ($p > 0.05$). In the ADMA group, the mean PD values at baseline and after therapy were 0.61 ± 0.42mm and 0.86 ± 0.38mm, respectively. It was obviously noted that there was no statistically significant difference between both values ($p > 0.05$). There were also no significant variations in values of SCTG compared to ADMA values at baseline and after therapy ($p > 0.05$).

Moreover, the mean values of CAL in SCTG and ADMA groups at baseline and after therapy were 3.86 ± 0.90, 1.29 ± 0.76, 3.71 ± 0.76 and 1.36 ±0.65 mm, respectively. Noteworthy, there was a highly statistically significant difference between values in both SCTG and ADMA after therapy in comparison to baseline values ($p < 0.001$). However; there was no significant difference between values of PD after therapy in both SCTG and ADMA ($p > 0.05$).

The mean values and standard deviations of gingival recession width (GRW) and gingival recession length (GRL) measured in mm at baseline and after therapy of SCTG and ADMA patients are shown in Table 4.

The mean values and standard deviations of gingival recession width (GRW) at baseline and after 3 months in the SCTG group were 2.70 ± 0.48 mm and 1.02 ± 0.70 mm, respectively. Where as in ADMA group, GRW values were 2.65 ± 1.50 mm and 1.1 ± 0.54 mm at baseline and after 3 months of therapy, respectively. Of interest, there was a highly statistically significant difference of GRW after 3 months of surgical therapy in both SCTG and ADMA groups compared to their baseline values at $p < 0.001$. However; there was no significant difference in the outcome values (after therapy) between ADMA and SCTG patients at $p > 0.05$.

Moreover, the mean values and standard deviations of gingival recession length (GRL) at baseline and after 3 months in the SCTG group were 2.59 ± 0.76 mm and 0.57 ± 0.53 mm, respectively. It was notably observed that there was a highly significant difference between baseline and after 3 months ($p < 0.001$). For AMDA group, the GRL values were 2.86± 0.69 mm and 0.64± 0.63 mm, respectively. There was a highly significant difference between baseline and after 3 months ($p < 0.001$). Of importance, it was found that there was no significant difference of GRL values of ADMA patients when compared to SCTG patients at $p > 0.05$.

The mean values and standard deviations of the width of keratinized gingiva (WKG) measured in millimeters and the percentage of root coverage (RC %) at baseline and after therapy of SCTG and ADMA patients are represented in Table 5. The baseline mean values of WKG of SCTG and ADMA patients were 3.14± 1.07 mm and 3.32 ± 1.14 mm, respectively. Whereas after 3 months of therapy, the mean values of WKG of SCTG and ADMA patients were 5.51 ± 0.95 mm and 5.34 ± 0.67 mm, respectively. There was a highly significant difference of the values of WKG after therapy compared to baseline values in both SCTG and ADMA patients at $p < 0.001$.However; there was no significant difference of WKG values after therapy between SCTG and ADMA patients at $p > 0.05$. In the same table, the root coverage percentage (RC %) gained after surgical therapy in SCTG and ADMA were 83.3 ± 14 % and 80.2 ± 17.4 %. Most importantly, there was no significant difference of the root coverage percentage (RC %) gained after 3 months of surgical therapy between SCTG and ADMA patients at $p > 0.05$.

Table 6 showed the patients' satisfaction score and total satisfaction percentage of SCTG and ADMA groups. In SCTG group, five patients were fully satisfied and two patients were satisfied. The total satisfaction percentage in SCTG group was 85.7 %. While in ADMA group, four patients were fully satisfied and three patients were satisfied. The total satisfaction percentage in SCTG group was 78.5 %.The number of fully satisfied patients and satisfied patients in both SCTG and ADMA groups showed no statistically significant difference ($p > 0.05$). It was of great importance that there was no unsatisfied patient of the treatment outcome in both SCTG and ADMA groups. Regarding the total satisfaction percentage of SCTG and ADMA groups, there was a modest increase of the satisfaction % in SCTG compared to ADMA. However; there was no statistically significant difference between both groups ($p > 0.05$).

Discussion

Denuded root surfaces especially in the anterior region of the mouth pose a significant aesthetic problem; hence predictable coverage of denuded roots has been one of the most important goals of periodontal plastic surgery [16]. Different root coverage techniques have been already suggested; namely, free gingival graft, double papilla graft, sliding flap, coronally positioned flap and subepithelial connective tissue graft. The aforementioned techniques could be combined with the use of various guided tissue

regeneration membranes, various growth factors or enamel matrix derived proteins [17,18].

Though subepithelial connective tissue graft (SCTG), known as the gold standard, provides a higher rate of predictability and acceptable aesthetic with a high percentage of root coverage, its limitation such as the limited amount of available graft and the existence of two surgical sites leads to more inconvenience, pain and bleeding from the patient [19].

Recently, the use of acellular dermal matrix allograft (ADMA) has been proposed as a promising technique to obtain satisfactory root coverage. ADMA is an acellular, non-immunogenic cadaveric human dermis; the epidermis and all dermal cells are eliminated through chemical procedures and the bioactive matrix is preserved and freeze-dried. Through cell elimination, infection resources, disease transfer and immunologic responses are deleted. As a result, the integrity of acellular matrix is preserved and the inflammatory responses are prevented [20].

The principal objective of the current study was to clinically compare the effectiveness of acellular dermal matrix allograft (ADMA) in the treatment of Class I and Class II gingival recession in comparison to the subepithelial connective tissue graft (SCTG).The results of the present study showed that both treatment modalities (SCTG &ADMA) significantly improved all clinical parameters evaluated from baseline to 3 month after complete healing, with the exception of probing depth (PD) that did not significantly decrease in either group. However, this particular finding related to the probing depth was expected and justified as the baseline PD in our patients was compatible with a healthy gingival condition. This result is similar to findings revealed in other clinical studies [21,22].

In the present study, the mean clinical attachment level (CAL) reduced significantly in both SCTG and ADMA groups within the same range. The gain in attachment level in SCTG and ADMA groups was not statistically significant between both groups. These finding were in agreement with previous investigations [23-25].

It was demonstrated in the current study that significant reductions of the gingival recession width (GRW) and gingival recession length (GRL) were observed after 3 months compared to baseline in both SCTG and ADMA patients. These findings are consistent with results obtained by others [26]. However, the observations reported by Sadat and his colleagues were noted after 6 months follow-up.

Our present study also showed that SCTG and ADMA were effective in root coverage leading to 83.3% and 80.2% root coverage in a 3 month period, respectively. The reduction in gingival recession and the amount of root coverage (RC %) in SCTG group was almost equivalent to the ADMA in the present study, though SCTG showed slightly better results. Although clinically SCTG was slightly better, there was no statistically significant difference between the two groups, indicating that both SCTG and ADMA equally improved the clinical outcome from baseline. These results are consistent with the previous studies where in both SCTG and ADMA were found equally effective in the treatment of gingival recession and achieving adequate root coverage and esthetics [27-30].

In a clinical split mouth study, the mean recession coverage percentage showed 86.6% in SCTG sites and 84.2% in ADMA sites [31]. These results are in accordance with our findings; however, we did not use the split mouth design in the current study because most individuals enrolled in our study did not have multiple recession sites to adopt this study design (except 2 cases out of 14 cases).

Earlier studies observed that 99% root coverage occurred in SCTG group and 95% for ADMA group [23]. It is obvious that the recession coverage in this study showed higher percentage than that observed in our results. The variation in this study could be explained due to the large sample size used and the selected recession defects were all single maxillary defects.

However; in another study, it was found that SCTG and ADMA root coverage were 86% and 71% in a 6 month period, respectively, which used a small sample size as in our present study [26]. Our study showed better outcome in ADMA group regarding the root coverage percentage compared to Sadat and his colleagues study, however; our assessment period was after only 3 months.

It was found that the root coverage in both the treated groups in SCTG group was 97% and in ADMA group was 94% [24]. In this study, more number of patients was also used and only anterior teeth involved. However, the successful treatment outcome of SCTG and ADMA groups does not show any statistically significant variation between both groups and this comes in agreement with our findings. It is clear in our study that the use of an acellular dermal matrix allograft (ADMA) has shown results comparable to SCTG which is considered the gold standard in terms of successful root coverage [28].

It was reported that the mean percentage of defect coverage at 3month in SCTG cases was 83.1% which was reduced to 74.9% after 6months, with a range of 50-100%. This showed a mean reduction of 9.8%. The mean percentage of defect coverage for ADMA at 3 months was 72.8% and lasted without any change at 6 months evaluation, with a range of 67-100% [25]. The overall result exhibited that the difference between the two different treatment modalities was statistically not significant and this comes in agreement with our findings.

In the present study, it was noticed that after rehydrating the ADMA for 20 minutes, the handling characteristics were similar to the natural connective tissue harvested from the palate in the SCTG. This observation was also noted in previous similar studies [16,19].

In 2006, investigators reported that the root coverage percentage in SCTG and Alloderm groups were 70% and 72%, respectively [18]. In another study by Barros and his co-workers, the root coverage obtained with the SCTG decreased from 60% at 1 year to 58% at 3 years; while for the ADMA it remained stable around 83% over 3 years [32].

Results of these studies exhibited lower root coverage percentage in comparison to our findings. This might be due to the diversity of sites treated in this study between posterior and anterior teeth in both upper and lower jaws and also the long term assessment which extended for 3 years. However, in a case report, it was shown that after

treatment of a gingival recession with an acellular dermal matrix allograft (ADMA), the gingival margin had remained stable after 10 years. Moreover, the gingival margin had shifted coronally from 6 months after surgery and during the follow-up period [33].

In a 6-month and 12-month evaluations [32,34], it was concluded that an extended flap (new technique) is more suitable for the treatment of localized gingival recessions with the ADMA when compared with the conventional SCTG flap design. It was revealed that the new surgical approach fulfills the allograft's extravascular supply requirement. It is important to emphasize that the ADMA is obtained from a human donor skin tissue process that removes its cell components while preserving the remaining bioactive components and the extracellular matrix. During this process only the collagen and elastin matrices are maintained undamaged to function as a scaffold to allow in growth by host tissues [35]. Therefore, the allograft retains a non-vital structure that depends on cells and blood vessels from the recipient site to achieve reorganization [36]. In fact, ADMA is totally incorporated inside the tissue with no absorption or exfoliation [27].

In contrast, the healing and revascularization of an autograft is also based on the anastomoses between blood vessels of the gingival corium and those preexisting in the graft [37,38].

In our study, we used ethylenediaminetetraacetic acid (EDTA) as a root conditioning agent after thorough SRP in both SCTG and ADMA groups before placement of the graft to increase the success rate of the procedures performed. It was proved that scaling and root planing (SRP) are effective in removing the bacterial deposits and accretions as well as in removing endotoxins from the exposed root surface [39].

However, it is not possible to completely decontaminate a periodontitis-affected root surface by mechanical means alone [40]. The instrumented surface will inevitably be covered by a smear layer which is produced by most forms of root manipulation and could potentially affect fibroblast adaptation in the healing of periodontal wound [41]. This smear layer contains remnants of dental calculus, contaminated root cementum and subgingival plaque which act as a physical barrier between periodontal tissues and root surface, thus inhibiting the formation of new attachment [42]. Furthermore, the smear layer is resistant to saline rinsing [41,43].

Thus, root conditioning has been recommended as an adjunct to mechanical root surface debridement to remove smear layer and root associated endotoxins and to expose collagen fibers on the dentin surface [44]. Root conditioning helped in the removal of smear layer, exposure of dentinal tubules and also widening of dentinal tubules. The use of EDTA in clinical practice may be considered beneficial given its neutral pH and high efficacy in removing the smear layer and other toxins from the root surface [45].

In the present study, the mean width of keratinized tissue (WKT), increased from (3.14±1.07)mm to (5.51±0.95) mm in SCTG group and (3.32±1.14)mm to (5.34±0.67) mm in ADMA group. These values were statistically significant post-operatively in both groups. These results were the same as findings observed by others [18,24-26,32,46].

Although in a short-term study, keratinized gingiva (KG) increased as 1 mm and 2.6 mm for Alloderm and SCTG groups, respectively, revealing a significant increase only for SCTG group [47]. It should be noted that the aforementioned study was not a blind type and SCTG was used for cases with less keratinized tissue. In order to explain less amount of KG in the Alloderm group compared to the SCTG group, Wei and collaborators, in their histologic investigation of two techniques, mentioned that ADMA is not able to induce an appropriate keratinization in the epithelial cells. They believed that the difference could be attributed to considerable shrinkage of ADMA during the healing phase [48].

The possible effect of ADMA in increasing the amount of keratinized gingiva is not clear. It is known that epithelialization of connective tissue graft available from keratinized donor sites results in keratinized epithelium via an induction mechanism. Logically, the ADMA graft taken from keratinized skin could present the same induction ability [18].

According to Shin and Mahajan studies, the iodine test has not been used to evaluate KG in their studies. The distance between mucogingival junction and gingival margin has been measured and recorded visually [49,50], and this is similar to the methods adopted in our study. So, similar values of attached gingiva and KG have been obtained.

In the present study, the Alloderm basement membrane, in correspondence with other studies [22,26,28,32,46,50] was placed toward the tooth and bone. The most important reason according to Tal and his co-workers would be that the connective tissue matrix of Alloderm is placed toward the connective tissue of the covering flap causing vascularization in this way [22], although others claimed that a root coverage of 93% could be achieved apart from Alloderm direction [51].

Periodontists, who reported less root coverage in their investigation, found that the direction of the connective matrix was toward the flap [46]. While in another study, its direction was toward the root [29].

It was observed in previous literature that very few studies, conducted on the surgical approaches concerned with the correction of gingival recession, have dealt with the aesthetic satisfaction of the patients after surgery. Thus, in the present study, we recorded the patient satisfaction scores and their percentages in both SCTG and ADMA patients to evaluate this missed aspect in most previous studies. We adopted the model proposed by Mahajan and his colleagues in our study [15]. Our results showed that the total satisfaction percentages in SCTG and ADMA groups were 85.7% and 78.5%, respectively. However; there is modest increase of the satisfaction score of the SCTG group over ADMA group, there is no observed statistically significant difference between both groups. This observation comes in agreement with Mahajan's study.

It was observed from this present study that one of the advantage of ADMA is that the need for palatal donor material is eliminated which reduces postoperative morbidity. In addition, it provides an unlimited supply of graft material, thus permitting multiple site root coverage

that can be extended for a sextant, quadrant, or even a full mouth arch at one time.

Moreover, other advantage of ADMA was an excellent tissue colour match obtained. Although there was no attempt to objectively evaluate colour match in this investigation, however, the effect was clearly seen clinically. The root coverage obtained by both procedures, although, was satisfactory. Patient's satisfaction was especially observed with the use of ADMA as most of the patients were treated with aesthetic request.

One of the limitations of the present study is obviously the small number of the patients selected to conduct this investigation and the short follow up period. It was also clear that the split-mouth design in such studies is better than dealing with different groups of patients who have inherent individual variations. Another limitation which is difficult to accomplish in human studies, is the histological evaluation of the acellular dermal matrix allograft (ADMA). The last limitation is the high cost of the material if used in treating multiple recession defects.

Regardless of these limitations, it seems from the promising results of the current study that ADMA could be an equal alternative to the subepithelial connective tissue graft (SCTG). Thus, we recommend conduction of large scale clinical studies using ADMA and planning it with longer follow-up periods. Animal studies also are recommended for histological evaluation of this new graft material.

Conclusion

It was concluded from the current study that:

1Acellular dermal matrix allograft (ADMA) could be considered as an excellent alternative to subepithelial connective tissue graft (SCTG) in treating Miller's class I and II gingival recession defects.

2 ADMA eliminates the need for a second surgical site and permits the one-stage treatment of an unlimited number of defects.

3 SCTG and ADMA group showed mean root coverage of 83.3 % and 80.2 % of the recession defects, respectively at 3 months postsurgically.

4 ADMA gives significant clinical attachment gain and pronounced increased width of keratinized gingiva comparable to SCTG, which is considered the gold standard technique.

5 ADMA has easy and good handling characteristics after rehydration and gives excellent color matching with the surrounding tissues.

6 ADMA did not induce any allergic or inflammatory responses in the recipient sites treated. Hence, it is a well-tolerated graft material.

Figure 1: ADMA group (A) showing Class I Miller's gingival recession related to right mandibular 1st premolar tooth preoperatively. (B) Case 2 after 3 months of complete healing. (C) Insertion of acellular dermal matrix allograft (AlloDerm) in sterile saline to rehydrate for 20 minutes before placement under the surgical flap.

Figure 2: SCTG group (A)Preoperative clinical photograph of Case 5 showing class I Miller's recession defect related to lower left central incisor (This case is assigned to perform subepithelial connective tissue graft). (B)Clinical photograph of Case 5 showing dissection and separation of the subepithelial connective tissue graft (SCTG). (C)Clinical photograph of Case 5 after 3 months.

Table 1: Demographic characteristics of individuals enrolled in the study

Parameter	SCTG (n=7)	ADMA (n=7)
Age(M±SD)(years)	31.6±5.9	29.3±6.9
Age range (years)	23-40	22-42
Gender (M/F)	2/5	3/4

Table 2: Mean (± SD) values of Plaque Index (PI), Gingival Index (GI) and Papillary Bleeding Index (PBI) at baseline and after therapy of SCTG and ADMA patients.

Para-meter	SCTG		ADMA		*P*-value
	Baseline	**3 months**	**Baseline**	**3 months**	
PI	0.67±0.10	0.79 ±0.10	0.66±0.12	0.81±0.15	NS
GI	0.22±0.11	0.24±0.13	0.23±0.12	0.26±0.11	NS
PBI	0.65±0.08	0.66±0.16	0.63±0.10	0.64±0.15	NS

NS = Not significant

Table 3: Mean (± SD) values of Probing Depth (PD) and Clinical Attachment Level (CAL) in millimeter (mm)at baseline and after therapy of SCTG and ADMA patients.

Para-meter	SCTG (mm)		ADMA (mm)		*P*-value
	Baseline	**3 months**	**Baseline**	**3 months**	
PD	0.57 ± 0.53	0.71 ± 0.49	0.61 ± 0.42	0.86 ± 0.38	NS
CAL	3.86 ± 0.90	1.29 ± 0.76*	3.71 ± 0.76	1.36 ± 0.65	< 0.001

∗ p = Highly significant difference, NS = Not significant**.**

Table4: Mean (± SD) values of Gingival Recession Width (GRW) and Gingival Recession Length (GRL) measured in mm at baseline and after therapy of SCTG and ADMA patients.

Para-meter	SCTG (mm)		ADMA (mm)		*P*-value
	Base-line	**3 months**	**Base-line**	**3 months**	
GRW	2.7±0.48	1.02±0.70*	2.65±1.50	1.1±0.54*	< 0.001
GRL	2.59±0.76	0.57±0.53*	2.86±0.69	0.64±0.63*	< 0.001

∗ p = Highly significant difference

Table 5: Mean (± SD) values of Width of Keratinized Gingiva (WKG) in mm and Percentage of Root Coverage (RC %) at baseline and after therapy of SCTG and ADMA patients.

Para-meter	SCTG		ADMA		*P*-value
	Base-line	**3 months**	**Base-line**	**3 months**	
WKG (mm)	3.14±1.07	5.51±0.95*	3.32±1.14	5.34± 0.67*	0.001, NS
RC%	83.3±14		80.2±17.4		NS

∗ p = Highly significant difference, NS = Not significant

Table 6: Patient satisfaction scores and total satisfaction percentage of SCTG and ADMA groups.

Patient satisfaction score	SCTG Total score (n × patient score)	ADMA Total score (n × patient score)	p-value
Fully Satisfied (2)	5×2= 10	4×2= 8	NS
Satisfied (1)	2 ×1= 2	3× 1= 3	NS
Grand Total Score (sum of scores /14)	12/14	11/14	NS
Total satisfaction (%)	85.7 %	78.5 %	NS
Unsatisfied (0)	0 ×0= 0	0 ×0= 0	NS

NS = Not significant**.**

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