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Modified tunnel technique for management of gingival recession in esthetic zone using acellular dermal matrix versus connective tissue graft

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ABSTRACT

Gingival recession often results in major aesthetic problems. Further complaints of increased root surface sensitivity and root caries could also be encountered. Numerous techniques have been described for the management of recession. The development of the tunnel technique represents an important esthetic advancement in managing recession defects. This study was performed to compare between the use of Acellular Dermal Matrix (ADM) and connective tissue graft (CTG) under a modified tunnel technique for management of gingival recession in the esthetic zone. Sixteen Miller class I and II recession defects were equally divided for treatment with the two donor materials. Plaque index (PI), gingival index (GI), gingival recession depth (GR), clinical attachment level (CAL) and keratinized tissue width (KTW) were assessed at base line and six months postoperatively. Both groups showed significant decrease in GR and gain in CAL slightly in favor to the ADM group. However no significant difference was recorded between the two groups in any of the studied parameters. Hence, ADM can be used as an alternative to CTG having the advantage of the absence of a secondary surgical site.

1. Introduction

Establishment of an esthetic smile is the goal of modern dentistry. Recession can lead to major aesthetic problems. Recession may also be associated with increased root surface sensitivity, increased root caries susceptibility, and development of cervical abrasions. It can also impede proper plaque control. Gingival recession are more prevalent in males and is reported to increase in extent, and severity with age [1,2]. Etiologic factors that lead to the development of recession defects include gingival anatomic factors, tooth mal alignment, chronic trauma, and periodontitis [1–5].

Various surgical techniques and materials have been described for management of recession defects such as pedicle soft tissue graft [6,7], free gingival graft [8,9], suprastructure connective tissue graft (SCTG), [9–11] acellular dermal matrix allograft (ADM), [12,13] and guided tissue regeneration [14].

In 1994 Allen AL introduced the tunnel procedure for root coverage, it was termed the supraperiosteal envelope [15,16]. The tunnel technique has a minimally invasive nature since the interdental papillae are left intact and vertical incisions are not performed which results in better esthetics. This technique entailed the placement of a connective tissue graft in the tunnel. Complete graft coverage is not mandatory as long as the graft dimensions are sufficient to ensure its survival. Coronal advancement of the marginal tissue was then performed as a modification to the tunnel technique, which allowed complete graft coverage [17]. This advantage allowed the choice of acellular dermal matrix (ADM) as a graft material under the tunnel.

ADM represents an allograft of human dermis, its processing includes removal of all cells, thus minimizing the probability of graft rejection. However, the remaining extracellular matrix with its vascular channels are left structurally intact. The healing process of ADM is therefore described as tissue regeneration, where graft incorporation and replacement with host tissue takes place [18]. Introducing ADM eliminated the need to harvest palatal tissue for root coverage procedures. Therefore, its use resulted in less complications and postoperative discomfort with more patient satisfaction.

ADM placed under a coronally positioned flap have demonstrated similar results to those seen with the autogenous graft procedure regarding mean percentage of recession coverage and predictability of gaining 100% coverage [18–22]. Positive result regarding gain in keratinized tissue thickness have been reported, with healing pattern similar to autogenous grafts regarding the mode of attachment to the tooth surface [19–23]. The use of ADM under prepared tunnel has been gaining much attention and has been replacing the use of CTGs [24].

This study was performed to evaluate the effect of modified tunnel technique in the management of Miller class I and II recession defects

Keywords:
Modified tunnel technique
Gingival recession
Root coverage
Acellular dermal matrix
Connective tissue graft
Esthetic zone

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using ADM in comparison to CTG.

2. Material and methods

Sixteen Miller Class I or II recession defects (≥2 mm) in incisor, canine or premolars in 11 subjects were enrolled in the study [25]. Patients were recruited from the out-patient clinic at department of Periodontics faculty of dentistry Alexandria University. The research protocol was approved by the research ethics committee, faculty of dentistry Alexandria University. (IRBNO:00010556-IORG0008839) All patients were informed about the study protocol and signed an informed consent before agreeing to be enrolled in the study. Teeth associated with caries/restorations were excluded. Pregnant females and patients having debilitating systemic diseases, parafunctional habits or smoking were excluded from the study. Recession defects were randomly divided into two groups: Group I (8 defects) were treated with the modified tunnel technique and ADM regenerative tissue matrix, Group II (8 defects) were treated with the modified tunnel technique and a palatal connective tissue graft.

2.1. Surgical procedure

Tunnel preparation was performed to treat recession defects without any vertical releasing incisions. An initial incision was made using a # 15c surgical blade on the labial surface of the tooth with the recession defect including one tooth mesial and one tooth distal was performed. The tissue was elevated using a split-thickness incision by sharp dissection past the mucogingival junction, extending apically until adequate release was obtained to permit adequate coronal positioning. The exposed root surfaces were planed, then reshaped using smooth diamond bur. For group I the ADM group, The ADM (AlloDerm: Biohorizons, Birmingham, AL) was prepared for grafting as manufacturer’s instructions. Briefly, for rehydration it was submerged for about 30 min in 50 cc of 37°C sterile normal saline, the backing was peeled and when fully rehydrated it was positioned under the tunnel at the level of the CEJ. The flap was coronally positioned to cover the ADM. A bioabsorbable vicryl 5-0 suture was used to secure the ADM and the flap (Figs. 1–3). For group II tunnel preparation was performed, followed by harvesting a palatal connective tissue graft using trap door procedure [26]. The harvested graft was trimmed to obtain a thickness of about 1–1.5 mm. The palatal donor site was immediately sutured using a cross-mattress suture. The CTG was placed under the prepared tunnel, the flap was coronally advanced, and both the graft and the flap were sutured similar to the ADM group (Fig. 4).

2.2. Post-surgical management

Postoperative medications included: Antibiotics 1 gm tablet (Augmentin, GlaxoSmith Kline, UK) (Amoxicillin 875 mg clavulanic acid 125 mg), once every 12 h for 5 days postoperatively; Non-steroidal anti-inflammatory drugs Diclofenac potassium 50 mg tablets (Cataflam 50 mg), (Novartis, Swiss multinational pharmaceutical company, Novartis, New Jersey) every 8 h for 5 days, chlorhexidine HCL (0.12%) mouth wash (Hexitol), the Arab Drug Company, Cairo, ARI) three times daily for 2 weeks. Sutures were removed two week post-operatively. All subjects were checked weekly for 2 weeks, then every 2 weeks for a period of 2 months, and then monthly for the remaining follow up period. Postoperative visits included oral hygiene reinforcement and supra-gingival plaque removal when needed.

2.3. Clinical assessment

The following baseline data were obtained: Miller classification of the recession defect, plaque index (Pl) [27], gingival index (G1) [28], gingival recession (GR) measured as the distance from the gingival margin to the CEJ, clinical attachment level (CAL), keratinized tissue width (KTW) measured as the distance from the mucogingival junction (MGJ) to the gingival margin. All probing measurements were recorded in millimeter (mm) at the mid-facial point of teeth with recession. To avoid interference with wound healing, clinical parameters were recorded at baseline and 6 months post-surgically.

2.4. Statistical analysis

IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) was used to analyze collected data. The Kolmogorov-Smirnov test was performed for validation of the normality of distribution of variables. Mann Whitney test was used to compare between two groups for not normally distributed quantitative variables, While Wilcoxon signed ranks test was used to compare different periods. Significance was judged at the 5% level for the obtained results.

3. Results

All patients tolerated the surgical procedures well. There were no postsurgical complications in the ADM group. However, the CT graft group seemed to have more postoperative discomfort with one case showing ulceration of the flap at the donor site.

3.1. Clinical indices

The mean plaque index was initially low for both groups (0.6 ± 0.3) and decreased slightly by 6 months to reach (0.3 ± 0.40 and 0.4 ± 0.3) for the ADM and the CTG groups respectively. The mean gingival index was (0.5 ± 0.5 and 0.4 ± 0.4) initially for the ADM and CTG groups respectively and remained at about the same level at 6 months (0.4 ± 0.4) for both groups. No statistically significant differences was detected between the initial and 6-month

![Fig. 1](https://digitalcommons.aauu.edu/fdj/vol5/iss2/1)
values or between the groups for both clinical indices (P > 0.05) (Table 1).

3.2. Probing measurements

Both treatment modalities demonstrated significant improvement in GR depth and CAL gain, in comparison to baseline. The mean labial recession depth at the initial examination for the ADM group was 2.9 ± 0.8 mm, which decreased to reach 0.4 ± 0.5 mm at 6 months with a percent of defect coverage of 84.4 ± 22.9. For the CTG group, the mean initial recession was 3.1 ± 1.0 mm, which was reduced to 0.6 ± 0.7 mm at 6 months with a percent of defect coverage of 79.8 ± 25.9. No statistically significant differences was detected between the groups. The mean clinical attachment level was located more apically initially (4.0 ± 1.4 and 3.5 ± 0.9 mm), but improved significantly by 6 months to (0.9 ± 1.1 and 1.0 ± 1.2). Mean Keratinized tissue width was initially (3.0 ± 1.1 and 2.9 ± 1.1 mm) and increased to (3.5 ± 1.2 and 3.4 ± 1.1 mm) for the ADM and CTG groups respectively, this increase was significant for the CTG group. However, the difference between the groups was not statistically significant (P > 0.05) (Table 2).

4. Discussion

Treatment of gingival recession and reestablishment of mucogingival complex integrity represents a great challenge. Attempts of root coverage by raising an envelope flap can lead to altered esthetics [29]. The minimal invasive nature of the tunnel technique eliminates possible papillary recession that can occur due to flap reflection and maximizes the papillary and lateral blood supply to the wound area [30]. The current study was performed to evaluate management of Miller Class I and II recession defects by the modified tunnel procedure using ADM in comparison to CTG.

The results presented in this study show that both ADM and CTG yield significant reduction in GR and gain in CAL. The percent of root coverage and the gain in CAL were slightly in favor of the ADM group than the CTG group. Nevertheless, these differences were not statistically significant, indicating that ADM and SCTG are equally effective in the treatment of GR. These findings are in accordance with previous studies which reported significant clinical improvement in root coverage using the two different donor materials [31–33].

Recession coverage obtained by ADM represented 84.4% in accordance to the mean root coverage obtained in another study using

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### Table 1

Comparison between the two studied groups according to plaque index and gingival index.

<table>
<thead>
<tr>
<th></th>
<th>ADM (n = 8)</th>
<th>CTG (n = 8)</th>
<th>U</th>
<th>p</th>
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<tbody>
<tr>
<td>Plaque index</td>
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<tr>
<td>Baseline</td>
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<td></td>
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<tr>
<td>Median (Min. – Max.)</td>
<td>0.5(0.3–1.0)</td>
<td>0.5(0.0–1.0)</td>
<td>31.0</td>
<td>0.914</td>
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<tr>
<td>Mean ± SD.</td>
<td>0.6 ± 0.3</td>
<td>0.6 ± 0.3</td>
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<tr>
<td>6 months follow up</td>
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<tr>
<td>Median (Min. – Max.)</td>
<td>0.3(0.0–1.0)</td>
<td>0.4(0.0–1.0)</td>
<td>29.0</td>
<td>0.745</td>
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<td>Mean ± SD.</td>
<td>0.3 ± 0.4</td>
<td>0.4 ± 0.3</td>
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<tr>
<td>Z(p)</td>
<td>1.223(0.068)</td>
<td>1.29(0.194)</td>
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<tr>
<td>Gingival index</td>
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<td>Baseline</td>
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<td>Mean ± SD.</td>
<td>0.5 ± 0.5</td>
<td>0.4 ± 0.4</td>
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<td>0.3(0.0–1.0)</td>
<td>31.0</td>
<td>0.913</td>
</tr>
<tr>
<td>Mean ± SD.</td>
<td>0.4 ± 0.4</td>
<td>0.4 ± 0.4</td>
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<tr>
<td>Z(p)</td>
<td>0.343(0.732)</td>
<td>0.105(0.915)</td>
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</table>

U: Mann Whitney test.

p: p value for comparing between the two groups.

Z: Wilcoxon signed ranks test.

{* p value for comparing between Baseline and 6 months follow up.

*: Statistically significant at p ≤ 0.05.
ADF which was 82.5% [34]. Other studies achieved ≥ 90% mean recession defect coverage using coronally displaced flap plus ADM [35,36]. On the other hand a study reported 78% root coverage when ADM was used with the tunnel technique [17]. Variation in the obtained results could be attributed to the influence of different factors that may affect the success of treatment including; root surface characteristics the type of defect, the surgical technique, and the host conditions (e.g., muscle pulls and smoking habits) [37,38].

Both treatment groups showed initially low plaque and gingival indices, that remained low throughout the study period. Oral hygiene compliance and proper patient selection contributed to the good results obtained by this study. Regarding keratinized tissue width, significant increase was observed for the CTG group. Both groups gained an increase of 0.5 mm with no significant difference between the two treatment procedures. It has been reported that ADM has increased the keratinized tissue width from 0.4 to 2.2 mm in different studies [39-42]. Thomas et al. reported a greater increase in the width of keratinized gingiva in the CTG group [43]. On the other hand a recent systematic review and meta-analysis found that ADM had a small but statistically significant advantage in terms of keratinized tissue width [44,45]. However, there was no statistically significant difference between the use of ADM and CTG in terms of mean root coverage, percent root coverage, and mean gain in clinical attachment as reported by the same systematic review [44]. Hence, in light of the results of the present study and the reported results, patients with gingival recession will benefit from the use of ADM in a comparable way to the gold standard of CTG [45].

The use of ADM however, has an additional advantage over the CTG that permits the treatment of many multiple recessions without the anatomical limitations of the patient's palate. In addition the uniform dimensions of the ADM makes it amenable to use with the tunnel technique. Additionally, the modified tunnel technique reduces the time of surgery and introral surgical sites and satisfies the patient's esthetic demand, which include final color, scars, and tissue harmony of the grafted area site [46].

ADM serves as an architectural scaffold to facilitate the migration of and repopulation by the host's fibroblasts, blood vessels, and epithelial cells [47]. As healing proceeds ADM is replaced by and fully integrated into the host tissues [48]. Since ADM relies entirely on the migration of host cells and vessels for nutrition and repair, its direct contact to the flap is crucial, and thus, it requires complete coverage. It has been reported that exposure of ADM may result in partial failure of the graft [49]. However, noteworthy, in one of the study cases (Fig. 1) the exposed ADM did not cause adverse result. It increased keratinized tissue width; where it was either totally replaced by host tissue or it was compensated by creeping attachment.

Unlike ADM, CTG healing takes place through anastomoses between the graft's vessels and those of the host tissue [50]. Hence, complete graft coverage is not mandatory. Although healing in both CTG and ADM occurs through a different process, both techniques result in an interface which consists of a long junctional epithelium at the coronal part and connective tissue attachment apically. Núñez et al. found regeneration with newly formed cementum and alveolar bone in both graft types in an experimental study [47]. Hence, comparable clinical and histologic data for both ADM and CTG suggest a wider use of ADM for root coverage owing to its ease of manipulation and material availability. In light of, the aforementioned studies and the current study, the use of ADM under a modified tunnel technique is an effective treatment availability for management of recession defects yielding comparable results to those obtained by the CTG.

References


