Clinical Comparison of Subepithelial Connective Tissue Grafts and Coronally Advanced Flaps with Emdogain in the Treatment of Gingival Recessions

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Abstract:

Objective: The aim of this study was to compare subepithelial connective tissue grafts (SCTG) and coronally advanced flaps (CAF) with the addition of Emdogain in the treatment of gingival recession.

Materials and Methods: This interventional randomized controlled clinical trial involved eleven patients and 31 teeth demonstrating facial recessions of ≥ 2 mm identified as Miller’s class I or II. Recession depth (RD), recession width (RW), probing depth (PD), clinical attachment level (CAL), and keratinized tissue (KT), were measured at baseline and at 4, 12 and 24 weeks postoperation. Before surgery the samples were randomized to receive either a CAF with Emdogain (test group) or a connective tissue graft (control group). Data were analyzed using independent t-test and univariate analysis of variance.

Results: Twenty-four weeks after therapy, the mean root coverage in the test and control cases was 50.24% and 65.82%, respectively. There was no significant difference between the two groups (P=0.759). Within the 24-week follow-up period both procedures resulted in statistically significant improvement in RD, RW and CAL, but not in PD. KT increased 0.7 mm in the SCTG group while it decreased 0.5 mm in the Emdogain group (P<0.05).

Conclusion: The SCTG procedure provided better results in comparison to CAF with Emdogain. However the later method is easier and less technique-sensitive. Therefore it can be considered as a possible substitute for the treatment of gingival recessions, especially when increasing KT is not required.

Key Words: Enamel matrix derivative; Sub-epithelial connective tissue graft; Gingival recession; Root coverage

INTRODUCTION

Gingival recession is a common multifactorial condition associated with anatomical, physiological or pathological factors. This phenomenon is characterized by the apical migration of the gingival margin beyond the cemento-enamel junction (CEJ) [1], and can involve a single tooth, a group of teeth or even the whole mouth [2]. Root exposure poses esthetic problems and may lead to root sensitivity, root caries and cervical abrasions [3,4]. Several surgical procedures have been suggested for the treatment of gingival recession such as pedicle graft (PG), free gingival graft...
(FGG), connective tissue graft (CTG), and guided tissue regeneration (GTR) [5].
The subepithelial connective tissue graft (SCTG) introduced by Langer and Langer in 1985, achieved a high success rate by combining the advantages of both free gingival and pedicle grafts [6,7]. This technique has been proposed as “Gold standard”, as far as predictability and esthetics are concerned [8]. However harvesting the graft from a donor site results in an additional wound site leading to post-surgical pain and discomfort for the patient [9,10].

Treatment of exposed roots with coronally advanced flaps (CAF) is considered as a relatively easy method that can produce optimal results. In contrast to connective tissue grafts, CAF does not require a second surgical site, therefore is more acceptable for the patient. Mean root coverage of 55% to 99% has been reported for CAF [11].

A new material composed of Enamel Matrix Derivative (EMD) has been recently introduced as a novel approach to regenerative therapy [12-14]. It contains several enamel matrix-derived proteins, primarily amelogenin, which is harvested from embryonic porcine teeth. This material has been claimed to mimic the function of enamel matrix proteins secreted by the inner layer of Hertwig’s epithelial root sheath. [15]. Clinical studies have shown the possibility of combining EMD with root coverage procedures, especially CAF, to achieve root coverage and periodontal regeneration on previously exposed root surfaces [16]. The aim of the current investigation was to assess the clinical efficacy of a coronally advanced flap procedure with the addition of EMD for the treatment of gingival recession and to compare it to the subepithelial connective tissue graft method.

MATERIALS AND METHODS
This randomized controlled clinical trial involved twelve individuals (5 females and 7 males), with an age range of 24 to 45 years (mean, 35 years) referred to the Department of Periodontology, Tehran University of Medical Sciences. All patients suffered from complications of root exposure including root sensitivity, root caries, esthetic problems etc. A total of 31 teeth with gingival recessions were classified as Miller’s class I and II defects with recession depths of ≥2 mm. Signed informed consents were obtained from all participants. Inclusion criteria required that the patient had at least 2mm keratinized gingiva on the buccal aspects of the involved teeth and no contra-indications for periodontal surgery.

The exclusion criteria included, systemic disease; history of allergic reaction to the materials used in the study; history of periodontal surgery on test or control sites; tobacco use; pregnancy; poor oral hygiene; caries or buccal restorations on test or control sites; pathologic mobility of teeth and uncooperative patients.

All participants received instructions on oral hygiene and proper tooth brushing until they demonstrated satisfactory plaque control (achieving a modified O’Leary plaque index score of 15-20%) [8]. Pre-surgical preparation included scaling, root planning and occlusal adjustment when needed.

Using a millimeter graded Williams style periodontal probe (Hu-friedy Co., U.S.A), the following measurements were recorded by a single blinded examiner (not the operator) at baseline and at 4, 12 and 24 weeks after surgical treatment:

Recession width: width at the coronal extent of the recession, measured from mesial to distal at the CEJ level.
Recession Depth: depth of the gingival defect, measured from the CEJ to the most apical extension of the gingival margin.
Probing Depth: measured from the gingival margin to the bottom of the sulcus.
Keratinized Tissue: measured from the gingival margin to the mucogingival line (MGL), determined by the Rolling test.
Clinical Attachment level: measured from the CEJ to the bottom of gingival sulcus.

The samples were randomly allocated into either test or control groups, before surgery. Antisepsis of the oral cavity was accomplished for each patient before surgery using 0.2% Chlorhexidine digluconate mouthrinse (Shahre Daroo lab, Iran). The procedures were the same for both groups, except that the control group received connective tissue grafts, while the test group received enamel matrix derivatives. Following local anesthesia, root planning was performed on the exposed root surfaces using hand instruments. An intrasulcular incision was made with a #15C blade on the buccal aspect(s) of the involved tooth/teeth. All incisions extended horizontally into the adjacent interdental areas starting at the CEJ of the tooth with recession, to the CEJ of the adjoining teeth. The adjacent papillae were only partially involved and the soft tissues were preserved so that the buccal gingival margins of the adjacent teeth were left intact. When recession involved multiple teeth, additional horizontal incisions were made, parallel to the CEJ of the adjacent teeth with the recession.

A partial-thickness flap was raised following two oblique apically diverging incisions extending from the mesial and distal aspects of the intrasulcular buccal incision beyond the muco gingival junction. A horizontal dissection was performed at the base of the flap to allow tension-free coronal displacement. Interdental papillae were de-epithelialized to create a bleeding connective tissue bed.

The control group was treated with connective tissue grafts, which were taken from the palate in the bicuspide region on the same side as the recipient bed. After the palatal area was anesthetized, a horizontal incision was placed 4 mm from the free gingival margin and extended in correspondence with the dimensions of the recipient site. Two parallel internal vertical incisions, one superficial and one deep, were made and connected mesially and distally. The underlying connective tissue was released at its base and after removal it was shaped to fit the recipient site. For suturing, 3–0 silk sutures and 4-0 bioabsorbable polyglactine 910 were used in the palate and recipient site, respectively (Fig. 1).

In test group, all root surfaces were irrigated and then conditioned with 24% Ethylene De Amine Tetra Acetic Acid (EDTA) gel for 2 minutes to remove the smear layer and to obtain a surface free of organic debris. This was followed by rinsing with water and drying with a gauze sponge. They were then covered with a coronally positioned flap and sutured with 4-0 bioabsorbable polyglactin 910 (Supa). This was followed by application of EMD using its syringe needle starting from the most apical point of the root to the CEJ (Fig 2).

After placing the EMD and SCTG on the exposed root area, the graft was secured against the tooth/teeth with sling sutures (4-0 bioabsorbable polyglactin 910 suture), at the CEJ level. The flaps were coronally positioned to cover the grafts using the same sutures. Finally, the releasing incisions were closed with interrupted sutures and periodontal dressing (Coe
A 0.2 % chlorhexidine mouthwash was prescribed twice daily for 2 weeks (each time for one minute), and analgesics were to be used as needed (Ibuprofen 400 mg Q.I.D). The periodontal dressing and sutures were removed from the palate after 10 days. Patients were advised to avoid excessive tooth brushing or trauma to the treated area during the first 6 weeks. Afterwards, the subjects were instructed to perform the roll brushing technique with a soft toothbrush.

The participants were recalled every 2 weeks until 8 weeks and then once a month until 6 months. All measurements were repeated 4, 12 and 24 weeks after surgery. Statistical analysis was performed using \( t \)-test, and univariate analysis of variance.

RESULTS
A total of 31 teeth including 6 incisors, 10 canines, 9 first premolars and 6 second premolars constituted the study sample. Seventeen teeth were on the right side and 14 were observed between the two groups with respect to gender (P= 0.24).

Table 1: Recession Depth (mm) before and after surgical intervention.

<table>
<thead>
<tr>
<th>Group</th>
<th>Teeth (n)</th>
<th>Baseline</th>
<th>4</th>
<th>12</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMD</td>
<td>16</td>
<td>3.09 (0.95)</td>
<td>1.34 (1.09)</td>
<td>1.25 (1.03)</td>
<td>1.59 (1.06)</td>
</tr>
<tr>
<td>SCTG</td>
<td>15</td>
<td>3.4 (1.41)</td>
<td>1.2 (0.9)</td>
<td>1.13 (0.74)</td>
<td>1.13 (0.83)</td>
</tr>
<tr>
<td>P-value</td>
<td>-</td>
<td>-</td>
<td>0.006</td>
<td>0.008</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Values in parentheses are standard deviation.

The mean (SD) age in the EMD (test) and SCTG (control) groups were 41.21 (5.88) and 36.68 (4.65), respectively. The difference was not statistically significant. (P= 0.233).

The mean root coverage (RC) between 1 and 6 months was 57.4% (33.71) in the test group and 63.76% (27.92) in the control group. At the final recording (24 weeks), the mean RC in the EMD and SCTG groups were 50.24% (27.48) and 65.82% (34.07), respectively. According to Levene’s test for equality of variance no significant difference was found between the two groups at 12 or 24 weeks post-surgery.

In the test and control groups, complete root coverage was achieved in 4 out of 16 (25%) and in 4 out of 15 (26.66%) teeth, respectively. At 24 weeks follow up, Recession Depth (RD) decreased 1.5 (0.83) mm in the test group and 2.26 (1.3) mm in the control group. RD changes were significantly different between the two groups; and also among the measurements obtained at 4, 12 and 24 weeks post-surgery (Table I, Fig. 3). In the test group, Recession Width (RW) decreased 1.37 (1.36) mm while a reduction of 2 (1.69) mm was seen in the control group at the final recording. The changes of RW were not statistically significant between the test and control groups, at all time intervals.

Keratinized tissue (KT) changed from 4 (1.58) mm to 3.5 (1.68) mm and changed 0.5 (0.89) mm in the test group and from 1.93 (1.27) mm to 2.63 (1.07) mm and differed 0.7 (0.13) mm in the control group. During the 24-week follow-up, KT increased in the control and decreased in the test sites, which showed a
significant difference (Table II). A significant difference in KT was also observed between the two groups at all time periods.

In the test group, Clinical Attachment Level (CAL) decreased from 7.09 (1.57) mm to 5.09±1.31 mm, a total of 2 (1.47) mm reduction throughout the study period whereas a total reduction of 1.56 (1.49) mm was observed in the control sites. A statistically significant difference in reduction was found between the two groups. (Table III)

At 24 weeks post-surgery, Probing Depth (PD) changed from 1.75 (1.06) mm to 1.03 (0.28) mm, and from 1.93 (1.34) mm to 1.46 (0.48) mm in the test and control sites, respectively. According to these results, PD remained shallow and showed a small decrease from baseline to 24 weeks after surgery in both groups (P>0.05).

The mean changes of PD did not reveal significant differences between the two groups in any of the follow up intervals.

**DISCUSSION**

This interventional randomized controlled clinical trial compared the clinical efficiency of a CAF method with the additional use of EMD (test), and SCTG (control) in patients with recession type defects. Recession depth (RD), recession width (RW), probing depth (PD), keratinized tissue (KT), and clinical attachment level (CAL) were measured in this study. The SCTG procedure was considered as the “gold standard” because of its predictability and acceptable esthetic results. The CAF procedure with the use of EMD is a relatively easy and effective technique, with the advantage of avoiding a second surgery at the donor site. Therefore patients experience less morbidity, especially compared to connective tissue graft surgeries [9,11,15]. Data from the present study revealed a significant improvement in RD from baseline to 24 weeks postsurgery (1.5 mm for the EMD group and 2.2 mm for the SCTG group). This corresponds to about 50.24% root coverage (RC) for EMD cases and 65.82% for patients receiving SCTG. The difference was not significant but RC was slightly superior in the control group. In fact the results from RD measurements in all the follow up intervals were better in the SCTG group.

**Table II:** Mean (SD) keratinized tissue (mm) before and after surgical intervention.

<table>
<thead>
<tr>
<th>Group</th>
<th>Teeth (n)</th>
<th>Baseline</th>
<th>4</th>
<th>12</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMD</td>
<td>16</td>
<td>4 (1.58)</td>
<td>3.84 (1.94)</td>
<td>3.4 (1.55)</td>
<td>3.5 (1.68)</td>
</tr>
<tr>
<td>SCTG</td>
<td>15</td>
<td>1.93 (1.27)</td>
<td>3.83 (1.06)</td>
<td>3.26 (1.27)</td>
<td>2.63 (1.07)</td>
</tr>
<tr>
<td>P-value</td>
<td>-</td>
<td>-</td>
<td>0.002</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Table III:** Mean (SD) Clinical Attachment level (mm) before and after surgical intervention.

<table>
<thead>
<tr>
<th>Group</th>
<th>Teeth (n)</th>
<th>Baseline</th>
<th>4</th>
<th>12</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMD</td>
<td>16</td>
<td>7.09 (1.57)</td>
<td>5.18 (1.63)</td>
<td>4.59 (1.41)</td>
<td>5.09 (1.31)</td>
</tr>
<tr>
<td>SCTG</td>
<td>15</td>
<td>5.33 (1.24)</td>
<td>5.03 (1.26)</td>
<td>4.4 (0.96)</td>
<td>3.76 (1.29)</td>
</tr>
<tr>
<td>P-value</td>
<td>-</td>
<td>-</td>
<td>0.36</td>
<td>0.015</td>
<td>0.001</td>
</tr>
</tbody>
</table>
In a similar study, McGuire and Nunn [18] reported 95.1% RC for patients treated with EMD and 93.8% for subjects receiving SCTG. They also found no significant difference between the two procedures.

Moses et al [19] indicated a significant difference in RC between the EMD (76.9%) and SCTG (84.3%) groups.

Nemcovsky et al [16] reported a 71.7% and 87% RC for EMD and SCTG cases, respectively; and showed a statistically significant difference between the two groups.

The two later studies showed a higher percentage of root coverage following application of the SCTGs. This was similar to the findings obtained in the current investigation but in contrast to those described by McGuire and Nunn [18].

Moses et al [19] and Nemcovsky et al [16] conducted multicenter studies in which the patients were treated in several centers. However, it seems that the results obtained by a single operator are more reliable than those reported by more than one practitioner. Therefore the findings of the present investigation and those reported by McGuire and Nunn [18], may be more accurate than the former multicenter studies.

Different follow-up periods may also explain the differences between the current investigation and other similar studies.

McGuire and Nunn [18] and Nemcovsky et al. [16], followed their patients for 12 months; while Moses et al [19], similar to our investigation, reported a follow-up period of 24 months.

It has been shown that the success rate of cases with shallow RDs (≤3 mm) is worse than those with deeper ones [17,20,21]. The mean baseline RD was ≥4 mm and 4.5 mm in the studies conducted by McGuire and Nunn [18] and Nemcovsky et al [16], respectively. In the current investigation the mean baseline RD was 3.2 mm in both groups. This could also be considered as another factor responsible for the different amounts of root coverage observed between our study and these two investigations.

Recently it has been shown that greater root coverage is associated with greater coronal displacement of the flap margins [20]. In the present investigation all flap margins were situated at the level of the CEJ, but in most other studies the flap margins were positioned “as coronally as possible”.

EMD is a viscous gel and the operator has limited control during its application on the root surface. This may be a logical explanation for the fact that root coverage was superior in cases treated with the SCTG technique.

Trombelli [22] suggested that the goal of RC procedures should include regeneration of the lost attachment apparatus. This includes the formation of new cementum with insertion of the connective tissue fibers, alveolar bone regeneration and recreation of a functional and esthetic morphology of the mucogingival complex.

The capability of EMD to induce periodontal tissue regeneration has been previously demonstrated [23,24]. Throughout the study period, a 2mm and 1.56 mm decrease in CAL was observed in the test and control groups, respectively; which showed a significant difference. McGuire and Cochran [25] histologically evaluated the type of attachment achieved with subepithelial connective tissue grafts and coronally advanced flaps with enamel matrix derivative. They concluded that CT attachment occurred after application of the SCTG technique while regeneration was observed following the use of EMD.

The utilization of free connective tissue grafts to increase the width of keratinized gingiva has been substantiated [26]. Various studies have also shown an increase in KT following SCTGs [27,28]. According to Bouchard [7] and Cordioli [29], the height of the grafted connective tissue (CT) that is exposed coronal
to the flap margin at the end of the surgical procedure, can positively affect the resultant keratinized tissue width. They reported less than 1mm increase in KT width when CT was completely covered by the overlying flap [7,29].

An increase in KT has been observed using the SCTG technique in studies similar to the current investigation [16,18,19]. In our study, in contrast to previous investigations, the CTG was completely covered with the recipient tissues. Incomplete coverage of CTG can induce a larger increase in the width of KT.

During the 24 week follow-up period, KT increased in the control group but showed reduction in the test group. This may be related to the flap necrosis that occurs after surgery. SCTG is a vital graft that can be revascularized even when not completely covered, but EMD needs full coverage by a flap.

It can be concluded that CTG can provide better root coverage (PCR), RW, RD and KT. However a coronally advanced flap with the addition of EMD is an easier and less technique-sensitive procedure. Therefore when increasing KT is not essential and there are no financial limitations, this method can be considered as a substitute for the treatment of gingival recessions.

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