Clinical evaluation of a porcine acellular dermal matrix for the treatment of multiple adjacent class I, II, and III gingival recessions using the modified coronally advanced tunnel technique

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Objective: To evaluate the clinical efficacy of a new porcine acellular dermal matrix (PADM) for the treatment of Miller Class I, II, and III multiple gingival recessions using the modified coronally advanced tunnel technique (MCAT). Method and Materials: Twelve nonsmoking, systemically healthy patients presenting at least two adjacent Miller Class I, II, or III gingival recessions (GR), with a minimal depth of 2 mm, were treated consecutively with MCAT in conjunction with PADM. At baseline and 12 months postoperatively, complete root coverage (CRC, eg 100% root coverage), mean root coverage (RC), recession depth, recession width, attached gingiva (AG), keratinized tissue (KT), periodontal pocket depths (PD), and clinical attachment level (CAL) were evaluated. The main outcome variable was CRC.

Results: Postoperative healing was uneventful in all cases, without any matrix loss or exposure or infection. Statistically significant improvements (P < .0001) were observed 12 months postoperatively in 53 of the included 54 GR (98.15%). Twenty two recessions (40.74%) showed CRC while the mean RC measured 73.20 ± 27.71%. Mean GR reduction was 2.06 ± 1.18 mm while the gain of AG amounted to 0.84 ± 0.73 mm and of KT to 0.69 ± 0.51 mm, respectively. There were no statistically significant changes for PD at 12 months; CAL showed a significant decrease (P < .05) at 12 months from 3.77 ± 1.28 mm to 2.30 ± 1.02 mm.

Conclusion: PADM in conjunction with MCAT may be successfully utilized for the treatment of Miller Class I, II, and III multiple adjacent GR.

Key words: clinical study, coronally advanced tunnel, gingival recession, porcine acellular dermal matrix, root coverage

When treating gingival recession defects (GR), the main goals of plastic periodontal surgery are to predictably obtain complete, long-lasting root coverage and to achieve an optimal blending of the soft tissues, thus improving esthetics. A very recent review and meta-analysis highlighted the importance of treating GR, pointing out not only the high probability of recession progression over time (78.1% of the GR showed an increase in recession depth), but also an increase in the number of GR (79.3%).¹

Successful treatment of multiple adjacent gingival recessions (MAGR) still represents a challenge for the
clinician, considering the need for coverage of a wider and more extensive avascular surface, with different recession depths (RDs) and recession widths (RWs) or tooth positions. Several authors reported successful outcomes using the coronally advanced flap (CAF), the simple or modified tunneling technique with or without connective tissue grafts (CTG). In a review evaluating the efficacy of periodontal plastic procedures for the treatment of MAGR, CAF in conjunction with a graft showed the best treatment outcomes, while CAF and tunnel approaches expressed the highest levels of complete root coverage (CRC). Furthermore, in recent years, the modified coronally advanced tunneling technique (MCAT) has been successfully employed for the treatment of MAGR defects. Several clinical studies have shown predictable results with this technique in conjunction with CTG or other tissue replacement grafts in Miller Class I, II, and III GR.

Another literature review has evaluated the clinical benefit of the adjunctive use of CT, enamel matrix derivative (EMD), nonresorbable and resorbable barrier membranes (BM), and acellular dermal matrix (ADM) compared to CAF alone for the treatment of class I-II single recessions. Results have shown that only CTG or EMD in conjunction with CAF were able to enhance the probability to achieve CRC and to improve recession reduction.

However, in many clinical cases, especially in patients with a thin gingival biotype, the availability of connective tissue at the donor site, especially for coverage of MAGR, is limited. Furthermore, connective tissue harvesting is associated with increased surgical time and patient morbidity, and higher risk for postoperative complications.

In recent years, attempts have been made to develop new surgical techniques and materials aiming to improve the predictability of root coverage procedures and to reduce patient morbidity. These included the application of biologic factors such as EMD or platelet rich fibrin (PRF), or the use of ADM or various bioabsorbable membranes instead of CTG to support the gingival margin and increase the thickness of the gingiva. Histologic and clinical studies indicate that ADM may show comparable results to CTG. However, in some countries, ADM is still a controversial replacement for CTG due to its human origin and potential risk for disease transmission. So far, the use of a porcine-derived collagen matrix for the treatment of multiple GR has been effectively applied in some preclinical and clinical studies. Recently, a new porcine-derived acellular dermal collagen matrix (PADM; Mucoderm, Botiss Dental) has been introduced for the treatment of GR. In-vitro and in-vivo findings have provided evidence that this matrix can promote growth and proliferation of human gingival fibroblasts, osteoblasts, and endothelial cells. A very recent histologic study provided evidence that this matrix in conjunction with enamel matrix derivatives may promote periodontal regeneration in GR.

However, the literature is still scarce regarding the outcomes following treatment of MAGR by means of various types of soft tissue replacement grafts. Therefore, the aim of this consecutive case series was to evaluate the clinical efficacy of PADM for the treatment of MAGR defects by means of MCAT.

**METHOD AND MATERIALS**

**Patient selection**

Twelve nonsmoking, systemically healthy patients (3 men, aged from 26 to 48 years, mean age 34 ± 7.97 years) presenting at least two adjacent Miller Class I, II, or III GR, with a minimal depth of 2 mm, were included in this case series evaluation. All patients underwent professional tooth cleaning and received oral hygiene instructions so that prior to surgery patients showed a good oral hygiene level (full-mouth plaque score ≤ 25%). The study was conducted according to the Declaration of Helsinki (1964, revision 2008) and approved by the Ethical Committee of the Faculty of Medicine and Pharmacy of Cluj-Napoca (Application #579/13.04.2012). Informed written consent to participate in this study was obtained from all participants.

**Surgical procedure**

In all 12 patients, surgical GR coverage was performed with the MCAT as described by Sculean et al. Briefly: under local anesthesia, scaling and root planing...
was performed at all teeth scheduled for root coverage (Figs 1 and 2). Thereafter, a mucoperiosteal flap was raised using several tunneling knives beyond the mucogingival junction, maintaining interdental papillae intact, thus creating a tunnel flap (Figs 3 and 4). The tunnel was then extended apically and laterally in a split flap, sectioning and releasing all attached muscle and collagen fibers from the inner aspect of the flap. After gentle undermining but not disruption of the interdental papillae, the tunnel flap was mobilized so as to allow complete coronal tension-free advancement (Figs 5 and 6).

Subsequently, the PADM (Mucoderm, Botiss Dental) was adapted in size for the entire recession area to be
covered and hydrated for 5 minutes in sterile saline solution (Fig 7). By means of a mattress suture, the membrane matrix was then pulled into the tunnel and fixed mesially and distally at the inner aspect of the flap. Subsequently, the membrane matrix was fixed with sling sutures (6.0 Seralon, Serag-Wiessner) at the cementoenamel junction (CEJ) of each treated tooth (Fig 8). Finally, using sling sutures, the tunnel was moved and fixed coronally covering completely the membrane matrix and the recessions (Fig 9).

The postsurgical protocol consisted of analgesics (3 x 400 mg/day ibuprofen) for 2 to 3 days and antibiotics (1 x 1,000 mg amoxicillin plus clavulanic acid) for 7 days. For 3 weeks postoperatively, patients were instructed not to brush the surgical area, to rinse twice a day for 2 minutes with 0.2% chlorhexidine digluconate mouthwash, and to apply 0.12% chlorhexidine digluconate toothpaste (Elugel, Pierre Fabre). Sutures were removed 21 days postsurgically, when patients also resumed toothbrushing at the surgical site. All surgeries were performed by two experienced and previously calibrated periodontists (RC and AS).
Evaluated parameters
At baseline and at 12 months postoperatively, the following clinical parameters were assessed by the same two clinicians that performed the surgeries: probing depths (PD), clinical attachment level (CAL), complete and mean root coverage (CRC and RC), width of keratinized tissue (KT), and attached gingiva (AG).

The demarcation between the KT and alveolar mucosa was performed visually by an experienced periodontist.

Statistical analysis
Statistical analysis was performed using the commercially available software SPSS (version 18; IBM). Descriptive statistics were performed using mean ± standard deviation (SD) for quantitative variables; percentages were used for qualitative variables (CRC). CRC (eg, 100% root coverage) was defined as the primary outcome variable. Differences between baseline and 12 months, and between mandible and maxilla were checked for significance using Wilcoxon signed ranks test. The statistical significance level was set at $P < .05$.

RESULTS
Twelve patients with 54 recessions were included in this case series. The postoperative healing was uneventful in all cases: neither matrix loss or exposure, nor infection or allergic reactions were observed.

Recession coverage occurred to a varying extent at all defects with the exception of one Miller Class III GR located at a mandibular central incisor. At 12 months, mean RC improved statistically significantly ($P < .0001$) compared to baseline and measured $73.20 ± 27.71\%$ (Table 1). Twenty-two GR (40.74%) showed CRC while 53.70% of the recessions (29 GR) had RC > 80%, 40.75% (22 GR) had RC between 50% and 99% and 15.82% (8 GR) had RC < 50%.

Twenty six (48.14%) of the total number of GR were Miller Class I recessions, out of which 50% (13 GR)
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showed CRC, 38.46% had 50% to 84% (10 GR) RC, and 3 recessions had 30% to 50% RC. Three recessions out of the 54 were Miller Class II; two of these had a RC of 60% and one had 80% RC. The rest of 25 recessions out of the initial 54 were Miller Class III recessions, of which 36% (9 GR) showed CRC, 40% (10 GR) had 50% to 84% RC, 20% (5 GR) had under 50% RC, and one recession showed no RC compared to baseline (Table 1).

There were no statistically significant differences regarding RD between the maxilla and mandible at baseline. However, mean RD, reduction of RD, and RC at 12 months were statistically significantly higher in the maxilla as compared to the mandible (Table 2; *P < .05*).

Twelve recessions were localized at canines, 26 at lateral and central incisors, and 16 at premolars (Table 3). Results obtained by tooth type are depicted in Table 3. Incisors obtained the highest percentages in RC (66.07 ± 33.39%) and a CRC of 48.00% (canines: CRC of 41.66%, RC of 53.66 ± 29.30%; premolars: CRC of 31.25%, RC of 53.66 ± 29.30%) (Fig 10).

**DISCUSSION**

The aim of the present case series was to evaluate the effectiveness of a new porcine-derived dermal matrix for the treatment of MAGR using the MCAT. All selected
patients presented multiple adjacent Miller Class I, II, or III GR, with a minimal depth of 2 mm. The main outcome variable in the present study was CRC, while the significance level was set at $P < .05$.4

The results show a general decrease (Table 1) in the depth and width of the recessions, with 40.64% of the defects exhibiting 100% RC. The total mean RC was 73.20% with a total mean RD reduction of 2.06 ± 1.18 mm. These outcomes are comparable to other studies in the literature evaluating multiple recession coverage with various types of soft tissue replacement grafts and/or techniques. A multicenter study evaluating the use of a xenogeneic collagen matrix in conjunction with CAF for the treatment of multiple Miller Class I and II GR obtained, after 6 months, similar results regarding mean RC (75.29%) and CRC (36%).26 In a further study by Aroca et al,6 CRC in Miller Class I and II multiple GR using MCAT and the same collagen matrix was achieved in 42% of the sites, with a total mean RC of 71 ± 21%. Using the same collagen matrix as in the study by Aroca et al,6 but combined with CAF technique, Cardaropoli et al24 obtained after 12 months a twice higher percentage of recessions with 100% RC and a mean RC of 93.25 ± 10.01%. However, the recession reduction and gain in AG obtained at 12 months are comparable to the present outcomes (Cardaropoli et al24 RD reduction 2.28 mm, AG gain 0.97 mm; present study: RD reduction 2.06 mm, AG gain 0.84 mm). Explanations for the higher percentage of CRC obtained by Cardaropoli et al24 may be related to differences in the included defects (only Miller Class I and II GR were included) and by differences in the used surgical technique, that might be less sensitive compared to MCAT, especially when collagen matrices are utilized. This view seems to be supported by the current literature, which indicates that better clinical outcomes may be expected when soft tissue replacement grafts are used in conjunction with CAF than with the tunnel technique.35 However, the outcomes reported by Ozenci et al35 with the tunnel technique using ADM are comparable to those obtained in the present study, ie mean RC was 75.72% (present study 73.20%), recession reduction was 2.45 ± 0.20 mm (present study 2.06 ± 1.18 mm), RW reduction was 1.83 ± 0.6 mm (vs 2.11 ± 1.67 mm), KT gain was 0.87 ± 0.42 mm (vs 0.69 ± 0.51 mm), AG was 0.85 ± 0.73 mm (vs 0.84 ± 0.72 mm), CRC was in 37.36% of the sites (vs 40.74% CRC in the present study).35 Furthermore, the present results in the maxillary arch are comparable with those of Chaparro et al,36 who used the tunneling technique combined with ADM (CRC: 67.9% vs 57.14% in the present study; RD: 3.02 ± 1.17 mm vs 2.51 ± 1.15 mm in the present study; Table 2). However, Chaparro et al36 obtained higher

<table>
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<tr>
<th>Parameters</th>
<th>CRC (%)</th>
<th>RC (% mean ± SD)</th>
<th>RD reduction (mm, mean ± SD)</th>
<th>RW reduction (mm, mean ± SD)</th>
<th>AG gain (mm, mean ± SD)</th>
<th>KT gain (mm, mean ± SD)</th>
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<td>Maxillary (n = 12)</td>
<td>63.66</td>
<td>91.34 ± 13.89</td>
<td>2.33 ± 0.91</td>
<td>3.18 ± 1.34</td>
<td>0.72 ± 0.72</td>
<td>0.72 ± 0.64</td>
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<td>Mandibular (n = 14)</td>
<td>35.71</td>
<td>66.07 ± 33.39</td>
<td>1.35 ± 0.75</td>
<td>1.35 ± 1.13</td>
<td>0.65 ± 0.45</td>
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<td>Canines (n = 12)</td>
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<td>Maxillary (n = 6)</td>
<td>83.33</td>
<td>91.66 ± 20.41</td>
<td>3.45 ± 1.59</td>
<td>4.22 ± 1.73</td>
<td>0.88 ± 0.83</td>
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<td>Mandibular (n = 6)</td>
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<td>57.63 ± 22.73</td>
<td>2.16 ± 1.57</td>
<td>0.83 ± 1.21</td>
<td>0.83 ± 1.12</td>
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<td>Premolars (n = 18)</td>
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<tr>
<td>Maxillary (n = 11)</td>
<td>36.33</td>
<td>72.63 ± 24.97</td>
<td>2.18 ± 0.87</td>
<td>1.96 ± 1.46</td>
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<td>Mandibular (n = 5)</td>
<td>20.00</td>
<td>53.66 ± 29.31</td>
<td>1.20 ± 0.57</td>
<td>1.50 ± 1.41</td>
<td>1.30 ± 0.75</td>
<td>0.70 ± 0.57</td>
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AG, attached gingiva; CRC, complete root coverage; KT, keratinized tissue; RC, root coverage; RD, recession depth; RW, recession width; SD, standard deviation.
improvements in the mandible as compared to the present study (CRC 52.5%, RD 3.12 ± 1.28 mm). The discrepancies between these results might be due to the higher number of recessions included in the study by Chaparro et al.,36 the present study being just a report of 12 consecutive patients. The present results regarding RC, RD reduction, and gain in KT are also comparable with those obtained by Nevins et al.38 using CAF and a placental allograft (RC 55.81 ± 25.26%; RD reduction 2.65 ± 1.53 mm, 0.86 ± 1.21 mm; for the present results see Table 1) and by Tunaliota et al.37 that used autologous PRF combined with CAF (mean RC 76.63% in the PRF+CAF group).38

In conclusion, the present findings suggest that the new PADM may be successfully utilized for the treatment of Miller Class I, II, and III MAGR.

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REFERENCES


