Treatment of Periodontal Intrabony Defects Using Enamel Matrix Derivative: Surgical Reentry After an Observation Period of at Least 5 Years

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The purpose of this study was to assess the healing of periodontal intrabony defects treated using enamel matrix derivative (EMD) after at least 5 years of follow-up. Six patients with seven intrabony defects were included in the study. Treatment with EMD yielded a mean clinical attachment level gain of 4.3 ± 2.4 mm, a mean probing depth reduction of 4.7 ± 2.1 mm, and a mean gingival recession increase of 0.7 ± 1.8 mm. Reentry measurements showed a complete resolution of the intrabony defect in five cases, while in two cases a residual intrabony component was recorded. The present study indicates that treatment using EMD provided good clinical outcomes maintained in most cases over a period of at least 5 years. Int J Periodontics Restorative Dent 2019;39:537–543. doi: 10.11607/prd.4148

The goal of periodontal therapy is to arrest periodontal disease progression and to reconstruct the tissue defects caused by infectious process. During the last few decades, various treatment modalities, such as the use of different bone grafting materials,1–3 guided tissue regeneration (GTR),4,5 enamel matrix derivative (EMD)6,7 or combinations thereof,8,9 and growth factors,10–12 have been used to regenerate the tooth’s supporting tissues. Histologic studies in animals and humans subsequently demonstrated that periodontal regeneration including root cementum, periodontal ligament, and alveolar bone did not predictably occur.13 A proper understanding of the basic biologic mechanisms involved in periodontal wound repair and regeneration requires the assessment of the macroscopic, microscopic, cellular, and molecular components of the healing process.14,15

Application of enamel matrix proteins, derived from the Hertwig root sheath, yielded histologic evidence of periodontal tissue regeneration both in vitro16 and in human studies.17 These findings have confirmed that EMD application on debrided root surfaces may induce a series of biologic events leading to de novo formation of cementum, periodontal ligament, and alveolar bone without root resorption.
and ankylosis. In addition, a study provided evidence indicating that the use of EMD in conjunction with an access flap significantly improved the clinical outcome in intrabony defects compared with access flap alone. Therefore, the combination of biologic activity of EMD with a strict surgical approach provides satisfactory clinical results. Furthermore, one clinical study indicated that regeneration of the periodontal tissues obtained by means of EMD application may be achieved and maintained long-term in humans. In fact, data of a clinical study conducted by Sculean et al suggested that treatment of intrabony defects with EMD may result in statistically significant reductions in probing depth (PD) and gains in clinical attachment level (CAL), which can be maintained over a period of 10 years.

The aim of this study was to evaluate clinically and by means of a surgical reentry the healing of intrabony defects treated with EMD after an observation period of at least 5 years.

**Materials and Methods**

**Patient Population**

Six patients suffering from chronic periodontitis with seven periodontal intrabony defects surgically treated using EMD (Emdogain, Straumann) were included in the study. Each patient was informed about the possible risks, and each one provided informed written consent. The institutional ethical committee of the University of Messina approved the study protocol. The prospective observational study was performed in accordance with the principles stated in the Declaration of Helsinki and the Good Clinical Practice guidelines.

**Clinical Procedure**

The following clinical measurements were assessed using a graduated manual periodontal probe at six sites per tooth (distobuccal, buccal, mesiobuccal, mesiolingual, lingual, and distolingual): full-mouth plaque score (FMPS), full-mouth bleeding score (FMBS), PD, CAL, and gingival recession (GR). Before the surgical treatment, patients received initial periodontal therapy with oral hygiene prophylaxis, professional tooth cleaning, and scaling, as previously reported. Depending on the mesiodistal width of the interproximal space and on the depth of radiographic intrabony component (Fig 1), different surgical approaches were selected to access the intrabony defect areas (ie, papilla preservation techniques or minimally invasive surgical techniques). After flap elevation, the granulation tissue was removed from the intrabony defect, and scaling and root planing were performed using metal curettes and power-driven instruments (Fig 2). The following intrasurgical measurements were recorded at baseline and during the surgical reentry: the vertical linear distance from the cemento-enamel junction (CEJ) to the bottom of defect (CEJ-BD), the vertical linear distance from the bone crest to the bottom of defect (BC-BD), and the horizontal linear distance from
the root surface to the bone crest (RS-BC). EMD was applied after root conditioning for 2 minutes with a 24% EDTA gel (PrefGel, Straumann) and rinsing with sterile saline solution according to the manufacturer’s instructions (Figs 3 and 4). After flap repositioning, a tension-free primary closure of the interdental papillae was achieved using a non-resorbable suturing material (Fig 5). The sutures were removed after 10 days, and patients were instructed to rinse twice daily with a chlorhexidine 0.2% solution and to use modified oral hygiene procedures, particularly in the surgical sites, for the first 4 weeks postsurgery. After a 12-month (Fig 6) healing period, all patients were enrolled in a maintenance periodontal program with a recall visit every 6 months.

Surgical Reentry

Surgical reentry was performed for different reasons (ie, presence of a pocket depth ≥ 5 mm in the treated or adjacent sites; mucogingival or restorative treatment) after 5 years in three cases, 7 years in two cases, and 10 years in one case, and all intrasurgical measurements were repeated (Fig 7). Before surgical reentry, the same clinical measurements as taken at baseline were recorded.
Results

The characteristics of the patients are illustrated in Table 1. Six non-smoking subjects (three females and three males) with a mean age of 40.8 ± 8.6 years and with good plaque-control levels (FMPS: 17.7% ± 2.3%; FMBS: 15.2% ± 3.0%) were included. The detailed characteristics and locations of periodontal intrabony defects are presented in Table 2. Two three-wall intrabony defects were treated by means of the minimally invasive surgical technique (MIST) and the modified MIST (mMIST), meanwhile five intrabony defects (two three-wall defects and three one-wall defects) were treated using conventional flap with papilla preservation technique (CFPPT). After an observation period of at least 5 years (mean observation time: 7 years), the change in PD was statistically significant \((P = .001)\), decreasing from 8.7 ± 1.6 mm to 4.0 ± 2.6 mm (mean change 4.7 ± 2.1 mm). A statistically significant CAL gain \((P = .003)\) was recorded, changing from 10.8 ± 2.2 mm to 6.5 ± 3.2 mm (mean change: 4.3 ± 2.4 mm). The mean gingival recession (GR) increased from 1.7 ± 1.7 mm to 2.4 ± 1.7 mm (mean change: 0.7 ± 1.8 mm), but statistically significant differences were not found \((P = .334)\). Clinical parameters at baseline compared to follow-up are shown in Table 3. Table 4 summarizes the intrasurgical parameters at baseline and at surgical reentry. Statistically significant differences between baseline and surgical reentry were recorded in terms of CEJ-BD \((P = .001)\), BC-BD \((P = .0001)\), and RS-BC \((P = .010)\). At
baseline, the mean CEJ-BD was 12.1 ± 2.6 mm, the mean BC-BD was 6.8 ± 1.4 mm, and the mean RS-BC was 4.4 ± 1.0 mm. At surgical reentry, the mean CEJ-BD was 8 ± 3.1 mm, the mean BC-BD was 1.8 ± 2.5 mm, and the mean RS-BC was 1.6 ± 1.6 mm. A complete resolution of the intrabony defect was achieved in five cases, while in two cases a residual intrabony component was observed (Table 5).

**Discussion**

During the last three decades, various treatment approaches involving nonsurgical techniques, as well as conservative, resective, and regenerative surgical techniques, have been employed for the treatment of intrabony defects showing different outcomes.27–29

The results of the present study indicate a predictable and long-term reliable reduction of PD and improvement of clinical attachment in defects treated with EMD. These findings are in agreement with the ones reported by Silvestri et al30 on a larger sample of 120 defects healed with regenerative techniques, 47 of which were treated with EMD and showed a mean CAL gain of 4.1 ± 2.1 mm over a mean follow-up period of 9 years. Although no surgical reentry procedures were performed, defect fill occurred following surgical regenerative therapy.

In the present study, the mean defect fill was 4.1 mm after an observation period of at least 5 years. These findings are in agreement with those presented by Froum et al31 in a clinical study with surgical reentry reporting a mean defect fill of 3.8 mm for the sites treated with access flap and EMD vs 1.4 mm for the sites treated with access flap alone. The rate of defect fill was more than three times greater for the sites treated using EMD compared to control-group sites (74% vs 23%) after a 12-month follow-up. In the present study, the surgical reentry was performed after an observation period of at least 5 years (range: 5 to 10 years), and data confirm the long-term efficacy of using EMD for new attachment procedures. Similar results were observed in a study conducted by Rasperini et al32 using EMD to treat periodontal intrabony defects, where surgical reentry showed a complete closure of the intrabony component. Contrastingly, the present study recorded residual intrabony components of 5 mm and 7 mm at surgical reentry after 5 years of follow-up in two out of the seven reported cases. The presence of a residual intrabony component might be due to the deep and noncontaining nature of the original defects, both only having one wall. As a matter of fact, defect morphology, such as the number of remaining bony walls and defect depth and width, plays a significant role in the outcome of regenerative procedures. Defects with a depth ≥ 4 mm and a radiographic angle ≤ 25 degrees have the greatest regenerative potential and, in accordance with the

<table>
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<th>Defect no.</th>
<th>Tooth</th>
<th>No. of walls</th>
<th>Complete intrabony defect resolution</th>
<th>Residual intrabony component (mm)</th>
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Table 4 Intrasurgical Parameters at Baseline and Surgical Reentry

<table>
<thead>
<tr>
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<th>CEJ-BD (mm)</th>
<th>BC-BD (mm)</th>
<th>RS-BC (mm)</th>
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<tr>
<td>Baseline (mean ± SD)</td>
<td>12.1 ± 2.6</td>
<td>6.8 ± 1.4</td>
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<tr>
<td>Follow-up (mean ± SD)</td>
<td>8.0 ± 3.1</td>
<td>1.8 ± 2.5</td>
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<tr>
<td>Difference (mean ± SD)</td>
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<td>2.9 ± 2.0</td>
</tr>
<tr>
<td>P</td>
<td>.001*</td>
<td>.0001*</td>
<td>.010*</td>
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</table>

*Statistically significant difference.

CEJ-BD = vertical linear distance from the cementoenamel junction to the bottom of defect (BD); BC-BD = vertical linear distance from the bone crest (BC) to the BD; RS-BC = horizontal linear distance from the root surface (RS) to the BC; SD = standard deviation.
present results, a positive correlation has been found between the number of remaining walls and the regenerative outcome. Thus, the predictability of treatment with EMD is highly sensitive to the defect anatomy, which should be carefully evaluated before choosing the regenerative technique.

Conclusions

In most cases, the use of EMD for the treatment of periodontal intrabony defects shows good clinical outcomes in terms of PD reduction and CAL gain after an observation period of at least 5 years. However, surgical reentry measurements showed a residual intrabony component in cases of one-wall intrabony defects.

Acknowledgments

This work was performed with institutional funding only. The authors declare that they have no conflicts of interest in this study.

References