Direct Pulp Capping in Primary Molars with Enamel Matrix Derivative: Report of a Case

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Enamel Matrix Derivative (EMD) is a rich amelogenin and amelin biomaterial that has been demonstrated to induce a reparative process similar to normal odontogenesis when placed in contact with pulp tissue. However, its effects in pulp capping on primary teeth has not been previously reported. The ***aim*** *of the present case report is to present the favorable clinical and radiographic findings of a primary molar treated with direct pulp capping (DPC) and using EMD as capping material in a 6-year-old girl.* ***Results:*** *After 12 months, there was no sign or symptom indicative of treatment failure, such as pain, gingival swelling, sinus tract, sensitivity to percussion or palpation, abnormal mobility, widening of periodontal space, internal or external root resorption, or supporting bone or furcal area radiolucencies.*

Keywords: *direct pulp capping, primary molars, enamel matrix derivative.*
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INTRODUCTION

Pulp management of primary teeth requires effective techniques that consume reasonably little chair time, and generate a favorable functional long term result until natural exfoliation occurs. Although pulpotomy and pulpectomy are procedures routinely employed in pediatric dentistry, direct pulp capping (DPC) has not been entirely accepted because some authors have reported a high risk of internal resorption owing to the cell-heavy content in primary pulps, and other secondary pathological effects;[1-3] Other authors however, showed promising results.[4,5] This controversy is partly due to the fact that the dental community has not agreed to what constitutes an ideal capping material, nor does one exist. Furthermore there is no specific or standardized technique for the DPC procedure on primary molars. The most common medication used for this technique is calcium hydroxide, although also other materials have been proven[1,6,7] such as dentin adhesives, zinc oxide and eugenol (ZOE), and mineral trioxide aggregate (MTA) with varying rates of success. It is generally accepted that DPC in primary teeth should be performed only when physiologic exfoliation is expected in 1 or 2 years. [2]

Enamel Matrix Derivative (EMD) is a biomaterial derivated from the extracellular enamel matrix that is rich in amelogenin and amelin. These proteins have been related to important biological functions in tooth development; they stimulate natural cementogenesis to restore a fully functional periodontal ligament, cementum, and alveolar bone[8] in the treatment of intrabony defects in patients having severe or advanced periodontitis through regeneration of affected tissues.[9-11] When applied to denuded root surfaces, EMD forms a matrix that locally facilitates regenerative responses in the adjacent periodontal tissues.[12] EMD facilitates the triggering of regenerative responses in PDL cells; therefore, it has been employed in cases of reimplantation of permanent teeth.[13] As a dressing in pulpotomies of primary teeth, it has proven to have successful clinical and histological results.[14]

As a DPC material, EMD has been used on animal teeth[15–17] and human premolars[18] with promising results. Its regenerative process consists of differentiation of odontoblasts and subsequent dentin formation and pulpal wound healing without affecting the normal function of the remaining pulp in a behavior similar to normal dentinogenesis.[8,19]

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Additionally, EMD induces the odontoblasts and endothelial cells of pulpal capillary vessels to produce a hard tissue barrier over the pulp exposure.[18] It has been demonstrated that EMD stimulates the production of a large amount of new, dentin-like tissue when applied as a DPC material onto the exposed pulp of permanent molars in adult miniature swine.[15] EMD has been shown to be clinically secure because amelogenin and amelin are recognized as "autoproteins" by our immune system, therefore no allergic or immunological reactions have been reported during more than 10 years of use.[10,20]

Nevertheless, the effect of EMD as a DPC material on primary molars has not to date been reported. The purpose of this paper is to present a case of DPC performed with EMD on a primary molar, with a clinical and radiographic follow-up period of 12 months.

CASE REPORT

A 6-years-8-months-old female patient was brought to the Pediatric Dentistry Postgraduate Clinic (Faculty of Dentistry, University of San Luis Potosí, Mexico) for routine dental attention. Her general health was good and her medical history revealed no systemic, allergic, or immuno-compromising illness. Oral examination revealed a poor oral hygiene and several deep carious primary teeth with no irreversible pulpitis, pulpal necrosis, or other clinical signs or symptoms. Her cooperation was fair. Parents were fully informed about the benefits and risks of DPC treatment and signed an informed consent form.

DPC was performed on the mandibular left mandibular first primary molar (# 74) using the following technique: Under local anesthesia and rubber dam isolation, the decayed tissue was removed with a number 3 round carbide bur (Indeco/plus, Mexico City, Mexico) with a high speed handpiece. During this procedure, the pulp was minimally exposed, and the exposure was enlarged (to 1mm of diameter) with a number 2 round sterile carbide bur . The blood was noted to be light red, and homeostasis was evident in 3 minutes. Performing of DPC was confirmed at that moment. The exposure was carefully irrigated with alternating solutions of sterile saline and chlorhexidine (Consepsis, Ultradent Products Inc, St Jordan, UT, USA), and dried gently with sterile cotton pellets. A drop of EMD gel (Emdogain, Biora AB, Malmö, Sweden) was immediately placed over the exposure with a round-head metallic applicator, before formation of a clot at the exposure site. Then the gel was covered and sealed with a dentin adhesive (Singlebond, 3M Unitek, Monrovia, CA, USA), and the tooth was built up with glass ionomer base (Vitrebond, 3M ESPE, St. Paul, MINN, USA). Both were light-cured for 40 seconds; finally, a preformed metallic stainless steel crown (3M ESPE) was adapted and cemented (PCA, SS White, Gluocester, UK).

Parents were requested to return to the clinic after the appointment, in order to carry out a complete clinic and radiographic evaluation of the treated molar. They were asked to call in case any complication such as pain or gingival swelling was observed. Two evaluations appointments were scheduled: at 6 and 12 months. At each appointment, a parental interview was completed, and a careful examination of the patient was made and a periapical radiograph taken. The presence of any of following signs or symptoms was considered as a treatment failure: pain, gingival swelling, sinus tract, sensitivity to percussion or palpation, abnormal mobility, widening of the periodontal space, internal or external root resorption, and supporting bone or furcal area radiolucency.

At each of the postoperative appointments no pathological changes were evident. No painful symptomatology, sensitivity to percussion, or palpation or pathologic mobility was reported for the treated molar, and the clinical examination did not reveal any abnormality in the soft tissues. Clinical and radiographic examinations were considered normal after 12 months of follow-up.

DISCUSSION

The dental pulp is a highly vascular and innervated connective tissue that is capable of healing by forming hard-tissue barriers or dentin bridges following DPC.[14,21] Innovative therapies have been used in an attempt to apply biological modulators that have been identified during tooth and bone embryogenesis; these agents are intended to improve treatment modalities and induce tissue regeneration.[22] One of the primary objectives of pulp therapy in pediatric dentistry is to maintain the integrity, health, and function of deeply decayed primary teeth and their supporting structures. The dental pulp is essentially a connective tissue composed of fibroblasts and odontoblasts, with the capability to produce reparative dentin when the environment is favorable.[23] DPC is an accepted and commonly used procedure for permanent teeth; however, in primary teeth this treatment is a source of distrust and controversy because of contradictory reported results.[1] For this reason, pulpotomy is preferred when any kind of pulp exposure occurs, regardless of its origin: caries, trauma or cavity preparation.

EMD by means of its amelogenin and amelin-rich fraction, has the potential to induce a process that seems to imitate normal dentinogenesis; further, it clearly influences the odontoblasts and endothelial cells of the pulpal capillary vessels to create a calcified barrier over the pulp exposure.[16,18] It has been reported that enamel matrix proteins participate in differentiation and maturation of odontoblastic cells, and when the pulp wound is exposed to EMD, a substantial amount of reparative, dentin-like tissue is formed in a process much resembling classic wound healing with subsequent neogenesis of normal pulp tissues. The formation of new dentin starts from within the pulp at some distance from the exposure site.[8]

The success of the DPC treatment was due to 3 factors: (1) Strict case selection, both clinically and radiographically. One of the factors that greatly improve the prognosis of the DPC procedure is the absence of inflammation of the exposed pulp tissue.[23] (2) Careful operative technique. Widening of exposure site had 3 purposes: To remove the inflamed pulp tissue from the exposed area, to facilitate

washing decayed and contaminated dentin from the debris, and to allow more contact between the capping material and the exposed pulp. (3) Microleakage was controlled to the utmost; this factor greatly affects the prognosis of pediatric pulp treatments. Over a layer of glass ionomer, placement of a metallic crown offers superior resistance to fracture and microleakage compared with IRM, glass ionomer alone or other materials. After a 12-month follow-up period, no sign or symptom indicative of treatment failure was detected.

CONCLUSIONS

We found that the use of EMD in direct pulp capping of a primary molar may represent a promising treatment in small pulp exposures; after a 12-month follow-up period, no sign or symptom indicative of treatment failure was detected. The positive result of the present case report emphasizes the need for further clinical investigation. Such a study should be a randomized blinded clinical assay, so that the clinical and radiographic effects of EMD as a DPC biomaterial placed on primary molars can be compared with a control group, with an adequate follow-up period and a sufficient and representative sample size. All clinical and operative factors mentioned above should be controlled, and the guidelines suggested by the consort group for this kind of experimental design followed.

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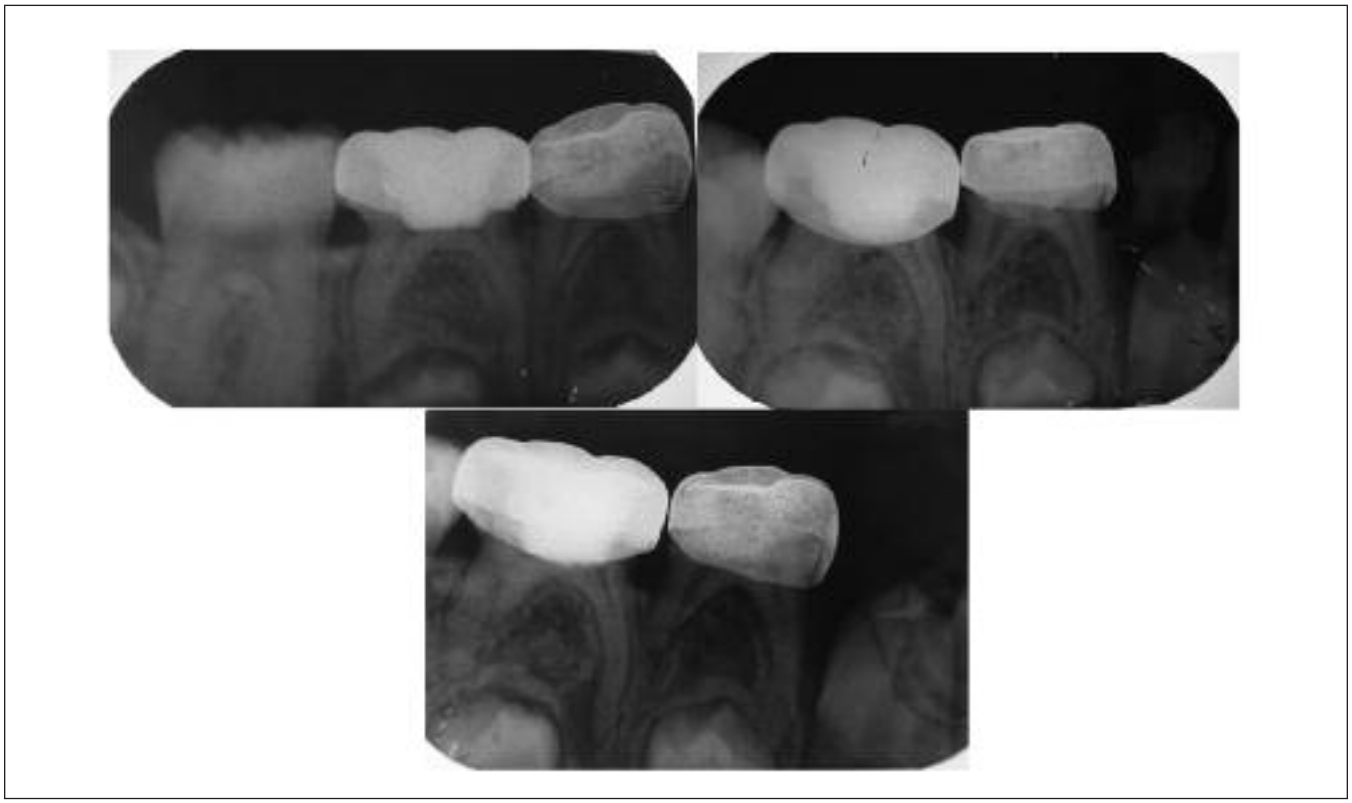

Figure 1. *Upper left:* Periapical X-ray immediately after pulpal and restorative treatment. *Upper right:* 6 months after treatment. *Lower:* 12 months after treatment.

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