Portland cement as pulp dressing agent in pulpotomy treatment of primary molars: a 12-month clinical study



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DOI 10.23804/ejpd.2019.20.01.05

Abstract

Aim Pulpotomy is the most frequent endodontic treatment performed on primary teeth. Different pulpotomy procedures and materials have been studied during the last years and recently interest has been focused on the use of Portland Cement (PC) as an alternative to these materials including Mineral Trioxide Aggregate (MTA), but still few clinical studies have been carried out. The aim of this study was to analyse the clinical and radiographic response to the use of Portland cement (PC) in primary molars pulpotomies through a clinical study in paediatric patients.

Materials and methods Eleven carious primary mandibular molars of children aged 3–9 years old were treated by a conventional pulpotomy technique using PC. The teeth were restored with stainless steel crown. Clinical and radiographic follow-up was performed 6 and 12 months after the treatment.

Results All the treated molars were clinically and radiographically successful at all the follow-up appointments as no pathological findings were observed in any molar. Reparative dentin formation was observed in 100% of the treated molars.

Conclusions PC could be considered a reasonable alternative to the use of MTA in pulpotomy treatments in primary molars, although more long-term clinical studies are needed to confirm these results.

KEYWORD Mineral trioxide aggregate (MTA), Portland Cement, Primary molars, Pulpotomy.

Introduction

Pulpotomy treatment is indicated in primary teeth with inflammation of the coronal pulp caused by caries with no involvement of the radicular pulp. This technique mainly consists in removing the coronal pulp and healing the radicular pulp with a medicament to maintain the treated tooth asymptomatic until its exfoliation. The main goal of the treatment is to keep the integrity of radicular pulp and health of the tooth and its supporting tissues [Rood et al., 2006; AAPD, 2014; Hincapié et al., 2015].

To perform this type of pulp treatment, different materials and techniques have been used which have been under investigation for many years, as each treatment acts differently on the dental pulp and even on other tissues and organs [Hincapié et al., 2015]. Medicaments used for pulpotomy treatments have included formocresol, ferric sulfate, calcium hydroxide and mineral trioxide aggregate (MTA) [Smith, Seale and Nunn, 2000; Waterhouse, Nunn and Whitworth, 2000; Huth et al., 2005; Fuks, 2008; Moretti et al., 2008; Malekafzali et al., 2011; Odabaş et al., 2012; Cuadros et al., 2013; Lin et al., 2014]. Recently, interest has been focused on the use of Portland Cement (PC) as an alternative to MTA. Many studies have compared these two materials, which have similar composition and also similar physical, chemical and biological properties [Araki et al, 2005; Conti et al., 2009; Sakai et al., 2009; Steffen, 2009].

The most significant difference between PC and MTA, in terms of composition, is that the MTA contains bismuth oxide, adding radiopacity properties for dental use [Camilleri et al., 2005; Hwang et al., 2009; Srinivasan, Waterhouse and Whitworth, 2009]. PC contains more gypsum ($CaSO_4$), aluminum and potassium ions than MTA [Srinivasan, Waterhouse and Whitworth, 2009]. It has also been shown that the MTA has an average particle size smaller than PC and it is processed under an additional purification process [Abdullah et al., 2002; Camilleri et al., 2005; Islam, Chng and Yap, 2006]. In relation to the physical properties, it has been observed that MTA has a higher curing time, probably due to the lower amount of gypsum ($CaSO_4$) in its composition [Srinivasan, Waterhouse and Whitworth, 2009]. On the other

hand, it has been determined that Portland cement and MTA have a similar antibacterial activity [Sipert et al., 2005; Srinivasan, Waterhouse and Whitworth, 2009; Steffen, 2009]. Investigation with animal cells has demonstrated that both PC and MTA show a similar effect on pulpal cells when used for direct pulp capping [Wucherpfenning and Green, 1999] and also both can stimulate dentin bridge formation after pulpotomy treatments [Holland et al., 2001].

Clinical studies using PC in pulpotomy treatments have also been published, even if those investigations are still very few. Conti et al. [2009] showed the clinical and radiographical success using PC as a medicament for pulpotomy treatment of primary molars in two clinical cases where three molars where treated in a 12-month follow-up study. Additionaly, dentin bridge formation was also found below the PC treatment. Sakai et al. [2009] compared the use of PC and MTA in a 24-month follow-up study in 30 molars showing the success of the treatment in 100% of the cases with both materials. Reparative dentin formation in root canals was also demonstrated in both clinical groups, however mineralised material deposition obliterating the root canal was more frequent with the use of PC. Another recent clinical study was carried out comparing PC with PC mixed with iodoform and PC mixed with zirconium oxide [Lourenço et al., 2015]. The sample consisted in 30 molars divided into three groups and followed during 24 months. The results showed again 100% of clinical and radiographic success even with the addition of opacifiers.

As PC and MTA have shown similar composition and properties [Wucherpfenning and Green, 1999; Steffen, 2009], and as the clinical and radiographic success of the use of MTA in primary teeth pulpotomies has been already demonstrated [Maroto et al., 2003; Maroto et al., 2005; Maroto et al., 2006; Srinivasan, Waterhouse and Whitworth, 2009; Cardoso et al., 2011], it seems reasonable to consider PC as a possible alternative to MTA, taking in account its lower cost for dental use. Therefore, the aim of this study was to analyse the clinical and radiographic response to the use of Portland cement (PC) in primary molars pulpotomies through a clinical study in paediatric patients.

Materials and methods

Before starting the investigation, the study protocol received the approval of the Coordination Unit for Clinical Trials at the Complutense University of Madrid, Spain. Parents or guardians of the children signed informed consent forms after receiving information concerning treatments.

The study sample included lower primary molars of children aged between 3 and 9 years old presenting caries lesions with pulp involvement limited to the pulp chamber. Molars belonging to children with general diseases or submitted to medical treatment were excluded. Molars were also excluded if presenting one or more of those findings: previous restorative or pulp treatment; coronary destruction making impossible a proper sealing with preformed crown; root length smaller than one third; radicular pulp degeneration signs such an excessive bleeding from the root canal, furcation involvement, internal or external root resorption, abscecess or fistulous tracts.

Finally a total of 11 lower molars, 6 first molars and 5 second molars, were selected for the study (Table 1 and Figure 1).

In all cases, pulpotomy treatment with PC was carried out by the same investigator, already involved in several pulpotomy studies and using a standardised technique. Molars were treated under local anaesthesia and the procedure with each molar consisted in the following:

1. Isolation with rubber dam.
2. Preparation of the molar with high speed and 169L bur with irrigation water and fitting of a stainless steel crown.
3. Removal of the carious tissue with handpiece and a round bur.
4. Opening of the pulp chamber and removal of the coronal pulp tissue with a large round bur at low speed.
5. Drying and controlled bleeding of the remaining pulp using slight pressure with a sterile cotton pellet.
6. Mixing of the PC (MEDCEM Medizinischer Portlandzement®) with sterile water on a glass slab following the manufacturer's instructions and placement of cement in the pulp chamber.
7. Pressing the PC to the walls and floor of the pulp chamber with a cotton pellet moistened in sterile water.
8. Filling the pulp chamber with a 3–4 mm layer of light curing glass-ionomer cement (Vitrebond®).
9. Cementation of the stainless steel crown with glass-ionomer cement (Ketac-Cem®).

The periodic follow-up examinations were carried out every 6 and 12 months after the treatment. The distribution of the final sample is described in Table 2. The

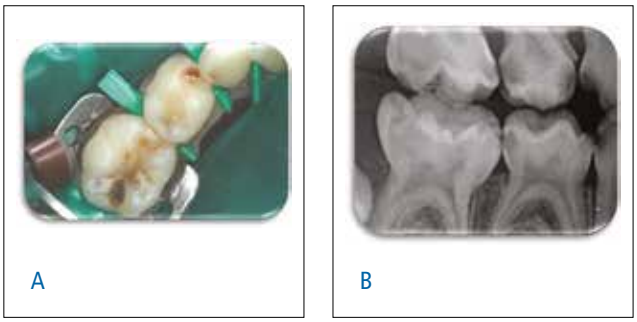


FIG. 1 A Preoperative clinical image of a lower first molar selected for the pulpopomy treatment with Portland Cement.
B Preoperative radiographic image

	First molar	Second molar	Total
Right	3	2	5
Left	3	3	6
Total	6	5	11

TABLE 1 Distribution of the mandibular molars selected for the study.

	First molar		Second molar		Total
	left	right	left	Right	
6 months	2	3	3	2	10
12 months	2	2	1	2	7

TABLE 2 Follow-up time of pulpotomised mandibular primary molars.





FIG. 2 A Preoperative radiograph of the mandibular left primary first molar. B 6-month follow-up radiograph showing absence of pulpal pathology and initial obliteration of mesial and distal pulp canals.





FIG. 3 A Preoperative radiograph of the mandibular left primary second molar. B 12-month follow-up radiograph showing absence of pulpal pathology and initial obliteration of mesial and distal pulp canals.

recall evaluations involved the clinical and radiographic examination of each treated tooth and its periradicular area. The treatment was considered a failure if one or more of these signs were observed: inflammation, abscess or fistula, pathological mobility, external or internal pathological root resorption, furcation pathology, pathological thickening of the periodontal membrane, or dissolution of the PC.

Results

All the treated molars were clinically and radiographically successful during all the follow-up appointments as no pathological findings were observed in any molar (Fig. 2 and 3). No teeth showed signs of inflammation, mobility or pathological root resorption.

Moreover, reparative dentin formation was observed in 100% of the treated molars as all teeth presented mineralised material deposition obliterating the root canal at 6 and 12 months follow-up examinations (Fig. 2, 3).

Discussion

Several studies have already shown successful results using MTA in pulpotomy treatment of primary molars and also other studies have reported similar chemical and physical properties of MTA and PC [Sipert et al., 2005; Araki et al., 2006; Srinivasan, Waterhouse and Whitworth, 2009]. It seems then interesting to assess the clinical results of the use of PC in pulpotomy treatments.

In the literature there are fewer publications on the application of Portland cement in primary molars pulpotomy compared with publications on MTA. Only three clinical studies have been published so far, and all of them show the clinical and radiographic success of PC, which are similar to the results obtained with MTA [Conti et al., 2009; Sakai et al., 2009; Lourenço et al., 2015].

In the present study, we found a 100% clinical and radiographic success using PC as pulpotomy agent, as any of the treated molar did not show any pathologic sign during the 12 months study time. This result agrees with what observed by Conti et al. [2009] for a follow-up of 3, 6 and 12 months and also with Sakai et al. [2009] for a follow-up of 6, 12, 18 and 24 months.

Reparative dentin deposition in the pulp canals was detected in all cases. This was demonstrated by the presence of pulp canal stenosis in 100% of radiographic images. Root stenosis involves the formation of tertiary reparative dentin over the exposed pulp. Dentin formation entails the presence of odontoblastic activity, which demonstrates the root canal pulp vitality [Duarte et al., 2005; Maroto et al., 2005; Maroto et al., 2006; Moretti et al., 2008]. Absence of radiographic or clinical signs of failure can also confirm the radicular pulp vitality. It can be deduced that the use of PC produced one of the aims of pulpotomy treatment, which is to maintain the tooth vitality without radicular pulp pathology. Our results match those obtained in the clinical studies published so far [Conti et al., 2009; Sakai et al., 2009; Lourenço et al., 2015].

Some authors have shown concern regarding the presence of leachable arsenic in PC composition, but some studies have reported that arsenic concentration in PC is very similar to that present in MTA [Duarte et al., 2005] so there will be no contraindication to the clinical use of PC. Moreover, the use of PC as material in dentistry has been accepted by the European Community (EC). On the other hand, PC shows a lower radiopacity compared with MTA as some studies have already shown [Srinivasan, Waterhouse and Whitworth, 2009; Steffen, 2009], but we can say, based on our study, that this fact does not compromise the execution of pulpotomy treatment and its follow-up assessment.

Conclusion

According to this study, PC could be considered a reasonable alternative to MTA in pulpotomy treatments in primary molars, although more long-term clinical studies with larger samples are needed to confirm these results.

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