



Original article

SUCCESS RATE OF MEDCEM PORTLAND CEMENT AS A PULP CAPPING AGENT IN PULPOTOMIES OF PRIMARY TEETH

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ABSTRACT:

Aim: To evaluate the clinical and radiographic outcomes of Portland cement (PC) as a pulp capping agent in primary teeth pulpomoties.

Material and methods: The study included 71 primary teeth (9 incisors and 62 molars), from 20 children aged 3-8 years, of both genders. The teeth had deep carious lesions and symptoms of inflammation of the coronal pulp. Treatment was performed under general anaesthesia, and with the technique of vital amputation. MedCem Portland cement was used as pulp capping agent. GIC was placed over the PC. Incisors were finally restored with composite and molars with preformed stainless steel crowns. Clinical and radiographic success and failure were recorded at 6, 12, 18 and 24-month follow-ups. The treatment success was measured using predetermined criteria and the results were statistically evaluated.

Result: After 12 months 69 teeth (97.18%) were assessed as successfully treated. After 24 months, the treatment of 66 teeth (92.96%) were defined as successful. The results showed a satisfactory success rate of pulpomoties using MedCem PC as a pulp agent in the primary dentition during the observation period.

Conclusions: Portland cement may serve as an effective and inexpensive material in primary teeth pulpomoties. Further studies and longer follow-up assessments are needed.

Keywords: Med-Cem Portland Cement, MTA, primary teeth, pulpotomy,

INTRODUCTION:

Pulpotomy is a widely used endodontic treatment in primary dentition. It is the treatment of choice in cases with reversible pulpitis, when caries removal results in pulp exposure or after traumatic exposure [1]. Vital pulpotomy consists of complete removal of the infected and inflamed coronal pulp and leaving the radicular pulp tissues. In order to enhance the treatment and to fix the remaining vital pulp tissue in the root canals and to preserve its vitality, the surface of the pulp should be covered with a therapeutic agent [2]. The aim is to remove the bacterial infection and to preserve the integrity of the dental arch by avoiding early ex-

traction of heavily decayed teeth thus - to reduce the risk of malocclusions [3].

During the years, different materials were used as drugs for pulpomoties: formocresol (FC), ferric sulphate, calcium hydroxide (CH), a calcium-enriched mixture and mineral trioxide aggregate (MTA) [4,5]. Research has shown different levels of success after application of these agents. Both their advantages and disadvantages have been reported [6].

The success of the therapy depends mainly on the correct diagnosis of the inflamed dental pulp and the selection of biocompatible and bioinductive material [7, 8]. An ideal pulpotomy agent must be bactericidal, promote healing of the radicular pulp, be biocompatible, offer the dentin-pulp complex a relatively stable environment, support the regeneration of dentin-pulp complex and not interfere with the physiological process of root resorption [9]. No evidence to identify one superior pulpotomy medication and technique was clearly found.

Recently a great interest has been focused on the evolution of Portland cement (PC) as an alternative to MTA [7,8,10]. Portland cement is the primary component of MTA [11]. There is no statistically significant difference between MTA and PC when comparing the compressive strength, the dimensional change, the setting time, the pH and the radiopacity [12]. MTA and PC have similar properties the only significant difference is a lower radiopacity of PC [13]. PC contains low aluminium and ferric oxide and the best biocompatibility, it is tested for heavy metal content esp. arsenic, cadmium and lead, it gives best chemical and physical properties and contains no radiopacity additives which induce discolouration i.e. bismutoxide [13].

The aim of the study was to evaluate the clinical and radiographic outcomes of Portland cement (PC) as a pulp capping agent in primary teeth pulpomoties after two years of follow up.

MATERIALS AND METHODS:

The study included 20 healthy children, without any allergy indications. The children, of both genders, were aged between 3-8 years and were all belonging to the ASA I (American Society of Anaesthesiologists) category. The

decision why the treatment was performed under general anaesthesia was taken after all children have attempted treatment using LA alone and been unable to co-operate and all children had deep decay in more than one quadrant (Guideline for the Use of General Anaesthesia (GA) in Paediatric Dentistry 2008).

A treatment plan with all necessary information was offered to the parents. A written declaration of an informed consent was given by the parents before the beginning of treatment.

The treatment was carried out on 71 primary teeth (9 incisors and 62 molars). All teeth were initially evaluated clinically and radiographically. Criteria for including teeth into the study were the following: Teeth with deep carious lesions presenting a potential risk of pulp exposure during the excavation, with symptoms of inflammation of the coronal pulp and without symptoms of spontaneous or/and night pain. The final decision on selection was based on an evaluation of the pulp tissue after coronal pulp amputation, of bleeding time and blood colour.

The criteria for the exclusion of teeth of the study was based on clinical and radiographic data. Clinical criteria for exclusion were spontaneous and/or night pain, tooth mobility, fistula, abscess (gingival redness and swelling) or systemic diseases. Radiographic criteria for exclusion were teeth which showed up more than 2/3 root resorption, periodontal ligament widening and periodontal and/or furcation bone resorption.

Technique of vital amputation:

The treatment was performed under general anaesthesia. Therefore, without additional local anaesthesia, the pulp chamber was opened with a high-speed, water cooled diamond bur. Followed by removal of the entire coronal pulp with a round high speed diamond bur and water cooling. The pulp chamber was rinsed with a sterile saline and sterile cotton pellets were applied on the radicular pulp

stumps under slight pressure for no more than 5 min. until haemostasis was achieved. If there was no successful haemostasis after 5 minutes the pulp tissue was assumed to be infected and the tooth was excluded from the study.

MedCem Portland Cement (PC) was used as pulp capping agent. The cement was prepared according to the manufacturer's instruction. Then, the materials were applied into the pulp chambers with a spatula. GIC (KetacCem radio pac) was placed over the Portland Cement.

Finally, the incisors were restored with composite (later on some of them were replaced with EZ-Pedo crowns) and molars - with preformed stainless steel crowns (3M-ESPE).

Follow up:

Clinical and radiographic success and failure were recorded at 3, 6, 12, 18 and 24-month follow-up. The treatment success was measured using predetermined criteria. A radiographic success was considered if there was a presence of hard tissue barrier formation (HTB), a pulp calcification (Pc), the absence of internal or external root resorption (R) and furcation radiolucency (FRL). Clinical criteria for failure was determined by spontaneous pain (SP), swelling (Sw), abscess (gingival redness and swelling), sensitivity to percussion, mobility (M), fistula (Fst). Radiographic failure was determined by periodontal ligament widening and periodical and furcation bone resorption (RR).

Statistical analysis:

Data were submitted to statistical analysis that was performed using the statistical software SPSS 17.

RESULTS:

After 3 months, the treatment of 70 teeth (98.59%) was assessed as successful. Only the treatment of one primary maxillary molar (tooth 54) was determined as failure. The tooth showed up intraoral swelling and fistula but no pain (tabl.1).

Table 1. Distribution of follow-up clinical and radiographic criteria after 3, 6, 12, 18 and 24 months.

m* N*	Clinical criteria		x-Ray criteria					Total	
	SP*	M*, Sw*, Fst*	R*	HTB*	Pc*	RR *	FRL*	S*	F*
3 m N		1 Tooth Sw, Fst						70	1
6 m N							1 Tooth	69	2
12 m N									
18 m N		1 Tooth – Sw; 1 Tooth - Fst						67	4
24 m N						1 Tooth		66	5

*N - number of teeth, m - month, SP - spontaneous pain, M - mobility, Sw - swelling, Fst - fistula, R - internal or external root resorption, HTB - hard tissue barrier, Pc - pulp calcification, RR - periodontal ligament widening and periodical and furcation bone resorption, S - success, F - failure.

After six months, a furcation radiolucency (FRL) was observed on the x-ray by the treated tooth 85, intraoral no pain, no swelling and no fistula were observed. Two incisors fillings 51,61 were replaced by Zirconia Crowns, be-

cause of severe filling abrasion.

After 12 months 69 teeth (97.18 %) were assessed as successfully treated (table 2).

After 18 months of treatment two teeth were deter-

mined as failure. One tooth 84 showed up swelling but no pain and one tooth 55 showed up fistula but no swelling and no pain (table 2).

Two years (24 months) after treatment only one tooth

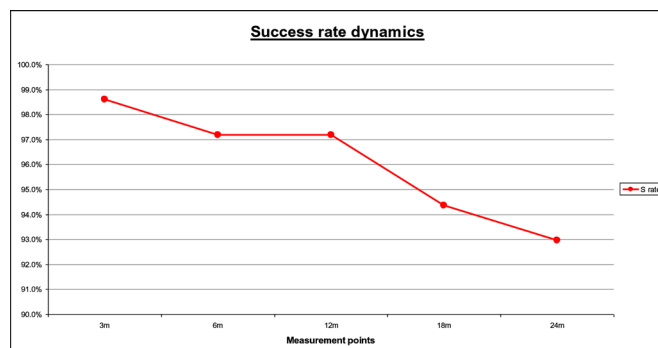
74 showed internal resorption (R) on x-ray and intraorally a low degree of mobility but without pain and fistula. Thus, the treatment of 66 teeth (92.96%) was defined as successful (table. 2).

Table 2. Success rate of pulpotomies using MedCem Portland Cement as pulp capping agent in primary dentition during the observation period.

Measure	Success rate	95% Confidence Interval		P
		Low border	Upper border	
3 m	98,59%	92,40%	99,97%	>0,05
6 m	97,18%	90,19%	99,66%	
12 m	97,18%	90,19%	99,66%	
18 m	94,37%	86,19%	98,45%	
24 m	92,96%	84,31%	97,68%	

The difference between the treatment in the beginning - 98.59% and in the end - 92.96% is not statistically significant for the tracked period. That means the success of 92.96% after 24 months does not differ to the success after 3 months 98.59%. There is a tendency of a declining success rate during the period of the two years, but this reduction is also not significant compared to the result given after the 3rd month. The highest success rate is 97,18% after one year and it is 92,96% after the second one (Diagram 1).

Diagram 1. Success rate of pulpotomies using MedCem Portland Cement as pulp capping agent in primary dentition during the observation period of 2 years.



DISCUSSION:

The study monitors the levels of clinical and radiographic success of PC as a pulp capping agent in pulpotomy in primary dentition during a period of two years.

In recent years PC has aroused great interest in research as an alternative to MTA. The reason for this interest is the same physical and mechanical qualities and at the same time lower cost of PC compared to MTA [7, 8, 12-15].

The main disadvantage of PC is that it is not radiopaque [10, 13, 15, 16]. The absence of radiopacity makes it difficult to distinguish PC from dentin and other anatomic structures and compromises the evaluation of biocompatibility between PC and the human pulp tissue [17]. To overcome this disadvantage of PC, different radiopaque additions are added and tests are performed with the

aim to evaluate their effect on its biocompatibility [17,18] and their impact on its physical and chemical qualities [10, 15, 16]. Some of the radiopaque additions can affect its strength and increase the setting time of PC [19] without changing its biological effect [18] but these additions lead to colour changing of the treated tooth [20].

The presence of a leachable amount of arsenic and lead in PC is one of the major concern about this material. Arsenic and lead are impurities of limestone that are used in the manufacturing of PC [12] Duarate et al., 2005 [21] showed that the concentration of arsenic is low in PC and closely similar to that present in MTA.

Portland cement is used since recently as a pulp capping agent in both dentitions [7]. Because of this, there are not enough results to be found for its use in teeth of the primary and secondary dentition in the specialised literature [22]. There are some experimental studies which compare both materials (PC and MTA) and which describe them to be very similar and to have the same effect as a pulp capping agent used in primary teeth [15]. Antibacterial activity and a similar effect on pulpal cells have been shown when MTA or PC are used for direct pulp capping in rat teeth [23].

In specialist literature results of clinical studies are shown in which Portland cement (PC) was applied as a pulp capping agent in pulpotomy of mandibular primary molars in children [22, 23]. A follow-up at 3, 6 and 12-months clinical and radiographic examinations of the treated teeth and their periradicular area revealed that the treatments were successful, the teeth maintained asymptomatic and preserved pulpal vitality [8, 17].

Our study showed a success of treatment in 69 teeth (97,18% tab. 1, 2, diag.1) after 12 months (Fig. 1 C, Fig. 3 B). Two teeth were considered as not successfully treated as swelling and fistula was determined, they were considered as a clinical failure, and a radiographic translucency was determined at the other tooth and this one was considered as a radiographic failure as well. After two years, our study using PC as a pulp capping agent was rated as successful in 66 (92,96%) teeth (tab. 1, 2, diag.1). The reason for treatment failure was swelling, fistula and resorption.

Fig. 1A, B. Diagnostic x-ray before treatment of teeth 85, 84, 74, 75 with cavitated deep caries lesions on the occlusal surface of a 4-year-old child. The treatment was performed under GA and technique of vital pulpotomy with PC for teeth 84, 85, 74, 75, 55. Finally the teeth were restored with stainless-steel crowns.

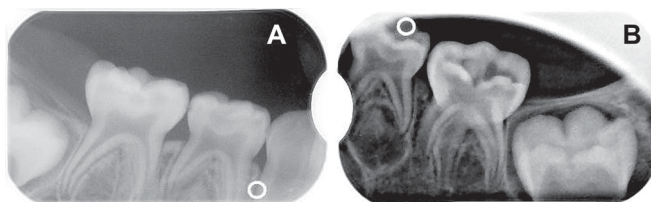


Fig. 1C. Panoramic X-ray of the same child 12 months after treatment. All treated teeth were asymptomatic, with any signs of failure.



Fig. 1D. Panoramic x-ray (same child) after 24 months. The tooth 55 was extracted after 18 months of treatment, there was an intraoral fistula. All treated teeth were asymptomatic and were considered as successful treated.



Fig. 2 A. Tooth 51,61 - 3 months after treatment with PC pulpotomy. Initially the teeth were restored with composite fillings. **B.** Because several filling loss after 6 months of treatment the teeth 51,61 were restored with EZ-Pedo crowns. **C.** Teeth 51, 61 - 6 month with EZ-Pedo crowns, x-ray after 18 months of treatment.

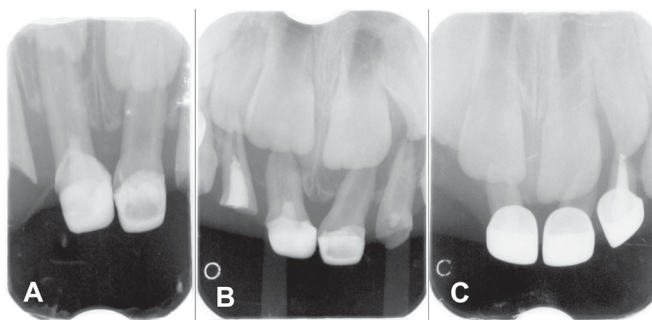


Fig. 3. A. Diagnostic x-ray showed deep carious lesion on 64. The tooth was treated with PC pulpotomy and restored with stainless-steel crown. **B.** Same tooth 12 months later without any clinical or radiographic-pathological signs.

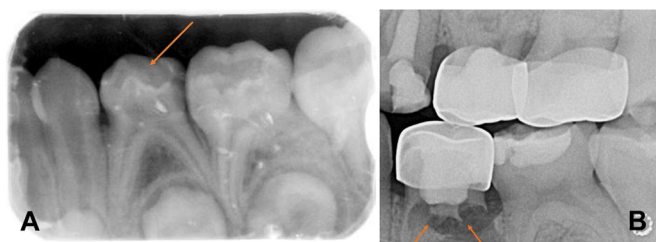


Fig. 3. C. Tooth 64 after 24 months of treatment. The tooth was asymptomatic.



In our study, we observed one tooth with root resorption after 24 months (Fig. 4 B) which was determined as a radiographic failure. Internal root resorption was regarded as a sign of radiographic failure because it is the result of the osteoclastic activity of inflamed pulp [24].

Fig. 4. A. Diagnostic x-ray of tooth 74 before treatment. **B.** Two years after treatment on the x-ray was registered an internal root resorption



The achieved results show a satisfactory performance of PC as a pulp capping agent and the results match with similar studies [18]. There were no significant differences between the clinical and radiographic outcomes of pulpotomy in primary molars treated with PC compared the high success rates using PC reported elsewhere in the literature [7, 8].

Data of successful results using PC in permanent dentition were also reported. Another case reported clinical success after 1 year follows up along with no signs of periapical rarefaction, therefore a PC plug was used for apexification with absorbable collagen sponge barrier [23].

Portland cement has shown good biocompatibility and tissue response. Through electron microscopy scanning it was revealed that human pulp cells attached to the Portland cement were flat and had numerous cytoplasmic extensions. These results suggest that Portland cement is biocompatible, allows the expression of mineralization-related genes on cultured human pulp cells, and has the potential to be used as a proper pulp-capping material [24].

A lot of information could be found in the literature for good results using MTA in pulpotomy in primary dentition [7, 8, 23]. Levels of clinical success were reported

within the range of 94.1%–100% [25-27] and radiographic success rates of 91%–100% [25, 27].

Our results using PC in pulpotomy are similar to the level of success of those using MTA (97,18% after the first year and 92,96% after the second year). For this reason, the use of PC can be considered as a good and effective alternative for MTA in primary dentition pulpotomy [21,29].

For successful treatment of pulpotomy it is essential to achieve an optimum cavity seal. For this reason, the final restoration is one of the most crucial concerns in pulpotomy. It should provide a perfect seal to prevent marginal leakage of the pulp capping agent [29].

The use of stainless steel crowns in the present study was aimed to increase the success rate of pulpotomy. As stainless steel crowns are considered to protect the underlying pulp against leakage they are necessary for a long-term success of pulpotomies [30]. Also, the fact that all patients were treated under GA might attribute to the high success rate of this study, eliminating the compliance of the patient. Although our results recommend the use PC as a pulpotomy agent, more studies with larger number of teeth and possibly longer follow-up period are needed to justify the use of Portland Cement.

CONCLUSION:

- Portland Cement may serve as an effective and inexpensive material in primary teeth pulpotomies.
- Further studies and longer follow-up assessments are needed.

Disclosure statement

No potential conflict of interest was reported by the authors.

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