SUCCESS FREQUENCY OF ROOT CANAL FILLING MATERIALS MOST USED IN PEDIATRIC DENTISTRY

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Palavras-chave: Pulpectomia. Dente Decíduo. Obturação do Canal Radicular.

RESUMO

Introdução: Não há consenso na literatura quanto ao material obturador ideal para canais radiculares de dentes decíduos. **Objetivo**: O objetivo deste estudo foi descrever os materiais obturadores para canais radiculares mais utilizados na clínica Odontopediátrica, mostrando os índices de sucesso observados. **Fonte dos dados**: Uma busca, limitada aos últimos 10 anos e sem restrição de idioma, foi realizada em outubro de 2018 nas bases de dados PubMed, Cochrane e LILACS usando os termos "pulpectomy" e "primary teeth". Esta revisão narrativa da literatura incluiu estudos clínicos controlados randomizados em crianças submetidas a pulpectomia como tratamento endodôntico, com, no mínimo, seis meses de acompanhamento clínico e radiográfico. **Síntese dos dados**: Foram recuperados nas bases de dados 254 artigos. Após a aplicação dos critérios de inclusão e exclusão um total de 25 artigos foram incluídos nesta revisão. A pasta à base de óxido de zinco e eugenol (OZE) foi o material obturador mais utilizado para canais radiculares de dentes decíduos em pesquisa clínica Odontopediátrica, mostrando sucesso clínico e radiográfico geral que variou de 63,3% a 93,3%. **Conclusão**: A pasta à base de óxido de zinco e eugenol é o material mais utilizado para a obturação de canais radiculares de dentes decíduos, embora exista uma tendência para a utilização de pastas à base de iodofórmio com hidróxido de cálcio, que apresentam altas frequências de sucesso.

Keywords: Pulpectomy. Primary Teeth. Root Canal Obturation.

ABSTRACT

Introduction: There is no consensus on the literature about the best root canal filling material for primary teeth. **Objective:** The aim of this study was to describe the root canal filling materials most widely used in clinical pediatric dentistry, showing the observed success rates. **Sources of data:** A search, limited to the last 10 years and, no language restriction, was performed in October 2018 in the PubMed, Cochrane and LILACS databases using the terms "pulpectomy" and "primary teeth". This narrative literature review included clinical and randomized controlled trials conducted on children who had undergone pulpectomy as root canal therapy, with at least six months of clinical and radiographic follow-up. **Synthesis of data:** A total of 254 papers were retrieved from the databases. After applying the inclusion and exclusion criteria, 25 papers were included in this review. Zinc oxide and eugenol (ZOE) based paste was still the most widely used root canal filling material for primary teeth in pediatric clinical research, showing an overall clinical and radiographic success ranging from 63.3% to 93.3%. **Conclusion:** ZOE based paste is still the most used material for root canal filling in primary teeth, although there is a trend in the use of iodoform with calcium hydroxide pastes, which show high frequencies of success.

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INTRODUCTION

Pulpectomy is the treatment indicated for primary teeth diagnosed with irreversible pulpitis with minimal physiological or pathological root resorption, not exceeding 1/3 of the root length, which could receive a final restoration. The rationale behind this procedure is based on cleaning, disinfecting and filling the root canal with a resorbable paste. However, the morphology of the root canal system of the primary molars is complex and makes the ideal cleanliness hard to achieve. Thus, root canal filling materials with antibacterial and anti-inflammatory properties are recommended. Until now, there has been no consensus in literature concerning the best root canal filling material for primary teeth,[1,2] although there is moderate evidence in favour of zinc oxide and eugenol (ZOE)-based paste, and iodoform with calcium hydroxide-based pastes.[2]

Since the first described root canal therapy in 1930 by Sweet who used a final procedure of canal filling with ZOE-based paste, this material has been used in primary teeth.[3] High success rates have been described for ZOE,[4–6] although this material presents a low resorbing rate, which has been associated with ectopic eruption of permanent successor teeth[7] and cytotoxicity.[8] With the aim of overcoming such drawbacks, alternative pastes have been proposed for root canal filling of primary teeth, including iodoform with calcium hydroxide-based pastes. These pastes have been used with reportedly high rates of clinical and radiographic success,[5,9] show antibacterial properties and are more easily resorbed than ZOE-based pastes.[2]

The aim of this study was to review the literature regarding the root canal filling materials most widely used in clinical pediatric dentistry, showing the clinical and radiographic success rates reported.

Study design

Electronic searches up to October 2018 were conducted using PubMed, Cochrane Library and LILACS electronic databases. The searched terms were "pulpectomy" and "primary teeth", limited to the title and abstracts fields. A 10-year publication limit was applied in the search performed in by two review authors (MS, ABN). No language restriction was applied. Titles and abstracts and, when needed, results and full text of the retrieved papers were read and evaluated by the two review authors (MS, ABN) for the identification of eligible studies. Any differences between the two readers were solved by consensus or by a third reviewer (AVBP). According to the eligibility criteria, clinical and randomized controlled trials conducted on children who had undergone pulpectomy as root canal therapy, with at least six months of clinical and radiographic follow-up and published between October 2008 and October 2018 were included in this review. There were no restrictions regarding patient's age, gender, ethnicity, tooth type or initial pulpal diagnostic condition.

Data extraction included: references (title, authors, year of publication, geographic location), type of study (clinical, clinical controlled, randomized controlled trial), filling materials used, sample size, follow-up period, and radiographic and clinical outcome with percentage success rate. The clinical and radiographic outcome considered the established criteria of each manuscript.

Synthesis of data

Initially, 111, 90 and 53 references were retrieved from PubMed, Cochrane library and LILACS, respectively. After the application of a 10-year post-publication limit, 82, 90 and 28 remained, and based on the inclusion and exclusion criteria, 25 papers were selected and included in this review.

The main characteristics of the selected studies were compiled (Table 1). Zinc oxide and eugenol-based paste was the most used root canal filling material (n=13). ZOE was the control material for the evaluation of pulpectomies performed with other filling materials.[5,10–13] Also, ZOE was the filling material chosen when the evaluation of other endodontic technique parameters was the main objective.[14–17] In the selected studies, the frequency of overall clinical and radiographic success ranged from 63.3%[11] to 93.3%,[18] however, no statistically significant variation was observed between the ZOE-based paste groups and the other root canal filling materials evaluated.[5,11–13,18] Likewise, ZOE was used in a study that evaluated restorative techniques.[19]

Iodoform with calcium hydroxide-based (I/CH) pastes were the root canal filling material used in nine studies.[5,6,9,10,13,18,20,21,29] This material was used as the control material in the evaluation of the pulpotomy procedure performed with other materials,[20] and in the evaluation of a biological approach, lesion sterilization and tissue repair technique, in the treatment of carious lesions with pulpal and periapical involvement using a mixture of three antibiotics (ciprofloxacin 200 mg, metronidazole 500 mg, minocycline 100 mg, mixed in a 1:1:1 ratio)[9]. Furthermore, an I/CH paste was the root canal filling material used in a study that evaluated different irrigant solutions[21]. The frequency of overall success reported ranged from 89%[5] to 100%.[18]

Calcium hydroxide was the root canal filling material used in three studies,[22–24] among which evaluated different restorative techniques,[22] and compared the outcomes of pulpectomies with those of pulpotomies with formocresol and ZOE paste as filling material.[23] Considering a long-term follow-up, a high frequency of overall success (92.3%) was observed for a calcium hydroxide-based material.[24]

***Table 1**: Characteristics of the included studies*

Reference	Study location	Filling material	Sample size	Follow up (months)	Results (success rates)		
					Overall success	Clinic success	Radiographic success
Chen[29]	China	ZOE	47 M	18		92.2%	88.2%
		I + CH (Vitapex®)	40 M			71.4%	53.6%
		ZOE+I+CH (Endoflas®)	51 M			96.2%	92.5%
Sahebalam[30]	Iran	ZOE	50 M	6		89.7%	79.5%
Cancio[31]	Brazil	I	8	36	75%		
Brustolin[32]	Brazil	CH + ZO	81	12	62.9%		
Tang[33]	China	I + CH (Vitapex®)	91 M	18	79%		
Reddy[34]	India	ZOE (intracanal medication - 3-MIX)	30	12		97%	97%
		ZOE (intracanal medication - formocresol)	30			83%	47%
Aminabadi et al.[28]	Iran	ZOE	40 M previous perforation repared with antibiotics and simvastatin	24			96.8%
			40 M previous perforation repared with MTA				0%
Al-Ostwani et al.[13]	Syria	ZO + propolis	16 M	12		93.5%	62.5%
		ZOE+I+CH (Endoflas®-chlorophenol free)	6 M			87.5%	81.3%
		I + CH (Metapex®)	16 M			87.5%	75%
		ZOE	16 M			87.5%	56.3%
Pramila et al.[10]	India	ZOE + I (RC Fill)	35 mandibulars M	30			94%
		I + CH (Vitapex®)	35 mandibulars M				90%
		ZOE (Pulpdent)	36 mandibulars M				97%
Rewal et al.[12]	India	ZOE	24 M	9		83%	100%
		ZOE+I+CH (Endoflas®)	26 M			100%	100%

***Table 1**: Characteristics of the included studies*

Reference	Study location	Filling material	Sample size	Follow up (months)	Results (success rates)		
					Overall success	Clinic success	Radiographic success
Khairwa et al.[26]	India	ZO + aloe vera gel	15 mandibulars M	9		86.67%	73.34%
Chandra et al.[11]	India	ZOE	30 M	12	63.31%		
		ZO + ozonized sesame oil	30 M		93.3%		
Howley et al.[20]	USA	I + CH (Vitapex®)	74 I	23			73%
Barcelos et al.[15]	Brazil	ZOE	40 T (G1=smear layer removed)	24	91.2%		
		ZOE	42 T (G2=smear layer not removed)		70.0%		
Louwakul & Prucksathamrongkul[21]	Tailand	I + CH (Vitapex®)	32 M (irrigated with saline solution)	18	97%		
			32 M (irrigated with chlorhexidine solution 2%)		93%		
Tannure et al.[16]	Brazil	ZOE	47 T	60	91.5%		
Tannure et al.[17]	Brazil	ZOE	18 I (G1=smear layer removed)	36	82.3%		
		ZOE	8 I (G2=smear layer not removed)		88.2%		
Subramaniametal.[18]	India	ZOE	15 M	18	93.3%		
		ZOE+I+CH (Endoflas®)	15 M		93.3%		
		I + CH (Metapex®)	15 M		100%		

Table 1: *Characteristics of the included studies*

Reference	Study location	Filling material	Sample size	Follow up (months)	Results (success rates)		
					Overall success	Clinic success	Radiographic success
Ramar & Mungara[6]	India	I + CH (Metapex®)	30 M	9	90.5%		
		ZOE + I (RC Fill)	34 M		84.7%		
		ZOE + I + CH (Endoflas®)	32 M		95.1%		
Nakornchai et al.[9]	Tailand	I + CH (Vitapex®)	25 M	12		96%	56%
		Antibiotics	25 M			100%	76%
Aminabadi & Farahani[19]	Iran	ZOE	144 T	24		81.5%	
Zulfikaroglu et al.[22]	Turkey	CH	15 T amalgam	12	73%		
			15 T resin TPH / Prime & Bond NT		93%		
			15 T Dyract / Prime & Bond NT		73%		
			15 T Dyract NRC / Prime & Bond NT		80%		
			15 T F-2000 / Prompt L-loop		87%		
Coser et al.[23]	Brazil	CH (Calen®)	23 M	48			90%
Trairatvorakul & Chunlasikaiwan[5]	Tailand	ZOE	27 M	12	85%		
		I + CH (Vitapex®)	27 M		89%		
Sari et al.[24]	Turkey	CH (Sealapex®)	62 T	36	92.3%		

Legend: ZOE = zinc oxide and eugenol; I = iodoform; CH = calcium hidroxide; PCFC = parachlorophenol; M = molars; I = incisors; T = teeth.

Endoflas® is a root canal filling paste composed of a powder component of iodoform, zinc oxide, calcium hydroxide and barium sulphate, and a liquid consisting of eugenol and paramonochlorophenol. The standard formulation was used in three studies compared with ZOE[6,12,18,29] and two with I/CH based pastes.[6,18,29] The authors reported a frequency of overall success for Endoflas® that ranged from 93.3%%[18] to 100%.[12] A chlorophenol-free formulation was clinically evaluated[13], and 87.5% and 81.3% clinical and radiographic success rates were obtained after 12-month follow-up.

DISCUSSION

For many years, ZOE paste has been the first-choice material for the filling of primary teeth with an indication for pulpectomy.[15] Furthermore, ZOE-based paste has remained the preferred material for root canal filling of primary teeth (85%) of the pediatric dentistry programs of U.S. dental schools, although the use of iodoform paste with calcium hydroxide has increased.[25] However, ZOE-based paste has some drawbacks, including the limited antibacterial effect, lower resorbing pace compared to physiological exfoliation of the primary teeth and irritation to the periapical tissues caused by eugenol.[2,11]

As an alternative to ZOE-based pastes, other vehicles have been added to zinc oxide powder, which is a mild astringent and topical protectant with a relatively antiseptic property. The combination of ozonated oil and zinc oxide, aimed at long-lasting antibacterial action, showed a clinical and radiographic overall success rate of 93.3% compared to the 70% obtained with ZOE-based paste.[11] When aloe vera, an anti-inflammatory, antibacterial and pain-relieving substance, was introduced the success rates observed were 100% and 73.34% for the clinical and radiographic parameters[26]. Likewise, the introduction of propolis, a natural antibacterial product, showed a higher frequency of clinical

success (93.8%) than other materials, although the radiographic success rate was lower (62.5%).[13]

Based on this literature review, the most widely used root canal filling material for primary teeth was the ZOE-based paste. Of the 25 articles in our literature search, 13 used ZOE as filling material. Our result corroborates the conclusion of two systematic reviews in the literature on ZOE-based paste for root canal filling of primary teeth. Barcelos et al.[1] compared the clinical and radiographic performance of ZOE-based paste with other root canal filling materials for primary teeth in a long-term follow-up. The overall success rates for the pulpectomies performed with the ZOE-based paste, with iodoform with calcium hydroxide and with calcium hydroxide alone were respectively 85–100%, 89–100% and 80%. Barja-Fidalgo et al.[2] compared the effectiveness of other root canal filling materials for primary teeth with the ZOE-based paste and concluded that both the latter and iodoform with calcium hydroxide were suitable materials.

Iodoform-based pastes have several favourable characteristics: i) they are effective in removing remaining infections, ii) they resorb quickly when extruded beyond the root canal apex, and iii) they are easily applied[5]. Different formulations of root canal filling materials containing iodoform are available and were identified in our search: i) iodoform, camphor, menthol and parachlorophenol;[27] ii) iodoform, zinc oxide, calcium hydroxide, barium sulphate, eugenol and paramonochlorophenol;[18] iii) iodoform, zinc oxide, calcium hydroxide, barium sulphate and eugenol;[13] iv) ZOE with iodorform;[6] and v) calcium hydroxide and iodoform.[5] In recent studies, an I/CH was used as control material for pulpotomies[20] and for the evaluation of pulpectomies that used the antibiotic paste.[9] Nakornchai et al.[9] found a similar frequency of radiographic success between the I/CH and antibiotic-based paste groups in the initial six months of follow-up. However, after 12 months, only 56% of the evaluated teeth were still filled with the I/CH paste. Trairatvorakul and Chunlasikaiwan[5] also observed the resorption of the material inside the root canals of primary teeth. Despite this I/CH drawback, the comparison of the overall success rates of the ZOE-based paste and iodoform with calcium hydroxide was 89% to 85%[5] and 89% to 100%.[1]

It is worth mentioning that the clinical and radiographic frequencies of success should be carefully analysed and compared, since there is no consensus regarding an ideal standard protocol for the pulpectomy procedure.[2] While most of the studies reported a single intervention visit,[5,6,9-13,17-19,21,22,24,26,32,33] other studies two-visits[9,15,16,23,28,29,31,34] and two did not present the information[20,30]. In addition, regarding the filling techniques, the use of lentulo spirals,[5,6,10-13,15,17,22-24,29,32,34] syringes[6,9,10,16,18,19,21,29,32,33] and K-file[32] were reported. Furthermore, the included studies presents some differences as type of study, sample size, inclusion and exclusion criteria and also clinical, radiographic and overall criteria for outcome evaluation, the comparison of results demand a certain amount of caution. However, we observed high clinical and radiographic success rates in the selected studies for all the proposed treatments.

The diversity of root canal filling materials identified in this study shows that the search for an ideal material for primary teeth is still an object of concern among pediatric dentistry researchers. Although the use of iodoform with calcium hydroxide-based pastes as a root canal filling material has increased, ZOE-based paste is still most widely used as endodontic filler for primary teeth, as a control material for other materials and for the evaluation of different technique parameters.

CONCLUSION

In light of this literature search, it can be concluded that ZOE paste is still the most widely used root canal filling material for primary teeth, although there is a trend towards the use of iodoform with calcium hydroxide-based pastes, which presents high frequency of success.

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