Partial Removal of Carious in Primary Teeth: A Systematic Review of The Literature

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Abstract

Partial caries removal has been considered a promising method to treat primary teeth especially in deep carious lesions, however its longevity and clinical and radiographic success still is controversy. So, the purpose of this systematic review was to determine the clinical evidence of partial carious removal in primary teeth as to longevity of restorer treatment and clinical and radiographic success. The PRISMA guidelines were followed. We searched in the PubMed, Embase, Cochrane Library, Scielo, BBO and LILACS databases. There were no language restrictions and time limitation and the last survey was conducted in February 2016. The terms used were "partial caries removal" and "primary teeth". The analysis was limited to clinical studies about partial carious removal in the primary teeth. After title, abstract and full versions reading, the data were extracted and the studies were subjected to the evaluation of risk of bias according to predetermined criteria of Cochrane Collaboration's tool. Narrative synthesis of the included studies was performed. Partial carious removal showed high clinical and radiographic success rates and longevity of restorations was satisfactory for this method. For the analysis of these criteria, two studies with low risk of bias and four of uncertain risk were included from 60 studies previously selected. There is evidence to support the partial carious removal in primary teeth as to longevity of restorer treatment and clinical and radiographic success.

Key Words: Primary teeth, Partial carious removal, Deep carious lesions, Caries dental

Introduction

The conservative Odontology focused at the treatment of carious lesions has been studied for some time. Increasingly less invasive techniques have been used for both early enamel lesions, cavities or not, as for dentin lesions [1,2] in order to preserve at the utmost the tooth structure and to maintain pulp vitality [3]. In Pediatric Dentistry, this is even more required, due to the difficulty in the management of children, as these techniques reduce the time of clinical work, since they are easily performed and often dispenses the use of anesthesia, facilitating the professional conduct [4-7].

The partial caries removal (PCR) has as biological aim to create a favorable environment for dentin remineralization. Such technique consists of removal of the infected dentin and maintenance of the affected dentin, followed by sealing with restorative material [8,9]. This has been indicated for the treatment of acute deep carious lesions in dentin, both in primary teeth as in permanent teeth [10] with the purpose of providing conditions for the pulp to react to aggressive stimulus, triggering a defense mechanism through dentin sclerosis and the formation of reparative dentin [3,11].

Certain criteria should be evaluated prior to the PCR execution, since this procedure is intended only for teeth that do not present clinical and radiographic manifestations of irreversible pulp pathology, such as: presence of fistula or edema, mobility not compatible with the degree of root resorption, spontaneous or night pain, change in radiopacity in the furcation area or periapex and external or internal radicular resorption [12-14].

The practical application of PCR is based on the following techniques: indirect pulp treatment, atraumatic restorative treatment (ART) and stepwise excavation. The indirect pulp treatment consists in maintaining the caries tissue closer to the pulp, and then covered with a biocompatible material [10]. In ART, in turn, the carious tissue is removed under relative isolation, using hand instruments, and then the tooth is sealed with glass-ionomer cement (GIC) [15]. The excavation stepwise is carried out in two sections and is characterized mainly by the removal of the necrotic dentin and the sealing of the cavity, for subsequent reopening and additional excavation [12,16].

The PCR is a promising method, since that, compared to TCR, both techniques showed similar results regarding the standstill of the process of carious lesions and longevity of restorations [17]. Authors reported clinical and radiographic success after PCR [5,13,18-24], it is feasible to preserve part of carious tissue under restorations, therefore achieving satisfactory results. On the other hand, authors have questioned the permanence of carious dentin intentionally left in the pulp wall, since there is a difficulty of adhesion regarding the material adhered to the carious dentin [25,26]. Furthermore, PCR may reduce the resistance to fracture of the dental structure [27].

Finally, PCR is reason for controversy in the literature, and it is necessary a consensus on the effectiveness of this method of treatment of carious process, with relevant evidence. Therefore, the objective of this systematic review was to determine the clinical evidence of PCR in the primary dentition regarding to (1) longevity of the restorative treatment and (2) clinical and radiographic success.

Study Design

Protocol, information sources and search

The recommendation of the PRISMA statement for the report of this systematic review [28] was as following:

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The research question was: "What is the effectiveness of PCR in primary teeth, regardless of liner and restorer materials, regarding to longevity of the restorative treatment and clinical and radiographic success?"

The searched databases were PubMed, Embase, Cochrane Library, Scielo, BBO e LILACS. There was no language restriction or time limitation, and the search was conducted until February of 2016. The terms used were "partial caries removal" and "primary teeth". Only original papers were considered. Reports, abstracts, letters, communications, literature reviews and textbooks chapters were discarded. The analysis was limited to clinical studies about partial carious dentin removal PCR in primary teeth.

Eligibility criteria

Clinical studies evaluating the longevity of restorations and/or clinical and radiographic success of PCR in primary teeth were included. Exclusion criteria were studies about: effect of sealing of pit and fissures in controlling early carious lesions on occlusal surfaces of primary teeth; complete removal and no caries removal; the dentin characteristics of primary teeth after PCR; PCR in permanent teeth and microbiology; comparison between liners and restorative materials.

Study selection, data collection process and data items

Initially two researchers (KMSM and DASM) independently screened titles and abstracts for primary selection. All the abstracts obtained were further assessed for eligibility. Then, the full-text articles were checked according to the inclusion criteria. The following data were extracted in each article: first author, type of treatment in which the PCR was carried out, sample size, age of participants, study review times, restoration longevity (percentage of present and satisfactory restorations in the study follow-up), clinical success (absence of signs and symptoms) and radiographic (no signs). When two researchers had not reached consensus in study selection and data extraction, another group member (MSSP) was consulted.

Risk of bias within individual studies

The risk of bias within studies was assessed by the same members mentioned previously, also independently, according to predetermined criteria for Cochrane Collaboration's tool for assessing risk of bias in clinical trial, as described in Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0. The criteria were: randomization and allocation of participants; Blinding of participants and professionals, blinding in the evaluation of results; incomplete results and other bias. For summary assessments of risk of bias, each work was evaluated following the score: L (Low risk of bias for all key domains), U (Unclear risk of bias for one or more key domains) and H (High risk of bias for one or more key domains) [29].

Summary measures of results

The results were evaluated by means of percentage of the longevity of restorations and clinical and radiographic success of PCR, as well as a narrative synthesis of studies was performed. The meta-analysis was not possible, once these studies had no comparable data.

Results

Study selection and characteristics

At first, 60 articles were identified; of these, 14 remained after reading the titles and abstracts. Finally, with the complete reading of the texts, 8 studies were excluded [7,23,30-35], according to the criteria already described (*Figure 1*). Therefore, the 6 remaining studies were included in this systematic review. The characteristics of the studies are presented in *Table 1*.

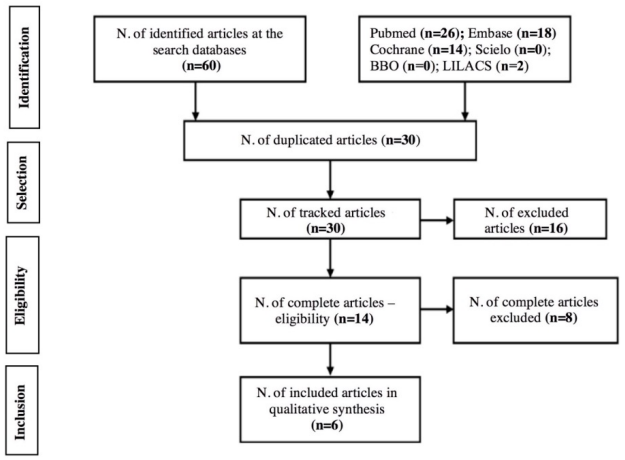

Figure 1. *Information flowchart of different phases of the Systematic Review. Adapted from PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement.*

Table 1. *Characteristics of included studies in this systematic review. * Atraumatic Restorative Treatment: ART; NI: Data not informed in the article.*

First author and Year of study	Type of treatment by which the caries partial removal was performed	Sample (number of participants)	Age range or age average of participants	Time of study evaluation	Longevity of restoration (%)	Clinical success (absence of signs and symptoms)	Radiographic success (absence of signs)
Franzon [34]	Indirect pulp cappmg	38	3 - 8 years	24months	82%	66%	NI
Franzon [6]	Indirect pulp	38	3 - 8 years	24months	NI	92%	92%

	cappmg						
Hesse [18]	Conventional restoration	19		6 months	NI	100%	100%
			4- 9 years	12 months	NI	100%	100%
				18 months	NI	100%	100%
Casagrande [32]	Indirect pulp capping (deep lesions) and Conventional restoration	66	5 - 9 years	18 months	87%	NI	NI
Phonghanyudh [33]	Conventional restoration	92	6 -11 years	6 months	89%	99%	99%
				12 months	83%	99%	99%
	Art	91		6 months	92%	100%	100%
				12 months	83%	100%	100%
Foley [35]	Conventional restoration Indirect pulp	43	6.8 years	24 months	76.7%	NI	NI
	cappmg	36			66.6%	NI	NI

Risk of bias within studies and results of the studies

The bibliography analysis raised presented relevant results to the present study. Four studies were classified as uncertain risk of bias [22,36-38] and two as low risk of bias [9,39]. The classification of the studies as to risk of biases is on *Table 2*.

*Table 2. Risk of bias assessment of the included studies in this critical analysis. *L: Low risk of bias for all key domains; U: Unclear risk of bias for one or more key domains.*

Clinical Studies	Generation of random sequence	Blinding of allocation	Blinding of participants and professionals	Blinding of outcome evaluators	Incomplete outcomes	Other sources of bias	Summarization of risk of biases
Franzon et al. [15]	low	uncertain	low	low	low	low	U
Franzon et al. [14]	low	low	low	low	low	low	L
Hesse et al. [16]	uncertain	uncertain	uncertain	uncertain	low	low	U
Casagrande et al. [7]	low	low	uncertain	uncertain	low	low	U
Phonghanyudh et al. [31]	low	uncertain	uncertain	low	low	low	U
Foley et al. [12]	low	low	low	low	low	low	L

Casagrande et al. [36], in order to evaluate the clinical performance of adhesive restorations of resin composite and resin-modified glass-ionomer cements in primary molars analyzed cavitated carious lesions (with radiographic Involvement of the inner half of the dentin), located on the occlusal and occlusal -proximal surface. The sample was divided into three groups: 1 – universal restorative system (Adper Single Bond 2 system and Filtek Z350); 2 – Resin-modified glass-ionomer cement (Vitremer); and 3 – Low shrink restorative system (Filtek P90). The estimate of survival for the longevity of restoration was assessed by the Kaplan-Meier method. The authors found that the survival rates in the follow-up were similar concerning the number of restored surfaces and carious dentin removal technique (partial or complete).

Phonghanyudh et al. [37] also evaluated clinical and radiographic performance of GIC in restorations of primary molars using three caries removal techniques: 1 – partial soft caries removal at enamel-dentine junction by spoon excavation; 2 – complete soft caries removal by spoon excavation; and 3 - conventional caries removal by steel burs. The dentinal carious lesions on occlusal and occlusal-proximal surface extending at, at least, one-third of dentine without signs and/or symptoms of irreversible pulpitis were included. The survival of the restorations was calculated by the Kaplan-Meier method. The results showed no statistically significant differences in survival of the restorations of GIC or pulp in the three groups.

Following a same analytical study profile, Hesse et al. [22] verified the efficacy of pits and fissures sealants in the detention of carious lesions in dentin in comparison with

partial removal and restorative treatment in primary molars. Patients with cavitary lesion on the occlusal of molars reaching outer half of dentin were randomly divided into two groups: sealant application (experimental group) and restoration with composite resin (control group). Clinical and radiographic evaluations were performed. The treatments survival rate was analyzed through the Kaplan-Meier test. The authors report that, with regard to differentiation of two types of treatment, there were no differences in the progression of caries when carious lesions in the outer half of dentin of primary teeth were treated with a composite resin restoration or resin-based sealant.

Trying to compare the survival of composite resin restorations in primary molars after PCR e TCR, Frazon et al. [38] conducted randomized clinical trial in children with deep carious lesions, in which, for PCR, excavation was stopped when hardened, dried dentin with a leathery consistency was achieved while the TCR group, the total absence of carious tissue was confirmed by a blunt-end probe. The pulp exposure occurred in 1 of the 15 teeth treated with PCR and TCR, respectively ($p<0.01$). PCR showed lower survival of restorations, increasing 2.90 times the probability to have a restorative failure ($p=0.03$). When the pulp exposure and restoration failure were considered as a result, there was no significant difference between the two groups.

Throughout the same study published in the previous year, Frazon et al. [9] aimed to compare the results of pulp health of primary molars after PCR and TCR with composite resin restoration. The methodology was the same. The obtained results demonstrated that pulp exposure occurred in 2 and 27.5% of teeth treated with PCR and TCR, respectively ($p<0.01$). The operation time was significantly higher for TCR. The difference between TCR and PCR remained insignificant, although there was a tendency for flaws (pulp necrosis) significantly higher in PCR.

Foley et al. [39] conducted a controlled randomized clinical study in order to determine the durability and efficiency of black copper cement (BCC) and GIC, when used to restore primary molars after PCR and compare the results with conventional cavity preparation and restoration. To this end, there was an analysis of patients previously non-restored, with cavitated carious lesions without pulp involvement in primary molars, divided into groups of three types of procedures: 1 – PCR followed by lining with BCC and restoration with GIC; 2 – PCR and restoration with GIC alone and 3 – TCR and conventional restoration. The durability and effectiveness of restoration were assessed clinically and by X-rays. During the experimental period, there were no differences in the proportions of lost restorations among the types of restoration, although PCR followed by BCC placement had shown significantly more abscess / fistula formation. In addition, fewer restorations were lost with TCR.

Discussion

The analysis of the results presented by the clinical trials associated with their specificities regarding the risk of bias led to relevant notes for this research.

Regarding the longevity of restorations preceded by PCR, no statistically significant differences were observed between PCR and TCR in primary molars [9,36,37]. The durability and efficiency of PCR was comparable to TCR [39]. The results of these studies indicated that PCR is a minimally invasive approach for reliable primary teeth, as well as providing other clinically relevant advantages, especially the lower incidence of pulp exposure and shorter operation time, corroborating the literature [3,6,7].

However, a reduced longevity of the restorations was demonstrated in a study in which PCR was performed [38]. This suggests these restorations must be monitored for a longer period than when the TCR is performed, especially when multi-surface restorations are involved. Furthermore, they also had lower incidence of pulp exposure and, consequently, less invasive treatments were required.

Clinical and radiographic evaluations showed similar results for dentin partial removal techniques (conventional restoration and ART) when compared to PCR [9,22,37], being noticed clinical and radiographic success in all teeth (100%) where PCR was carried out [22].

Therefore, this systematic review observed high clinical and radiographic success rates [9,22,37], although only one study has been considered as high evidence [9]. With regard to the longevity of the restorations, a good performance was found [36,37,39], highlighting the study pondered as high evidence [39]. In articles with uncertain risk of bias [22,36-38], the most presents were "Blinding of allocation", "Blinding of participants and professionals" and "Blinding of outcome evaluators", factors that may affect the accuracy of results.

Hence, PCR has been a promising method both for longevity of restorations as for clinical and radiographic success. However, additional clinical studies with low risk of bias should be performed so that a more accurate evidence of PCR in primary dentition is determined.

Conclusion

There is evidence to support the PCR in primary teeth as to longevity of restorations and clinical and radiographic success.

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