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ADVANCED ENDODONTIC DEVELOPMENTS IN PULPECTOMY OF PRIMARY TEETH

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ABSTRACT

Objective. To appraise studies about pulpectomy in primary teeth with nickel-titanium rotary files and smear layer removal and to find out may these developments enhance pulpectomy outcomes in primary teeth.

Material and methods. A systematic search was implemented for PubMed, Google and Google Scholar between the years 1995-January 2016 to identify eligible studies. Studies design was established according to the CEBM recommendations. Evidence quality of studies was appraised by risk of bias.

Results. Six studies about pulpectomy met the inclusion criteria, of which five were randomized controlled trials. Only one research demonstrates the enhanced outcome of pulpectomy in primary teeth with smear layer removal. Chosen studies have low overall evidence quality.

Conclusions. Given the paucity, high heterogeneity of high-quality articles and their level of bias, recommendation for the use of nickel-titanium rotary files and smear layer removal in pulpectomy in primary teeth can yet not be formulated.

Key words: primary teeth, pulpectomy, smear layer, root canal preparation.

Nonvital pulp treatment for primary teeth remains a significant problem in pediatric dentistry. All endodontic developments appear early in adult dentistry than in pediatric dentistry. In the last few years there has been a growing interest in advanced instruments and techniques in pulpectomy procedures. Previous researches have documented that rotary files

save time [1,2], have better cleaning (cutting) efficacy at canal preparation [3,4], and reduce significantly more bacteria in root canals of primary teeth than K-files [5]. The effect of smear layer removal in primary root canals [6,7] has been recently examined in pediatric endodontics. Previous reviews about pulpectomy in primary teeth have assessed the effectiveness of pulpectomy with different root obturation material [8,9,10]. Unfortunately, there are no reviews that address the problem of such advanced endodontic developments in root canal treatment as nickel-titanium rotary files and smear layer removal.

The objective of study was to appraise studies about pulpectomy in primary teeth with nickel-titanium rotary files and smear layer removal and to find out may these developments enhance pulpectomy outcomes in primary teeth.

MATERIAL AND METHODS

Searching strategy for identification of articles published between the years 1995-January 2016 was conducted by four reviewers independently through PubMed/MEDLINE, Cochrane Database of Systematic Reviews, Google Scholar. The search strategy was a combination of MeSH terms and free text words such as ‘nickel-titanium rotary files in primary teeth’, ‘irrigation in primary teeth’, ‘nonvital therapy in primary teeth’, and ‘pulpectomy in primary teeth’. The search was complementated by checking references of relevant review articles, eligible studies for additional useful publications, written and published in English.

Inclusion criteria were original clinical studies on pulpectomy of primary teeth with nickel-titanium rotary files and smear layer removal, studies between 1995 and January 2016, prospective studies. Evaluation of success based on both clinical and radiographic outcome measures. The relevance of the studies was evaluated by reviewers independently by a selection based on a title and an abstract, and full-text analysis was performed for further methodological appraisal. Studies design was established according to the CEBM

recommendations [11]. Evidence quality of studies was estimated by risk of bias independently; the studies were classified according to modified criteria proposed by Barcelos et al. [10]. Each criterion was assessed by answering yes, no or undetermined. No blinding for author, institute or journal was performed.

For each study, the following data were extracted by the four reviewers: study design, number of treated teeth, preoperative criteria, dropouts, and follow-up time, age range of study groups or mean patient age, treatment and outcome details, success rates of compared groups (%). Odds ratios (OR) and 95% confidence interval (CI) were calculated with MedCalc [12]. Heterogeneity was assessed visually.

RESULTS

A total of 64 papers were found in this search; 10 duplicates were excluded leaving papers for review by a title and abstract. Both reviews agreed on all included and excluded papers. A number of 33 articles did not satisfy the inclusion criteria because they were reviews (n = 6), guidelines (n = 3) or outside scope of this review (n = 27). A total of 24 articles fulfilled the inclusion criteria and were included for methodological appraisal. 18 papers were methodologically unacceptable because of study design or a follow-up period shorter than six months.

Six RCTs on pulpectomy in nonvital primary teeth were included for data analysis. Given the lack of information in English summary Mortazavi et al. [13] were contacted via e-mail, but they did not answer. Full text was available for data extraction after translation from Persian to English by the native speaker.

Table I presents multi-visit pulpectomy protocols, table II demonstrates single-visit ones. Follow-up period varied from 6 to 36 months, patient age varied from 3 to 9 years. Type of restoration was stainless steel crowns (SSC) [13,14,15], glass ionomer (GIC) [1,14], composite resin [14,16], and temporary crowns [1].

Two researchers [13,16] reported same inclusion criteria for nonvital treatment of primary teeth. Molars meeting of the following criteria were included: history of spontaneous pain, presence of an abscess or a fistula, gingival swelling, pain on percussion, and radiograph revealing the interradiolar radiolucency or periapical radiolucency less than a half of the root, without root pathological and internal resorption, restorable teeth. Other authors changed radiographic criteria and type of teeth [1,14,15,17]. Success criteria for treatment were formulated according to the following parameters: absence of pain, swelling or sinus tract, fistula, and abnormal mobility; reduction in the size of the radiolucent area that was previously observed in the preoperative radiographs and no newly formed radiolucency in the cases without radiolucency at the beginning of the treatment.

Included papers estimated pulpectomy outcomes performed on primary teeth with different types of instrumentation, irrigation and root filling material. Mortazavi et al. [13] reported about 100% success rate of pulpectomy with Pro Tapers (n = 20) and K-files (n = 20) after 6 months follow-up. In agreement with previous report Viyera et al. [1] demonstrated 95% success rate of pulpectomy with Pro Tapers (n = 15), K-files (n = 15) and rotary Light Speed LSX instruments (n=15) at the 12-24 month follow-up time. Guler et al. [17] compared the pulpectomy efficacy of conventional stainless-steel hand files (n = 60) to Pro Tapers (n = 60) after 12 months. Outcomes were not statistically different ($P > 0.05$), presenting 0.79 odds ratio (95% CI 0.3 to 2.06). In case series Kuo C-I et al. [15] found that the success rate of endodontic treatment in primary molars using Pro Tapers (n=51) for root canal preparation was 95% at the 12-month recall examination.

Two RCTs that evaluated the effect of smear layer removal by citric acid on success rate of pulpectomy had opposite results [14,16]. Tannure et al. [16] performed the pulpectomy on primary anterior teeth both with (n=17) and without 6% citric acid (n=17). Outcomes were assessed at 36 months, presenting lower success rate in the group without smear layer

removal, 82.3% and 88.2%, retrospectively (OR=0.62 at 95% CI 0.09 to 4.3). Barcelos et al. [14] performed the pulpectomy on primary teeth with smear layer removal (n=33) and without one (n=34), but changed NaOCl concentration on 2.5% and used the multi-appointment protocol. In contrast with previous report success rates were higher in the group with smear layer removal after 6, 12, 18, and 24 months, presenting odds ratio varied from 1.14 (95% CI 0.0683 to 19.1329) to 5.72 (95% CI 0.27 to 123.4).

Regarding the quality assessment articles were classified as low, moderate or high risk of bias (Table III). The study of Barcelos et al. [14] was designed according to the Consolidated Standards of Reporting Trials (CONSORT) that includes the allocation concealment mechanism.

Because of high heterogeneity of data generated by the use of different endodontic instruments, types of irrigation and root filling, and collected over different follow-up periods, a meta-analysis among the selected studies was considered to be inappropriate.

DISCUSSION

It was the purpose of this review to pay attention to the nickel-titanium rotary files and smear layer removal in pulpectomy protocols. Particular attention is paid to the question whether these developments may enhance treatment outcomes of pulpectomy in primary teeth.

Such preoperative criteria as clinically asymptomatic teeth and teeth without root resorption were only common in two included papers [13,16]. Other authors changed preoperative radiographic criteria by different way [1,14,15,17]. As was mentioned by Moskovitz et al. [18] if a tooth had a periradicular radiolucent defect before the RCT the chances of failures is higher than if such a defect was absent before the treatment. Thus, different radiographic criteria in included studies could affect treatment outcomes. Variable

inclusion criteria could bias the study findings. Therefore, common inclusion and exclusion criteria are required in future studies.

Three included studies [1,13,15] found no difference in success rate of pulpectomy between conventional and rotary instruments. Given the time saving and microbial reduction further studies are required to prove that rotary files increase the pulpectomy success in primary teeth.

The significant difference between the RCTs that evaluated the effect of smear layer removal by citric acid on success rate of pulpectomy [14,16] may be explained by the different number of appointments, the type of teeth, the follow-up period (respectively 24 and 36 months), and the different type of restoration. According to Moskovitz et al. [19] type of restoration is the important factor affecting the success rate of root canal treatment. Additional studies are needed to demonstrate that the smear layer removal improves pulpectomy outcomes in primary teeth.

The pulpectomy outcomes in included studies [1,13-17] have to be interpreted with some caution because these studies have the different follow-up period, the type of instrumentation, irrigation, and root filling; therefore, it is unclear which part of the intervention is having the primary effect on treatment outcomes.

Only RCT of Barcelos et al. [14] demonstrated enhanced treatment outcomes of the pulpectomy in primary teeth with such advanced technique as smear layer removal. Accordingly, this study has OR higher than 1 (Table 1). Two RCTs show low success rate with advanced developments [16,17] and have OR lower than 1. Odds ratio were not applicable for studies that found no difference in success rate of the pulpectomy with advanced developments [1,13,15] (Table 1). Included papers [14,16,17] have wide confidence interval indicating the small number of trials to make a precise estimate. Therefore, in order for

obtaining scientifically based evidence the number of participants required for a desired expected width of CI has to be determined by the formula [20].

RCT by Mortazavi et al. [13] had follow-up period less 12 months, which is short. Considering the outcomes of Barcelos et al. [14] worsened with time follow-up period might be a significant bias factor. Hence, long-term RCTs until the eruption of the permanent successor are required for selection of the best pulpectomy protocol in primary teeth.

Only RCT by Barcelos et al. [14] meet the criteria to qualify for low risk of bias and has allocation concealment. RCTs of Mortazavi et al. [13] showed high risk of bias as it failed to record information about blinding method, withdrawals and drop outs which is important for randomized clinical trial reports. Although the randomization method was adequate in Guler et al. [17] and Tannure et al. [16] studies, attempts to conceal allocation were not reported.

Considering the risk of bias the overall quality of evidence regarding pulpectomy in primary teeth is low. More high-quality RCTs on the pulpectomy with comparable outcomes are still necessary before obtaining a definitive answer to the question may advanced endodontic developments enhance treatment outcomes of pulpectomy in primary teeth.

This study has limitations, because we could not avoid possibility of selective reporting of trials dealt with only advanced endodontic developments.

CONCLUSIONS

There is limited number of high-quality clinical research articles (five RCTs and one CS) on pulpectomy in primary teeth, displaying high heterogeneity of data (different endodontic instruments, types of irrigation and root filling) that are collected over different follow-up periods. Only one research demonstrates the enhanced outcome of pulpectomy in primary teeth with smear layer removal.

There is a low evidence quality regarding pulpectomy in primary teeth with nickel-titanium rotary files and smear layer removal. However pediatric dentists want to use effective pulpectomy protocols that save time and decrease failure rate. Therefore, scientists have to solve out this problem. Evidence level strengthening can be achieved through well-designed randomized controlled clinical trials with follow-up until the eruption of the permanent successor tooth, compared developments in instrumentation, irrigation and root filling with conventional techniques. This will enable the formation of pulpectomy protocol for the best management of primary teeth.

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Table I. Characteristics of the multi-visit protocols for pulpectomy in primary teeth used in the studies included in this review.

Table II. Characteristics of the one-visit protocol for pulpectomy in primary teeth used in the studies included in this review.

Table III. Determination of the quality of the studies.

Table I.

Clinical procedures	Barselos et al. ¹⁴	<i>Mortazavi et al.</i> ¹³	Kuo et al. ¹⁵
Study design	RCT	<i>RCT</i>	Case series, 4
Samples	67	40	51
Age	from 2 to 9 years	5.7+0.92 years	from 3.2 to 7.7 years
Appointments	<p>First appointment: instrumentation, irrigation, cotton pellet with camphorated paramonochlorophenol put into pulp chamber and coated with warm gutta-percha, temporary filling.</p> <p>At asymptomatic cases second appointment – irrigation and filling of canals with ZOE, restoration.</p> <p>Third appointment- SSC.</p>	<p>First appointment: pulpotomy, cotton pellet with formocresol, second appointment – instrumentation and filling of canals with ZOE.</p>	<p>First appointment: Pro Tapers, SX and S2 with irrigation, after this a dry cotton pellet moistened with one-fifth diluted Buckley's formocresol was placed over the root canal orifices under temporary filling. At second appointment following copious sodium hypochlorite and normal saline irrigation the root canals were checked by H-file for cleanliness, then dried and filled.</p>

Root canal instrumentation	K files	Pro Tapers (S ₁ , S ₂ , F ₂) in the first group and K-files (10-30) in the second group	K-file 10 size, Pro Tapers (SX and S2)
Type of irrigation	2.5% NaOCl, with or without 6% citric acid, saline solution finally	saline solution	2.5% sodium hypochlorite and normal saline solution
Type of obturation	ZOE	ZOE	Vitapex
Type of restoration	GIC, composite resin, SSC	SSC	SSC
Follow-up period	6,12,18,24 months	6 months	12 months
Overall clinical and radiographic success rate	100% and 94%, 97,1% and 90,6%, 96,8% and 96,5%, 94% and 82.3%	100% in both groups	95%
Odds ratio (95% CI)	5.72 (0.27-123.4) 3.52 (0.35-35.68) 1.14 (0.07-19.13) 1.11 (0.02-57.55)	not applicable	not applicable

Table II.

Study, design	Study sample	Age	Root canal instrumentation	Type of root canal irrigating solution	Type of obturation	Follow-up period	Type of restoration	Overall clinical and radiographic success rate	Odds ratio (95% CI)
Guler et al. ¹⁷ , RCT	60	from 5 to 8 years	Pro Tapers or conventional stainless-steel hand files	0.4% CHX or 0.5% NaOCl and saline solution	ZOE or Apexit Plus	12 months	SSC	82% and 85%	0.79 (0.3 to 2.06)
<u>Tannure</u> et al. ¹⁶ , RCT	17	from 3 to 5 years	K files	1% sodium hypochlorite, saline solution, 6% citric acid	ZOE	36 months	composite resin	with acid 82.3%, without - 88,2%.	0.62 (0.09-4.3)
Vieyra et al. ¹ , RCT	45	from 4 to 7 years	K-files or Light Speed LSX	0.5% sodium hypochlorite, distilled water	Vitapex	12-24 months	GIC and temporary crowns	95%	not applicable

			instruments, or Pro Tapers	from EndoVac irrigation system					
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Table III.

Study	Exclusion and inclusion criteria defined	Description of randomization method	Description of allocation concealment	Description of evaluator blinding method	Report of withdrawals and drop outs report	Success and failure criteria defined	Risk of bias*
Guler et al. ¹⁹	Yes	Yes	No	Yes	No	Yes	B
Tannure et al. ¹⁸	Yes	Yes	No	Yes	Yes	Yes	B
Barselos et al. ¹⁶	Yes	Yes	Yes	Yes	Yes	Yes	A
<i>Mortazavi</i> et al. ¹⁵	Yes	Yes	No	No	No	Yes	C
Vieyra et al. ¹	Yes	Yes	No	No	No	Yes	C
Kuo et al. ¹⁷	Yes	No	No	No	No	Yes	C

*A – low risk of bias, when the answer was “yes” for all questions; B – moderated risk of bias, when the answer was “no” for one or two

question; C – high risk of bias, when the answer was “no” for three or more questions.