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ORIGINAL ARTICLE

Does Endodontic Re-Treatment in Primary Teeth Increase the Functional Tooth Retention? A Clinical, Retrospective, University-Based Study

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Abstract

Objective: To investigate the longevity of endodontic treatments and the survival of endodontic re-treatments performed in primary teeth. **Material and Methods:** The sample included endodontic treatments and re-treatments conducted in anterior and posterior primary teeth without sedation or general anesthesia among children attending a university dental service. Information collected retrospectively from clinical records was used for analyzing data. The Kaplan-Meier estimator test was used to analyze the longevity and survival of endodontic treatment and re-treatments, respectively. **Results:** A total of 73 patients with endodontic therapy in primary teeth were included in the study, and 116 teeth were analyzed. After one year, the longevity of endodontic treatments performed on primary teeth was 65.74% with an annual failure rate (AFR) of 34.2%. From 47 endodontic treatment failures, 14 teeth (29.8%) were endodontically re-treated. When the endodontic re-treatment was considered as survival, the longevity of treatments reached 68.06% with 31.9% of AFR after one year of follow-up. There was a significant increase in functional tooth retention in those patients that received an endodontic re-treatment ($p<0.001$). Retreatment provided an additional mean survival time of 8.3 months. **Conclusion:** Endodontic treatments performed in primary teeth presented a limited longevity. Endodontic re-treatment is a more conservative alternative for endodontically treated primary teeth that have failed and significantly increase tooth retention.

Keywords: Tooth, Deciduous; Root Canal Obturation; Pulpectomy.

Introduction

The early loss of primary teeth due to caries or trauma leads to functional, aesthetic and psychological sequelae in the pediatric patient and, therefore, the maintenance of these teeth in the oral cavity until the period of physiological exfoliation is among the main objectives of Pediatric Dentistry [1,2].

Although the worldwide population experienced an overall reduction of caries prevalence, its occurrence in the primary dentition is still high. Lesion progression may lead to irreversible pulp inflammation or necrosis and, consequently, the necessity to perform endodontic treatment. The occurrence of dento-alveolar traumatisms at preschool age is also of high prevalence, which may compromise pulp vitality and also requires endodontic treatment [1,3].

Endodontic treatment in primary teeth is indicated when there is irreversible pulpal inflammation or pulpal necrosis, and is considered a more conservative alternative in comparison with tooth extraction. The clinical diagnosis of these conditions comprises the presence of signs and symptoms such as spontaneous tooth pain, gingival edema (not resulting from gingivitis or periodontitis), fistula, dental mobility not associated with trauma or exfoliation, presence of apical / furcation bone radiolucency or radiographic evidence of internal or external inflammatory resorption [4].

There are several reasons that lead to an unfavorable outcome of endodontic treatment in primary teeth. The inherent complexity of the root canal system, which hinders the chemical-mechanical preparation, and consequently, the control of the microbiota; the difficulty of inserting the endodontic paste into the total working length of the canals; and the management of the child's behavior during the procedure, are conditions that may contribute to the treatment failure.

The clinical protocol used in the endodontic treatment of primary teeth varies widely among Brazilian universities [5]. Although some randomized controlled trials (RCTs) have a satisfactory success rate for primary tooth endodontics [6], the same rates are not reported in observational studies [2]. Recently, a university-based retrospective study [2] showed that endodontic treatments performed by dental students had a limited survival rate, reaching 62.9% after one year of follow-up. After the failure of an endodontic treatment in primary teeth, there are two clinical alternatives: tooth extraction or re-treatment. Studies have reported a high success rate of endodontic re-treatment in permanent teeth (91%), with very similar results when compared to the initial endodontic intervention (97%) [7]. Although endodontic re-treatment is a procedure often indicated as the first treatment option for cases of failure in prime pulp therapy of permanent teeth, there is no study in the literature that evaluates the endodontic re-treatment in primary teeth.

Thus, the present University-based retrospective study aims to investigate the longevity of endodontic treatments and re-treatments performed in primary teeth.

Material and Methods

Experimental Design and Sample Characteristics

The present retrospective analytical observational study was performed at the Child and Adolescent Clinic of the Faculty of Dentistry, Federal University of Rio Grande do Sul (UFRGS), Porto Alegre – Brazil, from January to May 2017. The convenience sample consisted of clinical records from patients submitted to endodontic treatments in primary teeth.

The procedures were carried out by 4th year undergraduate students or Dentists of the Specialization Course in Pediatric Dentistry - UFRGS, supervised by clinical staffs (Specialists in Pediatric Dentistry). The dental health care provide to patients includes preventive and / or curative approaches, according to the priorities of each individual case.

The patient´s records were selected according to the following inclusion criteria: a) Records of endodontic therapy in primary teeth; b) Clinical and / or radiographic follow-up of the endodontic treatment (presence of clinical examination before and after the endodontic procedure); and c) Records correctly filled in and signed by the person in charge of the patient, as well as by the clinical staff. The records were not included if: a) The endodontic treatment was not concluded; and b) Follow-up time of less than 7 days.

Clinical Protocol

The clinical protocol of endodontic treatment taught in Pediatric Dentistry Clinic (UFRGS) comprises one, two or more visits, depending on the behavior and clinical-related characteristics of the case. Usually, treatment is performed in a single visit for vital and non-infected teeth and a minimum of two appointments for teeth with abscesses, swellings or periapical and/or interradicular radiolucencies. The endodontic working length is determined by periapical radiography.

Following local anesthesia and rubber dam isolation, the pulp chamber is accessed and the canals are cleaned and shaped with Kerr files under copious irrigation with 1% sodium hypochlorite. The endodontic obturation of vital and non-infected teeth is performed in a single visit, by using a resorbable Calcium Hydroxide-based paste (thickened by zinc oxide - 3:1 weight proportion) mixed to a semi-fluid consistency, which is introduced into the root canal with a K-file and/or lentulospiral or Centrix syringe (anterior teeth).

In cases of pulp necrosis, final irrigation is performed with ethylenediaminetetraacetic acid (17% EDTA) for 2 min. An intra-canal dressing (calcium hydroxide propylene glycol paste) is placed into the canals of teeth with abscesses, swellings or periapical/interradicular involvement, remaining for approximately 15-30 days. The endodontic treatment is complete after this period, when the canals are re-accessed and filled with calcium hydroxide paste thickened by zinc oxide.

The teeth is restored with Resin-Modified Glass Ionomer Cement (RMGIC) or Composite Resin (CR). Immediate postoperative radiographs are obtained to determine the extent of the filling material.

Data Collection

The data was collected by two researchers and recorded in a specific worksheet prepared for the study (Microsoft Office Excel, 2007). Information on the individual level (age, gender, dmft, oral hygiene) and variables related to the endodontic treatment (dental type, pain, tooth condition, pulp diagnosis, chemical-mechanical preparation, intracanal medication, endodontic filling, restorative material, among others) were collected. The dates of the primary endodontic procedure and re-intervention (endodontic re-treatment or extraction), as well as the patient's last appointment, were considered to calculate the survival of endodontic treatments.

Outcomes

The outcomes were considered in two levels:

- Level 1 (Success): The longevity of endodontic treatments in primary teeth was established as the main outcome, defined as the period between the primary endodontic treatment and the last dental appointment (= censoring date) without the patient undergoing a re-intervention. The clinical and radiographic records of each patient were evaluated to verify whether the endodontically treated teeth required a re-intervention, which was considered as failure (endodontic re-treatment or extraction).
- Level 2 (Survival): Functionally retained primary teeth (functional tooth retention), even after endodontic re-treatment, were not considered as failure. The treatment was considered as failure, only when the tooth extraction was performed.

Clinical criteria for definition of success / failure were defined based on the information collected in the records concerning pain, swelling, fistula, sensitivity to percussion, and pathological mobility. Radiographic criteria for "Success" included the analysis, by comparison, of interradicular and/or periapical radiolucencies that should present the stabilization or regression of radiolucent area. Failure was considered in cases where there was an increase in the radiolucent area. A blind and calibrated examiner performed the evaluations.

Data Analysis

Data on endodontic treatment and re-treatment were included into a database, analyzed using Statistical Package for Social Sciences version 20.0 (SPSS Inc., Chicago, IL, USA) and expressed in frequencies and percentages according to the independent variables.

Survival curves were evaluated using Kaplan-Meier analysis. Differences in survival rates were tested by the Log-rank test and the level of significance was set at 5%. The annual failure rate (AFR) was calculated using the formula $(1 - y)^z = (1 - x)$, where "y" is the mean AFR and "x" is the total failure rate at "z" years.

Ethical Considerations

The study protocol was submitted and approved by the Research Committee (Protocol No. 25819) and by the local Ethics Committee (CAAE 24813613.7.0000.5347). Permission to use patient data was obtained through the consent and signature of the parents or guardians.

Results

A total of 232 clinical records were reviewed and, after applying the inclusion and exclusion criteria, 116 endodontic treatments performed in 73 patients were included in the analysis. The demographic characteristics of the sample, according to individual (patient) and clinical (tooth) parameters are shown in Table 1. Cohen's kappa coefficient for the intra-examiner reproducibility of radiographic evaluations was 0.98.

Table 1. Distribution of endodontic treatments and re-treatments performed on primary teeth according to individual and dental variables.

Variables	Endodontic Treatment	Endodontic Re-Treatment
Sex		
Male	37	7
Female	36	6
Clinical Profile		
Caries Free	1	-
Caries Inactive	1	-
Caries Active	71	14
Tooth Position		
Anterior	27	5
Posterior	89	9
Tooth Position in Dental Arch		
Maxillary	66	9
Mandibular	50	5
Status		
Trauma	4	-
Caries	84	11
Caries + Trauma	3	1
Restoration	12	1
Restoration + Adjacent Lesion	13	1
Pulp Diagnosis		
Necrosis	95	-
Irreversible Pulpitis	15	-
Not Reported	6	-
Pain		
No	105	14
Provoked	2	-
Spontaneous	9	-
Clinical Signs		
Absent	80	5
Present (Fistula/Swelling/Pulp Polyp)	36	2
Restorative Failure (Partial/Total Lost)	-	7
Radiographic Signs		
Absent	37	2
Present	74	7
Not Possible Evaluate	6	5
Apical/Furaction Lesion		
Absent	37	2
Between Roots (Posterior)	34	3
Apical Involvement (Posterior)	23	3
Apical (Anterior)	16	1
Not Possible Evaluate	-	5
	Mean (SD)	
Age (Years)	5.3 ± 1.7	
VPI*	28.6 ± 28.7	
GBI**	18.7 ± 32.4	
Dmf-t***	10.6 ± 4.7	

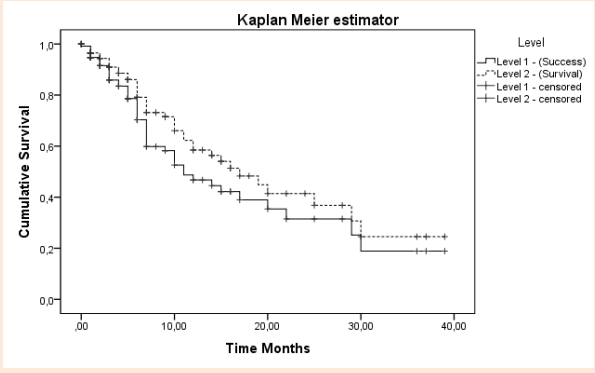
*Visible Plaque Index; **Gingival Bleeding Index; ***Decayed, Missing, Filled Tooth Index.

Endodontic treatment was more frequent in posterior primary teeth (61 second molars, 28 first molars) than in anterior teeth (25 incisors and 2 canines). The pulp condition at the moment of the diagnostic examination revealed pulp necrosis in 95 cases (81.9%), of which 73 had a periapical / furcation lesion, followed by irreversible pulpitis in 15 cases (12.9%). In 6 teeth, no pulpal diagnosis was reported in the clinical records.

A topic medicament was used over the pulp in 13.8% of the cases (Otosporin – 2.6%; Formocresol 11.2%). Sodium hypochlorite (1% NaOCl) was the irrigant solution most used for root canal sanification (98.0% of the cases). In most cases, the diameter of the canals was extended to n. 40 Kerr type file instrument for both anterior (35.7%) and posterior (29.2%) teeth. After the chemical-mechanical preparation of the root canals, 24.5% of the teeth were irrigated with EDTA; and 64.6% received intracanal dressing (calcium hydroxide propylene glycol paste – 56.0%; Calen – 4.3%; Iodoform-based paste – 4.3%). In 9% of the cases, the intracanal dressing was not reported; and 20.7% of endodontic treatment (24 teeth) was performed in one session. For all endodontic treatments, the root canal obturation was performed using calcium hydroxide paste with zinc oxide (3:1 weight proportion).

Composite Resin (CR) was the most used restorative material after the endodontic treatment (38.7%), followed by Resin Modified Glass Ionomer Cement (RMGIC = 20.7%) and conventional Glass Ionomer Cement (GIC = 14.6%). Other restorative alternatives, such as IRM and the association of CR and RMGIC, presented a low frequency (3.4%). In 22.6% of the cases, the restorative material used was not reported.

The longevity of endodontic treatments at 12 months was 65.74% (Level 1) with AFR of 34.2% (Figure 1A). Forty-seven primary teeth presented failure after the first endodontic treatment, being 14 teeth (29.8%) endodontically re-treated. The mean time between the first endodontic treatment and the second intervention (retreatment) was 190 days. From these teeth indicated for re-treatment, 78.6%% presented "underfilled" (filling material more than 2mm short of the radiographic apex) after the first endodontic intervention.



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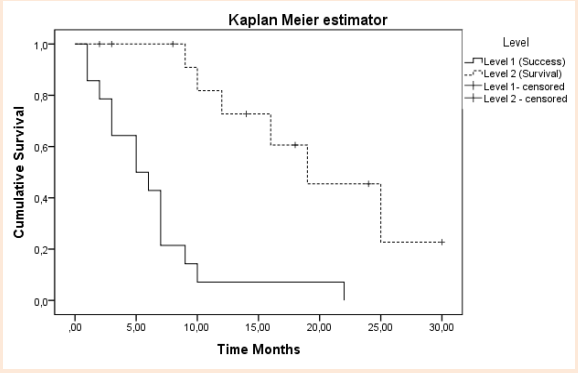

B

Figure 1. Kaplan-Meier survival curves. The differences between the curves were tested by the Long-rank test (A) Longevity of endodontic treatments performed on primary teeth (n = 116), considering Level 1 and Level 2 outcomes (p = 0.14). (B) Survival of primary teeth in the primary endodontic treatment and after endodontic re-treatment (p<0.001).

Most of cases of endodontic retreatment were performed in one session (9/64.3%). When the teeth were retreated in two sessions (5/35.7%), calcium hydroxide propylene glycol paste was the intracanal dressing material of choice. When considering re-treatment as survival, treatment longevity reached 68.06% with 31.9% of AFR, after one year of follow-up (Figure 1B).

Considering "tooth retention" as a secondary outcome, there was a significant difference in functional tooth retention time for teeth that received re-treatment ($p<0.001$). Endodontic re-treatment provided an additional mean survival time of 8.3 months.

Discussion

This retrospective university-based study was based on records of clinical procedures and radiographic evaluation of endodontic treatments and re-treatments performed in primary teeth. Overall, the results demonstrated a limited longevity for endodontic treatments. The survival rate of primary endodontics at 12 months was 65.7% (Level 1) and annual failure rate was 34.2%. When the re-treatment was considered as survival (Level 2), the longevity of treatments reached 68.0% (AFR = 31.9%). However, considering only teeth that received endodontic re-treatment (14 teeth), there was a significant increase in their functional retention.

Several factors may have contributed to this limited success rate. The sample included in this study consisted basically of patients with low socioeconomic level and a high caries experience (dmft = 10.6 ± 4.7), who seek dental care in a university due to the low cost of treatment. Previous studies have already demonstrated a significant association between low socioeconomic status and restricted longevity of restorative procedures [8].

The low age of patients associated with the limited experience of the operators, can also be considered as influencing factors in the treatments outcome. It has already been shown that less experienced dentists produce restorations with lower longevity in primary teeth [9]. If this association has been shown to be significant for restorative procedures, it is likely that for the endodontic technique in primary teeth, the result may be even more limited since, in addition to the final restorative step, the protocol involves the chemical-mechanical preparation and filling of the endodontic canal.

An interesting fact that should also have contributed to the low levels of success is that, even presenting a high frequency of cases of pulp necrosis (81.9%), only 24.5% of the teeth received dentin treatment with EDTA. In a randomized controlled clinical trial with primary teeth, the smear layer removal before the root canal filling proved to be statistically superior for the clinical and radiographic outcomes compared to those teeth without smear layer removal, especially when teeth presented pulp necrosis or preoperative pain [10]. In these cases, when the dentin pre-treatment was performed with a 6% citric acid solution, the smear layer removal from the dentinal tubules allows the medication/endodontic dressing to have direct action on the microorganisms that internally colonize the dentinal tubules. Thus, although this step is indicated in the endodontic protocol of primary teeth with pulp necrosis, this step seems to have been neglected.

Although there is no consensus regarding the endodontic protocol for primary teeth, recent studies have demonstrated the importance of using an intra-canal medicament between sessions in order to decrease the microbial contamination of root canals (11). From these perspectives, the endodontic protocol for primary teeth taught and practiced at UFRGS contemplates the use of an intra-canal dressing (calcium hydroxide) between sessions in cases of fistula, swelling, suppuration and pulp necrosis with or without furcation/periapical involvement.

It is important to highlight that teeth that received endodontic re-treatment showed a significant increase in survival. This is particular important because depending on the odontogenesis stage, this increase in functional retention may allow, for example, the eruption of a permanent first molar in a more adequate occlusion position, for posterior placement of a space-maintaining device. Thus, both endodontic treatment and re-treatment should be considered not only from the point of view of pulp diagnosis and prognostic of the treated teeth, but also in a broader treatment plan, contemplating the occlusion development of the patient.

The American Academy of Pediatric Dentistry (AAPD) indicates endodontic treatments in deciduous teeth following a protocol in which the root canals are debrided and molded with hand instruments and irrigated with 1% sodium hypochlorite solution for decontamination and then filled with resorbable material. However, it does not indicate which course to take against the failure of treatments, which are indicated as presence of signs and symptoms, absence of bone deposition in the radiolucent areas pre-treatment and pathological reabsorption of the root [4].

The low number of endodontically treated teeth and the relative short follow-up time are limitations of the present study. However, despite the low frequency of re-treatment cases, endodontically re-treated primary teeth showed a significant increase in functional tooth retention. Up to date, no information on re-treatment of primary teeth after endodontic treatment failure was found in the literature. Further studies with a larger sample, longer follow-up time and that include functional retention as an outcome are necessary to clarify the effectiveness of re-intervention.

Conclusion

Overall, the results demonstrated a limited survival of endodontic treatment performed in primary teeth, however, teeth that underwent endodontic re-intervention showed a significant increase in functional tooth retention. This may benefit patients with the first permanent molar in process of eruption, as the presence of a second primary molar in the dental arch could guide them to a more desirable occlusion position. Furthermore, the essential steps of the endodontic treatment, including the smear layer removal of necrotic teeth, as well as the dental caries profile of the patients may play an important role in the success of the treatment, and then, should be evaluated in future studies.

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Conflict of Interest: The authors declare no conflicts of interest.

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