# The clinical success of different root canal treatments in primary molars

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Received: 19 June 2012 Accepted: 14 August 2012

**ABSTRACT**

**Objectives:** To examine the success rate of root canal treatment in primary molars with the use two different root canal instrumentation ways, irrigation solutions and root canal sealers.

**Materials and Methods:** Root canal treatment was applied to 120 second primary molars of 69 children between 5-8 years old. The teeth were divided in 8 groups randomly according to instrumentation ways [conventional stainless-steel hand files / Nickel-titanium (Ni-Ti) rotary files], irrigation solutions [0.5% sodium hypochlorite (NaOCl) and 0.9% saline solution combination / 0.4% chlorhehexidine (CHX)] and root canal sealers [Zinc oxide eugenol cement (ZOE) and Apexit Plus (AP)]. All teeth were restored with stainless steel crowns. The teeth were followed 12 months both clinically and radiographically. All data was analyzed statistically by $\chi^2$ and Wilcoxon test.

**Results:** Statistical significance were found according to "age" and "root canal sealers" factors on success rate of root canal treatment ($p<0.05$). No statistical significance were found according to gender, jaw, tooth type, root canal instrumentation ways and irrigation solutions on success rate of root canal treatment ($p>0.05$). The clinically and radiographically success rate of ZOE and AP were 98.3% and 68.3%, respectively.

**Conclusions:** Root canal treatment is a successful treatment in primary molars. Ni-Ti rotary files and CHX can be a good alternative for root canal treatment in primary molars. The most effective factor to obtain clinical success of root canal treatment is properties of using root canal sealer.

**Keywords:** Primary second molar, root canal treatment, conventional stainless-steel hand file, nickel-titanium rotary files, NaOCl, CHX, ZOE, apexit plus.

## INTRODUCTION

One of their principal goals of paediatric operative dentistry is to protect primary teeth in a healthy state until normal exfoliation occurs.[1] Root canal treatment procedures have been recommended to prevent premature loss of primary teeth even with evidence of severe chronic inflammation or necrosis in the radicular pulp.[2] One of the principal objectives of root canal treatment in primary molars is to protect from bacteria, inflammation and external aggressions the forthcoming permanent teeth and keep the path of eruption.

The success of root canal treatment depends on the method and the quality of instrumentation, irrigation, disinfection and three-dimensional obturation of the root canal.[2-7]

Nickel-titanium (Ni-Ti) rotary files in primary teeth root canals as in vivo was first described by Barr et al.[8] Recently, some researches have been prepared limited study as in vitro related to using in primary teeth of Ni-Ti rotary files. [9-13] These studies explained that Ni-Ti rotary files can be used successfully for root canal treatment in primary teeth.

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Irrigants such as 0.5-1% sodium hypochlorite (NaOCl) or 0.4% chlorhehexidine (CHX) solutions can be used in primary teeth.[14] However, using NaOCl for irrigation in primary teeth can damage peripheral tissues, oral mucosa and underneath permanent tooth follicles, so it has been suggested that CHX should be used as an alternative to NaOCl.[15]

Selection of root canal sealers is also important for success of endodontic treatment. Zinc oxide-eugenol cement (ZOE) was first described by Sweet in 1930 and recommended for primary teeth were first root canal sealers.[16] However, discussion is still the resorption rate of ZOE. Researches explained that the resorption rate of ZOE different from physiologic root resorption.[17,18] In addition, authors explained that it was likely causing enamel defects in underneath permanent tooth and might deflect the path of eruption of the permanent teeth.[18] Also, it can cause a mild foreign body reaction when extruded beyond the apices.[18,19] Apexit Plus (AP) sealer is based on calcium hydroxide. A study related to AP in primary teeth is not found in literature.

The aim of this study is to determine the clinical and radiographic survival rate of second primary molars which was practiced root canal treatment by using two different root canal instrumentation strategies (conventional stainless-steel hand file and Ni-Ti rotary files), irrigation solutions (0.5% NaOCl and 0.9% saline solution combination and 0.4% CHX) and root canal sealers (ZOE and AP).

## MATERIAL AND METHODS

This study was designed as a randomized single-blind clinical trial. The study comprised 120 second primary molars (50 upper jaws and 70 lower jaws) of 69 children (38 males, 31 females) aged between 5-8 year old (average 6.91 ± 1.08 years). The participants were recruited from the patients who were referred to the pediatric dental clinic of the Ataturk University School of Dentistry. The study was reviewed and approved by the Ethical Committee of Health Sciences Institute of Ataturk University (01.01.2006/22). The clinical procedures were explained to each child and the parents, and written informed consents were obtained from the children's parents before to the procedures.

**Patient Selection Criteria:**

The inclusion criteria for each participant: all participants displayed no signs of acute illness, infection, immunological disease, or blood coagulation disorder, and had no history of allergy to local anesthetics and other drugs. In addition, each participant had to achieve a score of at least 3 from the Frankl scale[20] (Rating 1: Definitely negative, Rating 2: Negative, Rating3: Positive and Rating 4: Definitely positive).

***Clinical Selection Criteria of the Teeth:***

Root canal treatments were performed in 120 second primary molars (50 upper jaws and 70 lower jaws). Clinical selection criteria of the teeth were tenderness to percussion/palpation, and history of spontaneous pain or pain at night. In addition, there was no presence of abscesses, swellings, sinus tract and pathological mobility.

***Radiographic Selection Criteria of the Teeth:***

Radiographic selection criteria were score 3 or 4 according to the caries detection scale of Ekstrand et al.[21] (there had to be radiolucency in one-third of the middle or pulpal dentine), score of $Res_i$ (resorption of the root had not yet begun) or $Res_{1/4}$ (resorption of the root was just beginning) according to the root resorption degree scale of Fanning[22], normal position of the underneath permanent teeth, intact lamina dura and normal thickening of periodontal membrane. In addition, there was no presence of furcal or periapical radiolucency, internal or external

pathological root resorption, and pulp canal obliteration.

**Root Canal Treatment Procedure:**

All pulpectomies were performed 1-visit and by experienced pediatric dentist (CG). After administration of local anesthesia, each selected second primary molar was isolated with a rubber dam. After removing the carious tissue using a #11 low speed hand piece bur (NTI, P11.002, Germany), the roof of the pulp chamber was penetrated using a #330 diamond high speed bur (NorthBel, 820/042, Italy). The pulp tissues were removed with barbed broaches and the working length was determined by a periapical radiograph. The teeth were treated randomly according to instrumentation files, irrigation solutions and root canal sealers as follows (Table I):

Group 1 (G 1, n=15): instrumentation with conventional stainless-steel hand file (FKG Dentaire, La Chaux-de-Fonds, Switzerland) + irrigation with 10 ml 0.5% NaOCl (Sultan Chemists, Inc, Englewood, NJ) and 10 ml 0.9% saline solution (İ.E. Ulagay, Istanbul, Turkey) combination (the one after the other) + obturation with ZOE (Sultan Chemists, Englewood, USA).

Group 2 (G 2, n=15): instrumentation with conventional stainless-steel hand file + irrigation with 10 ml 0.5% NaOCl and 0.9% saline solution combination (the one after the other) + obturation with AP (Ivoclar Vivadent AG, Schaan, Liechtenstein).

Group 3 (G 3, n=15): instrumentation with conventional stainless-steel hand file + irrigation with 10 ml 0.4% CHX (Drogsan, Ankara, Turkey) + obturation with ZOE.

Group 4 (G 4, n=15): instrumentation with conventional stainless-steel hand file + irrigation with 10 ml 0.4% CHX + obturation with AP.

Group 5 (G 5, n=15): instrumentation with Ni-Ti rotary files (Protaper, Dentsplay Maillefer, Switzerland)+ irrigation with 10 ml 0.5% NaOCl and 10 ml 0.9% saline solution combination (the one after the other) + obturation with ZOE.

Group 6 (G 6, n=15): instrumentation with Ni-Ti rotary files + irrigation with 10 ml 0.5% NaOCl and 10 ml 0.9% saline solution combination (the one after the other) + obturation with AP.

Group 7 (G 7, n=15): instrumentation with Ni-Ti rotary files + irrigation with 10 ml 0.4% CHX + obturation with ZOE.

Group 8 (G 8, n=15): instrumentation with Ni-Ti rotary files + irrigation with 10 ml 0.4% CHX + obturation with AP.

Root canals were shaped and irrigated according to groups. Root canals were dried with sterile paper points, and then filled with ZOE or AP using clockwise rotating lentulo spirals to standardize the obliteration technique. Radiographs were taken to determine whether the root canals were completely filled. All teeth were restored with stainless steel crowns (3M ESPE, St Paul, USA).

**Evaluation Procedure:**

The teeth were evaluated by experienced pediatric dentist (TG) who was blinded to the type of instrumentation ways, irrigation solutions and root canal sealers that was used in each tooth. Teeth evaluated during 12 months as clinical in every 3 months and radiographical in every 6 months. The treatment was judged to be successful when both the clinical and radiographic criteria were fulfilled. The treatment was considered as failure when one or more of the following clinical or radiographical signs were observed.

These clinical signs of failure were swelling on the vestibular sulcus, color change in the vestibular mucosa, the presence of sinus tract, pathological mobility, tenderness to percussion, and lymphadenopathy in the associated region and asymmetry on face.

The radiological signs of failure were periapical and furcal radiolucency, internal and/or external pathological root resorption, and pulp canal obliteration.

**Table 1.** The distribution of groups according to the instrumentation files, irrigation solutions and root canal sealers.

| Groups | İnstrumentation Files | İrrigation Solutions | Root Canal Sealers |
|---|---|---|---|
| **G 1** | Conventional stainless-steel hand file | 0.5% NaOCl and 0.9% saline solution combination | ZOE |
| **G 2** | Conventional stainless-steel hand file | 0.5% NaOCl and 0.9% saline solution combination | AP |
| **G 3** | Conventional stainless-steel hand file | 0.4% CHX | ZOE |
| **G 4** | Conventional stainless-steel hand file | 0.4% CHX | AP |
| **G 5** | Ni-Ti rotary files | 0.5% NaOCl and 0.9% saline solution combination | ZOE |
| **G 6** | Ni-Ti rotary files | 0.5% NaOCl and 0.9% saline solution combination | AP |
| **G 7** | Ni-Ti rotary files | 0.4% CHX | ZOE |
| **G 8** | Ni-Ti rotary files | 0.4% CHX | AP |

**Statistical Analysis:**

The data were analyzed using the SPSS 15.0 statistics program (SPSS Inc., Chicago IL, USA) for Windows at the 5% significance level. The $\chi^2$ test was used to determine the the effect of "age, gender, jaw, tooth type, root canal instrumentation ways, irrigation solutions and root canal sealer" factors on success rate of root canal treatment. Wilcoxon test was used to determine the differences of survival rate according to the "age, gender, jaw, tooth type, root canal instrumentation ways, irrigation solutions and root canal sealers" factors. Kaplan Meier analysis was used to determine survival time as graphically.

**RESULTS**

20 of the 120 treated teeth were determined failure during 12 months. These 20 teeth were deemed both clinically and radiographically as failure. Failure distribution according to groups: 1 specimen in G 1, 5 specimens in G 2, 3 specimens in G 4, 7 specimens in G 6 and 4 specimens in G 8.

When $\chi 2$ test evaluated the effect of "age, gender, jaw, tooth type, root canal instrumentation ways, irrigation solutions and root canal sealers" on success rate of root canal treatment, statistical significance difference was found for "age" and "root canal sealers" factors ($P<0.05$) The differences were result from the age 8 for "age" and AP sealer (based on calcium hydroxide) for "root canal sealers". The clinically and radiographically success rate of 5, 6, 7 and 8 ages were 100%, 89.7%, 87.9% and 69%, respectively (Table II). The clinically and radiographically success rate of ZOE and AP were 98.3% and 68.3%, respectively (Table III). No statistical significance difference were found according to gender, jaw, tooth type, root canal instrumentation ways and irrigation solutions on success rate of root canal treatment ($p>0.05$).

Figure 1 presented the survival rate graphic according to "age" factor. Figure 2

presented the survival rate graphic according to "root canal sealers" factor. Figure 3 presented the example of failure conditions as clinically and radiographically.

**Table 2.** Failure distribution according to "age".

| Ages | Treated Teeth Number | Failure Teeth Number | Survival Rate (%) |
|---|---|---|---|
| 5 | 16 | 0 | 100 |
| 6 | 29 | 3 | 89.7 |
| 7 | 33 | 4 | 87.9 |
| 8 | 42 | 13 | 69 |

**Table 3.** Failure distribution according to "root canal sealer".

| Sealers | Treated Teeth Number | Failure Teeth Number | Survival Rate (%) |
|---|---|---|---|
| ZOE | 60 | 1 | 98.3 |
| AP | 60 | 19 | 68.3 |

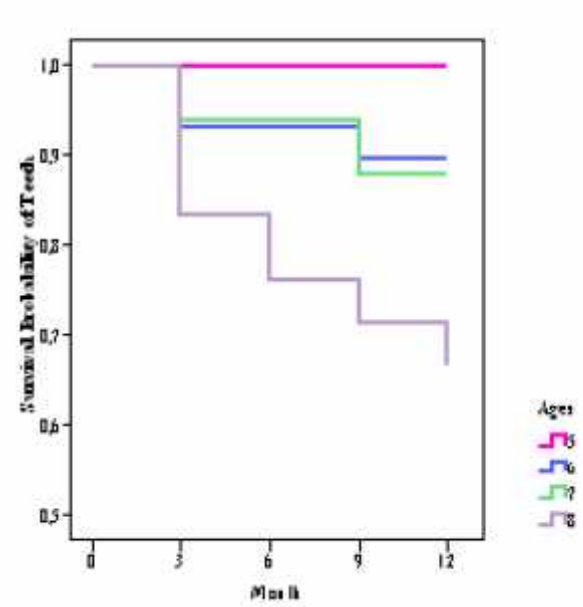


**Figure 1.** Survival rate graphic according to "age" factor.

## DISCUSSION

Primary teeth have different anatomical characteristics from permanent teeth, so caries lesions in primary teeth progress more quickly and affects the pulp.[23,24] The main objective of endodontic treatment in infected primary teeth is to remove effectively the infection. For this purpose, treatment is more frequently pulpotomy (root canal treatment) than pulpectomy.[25,26]

In this study, root canal treatments in second primary molars were evaluated as clinically and radiographically during 12 month. 20 of the 120 treated teeth were determined both clinically and radiographically failure. When $\chi 2$ test evaluated the effect of "age, gender, jaw, tooth type, root canal instrumentation ways, irrigation solutions and root canal sealers" on success rate of root canal treatment, statistical significance difference was found for "root canal sealers" factors ($P<0.05$). The worst results were found with AP (based on calcium hydroxide) sealer. The clinically and radiographically success rate of ZOE and AP were 98.3% and 68.3%, respectively. The failures with AP sealers may be explained by factors such as beginning of physiological root resorption in primary second molars, no parallel resorption with physiological root resorption of root canal sealer and content of root canal sealer.

The studies examining activity of Ni-Ti rotary files in primary teeth are very limited.[8-13] Barr et al.[8] reported that the

same principles apply to the primary dentition even if specific to permanent teeth. Researchers explained that use of Ni-Ti rotary files is faster than hand files, facilitates a consistently dense fill and less dentin removal.[8,9,11] In addition, tissue and debris are more easily, quickly removed and it is more advantageous for child patients regarding the chair.[12] Canoglu et al.[13] reported that Ni-Ti rotary files can be a viable alternative to manual instrumentation in primary teeth. In this study, we were compared effects on clinically and radiographically successful of two different root canal instrumentation ways. However, when evaluated success rate of root canal treatment according to root canal instrumentation ways, statistical significance different were not found (P>0.05). Distributions of 20 failure teeth were 9 for conventional stainless-steel hand file and 11 for Ni-Ti rotary files. As no statistical significance difference according to "instrumentation ways", the Ni-Ti rotary files are more easily and quickly procedure in this study. Finally, we believed that it can be use both root canal instrumentation ways for root canal treatment in primary teeth. In addition, Ni-Ti rotary files can be a viable alternative to manual instrumentation in primary teeth because of more easily and quickly procedure.

0.5% NaOCl and 0.9% saline solution combination and 0.4% CHX were used as irrigation solutions in this study. Distributions of 20 failure teeth were 13 for NaOCl and saline solution combination and 7 for CHX. No statistical significance differences were found according to "irrigation solution", even with less failure for CHX (P>0.05). But, we believed that CHX can be use as irrigation solution for root canal treatment in primary teeth due to the lower number of failures, although without statistical difference. Although studies comparing the antibacterial effect of CHX and NaOCl have produced somewhat conflicting results, it seems that when used in identical concentration, their antibacterial effects are similar.[27,28]

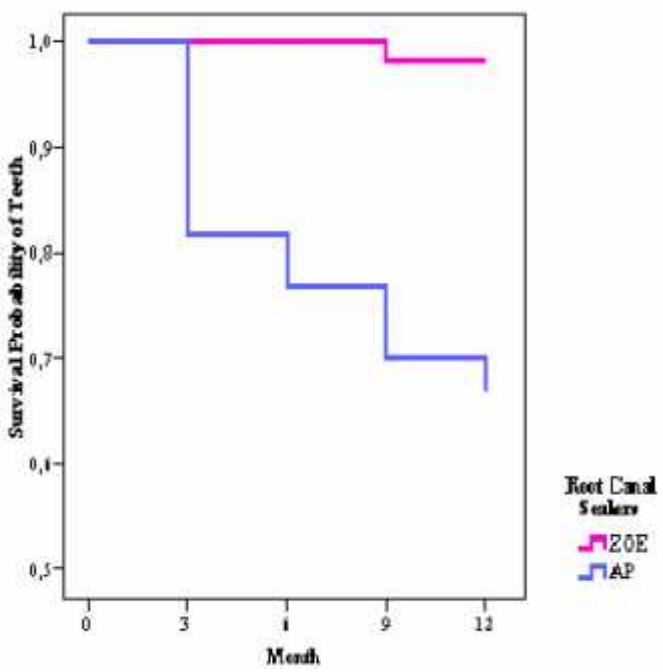


**Figure 2.** Survival rate graphic according to "root canal sealers" factor.

The physical, chemical and biological properties of the root canal sealers are effect on success of root canal treatment. Apexit Plus sealer is based on calcium hydroxide. Martin and Crabb[29] suggested that calcium hydroxide for success of root canal treatment have used somewhat conflicting because of it is too resoption in canal. This result is agreement with the results of our study. Distribution of 20 failure teeth were 1 for ZOE and 19 for AP. Statistical significance differences were found according to "root canal sealers" (P<0.05). Low success rate obtained with AP can be resulted by no providing apical leakage and resorption in canal of AP. A study with using AP in primary teeth is not as root canal sealer. Thus, our results must be supported with further study.

Kubota et al.[30] reported that calcium hydroxide caused internal resorption was

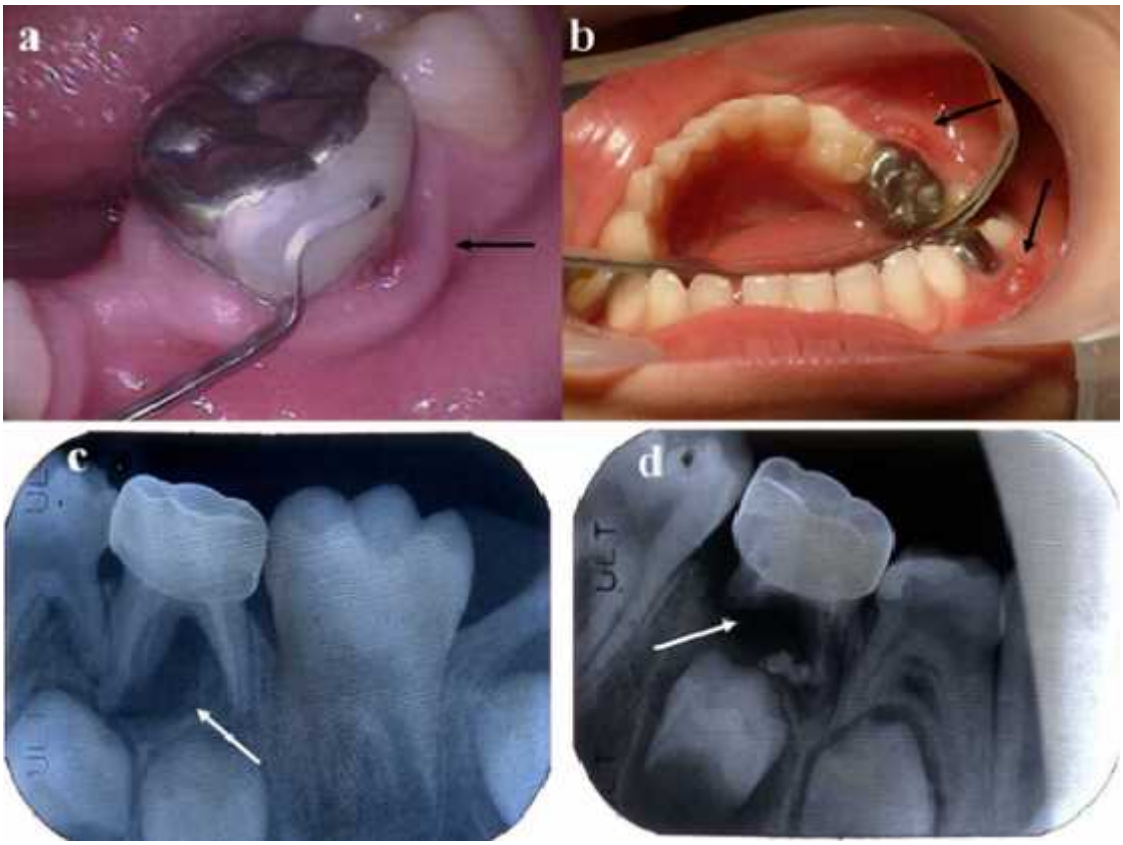


**Figure 3.** Example of failure condition as clinically and radiographically
**a:** color change in the vestibular mucosa in G 4
**b:** sinus tract in G 2
**c:** periapical and furcal radiolucency in G 8
**d:** external pathological root resorption and excess of material below the root apices in G 1.

detected. In this study determined only 1 external resorption while no internal resorption.

Mani et al.[19] explained that clinically success rate of calcium hydroxide in root canal treatment are similar to ZOE. These results are not agreement with the results of our study. Clinically success rate in this study was found 68.3% for AP and 98.3% for ZOE, respectively. Different content sealers used for root canal sealers in our study may be caused these differences.

## CONCLUSION

Finally, ZOE gave encouraging results as both clinically and radiographically for root canal treatment in primary teeth. Ni-Ti rotary files can be a viable alternative to conventional stainless-steel hand file as instrumentation way for root canal treatment in primary teeth. In addition, CHX may be a viable alternative to NaOCl as irrigation solution. Root canal sealer is the most effective factor to achieve of clinical success.

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