

In vitro evaluation of the accuracy of Two electronic apex locators in primary teeth

Aylin AKBAY OBA*, Ali ERDEMİR**, Merve ERKMEN*

* Kirikkale University Faculty of Dentistry, Department of Pedodontics, Turkey
** Kirikkale University Faculty of Dentistry, Department of Endodontics, Turkey

Abstract

Aim: The aim of the this study was to evaluate the accuracy of two electronic apex locators; Root ZX (Morita, Kyoto, Japan) and Propex (Dentsply, Maillefer, Switzerland) in primary teeth in vitro.

Methods: Twenty seven extracted human primary molars were selected for a total of 69 root canals. Root canal length was measured visually with the placement of a K-file 0.5 mm short of the apical foramen or the apical resorption level. Then following the manufacturer's instructions the length was determined using two apex locators. Data were analysed statistically using one-way ANOVA and Multiple Comparison.

Results: Root ZX and Propex showed similar values with the actual lengths. No statistical significance was found between the measurements of both apex locators.

Conclusions: Root ZX and Propex electronic apex locators accurately determined the root canal lengths in primary teeth. These devices can be recommended for use in primary teeth during root canal therapy.

Key Words: Agar diffusion, antibacterial, root canal sealer, primary teeth, Enterococcus faecalis.

Key words: Apical foramen, root canal, primary teeth

Özet

Amaç: Bu çalışmanın amacı, Root ZX (Morita, Kyoto, Japan) ve Propex (Dentsply, Maillefer, Switzerland) isimli iki farklı elektronik apeks bulucunun doğruluğunun süt dişleri üzerinde in vitro olarak değerlendirilmesidir.

Materyal Metod: Çalışmada yirmi yedi adet süt molar dişte toplam 69 kök kanalı kullanılmıştır. Kök kanal uzunlukları K tipi eğe ile apikal foramen ya da apikal rezorpsiyon seviyesinden 0.5 mm kısa olacak şekilde gözle ölçülerek kaydedilmiştir. Daha sonra üretici firmanın talimatları doğrultusunda apeks bulucular kullanılarak kanal uzunlukları ölçülmüştür. Veriler istatistiksel olarak tek yönlü ANOVA ve çoklu karşılaştırma testi kullanılarak analiz edilmiştir.

Bulgular: Root ZX ve Propex kullanılarak gerçek kanal uzunlukları ile benzer değerler belirlenmiştir. İki apeks bulucunun ölçüm değerleri arasında istatistiksel olarak anlamlı bir fark bulunamamıştır.

Sonuç: Root ZX ve Propex elektronik apeks bulucuları, süt dişlerinin kök kanal boyu uzunluklarını doğru olarak tespit etmiştir. Bu cihazların süt dişlerinin kök kanal tedavisinde kullanımı tavsiye edilebilir.

Anahtar kelimeler: Apikal foramen, kök kanalı, süt dişleri

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Introduction

Root canal treatment helps to maintain the integrity of primary dentition until normal exfoliation when their pulps become infected¹. Especially in primary teeth^{2,3} root length determination is a crucial factor for successful root canal treatment^{2,4}. Moreover, it is important to avoid injury of the succedaneous teeth bud¹.

In primary teeth, the ideal method used to determine the root canal length is controversial^{1,5,6}. Traditionally, radiographs have been the principal tool for determining primary root canal lengths^{7,8}. However, radiographs can only provide two-dimensional image^{9,10}. The accurate determination of root canal length or even an estimation of the dentinocemental junction cannot be achieved radiographically because of anatomical variations, interference of anatomical structures or errors in projection¹¹⁻¹⁵. Also, superimposition of permanent

successors over primary root apices may obscure root canal length determination⁷. Furthermore, radiographic assessment is difficult particularly in cases where the physiological resorption in primary teeth occurs on the root's buccal or lingual aspects¹². In children, it is often very difficult to get intraoral radiographs to measure the root canal length because of poor cooperation and limited access to the mouth^{1,16}.

Recently, electronic methods for determining the root canal length in both permanent and primary teeth have gained popularity amongst dentists because of the hazards of radiation^{2,19,20}, the technical problems associated with radiographic techniques^{2,19}, and the avoiding overinstrumentation beyond the root canal terminus¹⁴. However, there are few studies about the use of electronic apex locators in primary dentition^{1,17,21,22}.

The apex locator Root ZX (J Morita Corp., Kyoto, Japan), a third generation electronic device, has reportedly been able to detect the narrowest diameter of the root canal under both wet and dry conditions, and several studies have indicated its high level of reliability^{2,22}. The apex locator Propex II (Dentsply, Maillefer, Switzerland) is multi-frequency design for wet or dry accuracy²³. In the previous literature, there is no data about the use of Propex in primary teeth. In this study we compared the accuracy of Propex II and Root ZX electronic apex locators in primary teeth.

Materials and Methods

Human primary molar teeth with and without physiological apical resorption up to one third of the root were selected for the study. Preliminary radiographs were taken to evaluate the root canal anatomy, identify the radiographic apex and exclude teeth with calcification. Sixty nine root canals of twenty seven primary molars (15 mandibular and 12 maxillary) were included the study and all root canals were numbered.

The cusps of the teeth were flattened with a diamond bur using a high-speed handpiece under water irrigation to establish a level surface to serve as a stable unequivocal reference for all measurements². After standard endodontic access cavities were prepared, the pulp tissues were removed with barbed broaches and the canal orifices were widened using Gates-Glidden drills. The root canals were irrigated with 5.25% NaOCl and dried with absorbent paper point. Then a K-file (the diameter was chosen according to the canal size) fitted with a rubber stop was passively introduced into the root canals until the tip was just visible at either the apical foramen or the apical resorption level under a 30× stereomicroscope (NikonSMZ 800). The file length was recorded with a millimeter scale to 0.5 mm precision and 0.5 mm was subtracted from the measurement. The values were registered for each root canal as the actual length.

The electronic root canal length determination was undertaken using two apex locators: Root ZX (J Morita Corp., Kyoto, Japan) and Propex (Dentsply, Maillefer, Switzerland). The roots of the teeth were embedded up to the cemento-enamel junction in freshly mixed alginate (Zhermack). The K files chosen according the canal

size were inserted into the root canals. Both apex locators were operated following the manufacturer's instructions. During electronic measurement, the circuit was closed in vitro environment by inserting the labial clip of the corresponding locator into the alginate and attaching the file holder to the file. Root ZX measurements were accomplished until the signal on display flashed '0.5 bar' and Propex measurements were registered when the signal showed 0.5 mm to the apex. The electronic measurements were recorded for further comparison with those obtained by direct determination of the root canal length.

Statistical evaluation was carried out using one way ANOVA and Multiple Comparison test.

Results

The results are presented in Table 1. No statistical significance was found between measurements of actual lengths and electronic apex locators. Both electronic devices showed similar values with the actual lengths. Multiple comparisons were not displayed any statistical significant difference. ($p>0.05$)

Discussion

An accurate determination of the working length contributes to a safe and effective instrumentation of the root canals^{11,15,24}. However, traditional radiographic method to measure root canal length is difficult in primary dentition¹¹, because various degrees of physiological root resorption in primary teeth are unique and there is a tendency for primary apices to be variable and dynamic and they have less traditional orifices⁷. Electronic root length determination may be helpful in overcoming the shortcomings of the radiographic method¹. In this study radiographic evaluation were not included, because the main purpose was to evaluate the accuracy of two different electronic devices and to compare their results with actual canal lengths¹. In this study, no statistical significant differences were found between actual lengths and electronic measurements. Also, there was no statistically significant difference between Root ZX and Propex measurements.

	n		standard deviation	minimum	maximum
Visually determined length	69	11,97	1,98	8,00	16,50
Root ZX	69	11,89	1,85	8,00	16,00
Propex	69	11,91	1,71	9,00	16,00

Table 1. Mean, standard deviation and minimum-maximum value obtained by each technique

Katz et al.²⁰ first reported the use of an apex locator in the primary dentition in 1996. Root canal lengths determined by Root ZX were similar to the actual canal length, and they recommended the use of Root ZX in primary teeth. Ghaemmaghami et al.⁷ tested Root ZX in their study to compare in vivo and in vitro measurements of root canal lengths in primary teeth, and reported that Root ZX was able to locate the apex within clinically acceptable range. The study of Tosun et al.² evaluated the accuracy of Root ZX and Tri Auto ZX in primary teeth and demonstrated that both apex locators used in the study could accurately determine the root canal length in primary teeth. Also in their study Root ZX was not affected by the presence of root resorption. Angwarawong & Panitvisai²⁵ reported that the accuracy of the Root ZX was high within ± 0.5 mm of the apical foramen. According to the result of their in vitro study, they supported the use of electronic apex locators to determine root length in primary teeth. Kielbassa et al.²¹ tested Root ZX clinically in primary teeth and after extraction they compared the results to the actual lengths. They reported that the performance of Root ZX seemed to be satisfactory and suggested this electronic device for clinical implementation of endodontics in primary dentition. The findings of the studies above^{2,7,20,21,25} agree with our results.

Bodur et al.¹ evaluated in vitro the accuracy of Root ZX and Endex apex locators in primary teeth with or without root resorption. They found statistically significant difference between canal lengths obtained by the electronic apex locators and actual lengths, and concluded that both apex locators did not provide reliable data in primary teeth with or without root resorption. Our study results were not in accordance with the findings of Bodur et al.¹, as in our study the differences between the actual lengths and electronic measurements were not significant. This could be explained by using together primary teeth with or without root resorption in our study.

In the previous literature, there is no data about the use of Propex in primary teeth. But in a previous study²⁶ which evaluated the accuracy of Root ZX and ProPex apex locators in permanent teeth, the percentage of measurements within ± 0.5 mm of the actual lengths was 97.37% for the Root ZX and 100% for the ProPex. Krajczár et al.²⁷ compared working length determination by Propex and radiographic method in permanent teeth. They reported that there was no significant difference in the measuring accuracy between the two methods. According to the results of our study, Propex electronic apex locator showed similar values with the actual lengths in primary teeth.

The results of the present study showed that Propex and Root ZX apex locators accurately

determined the root canal lengths in primary teeth. Both electronic apex locators can be recommended for use in primary root canal treatment, however, further in vivo and in vitro evaluations of the electronic apex locator in primary teeth should be carried out.

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Corresponding author:

Aylin Akbay Oba
Kırıkkale Üniversitesi
Diş Hekimliği Fakültesi, Pedodonti AD
Mimar Sinan cad. No: 25
Kırıkkale, Türkiye
Business Tel: +90 318 224 49 27
Fax: +90 318 224 69 07
E-mail: akbayoba@hotmail.com