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Research Article

**EFFECT OF PULP STATUS ON THE ACCURATENESS OF  
ROOT ZX ELECTRONIC APEX LOCATOR**<sup>1</sup>Dr Muhammad Ammar Iftikhar, <sup>2</sup>Dr Hassan<sup>1</sup>Punjab Dental Hospital, Lahore., <sup>2</sup>de'Montmorency College of Dentistry Lahore**Article Received:** July 2020**Accepted:** August 2020**Published:** September 2020**Abstract:**

**Aim:** The aim of the study was to compare digital radiography with the electronic Root ZX (EAL) apical apparatus as a conventional method of measuring the length of the root canal in the primary anterior teeth and to clinically assess the influence of the pulp condition (vital pulp or necrotic) on Root ZX EAL accuracy.

**Place and Duration:** The study was held in the Punjab Dental Hospital, Lahore for one-year duration from January 2019 to January 2020.

**Methods:** The study included 40 upper anterior primary teeth indicated for pulpectomy in 19 healthy pediatric patients. Electronic canal assessment was taken with the Root ZX electronic tip finder with the file in place and x-rays were taken to check the correct working length. Radiographic measurements were obtained by measuring the root canal length with a digital ruler in the Romexis software (Planmeca, 4.5.2.R). Root canals were cleaned, watered, dried, filled and teeth rebuilt.

**Results and Conclusion:** Given that the clinically acceptable error tolerance was  $\pm 0.5$  mm, 48.6% (17/35) of the channels showed acceptable differences between the two measurements. The state of the dough had no significant effect ( $P > 0.05$ ) on the accuracy of the root ZX (EAL) measurement. Root ZX (EAL) can be used as an aid in taking radiographs during root canal treatment of milk teeth.

**Key words:** Primary teeth, pulp treatment, vital teeth, root apex Locator, necrotic teeth.

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**INTRODUCTION:**

Pulp treatment in deciduous teeth involves treating young milk and pulp-affected permanent teeth in children. The main goal of pulp treatment in deciduous teeth is to protect the integrity and health of the oral tissues [1-2]. Pulpectomy is defined as the root canal treatment of irreversible or infected pulp tissue caused by caries or trauma. In contrast to the structure of the milk tooth, due to the open apices that make it difficult to determine the length of the root canal, certain principles of effective endodontic treatment of permanent teeth have been established [3-4]. Determination of the root canal length (working length, root length, tooth length) is an important element of endodontic treatment. The length of the root canal is the distance from the reference point on the tooth crown to the end of the canal preparation and filling. The method of using radiography used by Ingle was one of the best known and most reliable methods of determining the length of a root canal. However, due to the difficulty in locating the apex taper and factors such as conical beam angles, distorted image exposure leading to error due to laterally positioned holes, and the radiographic artifact that may occur, precision is not easy to obtain and leads to misinterpretation. Additionally, there is a radiation hazard for the patient and dental staff. The electronic apex finder (EAL) was first introduced by Sunada (1962) to find the root apex to measure the length of the root canal [5-6]. Kielbass et al. (2003) suggested using the Root ZX apex finder to determine the length of the root canal in deciduous teeth. Ghaemmaghani et al. (2008) reported that the use of Root ZX in primary incisors allows for accurate measurement of root canal length. Angwaravong and Panitvisai (2009) concluded that the sensitivity of Root ZX is high, even in the presence of root resorption. The accuracy of the EAL may be affected by the presence of blood in the root canal as an electrolyte. Studies have been carried out on the effect of the presence or absence of blood in the root canal of permanent teeth on the precision of EAL, and it was found that the state of the pulp (viable or inanimate) does not have a significant effect on sensitivity. different EAL. However, no studies on the effect of pulp status on EAL accuracy in deciduous teeth have been reported. Therefore, the aim of the study was to compare digital radiography with the electronic Root ZX (EAL) apical apparatus as a conventional method of measuring the length of the root canal in the primary anterior teeth and to clinically assess the influence of the pulp condition (vital pulp or necrotic) on Root ZX EAL accuracy.

**METHODOLOGY:****Patient and tooth selection**

The study was held in the Punjab Dental Hospital, Lahore for one-year duration from January 2019 to January 2020. Written consent was obtained from the parents / guardians of each child selected for the study. Inclusion criteria: primary anterior teeth with one maxilla root, including central incisors, lateral incisors and canines with pulpitis or irreversible necrosis, root condition with or without mild resorption. Exclusion criteria: teeth after endodontic treatment, calcification, metal restoration, irreversible crowns, periapical translucency reaching the permanent tooth bud, teeth associated with cysts, pathological resorption of more than 1/3 of the root, incomplete root formation and obvious. internal resorption or teeth with difficulties in determining the position of the root canal. Children with systemic diseases such as heart, liver, blood and immunocompromised children were also excluded.

**Electronic measurement of the root canal length:**

Pre-operative x-rays of each tooth were taken. Patients were given local anesthesia. A Rubber dam was used as isolation. The tooth crowns were prepared to obtain a specific and repeatable reference point. Access cavities were prepared using round bur in high-speed hand piece. Root ZX (Morita, Kyoto, Japan) was used to electronically determine the canal length according to the manufacturer's instructions. Electronic measurements involve placing the clip in the corner of the patient's mouth. The K file was selected based on the size of each target canal based on a pre-operative tooth X-ray and then added to the Root ZX (EAL). The file was then gently inserted into the root canal until an intermittent strip appeared on the device and a sound was heard indicating the correct canal length. The decision on the appropriate length of the examination is based on the Ingle technique (file 1 mm shorter than the radiographic apex) (Ingle, 1957) and the clinically acceptable error tolerance of  $\pm 0.5$  mm (Kim and Lee, 2004 and Wrbas et al. 2007 16 17). A silicone plug was placed in the prepared coronal reference and an X-ray was taken to verify its position with the Planmeca Prox intraoral X-ray machine using the paralleling technique.

**Radiographic measurement of the root canal length:**

Using a Romexis digital soft wear ruler (Planmeca, 4.5.2.R), the initial working length of the root canal was estimated using the Ingle technique. The estimated root canal length was measured as the distance from the prepared reference point to a point (1 mm) shorter than the radiographic apex. A K file was then inserted into the tooth according to the

estimated length, and an X-ray was taken with a Planmeca Prox intraoral machine using the parallelism method. The patient sat down and a protective lead gown with a disc collar with a supported head and an occlusal plane parallel to the floor was put on the patient's body. The Planmeca Prox X-ray machine was automatically set to 63 kV and the exposure time was 125 seconds. After determining the initial working length, the coronal and root pulp tissue was removed with K files, and the root canals were cleaned and rinsed with sodium hypochlorite (1%) and saline. In addition, the channels were dried and filled with biocompatible material using paper tips. The teeth were finally restored and a final X-ray was taken. The difference between electronic root canal length measurements and radiographic root canal length measurements was calculated from the difference between the initial file lengths for each method used for each root canal

using a standard endodontic ruler to measure the file length.

#### Statistical Analysis:

Data were entered and analyzed with SPSS PC + software (21.0). Descriptive statistics (mean, standard deviation and coefficient) were obtained. Pearson's chi-square test was used to determine the relationship between the length values of both methods. A p value <0.05 was considered statistically significant. The intra-operative reliability of the channel measurements was previously determined in a pilot study using the intra-class correlation coefficient (ICC).

#### RESULTS:

The intra-operator reliability test was high (ICC = 0.92). The differences between the two methods of measuring the primary canal length (EAL and radiography) are presented in Table 1.

**TABLE 1: ROOT CANAL LENGTHS IN PRIMARY ANTERIOR TEETH DETERMINED BY DIFFERENT METHODS**

Methods	N	Mean $\pm$ SD (mm)	95% Confidence Interval	Range (mm)
Root ZX	40	13.699 $\pm$ 2.19	lower: 12.99 upper: 14.52	9.00-18.00
Length on RG	40	14.60 $\pm$ 2.30	lower: 13.79 upper: 15.34	9.50-11.5

Of the 26 children who participated in this study, 14 were male and 12 were female, aged 5 to 9 years, and the mean age was 7.4 ( $\pm$  1.13) years. 40 teeth met the inclusion criteria and were indicated for pulp extraction. About half of the cases (49.5%) showed acceptable differences between the two measurements. Pearson's chi-square test did not show any significant influence of the pulp status on the

measurement accuracy ( $p > 0.05$ ). Of the 18 (51.4%) unacceptable differences in the measurements obtained (ie Difference  $\geq 0.5$  mm), there were 13 cases where the file tip was less than (1 mm) from the radiographic apex. There was no correlation ( $p > 0.05$ ) between the unacceptable difference in the measurements between the two methods and the pulp status (Table 2).

**TABLE 2: EFFECT OF THE PULP CONDITION ON THE ACCURACY OF ROOT ZX EAL**

Measurement Difference (mm)	Total Frequency (%)	No. of Necrotic Canals (%)	No. of Vital Canals (%)	P Value
.5	(49.5)	(44.1)	(51.9)	0.468
1.0	(36.9)	(43.5)	(31.9)	0.783
1.5	(14.8)	(12.2)	(15.5)	0.656

#### DISCUSSION:

Root ZX (EAL) has proven its accuracy in many in vivo and in vitro tests. The current in vivo study is expanding the existing knowledge by providing data on the effect of pulp status on Root ZX (EAL) precision when evaluated under standard clinical

conditions. The same operator has taken all the measurements and has been trained to operate the device, thus reducing the possibility of operator bias. However, to date, there are no studies showing a link between operator skill and the accuracy of these devices<sup>7-8</sup>. However, as noted by Akisue *et al.* (2007),

it is essential that the operator has training and experience in using the EAL to ensure accurate measurements. Other factors taken into account to obtain reliable data were the use of stainless steel K files, whereas previous studies have shown negative results with nickel titanium files. This is because the operation of the EAL can be attributed to the training / skills of the practitioner, the study design, the electrical properties of the root canal walls, the feet, and the electrical conduction mechanisms of the canal. Using the correct file size may also affect the reliability of the measurement. Ebrahim et al. (2006) concluded that a file should be used with a size similar to the diameter of the canal prepared for measuring the root length. Moreover, Akisue et al. (2007) emphasized the use of files according to the size of the root canal [9]. In this study, Root ZX (EAL) showed similar sensitivity ( $p > 0.05$ ) in viable and non-viable (necrotic) anterior deciduous teeth in the group of acceptable measurements, according to the study by Kim and Lee (2004) and Wrbas et al. (2007). However, some studies have shown that EALs are more sensitive in measuring the length of root canals in vital canals compared to necrotic canals. Regardless of the pulp status, the precision in the acceptable group in this study is consistent with other studies [10]. In vital and necrotic teeth, the percentage of acceptable measurements was (48.6%), which indicates that Root ZX can be used as a complementary tool for radiographs to determine the length of the root canal. However, given the number of teeth in this study, it is believed that Root ZX will exhibit greater sensitivity with a larger sample size [11-12]. In a similar study as now, Renner et al. (2012) found that the pulp status did not have a significant effect on the precision of the EAL, and the EAL showed 73.61% agreement with the radiological findings. However, their work involved 144 canals of permanent teeth, which explains the lower percentage of acceptable measurements obtained in this study. Kolanu et al. (2014) investigated the effect of the critical apex diameter and file size using the EAL in determining the test length and found that the accuracy of the EAL decreases with the expansion of the apex [13-14]. Therefore, caution should be exercised in clinical application to deciduous teeth. A tolerance coefficient of  $\pm 0.5$  mm was used in this study, which is consistent with the clinical studies by Akisue et al. (2007) [14] and Renner et al. (2012) [12]. Almost half of the channels in this study fell into the group of unacceptable measures. Inadequate equipment in the treatment of pulp increases the risk of root canal treatment failure, especially of teeth with preoperative periapical damage. The possible reason for the short measurements observed in this study may be the use of the tolerance coefficient ( $\pm$

0.5 mm) proposed by Kim and Lee (2004) and Wrbas et al. (2007). Further studies on a larger sample using different groups of teeth are recommended, taking into account factors such as the irrigation used and the degree of root resorption [15].

#### CONCLUSION:

- The condition of the root canal (alive or necrotic) had no significant effect on the measurement of the root canal length using the Root ZX (EAL) method.
- Based on the acceptable tolerance factor of  $\pm 0.5$  mm, almost half of the root canals examined in single upper maxillary teeth showed an acceptable difference between digital radiography and EAL in the measurement of the root canal length.

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