

Original Research**COMPARISON OF ACCURACY OF ROOT ZX, PROPEX PIXI AND ROMIDAN APEX LOCATOR - AN IN-VITRO STUDY****T.Manisha Choudary¹, Bharat Deosarkar²,Samay Chavan³, Kapil Kurtikar⁴, Pawan Darak⁵**¹Professor & HOD,Dept of Endodontics, Saraswati Dhanwantri Dental College, Parbhani (Maharashtra)²Senior Lecturer, Dept of Endodontics, Saraswati Dhanwantri Dental College, Parbhani (Maharashtra)⁴Senior Lecturer,Dept of Oral surgery, Nanded rural dental college,Nanded (Maharashtra)⁵Senior Lecturer,Dept of Endodontics, Dr.Hsrsm dental college,Hingoli (Maharashtra)³Pg Student,Dept of Endodontics, Saraswati Dhanwantri Dental College, Parbhani (Maharashtra)

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ABSTRACT

Objective: The objective of this in vitro study was to compare the accuracy of the three different apex locator i.e Root -ZX apex locator, Propex pixi & Romidan apex locator. **Methods and Material:** Thirty single rooted extracted teeth were mounted into alginate. The teeth were decoronated and the coronal section of each canal was flared using Gates- Glidden drills. Canals were irrigated with 5 % sodium hypochloride solution. Actual root canal length were determined by inserting a # 15K- file until the tip was visualized (by Vision inspection system) just within the apical foramen .The results obtained with each electronic apex locator (EAL) were compared with the actual canal length. Differences between the electronic and actual length were calculated. **Results:** The statistical analysis of the results showed EAL reliability in detecting the apical foramen to 89.7% for Root-ZX and 82.1% for the Propex pixi & Ramidan showed 79%, taking the tolerance of ± 0.5 into consideration. A paired sample t- test showed that there was no statistically significant difference between the accuracy of the two devices ($p= 0.4305$) **Conclusion:** The results of this study indicate that the Root- ZX, Propex pixi & Ramidan are useful devices for apical foramen location. This study shows that Root zx is showing more accuracy than the Propex pixi and Propex pixi showed more accuracy than Romidan

Introduction

Working length has been defined as “ the distance from a coronal reference point to the point at which canal preparation and obturation should terminate”.¹ The determination of accurate working length is one of the most critical steps of endodontic therapy. Failure to accurately determine and maintain the working length, might result in the length being too long and might lead to preparation through apical constriction, causing over preparation and over filling. Failure to determine the working length (WL), might also lead to cleaning and shaping short of apical constriction causing under filling.²

Instrumentation and obturation of the root endodontic system should be terminated at the apical constriction.³ The apical constriction also defined as minor diameter, represents the histologic point of transition between the pulpal and the periodontal tissues at the cementodentinal junction (CDJ) . It has been suggested that the canal filling should terminate at the CDJ.^{4,5} However, it is variable, on average, it occurs 0.50 to 0.75mm coronal to the apical foramen. Although the apical foramen is 0.5mm coronal to the anatomic apex, the CDJ may be as far as 2.0mm from the apical foramen. Traditionally, the root canal working length is determined by the interpretation of a radiograph of an instrument placed in a root canal. The most obvious

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drawback to this method is that the position of the apical constriction or the major foramen cannot be determined.^{6,7,8,9} However, it has been reported that it



Fig 1 : Vision inspection system

is difficult to determine the working length accurately with a two dimensional image.^{6,7} Moreover, the maintenance of the apical constriction is crucial for the instrumentation, and neither radiograph nor tactile methods can adequately determine this point.⁹ Finally, the superimposition and bony structure can hinder the identification of radiographic apex of some teeth.¹⁰ Cianconi et al. have shown that electronic apex locators (EALS) provide more accurate estimation of the WL than radiograph.¹¹ Cluster was first to introduce an electrical method of locating the apical foramen.¹² Electronic apex location began in 1942, with studies by Suzuki.¹³ He discovered that a constant electrical resistance of approximately 6.5 kilo ohms existed between the periodontium and the oral mucous membrane in vivo. In 1962, Sunada formulated his principle of "biological characteristic theory", stating that electrical resistance values between the periodontal ligament and the oral mucosa can be determined by electronic means.¹⁴

As many as four generations of electronic apex locators have been developed since their inception. The first generation of EALS was resistance based whereas the second generation was based on impedance. The main shortcoming of both types

(which corresponds to poor accuracy with electrolytes) was overcome by the introduction of the third generation apex locators, such as Root ZX (J Morita



Fig 2 : Samples with access open & mounted in fresh alginate

Corp, Tokyo, Japan). The Root- ZX uses the ratio method to measure the root canal length. This method involves the measurement of impedance value at two frequency (8kHz and 0.4kHz), simultaneously and calculation of a quotient that express the position of the file tip in the canal.¹⁵ The Root - ZX apex locator is considered to be the gold standard against which newer EALS are evaluated.¹⁶ In vivo studies have demonstrated that Root ZX to be accurate in locating the minor diameter to within 1mm.^{17,18,19,20}

A newly designed apex locator Propex pixi (Densply-Maillefer, Tulsa) has been recently developed. Propex pixi is a multi-frequency based apex locator that is based on the same principle of the other modern devices that uses multifrequencies to determine the root canal length. Rather than using the amplitude of the signal as for all EALS, it measures the energy of the signal with multi signal frequencies. Briesno-Marroquin et al. in their study found that the precision of Propex pixi in determination of apical foramen is 83.45%, 88.28% and 91.41% with instrument sizes 08, 10, and 15, respectively with acceptable range of ± 0.5 mm and 93.79%, 95.86%, and 97.66% with ± 1 mm of acceptable range instrument sizes 08,10, and 15 respectively.²¹

A newly designed apex locator Romidan (manufactured by Ramidan Ltd Simmcha Holzberg St,Israel) battery operated portable device which uses

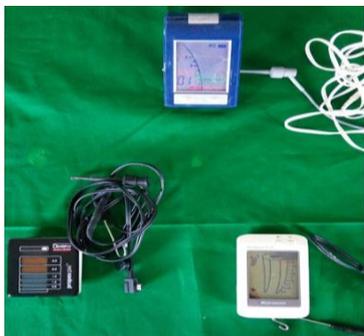


Fig 3 : Three Different Apex Loactors

the frequency-dependent impedance method with propriety algorithms to determine the position of the apical foramen.

The purpose of this study was to compare the accuracy of the Root-ZX and Propex pixi & Romidan (Fig 3) in accurately locating the major diameter (apical foramen).²²

MATERIALS AND METHODS

A total of 30 teeth with mature apices were selected for this study. The teeth were kept in 10% formaldehyde after extraction. Roots representing fractures, resorptions or any other anatomical irregularities were not included. Presence of only one straight non-calcified canal was confirmed with radiographs. Occlusal or incisal surfaces of the teeth were flattened with a diamond bur until a reliable reference point was obtained. Access cavities were prepared (Fig 2).

A size 10 K-file was progressed throughout the root canal until it became visible at the apical foramen (AF) under Vision inspection sytem (VIS) (Fig1). The file was withdrawn 0.5 mm from this point, the length between file tip and reference was measured VIS. This

distance was recorded as actual working length (AWL).A new file was used for each tooth to avoid the misleading effect of the stoppers resulting from detente of them. Before being used, each root was carefully examined under 5X magnification for detection of presence of external cracks. Cotton pellets were used to remove excess from the pulp chamber. The lip electrode was immersed in the respective orifice in contact with the conducting medium and a #15 K- file was then connected to the other electrode for electronic measurement. For each one of the specimen, a file was gently inserted into the canal. When the signal reached the 0.0 mark (apical foramen) the measurement were noted. The Silicone stop of the instrument was adjusted to the reference level and the distance between the rubber stop and the file was measured with a digital caliper and its length registered as the electronic length (EL).²³

The actual root canal length (AL) is the distance from the coronal reference plane to the apical foramen. It was measured by inserting a #15 K-file file into the canal until the file was just visible at the level of the apical foramen. This procedure was carried out under 5X magnification. After adjusting the stopper to the coronal reference, the file was removed from the root canal and the length was measured with a digital calliper and recorded as the actual length.

The results obtained (in millimetre) for each were recorded in independent tables. Differences between the electronic and actual canal length were calculated. Positive values indicated measurement that were long of the apical foramen, negative values indicating measurement that were short of the apical foramen and 0.0 values were considered coinciding measurements with the actual canal length, with a ± 0.5 mm range of clinical acceptability. Paired t- test was used to

statically analyse the significance of the mean difference between EAL and AL at 5% significance level.

RESULTS

Each tooth served as its own control. Statistical results showed no difference between Root- ZX and Propex pixi in their ability to accurately identify the apical foramen. Root ZX was accurate 89.7% of the time ± 0.5 in locating apical foramen as compared to Propex pixi which was accurate 82.1% ± 0.5 in locating the apical foramen & Romidan showed 79% accuracy (Table1).

DISCUSSION

The main purpose was to evaluate the accuracy of one EAL most widely used in clinical practice the Root-ZX and an upgraded version of the original Propex pixi EAL i.e. the Propex pixi EAL & Romidan. An in vitro study was developed in view of the difficulties posed by the clinical studies in comparing the electronic measurements with the control. The use of apex locators to determine the working length has gained popularity, particularly after the introduction of the latest generation of apex locators that not only allowed measurement in the present humidity but also actually require the presence of solution within the root canal system to function correctly.

There has been a controversy as to whether EALs are able to determine the minor constriction Or the major foramen. According to the manufacturer, the Root-ZX meter 0.5 reading indicates the tip of the file in the apical constriction.²⁴

Several in vitro researches have assessed the accuracy of Root- ZX (J.Morita Corp,Tokyo, Japan). A study carried out by Shabahang et al. produced values to a precision of 96.2%.¹⁸ Lucena Martin et al. showed

that it gave precise measurements in 85% of the cases.²⁵ However, Goldberg et al., through an in vitro

Distance from Apical Foramen (mm)	Root-ZX(n=38)	%	Propex pixi(n=38)	%	Ramidan (n=38)	%
< -0.5	1	(2.6%)	2	(5.1%)	3	(7.1%)
- 0.5 to 0.5*	35	(89.7%)	32	(82.1%)	27	(79.1)
>0.5	2	(5.1%)	4	(10.5%)	6	(12.5%)

The File Tip in correspondence to the Apical Foramen as Determined by Root - ZX And Propex pixi & Ramidan

study evaluated the accuracy of three apex locator in determining working length during the retreatment procedure.²⁶ The authors evaluated the Propex, Novapex , and Root-ZX and as a results they had 80%, 85%, and 95% of accuracy respectively for the three devices.

Mayeda et al. had concluded that EALs are only capable of detecting the major foramen.²⁷ Ounsi and Naman confirmed this point concluding that the Root-ZX is not capable of detecting the 0.5mm from the foramen position and thus should only be used to detect the apical foramen (major diameter).²⁸ Lee et al. found that termination point of the file tips was in the area of the major foramen regardless of the CDJ presence and the major foramen is a better level test for EAL accuracy.²⁹ Finally Hassanien et al. found that CDJ and apical constriction are not the same point, the apical constriction was always found coronal to CDJ and when using the apical constriction bar in the Root - ZX display, the measurements obtained is closer to the CDJ than to the apical constriction.³⁰ Therefore, the current study used the major foramen as the measuring point for the two EALs.

Ibarrola et al. suggested that pre-flaring root canals before using the Root-ZX led to an increased accuracy of the electronic apex location. For this reason the canals were carefully pre-flared with Gates Glidden in the present study.³¹

The apical limit used was the apical foramen. The measurement with the Root -ZX and Propex pixi were 89.7% and 82.1% & Romidan 79.1% respectively from the apical foramen. In our research only one operator carried out the electronic and actual working length.

CONCLUSION

Under the conditions of this in vitro study there were no statistically significant differences between the three devices. The results of this study indicate that the Root- ZX, Propex pixi & Romidan are useful devices for apical foramen location.

This study shows that Root zx is showing more accuracy than the Propex pixi and Propex pixi showed more accuracy than Romidan

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