COMPARISON OF ACCURACY OF ROOT ZX, PROPEXPIXI AND RAMIDAN APEX LOCATOR - AN IN-VITRO STUDY

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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,Propexpixi&Ramidan apex locator.

Methods and Material: Thirty single rooted extracted teeth were mounted into alginate.The teeth were decoronated and the coronalsection of each canal was flared using Gates- Glidden drills. Canals were irrigated with 5 % sodium hypochloridesolution. 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) werecompared 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% forRoot-ZX and 82.1% for the Propexpixi&Ramidan showed 79%, taking the tolerance of ± 0.5 into consideration. A paired sample t- testshowed 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,Propexpixi&Ramidanare useful devices for apical foramenlocation.This study shows that Root zx is showing more accuracy than the Propexpixi and Propexpixishowed more accuracy thanRamidan

Key Words: Electronic**,** Apex Locator, Working, Length.

INTRODUCTION :-

Working length has been defined as " thedistance from a coronal reference point to the point at which canal preparation and obturation shouldterminate".[1]The determination of accurate workinglength is one of the most critical steps of endodontictherapy. Failure to accurately determine andmaintain the working length, might result in thelength being too long and might lead to preparationthrough apical constriction, causing overpreparation and over filling. Failure to determinethe working length (WL), might also lead tocleaning and shaping short of apical constrictioncausing under filling.[2] Instrumentation and obturation of the rootendodontic system should be terminated at the apical constriction.[3]The apical constriction alsodefined as minor diameter, represents the histologic point of transition between the pulpaland the periodontal tissues at the cemento-dentinaljunction (CDJ) . It has been suggested that the canalfilling should terminate at the CDJ.[4,5]However, itis variable, on average, it occurs 0.50 to

0.75mm coronal to the apical foramen. Although the apicalforamen is 0.5mm coronal to the anatomic apex,the CDJ may be as far as 2.0mm from the apicalforamen.Traditionally, the root canal working length is determined by the interpretation of a radiographof an instrument placed in a root canal. The mostobvious drawback to this method is that theposition of the apical constriction or the majorforamen cannot be determined.[6,7,8,9]However, ithas been reported that it is difficult to determinethe working length accurately with a twodimensional image.[6,7]Moreover, the maintenanceof the apical constriction is crucial for theinstrumentation, and neither radiograph nor tactilemethods can adequately determine this point.[9]Finally, the superimposition and bony structure canhinder the identification of radiographic apex of some teeth.10 Cianconi et al. have shown thatelectronic apex locators (EALS) provide moreaccurate estimation of the WL than radiograph.11Cluster was first to introduce an electrical method of locating the apical foramen.12 Electronicapex location began in 1942, with studies by Suzuki.13 He discovered that a constant electricalresistance of approximately 6.5 kilo ohms existedbetween the periodontium and the oral mucousmembrane in vivo. In 1962, Sunada formulated hisprinciple of ‘’biological characteristic theory’’,stating that electrical resistance values between theperiodontal ligament and the oral mucosa can bedetermined by electronic means.14

As many as four generations of electronic apexlocators have been developed since their inception.The first generation of EALs was resistance basedwhereas the second generation was based onimpedance. The main shortcoming of both types(which corresponds to poor accuracy withelectrolytes) was overcome by the introduction ofthe third generation apex locators ,such as RootZX (J Morita Corp, Tokyo, Japan). The Root- ZXuses the ratio method to measured the root canallength. This method involves the measurement ofimpedence value at two frequency (8khz and0.4khz), simultaneously and calculation of aquotient that express the position of the file tip inthe canal.15 The Root - ZX apex locator is consideredto be the gold standard against which newer EALSare evaluated.16 In vivo studies have demonstratedthat Root ZX to be accurate in locating the minordiameter to within 1mm.17,18,19,20

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

A newly designed apex locator Ramidan(manufactured by Ramidan ltd Simmcha HolzbergSt,Israel) battery operated portable device which uses the frequency-dependent impedence method

with propriety algorithms to determine the position of the apical foramen.

The purpose of this study was to compare theaccuracy of the Root-ZX and Propexpixi&Ramidanin accuratelylocating 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-

Position of The File Tip in Relation to the Apical Foramen as Determined by Root - ZX AndPropexpixi&Ramidan

Distance from Apical Foramen (mm)	Root-ZX (n=38)	%	Propexpixi (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%)

*negative values indicates file position coronal to the apical foramen

classified 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. 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). 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 fordetection of presence of external cracks,Cotton pellets were used to remove excess fromthe pulp chamber. The lip electrode was immersedin the respective orifice in contact with theconducting medium and a #15 K- file was thenconnected to the other electrode for electronicmeasurement. For each one of the specimen, a filewas gently inserted into the canal. When the signalreached the 0.0 mark (apical foramen) themeasurement were noted. The Silicone stop of theinstrument was adjusted to the reference level andthe distance between the rubber stop and the filewas measured with a digital caliper and its lengthregistered as the electronic length (EL).24

The actual root canal length (AL) is the distancefrom the coronal reference plane to the apical foramen. It was measured by inserting a #15 K-filefile into the canal until the file was just visible atthe level of the apical foramen. This procedure wascarried out under 5X magnification. After adjustingthe stopper to the coronal reference, the file wasremoved from the root canal and the length wasmeasured with a digital calliper and recorded asthe actual length.

The results obtained (in millimetre) for eachwere recorded in independent tables. Differencesbetween the electronic and actual canal length werecalculated. Positive values indicated measurementthat were long of the apical foramen, negativevalues indicating measurement that were short ofthe apical foramen and 0.0 values were consideredcoinciding measurements with

the actual canallength, with a ±0.5mm range of clinicalacceptability. Paired t- test was used to staticallyanalyse the significance of the mean differencebetween EAL and AL at 5% significance level.

RESULTS

Each toothserved as its own control. Statistical results showedno difference between Root- ZX and Propexpixiintheir ability to accurately identify the apicalforamen. Root ZX was accurate 89.7% of the time±0.5 in locating apical foramen as compared toPropexpixi which was accurate 82.1% ±0.5 inlocating the apical foramen&Ramidan showed 79% accuracy.

DISCUSSION

The main purpose was to evaluate theaccuracy of one EAL most widely used in clinical practice the Root- ZX and an upgraded version ofthe original Propexpixi EAL i.e. the Propexpixi EAL&Ramidan. Anin vitro study was developed in view of thedifficulties posed by the clinical studies incomparing the electronic measurements with thecontrol.The use of apex locators to determinethe working length has gained popularity,particularly after the introduction of the latestgeneration of apex locators that not only allowedmeasurement in the present humidity but alsoactually require the presence of solution within theroot canal system to function correctly.

There has been a controversy as to whetherEALs are able to determine the minor constriction or the major foramen. According to themanufacturer, the Root-ZX meter 0.5 reading indicates the tip of the file in the apicalconstriction.Several in vitro researches have assessed theaccuracy of Root- ZX (J.MoritaCorp,Tokyo, Japan).

A study carried out by Shabahang et al. producedvalues to a precision of 96.2%.18 Lucena Martin etal. showed that it gave precise measurements in85% of the cases.25 However, Goldberg et al.,through an in vitro study evaluated the accuracyof three apex locator in determining working lengthduring the retreatment procedure.27 The authorsevaluated the Propex, Novapex , and Root–ZX and as a results they had 80%, 85%, and 95% of accuracy respectively for the three devices. Mayedaet al. had concluded that EALs are only capable of detecting the major foramen.28 Ounsi and Namanconfirmed 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).29 Lee et al. found that termination point of the file tipswas in the area of the major foramen regardless ofthe CDJ presence and the major foramen is a better level test for EAL accuracy.30 Finally, Hassanienetal. 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.31 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.

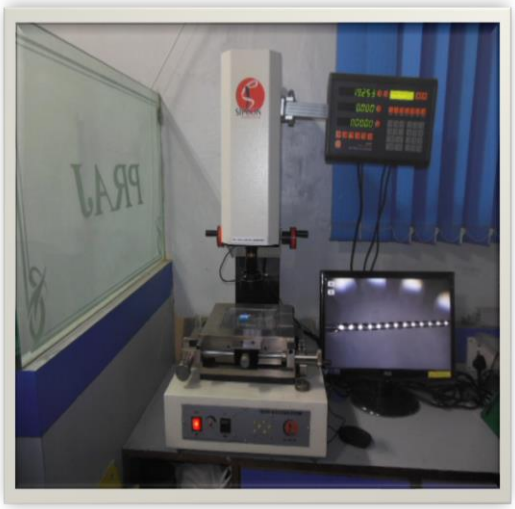
The apical limit used was the apical foramen.The measurement with the Root - ZX and Propexpixiwere 89.7% and 82.1% &

Ramidan 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 therewere no statistically significant differences betweenthe three devices. The results of this study indicate that the Root-ZX, Propexpixi&Ramidan are useful devices for apical foramen location.

This study shows that Root zx is showing more accuracy than the Propexpixi and Propexpixi showed more accuracy than Ramidan



Vision insection system

Fig no.2

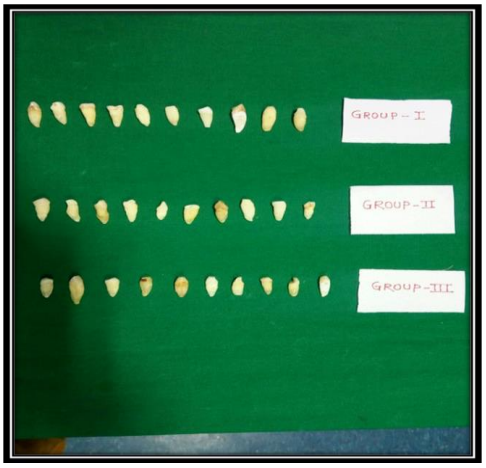


Fig.3

Group no.1

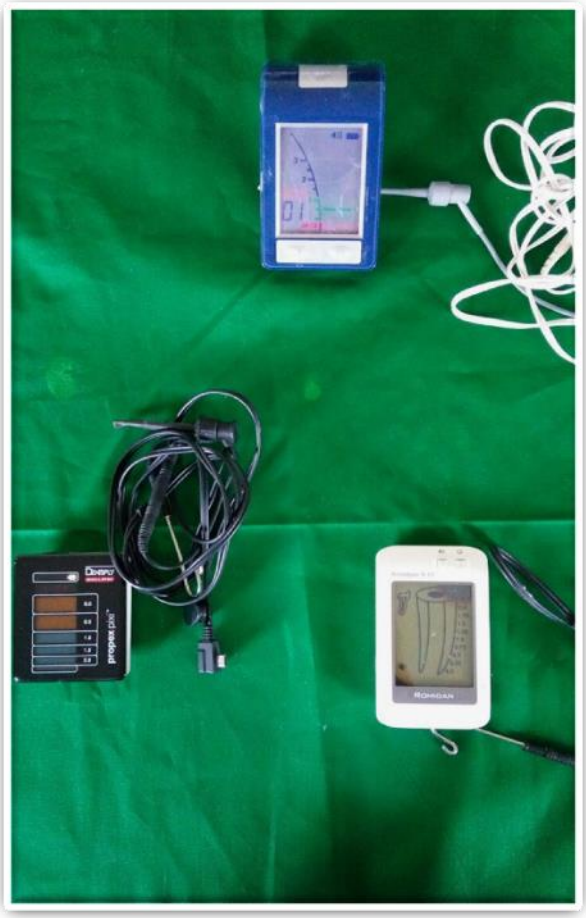
Sample no.	Root zx	Propex mini	Ramison
1	20.3 mm	20 mm	19.5 mm
2	20.5 mm	20 mm	20 mm
3	19 mm	19 mm	18.5 mm
4	21 mm	21 mm	21 mm
5	20.5 mm	20.3 mm	21 mm
6	22 mm	20.5 mm	21 mm
7	21 mm	20 mm	20 mm
8	20 mm	21 mm	21.5 mm
9	19 mm	20 mm	20 mm
10	19 mm	19 mm	19 mm

Group no.2

Sample no.	Root zx	Propex mini	Ramison
1	18 mm	17.5mm	17mm
2	18.5 mm	17.2mm	17.2mm
3	17.5 mm	15.2mm	15.1mm
4	23.67 mm	19.7mm	18.5mm
5	19 mm	18.5mm	18mm
6	18 mm	18mm	17mm
7	17 mm	16mm	15.7mm
8	17.3 mm	17.2mm	17mm
9	18mm	16mm	15.5mm
10	20.5mm	19mm	19mm

Group no.3

Sample no.	Root zx	Propex pixi	Ramison
1	21 mm	20.5 mm	19.78 mm
2	21.5 mm	21 mm	21 mm
3	21 mm	20.5 mm	20 mm
4	19.5 mm	18 mm	17.5 mm
5	19 mm	19 mm	18 mm
6	19 mm	18.5 mm	18.5 mm
7	19 mm	18 mm	17 mm
8	15.27 mm	15 mm	16.5 mm
9	15.28 mm	15 mm	14.5 mm
10	17 mm	16.7 mm	15.23 mm



Root zx

Propex
pixiDen
splyy

Ramidan

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