COMPARATIVE EVALUATION OF ACCURACY OF ROOT ZX AND PROPEXPIXI APEX LOCATOR'S WITH DIFFERENT APICAL CONSTRICTIONS: AN IN VITRO STUDY

Shori Deepa D.[1], Shenoi Pratima R.[2], Biyani Piyush[3], Holy Ahmed B.[4]
1. Profesor, Dept of Conservative dentistry & Endodontics, VSPM DCRC, Nagpur
2. Profesor & HOD, Dept of Conservative dentistry & Endodontics, VSPM DCRC, Nagpur
3. PG, Dept of Conservative dentistry & Endodontics, VSPM DCRC, Nagpur
4. PG, Dept of Conservative dentistry & Endodontics, VSPM DCRC, Nagpur

ABSTRACT:

Aim: To evaluate and compare the performance of Root ZX and PropexPixi apex locator's in closed and open apex cases.

Materials and methods: Working length of 40 single rooted teeth was determined. The teeth were divided into 2 groups (n = 20). First group included teeth with mature apices. Root canals of the other groups were progressively enlarged until a size 70 K file advanced 1 mm beyond (So apical size become 0.72mm). Samples were embedded in alginate and electronic apex locator (EAL) measurements were performed.

Results: Both devices show success rate of 90% in closed apex (within ±1mm) cases where as success rate of Root ZX drops down to 80%(within ±1mm) in open apex whereas PropexPixi continues to perform well.

Conclusion: Root ZX and PropexPixi both are comparable in closed apex cases. PropexPixi was more accurate in open apex cases.

Key words: canal straightening, F360, protaper next, protaper universal, shaping ability.

INTRODUCTION:

Today's root canal treatment depends upon exact working length to achieve optimum cleaning and shaping procedures for ultimate good prognosis.The apical constriction is also called cemento-dentinal junction is a "landmark" upto which bio-mechanical preparation, irrigation and obturation is recommended. It is the narrowest part of the root canal having smallest diameter and connected to periodontal and pulpal tissue.[1]

Apical foramen diameter is a critical point that influences accuracy of EAL's.[2]Over instrumentation, pulpal necrosis and root resorption which are main causes of lack of apical closure and results in open apices which is more difficult to record.[3]

The traditional methods like tactile sensation and radiography are deceptive because of secondary curvatures and only two dimensional image of 3-dimensional object.[4]To overcome these limitations EAL's are continuously

improving from 1st device to 7th generation to aim at accurately evaluating the working length in closed and open apex.

The Root ZX uses the ratio method to locate the minor foramen by simultaneous measurement of impedance using two frequencies. Accuracy of the Root ZX said to be not affected by presence of fluids and tissues.[5]

The ProPexPixi is successor in ProPex group of apex locators from Dentsply. So the purpose of present study is to evaluate the accuracy and predictability of Root ZX and ProPexPixi in closed and open apices.

MATERIALS AND METHODS:

A total of 40 teeth with mature apex is collected and handled as per guideline of OSHA.Roots representing fractures, resorptions or any other anatomical irregularities were not included.Teeth are confirmed for only one straight non calcified canal confirmed on radiograph.Occlussal/Incisal surface flattened to obtained fixed reference point. Access opening was done. Number 10 K file was then progressed through root canal until it was visible at the apical foramen under endomicroscope. Then file was withdrawn 0.5mm from this point.Then length between tip and reference was measured using vernier caliper. This was consideredto be actual working length (AWL). A new file is used for each sample.

Then teeth are grouped under

Group I (n=20)

Teeth with mature apex

Group II (n=20)

Teeth with open apex

Canals were progressively enlarged until a size 70 K file advanced 1 mm beyond. (So apical size become 0.72mm)

AWLs is measured as previously stated, EALs were used to measure working lengths. All prepared sample were embedded in alginate filled molds.Lip clip was inserted in alginate to complete the circuit. Canals were irrigated with 5.25% sodium hypochlorite. Excess removed from chamber with cotton pellet. Now electronic apex locators were used. File was attached to apex locator and advanced in canals.File was advanced in canal until the working length. Measurements were recorded if they were stable for 5 seconds (All measurements were recorded according to manufacturer's instruction).

DATA ANALYSIS

The results of two apex locators were assessed both intergroup and intra-group. Statistical analysis was performed with Fisher exact test. Significance was set at $P < 0.05$.

RESULT:

Results are presented in tables provided.

DISCUSSION:

Both EAL such as Root ZX and Propex Pixi performed well within ± 0.5 mm of AWL in closed apex group. But the accuracy of Root ZX significantly decreased in open apex group ($P < 0.05$). Whereas the Propex Pixi EAL showed significantly better results than Root ZX in open apex cases. The results of the present study represented that Root ZX revealed success rate of 60% within ± 0.5 mm and 90% within ± 1 mm in teeth with mature apices.[12]For open apices, the accuracy of Root ZX varies. The results of current study revealed that the success of Root ZX decreased with increasing apical diameter.

Propex Pixi apex locator was developed to measures the capacitance and resistance of the circuit, separately. In this study we have selected Propex pixi apex locator because it uses multi-frequency apex locator technology, it works in dry and wet canals, and no calibration, no zero adjustment is necessary. Less disturbance by tangling wires, improved visual control of the file progression.[6]

Numerous studies stressed on the importance of accurate working length determination.[7,8]Negishi *et al.*, stated that the treatment outcomes can be improved when instrumentation was done within a distance of 0-2 mm from radiographic apex.[9] Whereas, ElAyouti *et al.*, found that instrumentation within a distance of 0-2 mm from radiographic apex resulted in over instrumentation in 51% of premolars and 22% of molars and concluded that radiographic

measurement should be supplied with electronic measurement.[10]

The success of Root ZX was proved with several studies and the accuracy of different EALs were compared to that of Root ZX.[4,11,12] In accordance with previous studies, the results of the present study represented that Root ZX revealed success rate of 60% within ± 0.5 mm and 90% within ± 1 mm in teeth with mature apices.[1,12]

For open apices, the accuracy of Root ZX varies. In the study of Aydin U *et al.*, the performance of Root ZX was evaluated in teeth with apical diameters of 0.32 mm, 0.57 mm and 0.72 mm. The results revealed that the success of Root ZX decreased with increasing apical diameter.[1]

In vitro studies evaluating EALs utilized alginate, saline, agar, gelatin and other chemicals to simulate the apical electro-conductivity for electronic measurements. Baldi *et al.*, compared the effectiveness of alginate, agar, gelatin, saline and sponge soaked in saline and despite the lack of a significant difference among the groups, alginate was found to be superior to other groups.[13]Alginate is an electro conductive material, which simulates periodontal ligament with its colloidal consistency. The present study utilized alginate as a conductive media. Lipski *et al.*, completed the measurements in 30 minutes. In accordance with this study, we preferred to achieve EAL measurements within 30 minutes after

setting of alginate to avoid excessive loss of humidity.[14]

Studies evaluating the accuracy of EALs may be performed both *in vivo* and *in vitro*. In the study of Sindreu *et al.*, the accuracy of Root ZX was determined *in vivo* and *in vitro*. They concluded that no significant difference was present between *in vivo* and *in vitro* groups.[15]Ebrahim *et al.*, stated that *in vitro* studies provide objective evaluation of different variables, which cannot be obtained with *in vivo* studies.[16] The authors of the present study preferred to evaluate *in vitro* reading to better achieve standardization and to repeat measurements in teeth with different apical diameters.

CONCLUSION:

Within the limitations of present study, it can be concluded that Root ZX and Propex Pixi both are comparable in closed apex cases. Propex Pixi was more accurate in open apex cases. Further in vivo and in vitro studies are required to confirm the same.

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TABLES:

Table 1: The distance of file EMs to AWLs for Root ZX and Propex Pixi, in Closed apex group. *0 indicates EM is exactly the same as AWL. Negative values indicate EM is shorter than AWL. Positive values indicate EM is exceeding AWL

Distance Apex	Closed Apex	
	Root ZX	Propex Pixi
Sample size	20	20
>1mm	01	0
1 to 0.51mm	01	0
0.5 to 0.01mm	02	0
0	04	09
-001 to -0.5mm	06	10
-0.51 to -1mm	05	01
<-1mm	01	0
Accuracy +0.5 mm	60%	95%
Accuracy +1 mm	90%	5%
Accuracy +>1 mm	10%	-
Z-statistics	2.705	
p-value	0.0068 , Highly Significant	

In Closed Apex group, accuracy of measurement of Propex Pixi was significantly more accurate than Root ZX.

Table 2: The distance of file EMs to AWLs for Root ZX and Propex Pixi, in Open apex group. *0 indicates EM is exactly the same as AWL. Negative values indicate EM is shorter than AWL. Positive values indicate EM is exceeding AWL

Distance Apex	Open apex	
	Root ZX	ProPexPixi
Sample size	20	20
>1mm	01	00
1 to 0.51mm	03	00
0.5 to 0.01mm	02	04
0	03	09
-001 to -0.5mm	04	04
-0.51 to -1mm	03	02
<-1mm	04	01
Accuracy +0.5 mm	46.7 %	85 %
Accuracy +1 mm	80 %	95 %
Accuracy +>1 mm	20 %	5 %
Z-statistics	2.705	
p-value	0.0068 , Highly Significant	

In Open Apex group, accuracy of measurement of Propex Pixi was significantly more accurate than Root ZX.