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EVALUATION OF THE ACCURACY OF TWO APEX LOCATORS : AN IN VIVO AND AN EX VIVO STUDY

Endodontics

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ABSTRACT

Aim: This study was conducted to evaluate the accuracy of two apex locators Dentaport ZX and Raypex 6 by comparing their electronic length with actual length of teeth after the extraction. **Materials And Methods:** Twenty Eight vital, single rooted teeth with single canal, that were scheduled for extraction because of severe periodontal disease were included in this study. Teeth were divided randomly into two groups (Dentaport ZX and Raypex 6). The electronic working length (EWL) was measured using two different apex locators and compared with the actual working length (AWL) that was measured after the extraction of the teeth, to be categorized as accurate, short and long or beyond. **Results:** In Dentaport ZX apex locator the mean of EWL was 20.25±2.13 and AWL was found to be 20.71±1.86. In Raypex 6 apex locator the mean of EWL was 20.25±1.83 and AWL was found to be 20.14±1.42. **Conclusion :** Under the clinical conditions of this study both the groups showed no statistically significant difference between EWL and AWL.

KEYWORDS

Apex locators; AWL; Dentaport ZX; EWL; major foramen; Raypex 6

INTRODUCTION –

The success of root canal treatment depends on the complete removal of infected pulp tissue, necrotic material and microorganisms from the root canal and achieving homogeneous filling of the entire canal[1]. This canal length depends on correct determination of the tooth length which is the first important step in root canal therapy. The clinically acceptable working length in canal instrumentation is the distance between the reference point occlusally or incisally on the tooth and the apical cemento-dentinal junction (CDJ) or apical constriction. Although dentists routinely use radiography to determine the working length, the apical constriction is usually not seen in radiographs. Many reports show a mean apex to apical foramen distance of around 0.5-1 mm[2].

Apex locators have been developed to determine the true working length of root canals. The basic assumptions with all electronic length measuring devices is that human tissues have certain characteristics that can be modeled by combination of electrical components. It is based on the property that electrical resistance between the periodontal membrane and the oral mucosa is constant and equals 6.5KΩ when the tip of the instrument reaches the foramen. However accurate readings cannot be obtained if there is vital tissue[3].

Dentaport ZX (J Morita, Kyoto, Japan) is an updated version of Root ZX, which is comprised of an original Root ZX and an attached rotary motor device. Dentaport ZX measures the canal length based on the ratio method, which simultaneously measures impedance values at two frequencies (0.4 and 8 kHz) and calculates a quotient of impedances. This ratio is independent of the presence of various intracanal contents and irrigants[4].

The multiple frequency processing technologies and use of RMS (root mean square) incorporated into the Raypex 6 may have theoretical advantages for increasing the accuracy of working length measurements, by reducing the electrical noises affecting other physical parameters like amplitude or phase of the electrical signal that is used by other EALs[5].

The information regarding their accuracy in root canal length determination by in vivo studies and measuring the actual length of teeth is limited. The purpose of present in vivo study was to evaluate the accuracy of the Dentaport ZX and Raypex 6 apex locators at a position of 0.5mm short of the apical foramen.

MATERIALS AND METHODS

Twenty eight human maxillary or mandibular single rooted mature teeth in patients (aged 20-65 years) having severe periodontitis with grade III mobility and scheduled for extraction were selected. Patients that used heart pacemakers were excluded. The teeth with no apical patency or with the radiographic signs of resorption were excluded. Each patient was informed about the steps involved in the study and consented to participate.

Patient was anaesthetized (Lignox 2% A, Indoco Remedies LTD), rubber dam isolation done, teeth were flattened with a diamond rotary instrument and ink marking was done to serve as reference for the location of the silicon stop and access cavity prepared. Pulp was extirpated and canal was irrigated with normal saline. Excess saline was removed with paper point. EWL was measured after teeth were allocated to following groups. Group I : Working length determined with Dentaport ZX apex locator, Group II : Working length determined with Raypex 6 apex locator.

Determination of EWL was done with instument size selected according to the canal and new K file with firm silicon stopper, introducing K file into the canal till it indicated apex on the device. Once the rubber stopper was set to the reference point there was a stable reading for at least five seconds. Then the file was taken out, length was measured using digital caliper (Mitutoyo Corp, Tokyo, Japan) then 0.5mm was reduced from this length. Measurement was noted as EWL. Tooth extraction was carefully done and cleaned.

Apical foramen was observed under the scanning electron microscope(SEM) (FEI ESEM Quanta 200) under 30X magnification. Same file was introduced again into the root canal until tip of the file was just visible from the apical foramen when seen under the SEM. The actual working length was measured from the marked reference point till the tip of the file to the accuracy of 0.5mm using digital caliper. Then 0.5mm was subtracted from this measurement to get the actual working length (AWL).
The difference between the EWL and AWL was calculated in reference to AWL the samples were categorized using following criteria.

Accurate = 0.5mm short of the AWL

Acceptable = 0-1mm short of the AWL

Short = >1mm short of the AWL

Beyond = Beyond the AWL

The data were analyzed statistically using Independent sample test and Fishers exact test with SPSS software version 19.00 (IBM Corp, Armonk, NY, USA).

Ethics- ethical clearance was obtained from the PMNM Dental College and Hospital ethical committee

RESULTS

A total of 28 teeth were evaluated in this study. In Dentaport ZX apex

locator the mean of EWL was 20.25 ± 2.13 and AWL was found to be 20.71 ± 1.86. Comparison shows that there is no statistically significant difference between EWL and AWL with P value of 0.06 (P > 0.05) (table 1).

In Raypex 6 apex locator the mean of EWL was 20.25 ± 1.83 and AWL was found to be 20.14 ± 1.42. Comparison shows that there is no statistically significant difference between EWL and AWL with P value of 0.79 (P>0.05) (table 1).

Table 1:- Comparison Of EWL And AWL Of The Two Apex Locators

Group		N	Mean	SD	Mean Difference	95% Confidence Interval of the Difference		T	Df	p-value
						Lower	Upper			
1.00	Ewl	14	20.25	2.13	-0.46	-0.95	0.02	-2.06	13	0.06
	Awl	14	20.71	1.86						(NS)
2.00	Ewl	14	20.25	1.83	0.11	-0.73	0.94	0.28	13	0.79
	Awl	14	20.14	1.42						(NS)

Independent sample test
*p<0.05 Statistically Significant p>0.05 Non Significant, NS

The mean difference in group1 found to be 0.46 ± 0.84 and in group 2 it is 0.11 ± 1.44. The comparison of mean difference between both the groups shows that there is no significant difference with P value of 0.21 (P > 0.05)(table2).

Table 2:-Comparison Of Working Length Between The Two Apex Locator

	Group	N	Mean	SD	Mean Difference	95% Confidence Interval of the Difference		T	Df	p-value
						Lower	Upper			
Difference	**1.00**	14	0.46	0.84	-0.57	-1.49	0.35	-1.28	26	0.21
	2.00	14	-0.11	1.44						(NS)

Independent sample test
***p<0.05 Statistically Significant p>0.05 Non Significant, NS**

There is categorical difference between both the groups using Fisher exact test and results show that there is no statistically significant difference between both the groups with P value of 0.59 (P > 0.05).

Interclass correlation for Dentaport ZX apex locator for EWL and AWL was found to be 0.91(0.75-0.97) and the same for Raypex 6 apex locator was found to be 0.61 (0.14-0.86).

DISCUSSION-

The aim of the present study was to evaluate the accuracy of 2 apex locators (Dentaport ZX and Raypex 6) under clinical conditions since predictable endodontic success demands an accurate working length determination of the root canal.[6]

Apex locators have advantages over radiographic methods; EWL determination with apex locators is easier, faster and can be indefinitely repeated without exposure to radiation. Studies have shown that the accuracy of apex locators is higher when compared with that of the radiographic methods.[7]

In the present study, the AWL was established to be 0.5 mm coronal to the major foramen as suggested in previous studies.[8,9] Several researchers have suggested that the precise location of the AC cannot be determined and there might not be an apical constriction.[10,11] Consequently, we and many others have evaluated the accuracy of EALs in determining the WL taking as a reference point the major foramen or 0.5mm short of the major foramen.[12,13,14,15]

There is a wide variation of the accuracy of apex locators ranging from 15% to 93.4% as reported in several studies. The lower accuracies may be due to the presence of electrolytes, irrigants, exudates and tissue remnants.[16] The diameter of apical foramen may also influence the accuracy of EALs.[17] Contemporary units have degrees of accuracy that range from 85% to 95%.

Present study showed that there is no statistically significant difference between EWL and AWL in locating position 0.5mm short of the apical foramen for both Dentaport ZX and Raypex 6 apex locators when analysed qualitatively.

When the accuracy was evaluated for both the groups by observing the difference between their EWL and AWL measurements, both showed no statistical significant difference.

In the present study for group 1 the mean of EWL and AWL were 20.25±2.13 and 20.71±1.86 respectively and the difference between them was 0.06(p>0.05) which is statistically not significant . Similarly a study by Nikhil Puri et al showed that Dentaport ZX was accurate in 93.3% of the samples at a position 0.5mm short of the apical foramen.[18] A study by Saddy Moscoso et al reported 82.35% of the time to ± 0.5mm and 97.05% of the time to ± 1mm when detecting apical foramen.[19] Hale Cimilli et also showed that the measurements for Dentaport ZX was within ± 0.5 mm of retreatment tooth length (RTL 1mm short of apical foramen) in 93.3% of measurements and within ± 1.0mm of RTL 100% of the time with both EAL (major and minor) reading taken in distal canals. For the mesiobuccal canals, all EAL readings were within ± 1.0mm.[20]

In group 2 this study showed the mean of EWL and AWL 20.25±1.83 and 20.14±1.42 respectively and the difference between them was 0.79(p>0.05) which is statistically not significant . Similarly a study by Prahlad A. Saraf et al showed the accuracy of 95.6% for Raypex 6 device on comparing EWL and radiographic working length.[21] A study by Berenice R. Garcia-Harverth et al showed radiographic location of 0.543mm to 0.387mm between the precision of the radiographic location of the foramen for Raypex 6 device.[22] Ugur Aydin et al showed 85% and 95% accuracy within ±0.5mm and within ± 1mm, respectively in teeth with mature apices when file tip was kept 0.5mm short of the apical foramen.[23]

Owing to very few studies comparing Dentaport ZX and Raypex 6, there was also no statistical significant difference between the groups with independent sample test (table2) and also categorical difference (table3) between the two groups failed to show significant difference indicating the accuracy of Raypex 6 in par with Dentaport ZX. Finally interclass correlation also did not show significant difference in this study.

Though both the apex locators have some measurements overestimated the WL but Raypex 6 has more tendency to overestimate WL compared to Dentaport ZX measurements.[24] The variations in this study might be because of sample size and the EWL depending on the apical foramen diameter.

CONCLUSION

Under the conditions of this in vivo and ex vivo study , Dentaport ZX and Raypex 6 performed equally well in determining a position 0.5mm short of the major formation.

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