

COMPARISON OF ACCURACY OF WORKING LENGTH MEASURED BY APEX LOCATOR AND PERIAPICAL RADIOGRAPH

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ABSTRACT

The aim of this study was to compare the accuracy of working length measured by electronic apex locator and periapical radiograph. This cross sectional analytical study was conducted at Department of Operative Dentistry, Dental section, Dow International Medical College, DUHS from November 2014 till December 2014.

Thirteen teeth with twenty three canals were selected in patients having age between 18 to 60 years, who were advised extraction of teeth due to any reason. Access opening was performed and working lengths of all canals were measured using K file with apex locator and periapical radiographs. Access opening was filled with restorative GIC with the files present in canals. Teeth were then subjected to extraction. All extracted teeth were evaluated by sectioning the lower half or lower one third of the apices longitudinally. The distance of the file tip from the minor constriction was measured and recorded. Data were analyzed by using SPSS version 16. Intraclass co-efficient test was applied to see the agreement between the lengths measured with radiograph and apex locator than compared to the actual lengths as noted after sectioning. P-value of <0.05 was considered as significant.

The results of the study showed that accuracy of apex locator were 65% (n=15) with the file tip at minor constriction, while 22% (n=5) for periapical radiograph. Thus it is concluded that electronic apex locator is more accurate and reliable than periapical radiograph.

Key Words: Apex locator, working length, accuracy, periapical radiographs.

INTRODUCTION

The aim of endodontic treatment is to remove the infected or necrotic pulp, clean, shape, disinfect root canal and maintain disinfected environment by filling the root canal system with an aseptic material so that the tooth can retain its form and function.¹ Working length is defined as the distance from a coronal reference point to the point (i.e. apical constriction) at which the canal preparation and obturation should terminate,² the

apical constriction represents the transition between cemento-dentinal junction. This cemento-dentinal junction is the anatomical and histological landmark where the periodontal ligament begins and the pulp ends. It has been suggested as the position of termination of the root canal filling in majority of population.^{3,4}

Commonly used methods for working length determination include tactile sensation, periapical radiograph and electronic apex locator. Tactile sensation for working length determination is considered to be highly unreliable because in many cases root canal anatomy is highly variable and is not recommended.⁵

Periapical radiographs are highly informative in endodontics as they give information about anatomy of pulp canal system and its surrounding periodontium. However, radiographs can be subjected to magnification error, distortion, interpretation variability, and lack of three dimensional representation. On the other hand, electronic apex locator is presented as an instrument for identifying the apical constriction and determining the working length as an alternative or adjunct to the radiographic method. However, this device still has questionable reliability, because it may produce in-

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interference with metal restorations, show inconsistent and unstable readings, chances of short circuit, need of a lip clip, insuitable for teeth with open apices, lack of record keeping for medico-legal purposes and inability to be used in patients with cardiac pace maker.^{6,7} Therefore, it is worthwhile to conduct a comparative study to determine the difference in accuracy between these two methods.

The objective of present study was to compare the accuracy of working lengths measured by apex locator and periapical radiograph. Hence, it is hypothesized that apex locator is more accurate and reliable method for odontometry than periapical radiograph.

METHODOLOGY

This cross sectional analytical study was conducted at Out Patient Department of Operative Dentistry, Dental Section, Dow International Medical College, DUHS from November 2014 till December 2014. The sample size was calculated to be 23 by using WHO recommended sample size determination software and by considering the reference article.⁸

Using PASS version 11, chi-square test for multiple proportions with 95% confidence interval, sample size of 23*, effect size of 0.86*, 12 degrees of freedom, calculated power is 0.80, with which we justify our sample size for comparison of accuracy of both methods.

Total 13 teeth with 23 canals which were not restorable and those planned to be extracted, were selected. Informed consent were taken from each patient and those who refused to give consent, were excluded from the study. The inclusion criteria were, patients in age group 18-60, who were advised extraction of teeth, all maxillary and mandibular teeth with completely formed root apices. The exclusion criteria were third molars, teeth with lost reference points during extractions, teeth with calcified canals, supernumerary teeth, grossly carious teeth with loss of two third or more of coronal structure. Patients with unstable medical conditions and pregnant patients were also excluded.

After obtaining informed consent, local anesthesia (2% lidocaine with 1:80,000 adrenaline) was administered and tooth was isolated with rubber dam. It was made sure that every tooth in the sample must have a prominent and stable reference point and reference point for each canal was documented. For each selected tooth, access opening was performed with a tapered fissure and/or round diamond bur (Mani ISO TF-13 and/or ISO BR-31). Manual K file no 10. (Mani ISO 10, of tip diameter 0.01mm) was inserted to make gliding path and canals were irrigated with 2.5% sodium hypochlorite.

Working Lengths of all negotiable canals were

measured with manual K file no. 15 (Mani ISO 15, of tip diameter 0.015mm), using Dentaport Apex Locator (J. Morita Co, Tustin, CA). The same tooth was then subjected to periapical radiograph using parallel technique. Both readings were then recorded and access opening was filled with Glass Ionomer Restorative material, Ketac Molar Easy Mix (3M ESPE) with the files present in canals without cutting handles of files. Teeth were then subjected to extraction. Teeth which were fractured or broken during extraction or there is loss of reference point, were excluded from the sample. All extracted teeth were labeled individually and then stored in normal saline, disinfected and dried.

Lower one third of the apices of each tooth were then sectioned longitudinally with a straight fissure diamond bur (Mani ISO SF-04) till the file present in the canal becomes visible. The distance of the file tip from the minor constriction is measured in millimeters with the help of scale and endodontic loupes. (CE Dental Surgical Binocular Loupes 3.5X320mm).

Data collected in proforma, and entered in SPSS version 16. Intraclass co-efficient test was applied to see the agreement between the lengths measured with radiograph and apex locator than compared to the actual lengths as noted after sectioning. P-value of <0.05 was considered as significant.

RESULTS

In present study, total number of teeth were 13 and total number of canals were 23. The results of the study showed that apex locator were 65% (n=15) accurate with the file tip at minor constriction, 26% (n=6) were short and 9% (n=2) were beyond the minor constriction (Table 1). While considering radiographic method 22% (n=5) were accurate, 52% (n=12) were short of minor constriction and 26% (n=6) of files were beyond the apex (Table 2). The Intraclass Correlation Coefficient test was applied to see agreement between these two methods. The coefficient value is 0.413 (Table 3) which shows a moderate level of correlation between the two methods. The P-value was statistically significant i.e.

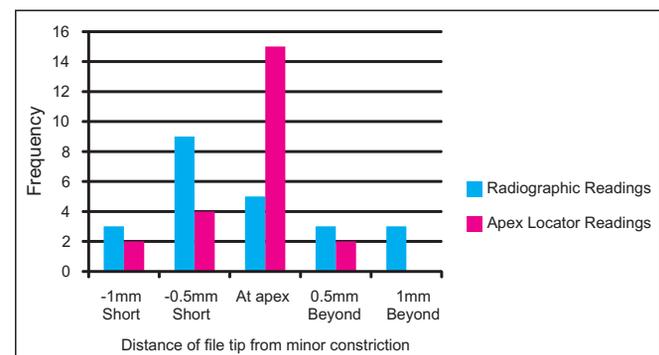


Fig 1: Apex Locator and radiographic readings according to the distance from minor constriction

TABLE 1: APEX LOCATOR READINGS ACCORDING TO THE DISTANCE FROM MINOR CONSTRICTION

		Frequency	Percent	Valid percent	Cumulative percent
Valid	-1mm Short	2	8.7	8.7	8.7
	-0.5mm Short	4	17.4	17.4	26.1
	At Apex	15	65.2	65.2	91.3
	0.5mm Beyond	2	8.7	8.7	100.0
	Total	23	100.0	100.0	

TABLE 2: RADIOGRAPHIC READINGS ACCORDING TO THE DISTANCE FROM MINOR CONSTRICTION

		Frequency	Percent	Valid percent	Cumulative percent
Valid	-1mm Short	3	13.0	13.0	13.0
	-0.5mm Short	9	39.1	39.1	52.2
	At apex	5	21.7	21.7	73.9
	0.5mm beyond	3	13.0	13.0	87.0
	1mm Beyond	3	13.0	13.0	100.0
	Total	23	100.0	100.0	

TABLE 3: INTRACLASS CORRELATION COEFFICIENT TO SEE AGREEMENT BETWEEN TWO METHODS

	Intraclass Correlation ^b	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.413a	-.002	.703	2.348	22	22	.026
Average Measures	.585c	-.004	.826	2.348	22	22	.026

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type A intraclass correlation coefficients using an absolute agreement definition.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

0.026 (< 0.05) which shows that there was difference between the two groups Hence the hypothesis that the apex locator is better in accurate length determination, is accepted.

DISCUSSION

The study was conducted to determine the accuracy of periapical radiographic working length and those measured by apex locator. The results indicated that there is statistically significant difference ($p = 0.026$) in accuracy of working lengths determined by these two methods.

Present study revealed that the accuracy of radiographic method is 22% ($n=5$, files observed at minor constriction) while the working length measured by apex locator revealed 65.2% ($n=15$) accuracy (with files at minor constriction). Hence, the electronic apex locator

is more accurate and reliable in measuring the working lengths of canals. Our hypothesis was thus accepted.

The findings of present study is similar to the study conducted by Qazi et. al which reports 90% accuracy of Electronic Apex Locator (Sybron Endo) in measuring working lengths.⁹ The reason apex locator is being more accurate in their study is probably the use of fourth generation apex locator compared to the third generation apex locator used in present study which showed 65.2% accuracy. Moreover the study was conducted in anterior teeth only where there is less variable anatomy compared to posterior teeth.

Another study conducted by Sikander M. stated 89% accuracy of apex locator in deciduous teeth with root resorption, though in present study only permanent teeth were included in sample.¹⁰

An interesting finding of present study that also supports the accuracy of apex locator was that not even a single file (0%, n=0) was observed 1 mm beyond apex while radiographic method showed 13% (n=3) of files 1 mm beyond apex.

Recent systematic review conducted by Jorge N.R. Martins also supported the idea that electronic apex locators are more accurate in odontometry than conventional periapical radiographs. Results of this study also showed that the measurement of working length by any of the two methods is independent of gender, age, tooth type, presence of apical pathology, intracanal humidity and type of apex locator.¹¹

It has been shown that in more than 50% of the cases minor constriction does not coincide with radiographic apex, it lies somewhere around 0.0 to 3.0 mm from the radiographic apex.¹² Some other factors like radiographic magnification errors, overestimation of canal length make the working length measurement unreliable¹³ therefore solely relying on radiograph for working length determination is dubious.

The limitations of the study was small sample size and the use of conventional rather than digital periapical radiograph. The study was also limited by the fact that the lower one third of root was sectioned with a straight fissure bur manually and the distance from the file tip and minor constriction was also measured manually, so there were chances of misinterpretation.

CONCLUSION

Despite being gold standard and most commonly used method in clinical dentistry, radiographic method for odontometry holds many drawbacks, therefore; it is concluded that electronic apex locators is more accurate and reliable than periapical radiograph.

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CONTRIBUTION BY AUTHORS

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| 2 Muhammad Adeel Ahmed: | Title selection, design planned analysis. |
| 3 Farah Naz: | Critical revision/referencing. |
| 4 Muhammad Amin: | Literature review/discussion. |