

Evaluation of Accuracy of PA Radiography and Root-ZX Apex Locator in Determination of Length of Teeth Canal with Destroyed Apical Constriction: An In-Vitro Study

Mohammad Hosein Yosefi¹, Mahdi Tabrizizadeh¹, Raziye Nazari²

¹Assistant Prof., Dept. of Endodontics, Dental School, Shahid Sadooghi University of Medical Sciences, Yazd, Iran

²Dentist, Dental School of Shahid Sadoughi University of Medical Sciences, Yazd, Iran

* Corresponding author's Email: nazari.mahra@gmail.com

ABSTRACT: In this study, 25 extracted single canal teeth were provided access cavity and became flat – from cusp area – for the purpose of creating suitable reference point. The teeth were numbered; then actual measure length of canals with proper k-file were measured and determined. Then, canals of teeth were filing – about 1 mm more than their actual length (wl+1) – to the file 30 ; so, apical constriction was destroyed and disappeared. Then they were instrumented to the file 60. Then teeth mounted in alginate and working length measurement with Root-ZX apex locator. In next step PA radiography was done by parallel method. After collecting the data, they were analyzed by paired T- test of descriptive statistics. With considering the range of 0.5 mm error – acceptable measuring was 88% for Root-ZX, and in the range of 1 mm error, its admission rate was 100%. With considering the range of 1 mm error – acceptable measuring for radiography was 72%, and in the range of 0.5 mm error, its admission rate was 40%. Since, in destroying apical constriction, the accuracy of Root ZX was more than radiography, using Root ZX apex locator is more useful and offered.

Keywords: Root Canal, Apex Locator, Destroyed AP, Ical Constriction Radiography

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INTRODUCTION

Accurate determination of the working length is an essential step in root canal therapy (Naito, 2005), and the success or failure of endodontic therapy is dependent on it (Nekoofar et al., 2006). Working length is the length between a coronal reference points to the point that must be filed flared and obturated (Walton and Torabinejad, 2009). Radiographic apex is the place of the root tip in a clear radiographic image; while the anatomical location of the apex is the root end in morphological aspect (Ingle and Bakland, 2008.). Cdj is a place in the canal that is where pulp tissue transmuted into periodontal tissues. This place considered as an ideal apical limit for determination but it isn't a constant and diagnosable feature in the clinical diagnosis, it can not be used as a clinical landmark (Gordon and Chandler, 2004; Dummer et al., 1984). Apical constriction is narrowest of the root canal, where we have the shortest diameter of the canal (Hasselgren, 1994). So, it could be used as the apical limit of working length and finding this apical is a critical step in endodontic therapy (Ricucci, 1998). Nevertheless in finding the exact location of the apical limit is a great challenge in clinical endodontic (Ricucci, 1998; Wu et al., 2000; Langeland, 1987; Ricucci and Langeland, 1998; Seltzer et al., 1969). There are several methods for determining the working length; the common method for determining root canal length- since a hundred years ago- has been radiography. In

1942, electronic apex locator was created for root length determination (Sunada, 1962). Root ZX apex locator is the third generation of the device - that was introduced by Kabayashi and Sonada between 1991- 1994 and its accuracy is being mentioned between 64 - 100%. Lloyd and Ingle (2008) studied on working length determined by apex locator Root-ZX and combining Root-ZX apex locator and radiography with a new technique ,and showed that using Root-ZX apex locator and radiography for working length at the same time is preferable, although there is little difference between the two (Kim et al., 2008). Herrera et al. (2011) studied and examined the accuracy of the electronic apex locator Root-ZX in the widened apical foramen; and showed that while increasing the diameter of the foramen the accuracy of the device gradually decreased.

In this study we examined the accuracy of pre apical radiography and Root-ZX apex locator in length determination of the teeth with destroyed apical constriction by In vitro evaluation.

MATERIAL AND METHODS

A total of 25 extracted human teeth with mature apices were used for this study. Actual measure length of canals were measured and determined by proper k-file (Mani CO. Japan) in proportion to the numbers of the teeth; and canals of teeth were filing – about 1 mm more

than their actual length (wl+1) – to the file 30; so, apical constriction was destroyed Then they were instrumented to the file 60. For determining the electronic working length with apex locator Root-ZX (Root-ZX mini, Morita MFG, Kyoto, Japan) the teeth were fixed into the alginate. the teeth were mounted into a plastic container filled with the alginate (Zrmach company, Italy), and electronic length was determined In order to working length determination by using pre apical radiography, at first, pre apical radiography was done by using parallel method by XCP (DensplyRinn) and parallel radiography was done.

RESULTS

Results shown that the accuracy of the apex locator Root-ZX – in the range of ± 0.5 mm error – was 88%; (22 teeth) and also in the case of radiographic method, the accuracy -in this range- was 40% (10 teeth). With considering the range of ± 1 mm error for the two methods the accuracy for Root-ZX was 100% (25 teeth) and for radiography was 72% (18 teeth); and 28% (7 teeth) – in radiographic technique- was out of the range of ± 1 mm. Frequency of measurement error for measuring canal length in both electronic and radiographic methods summarized in Table 1 and Figure 1.

Table 1. Frequency table showing the number and percentage of the RWL and the first EWL measurement values

Method	± 0.5	± 1	$\geq \pm 1$
Electronic	22(88%)	25(100%)	0
Radiographic	10(40%)	18(72%)	7(28%)

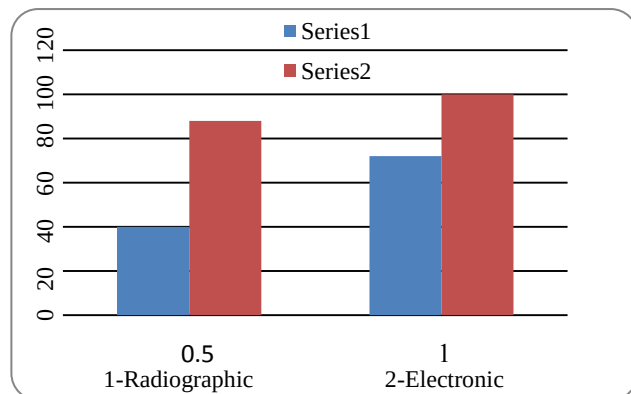


Figure 1. Frequency of percentage of the RWL and the first EWL measurement values

Based on paired T-test and the average of the lengths obtained from Root-ZX (24.0492 mm) and X (24.6432 mm) and also according to the average of actual length (24.0356 mm), statistically there wasn't a significant difference between the results from electronic method and actual length; but it was significant for radiographic method ($p = 0.001$) (Table 2).

Table 2. Comparison of actual working length whit length measured by radiographic procedure and electronic apex locator

Method	Mean of diff	P-Value
Electronic	-0.01360	0.840
Radiographic	-0.60760	0.001

DISCUSSION

Canal length determination is an important factor in successful endodontic therapy (Cohen and Burns, 2002). Although the exact criteria for endpoint root canal therapy remains controversial, but there is general agreement that, apical constriction is suitable as the base for the purpose of determining canal length. But this constriction isn't in the teeth with open apex or diseases of pulp and pre apical caused to root re-sorption (Kim and Chandler, 2013). The purpose of this study is laboratory analysis of radiography and electronic methods in determining canal length with destroyed apical constriction. Practitioners have challenges of working length determination during endodontic therapy for the teeth with open or immature apex.). Shabahang et al. [1996] have suggested that the range of ± 1 mm error is acceptable, and other studies suggested that the acceptable range of error in the teeth with closed apex is ± 0.5 mm. In the current study if we consider the acceptable range of ± 1 mm error, the accuracy of the Root ZX apex locator increases to 100%; which is consistent across the studies of Goldberg and colleagues and also Herrera et al ($P = 0.84$). In this study, the accuracy of radiographic method, – in the range of ± 0.5 mm error – was 40%; means that, when apical constriction has been destroyed because of iatrogenic causes, combined use of electronic apex locator and radiography is much better than radiography alone ($P = 0.001$). Herrera and colleagues studied and examined the accuracy of the electronic apex locator Root-ZX in the widened apical foramen; and showed that while increasing the diameter of the foramen the accuracy of the device gradually decreased (Neen and Ananthra, 2013). In the present study, the accuracy of the apex locator Root-ZX – in the range of ± 0.5 mm error – was 88%; that is greater than the accuracy of radiographic method. And if the range of ± 1 mm error is considered desirable and acceptable; so, Apex locator has been able to determine all cases correctly. But radiographs has been successful only in 72% of cases, and this difference is statistically very significant ($p = 0.001$). This finding is not consistent across Herrera et al. in 2007. In this case, the apical canal may be widened and caused to this problem. In Herrera and colleagues studies - as noted- if the canal widening is small, it wouldn't affect on the accuracy of the device; but, increasing the widening, gradually caused to reducing the accuracy.

For working length determination in the case of destroyed apical constriction, Root-ZX apex locator is better than radiography; so, in these cases, it is better to use apex locator along radiography.

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