WILEY'S

International Journal of Dentistry and Oral Health

Research Article ISSN 2471-657X

An Invitro Evaluation of the Accuracy of Two Different Apex Locators After Ca(Oh)2 Removal with Different Two Irrigants

Nooshin Sadat Shojaee*[1], Zahra Zaeri, M.Mehdi Shokouhuia[2]

[1]*Dept. of Endodontics, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran*

[2]*Undergraduate Student, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran*

An Invitro I

Corresponding author: Nooshin Sadat Shojaee
Dept. of Endodontics, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran. Tel: +98-713 6263193,
E-mail: shojaeen@sums.ac.ir

Citation: Nooshin Sadat Shojaee et al. (2018), An Invitro Evaluation of the Accuracy of Two Different Apex Locators After Ca(Oh)2 Removal with Different Two Irrigants. Int J Dent & Oral Heal. 4:11, 181-183

Received: October 09 , 2018
Accepted: October 13, 2018
Published: December 7, 2018

Introduction

Successful root canal treatment is partly dependent upon the correct assessment of the working length[1,2]. It is imperative that this procedure be confined to the canal in order to prevent irritation of the periapical tissues and possible overextension of the root filling[3]. Anatomically, the canal is believed to terminate at the apical constriction, or minor foramen[4]. Therefore, locating the exact terminus of the canal at the apical constriction is an important clinical step[5]. Electronic apex locators (EALs) have been used clinically for more than 40 years as an aid to determinethe file position in the canal. These devices, when attached to a file, are able to detect the point at whichthe file leaves the tooth and enters the periodontium. Using radiography followed by subsequent tooth extraction and sectioning, Stein and Corcoran found that the radiographically-established working length did not actually coincide with the true apical vertex[6]. EALs obviate this problem because their readings are not related to the apical vertex but rather to the apical foramen. Sunada demonstrated that the electrical resistance between the periodontal ligament and oralmucosa had a constant value that could be measured[7].

However, this value was influenced by electrolytes in the canal during measurement. Thus, a frequencydependent apex locator has been introduced[8]. Finally, Kobayashi and Suda developed an apex locater (Root ZX, J. Morita Co., Tokyo, Japan)[9] , which simultaneously calculates the ratio of two impedances in the same canal using two different electric current frequencies to determine the canal length, even in the presence of electrolytes or vital pulp tissue in the root canal. As shown in in vitro10-12 and clinical evaluations,13 EALs give accurate readings in about 80–94 per cent of canals. The measurements appear to be less accurate when the apical foramen is immature or otherwise large[11,12]. Clinically, the initial EAL length measurement is generally established with a small-sized instrument that can negotiate the canal to its terminus. However, it has not been clarified whether the accuracy of the instrument would be affected by the use of a small-sized instrument in enlarged canals with irrigants. This question may be particularly relevant to situations where the working length is verified by EAL after the completion of canal preparation. The aims of this in vitro study were:

(i) to evaluate the accuracy of Root ZX apex locator measurements in enlarged root canals with small size files and files that match the actual canal diameter; and

(ii) to observe effects of the agar model when sodium hypochlorite solution (NaOCl) or human blood was present in the canal during electronic measurements.

Materials and Methods

Twenty extracted, straight, single-rooted human mandibular premolars with a single canal were selected. Roots with resorption, fractures, or open apices were excluded from the study. Dental X-ray images from the buccolingual and mesiodistal angles were taken to evaluate the root canal anatomy. Soft tissue and calculus were removed from the root surfaces with hand instrumentation, and all teeth were stored in sterile saline solution (NaCl) (0.9%) until used. The teeth were decoronated at the cementoenamel junction to provide easy access to the canal space and to obtain a constant reference point for all measurements. The contents of the canals were removed with a proper barbed broach (VDW GmbH, M€unchen, Germany). The canals were instrumented up to a size 15 K-file (Dentsply Maillefer, Ballaigues, Switzerland), and apical patency was checked with a size 10 K-file (Dentsply Maillefer). Subsequently, the canals were irrigated with 2.5 mL 2.5% sodium hypochlorite (NaOCl) followed by 2.5 mL distilled water. The roots were artificially perforated in the middle third from the outside of the proximal root surface into the pulp space at a 90 angle with a size 012 round diamond bur (Medin, Nove Mesto na Morav e, Czech Republic). The perforations were approximately 1.5 mm in size. Before electronic measurement, the actual lengths (ALs) up to the perforation site were determined by visualization of the tip of a size 20 K-file (Dentsply Maillefer) at the perforation hole under a stereomicroscope (Stemi DV4; Carl Zeiss, G€ottingen, Germany) with a magnification of 20, and the distance from the rubber stop to the file tip was measured to the nearest 0.05 mm with a caliper. The teeth were then embedded in an alginate mold. Electronic measurements of the perforations were obtained by each EAL according to the manufacturer's recommendations in dry conditions and in the presence of 2.5% NaOCl, 0.9% NaCl, and 17% EDTA using a size 20 K-file. Each canal was irrigated with distilled water and then dried with paper points between the measurements with different irrigants. For the Dentaport ZX device, a size 20 K-file with a rubber stop was advanced into the canal until an "APEX" reading was obtained; it was then withdrawn until the last green bar was reached. For the Rootor device, the file was advanced until the EAL display indicated the "00" mark. The rubber stop was adjusted, the file was withdrawn, and the electronic length (EL) of the perforations was recorded for different canal conditions. All teeth were measured by the same operator, who was experienced in the use of EALs. The differences between the ELs and the ALs of the perforations were calculated. Negative and positive values indicated measurements that were short and long of the AL, respectively, whereas 0.0 indicated coinciding measurements. Statistical evaluation was performed using SPSS 13.0 (SPSS Inc, Chicago, IL). The Friedman and Wilcoxon signed rank tests were used to analyze the data. The level of significance was set at $P < .05$.

Results

Mean differences between electronic and actual lengths were 0.02 mm, 0.13 mm, and 0.15 mm for the RZX, the PAL, and the ELE, respectively. Analysis of variance showed a highly significant difference among EALs at $p = 0.003$. Student-Newman-Keuls post hoc analysis found significant differences between the RZX and the PAL and between the RZX and the ELE at $p < 0.05$. No significant difference was noted between the PAL and the ELE (Table 1). Chi-square analysis found no significant difference among the EALs in the proportion of measurements within a 0.5 range of clinical acceptability at $p = 0.190$. However, the minimum acceptable proportion of electronic canal lengths that should fall within this arbitrary range has not been established. The actual within-range proportions were as follows: 97.5% for the RZX, 95% for the PAL, and 90% for the ELE. Table 2 shows where sample measurements were short, long, or within this range.

Discussion

In the present study, the RWL was established to be 0.5 mm coronal to the major foramen, as suggested previously by various authors[17–19]. Hence, we determined the RWL by subtracting 0.5 mm from the measurement when the file appeared at the major foramen under the stereomicroscope, because the mean distance from the major foramen to the apical constriction was approximately 0.5–1.0 mm[20]. A review of the literature revealed an absence of in vivo studies that had evaluated the accuracy of the Raypex 5 in the presence of different irrigants. In the present study, the statistical analysis showed no significant differences in the accuracy of the Raypex 5 in determining the RWL when 2.5% NaOCl, 2% CHX, and 17% EDTA were used as irrigants. Other studies that have compared the accuracy of different EALs such as Root ZX, TriAuto ZX, and Bingo 4 in root canals filled with CHX, EDTA, and NaOCl have produced similar results[11, 12]. However, our results differed from those of some other studies because in these studies the irrigants used had an impact on the accuracy of some EALs[8, 9]. This discrepancy might be explained by the different methodologies and EALs used in the various studies. Fan et al[8] observed that Root ZX, Propex, and Neosono were accurate in establishing the RWL in a glass tubule with a diameter between 0.25 and 0.4 at 0%, 100%, and 100% of the time, respectively, to 0.5 mm with 17% EDTA and at 0%, 100%, and 91.7% of the time, respectively, with 2.5% NaOCl, whereas we observed that Raypex 5 was accurate 36.7% of the time with 17% EDTA and 63.3% of the time with 2.5% NaOCl. The main reason for the differences between the findings of Fan et al and those of the present study could be that the former used glass tubules that were parallel, without taper or constriction, rather than teeth. Unlike the natural anatomy of mature permanent teeth, the wall of each tubule was equally thick along its length, and the electrical features of glass are different from those of dentin. Our results also do not agree with those obtained by Ozseberg et al € (9), who observed that the Propex EAL was more accurate when the root canal was filled with CHX than when it was filled with NaOCl. This could be explained by the fact that the authors used 0.2% CHX rather than 2% CHX, as used in the present study; the latter is the concentration of CHX that is cited commonly as a root canal irrigant in the endodontic literature[10]. In relation to the measurements obtained with the Raypex 5, our findings are similar to those of Ding et al[21] and Wrbas et al[22]. We observed that the mean distance from the RWL to the file tip was 0.22 mm when 2.5% NaOCl was used (this was 0.28 mm short of the major foramen, because the RWL was set at 0.5 mm from the major foramen). In their studies, Ding et al and Wrbas et al reported that the file tip was at a mean distance of 0.367 mm and 0.15 mm, respectively, short of the major foramen when the Raypex 5 was used. The results of the present study also agree with those of St€ober et al[18], Clinical Research 1076 Gomes et al. JOE — Volume 38, Number 8, August 2012 who found that the mean distance from the RWL to the file tip was 0.174 mm. However, in the present study, the standard deviation (SD) obtained when 2.5% NaOCl was used (0.93) differs from the values obtained in the studies of St€ober et al and Wrbas et al (0.38 and 0.24, respectively). According to Lee et al[23], it is more important that the measurements of WL can be reproduced consistently, as measured by the SD, than to know the mean distance from the measurements to the RWL. Hence, it is important to analyze the SD of measurements obtained with different EALs. If the reading of the device is consistent (low SD) and if the mean distance between the file tip and the major foramen is known, an accurate WL can be obtained by subtracting or adding a predetermined value from the device reading. Therefore, it is important that the SD of the values obtained by using EALs should be low. Nevertheless, a high SD was observed in the present study. Such a finding, which was also observed in some other studies[7, 24], could be explained by the claim of some authors that the accuracy of an EAL is influenced by the anatomy of the root canal [21,2527]. The morphology of the minor and major foramen and the location of the major foramen are 3 important factors that influence EAL performance[21, 25–27]. The diameter of the major foramen is thought to be a major factor that influences the functioning of EALs[26]. Stein et al[26] reported that the accuracy of an EAL depended on the diameter of the major foramen. Other researchers have observed that the accuracy of measurements obtained by using EALs varies according to the diameter of the minor foramen[21, 27]. Hence, the different results (SD and mean) obtained among the different studies might be explained by differences in the teeth used in them. However, under the conditions of this in vivo study, the Raypex 5 performed equally well irrespective of the irrigant used.

References

1. Seltzer S, Bender IB, Turkenkopf S. Factors affecting successful repair after root canal therapy. J Am Dent Assoc 1963;67:651-662.

2. Bramante CM, Berbert A. A critical evaluation of some methods of determining tooth length. Oral Surg Oral Med Oral Pathol 1974; 37:463-473.

3. Ingle JI, Bakland LK, Peters DL, Buchanan LS, Mullaney TP.Endodontic cavity preparation. In: Ingle JI, Bakland LK, eds.Endodontics. 4th edn. Baltimore: Williams & Wilkins, 1994:92-227.

4. Kuttler Y. Microscopic investigations of root apexes. J Am Dent Assoc 1955;50:544-552.

5. West JD, Roane JB, Goerig AC. Cleaning and shaping the root canal

system. In: Cohen S, Burns RC, eds. Pathways of the Pulp. 6th edn. St Louis: Mosby Inc., 1994:179-218.

6. Stein TJ, Corcoran JF. Radiographic 'working length' revisited. Oral Surg Oral Med Oral Pathol 1992;74:796-800.

7. Sunada I. New method for measuring the length of the root canal. J Dent Res 1962;41:375-387.

8. Kobayashi C. Electronic canal length measurement. Oral Surg Oral Med Oral Pathol 1995;79:226-231.

9. Kobayashi C, Suda H. New electronic canal measuring device based on the ratio method. J Endod 1994;20:111-114.

10. Fouad AF, Krell KV. An in vitro comparison of five root canal length measuring instruments. J Endod 1989;15:573-577.

11. Saito T, Yamashita Y. Electronic determination of root canal length by a newly developed measuring device. Influences of the diameter of apical foramen, the size of K-file and the root canal irrigants. Dent Jpn 1990;27:65-72.

12. Fouad AF, Rivera EM, Krell KV. Accuracy of the Endex with variations in canal irrigants and foramen size. J Endod 1993;19:63-67.

13. McDonald NJ, Hovland EJ. An evaluation of the Apex Locator Endocator. J Endod 1990;16:5-8.

14. Nguyen HQ, Kaufman AY, Komorowski RC, Friedman S.Electronic length measurement using small and large files in enlarged canals. Int Endod J 1996;29:359-364.

15. Dunlap CA, Remeikis NA, BeGole EA, Rauschenberger CR. An in vivo evaluation of an electronic apex locator that uses the ratio method in vital and necrotic canals. J Endod 1998;24:48-50.

16. Pagavino G, Pace R, Baccetti T. A SEM study of in vivo accuracy of the Root ZX electronic apex locator. J Endod 1998;24:438-441.

17. Keller ME, Brown CE, Newton CW. A clinical evaluation of the Endocater – an electronic apex locator. J Endod 1991;17:271-274.

18. Shabahang S, Goon WW, Gluskin AH. An in vivo evaluation of Root ZX electronic apex locator. J Endod 1996;22:616-618.

19. Yamashita K. Variable factors in the impedance method of determining the working length of a root canal. Jpn J Conserv Dent 1981;24:865-880.

20. Pilot TF, Pitts DL. Determination of impedance changes at varying frequencies in relation to root canal file position and irrigant. J Endod 1997;23:719-724.

21. Waki H. A study of the electronic method for measuring the root canal length – AC impedance of reamer tip in electrolyte. Jpn J Conserv Dent 1981;24:115-131.

22. Baker GJ, Lankelma P, Wesselink PR, Thoden van Velzen SK. Electronic determination of root canal length. J Endod 1980;6:876-880.

23. McDonald NJ. The electronic determination of working length. Dent Clin North Am 1992;36:293-307.

24. Huang L. An experimental study of the principle of electronic root canal measurement. J Endod 1987;13:60-64.