Journal of Dental Sciences 20 (2025) 2004–2005

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.e-jds.com

Letter to the editor

Accuracy of electronic apex locators during root canal therapy in dentistry

The success of root canal treatment is closely linked to the extent of the filling material being limited to the region of the apical constriction. This region, which is approximately 0.5 mm short of the apical foramen, can be determined by electronic apex locators (EALs). In this respect, the exact determination of the working length (WL) plays a crucial role in the prognosis of root canal therapy. EALs are used to determine WL and detect root canal perforation during root canal therapy. In light of the above, the purpose of this letter was to provide information on the accuracy of EALs during root canal therapy under various conditions.[1–3]

In a review study, based on 21 articles, the effect of the various irrigation protocols on the accuracy of the EALs was evaluated during root canal therapy. Various generations of the EALs were used in the included study criteria. According to the study results, the EALs' accuracy was affected by the high electroconductivity of NaOCl. Therefore, to increase the accuracy of EALs, clinicians should reduce the intervention factor as much as possible while measuring the WL.[4]

Another review study evaluated the accuracy of various generations of EALs (i.e., 3rd, 4th, 5th, and 6th) in determining WL. To this end, 15 studies were included in the review study. Based on the meta-analysis, the study reported that the accuracy of electronic devices in determining the WL is not significantly affected by the generation of EALs. All generations were effective in determining the WL. Thus, regardless of generation EALs, they should be considered during root canal therapy.[3]

Ramezani et al. evaluated the accuracy of three EALs in determining WL compared to digital periapical radiography. For this purpose, 58 extracted maxillary premolars were posed for this study. The WL was measured for each sample using four devices. The study results showed that the accuracy of Root ZX, Woodpex V, Woodpex III, and digital radiography were 100 %, 89.66 %, 87.93 %, and 84.48 %, respectively. Although all devices showed acceptable accuracy in determining WL in the root canal, EALs can be used as reliable devices in case of suspicion of WL measurement compared to digital radiography.[5]

Root perforation is another challenge that can arise during root canal treatment. In this regard, the accuracy of the EALs for simulated root perforations was reported in the four studies as follows:

1) The first study evaluated the ability of Raypex 6, Propex Pixi, Dentaport ZX, Apex ID, Propex II, and Dr's Finder NEO to detect root perforations. In this study, 100 single-rooted samples were artificially perforated above 5 mm at the apex using burs with the following diameters (1.25 mm, 1.0 mm, 0.75 mm, 0.5 mm, and 0.25 mm). This study reported that high success rates in detecting root perforations at diameters of 1.25 mm, 1.0 mm, and 0.75 mm occurred on the lateral surfaces of the root canals.[2]
2) The second study investigated the accuracy of Root ZX, Raypex 6, and i-Root in detecting strip root perforations under different conditions in 30 extracted first mandibular teeth. The strip perforation was artificially created in the coronal third of each root canal. The study reported that all EALs were effective in detecting strip perforations. The presence of high electroconductivity of solutions affected the accuracy of all EALs.[6]
3) The third study evaluated the influence of NaCl, CHX (Chlorhexidine), MTAD (mixture of tetracycline, acid, and detergent), and QMix (CHX, EDTA (ethylene diamine tetraacetic acid), and detergent) in detecting simulated perforations in root canals using Raypex 6. Based on 25 single-rooted samples, the study reported that the most accurate perforation measurement was achieved under dry conditions or with NaCl.[7]
4) The last study investigated the accuracy of Root ZX and Raypex 6 in detecting root perforations. To this end, the authors enrolled 30 distal roots of extracted first maxillary molars in this in vitro study. Although both EALs were effective in determining WL, Raypex 6 showed more precise results in detecting root perforation.[8] Based on the results of four studies, EALs can be used as an additional diagnostic tool during root canal treatment when root perforation is suspected.

https://doi.org/10.1016/j.jds.2025.03.011

To evaluate the effect of instrument size on the accuracy of EALs, Vajpayee et al. examined different file sizes on three EALs. This clinical study included 200 patients (100 vital and 100 non-vital teeth). The samples were divided into 8 groups (n = 25). In addition, each root canal was irrigated after access cavity preparation. The authors evaluated the influence of K-files NOs. 8, 10, and 15 using EALs (i.e., Elements, iPex, and Root ZX) on the accuracy of determining the WL of each root canal. The results showed that the EALs could be used to determine the WL. Besides, using the K-files (i.e., 8, 10, and 15) showed the most promising result in determining the WL and should, therefore, be considered when using EALs. The accuracy of the EALs was not affected by the low electroconductivity of irrigation solutions.[9]

Regarding the accuracy of EALs, another study evaluated the accuracy of EALs (i.e., DentaPort and Bingo) in determining the WL with heated Ni–Ti files (ProGlider and HyFlex EDM Glide Path File). Based on the 30 single-rooted teeth, the study highlighted the lack of any adverse effect of heated Ni–Ti files on WL determination using EALs.[10]

The influence of rotary and reciprocating movements on the accuracy of integrated apex locators is an important issue to consider during root canal preparation and WL determination. In this context, a research study was conducted to evaluate the efficacy of the VDW Gold Endo-Motor with integrated EAL in two movements. For this study, 44 incisors teeth were selected and divided into two groups (n = 22). The actual WL was determined for each tooth. The root canals in the first and second groups were prepared with a glide path (15/0.04) using rotary and reciprocating movements until the auto-stop function was activated. The WL for each sample was compared with the actual WL. Two different files of the same size and taper (25/0.06) were used to shape the root canals. The results showed that the accuracy of the EAL was the same in both groups with glide-path ($P > 0.05$). There was a difference between the two groups in shaping the root canals ($P < 0.05$). The integrated apex locator was more accurate with rotary movement. The accuracy of the apex locator was reduced by increasing the size and taper of the file used in the root canal.[1]

According to the content of this letter, EALs are used as reliable devices for determining WL and detecting root perforation. Clinicians' ability to apply EALs and reduce intervention factors requires a multidisciplinary therapeutic approach that is indispensable for determining WL.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

Acknowledgments

None.

References

1. de Almeida Gardelin V, Vinholes JIAM, Grazziotin-Soares R, Pappen FG, Barletta FB. Influence of rotary and reciprocating kinematics on the accuracy of an integrated apex locator. *Aust Endod J* 2023;49:202–8.
2. Koç S, Kuştarcı A, Er K. Accuracy of different electronic apex locators in determination of minimum root perforation diameter. *Aust Endod J* 2023;49:179–86.
3. Nasiri K, Wrbas KT. Accuracy of different generations of apex locators in determining working length; a systematic review and meta-analysis. *Saudi Dent J* 2022;34:11–20.
4. Shekarbaghani SA, Bolhari B, Khalilak Z. The effect of different root canal irrigations on the accuracy of apex locators: a systematic review. *J Clin Exp Dent* 2024;16:e1538–46.
5. Ramezani M, Bolbolian M, Aliakbari M, et al. Accuracy of three types of apex locators versus digital periapical radiography for working length determination in maxillary premolars: an in vitro study. *Clin Pract* 2022;12:1043–53.
6. Shekarchizade N, Farhad A, Khalifezade S. The accuracy of three apex locators in determining the location of strip root perforation in different environments. *Iran Endod J* 2021;16:184–8.
7. Dumani A, Ates AA, Ucan CS, Yilmaz S, Unal I, Yoldas O. The influence of MTAD and QMix on the accuracy of electronic apex locator in locating simulated perforations. *Niger J Clin Pract* 2022;25:281–5.
8. Nasiri K, Wrbas KT. Comparing the accuracy of two electronic apex locators in the determination of working length and the detection of root perforations: an in vitro study. *Dent Oral Craniofac Res* 2019;5:1–5.
9. Vajpayee A, Khandare PD, Dutta SD, Marathe S, Viragi P, Maria R. In vivo study to evaluate the effect of instrument size on the accuracy of three different apex locators when various irrigation solutions are used in vital and non-vital teeth. *J Pharm BioAllied Sci* 2023;15:S1156–9.
10. Heo KY, Hwang HK, Jo HH. Accuracy of electronic apex locators using heat-treated Ni-Ti file. *Aust Endod J* 2023;49:111–6.

Karl-Thomas Wrbas
Center for Dental Medicine, Department of Operative Dentistry and Periodontology, Faculty of Medicine and Medical Center, University of Freiburg, Freiburg im Breisgau, Germany
Faculty of Medicine and Dentistry, Danube Private University, Krems, Austria

Kaveh Nasiri*
Independent Researcher, Essen, Germany

Ani Kiprova
Dental Clinic Budent, Sofia, Bulgaria

*Corresponding author. Independent Researcher, Koenigraetzstrasse 13, Essen 45138, Germany.
E-mail address: DDS.Nasiri@web.de (K. Nasiri)

Received 7 March 2025
Final revision received 10 March 2025
Available online 22 March 2025