Vol 12 No 2 (2024) DOI 10.5195/d3000.2024.765

Evaluation of the Accuracy of Different Apex Locaters with 45° Apical Root Resorption

Ahmed I Al-Jobory [1], Mohammed Ayad Taha [1], Mohammed Jabbar Atyiah [2]

[1] *College of Dentistry, Tikrit University, Tikrit, Iraq*

[2] *Ministry of Health, Iraq*

Abstract

Aim: This study was aimed to calculate the working length (WL) of permanent teeth with simulated 45° resorption of the apical part of the root using four electric apex locaters (EALs): NSK, Woodpecker III, Woodpecker V, and Eighteeth.

Methods: Twenty maxillary anterior single-rooted teeth were removed. Following tooth preparation to offer access to the root canal and replicate the 45° apical root resorption, each tooth underwent a microscope-assisted working length determination process. The four apex locaters measured each individual tooth and calculated electronic working lengths.

Results: No discernible change existed between all four apex locater devices.

Conclusion: NSK, Woodpecker III, Woodpecker V, and Eighteeth provide virtually the same measurement for 45° apical root resorption in single rooted teeth.

Keywords: Apex Locater Devices, Working Length, Electronic Working Length Test, 45° Root Resorption.

Citation: Al-Jobory AI, et al. (2024) Evaluation of the accuracy of different apex locaters with 45° apical root resorption. Dentistry 3000. 2:a001 doi:10.5195/d3000.2024.765
Received: November 1, 2024
Accepted: November 7, 2024
Published: November 22, 2024

Email: Mohammedayad@tu.edu.iq

Introduction

For endodontic therapy to be successful, the root canal length must be accurately determined, particularly in situations of recurrent infection or re-infection. In these situations, non-surgical methods are frequently used to solve the problem. Removing the old filling from the root canal is the first step in the conservative non-surgical retreatment. In order to appropriately cleanse and disinfect the root canal system, access must be granted. To guarantee that all filling materials, debris, diseased pulp tissue, and necrotic material are completely removed, further root canal preparation could be necessary. The root canal must be adequately enlarged and cleaned at the precisely measured length in order to successfully repair the periradicular tissues. The physician can guarantee that all afflicted or diseased regions are completely cleansed and treated by precisely measuring the root canal length [1–15]. Establishing the working length is crucial for root canal preparation and 3D obturation in primary endodontic treatments and retreatments [16]. Numerous radiographic pictures are acquired throughout the root canal retreatment, which exposes the patient to excessive radiation and makes it hard to establish the working length only by radiography [17]. The aim of this examination was to assess how well four EALs determined working length during root canal rehabilitation.

Material and Methods

Twenty maxillary anterior single-rooted teeth that had been removed were utilized. Prior research found that these teeth had been taken due to serious illness or orthodontic treatment [10,18].

After the blood was removed from the teeth, they were preserved in 5.25% sodium hypochlorite for two

hours and then placed in sterile 0.9% saline solution until the next step (Figure 1).

A diamond disc was used to de-coronate teeth at the cementoenamel junction, making it easier to access the root canal and create fixed occlusal landmark (Figure 2) [11,19].

A 45° oblique incision was performed at the root apex using a disc to mimic apical root resorption. Nickel titanium endo K file sizes of 8, 10, 15, and 20 were used for instrumentation, and 2.5% sodium hypochlorite was used for irrigation (Figures 3 and 4) [12]. Working length was determine under microscope and visual [13,20]. Resorption at 45° oblique cut was made because only a few studies have studied accuracy of apex-locator with root resorption [21]. To maintain the root canal wet, 0.5 ml of saline was inserted within the canal prior to the electronic working length (EWL) measurement [22]. Salt and water were utilized to create an electric circuit.

Figure 1. Samples used.

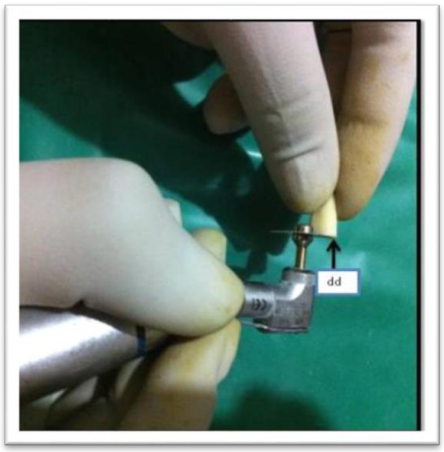

Figure 2. Cutting the crown with aa diamond disk.

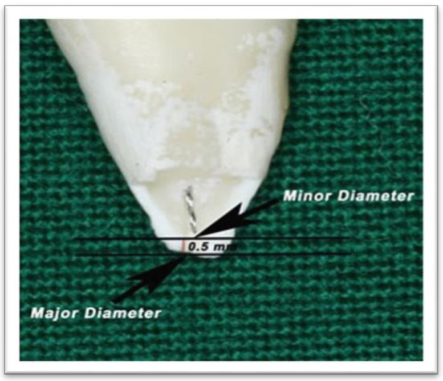

Figure 3. Oblique cut to simulate apical resorption.

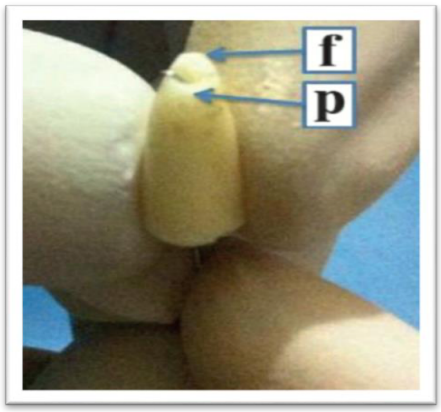

Figure 4. Simulated resorption at apex.

Four distinct apex locators were used to measure the electronic working length (EWL) values:

1. Woodpecker III
2. Eighteeth
3. Woodpecker V
4. NSK (i pex II)

These devices were used in this study because they are the most common uses in dentistry.

To maintain the root canal wet, 0.5 ml of saline was inserted within the canal prior to the electronic working length (EWL) measurement (Figure 5) [14].

To generate the current, the mounted roots were submerged in containers with 0.9% saline, ensuring that the apical and middle sections of the roots were completely submerged. One of the conductors was saline. The labial clip of the apex finder was also

submerged in saline. A #15 K-file was used for each measurement twice, and the mean value was computed (Figures 6 through 14). [15].

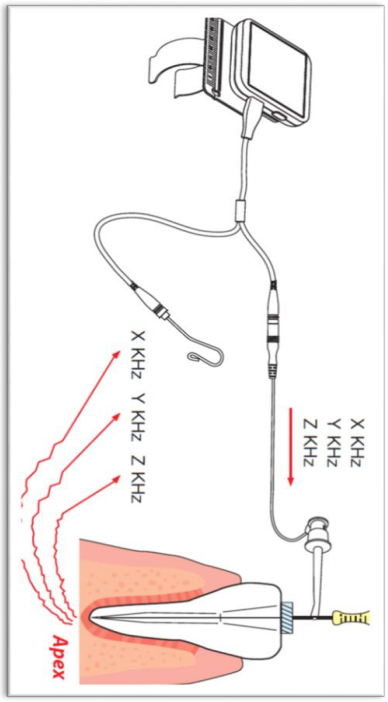

Figure 5. Measuring procedure.

Figure 6. Container of water and salt.

Figure 7. Bottle containing water and salt.

Figure 8. Method of measurement by endo ruler.

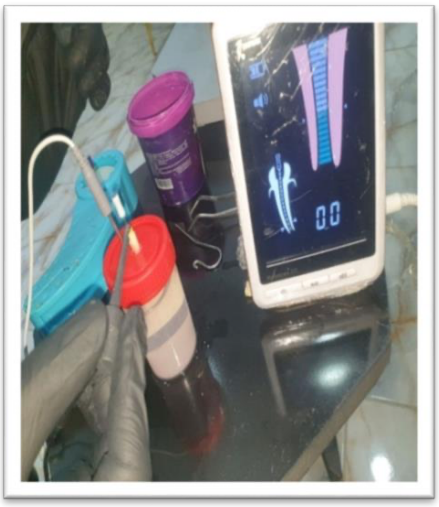

Figure 9. Measurement by Woodpecker III Apex Locator.

Figure 10. Measurement by Eighteeth Apex Locator.

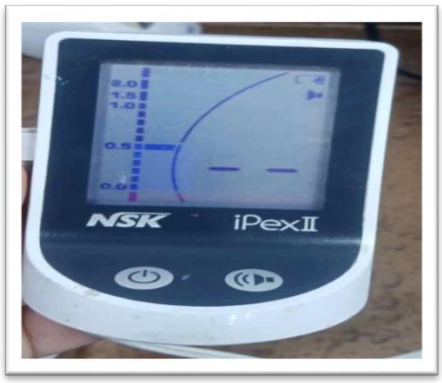

Figure 11. Measurement by NSK Apex Locator.

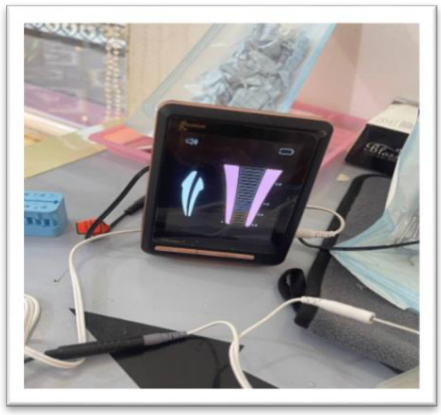

Figure 12. Measurement by Woodpecker V Apex Locator.

Figure 13. Measurement procedure.

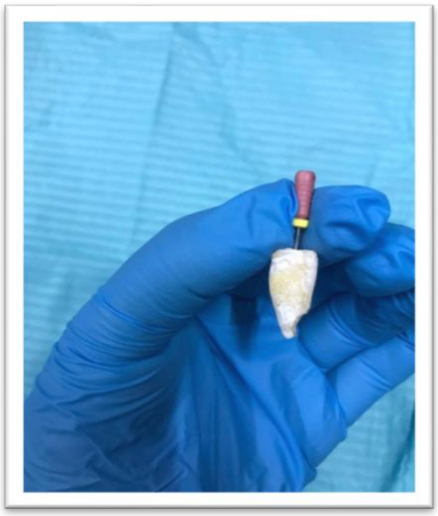

Figure 14. Resorption at 45° on the apex.

Results

Table1. Comparison Between Actual Working Length and the Four Devices.

N	Actual working length under microscope (mm)	NSK (mm)	Woodpecker lll (mm)	Woodpecker V (mm)	Eighteeth (mm)
1	17	17 / Yes	16.5 / No	16 / No	18 / No
2	16	17 / No	17.5 / No	16.5 / No	17.5 / No
3	11.5	11.5 / Yes	11 / No	11.5 / Yes	12 / No
4	13	13 / Yes	14 / No	13 / Yes	13.5 / No
5	16	16.5 / No	17 / No	17 / No	17.5 / No
6	10	10 / Yes	12 / No	10 / Yes	12.5 / No
7	20	20 / Yes	19 / No	20 / Yes	20.5 / No
8	12.5	11 / No	13.5 / No	13 / No	13 / No
9	13.5	13 / No	14 / No	13 / No	14.5 / No
10	14	13 / No	13.5 / No	14.5 /No	12.5 / No
11	11	11 / Yes	11 / Yes	11 / Yes	11.5 / No
12	9	9 / Yes	9.5 / No	9 / Yes	9 / Yes
13	10.5	11.5 / No	12 / No	11.5 / No	12 / No
14	13	13 / Yes	13 / Yes	12.5 / No	13.5 / No
15	11.5	11.5 / Yes	11.5 / Yes	11.5 / Yes	10.5 / No
16	13	13 / Yes	14 / No	13 / Yes	13 / Yes
17	14.5	13.5 / no	13 / No	14 / No	13 / No
18	14	14 / Yes	15 / No	14.5 / No	14 / Yes
19	10.5	10.5 / Yes	11 / No	10 / No	11 / No
20	14.5	13.5 / No	15 / No	13 / No	14 / No

The collected data revealed no significant differences between all test groups using a one-way ANOVA analysis (p=0.945).

Discussion and Conclusion

The precision of calculating the root canal length has a substantial impact on the success rate of root canal retreatment. Over-filling the root canals resulted in a success rate as low as 36%, suggesting that the infection was not adequately treated. Nevertheless, the effectiveness rate rose to 62% when the working duration was precisely ascertained during retreatment [23]. We selected the most commonly apex locators used in dentistry. Woodpecker V came as a replacement of Woodpecker III to improve determination of working length. Woodpecker III required a dry environment and fully charged battery for best results. Eighteeth apex locator is sensitive to canal fluids and requires fully charged battery. It does not work well in cases of excessive exudates or blood. NSK is less studied.

That relative error of NSK was (13.125%), Woodpecker V was (13.225%), Eighteeth was (13.65%), and Woodpecker III was (13.675%). Calculations of accuracy based on data on Table 1 show 86.875% for NSK, 86.775% for Woodpecker V, 86.35% for Eighteeth, and 86.325% for Woodpecker III.

Conflicts of interest

The authors declare no competing interest.

References

1. Khandewal D, Ballal NV, Saraswathi MV. Comparative evaluation of accuracy of 2 electronic apex locators with conventional radiography: An ex vivo study. JEndod. 2015;41:201.

2. Vieyra JP, Acosta J. Comparison of working length determination with radiographs and four electronic apex locators. Int Endod J. 2011;44:510–8.

3. D'Assunção FL, de Albuquerque DS, Salazar-Silva JR, de Queiroz Ferreira LC, Bezerra PM. The accuracy of root canal measurements using the Mini Apex Locator and Root ZX-II: An evaluation in vitro. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007;104:e50– 3.

4. Aydin U, Karataslioglu E, Aksoy F, Yildirim C. In vitro evaluation of Root ZX and Raypex 6 in teeth with different apical diameters. J Conserv Dent. 2015;18:66–9.

5. Koçak S, Koçak MM, Sağlam BC. Efficiency of 2 electronic apex locators on working length determination: A clinical study. J Conserv Dent. 2013;16:229–32.

6. Hargreaves KM, Cohen S. Cohen's Pathways of the Pulp. 10th ed. US: Elsevier Mosby; 2012. p. 99.

7. Leonardo MR, Silva LA, Nelson-Filho P, Silva RA, Raffaini MS. Ex vivo evaluation of the accuracy of two electronic apex locators during root canal length determination in primary teeth. Int Endod J. 2008;41:317–21.

8. Shabahang S, Goon WW, Gluskin AH. An in vivo evaluation of Root ZX electronic apex locator. J Endod. 1996;22:616–8.

9. Srivastava V, Jain N, Bagchi S, Negi MP. Evaluation of the use of sixth generation apex locators as a diagnostic tool to detect root perforations. Int J Dent Med Spec. 2015;2:10– 4.

10. ElAyouti A, Dima E, Ohmer J, Sperl K, von Ohle C, Löst C, et al. Consistency of apex locator function: A clinical study. J Endod. 2009;35:179–81.

11. Thomas MS, Acharaya S, Kundabala M. A comparative evaluation of the accuracy of third generation electronic apex locator (root zx) and conventional radiography to determine working length – An in vivo study. Endodontology. 2008;20:14–21.

12. Saritha S, Uloopi KS, Vinay C, Chandra Sekhar R, Rao VV. Clinical evaluation of Root ZX II electronic apex locator in primary teeth. Eur Arch Paediatr Dent. 2012;13:32– 5.

13. Alothmani OS, Friedlander LT, Chandler NO. Radiographic assessment of endodontic working length. Saudi Endo J. 2013;3:57–64.

14. Moshonov J, Slutzky-Goldberg I, Maor R, Shay B, Peretz B. In vivo evaluation of Apex NRG, a new Apex locator, and its comparison with root ZX. Endod Pract. 2005.

15. Versteeg KH, Sanderink GC, van Ginkel FC, van der Stelt PF. Estimating distances on direct digital images and conventional radiographs. J Am Dent Assoc. 1997;128:439– 43.

16.White SC, Pharoah MJ.Oral Radiology Principles and Interpretation.5th ed. US: Mosby; 2000. p. 164.

17. L. Vajrabhaya, P. Tepmongkol in endodontic working-length determination. Compend Contin Educ Dent. 1995;16:288, 290, 293–4.

18. da Silva TM, Alves FR. Ex vivo accuracy of Root ZX II, Root ZX Mini and RomiApex A-15 apex locators in extracted vital pulp teeth. J Contemp Dent Pract. 2014;15:312–4.

19. Filho EM, Rizzi CD, de Oliveira DS, Filho PN, da Silva RA, da Silva AB. New electronic apex locator Roamiapex A-15 presented accuracy for working length determination in permanent teeth. Dentistry 3000. 2014;2:1–4.

20.Torabinejad M, Corr R, Handysides R, Shabahang S. Outcomes of nonsurgical retreatment and endodontic surgery: a systematic review. J Endod. 2009;35(7):930–7. doi: 10.1016/j.joen.2009.04.023.

21. Friedman S, Moshonov J, Trope M. Residue of gutta-percha and a glass ionomer cement sealer following root canal retreatment. Int Endod J. 1993;26(3):169–72. doi: 10.1111/j.1365-2591.1993.tb00788.x.

22. Sjogren U, Hagglund B, Sundqvist G, Wing K. Factors affecting the long-term results of endodontic treatment. J Endod. 1990;16(10):498–504. doi: 10.1016/S0099-2399(07)80180- 4.

23. Bergenholtz G, Lekholm U, Milthon R, Engstrom B. Influence of apical overinstrumentation and overfilling on re-treated root canals. J Endod. 1979;5(10):310–4. doi: 10.1016/S0099-2399(79)80080-1.