Does mobile data and wifi interfere with electronic apex locator?

Dr. Navjot Singh Mann[1], Dr. Simranjit Kaur[2], Dr. Diksha Gupta[3], Dr. Sonali Sapra[4], Dr Navneet Kaur Mann[5]

[1] Professor and Head , Department of Conservative Dentistry and Endodontics, National Dental College and Hospital ,Derabassi, Punjab.

[2]Post graduate student, Department of Conservative Dentistry and Endodontics, National Dental College and Hospital,Derabassi, Punjab.

[3]Post graduate student ,Department of Conservative Dentistry and Endodontics, National Dental College and Hospital, Derabassi ,Punjab.

[4] Post graduate student , Department of Conservative Dentistry and Endodontics,National Dental College and Hospital, Derabassi, Punjab.

[5]Professor ,Department of Prosthodontics , National Dental College and Hospital , Derabassi ,Punjab)

Corresponding Author:Dr .Navjot Singh Mann

Context(background)- The using of devices that emitted electromagnetic radiation has been limited in many healthcare centers to prevent interference with medical devices. The purpose of this in vitro study was to evaluate the effect of Wi-Fi Router and network connection on working length determination using electronic apex locator.

Aims- To measure the effect of WiFi signals and mobile data on the performance of electronic apex locator during root canal therapy.

Subjects and methods- Single rooted extracted teeth were sectioned at cementoenamel junction. Working length was determined using size 15K file.The effect of wifi router and mobile data on accuracy of working length measurement by electronic apex locator was determined under following groups- Group 1 – with no-wifi router and mobile data nearby (control group),Group 2- under influence of wifi router, Group 3- under influence of mobile data and Group 4 –under influence of wifi router and mobile data both. The working length of teeth was compared with digital radiovisiography.

Statistical analysis used- The (ANOVA) test showed nonsignificant (NS) difference (P-value ≥ 0.05).

Results- No significant difference was found for electronic working length measurement in the presence or the absence of a mobile data and wifi used in this study.

Conclusions- It may be concluded that cellphones with data on and wifi routers can be used safely in a dental operatory without the fear of interference of EMI on EWL.

Keywords- Apex locator, J. Morita root ZX mini, mobile data, radivisography, wifi router, working length.

DOI: 10.48047/ecb/2023.12.8.491

INTRODUCTION

The success rate of root canal treatment depends on various factors among which correct working length (WL) estimation is a pivotal procedural step. [1]Underestimation of working length may lead to insufficient debridement of root canal, whereas overestimation may result in damage to periapical tissues. [2] Establishing the WL at the apical constriction is considered ideal for endodontic treatment .[3] The apical constriction or minor apical diameter represent the narrowest apical part of the root canal with an assortment of morphological variations that make its identification not to be predicted. Following the experiments by Custer in 1918, Sunada (1962) developed the first commercial electronic apex locator (EAL) proposing that the apical foramen could be located using a direct electric current. Today, the use of an EAL is considered a useful adjunct to WL determination.[4] EALs are claimed to increase the outcome of RCT and reduces the overall treatment time and radiation exposure to the patient. [5] Thus, electronic devices for determination of working length have gained popularity.[6]

Different models of EALs have been generated. Some measure resistance, while others measure impedance using either high frequency, two frequencies, or multiple frequencies. Various factors such as right application, presence of (irrigants, pulp tissue and pus) inside canal can effect on the accuracy of EALs .[7,8,9]EALs are generally safe to use but advised that they should not be used on patients with cardiac pacemakers without first consulting their cardiologist.[10,11] Another concern regarding EALs is the possibility of inaccurate readings as a consequence of

electromagnetic interference (EMI) caused by electronic devices, such as cell phones, including smartphones.

Devices that emit electromagnetic radiation (EMR) are used in industrial, scientific, medical, military, and domestic applications. The level of EMR in our environment has increased manifold due to a largescale expansion of communication networks behind such technologies as mobile phones. Wi-Fi Alliance (Wi-Fi) is a prevalent technology that allows electronic devices to connect to wireless local area network (WLAN) and exchange data wirelessly, mainly using the 2.4GHz and 5GHz frequency bands. However, the term "Wi-Fi" is used in general English as a synonym for "[Wireless Fidelity]" Generally, when the cellular telephones are in nearby to the medical devices, the electromagnetic interference (EMI) can occur between phones and medical devices.[12]The amount of electromagnetic radiation emitted from a digital smartphone is estimated to be low, which is around 42 V/m at 0.1 m dropping to below 7 V/m at 1 m in the standby mode.So, when a medical equipment is used in the vicinity of a smartphone, it to be taken into consideration that the amount of electromagnetic radiation they produce and the other is the safe distance at which the equipment should be placed. Regardless of the improved magnetic shielding of critical care and life support equipment, there is a possibility that EMI can cause equipment to display an incorrect value.[13,14]Moreover, dentists and assistances often keep their own cell phones, tablets, laptops connected to network with Wi-Fi signals of router during using EAL for measurement of WL of canals.

It has been proved through recent in vitro studies that there is no interference in the accuracy of measuring working length through EAL in direct contact with a smartphone.[15,16]So, the purpose of this vitro study aimed to evaluate the effect of Wi-Fi Router and network connection on working length determination using electronic apex locator.

MATERIAL AND METHODS

Forty human single rooted tooth (1 canal/tooth) without fracture or carious lesions were thoroughly cleaned before the experiment then observed under magnification (x20) to check for the existence of maturity of apex, single apical foramen. The roots with resorption, immature apex, and any other anatomic irregularities were excluded.

The teeth were decoronated at the cemento-enamel junction (CEJ) and stored in distilled water until usage to maintain their hydration.

The model of EAL that used in this study was J. Morita root ZX mini– a third generation Electronic Apex Locator. It uses two different frequencies (8 KHz and 400 Hz) simultaneously to measure the impedances in the canal. The device then determines a quotient value by dividing the 8 KHz impedance value by 400 Hz impedance value.[17]Connect broadband HG8145V5 (India) router was used in this study.It gives stable and wide range WiFi signal up to 300Mbps and wholehome coverage. It operates on 2.4GHz frequency band.

After identifying the root canal orifice, the pulp tissues were carefully removed using size 10 K-file. Then, a glide path was prepared with a precurved size 10 Kfile, and canal patency was confirmed; roots with canal obstructions (e.g. calcifications) were excluded. After rinsing with 2ml of NaOCl at 2.5%, a size 15 K-file fitted with a rubber stop was inserted until visible at the apical foramen. After withdrawing the size 15 K-file from the canal, its length was measured with an endogauge (DentsplyMallifer,Switzerland). This experiment was repeated 3 times per root، and the mean values were calculated and kept blinded for the remainder of the study.

The electronic working length (EWL) was established using an experimental design which was described and used by Hurstelet al.[18] Two holes were made in the cap of a plastic container, and the root was inserted in one of hole while the lip clip of the EAL was inserted through second one. The plastic container was filled with 0.9% NaCl solution, and the apical and middle thirds of the root were inserted into it. The root canal was irrigated with 2.5% NaOCl, and EWL was calculated. The file tip was inserted into the root canal, and the file clip was attached. The file was pushed beyond the 0 reading on the EAL display and withdrawn slightly until the 0.5 reading was appeared, this reading was confirmed by audible signal emitted from the EAL, then the file stop was adjusted, and this length was recorded as EWL.

For each canal of 40 specimens, the EWL was performed under 4 different conditions –

Group 1-No Wi-Fi router and mobile phone in the room -control group (Figure 1),

Group 2- under influence of wifi router(Figure 2),

Group 3- under influence of mobile data (Figure 3) and

Group 4 –under influence of wifi router and mobile data both (Figure 4).

The mobile phone was switched on and used to watch online video during the measurement with EAL. The experiment was carried out in a closed room to prevent interference from other phones or any other wireless devices that work on Wi-Fi.

The EWL measurements were recorded per canal and mean values were calculated for each condition for EAL.

Figure 1- Group 1-No Wi-Fi router and mobile phone in the room -control group

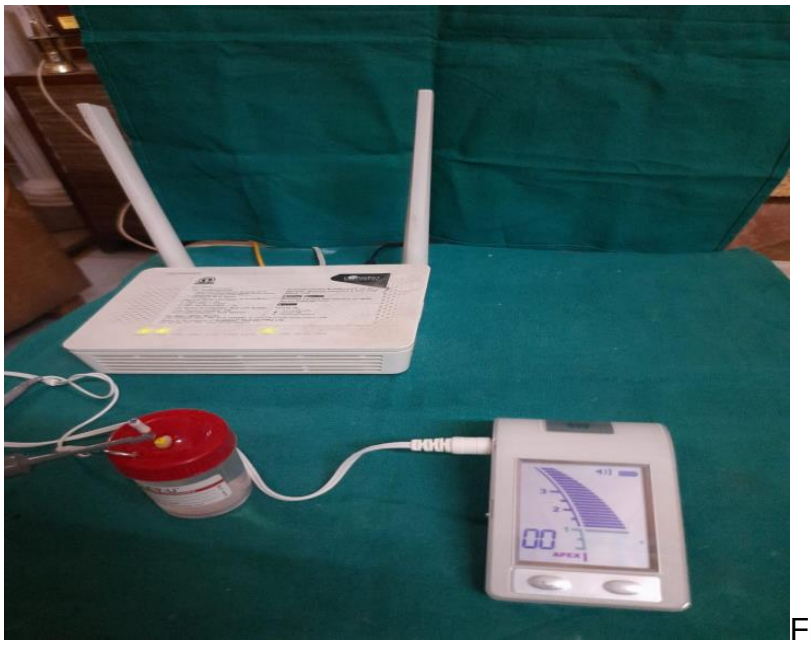

Figure 2- Group 2- under influence of wifi router

Figure 3- Group 3- under influence of mobile data

Does mobile data and wifi interfere with electronic apex locator?

Figure 4- Group 4 –under influence of wifi router and mobile data both

STATISTICAL ANALYSIS-

Data was analyzed using SPSS® software. Both descriptive statistics (Mean, Standard deviation), analysis of variance test (ANOVA) were used in order to analyze and assess the results of the study.

RESULTS

Table 1 :Mean and Standard Deviation (S.D.) Values of working length for each condition

GROUP	N	MEAN +/- SD	p-VALUE
1-with no-wifi router and mobile data nearby (control group)	10	21.4 ± 1.67	≥ 0.06
2- under influence of wifi router	10	21.0 ± 1.74	≥0.05
3- under influence of mobile data	10	20.2 ± 1.97	≥0.06
4 –under influence of wifi	10	21.8 ± 1.80	≥0.05

router and mobile data both			

According to the results of this study, the mean of WL by EAL measured under group 1,2,3 and 4 was 21.4 ± 1.67, 21.0 ± 1.74, 20.2 ± 1.97 and 21.8 ± 1.80 respectively. The (ANOVA) test showed nonsignificant (NS) difference among WL measurements in different conditions (P-value ≥ 0.05).

DISCUSSION

Working length determination is an integral part of the root canal therapy. Electronic apex locators are used to achieve this with enhanced reliability, stability, to lessen the treatment time and radiation exposure when compared to the conventional radiographic method of working length determination. With increasing usage of smartphones in recent days, it was found that more than 3.50 billion people own a mobile phone. According to a worldwide survey in 2019, this accounts for about 45.12% of the world population.Electromagnetic interference occurs when one or more electronic devices adversely interfere with the operation of another electronic device. Any device that transferring radio frequency, like mobile or laptop computer which connected to a network wirelessly, has the possibility to electronically interfere with the work of another electromagnetic device because of the physics governing radio waves as electron transfer, they make electromagnetic waves that diffuse through free space and potentially interact with other. In healthcare facilities, wireless EMI occurs when wireless devices interfere with medical equipment, potentially causing equipment malfunction.[19,20] In this study, the glide path was confirmed because the preflaring of root canals before measurement with EAL can increase the precision of WL determination .[21] The normal saline was used because this material has properties of electro-conductive materials , so the EAL can give accurate reading. [22] Also, each root was irrigated with 2.5% NaOCl, and EWL was calculated. The NaOCl can be safely used with EAL in WL determination.[23]

According to the results of this study, there was minimal change in measurement reading of WL in the presence of Wi-Fi signals and mobile phone or not. This change was not statistically significant and may be not effective clinically. This result was agreed with Hurstel et al. in 2015 and Sidhu et al. in spite of those authors in two

researches used others types of EALs and cellular phones but they don't used Wi-Fi router. [24]This result may be due to that Wi-Fi signals, have low power, so that the probability of occurrence of EMI was less. The cause of minimum power output can be related to the Institutions that manufactures these electronic devices to meet the regulations that allowed in each country.

Under all the experimental conditions the J. Morita root ZX mini EAL showed good reliability and stability. This result was agreed with Vasconceloset al.[25]This study concluded that presence of mobile phone in close proximity or at a distance from the EAL did not affect working length determination.

CONCLUSION

From the results of the present in vivo study, it may be concluded that cellphones can be used safely in a dental operatory without the fear of interference of EMI on EWL. The tested EAL does not interfere with WIFI or mobile phone. In dental clinics during electronic WL determination, mobile phones can be used without the phobia of causing electromagnetic interference. Further, in vitro and in vivo studies with different parameters may be beneficial to confirm the results of the present study.

REFERENCES

1- Kim E, Lee SJ. Electronic apex locator. Dent Clin North Am. 2004; 48:35-54.
2- Ricucci D, Langeland K. Apical limit of root canal instrumentation and obturation, part 2. A histological study. IntEndod J 1998;31:394–40.
3- Kuttler Y. Microscopic investigation of root apexes. J Am Dent Assoc. 1955; 50:544-552.
4- Kamath AK, Kudva AR, Shetty HK. Fast is fine, but accuracy is everything – A review on electronic apex locators. Int J Advanced Research 2016;4:1392–1395.
5- Kim E, Lee SJ. Electronic apex locator. Dent Clin North Am 2004;48:35–54.
6- Kim E, Marmo M, Lee CY, et al. An in vivo comparison of working length determination by only root-ZX apex locator versus combining root-ZX apex locator with radiographs using a new impression technique. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2008; 105:e79-83.
7- Chandler NP. Electronic apex locators. IntEndod J. 2004; 37:425- 437.

8- Akisue E, Gavini G, de Figueiredo JA. Influence of pulp vitality on length determination by using the Elements Diagnostic Unit and Apex Locator. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2007; 104:e129-132.
9- Ebrahim AK, Wadachi R, Suda H. In vitro evaluation of the accuracy of five different electronic apex locators for determining the working length of endodontically retreated teeth. AustEndod J. 2007; 33:7-12.
10- Hurstel J, Guivarc'h M, Pommel L, et al. Do cell phones affect establishing electronic working length? J Endod 2015;41(4):943–946. DOI: 10.1016/j.joen.2015.02.007.
11- Sidhu P, Shankargouda S, Dicksit DD, et al. Evaluation of interference of cellular phones on electronic apex locators: an in vitro study. J Endod 2016;42(4):622–625. DOI: 10.1016/j.joen.2015.12.027.
12- Clifford KJ, Joyner KH, Stroud DB, et al. Mobile telephone interference with medical electrical equipment. AustralasPhysEngSci Med 1994;17(1):23–27.
13- Patel MB, Thaker JP, Punnam S, Jongnarangsin K. Pacemaker interference with an iPod. Heart Rhythm 2007;4:781–784.
14- Klein AA, Djaiani GN. Mobile phones in the hospitals: past, present and future. Anaesthesia 2003; 58:353-357.
15- Hayes DL, Wang PJ, Reynolds DW et al. Interference with cardiac pacemakers by cellular telephones. N Engl J Med 1997;336:1473–1479.
16- Kobayashi C, Suda H. New electronic canal measuring device based on the ratio method. J Endod 1994;20(3):111–114. DOI: 10.1016/S0099-2399(06)80053-1.
17- Tselnik M, Baumgartner JC, Marshall JG. An evaluation of root ZX and elements diagnostic apex locators. J Endod. 2005;31:507–9.
18- Hurstel J, Guivarc'h M, Pommel L, Camps J, Tassery H, Cohen S, Frédéric B. Do Cell Phones Affect Establishing Electronic Working Length? JOE. 2015, 41(6):943-946.
19- Lapinsky SE, Easty AC. Electromagnetic interference in critical care. J. Crit. Care. 2006; 21(3), 267-270.
20- Assadi, M, Afrasiabi K. Biological effects (health risks) of radio-frequency electromagnetic radiation due to entrance of mobile phone into human's life. Iran J. Nucl. Med. 2010; 8,161.

21-de Camargo EJ, Zapata RO, Medeiros PL, et al. Influence of preflaring on the accuracy of length determination with four electronic apex locators. J Endod. 2009; 35:1300-1302.

22-Altunbas D, Kustarci A, Arslan D, et al. Comparison of various current electronic apex locators to determine the working length using the clearing technique. Niger J ClinPract. 2015; 18:359-363.

23-Duran-Sindreu F, Gomes S, Stober E, et al. In vivo evaluation of the iPex and Root ZX electronic apex locators using various irrigants. IntEndod J 2013; 46:769-774.

24-Sidhu P, Shankargouda S, Dicksit DD, Mahdey HM, Muzaffar D, Arora S. Evaluation of Interference of Cellular Phones on Electronic Apex Locators: An In Vitro Study. J Endod. 2016; 42(4):622-625.

25-Vasconcelos BC, BuenoMde M, LunaCruz SM, Duarte MA, Fernandes CA. Accuracy of five electronic foramen locators with different operating systems: an ex vivo study. J Appl Oral Sci. 2013;21(2):132-137.