

Influence of various electronic devices on the accuracy of Apex locator.¹Dr Hardik Parupaliya, ²Dr Gayatri Khode, ³Dr Janki Kareliya, ⁴Dr Saloni Kanodia, ⁵Dr Shikha Kanodia¹⁻⁵Government Dental College and Hospital, Asarwa, Ahmedabad, Gujarat - 380016**Corresponding Author:** Dr Shikha Kanodia, Government Dental College and Hospital, Asarwa, Ahmedabad, Gujarat 380016**Citation of this Article:** Dr Hardik Parupaliya, Dr Gayatri Khode, Dr Janki Kareliya, Dr Saloni Kanodia, Dr Shikha Kanodia, "Influence of various electronic devices on the accuracy of Apex locator", IJDSIR- July - 2023, Volume – 6, Issue - 4, P. No. 53 – 57.**Copyright:** © 2023, Dr Hardik Parupaliya, et al. This is an open access journal and article distributed under the terms of the creative common's attribution non-commercial License. Which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given, and the new creations are licensed under the identical terms.**Type of Publication:** Original Research Article**Conflicts of Interest:** Nil**Introduction**

The aim of root canal treatment is to remove all possible irritants and necrotic tissue from the root canal space [1]. Working Length Determination is important as it helps in and keeping the biomechanical preparation confined to the root canal space during the procedure [1,2]. Many studies have proven errors in measuring working length affect treatment outcome and also cause pain and discomfort during root canal procedure [3,4]. Several methods have been described for working length determination and these include tactile sense, radiographic measurement and electronic apex locators (EAL) [5-8]. Reading of EAL have shown that they are reliable devices that can be a reasonable adjunct to radiographic techniques to simplify root canal procedure. It is generally accepted that using EAL can help clinicians decrease the number of radiographs taken during root canal treatment.[5]. The Root ZX Mini (J. Morita Corporation, Kyoto, Japan) apex locator belongs

to the third generation of apex locators and has been shown to be reliable [2]. Various electronic devices are commonly used by doctors and patients like, mobile phones, laptops, Bluetooth speakers that work on radio frequency , which may affect reading of EAL. The aim of the present investigation was to determine the effect of Bluetooth speaker, laptop and mobile phone on workability of apex locator.

Materials And Methods

In this study, 20 single-rooted freshly extracted human teeth were collected from department of oral and maxillofacial surgery, GDC Ahmedabad. The teeth were initially examined under a dental operating microscope (Seiler Medical Equipments, United States)

Exclusion Criteria

Teeth with apical resorption, root tip fracture, a curved root, had previous endodontic treatment or an open apical foramina were excluded.

The teeth were decoronated at the cemento-enamel junction level in order to have a standard access and stable reference point for working length determination. The actual working length (AWL) of each root was determined by inserting a size 10 K-file (Mani, Tochigi, Japan) into the root canal and observing it under the Dental operating Microscope (Seiler Medical Equipments, United States) under 10× magnification to determine when the file tip reached the apical foramen. The rubber stopper was then positioned at the level of the reference point. The working length was then set at 0.5 mm less than the length observed. Each root was fixed into a alginate based custom made models (Figure 1) and the Root ZX mini (J. morita Japan) lip clip was also fixed in the model so that a complete circuit was provided and it Simulates clinical situation. [16].



Flow Chart 1: Overview of Methodology

Before starting the measurements, the cervical part of the root canals was enlarged with Gates Glidden sizes 2 and 3 (Mani, Tochigi, Japan). All initial measurements with the Root ZX Mini apex locators were performed in a room after making sure that there were no known devices with radio waves (such as wireless systems, cordless phones, mobile phones, MP4 player, TV remote

control) present. Each root canal was filled with 2.5% sodium hypochlorite (Ammdent India) and a size 10 K-file was inserted into the root canal to determine the working length with the Root ZX mini apex locator.

The root canal length was then determined by same Dentist to avoid operator bias with root ZX mini devices when one of the following devices was on: Mobile phone , Speaker , Laptop at a distance of 50 cm from the electronic apex locators. The Root ZX mini was used in accordance with the manufacturer’s instructions and the electrode was connected to a size 15 K-type file. The instrument was inserted into the root canal and advanced just beyond the major foramen as indicated by the flashing APEX bar on the monitor of the root zx mini. The instrument was then slowly withdrawn until the monitor showed a flashing bar between “APEX” and 1 to indicate a 0.5 reading.

In order to measure the effect of nuisance caused by other devices on apex locator measurement the Bland–Altman method with repeated measure was used.

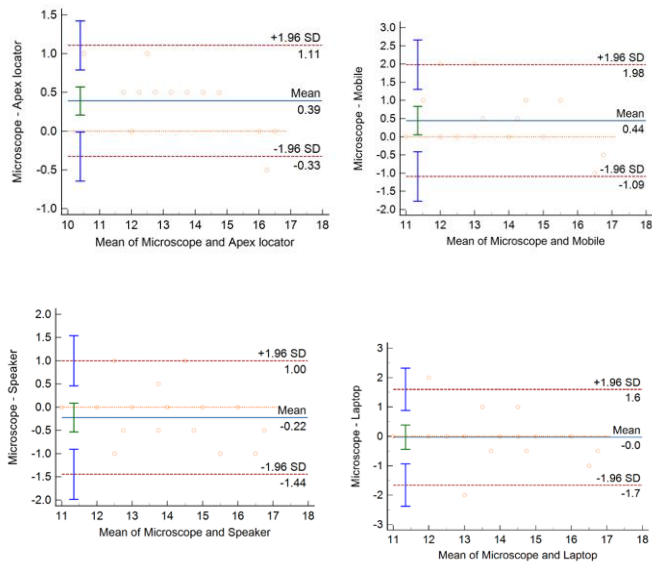


Figure 1: Roots Fixed Into A Alginate Based Custom Made Models And The Root Zx Mini Lip Clip Also Fixed In The Model.

Results

The bland-altman plots shows that the errors are slightly tends to be, on top of zero line in case of Apex locator

and Mobile, on bottom of zero line in case of speaker and overlapping with zero line in case of laptop. Apex locator and Mobile showed Highly significant and significant difference with actual working length respectively while speaker and laptop showed insignificant difference.



Graph 1: Bland Altam plots of various electronic devices and difference in working length to the gold standard (microscope)

Discussion

The present study has shown that except for Bluetooth speaker, all other electronic devices had not significant influence on determining the working length of root canals with the Root ZX mini apex locator. Various studies on electronic apex locators indicate that an error should not be more than ± 0.5 mm distance from the AWL. However, recent investigations simply compared AWL with working length measured by the apex locator [8]. Based on these previous investigations, the results of working length determination with the Root ZX mini in presence of mobile phone, laptop and Bluetooth speaker devices were unacceptable. Present study uses, the Root ZX Mini, because investigations by Duran et.al. have shown

that this device is more accurate in determining working length. Three brand new Root ZX Mini apex locators were used in this study because the manufacturer has claimed that the working life of the device is six years following production (Root ZX manual). The results of this study have shown that only Bluetooth speaker showed significantly different results in AWL determination with Root ZX mini during their activity in 50 cm distance from the measuring devices.

AWL was established as 0.5 mm less than the distance between the coronal reference point and the apical opening as observed under a microscope. Electronic devices that are likely to be used in many dental offices around the world were tested. Investigations reported by Gohil et al and Sidhu et al none of cell phones could significantly influence on the accuracy of measurement by the EALs. This supports the results of the present study . The cordless mobile phones were tested when ringing rather than in actual use. Measurements were not overestimated as done in previous studies [17,18]. Previous ex vivo investigations of apex locators have used either alginate or normal saline as the conducting medium. In the present study alginate was used as media as it to simulate the clinical situation. The cervical part of the root canals was enlarged with Gates Glidden drills (Mani) before using the Root ZX mini because Ibarrola et al. reported that pre-flaring the canal before using the Root ZX improved the efficacy of the apex locator. The manufacturer of the Root ZX Mini have declared in their catalog that “Root ZX Mini is intended for use in an electromagnetic environment in which radiated radio frequency disturbances are controlled”. The manufacturer also recommends that a minimum distance from the transmitters should be maintained, based on their maximum output power. A distance of 50 cm from the measuring device was chosen because, in theory,

radio waves may interfere with the device's performance in determining working length when devices with various wave lengths are placed near an apex locator. The frequency of Root ZX mini apex locator is 0.4 Hz and 8 KHz (User manual Root ZX Mini) and that of bluetooth speaker is 180Hz-20KHz.(Bluetooth Speaker Boat 200 user manual) The frequency of Mobile phone and laptop is in the range of 20-200 MHz.(One plus 6T and Lenovo Yoga 11th gen User Manual) The results of the present study have shown that for Bluetooth speaker care should be taken to prevent their presence near the Root ZX Mini during root canal measurement. Further studies should be done to determine the safe distance for each device as most dental offices, practitioners or patients have wireless devices switched on during daily activities in close approximation to work place. In addition, it is necessary to evaluate other generations of apex locators and compare them with the Root ZX Mini in order to understand whether they are also influenced by electronic devices.

Limitations

The study comparing different mobile phones, laptops and the bluetooth speakers could have been done for further understanding the influence of frequency on apex locators. Use of Wi-fi can also be checked on further studies.

Conclusion

In conclusion, based on the results of this study, electronic devices such as Mobile phone, laptops and specifically bluetooth speakers may have some influence on working length determination with the Root ZX Mini. It is advisable other electronic devices as such should be switched off during root canal procedures or should not be placed in close proximity.

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