

Use of Cell Phones in Operatory does not Interfere with the Readings of EALs – An In Vitro Analysis**Shalu Krishan Gupta¹, Navjot Singh Mann², Jatinderpal Singh³**

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ABSTRACT:

Introduction: Information and Communications technology has evolved so much that people are just a seconds away from their near and dear ones. Patients usually keep their cell phones on and near at hand during root canal therapy. Cell phones emit electromagnetic radiation which might interfere with electronic working length determination. The outcome of root canal therapy depends on various factors amongst which correct working length determination is a crucial step.

Aim: The aim of this in vitro study is to evaluate the effect of cell phones (Samsung Galaxy S2, Apple iPhone 6 and Oppo A37) on working length determination by electronic apex locators (EALs) Canal Pro, Propex Pixi and Root ZX.

Methods: Fifteen intact, non-carious single-rooted teeth were decoronated at the CEJ. The working length measurement was performed with the help of 15 K-file in the presence of 2.6% NaOCl under following four conditions: (1) visually, under the microscope till the file tip reached the apical terminus; (2) electronically, without the cell phone in close proximity; (3) electronically, with the cell phone placed in physical contact with the EAL, but in standby mode & (4) electronically, with the cell phone in calling mode.

Results: The EWL measurements were not influenced by the presence of cell phone and could be determined under all experimental conditions.

Conclusions: Within the limitations of this study, it can be concluded that cell phones do not interfere with the EWL determination.

Keywords: Cell phone, Electromagnetic interference, Electronic apex locator (EAL), Working length determination.

INTRODUCTION

Root canal therapy is an integral part of dental practice. The outcome of root canal therapy depends on various factors amongst which correct working length determination is a crucial step. Electronic apex locators (EALs) have been used throughout the world for working length determination. EAL allows the practitioner to save time and reduce the radiation dose to which the patient is subjected.¹ Moreover, studies have shown that EALs provide accurate working length determination when compared with the radiographic method.^{2,3}

It is known that electromagnetic radiation which is emitted from devices such as cell

phones, iPods, dental devices such as electronic pulp testers, electrosurgery units & ultrasonic scalers can interfere with the functioning of implanted cardiac pacemakers in patients with implanted cardiac devices.^{4,5,6} Cell phone frequencies used for transmission and reception depend on the type of connection and the network provider; they also differ across the continents. Studies have reported that cell phones can inhibit the functioning of a pacemaker and this depends on the distance between the pacemaker and the electronic device, power output of the electronic device, age of pacemaker, type of pacemaker and model of the cell phone.^{7,8,9} It is suggested that the use of cell phones should

be restricted in hospitals because electromagnetic interference (EMI) caused by cell phones can interfere with functions of medical devices.⁽¹⁰⁾

A dental office has no such limitations for the use of cell phones in dental operatory. Cell phones are used by the dentist, dental surgery assistants & patients. Moreover, patients often keep their own cell phones switched on and nearby during dental treatment. There is limited evidence base which can help a dental practitioner come to a decision whether cell phones can be used in close proximity to EALs & whether these devices can have any effect on the electronic working length (EWL) determination.

Hence, the purpose of this in vitro study was to evaluate the effect of cell phones (Samsung Galaxy S2, Apple iPhone 6 and Oppo A37) on working length determination by electronic apex locators (EALs) Canal Pro, Propex Pixi and Root ZX.

MATERIALS AND METHODS

Dental Samples

Fifteen single-rooted teeth with 1 canal and mature apices were selected for this study. Roots were examined under dental operating microscope and roots with carious lesions, fractures, resorptions, immature apices, or any other anatomic irregularities were excluded. The teeth were sectioned at the cemento-enamel junction and stored in distilled water at 4°C until usage to maintain their hydration.

EAL

Three different models of EALs were used in this study:

1. Canal Pro
2. Propex Pixi
3. Root ZX

CELL PHONES

Three cell phones were used in this study:

1. Samsung Galaxy S2
2. Apple iPhone 6
3. Oppo A37

During all the experiments, no other cell phone was present in the room. All EWL

determinations were performed in the same place to ensure that the signal intensity of the cell phone reception was stable.

LENGTH DETERMINATION UNDER MICROSCOPE

After identifying the root canal orifice, a glide path was prepared with a #10 K-file and canal patency was confirmed; teeth with canal obstructions, calcifications, etc were excluded. Pulp tissues were carefully removed using 2.6% sodium hypochlorite and a #10 K-file. After rinsing with 2 ml NaOCl, a #15 K-file fitted with a rubber stop was inserted until visible at the apical foramen using an operating microscope (15 X). After removing the #15 K-file from the root canal, its penetration depth was recorded with an endodontic ruler (mm). The measurements were performed to an accuracy of 0.25 mm as a base unit of length. Three readings were taken per tooth.

EXPERIMENTAL MODEL USED FOR EWL DETERMINATION

A screw top plastic container was filled with 0.9% NaCl solution; the tooth and the lip clip of the EAL were inserted through the screw top (Fig. 1) perforated with 2 self-made holes. The tooth position was adjusted until the middle third of the root was immersed into 0.9% NaCl solution. For each experimental condition, the EWL was determined with 2.6% NaOCl in the root canal and just beyond the "0" indicated on the display (apical patency). Then the #15 K-file was carefully withdrawn until it reached the "0" position. The EWL was confirmed by the audible signal from the EAL. The silicone stop was then adjusted on the specimen and the penetration depth was recorded.

CONDITIONS FOR EWL ASSESSMENT

For each canal, the EWL was performed under 3 different conditions:

1. No cell phone in the room (control group)

2. Cell phone placed in physical contact with the EAL during standby mode to maximize the chance of detecting EMI
3. Cell phone activated with a call under the same conditions



Figure 1

STATISTICAL ANALYSIS

Data were analyzed by using two-way repeated-measures analysis of variance. The statistical significance was set to 5% level of significance ($P < 0.05$).

RESULTS

Working length under Microscope		15.30 ± 1.05	
WL measured by Canal Pro		Mean values	ANOVA
No phone		14.85 ± 0.95	$P < 0.1980$
Iphone	Standby	14.80 ± 1.01	$P < 0.1785$
	On call	14.85 ± 1.20	$P < 0.2042$
Galaxy S2	Standby	14.85 ± 1.09	$P < 0.2122$
	On call	14.85 ± 1.21	$P < 0.2290$
Oppo A37	Standby	14.85 ± 1.02	$P < 0.1815$
	On call	14.85 ± 1.16	$P < 0.1990$

WL measured by Root ZX		Mean values	ANOVA
No phone		14.60 ± 0.95	$P < 0.1785$
Iphone	Standby	14.60 ± 0.95	$P < 0.1815$
	On call	14.60 ± 0.90	$P < 0.2208$
Galaxy S2	Standby	14.60 ± 1.05	$P < 0.2022$
	On call	14.60 ± 1.03	$P < 0.2170$
Oppo A37	Standby	14.60 ± 1.10	$P < 0.1915$
	On call	14.60 ± 1.18	$P < 0.2290$

WL measured by Propex Pixi		Mean values	ANOVA
No phone		14.80 ± 1.06	$P < 0.1807$
Iphone	Standby	14.80 ± 1.02	$P < 0.1785$
	On call	14.80 ± 0.90	$P < 0.1912$
Galaxy S2	Standby	14.85 ± 1.21	$P < 0.2120$
	On call	14.80 ± 1.09	$P < 0.2208$
Oppo A37	Standby	14.80 ± 1.16	$P < 0.1919$
	On call	14.80 ± 1.19	$P < 0.2090$

3 readings were taken for each tooth & mean of the readings were tabulated and compared for mean and standard deviation under the different conditions. The results of the first 2 repeated measures ANOVA were not significant. This meant that neither the cell phone type (Galaxy S2, iPhone 6, Oppo A37) nor the EAL (Canal Pro, Propex Pixi, Root ZX) affected EWL determination.

The results of the second 2 repeated measures ANOVA were also not significant, which meant that the EWL measurement gave the same results as the visual examination and that this length was not modified by the direct contact of the EAL and the cell phone, whatever its mode (standby or communication).

DISCUSSION

The results of this study showed that there is no correlation between cell phone use and EWL determination. Under all the experimental conditions the EAL indicated good reliability and stability. This study concluded that presence of cell phone in close proximity or at a distance from the EAL does not interfere with the readings of EALs. Thus, cell phones can be used in a dental operatory during root canal therapy without the risk of EMI between cell phone and EAL.

In vitro studies have used alginate, gelatin, agar agar and saline to simulate the root canal surrounding tissues in EWL determination.^{11, 12} Thus, saline was used as electro conductive material in the present study. Teeth were

horizontally sectioned at the CEJ for obtaining reproducible reference points & were mounted in a plastic container which was filled with 0.9% NaCl till the root was soaked in the solution. Irrigants are used for their antimicrobial, tissue dissolving & lubrication properties. Studies have reported that NaOCl can be safely used with EALs during working length determination.¹³ Thus, 2.6% NaOCl was used as a root canal irrigant in this study.

The experiments were carried out in the same room to ensure a stable intensity of the signal for each phone to permit a reliable comparison between the measurements. Because the distance between 2 electronic devices is a parameter that can influence EMI,^{4,5,7,14} a direct contact between the phone and the EAL was used to determine the working length and to maximize the chance of detecting EMI. The calling mode was tested with the EALs working because the wave emission is intense during the calling mode of the cellular phone,⁽¹⁵⁾ the calling mode was used to maximize the chances of detecting EMI.

Finally, the findings of this study, by testing 3 different EALs and cell phones, did not confirm frequent claims written in EAL user manuals that the possibility of inaccurate or incorrect readings may be caused by the proximity of a cell phone.

CONCLUSION

The present study revealed that EWL determination by apex locators is not affected by the presence of cell phones. Cell phones can be used in the dental office without the fear of causing electromagnetic interference in EWL determination during root canal therapy.

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