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DETERMINATION OF ACCURACY OF ELECTRONIC APEX LOCATOR IN THE FUNCTION OF DIFFERENT EMPLOYMENT PROTOCOLS IN VITAL AND NON VITAL TEETH : AN IN-VIVO STUDY

Dental Science

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ABSTRACT

Introduction: Accurate working length determination is a crucial factor that influences the outcome of root canal therapy. Root canal length determination is commonly performed using radiographic methods or apex locator.

Aim: Determination of accuracy of electronic apex locator in the function of different employment protocols in vital and non vital teeth.

Methodology: 20 patients are selected for root canal treatment. The patients are divided into 2 groups based on vital and non vital teeth. Working length determination is done by using an apex locator. The accuracy of working length determined is confirmed using digital radiography. The tooth to be treated is anaesthetised and isolated with rubber dam. Access opening is done and a 10k file is used for determining the working length using an electronic apex locator. As the file progress in, the reading is noted. Two employment protocols are used:

1. File stops at the apex and coming back to 0.5.
2. File goes beyond zero and coming back to 0.5.

Result: There is no statistical significant difference between the two protocols regardless of the conditions used. Protocol 2 showed favourable results when compared with protocol 1

KEYWORDS

apex loator, apical foramen

INTRODUCTION

Accurate working length determination is a prerequisite for the success of root canal treatment. In endodontics, the working length is defined as the distance from coronal reference point to the point at which chemo mechanical preparation and obturation has to terminate[1]. Apical anatomy determines the termination of the root canal instrumentation and filling. The cemento dentinal junction which is also described as apical constriction is the anatomical and histological landmark where the periodontal ligament begins and pulp ends[2].

One of the major problems in endodontic treatment has always been identification and maintenance of the biological length of the root canal system[3]. Different methods have been used for locating the position of canal terminus and measuring the working length of the root canal. This includes tactile, radiographs, electronic apex locator and other adjuvant methods[4].

The evolution of electronic apex locator has reached accuracy level of above 95 % and which is more accurate method to determine apical constriction[5]. Several studies have been dedicated to evaluate the accuracy of electronic apex locator such as pre-flaring of canals, or using different protocols that determine the insertion of the instruments until they reach some anatomic position (example: the apical foramen [AF], apical constriction, or even positions below the AF) has influence on accuracy of electronic apex locator[6,7,8,9]. Very few studies have taken vitality into consideration in determining the working length using electronic apex locator. The readings may vary if there is any structural alterations in root apex of the nonvital teeth, electric conductivity of dentinal wall, pathological alteration in the apex of the tooth with apical periodontitis[10]. Also, different impedance values between necrotic pulp and vital pulp due to the destruction of periodontal ligament[11,12] may result in erroneous readings with the electronic apex locator. Some studies have found statistically no difference in the accuracy of electronic apex locator to locate the apical constriction and apical foramen in vital and nonvital cases while some studies have found a significant difference[11,13,14,15,16]. But as far as my knowledge, there are no study conducted for determining the accuracy of electronic apex locator using different functional protocol (Protocol 1- file going till apex and coming back to .5. Protocol 2 - file going beyond apex and coming back to .5) used in different conditions of pulp (vital and non vital pulp).

MATERIALS AND METHODS

A total of 20 patients were selected for this in vivo study. The study subjects were recruited from a pool of patients referred to department of conservative dentistry and endodontics.

INCLUSION CRITERIA:

Single rooted tooth with mature apex, Vital and Nonvital pulp, Healthy patients without systemic disease or allergic reactions, Age group – 20-35.

EXCLUSION CRITERIA:

Patient with systemic disease, Severely damaged tooth, Periodontal disease, Tooth previously undergone root canal treatment, Fractured tooth, Teeth with more than one canal, Teeth with open apex, Apical resorption, Apical pathosis, Broken crowns/caries below the level of gingiva, Patient with cardiac pacemaker, Patient with implanted electrical devices, Retreatment cases, Calcified canals, Impossibility of achieving apical patency in any canal.

METHODOLOGY

All the patients were informed of the aim and design of the study and written authorizations were obtained before their inclusion. The medical and dental history of each patient was obtained, and pulpal/periapical status were examined via periapical radiographs, periodontal evaluation, palpation, percussion, electric pulp tester, and thermal tests. The following data were collected in clinical records. The pulpal status was rechecked by testing the presence of bleeding during the endodontic access (presence of blood in the canal indicates a vital pulp).

After topical anaesthetic application the teeth were anaesthetised with local anaesthetic solution containing 2% lidocaine with 1:80000 epinephrine. Caries removal and initial access was accomplished with

sterile high speed and low speed burs. The cavity access preparation was completed, pulp tissue was removed and the canal orifice was localized. The incisal or occlusal edges were ground lightly to create stable reference points for the rubber stops on the root canal files. The canal patency was determined with a sterile stainless steel k file size 10. The coronal part of each canal was flared with gates glidden drills and then each canal was irrigated with 2.5% NaOCl solution Afterwards , patients were randomly assigned to 4 groups during working length determination in vital and non vital teeth using electronic apex locator.

Group 1 =File goes beyond zero +0.5(red zone with continuous beep) and coming back to -0.5(green zone) as indicated in the apex locator in vital tooth.

FIGURE 1 & 2: File goes beyond zero +0.5 (red zone with continuous beep) and coming back to -0.5(green zone)

FIGURE 3 & 4: File stops at the apex (zero/red zone) and coming back to -0.5(green zone)

Group 2= File goes beyond zero +0.5 (red zone with continuous beep) and coming back to -0.5(green zone) as indicated in the apex locator in nonvital tooth.

Group 3=File stops at the apex (zero/red zone) and coming back to -0.5(green zone) as indicated in the apex locator in vital tooth.

Group 4= File stops at the apex (zero/red zone) and coming back to -0.5(green zone) as indicated in the apex locator in nonvital tooth.

The file is stabilized in patients mouth and a digital radiograph is taken using clark's rule to confirm the working length of apex locator used in different protocols.

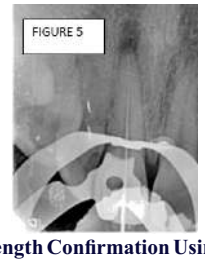


Figure 5: Working Length Confirmation Using Radiograph

STATISTICALANALYSIS

Descriptive analysis includes expression of errors in working length between EAL & Radiograph in terms of Mean and SD for each study group. Mann Whitney Test was used to compare the mean error between 2 protocols and between 2 different teeth condition. The level of significance [P-Value] was set at P<0.05.

RESULTS

Comparison of mean Error between 2 protocols in Vital Teeth using Mann Whitney Test					
Protocols	N	Mean	SD	Mean Diff	P-Value
Protocol 1	5	0.30	0.45	0.30	0.14
Protocol 2	5	0.00	0.00		

Note: Protocol 1 - Going till apex & coming back to 0.5
Protocol 2 - Going beyind apex & coming back to 0.5

Comparison of mean Error between Vital and Non-Vital Teeth under Protocol 1 using Mann Whitney Test					
Teeth	N	Mean	SD	Mean Diff	P-Value
Vital	5	0.30	0.45	-0.20	0.01
Non-Vital	5	0.50	0.87		

Comparison of mean Error between 2 protocols in Non-Vital Teeth using Mann Whitney Test					
Protocols	N	Mean	SD	Mean Diff	P-Value
Protocol 1	5	0.50	0.87	0.50	0.14
Protocol 2	5	0.00	0.00		

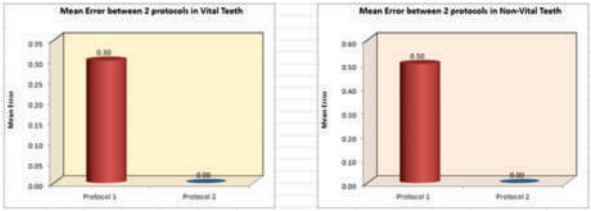
Comparison of mean Error between Vital and Non-Vital Teeth under Protocol 2 using Mann Whitney Test					
Teeth	N	Mean	SD	Mean Diff	P-Value
Vital	5	0.00	0.00	0.00	--
Non-Vital	5	0.00	0.00		

TABLE 1: COMPARISON OF MEAN ERROR BETWEEN 2 PROTOCOLS IN VITAL AND NON VITAL TEETH USING MANN WHITNEY TEST

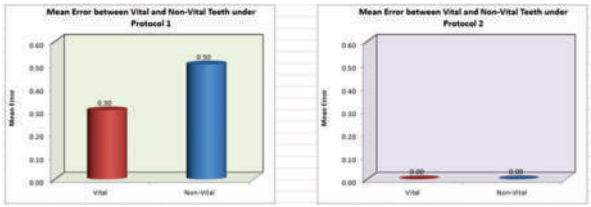
Comparison of mean Error between 4 groups using Kruskal Wallis Test							
Groups	N	Mean	SD	Min	Max	H	P-Value
Group 1	5	0.00	0.00	0.0	0.0	4.690	0.20
Group 2	5	0.00	0.00	0.0	1.0		
Group 3	5	0.30	0.45	0.0	0.0		
Group 4	5	0.50	0.87	0.0	2.0		

Note: Group 1 - Going beyond apex and coming back to .5 in vital teeth
Group 2- going beyond apex and coming back to .5 in nonvital teeth
Group 3-going till apex and coming back to .5 in vital teeth
Group 4-going till apex and coming back to .5 in nonvital teeth

TABLE 2: COMPARISON OF MEAN ERROR BETWEEN 4 GROUPS USING KRUSKAL WALLIS TEST



GRAPH 1: MEAN ERROR BETWEEN 2 PROTOCOLS IN VITALAND NONVITAL TEETH



GRAPH 2: MEAN ERROR BETWEEN VITAL AND NON-VITAL TEETH UNDER 2 PROTOCOLS

Considering the tested variations, the statistical analysis pointed out that, there is no statistical significant difference between the 2 protocols (file going till apex and coming back to .5 /file going beyond apex and coming back to .5) regardless of the conditions used (vital and nonvital teeth)

However, Protocol 2 (file going beyond apex and coming back to .5) showed favourable results in both vital and non vital teeth when compared with protocol 1(file going till apex and coming back to .5)

DISCUSSION

All measurements were conducted by the same experienced and trained operator, thus eliminating the possibility of operator bias. The evolution of electronic apex locators (EALs) has reached accuracy levels above 95% depending on the conditions in which they are used compared to other traditional methods[17,18,19,20,21,22]. Several studies have been dedicated to evaluate the accuracy of electronic apex locators, and in these, different employment protocols have been used offering conflicting results regarding the accuracy of electronic devices[15]. This particular study focus on function of accuracy of electronic apex locator using different protocols in different pulp and periapical conditions. The recent apex locators works on the phenomenon of Frequency dependent comparative impedance type (third generation) ratio type (fourth generation) and dual frequency ratio type (fifth generation). Thus it works accurate irrespective of pulp and periapical conditions[23]. In a study conducted by Taneja et al using different apex locators , CanalPro apex locator showed highest accuracy in all conditions in presence of irrigants, pulp/blood and open apices with accepted accuracy percentage above 90% when compared with Root ZX mini and Apex ID[24] .

In our study, electronic apex locator reading was reconfirmed using radiographic reading. Gordon[25] stated that the use of apex locator alone without the use of a post operative radiograph is not a recommended practice due to large variation in tooth morphology. El Ayouti[26] found accuracy of about 97% in electronic apex locator, but suggested reconfirmation using radiographs.

Only single rooted straight canal tooth was included in the study.

Hoer[27] noted that canal curvature was found to effect on function of apex locators. Apex locators are capable of assessing apical constriction in straight and wider canals with greater accuracy as compared to narrow and curved canals[28].

In this study the different protocols used (file going till apex and coming back to .5 /file going beyond apex and coming back to .5) showed no statistical significant difference in accuracy of determining the working length in different pulpal conditions. Aggarwal et al in his study stated that EAL measures the location of apical constriction and apical foramen with similar accuracy in vital and nonvital teeth[14]. However, in our study protocol 2 (file going beyond apex and coming back to .5) showed favourable results when compared with protocol 1(file going till apex and coming back to .5). The patency is achieved with a No. 6,8,10, or 15 hand file. The average minor constriction of the apical foramen is approximately .28 mm. This is especially true if file is precurved Small hand files (No.6-15) will not cause harm. Such small hand files pass unhindered through minor constriction and are inconsequential[29].

CONCLUSION

There is no statistical significant difference between the two protocols regardless of vital and non-vital pulp.

Protocol 2 (going beyond and coming back to .5) showed more accurate readings compared to protocol 1 (going till apex and coming back to .5)

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