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Comparison between apex locator and conventional radiography in working length determination of mandibular anterior teeth.

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Abstract

The aim of this in vivo study was to compare the accuracy of apex locator in determination of working length during endodontic work with that of conventional radiograph. A total of 24 mandibular teeth in patients (40-60 years) were used in this study. Working length for each tooth was measured using root ZX apex locator and conventional radiography. Results of this study revealed that twenty one readings obtained by the apex locator were shorter than readings obtained by radiographs; two cases were the same readings and only one case in which the reading by apex locator was more than the reading by radiograph. In conclusion the electronic apex locator (EAL) can be used for estimation of the working length and it is almost as the same as the conventional radiographs but with an important advantage which is the less radiation hazards.

Key words: Endodontic, apex locator, working length, conventional radiograph.

Introduction

To achieve the highest degree of accuracy in working length determination, a combination of several methods should be used, especially in canals for which working length determination is difficult. The most common methods are radiographic methods, digital tactile sense and electronic methods(R). Apical periodontal sensitivity and paper point measurements have also been used. (R).

Although the term apex locator is commonly used and has become accepted terminology ⁽¹⁾ it is a misnomer.⁽²⁾ So some authors have used other terms to be more precise. These devices all attempt to locate the apical constriction, the cementodentinal junction, or the apical foramen. The scientific basis for apex

locators originated with research conducted by Suzuki in 1942. ⁽³⁾ In recent years, several advancements and modification in the electronic design of apex locators have been reported. ⁽⁴⁾ All apex locators are functioning by using the human body to complete an electrical circuit. One side of the apex locator's circuitry is connected to an endodontic instrument. The other side is connected to the patient's body, either by a contact to the patient's lip or by an electrode held in the patient's hand. The electrical circuit is completed when the inserted endodontic instrument inside the root canal touches the periodontal tissues. The display on the apex locator indicates that the apical area has been reached.

The **ROOT ZX**, a third-generation apex locator that uses dual frequency and comparative impedance principles,

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was described by Kobayashi.⁽⁵⁾ The Root ZX simultaneously measures the two impedances at two frequencies (8 and 0.4 kHz) inside the canal. A microprocessor in the device calculates the ratio of the two impedances. The Root ZX is mainly based on detecting the change in electrical capacitance that occurs near the apical constriction.⁽⁶⁾ The Root ZX, as well as several other apex locators, allows shaping and cleaning of the root canal with simultaneous and continuous monitoring of the working length.⁽⁷⁻⁹⁾ Several studies have been conducted to study the accuracy and reliability of the **Root ZX**.⁽¹⁰⁻¹³⁾ In these studies, electronic working length determinations made by the Root ZX were compared with direct anatomic working length measurements. An in vitro and in vivo studies on the accuracy and reliability of using the apex locator in determining the working length have been conducted⁽¹⁴⁻¹⁷⁾ and another studies to compare its effectiveness to other methods also been reported.⁽¹⁸⁻²⁰⁾

The aim of the present study is to compare the accuracy of apex locator in working length determination of mandibular anterior teeth with that of conventional radiography.

Material and method

The sample of this study composed of twenty four patients (40-60 years old) attending the endodontic clinic seeking for endodontic treatment for their mandibular anterior teeth either because of pain or just for aesthetic purposes. Access opening and pulp extirpation was carried out for each of the selected tooth then a suitable size file or reamer was chosen with a rubber stopper, now working length determination begin first with apex locator (**Root ZX**) according to the

device's manufacturer instructions as following:⁽²⁵⁾

Turn ON the unit before plugging in the attachments and probe. The **Root ZX** will be automatically calibrates. A flashing indicator bar appears when the unit is done calibrating within a few seconds. First of all the pulp chamber should be dry while the canal may be wet. It is important to provide the file with a clear path to dentin with no alloy contact, and then the file was advance until an apex reading was obtained. The apical constriction should be approximately 0.5 mm shy of this point. Also it's important to remember that EALs work on the basis of contact with the canal walls and periapex. The better the adaptation of the file to the canal walls the better the reading. Therefore it is important to try to get a reasonably good file fit in larger canals; the file size should be fairly close to that of the foramen. Now while the file was in it's place inside the canal the patient's position was changed from the supine position to the upright position at the same time the x-ray machine prepared, in order to take a radiograph for working length while the file inside the canal. After the radiograph was taken, the file was removed and measured by the endodontic gauge, and then this gained reading was documented as the Root ZX reading then after processing of the radiograph the working length was determined radiographically by evaluating the position of the end of the file or reamer in the canal on the radiograph. Then the acquired values by these two methods were compared to each other statistically by using T-test.

Results

The distribution of the samples is summarized in table (1) in which the

readings obtained by the apex locator were shorter than that by radiographs as follows: 4 teeth were 0.5 mm shorter, 7 teeth were 1.0 mm shorter, 2 teeth were 1.5 mm shorter, 6 teeth were 2.0 mm shorter and 2 teeth were 3 mm shorter. On the other hand only one reading was longer in apex locator than radiograph, while only two readings were the same in both techniques. The statistical values obtained from radiograph and Root ZX are presented in table (2). Twenty one readings obtained by the apex locator were shorter than readings obtained by radiographs, two cases were the same readings and only one case in which the reading by apex locator was more than the reading by radiograph as shown in table (4).

One can clearly observe that with the apex locator the measurements were always shorter than that with radiographs, but these differences were not statistically significant using paired sample test as shown in table (3).

Discussion

The apical foramen is the main apical opening of the root canal. It is frequently eccentrically located away from the anatomic or radiographic apex. The apical constriction is the apical position of the root canal having the narrowest diameter, this position may vary but it is usually (0.5-1.0) mm short of the centre of the apical foramen (Ingle 2002).

From this study it was found that the estimation of working length by apex locator was almost as the same as that of the radiographic method which may suggest that using electronic apex locator as an easier technique for estimation of working length with less radiation hazards to both patient and the dentist., also by using such technique dentists can save time and facilitate the procedure for the patient.

The variation in results range between (0.5-2.0) mm except in only two cases in them the variation was 3 mm this may be explained by the incomplete dryness of the canal due to its extreme length(both cases were belong canines) or due to presence of abscess .

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Table (1) distribution of the sample

No	Tooth Number	Root ZX	X-Ray
1	42	17	18
2	41	18	18.5
3	41	18	19
4	31	16	16
5	31	18	19
6	31	20	21.5
7	33	20.5	21
8	33	19	22
9	32	19	18
10	31	19	20
11	33	17	17
12	43	20	22
13	42	17	18
14	41	18	20
15	41	16	18
16	32	17	19
17	32	18	19
18	43	20	23
19	41	19	19.5
20	41	18.5	19
21	32	14	16
22	31	15	17
23	41	16	17
24	42	16.5	18

Table 2. Case summaries

Values	Radiograph	Root ZX
N	24	24
Mean	18.9375	17.7708
Median	19.0000	18.0000
Grouped median	18.7500	17.8889
Std. Error of Mean	.3916	.3418
Sum	454.50	426.50
Minimum	16.00	14.00
Maximum	23.00	20.50
Range	7.00	6.50
First	18.00	17.00
Last	17.00	16.50
Std. Deviation	1.9185	1.6745
Variance	3.681	2.804

Table 3. Paired sample test

	Paired Differences Mean	S.D	Std. Error Mean	Correlation	t	df	Sig.
Pair 1 Root zx -Radiograph	-1.1667	.9517	.1943	.868	- 6.005	23	.000*

Non significant

Table 4. Comparison between apex locator and radiograph

Difference	Under	Over	Fit
X -ray & Apex locator techniques	21	1	2

Over = Apex locator is greater.

Under = radiograph is greater.

Fit = both reading are same