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The accuracy of the Raypex5 electronic apex locator using stainless-steel hand K-file versus nickel-titanium rotary Mtwo file

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Abstract

Objectives: Today many clinicians use both stainless-steel hand K-files and nickel- titanium rotary files during endodontic treatment. It is of great importance for the clinician to have confidence in the accuracy of an apex locator even if these files were used interchangeably. The purpose of this in-vitro study was to evaluate the accuracy of the Raypex5 electronic apex locator using stainless-steel hand K-file versus nickel-titanium rotary Mtwo file.

Study design: Twenty straight and single canals of maxillary central teeth were used. Access cavities were prepared; actual working length were determined and compared with electronic working length obtained by means of apex locator Raypex5 using stainless-steel hand K-file and nickel-titanium rotary Mtwo file. Data was analyzed by paired T-test.

Results: There was no significant difference between 15/0.02 stainless-steel hand K- file and 10/0.04 NiTi rotary Mtwo file for the mean differences between actual and electronic working length (p=0.126).

Conclusions: Under the conditions of this in-vitro study, Raypex5 registered more measurements in acceptable range using 15/0.02 stainless-steel hand K- file and 10/0.04 NiTi rotary Mtwo file. It is possible to use them interchangeably without compromising the working length.

Key words: *Apex locator, nickel-titanium, stainless-steel, working length.*

Introduction

The use of electronic apex locators (EALs) to determine working length has gained increasing popularity in recent years because of their high accuracy rates (1-5). EALs were frequently used with a small size 15 stainless- steel endodontic hand file and numerous apex locator studies have used this file for testing purposes. Today many clinicians use both stainless-steel and nickel- titanium rotary files during the treatment of a case. It is of great importance for the clinician to have confidence in the accuracy of an apex locator even if these files were used interchangeably.

Thomas et al. evaluated the accuracy of the Root ZX electronic apex locator using stainless-steel hand Flexo-

files, nickel-titanium hand Sureflex files, nickel-titanium rotary Lightspeed files, and nickel-titanium rotary Profile .04 taper files. They showed that statistically significant differences occurred between file types and sizes but the largest of these differences was not clinically significant (6). Kfir et al. compared the first tapered (K-file) and nontapered instrument (Lightspeed) that bind at the apical constriction. They showed that the first nontapered instruments to bind at the apical constriction were larger and reflected the actual narrow apical diameter of the canal better than the tapered instruments (7).

The new Mtwo rotary nickel-titanium instruments should be used in a single length technique. That means all files of the instrumentation sequence should be used to the full length of the root canal in a step-back manner. A literature search failed to reveal any published study that directly compare the accuracy of an apex locator using stainless-steel hand K-file and nickel-titanium rotary Mtwo file for determining working length.

The purpose of this in- vitro study was to compare the accuracy of the new electronic apex locator Raypex5 using stainless-steel hand K-file and nickel-titanium rotary first Mtwo file for determining working length.

Materials and Methods

Twenty straight and single canals of maxillary central teeth were used. Roots with resorption, fractures, open apices or radiographically invisible canals were excluded from the study. Standard access cavities were prepared. Canal patency was evaluated using a 10 K-file size (Mani, Japan). The size of root canal at the apical foramen was determined using the largest instrument fitting at this level without any force or instrumentation. Maxillary central teeth with apical terminus size 30-35 file were chosen. The cusps were flattened to establish an equal root length and a stable and reproducible reference point for all measurements. Pulp chambers and canals were cleaned by irrigating with 5 ml of normal saline.

The actual working length (AWL) was measured by inserting a small # 10 k-file until the file tip was just visible at using 3 x magnifications. After adjusting silicone stopper to the coronal reference, the file was removed from the canal and its length was measured. According to Kuttler`s study, 0.5 mm was subtracted from this length and the new length was considered as the actual working length (8).

The teeth were prepared for electronic working length (EWL) measurements by socking in normal saline for 15 min. Teeth were embedded in an alginate model specially developed to demonstrate electronic working length measurement (9,10). Next to the teeth a metal rod was also inserted to be attached with the lip clip of the apex locator. All measurements were made within 2 hours of the model being prepared in order to ensure the alginate was kept sufficiently humid (11). Canals were irrigated using normal saline and a blunt needle placed as deep as possible without obstructing the canal. The pulp chamber was then gently dried with a cotton pellet.

First, size 15 K-files (Mani, Japan) attached to the file holder was inserted into each canal. Using the Raypex5 (VDW, Munich, Germany) according to the manufacturer's instruction, the file was advanced within the root canal to just region of the apical constriction, as indicated by the linear high resolution scale of the APEX ZOOM with its three green segments. The silicone stop was then adjusted and the distance from the base of the silicone stop to the file tip was measured with a digital caliper to the nearest 0.01 mm.

On second stage, the first Mtwo instrument (10/0.04) (VDW, Munich, Germany) was connected to the file clip of apex locator and the working length was measured as described. One experienced operator performed all measurements. Finally, collected data was analyzed by paired t-test at a significant level of $P<0.05$.

Results

For each canal the difference between AWL and EWL was calculated. Positive values indicated that the file in position passed the apical foramen; negative values indicated that the file tip was short of the apical foramen, and zero values indicated that the file tip was flush to the apical foramen.

Standard deviation and the mean difference between actual working length and the electronic canal length measurements obtained with different files are illustrated (Table 1). The frequencies of canal measurements are presented (Table 2).

Paired T-test showed that there was no significant difference between 15/0.02 stainless-steel hand K- file and 10/0.04 NiTi rotary Mtwo file for the mean differences between AWL and EWL ($p=0.126$).

(Table 2) shows that when a size 15/0.02 K-file was used, 70% of the measurements were within ± 0.5 mm and 95% were within ± 1 mm of the AWL. Using a size 10/0.04 NiTi rotary Mtwo file 75% of the measurements were within± 0.5 mm and 85% were within ± 1mm of the AWL.

Table 1. Mean difference between actual and electronic working length (mm).

File	size	[a] Mean± SD (mm)
stainless-steel hand K-file	15/ 0.02 - 0.004 ±0.79	- 0.004 ±0.79
nickel-titanium Mtwo	10/ 0.04 -0.184 ± 0.84	-0.184 ± 0.84

aNegative value indicates measurements short of the AWL.

Table 2. Frequency of electronic working length measurements using different files.

Distance from actual length	File 15/0.02		File 10/0.04	
(mm)[a]	N	%	N	%
>1	0	0	0	0
01.0 to 0.5	2	10	1	5
0.5 to 0.01	11	55	7	35
0.0	0	0	2	10
-0.5 to- 0.01	3	15	6	30
-1 to -0.5	3	15	1	5
>-1	1	5	3	15

aNegative value indicates measurements short of the actual working length (AWL)

Discussion

The purpose of this in-vitro study was to compare the accuracy of the new electronic apex locator Raypex5 using stainless-steel hand K-file and nickel-titanium rotary first Mtwo file for determining working length.

Both in-vivo and in-vitro experiments have been designed to test various aspects associated with the use of EALs. Alginate model and extracted human teeth is one of the in-vitro models more developed to allow testing of the EALs (11,12). It is simple, inexpensive, and stable for hours and the root apices can not be seen. The relative stiffness of the alginate mould prevented fluid movement inside the canal that is responsible of premature electronic readings registered with previous models (12,13).

Electronic working length determination was influenced by the size of the canal at the apical terminus (2,14,15). Therefore, maxillary central teeth with apical terminus size 30- 35 file were chosen to control this parameter. Normal saline was used as the root canal irrigant and electrical conductive media because previous studies showed that in the presence of EDTA and saline, measurements were closer to the actual length (1).

Under the conditions of the present study, there was no significant difference between 15/0.02 stainless- steel hand K- file and 10/0.04 NiTi rotary Mtwo file for the mean differences between AWL and EWL. Raypex5 registered more acceptable range using both files. Therefore, according to the result of this study, it is possible to use them interchangeably without compromising the working length.

The result of this in-vitro study needs to be verified in an in- vivo study. Clinically, a higher variation of measurements is expected because in contrast to in-vitro studies favorable circumstances for precise measurements are not available.

Under the condition of the present study, both 15/0.02 stainless-steel hand K- file and 10/0.04 NiTi rotary Mtwo file are suitable for determining working length using Raypex5 apex locator. It is possible to use them interchangeably without compromising the working length.

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