

Original Research

A comparative study of different electronic apex locators for working length determination

¹Dr. Munish Dheeraj, ²Dr Prafulla Bharti, ³Dr. Shikha Chauhan, ⁴Dr. Tania Jandial, ⁵Dr Nikhil Bhagat

¹Senior Resident, Dental Department, ANIIMS, Port Blair, India;

²MDS, Periodontology and Oral Implantology, Private Practitioner, Jammu, J & K, India;

^{3,5}MDS Third year, Department of Conservative Dentistry and Endodontics, BRS Dental College and General Hospital, Panchkula, Haryana, India;

⁴MDS, Conservative Dentistry & Endodontics, Private Practitioner, Jammu, J&K, India

ABSTRACT:

Background: Several techniques have been proposed to establish the working length but the ideal technique is yet to be identified. The present study was conducted to compare different electronic apex locators for working length determination.

Materials & Methods: 30 freshly extracted single rooted maxillary central incisors were selected. Electronic working length measurement was determined using three apex locators. Group I had Root ZX II, group II had i-Root and group III had elements apex locator. The mean values of actual length and electronic working length readings were compared.

Results: The mean actual working length was 22.51 mm. Group I had 22.50 mm, group II had 22.45 mm and group III had 22.72 mm electronic working length. The difference was significant ($P < 0.05$). **Conclusion:** Root ZX II apex locators found to be effective in providing electronic working length comparable to actual length.

Key words: electronic apex locators, endodontic treatment, root canal

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Corresponding author: Dr. Munish Dheeraj, Senior Resident, Dental Department, ANIIMS, Port Blair, India

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INTRODUCTION

Success of endodontic treatment depends on the diagnosis, treatment planning, access cavity preparation followed by cleaning and shaping and obturation. It is generally accepted that root canal treatment procedures should be limited to within the root canal system.¹ To attain this objective, the end point of the root canal system, the canal terminus, should be detected as precisely as possible during preparation of the root canal.²

Clinically, several techniques have been proposed to establish the working length but the ideal technique is yet to be identified.³ Ingle described a radiographic method for working length determination which continues to be among the most commonly employed methods but it requires the paralleling technique and also lengthens the appointment time and exposes the patients and the dental personnel to ionizing radiations. Electronic apex locators (EALs) have been employed clinically to locate the file position in the

canal through the determination of apical constriction (AC).⁴

More recently, devices have been introduced that integrate an electronic apex locator with an endodontic handpiece for canal preparation.⁵ These apex locator-controlled handpieces eliminate the need to maintain working length with multiple files by stopping the rotation of the nickel- titanium (NiTi) files as the point estimated to be the end of the root canal is reached.

These devices can be used either as regular apex locators (with subsequent manual hand files) or for operating rotary NiTi files using the motor-controlled mode.⁶ The present study was conducted to compare different electronic apex locators for working length determination.

MATERIALS & METHODS

The present invitro study was conducted on 30 freshly extracted single rooted maxillary central Incisors of

both genders. Standard access preparation was carried out using a high-speed diamond round or fissure point.

Electronic working length measurement was determined using three apex locators. Group I had Root ZX II, group II had i-Root and group III had elements apex locator. Following this, the actual canal

length was determined by introducing a size 15 K-file into the canal until the tip of the file became visible at the apical foramen under microscope. The mean values of actual length and electronic working length readings were compared. Results thus obtained were clubbed together. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of teeth based on apex locators

Groups	Group I	Group II	Group III
Type	Root ZX II	i-Root	Elements apex locator
Number	10	10	10

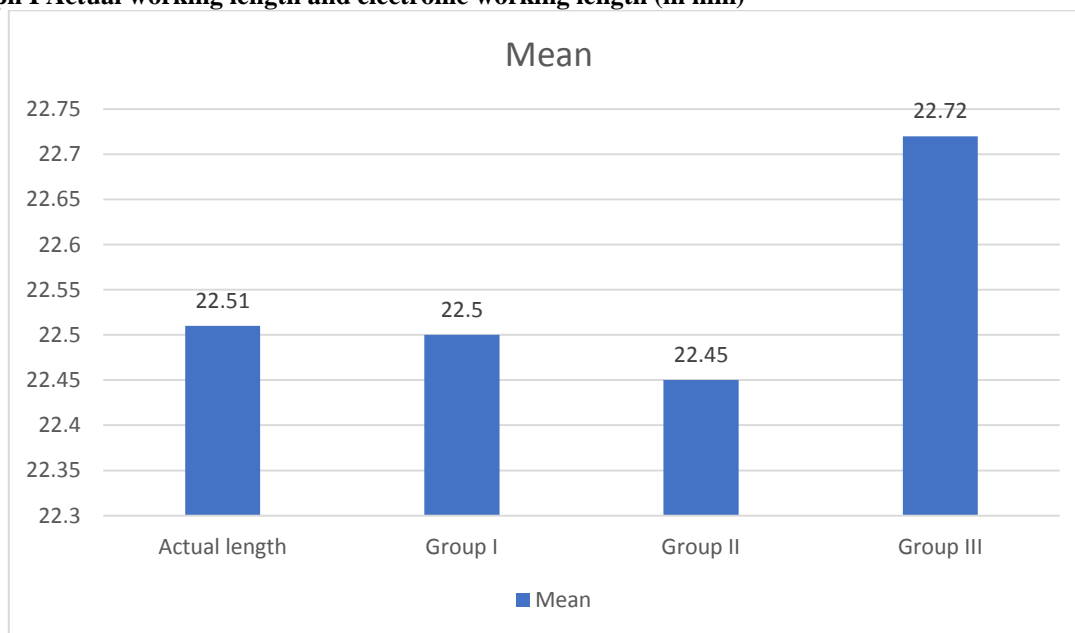
Table I shows distribution of teeth sample in different groups based on type of apex locator used.

Table II Actual working length and electronic working length (in mm)

Groups	Mean	P value
Actual length	22.51	0.02
Group I	22.50	
Group II	22.45	
Group III	22.72	

Table II, graph I shows that mean actual working length was 22.51 mm. Group I had 22.50 mm, group II had 22.45 mm and group III had 22.72 mm electronic working length. The difference was significant (P< 0.05).

Graph I Actual working length and electronic working length (in mm)



DISCUSSION

An electronic method for root length determination was first investigated by Custer. He found that the electrical conductivity of the tissues surrounding the apex of the root is greater than the conductivity inside the root canal system, coronal to the canal terminus.⁷ Subsequently, Suzuki in his experimental study on iontophoresis in dog's teeth indicated that the electrical resistance between a root canal instrument inserted into a canal and an electrode applied to the oral mucous membrane registered consistent values. The radiographic method is the most common method of measuring working length in root canal therapy.⁸

Considering that the apical foramen frequently does not coincide with the radiographic apex, positioning of the file at the radiographic apex will often lead to under or over instrumentation.⁹ In recent years, electrical devices have been developed for determining the length of the tooth without resorting to radiography. This is one of the breakthroughs that brought electronic science into the traditionally empirical endodontic practice.¹⁰ The present study was conducted to compare different electronic apex locators for working length determination.

In present study, Group I had Root ZX II, group II had i- Root and group III had elements apex locator. Sakir

et al¹¹ evaluated *in vitro* the efficacy of five different electronic apex locators (Root ZX II, i- Root, Endo Master, Triauto ZX, and Elements apex locator) in locating the minor diameter. Thirty freshly extracted single-rooted maxillary central incisors were used for the study. Standard access preparation was carried out and the teeth were glued to three plastic frames containing alginate. Electronic working length measurement was determined using all the five apex locators. Following this, the actual canal length was determined by introducing a size 15 K-file into the canal until the tip of the file became visible at the apical foramen under microscope. The average value for actual root canal length was 22.483 ± 1.8731 mm; and the mean electronic root canal length values for Root ZX II, i-Root, Elements, Endo Master, and Triauto ZX apex locators was 22.483 ± 1.7640 mm, 22.400 ± 1.7390 mm, 22.717 ± 1.9462 mm, 22.767 ± 1.9061 mm, and 22.417 ± 1.7523 mm, respectively. $P > 0.05$ for all the five tested apex locators.

We observed that mean actual working length was 22.51 mm. Group I had 22.50 mm, group II had 22.45 mm and group III had 22.72 mm electronic working length. Sahni et al¹² compared the efficacy of EAL, conventional radiography, digital radiography, and actual visual method for the estimation of in the root canal working length (RCL) in extracted primary teeth. Ninety extracted, single-rooted primary teeth were selected. Working length estimation was done with an EAL, conventional, and digital radiographic method, and compared it with an actual visual method. Accuracy of EAL was observed to be 99.7% followed by digital radiograph (98.1%) and conventional radiograph (96.1%). Both EAL and digital radiographic methods showed a high correlation as compared to conventional. The comparative efficacy of an EAL with a visual method was found to be statistically non-significant ($p > 0.005$).

Subramaniam et al¹³ evaluated the precision of the electronic method in primary teeth, which had demonstrated that electronic measurements were closer to the WL than those obtained radiographically. The anatomy and position of the apex are constantly varying in primary teeth, thus radiographic length determination is a challenge.

CONCLUSION

Authors found that Root ZX II apex locators found to be effective in providing electronic working length comparable to actual length.

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