



## ELECTRONIC APEX LOCATORS: A REVIEW

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**ABSTRACT**

Technology has evolved over the years and transformed every aspect of our life. The same applies to the dental profession as well. In recent years, electronic devices have been developed for determining the working length of a root canal and have proved to be a powerful adjunct to conventional radiographs in accurate measurement. The present article discusses about apex locators in detail including its mechanism of working, classification, various uses and shortcomings.

**KEYWORDS** : Apex Locator; Working Length; Root Canal.

**SUMMARY:**

Present article discuss in detail the latest technique in measuring the working length of the tooth during a root canal treatment. Apex locator an adjunct to this has been explained with different modifications explained thoroughly under different generations. This paper explains about the indications, contraindications, use, advantages, disadvantages, & principle of use of apex locators in dentistry.

**INTRODUCTION:**

The accurate determination of working length contributes a great deal to the prognosis of the root canal treatment. The radiographs are one of the traditional methods for determination of root canal length. [1] But nowadays the procedure has become slightly complicated because the apical constriction cannot be identified, and variables in technique, angulations and exposure distort this image leading to errors and multiple exposures which can be hazardous for the patient.

**WHAT IS AN APEX LOCATOR?**

In endodontics, an electronic device known as apex locator is used to determine the position of the apical foramen and its location and thus determine the length of the root canal space. Precise name of electronic apex locator (EAL) is Electronic Root Canal Length Measurement Device (ERCLMD) or Electronic Canal Length Measuring Devices. An electronic apex locator has been shown in Fig. 1 [2] Working Length of a canal is defined as 'the distance from a coronal reference point to the point at which the canal preparation and obturation should terminate.' [3]



**Fig. 1: Electronic Apex Locator**

Working of an Apex Locator: The working length is determined by

comparing the electrical impedance of periodontal membrane with that of the oral mucosa. [3] An electronic apex locator cord has two ends. One end is called 'lip hook' which is placed in contact with the oral mucosa of the patient. Other end is termed as 'file holder' which is a probe attached to the endodontic instrument in use. The attached file is slowly inserted into the root canal up to the estimated working length. As the file touches the soft tissues of the periodontal membrane, the electrical – resistance gauges for both oral mucosa and periodontal membrane would have similar readings and exact length of the canal can be determined.

**Significance of Working Length:**

- Determines how far into the canal the instruments are placed and worked and thus how deeply the tissues, debris, metabolites are removed.
- Limits the depth to which the canal filling may be placed. Affects the degree of pain and discomfort that the patient will feel following the appointment.
- If calculated within correct limits, it will play important role in determining the success of the treatment and conversely, if calculated incorrectly, may cause failure of the treatment. [4]

**CLASSIFICATION OF APEX LOCATORS:**

Apex Locators can be classified into various generations listed as under:

**1<sup>st</sup> Generation Apex Locators:**

These are primarily resistance based electronic apex locators. This measures apposition of flow of direct current which is resistance based on principle that resistance offered by periodontal ligament and oral mucous membrane is 6.5 kΩ. [5] These apex locators can give false readings in the presence of blood, pus, chelating agents and irrigants. The first apex locator based on this principle was the root canal meter. Other models are endodontic meter and endodontic meter S II. [6] Certain advantages of this generation apex locators are that it can be easily operated, can detect perforations, can be used handily with K files, has an audible indication and can be digitally read out. Disadvantages of this generation include that it requires a dry operative field for proper functioning, requires a good contact with the lip clip, requires calibration and cannot estimate beyond 2 mm.

**2<sup>nd</sup> Generation Apex Locators:**

This works on the principle of impedance hence they can also be

called impedance apex locator. Various types of 2<sup>nd</sup> generation apex locators include Endocater, Sono explorer, Digipex and Pio Apex Locator. [6] It holds certain advantages over first generation. It is based on analog method and does not require a lip clip to function. Also no patient sensitivity has been reported. A major disadvantage of these is that root canal has to be free of electro-conductive materials to obtain accurate reading. [7] The Endo Analyzer (Analytic/ Endo, Orange, USA) (Fig. 2) is self-calibrating with a visual indicator but have had variable reports of accuracy. [1]



Fig. 2: Endo Analyzer

### 3<sup>rd</sup> Generation Apex Locators:

These are similar to second generation apex locators except that they use multiple frequencies to determine the distance from the end of the canal hence they are called as frequency dependant apex locators. The device displays accurate results when the canal is well irrigated with an electrolyte such as saline or sodium hypochlorite. It simultaneously measures two impedances at two frequencies (8 kHz and 0.4 kHz) inside the canal. The disadvantage of this device needs "reset" or "calibrated" for each canal. [8] The Root ZX (J. Morita Japan) (Fig. 3) is a 3<sup>rd</sup> generation electronic apex locator that uses dual-frequency and comparative impedance principle.



Fig. 3: Root ZX

### 4<sup>th</sup> Generation Apex Locators:

These are ratio type apex locators which determine impedance at five frequencies. They take the resistance and capacitance measurement and compare them with a database to determine the distance to the apex of the root canal. A major drawback of fourth generation devices is that they perform in relatively dry or in partially dried canals. Also in heavy exudates or blood it becomes inapplicable [9] ProPex II (Fig. 4) comes under this category.



Fig. 4: ProPex II

### OTHER USES OF APEX LOCATORS:

1. Used as an alternative to detect location of any root or pulpal floor perforation. [8]
2. To detect horizontal fractures.

3. Recognize any connection between the root canal & periodontal membrane such as root fracture, cracks & internal or external resorption.

### NEW ADVANCEMENTS:

A latest advancement in modern dentistry is the integration of an apex locator with the endodontic slow-speed hand piece. These have following advantages:

- File starts to automatically rotate the moment the instrument is introduced into the canal.
- If the preset torque is exceeded, the hand piece automatically stops and reverses its rotation.
- Integrated apex locator stops file rotation and reverses the moment the file tip extends beyond the apex.

### SHORTCOMINGS OF APEX LOCATORS:

- Canal shape, lack of patency, accumulation of dentine debris and calcifications can affect accurate working length determination with electronic apex locators.
- Electronic apex locators have the potential to interfere with cardiac pacemakers. The manufacturer of electronic apex locators specifically warns against their use with patients with cardiac pacemaker. [10]
- Intact vital tissue, inflammatory exudates and blood can conduct electric current and cause inaccurate readings so their presence should be minimized before accepting apex reading. [1]
- Majority of present generation apex locators are not affected by irrigants within the root canal and the Root ZX has been found to be more accurate in the presence of sodium hypochlorite. [11]

### ACCEPTANCE OF APEX LOCATORS:

Usage of electronic apex locators for the purpose of determining working length has still not gained worldwide acceptance. This may be due to early devices which suffered from poor accuracy and did not function properly in the presence of common irrigants. Cost of the instruments and lack of exposure to the technology by the operator are also factors. [1]

Ideally electronic apex locators are not an alternative to the use of radiographs in endodontics. Solely using an apex locator without radiographs is not recommended due to variation in tooth morphology.

### CONCLUSION:

No single technique has been found to be completely satisfactory and shown 100% accuracy for determining working length of a canal. Certain limitations do exist with the use of apex locators. An individual should have the necessary knowledge about the anatomy of the apical third of the tooth in order to be a successful practitioner. Owing to the disadvantages of using this technique, they cannot completely replace the use of radiographs, but have proven to be a powerful and useful adjunct.

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