

Working length determination

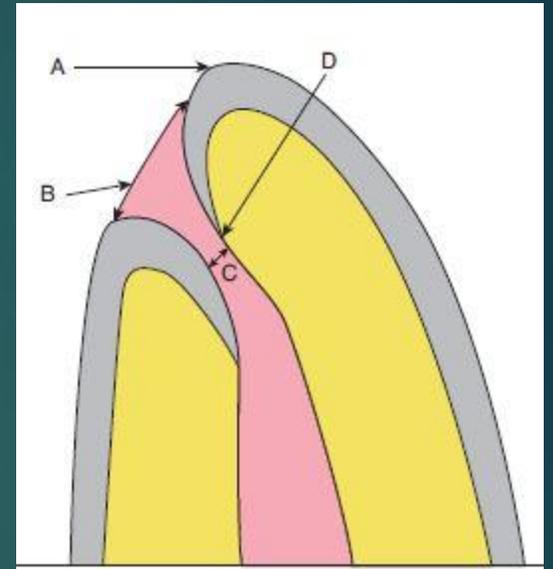
Dr: Mehrnoosh kaviani
Endodontist
Assistant professor of dental Ardabil faculty

What is meant by the 'working length'?

- ▶ The working length of a root canal is the distance from a specific coronal reference point to the chosen apical end-point of root canal preparation

What is the most desirable end-point for root canal preparation

The *apical constriction* is the narrowest point of the apical root canal and the ideal apical end-point for root canal obturation.



There are always two apices recognized for any tooth:

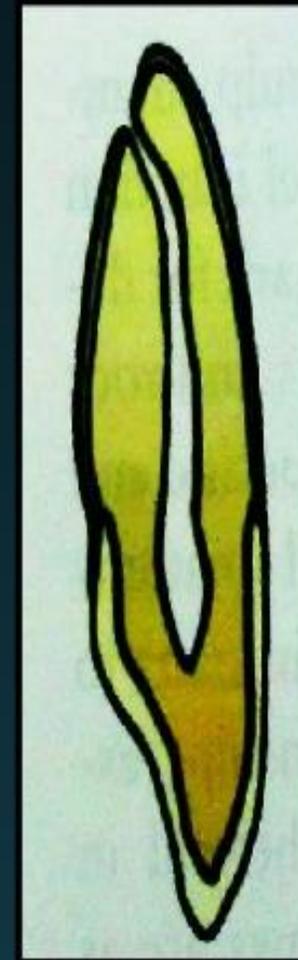
- Radiographic Apex
- Anatomic Apex

- **Radiographic Apex:**

- It is the external border of the root tip which is seen radiographically.

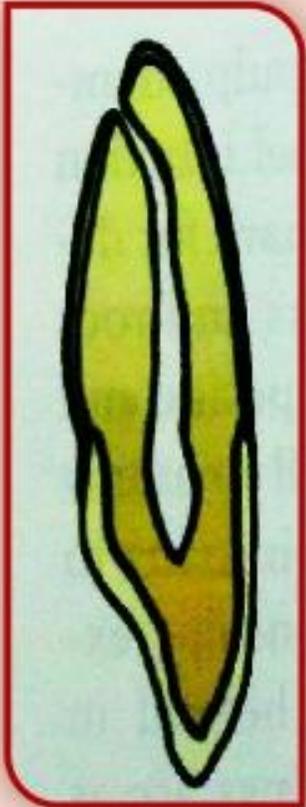
- **Anatomic Apex:**

- Natural apical constriction formed by the cemento-enamel junction

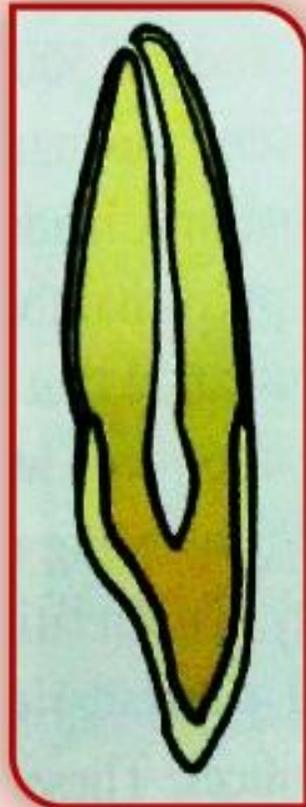


Course of Root Canals

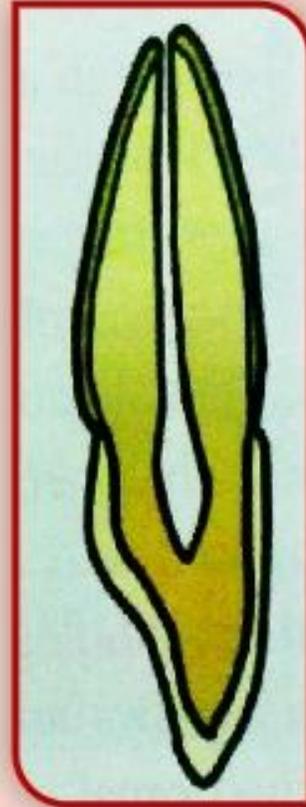
Curved root canals with apical foramen distant from the apex



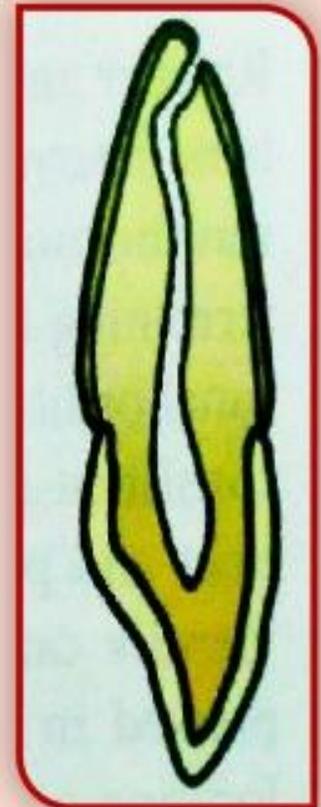
Curved root canals with apical foramen near the apex



Constricted root canal as the apical foramen is approached



Double curvature of root canal with the foramen at a distance from the root apex



Working length determination:

- ▶ Radiography
- ▶ tactile sensation
- ▶ the presence of moisture on paper points
- ▶ Apex locator

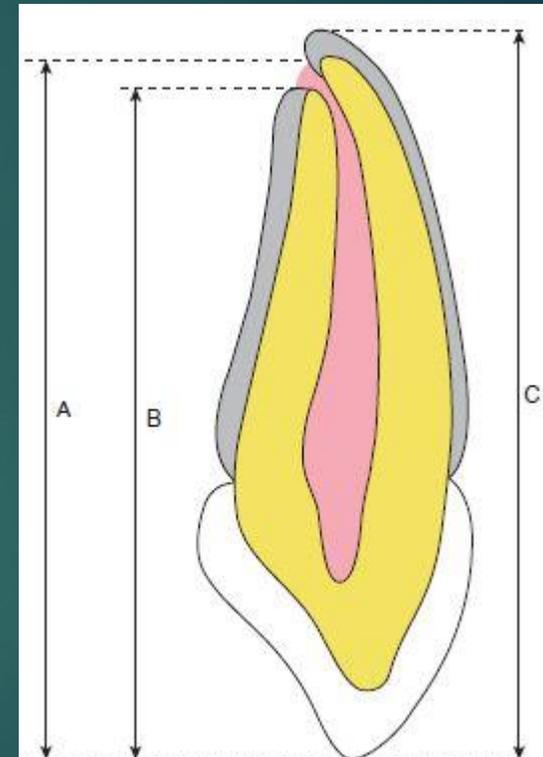
Working length estimation

A - Distance from incisal tip to apical foramen

B - Distance from incisal tip to apical constriction

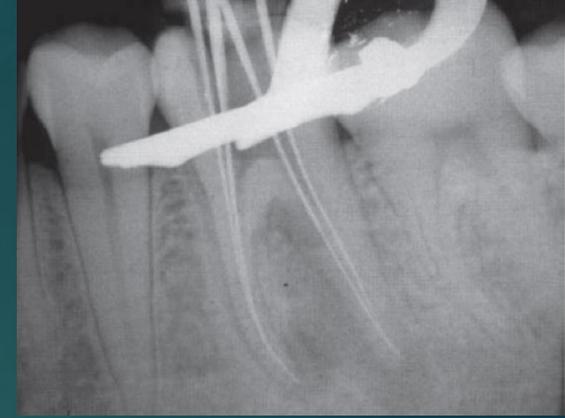
C - Distance from incisal tip to radiographic apex

The diagnostic radiograph only reveals the **position of the radiographic apex**. The radiographic apex does not accurately represent the position of the apical constriction or foramen



What are the drawbacks of estimating working lengths from radiographs

- ▶ a degree of error and 5–10% magnification.
- ▶ Superimposition of various anatomical structures
- ▶ Dense bone and anatomical structures can make the visualization of root canal files impossible by obscuring the apex
- ▶ The superimposition of the zygomatic arch has been shown to interfere radiographically with 20% of maxillary first molar apices and 42% of second molar apices.
- ▶ The deposition of secondary dentine and cementum can move the apical constriction further from accepted limits causing preparation errors



Paper points

- ▶ the root canal is dried, after which a pre-measured paper point is advanced slightly beyond the estimated length. The paper point is removed after a few seconds and assessed to see whether the tip has absorbed moisture (i.e. tissue fluid or blood)
- ▶ The root canal length is the length of paper point that remains dry
- ▶ not to keep the paper point in the canal for too long
- ▶ useful in teeth with a wide apical foramen where an apex locator may not give an accurate reading



Tactile sensation

- ▶ useful technique for the more experienced practitioner to determine where the apical constriction is located.
- ▶ useful when the apical constriction is small.
- ▶ as an adjunct to a more reliable method of length determination.

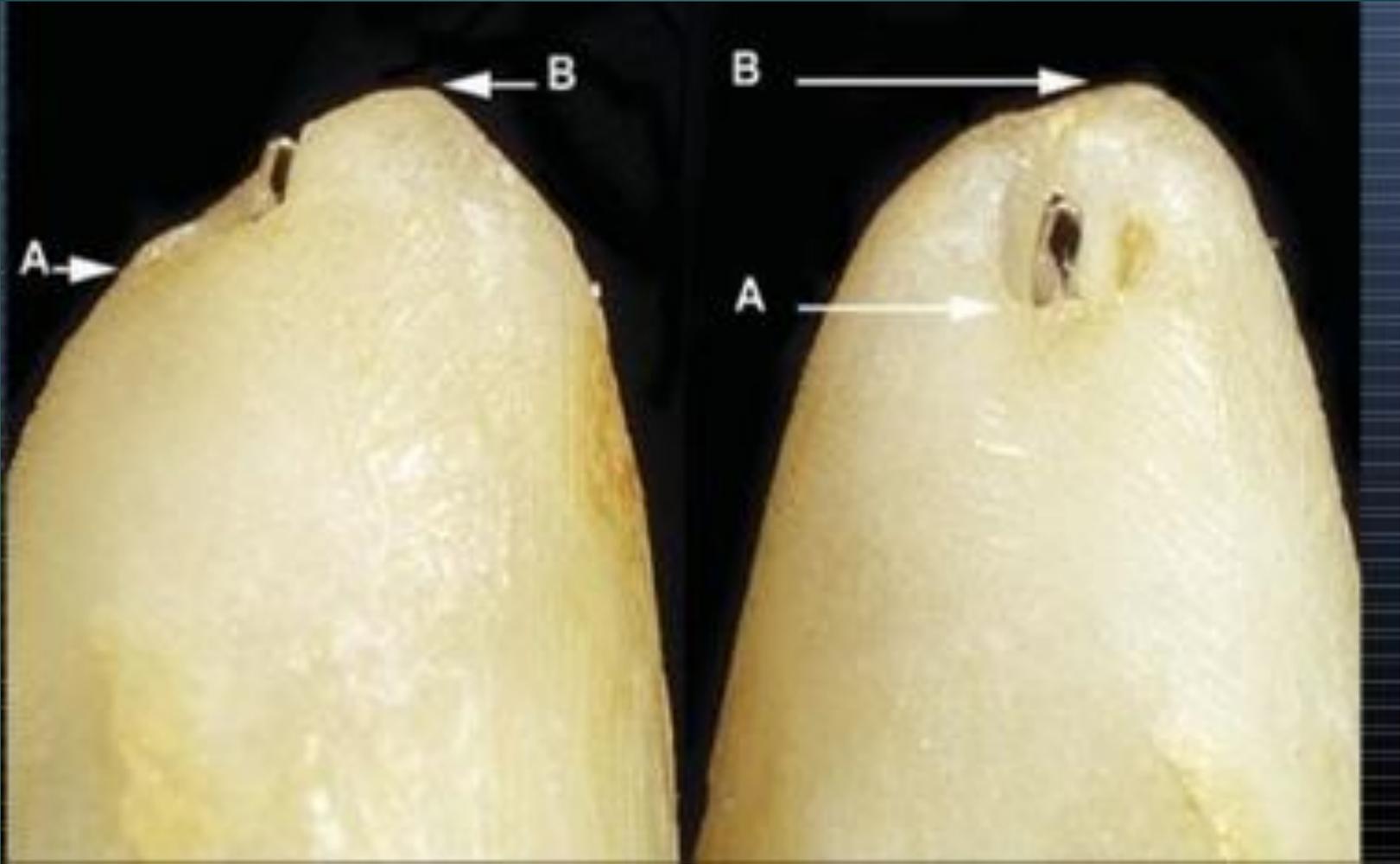
Electronic apex locator

- ▶ An electronic apex locator works on the principle of electrical impedance.
- ▶ Using an electronic apex locator has helped clinicians identify the position of apical foramina more accurately and allow safe canal shaping as close as 0.5 mm to the canal terminus.
- ▶ Correct name of electronic apex locator(EAL) electronic root canal length measurement device(ERCLMD)



Anatomy of apical foramen

- ▶ The apical foramen is not always located at the anatomical apex of the tooth. The foramen of the root canal may be located to one side of the anatomical apex sometimes it is up to 2mm short radiographic apex in 50 % of roots .
- ▶ The anatomy of the apical foramen changes with age



Generations /History

- ▶ First Generation - 1969. It used the resistance method and alternating current
- ▶ Second Generation- The change in frequency method of measuring was developed by Inoue in 1971 as the Sono-Explorer (Hayashi Dental Supply, Tokyo, Japan)

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- ▶ Third Generations- Third generation apex locators are similar to the second generation except that they use multiple frequencies to determine the distance from the end of the canal. *The Endex/Apiti Endex are reported in the literature, which give a combined accuracy of 81% to within ± 0.5 mm of the apical foramen. (Frank & Torabinejad 1993) Root ZX 95 -99 % OF ACCURACY
 - ▶ The fourth generation of EALs breaks impedance down into its primary Components (resistance and capacitance) and measures them independently during use. This eliminates erroneous reading and prevents EALs from being jumpy and erratic.

OTHER USES OF APEX LOCATOR

- ▶ All modern apex locators are able to detect root perforations
- ▶ Multiple-function apex locators are becoming more common and several have vitality testing functions.

HOW to USE

- ▶ Analyze the root anatomy for curvature and establish an estimated working length from the pre operative radiograph.
- ▶ The coronal aspect of the canal should be opened/prepared to provide straight line access or a “glide path” to the apical aspect of the root canal.
- ▶ Modern apex locators generally function well in the presence of fluids and irrigants in the root canal, but prior to using the apex locator excess irrigating fluids are removed from the access cavity of the root canal

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- ▶ _ Once the lip hook and file holder are attached, in most cases a size 15 or 20 file (see troubleshooting) is advanced into the root canal until the blue scale on the apex locator reaches the “apex and red triangle ” on the screen of the root ZX. This indicates that the file is now at the apical foramen.
 - ▶ A diagnostic radiograph is taken with the file at this length. If the radiograph confirms the file to be at the apex this length is effectively the “canal length”.

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- ▶ Since the apical constriction is on average 0.5 mm from the apical foramen, the working length is calculated by subtracting 0.5 mm from the canal length. The canal can now be prepared to the working length. If you are an advocate of patency filing, a size 10 file should be placed to the canal length to maintain the patency

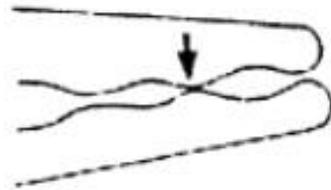
Type A: 'Traditional' single
constriction



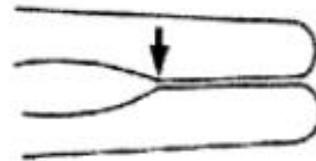
Type B: Tapering constriction



Type C: Multiconstricted



Type D: Parallel constriction

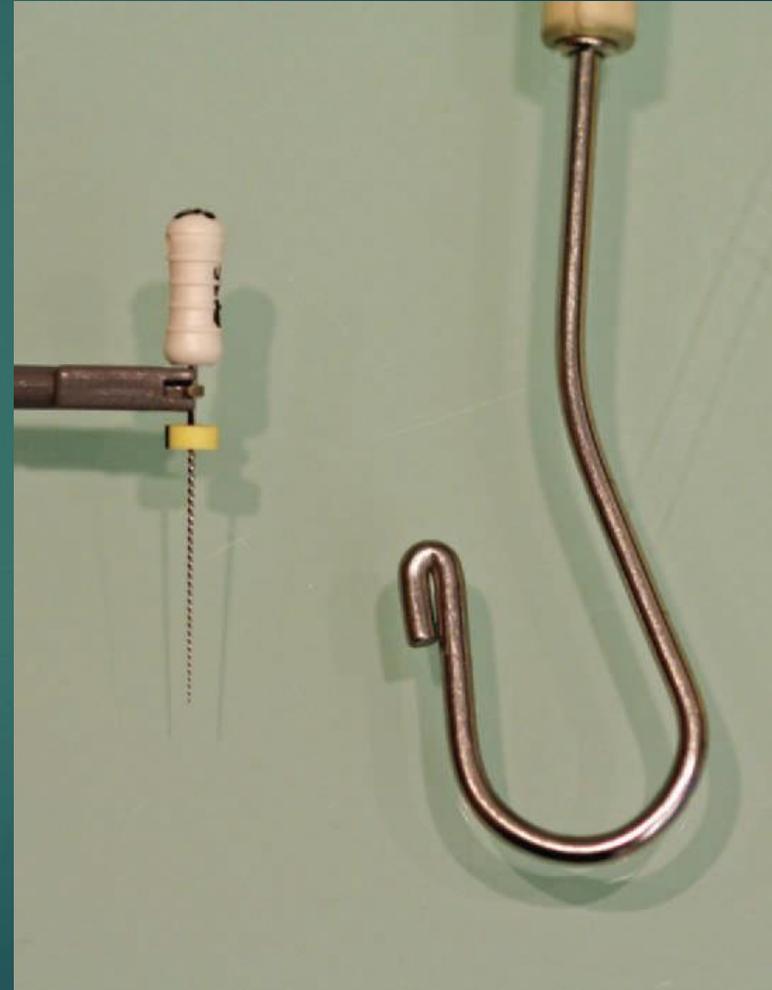


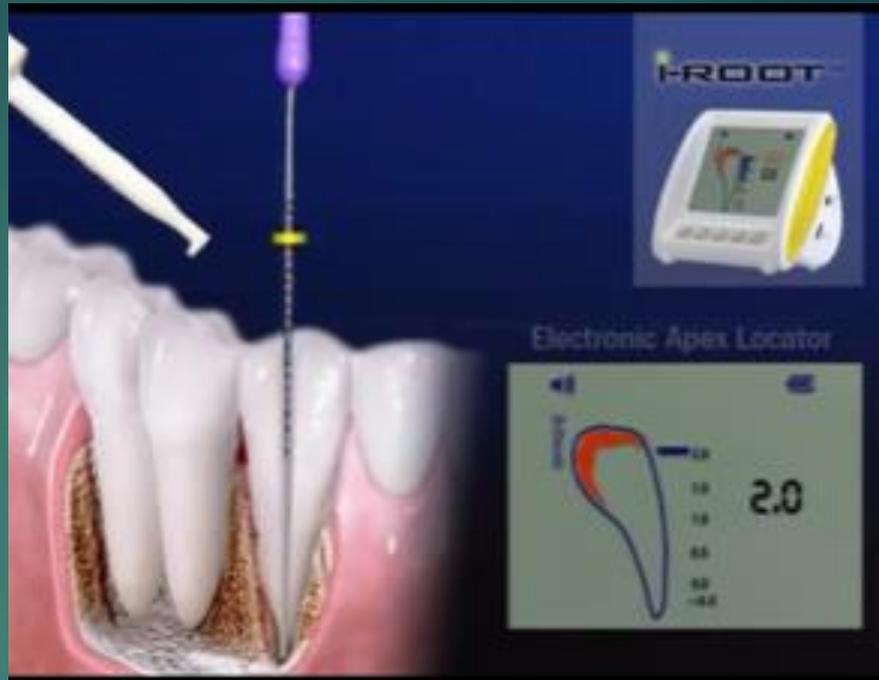
Apex locators consist of:

- ▶ a display
- ▶ two electrodes

a lip hook which is positioned at the corner of the patient's mouth, in contact with the oral mucosa.

makes contact with the endodontic instrument within the root canal





Precautions taken in order to avoid obtaining false reading

- ▶ The file of the locator should not contact metal crown or filling.
- ▶ There should not be any fluid contact between the pulp chamber and the gingiva/periodontal tissues, either through leaky cervical filling or deep or cervical caries. Such an outside contact may cause leakage of measuring current and inaccurate reading.

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- ▶ Generally the locator should be used in absence of fluid in the canal but Some newer models overcome this limitation.
 - ▶ As much of pulp tissue as possible should be removed prior to using Locator
 - ▶ The largest file that will bind the apex should be used
 - ▶ Too loose fitting instrument should be avoided

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- ▶ **ALWAYS.** Except in unavoidable situation, the reading should be confirmed in collaboration with radiographic findings. Precautions taken in order to avoid obtaining false reading.
 - ▶ EALs are ineffective in case of teeth with wide open apex as obtaining correct reading is almost impossible.
 - ▶ EALs should be avoided in patients wearing pace makers. Precautions taken in order to avoid obtaining false reading

Reasons for erroneous apex locator readings

- ▶ Excessive fluid in pulp chamber
- ▶ Contact with a metallic restoration (for example, amalgam filling, gold crown)
- ▶ Iatrogenic perforation of the pulp chamber floor or root canal
- ▶ Purulent discharge within canal
- ▶ Perforation due to internal or external root resorption
- ▶ Teeth with significant apical resorption
- ▶ Teeth with large apical foramina
- ▶ Lateral canal
- ▶ Root retreatment (gutta percha)



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- ▶ As the instrument approaches the terminus of the root canal, the electrical impedance gradually reduces until the apical foramen is reached.
 - ▶ contact with the periodontal ligament ('0' reading)
 - ▶ Modern apex locators can work in the presence of moisture or fluid within the root canal.
 - ▶ Apex locators are capable of measuring to within 0.5 mm of the apical foramen in over 90% of cases
 - ▶ High accuracy
 - ▶ Reduce exposure

Apex locator is better in

Lateral teeth of maxilla

Canine teeth of maxilla

Palatal root of molars

- ▶ Apex locators are capable of measuring to within 0.5 mm of the apical foramen in over 90% of cases
- ▶ High accuracy

Thank you for your attention

