

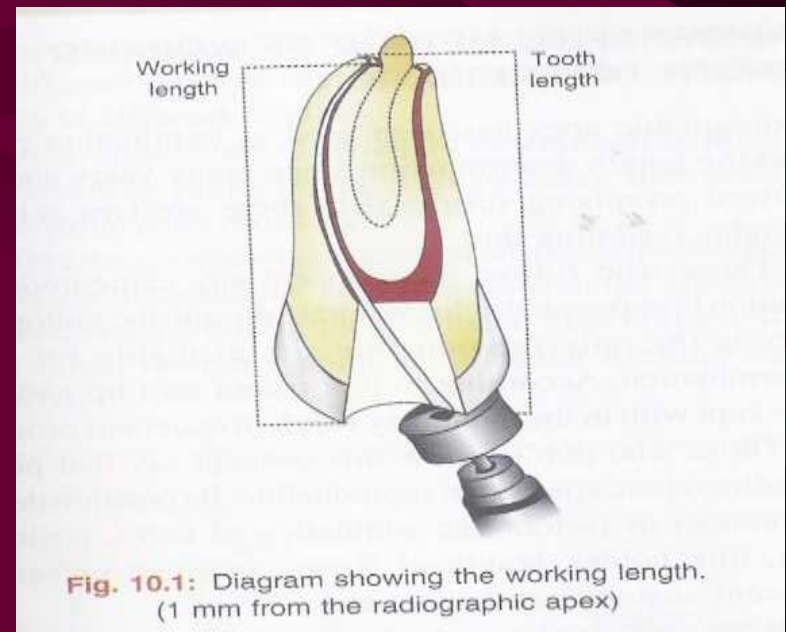
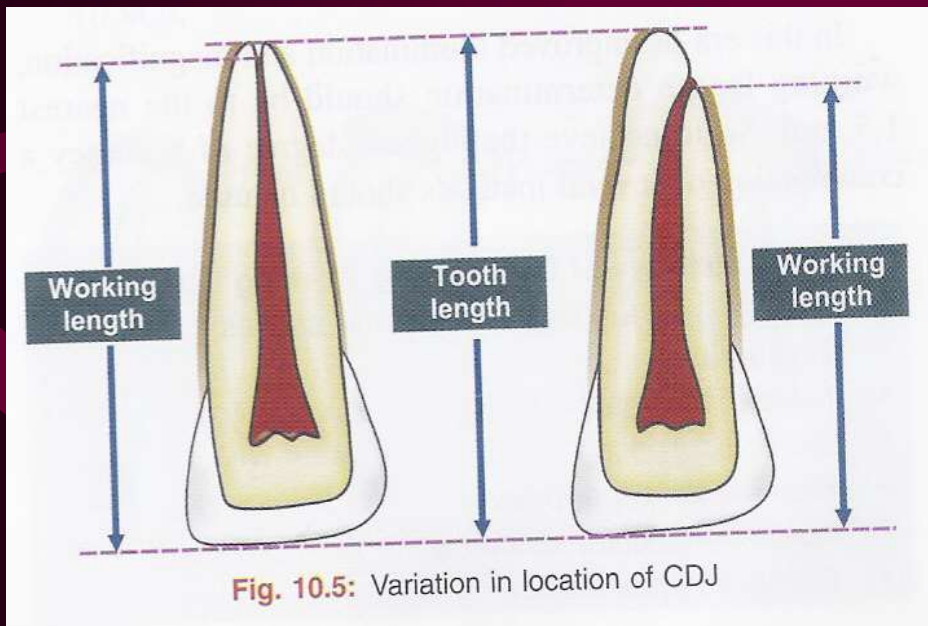
ENDOMETRICS

Root canal
working length determination



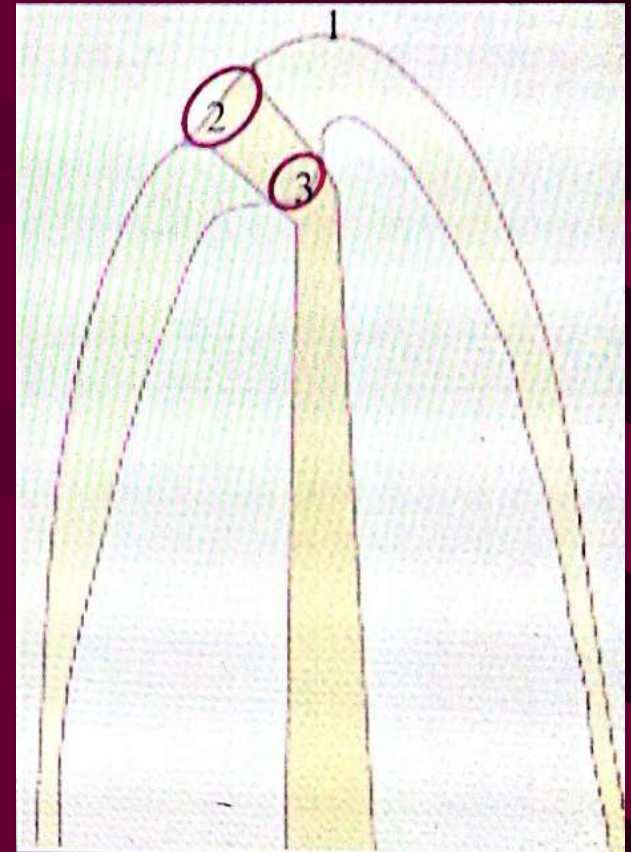
working length determination

Working length : the distance from a coronal reference point to the point at which canal preparation and obturation should terminate.



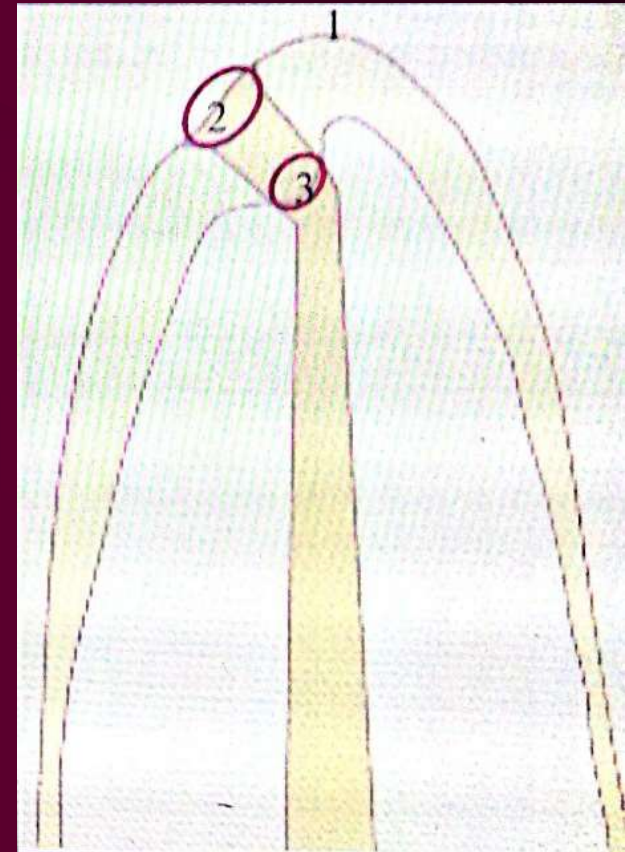
Anatomy of root apex

1. Tooth apex(radiographic apex).
2. Apical foramen(major foramen).
3. Apical constriction(minor foramen).

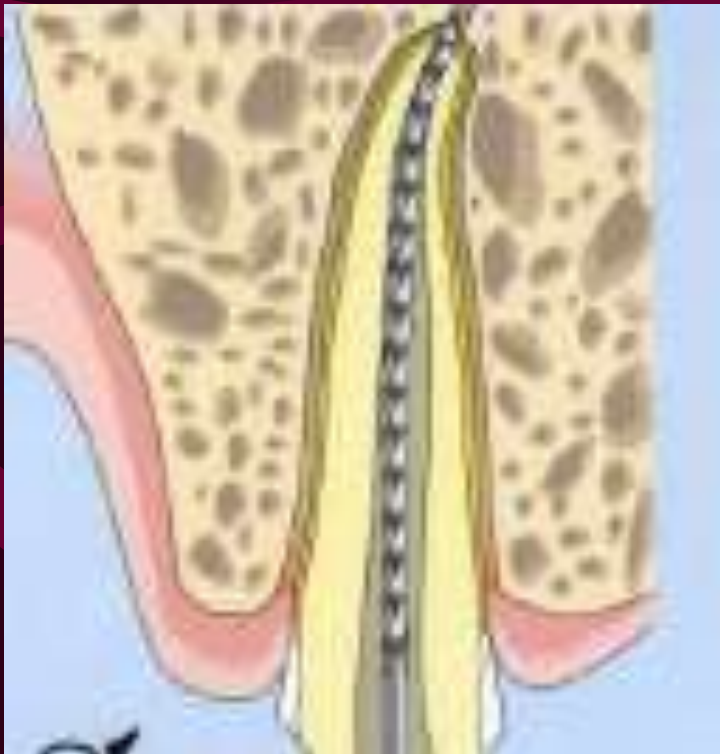


Anatomy of root apex

- Distant between 1&2
 - The apical foramen deviates from apex in(50%-98%) of the teeth.
 - The deviation average 0.3mm-0.6mm but could be as much as 3mm.
- The distance between 2&3
 - 0.5mm in (18-25)years old 0.7mm in (55+)years old
- The distance between 1&3
 - 0.89mm with average of 0.1mm to 2.7mm.



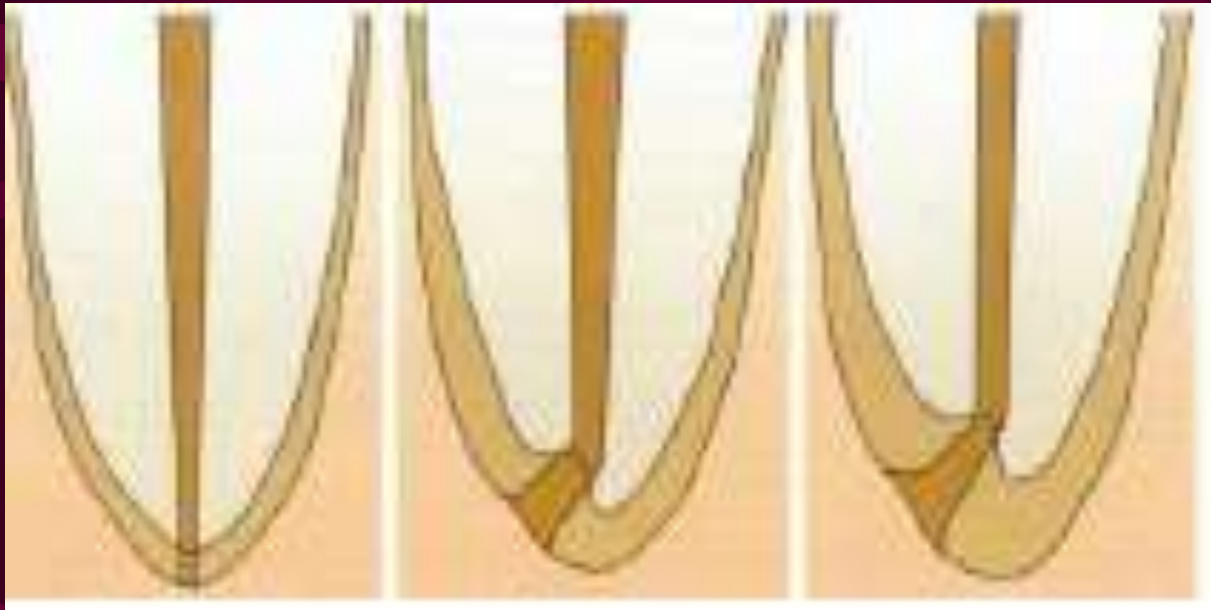
Anatomical apex: Is the tip or the end of the root determined morphologically,



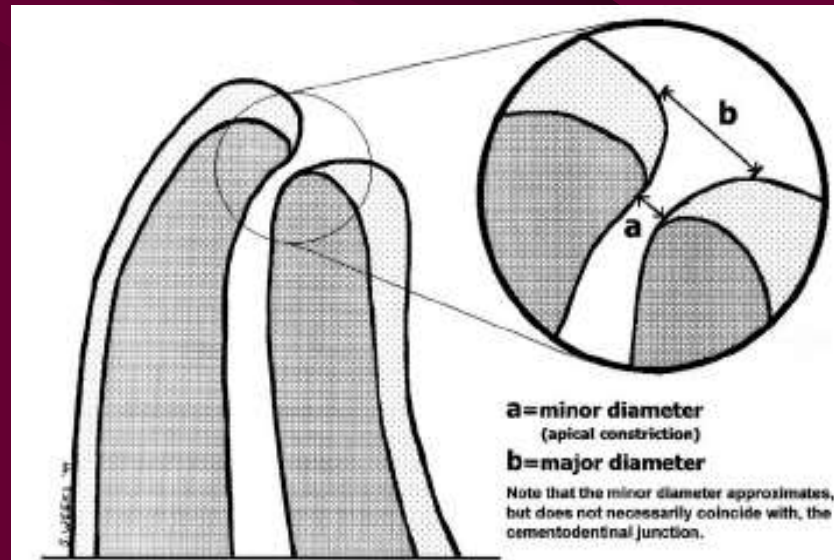
Radiographical apex is the tip or end of the root determined radiographically.



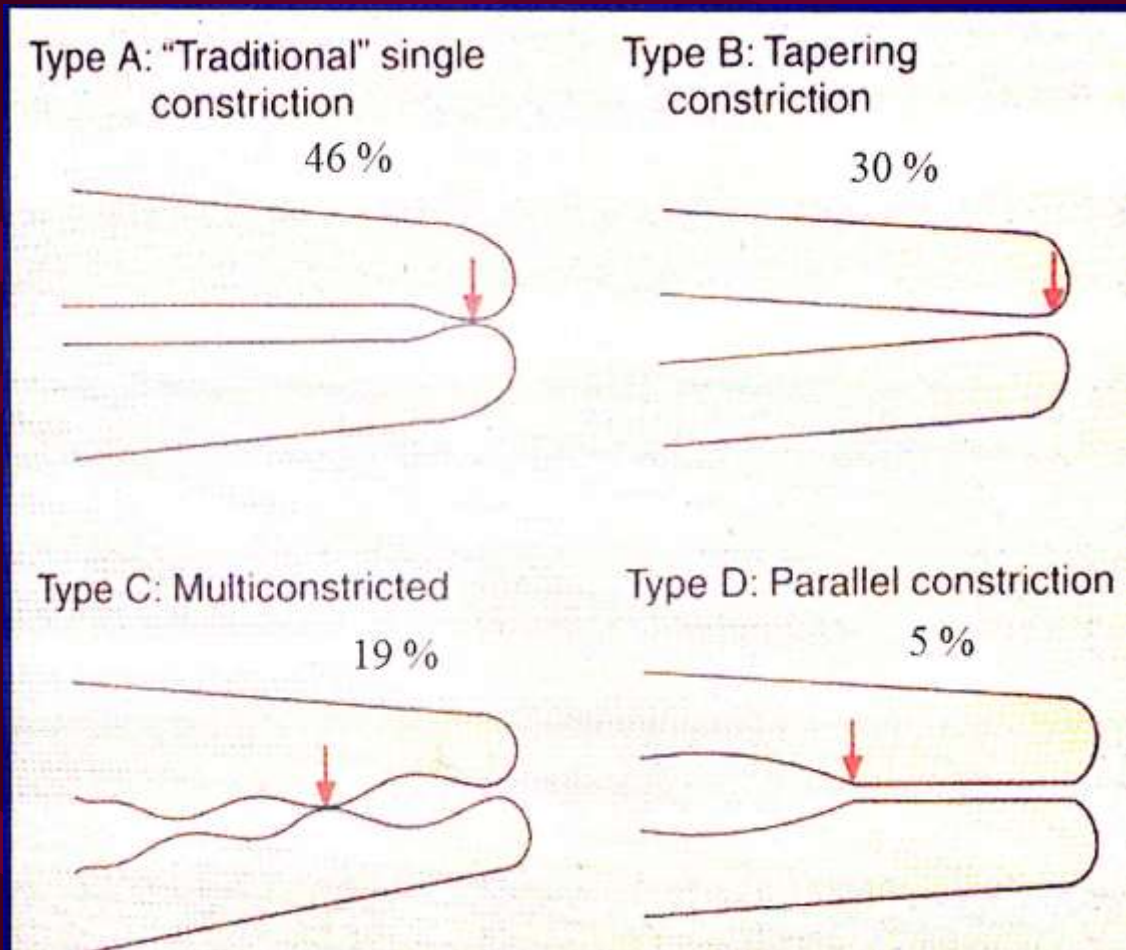
- The **apical foramen** – the main apical opening of the root canal.
- It is frequently eccentrically located away from the anatomic or radiographic apex.



- The **apical constriction** (minor apical diameter) – the apical portion of the root canal having the narrowest diameter.
- This position may vary but is usually 0.5 to 1.0 mm short of the center of the apical foramen.
- The **minor diameter** widens apically to **the foramen** (major diameter) and assumes a funnel shape.
- The **cementodentinal junction** – the region where the dentin and cementum are united, the point at which the cemental surface terminates at or near the apex of a tooth.
- **cementodentinal junction** does not always coincide with the apical constriction.
- The location of the **cementodentinal junction** ranges from 0.5 to 3.0 mm short of the anatomic apex.

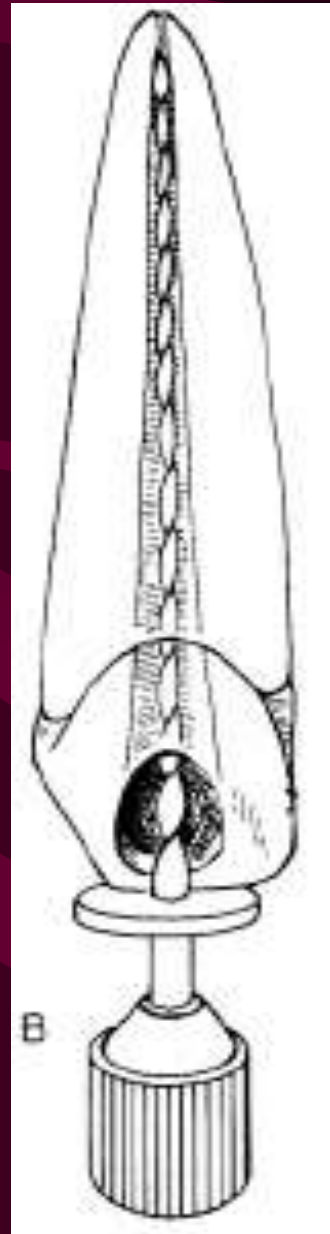


Topography of the apical constriction



Reference points

- It is the site on the occlusal or incisal surface from which measurements are made.
- This point is used throughout canal preparation & obturation.
- The measurement should be made from a secure reference point on the crown, in close proximity to the straight-line path of the instrument, a point that can be identified and monitored accurately.
- A definite, repeatable plane of reference to an anatomic land mark on the tooth – necessary.
(usually the incisor edge in anterior teeth , the cusp tip in posterior teeth).



Reference points

- .Don't use weakened enamel walls or diagonal lines of fracture as a reference site for Length of tooth measurement.**
- .Diagonal surfaces should be flattened to give an accurate site of reference.**
- . Weakened cusps or incisal edges are reduced to a well – supported tooth structure.**

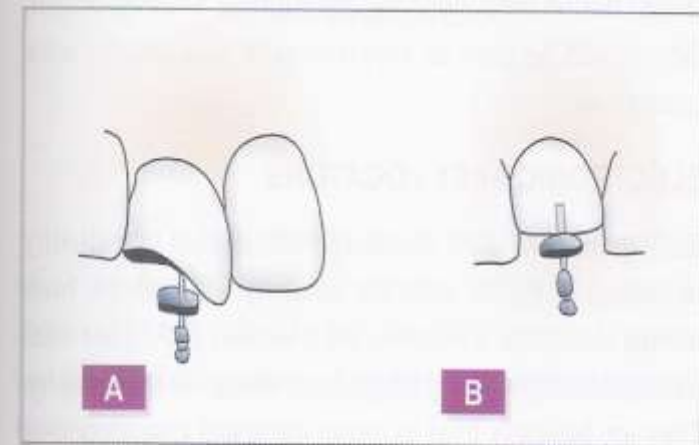
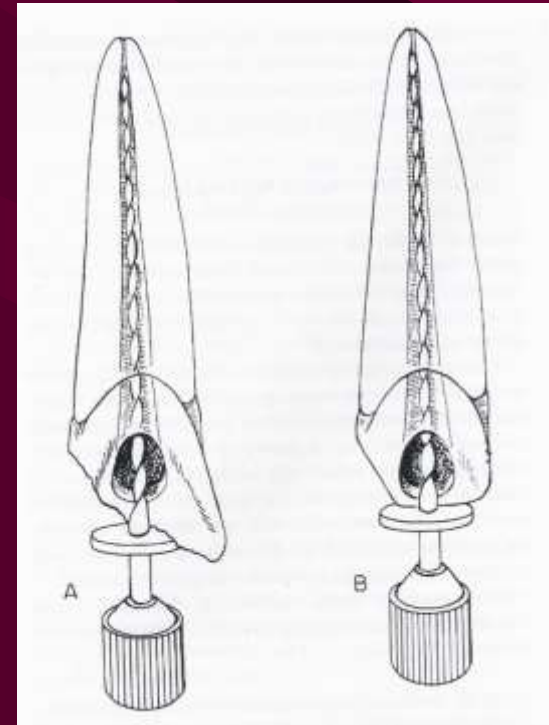
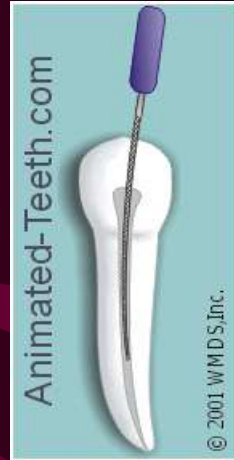


Fig. 10.6: (a) Reference point made at weakened or fractured tooth surface can cause error in working length (b) Weakened tooth surface is flattened to avoid errors



Significance of working length

- Determines how far into the canal the instruments are placed & worked & 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 & discomfort that the patient will feel following the appointment.
- If calculated within correct limits, it will play an important role in determining the success of the treatment & conversely, if calculated incorrectly, may doom the treatment to failure.



Methods of working length determination

I-Radiographical methods

1. Grossman formula.
2. Ingles method .
3. weine`s method.
4. Xeroradiography.
5. RadioVisioGraphy

II-Nonradiographical methods

1. digital tactile sense.
2. Apical periodontal sensitivity.
3. paper point method.
4. Electronic apex locatar.

Determination of the working length by radiographical methods



Radiographical methods

1. Grossman's method

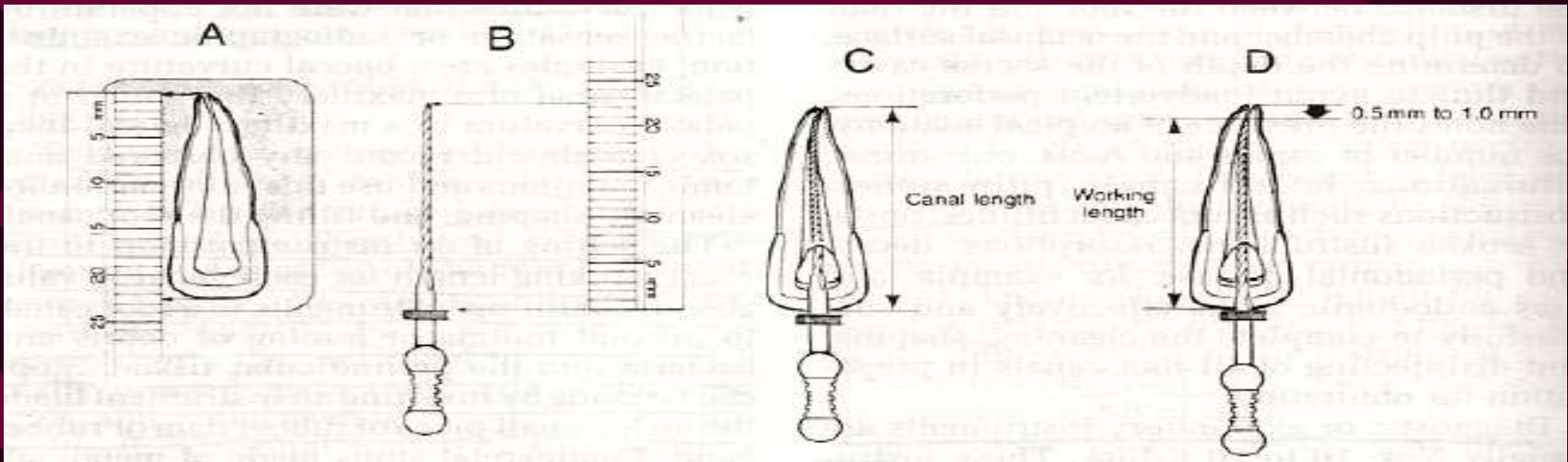
- Grossman (1970, 7th ed.) gave the following formula for determining the correct length of the tooth

- $CLT = KLI \times ALT / ALI$ Where, CLT= correct length of the tooth

KLI= known length of the instrument in the tooth

ALT= apparent length of the tooth on radiograph

ALI= apparent length of the instrument on radiograph



A, The length of the tooth is measured on the diagnostic radiograph (schematic view).

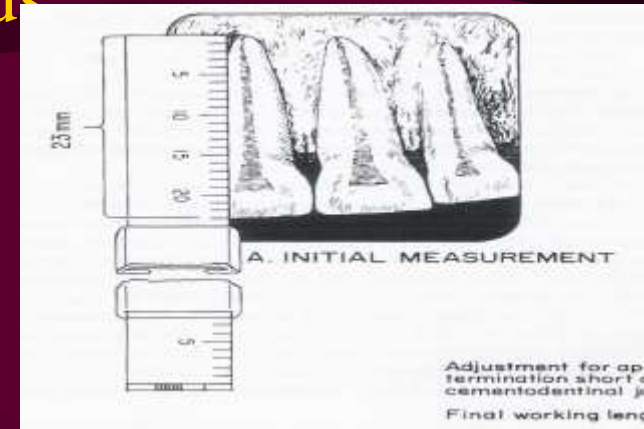
B, This measurement is transferred to a diagnostic instrument prepared with a silicone stop, the instrument is placed in the root canal, and a radiograph is made.

C and D, The root canal and working lengths are determined from the radiograph.

Radiographical methods

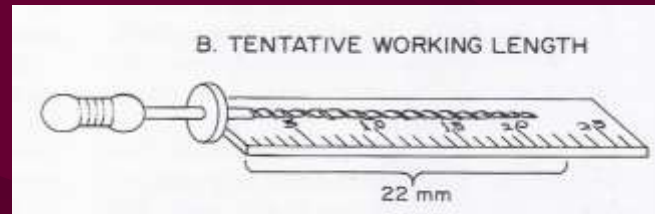
2.ingle method

1. Measure the tooth on the preoperative radiograph.



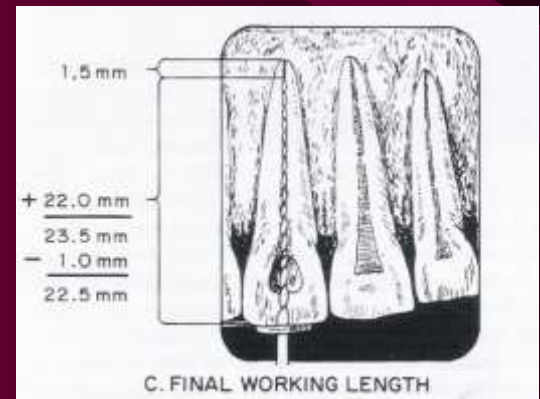
2. Subtract at least 1.0mm " safety allowance " for possible image distortion.

3. Set the endodontic ruler at this tentative working length and adjust the stop on instrument at that level



4. Place the instrument in the canal until the stop is at the plane of reference

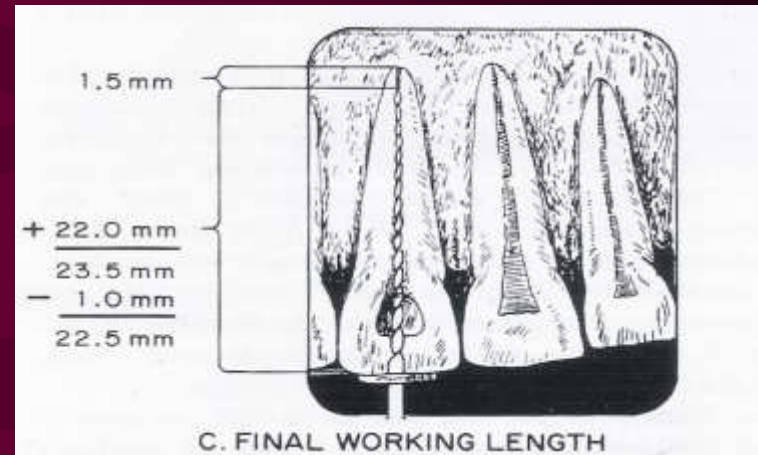
5. On the radiograph, measure the difference between the end of the instrument and the end of the root and add this amount to the original measured length the instrument extended into the tooth.



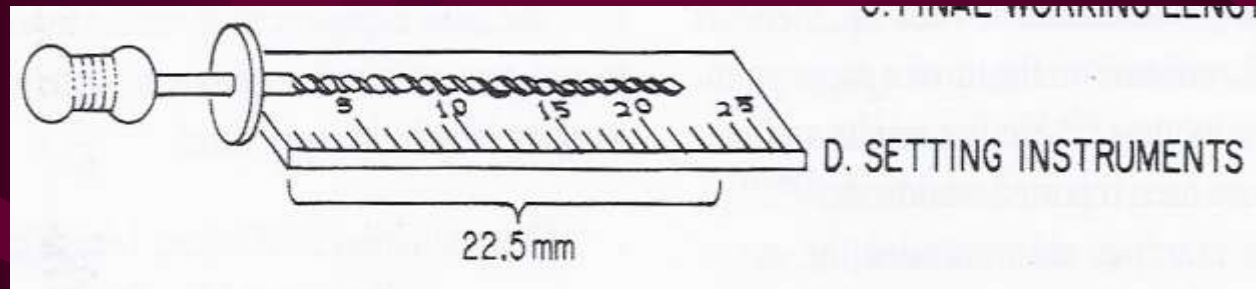
Radiographical methods

2.ingle method

6. From this adjusted length of tooth, subtract a 1.0mm "Safely factor" to conform with apical termination of the root canal at the apical constriction.



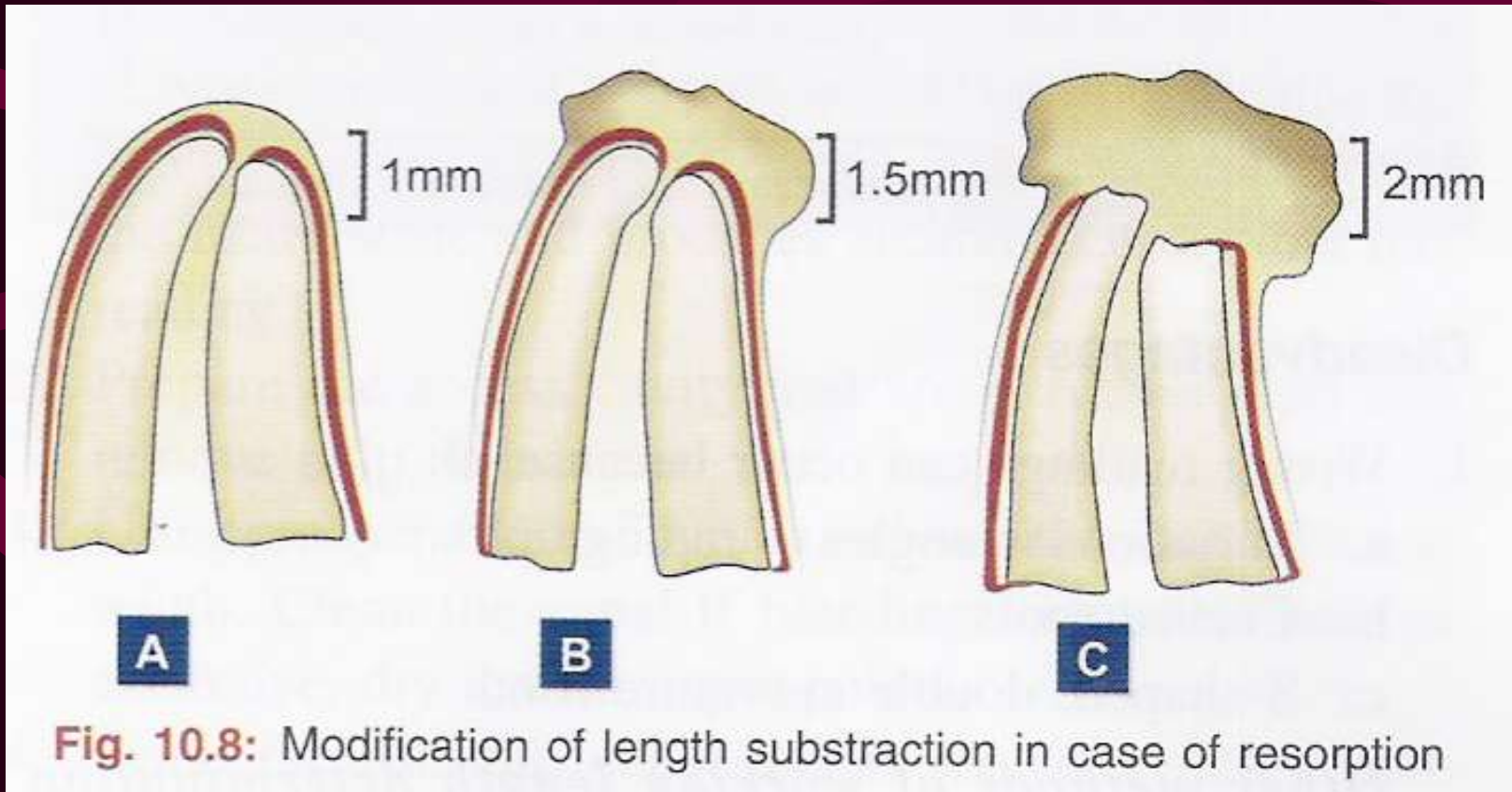
7. Set the endodontic ruler at this new corrected length and readjust the stop on the exploring instrument.



Radiographical methods

3. **Weine's modification**

- A.If, radiographically, there is no resorption of the root end or bone, shorten the length by the standard 1.0 mm.
- B.If periapical bone resorption is apparent, shorten by 1.5 mm, and
- C.if both root and bone resorption are apparent, shorten by 2.0 mm



Radiographical methods

4.Xeroradiography

- Xeroradiography – an electrostatic imaging system – that uses a uniformly charged x-ray sensitive selenium alloy photoreceptor plate in a light-proof cassette.
- When exposed to x-rays, the charge on the photoreceptor plate – dissipated according to tissue density
- A latent electrostatic image produced This latent image then transformed into a visible image by deposition of specially pigmented particles
- The visible image – transferred to a base sheet – that can be viewed either by reflected light or a trans-illuminated light



Radiographical methods

4.Xeroradiography

Advantages:

- 1.Produces image of superior quality – edge enhancement property and sharper contrast
- 2.Radiation levels are reduced to only 1/3rd
- 3.Rapid – require only 20 sec to produce a permanent dry image

Disadvantages:

- 1.Large areas of bone > 2 cm are shown better with conventional intra oral film technique than with xeroradiography
- 2.Greater degree of artefacts than in conventional technique

Radiographical methods

5. RadioVisioGraphy

This system is comprised of three main components:

Radio portion - a conventional x-ray head connected to a microprocessor - enables the unit to produce short radiation exposure times. Instead of a conventional silver halide-based film, the receptor is a sensor that consists of a scintillation screen, a fibre optic instrument, and a charged coupling device imaging system.

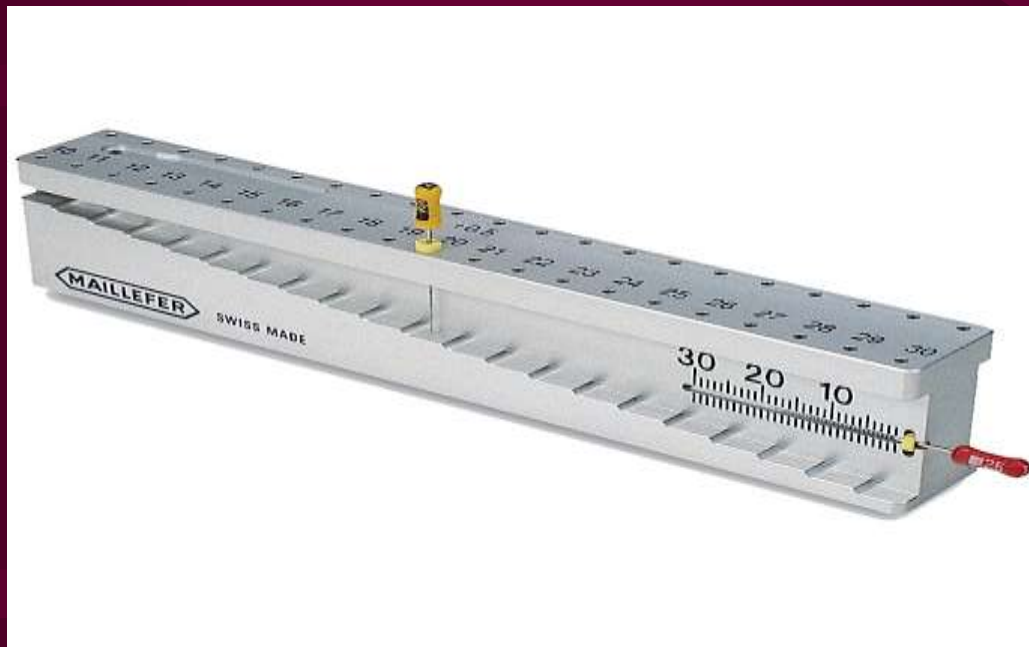
Visio section holds the signal - then converts it by unit area into 256 shades of gray.

Graphy portion of the system is a storage module that can be connected to a final imaging display. The module also can store the image electronically.

- The final image can be printed out using thermal paper or stored electronically for future retrieval.
- Typical radiation doses can be up to 75% lower than those in conventional radiography.



Determination of the working length by nonradiographical methods



II-Nonradiographic methods

1. digital tactile sense

- ❑ Although it may appear to be very simple, its accuracy depends on sufficient experience.
 - ❑ The clinician should be able to literally feel the foramen by tactile sense.
 - ❑ Confirmation may be done either by the radiographic or electronic method.
 - ❑ If the **coronal portion** of the canal is not constricted, an experienced clinician may detect an increase in resistance as the file approaches the apical 2 to 3 mm.
 - ❑ Tactile sensation, although useful in experienced hands, has many limitations.
- The anatomical variations in apical constriction location, size, tooth type and age make working length assessment unreliable.



In some cases the canal is sclerosed or the constriction has been destroyed by inflammatory resorption

II-Nonradiographic methods

2. Apical periodontal sensitivity

- Any method of working length determination, based on the patient's response to pain, does not meet the ideal method of determining WL



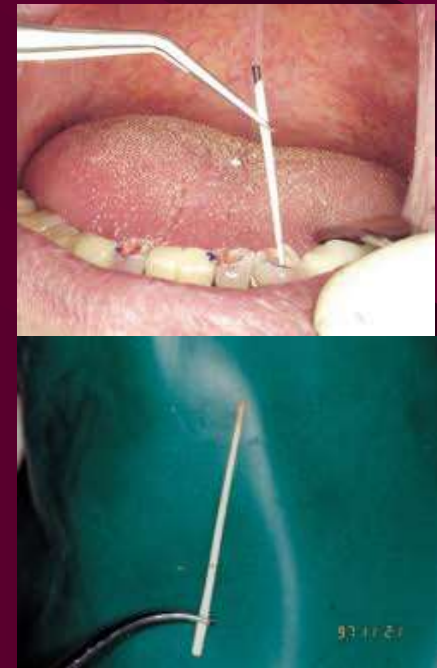
II-Nonradiographical methods

3.Paper Point Measurement

- ❑ In a root canal with an immature (wide open) apex, the most reliable means of determining WL is to gently pass the **blunt end** of a paper point into the canal after profound anesthesia
- ❑ The moisture or blood on the portion of the paper point that passes beyond the apex - an estimation of WL or the junction between the root apex and the bone.

This method, however, may give unreliable data

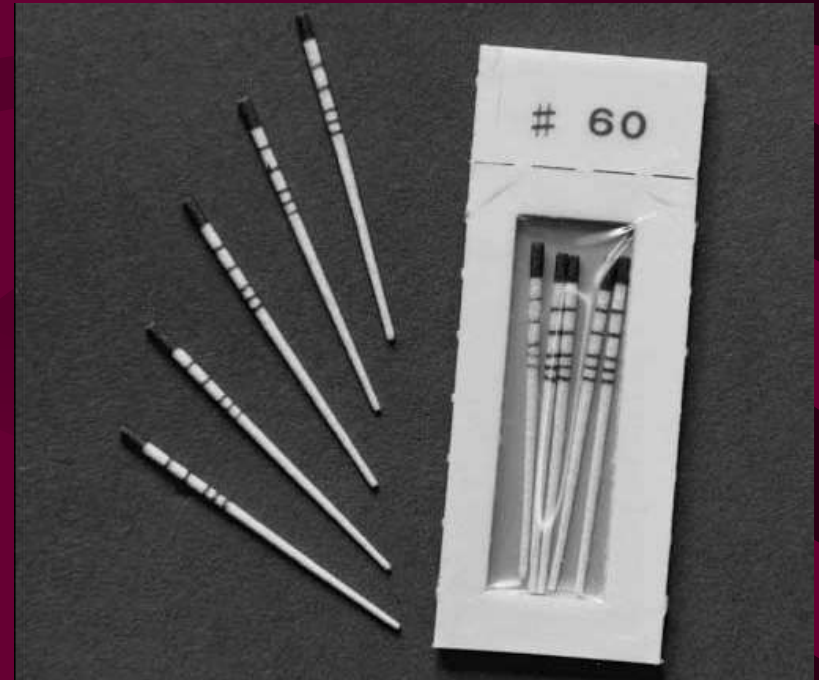
- If the pulp not completely removed
- If the tooth – pulpless but a periapical lesion rich in blood supply present
- If paper point – left in canal for a long time



II-Nonradiographical methods

3.Paper Point Measurement

- Recently millimeter markings have been added to paper points.
- These paper points have markings at 18, 19, 20, 22, and 24 mm from the tip and can be used to estimate the point at which the paper point passes out of the apex.



II-Nonradiographical methods

4. Electronic apex locator

- **Electronic apex locator** Most important advancement in the recent decade - Advancement in microchip technology
- In today's practice - one of the most important and essential instrument in endodontic practice
- These devices all attempt to locate the apical constriction, the cemento-dentinal junction, or the apical foramen.

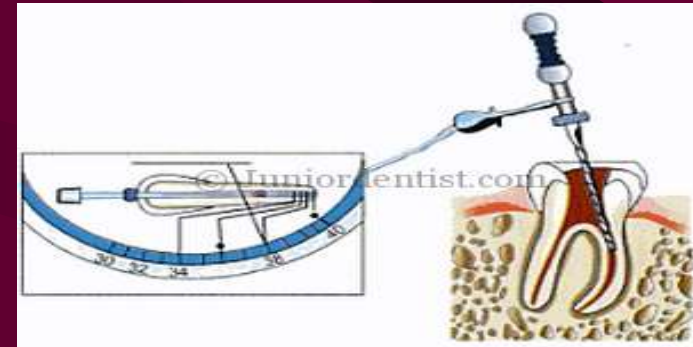


Classification and Accuracy of Apex Locators

- First-generation apex locators – based on **Resistance**



- Second-generation apex locators – based on **Impedance**



- Third-generation apex locators – based on **Frequency**



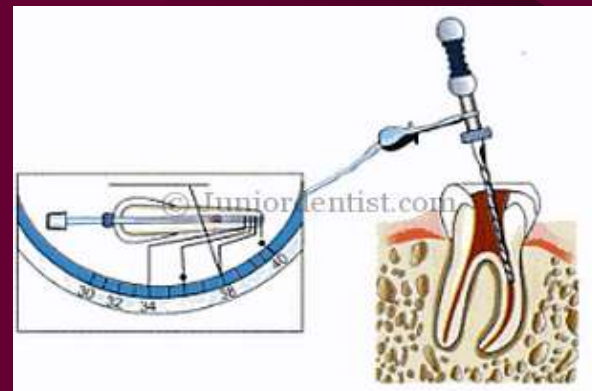
First-Generation Apex Locators

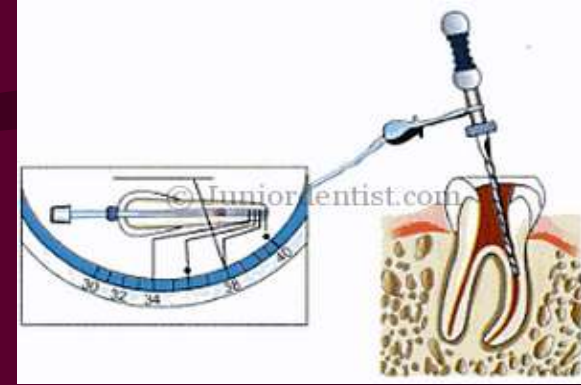
- ❑ First-generation apex locator devices, also known as resistance apex locators
- ❑ Measure opposition to the flow of direct current or resistance.
- ❑ When the tip of the reamer reaches the apex in the canal, the resistance value is 6.5 kilo-ohms (current 40 mA)
- ❑ often yield inaccurate results in presence of electrolytes, excessive moisture, vital pulp tissue, exudates and blood.



Second-Generation Apex Locators.

- ❑ Second-generation apex locators, also known as impedance apex locators
- ❑ measure opposition to the flow of alternating current or impedance
- ❑ Uses the electronic mechanism that the highest impedance is at the apical constriction where impedance changes drastically

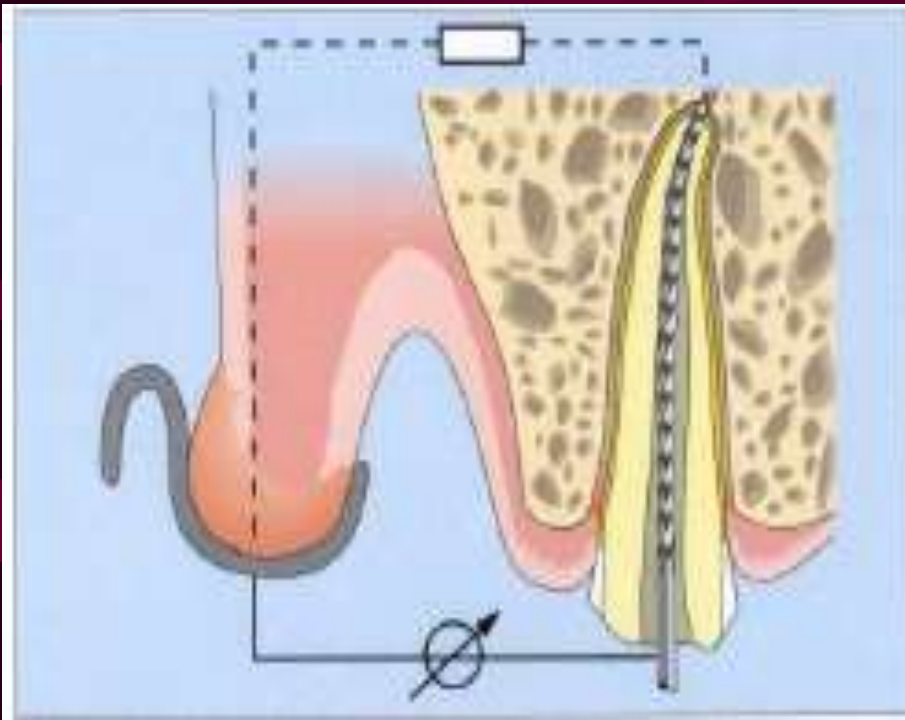




- **Disadvantages :**
- The major disadvantage of second-generation apex locators the root canal has to be reasonably free of electro-conductive materials to obtain accurate readings.
- The presence of tissue and electro-conductive irrigants in the canal changes the electrical characteristics and leads to inaccurate, usually shorter measurements.

Third-Generation Apex Locators.

- **Frequency dependant apex locators –**
- **Introduced in 1990s**



Advantages of Apex Locators.

- ❑ Devices are mobile, light weight and easy to use
- ❑ Much less time required
- ❑ Additional radiation to the patient can be reduced (particularly useful in cases of pregnancy)
- ❑ 80 - 97 % accuracy observed

Disadvantages of Apex Locators.

- A learning curve required
- Accuracy limited to mature root apices
- Extensive periapical lesion can give faulty readings
- Weak batteries can affect accuracy
- Can interfere with functioning of artificial cardiac pacemakers – cautious use in such patients

Summary & Conclusion

- The **cementodentinal junction** or minor diameter is a practical and anatomic termination point for the preparation and obturation of the root canal – and this cannot be determined radiographically.
- Modern apex locators can determine this position with accuracies greater than 90% but with some limitations.
- No individual method is truly satisfactory in determining endodontic working length.
- Therefore, combination of methods should be used to assess the accurate working length determination

Thank you

