ART AND SCIENCE OF DIAGNOSIS

Lect. 1

By: Dr. Ahmed Al-Jobory

2022

Diagnosis

- Is the ”Art and science of detecting and distinguishing change from health and the cause”.

- This procedure include:
- 1- Recognizes the problem.
- 2- Determine the cause of problem.
- 3- Develop a treatment plan to treat the problem.

* The process of diagnosis can be divided into five stages:

1. The patient tells the clinician the reasons for seeking advice.
2. The clinician questions the patient about the symptoms and history that led to the visit.
3. The clinician performs objective clinical tests.
4. The clinician correlates the objective findings with the subjective details and creates a tentative list of differential diagnoses.
5. The clinician formulates a definitive diagnosis .

#This information is accumulated by means of an organized.

- Neither the art nor the science is effective alone.

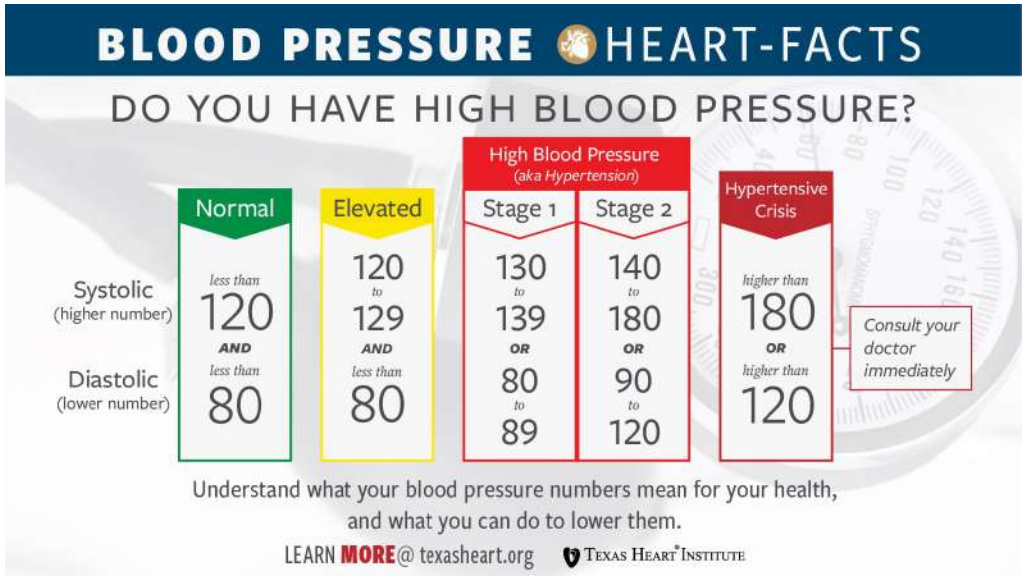
- Establishing a differential diagnosis in endodontics requires :

1- Knowledg: A dentist must depend on himself and his scientific background.
2- Interest and curiosity: The dentist must be interested in solving the problem of the patient and curios about the result of the diagnosis.
3- Patience: The dentist need time and patience to understand the reasons of the problem which not always are visible and needs some time and investigations to revel the cause of the problem.

Medical History

- The patient “of record” should be questioned at each treatment visit to determine whether there have been any changes in the patient’s medical history or medications .

- Blood pressure and pulse should be recorded for the patient at each treatment visit.
- Elevation in blood pressure or a rapid pulse rate may indicate an anxious patient who may require a stress reduction protocol, or it may indicate that the patient has hypertension or other cardiovascular health problems.



❖ **The clinician should evaluate a patient's response to the health questionnaire from two point of view:**

1. Medical conditions and current medication

- That will require altering the manner in which dental care will be provided any drug allergies or interactions, allergies to dental products, an artificial joint prosthesis, organ transplants, or is taking medications that may negatively interact with common local anesthetics, analgesics, sedatives, and antibiotics.

2. Oral manifestations or mimic dental pathosis

- Many of the oral soft tissue changes that occur are more related to the medications used to treat the medical condition rather than to the condition itself.
- More common examples of medication side effects are stomatitis, xerostomia, petechiae (a small red or purple spot caused by bleeding into the skin), lichenoid mucosal lesions, and bleeding of the oral soft tissues.

- When developing a dental diagnosis, a clinician must also be aware that some medical conditions can have clinical presentations that mimic oral pathologic lesions.

- **For example:**


Vietnamese man with tuberculosis lymphadenitis

- 1- Tuberculosis involvement of the cervical and submandibular lymph nodes can lead to a misdiagnosis of lymph node enlargement secondary to an odontogenic infection.

- 2- Immunocompromised patients and patients with uncontrolled diabetes mellitus respond poorly to dental treatment and may exhibit recurring abscesses in the oral cavity that must be differentiated from abscesses of dental origin.

- 3- Patients with iron deficiency anemia, pernicious anemia, and leukemia frequently exhibit paresthesia of the oral soft tissues .This finding may complicate making a diagnosis when other dental pathosis is present in the same area of the oral cavity.

- 4- Sickle cell anemia has the complicating factor of bone pain, which **mimics** odontogenic pain , and loss of trabecular bone pattern on radiographs ,which can be confused with radiographic lesions of endodontic origin.

- 5- Multiple myelom ; can result in unexplained mobility of teeth.
- 6- Radiation therapy to the head and neck region can result in the increased sensitivity of teeth and osteoradionecrosis.

- 7- Trigeminal neuralgia, referred pain from cardiac angina and multiple sclerosis can also mimic dental pain.

- 8- Acute maxillary sinusitis; is a common condition that may create diagnostic confusion because it may mimic tooth pain in the maxillary posterior quadrant. In this situation the teeth in the quadrant may be extremely sensitive to cold and percussion, thus mimicking the signs and symptoms of pulpitis.

❖This is certainly **not a complete list of all the medical entities that can mimic dental disease** ,but it should alert the clinician that a medical problem could confuse and complicate the diagnosis of dental pathosis.

Dental History

- Dental history can be defined as ” The List of events that lead up to the chief complaint" .
- This information will help guide the clinician as to which diagnostic tests are to be performed.
- The history should include any past and present symptoms ,as well as any procedures or trauma that might have raise the chief complaint.

EXAMINATION AND TESTING

Extraoral Examination

- Extraoral examination includes signs of physical limitations that may be present, as well as signs of facial asymmetry that result from facial swelling.

- Visual and palpation examinations of the face and neck are warranted to determine whether swelling is present.
- Many times a facial swelling can be determined only by palpation when a unilateral“ lump or bump ”is present.
- The presence of bilateral swellings may be a normal finding for any given patient ;however, it may also be a sign of a systemic disease or the consequence of a developmental event.

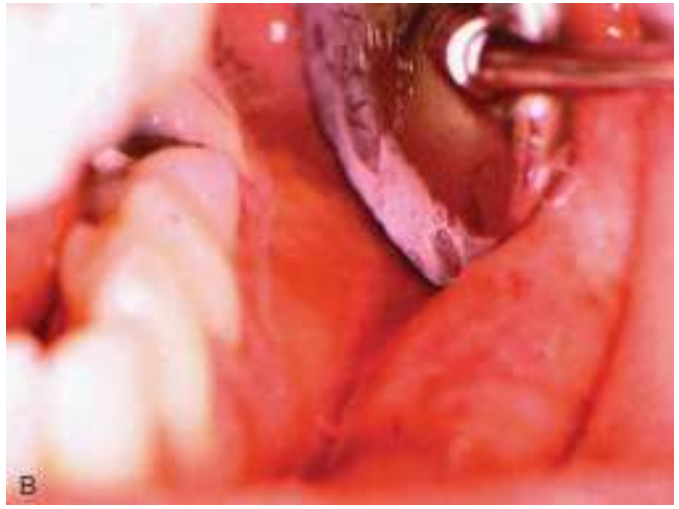
- Palpation of the cervical and submandibular lymph nodes. If the nodes are found to be firm and tender along with facial swelling and an elevated temperature, there is a high probability that an infection is present.

- Swellings of non-odontogenic origin must always be considered in the differential diagnosis ,especially if an obvious dental pathosis is not found.

- Pulpal necrosis and periradicular disease associated with a **maxillary canine** associated with a **canine space infection** ,**but** most extraoral swellings associated with the **maxillary centrals** express themselves as **a swelling of the upper lip and base of the nose**

- If the **buccal space becomes involved** , the swelling will be extraoral in the **area of the posterior cheek.**

- These swellings are generally associated with infections originating from the **buccal root apices of the maxillary premolar and molar teeth and the mandibular premolar and first molar teeth**.



- **The mandibular second and third molars** may also be involved, but infections associated with these two teeth are just as likely to exit to the **lingual** where other spaces.

- Extraoral swelling associated with **mandibular incisors** will generally exhibit itself in the **submental** or **submandibular space**

- Sinus tracts of odontogenic origin may also open through the skin of the face.
- These openings in the skin will generally close once the offending tooth is treated and healing occurs.

Intraoral Examination

Soft Tissue Examination

- The gingiva and mucosa should be dried with either a low-pressure air syringe or a gauze pad.
- By retracting the tongue and cheek, all of the soft tissue should be examined for abnormalities in color or texture.
- Any raised lesions or ulcerations should be documented and when necessary evaluated with a biopsy or referral.

Intraoral Swelling

- Intraoral swellings should be visualized and palpated to detemine whether they are diffuse or localized and whether they are firm or fluctuant.

- Swelling in the **anterior part of the palate** is most frequently associated with an infection present at the apex of the **maxillary lateral incisor** or the palatal root of the **maxillary first premolar**.

- A swelling in the **posterior part of the palate** is most likely associated with the palatal root of one of the **maxillary molars.**

intraoral Sinus tracts

- On chance, a **chronic endodontic infection** will **drain** through an intraoral communication **to** the gingival surface and is known as a **sinus tract** .
- This pathway, which is sometimes **lined with epithelium** ,extends directly from the source of the infection to a surface opening, on the attached gingival surface.
- It can be also extend extraorally .
- The term **fistula** is often inappropriately used to describe this type of drainage.
- Tracing the sinus tract will provide objectivity in diagnosing the location of the problematic tooth.
- To trace the sinus tract, a size #25 or #30 gutta-percha cone is threaded into the opening of the sinus tract.

- When a narrow defect is present, the differential diagnosis must include :

- 1- The opening of periradicular endodontic lesion.
- 2- Vertical root fracture.
- 3- The presence of a developmental groove on the root surface.

- **This type of sinus tract can be differentiated from a primary periodontal lesion???**

- **Because** the latter generally presents as a pocket with a broad coronal opening and more generalized alveolar bone loss around the root.

- Other pulp testing methods may assist in verifying the source of infection.

Palpation

- A palpation test is performed by applying firm digital pressure to the mucosa covering the roots and apex.
- The index finger is used to press the mucosa against the underlying cortical bone .
- This will detect the presence of periradicular abnormalities or specific areas that produce painful response to digital pressure.
- A positive response to palpation may indicate an active periradicular inflammatory process .

- **This test does not indicate whether the inflammatory process is of endodontic or periodontal origin.**

Percussion

- Pain to percussion does not indicate that the tooth is vital or nonvital; but is rather an indication of inflammation in the periodontal ligament (i.e., symptomatic apical periodontitis).

- This inflammation may be secondary to physical trauma, occlusal prematurities, periodontal disease, or the extension of pulpal disease into the periodontal ligament space.

- **Before percussing to any tooth, the clinician should tell the patient what will transpire during this test ??? Why ???**
- **Because** the presence of acute symptoms may create anxiety and possibly alter the patient's response, properly preparing the patient will lead to more accurate results .

- The contralateral tooth should first be tested as a control, as should several adjacent teeth that are certain to respond normally.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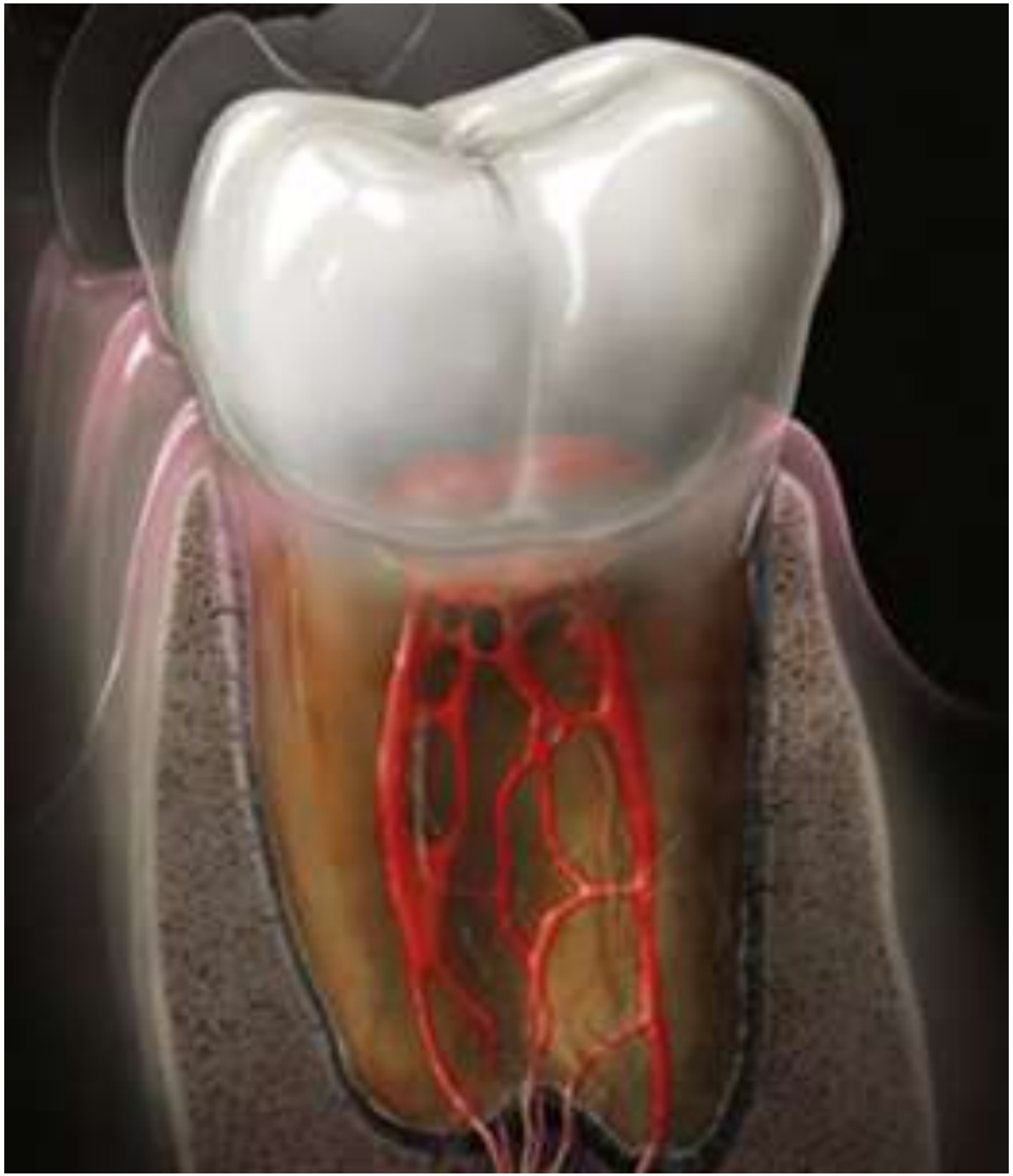

ART AND SCIENCE OF DIAGNOSIS

part 2

Lect. 2

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2022

Mobility test

- Like percussion testing, an increase in tooth mobility is merely an indication of a compromised periodontal attachment apparatus.

- **This compromise could be the result of:**

1. Acute or chronic physical trauma.
2. Occlusal trauma.
3. Parafunctional habits.
4. Periodontal disease.
5. Root fractures.
6. Rapid orthodontic movement.
7. Extension of pulpal disease, specifically an infection, into the periodontal ligament space.

- **Because determining mobility by simple finger pressure can be visually subjective** ,the back ends of two mirror handles should be used, one on the buccal aspect and one on the lingual aspect of the tooth.

- Any mobility that exceeds +1 should be considered abnormal.
- However, the teeth should be evaluated on the basis of how mobile they are relative to the adjacent and contralateral teeth.

Tooth Mobilty
+1 Mobility: First sign of movement greater than normal.
+2 Mobility: Horizontal tooth movement no greater than 1 mm.
+3 Mobility: Horizontal tooth movement greater than 1 mm, with or without the visualization of rotation or vertical depressability.

Periodontal Examination

- The measurement of periodontal pocket depth is "the distance between the height of the free gingival margin and the height of the attachment apparatus below", using a calibrated periodontal probe for all the aspects in millimeters.

- Periodontal bone loss that is **wide** ,as determined by a wide span of deep periodontal probings, is geneally considered to be of periodontal origin and is typically more generalized in other areas of the mouth.

- However, isolated areas of **vertical** bone loss may be of an endodontic origin specifically from a nonvital tooth whose infection has extended from the periapex to the gingival sulcus .

- A vertical root fracture may often cause a localized narrow periodontal pocket that extends deep down the root surface.

Pulp Tests

- Pulp testing involves attempting to make a determination of the response of pulpal sensory neurons.

- The tests involve **thermal or electrical** stimulation of a tooth in order to obtain a subjective response from the patient. (i.e., to determine whether the pulpal nerves are functional).
- **Or** the tests **may involve a more objective approach using devices** that detect the integrity of the pulpal vasculature.

- Unfortunately ,the quantitative **evaluation of the status of pulp tissue can only be determined histologically,** as it has been shown that there is not necessarily a good correlation between the objective clinical signs and symptoms and the pulpal histology.

Pulp Tests

I

Thermal test

- The basic is the response to the cold and hot.

- The **baseline or normal response** to either cold or hot is a patient's report that a sensation is felt but disappears immediately upon removal of the thermal stimulus.

- **Abnormal responses** include a:

1. lack of response to the stimulus,
2. a lasting or severity of a painful sensation after the stimulus is removed,
3. or an immediate, painful sensation as soon as the stimulus is placed on the tooth.

Cold testing

- **Cold testing** is the primary pulp testing method used by many clinicians today .
- It is especially useful for patients presenting with porcelain jacket crowns or porcelain-fused-to metal crowns where no natural tooth surface (or much metal) is accessible .
- If a clinician chooses to perform this test with sticks of ice ,then the use of a rubber dam is recommended ,**because** melting ice will run onto adjacent teeth and gingiva yielding potentially false-positive responses.

- One of example:
- **I- Frozen carbon dioxide (CO_2)** , also known as **dry ice** or **carbon dioxide snow** , or **CO_2 stick** , has been found to be reliable in eliciting a positive response if vital pulp tissue is present in the tooth.

- For testing purposes, a solid stick of CO2 is prepared by delivering CO2 gas into a specially designed plastic cylinder.

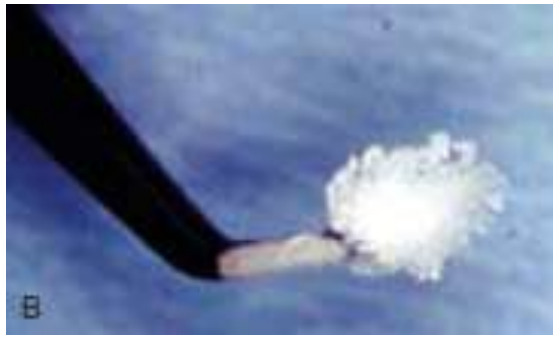
- resulting CO2 stick is applied to the facial surface of either the natural tooth structure or crown.

- The teeth should be isolated and the oral soft tissues should be protected with a 2-by-2-inch gauze or cotton roll; **so the frozen CO2 will not come into contact with these structures. Because of the extremely cold temperature of the frozen CO2** (−69°F to −119°F; −56°C to −98°C), **burns of the soft tissues can occur.**

- **II-** The most popular method of performing cold testing is **a refrigerant spray**.

- **Advantages:**

1. It is readily available.
2. Easy to use.
3. Provides test results that are reproducible, reliable, and equivalent to that of frozen CO2.



- Commonly the use of the dental triple syringe or cold water are questionable unless good isolation with rubber dam.

- **If a mature, nontraumatized tooth does not respond to both cold testing and electric pulp testing ,then the pulp should be considered necrotic.**

- However, a **multirooted tooth, with at least one root containing vital pulp tissue, may respond to a cold test and electric pulp test even if one or more of the roots contain necrotic pulp tissue.**

Heat testing

- When a patient is unable to identify which tooth is sensitive ,a heat test is appropriate.

- Starting with the most posterior tooth in that area of the mouth ,each tooth is individually isolated with a rubber dam.

- **I- An irrigating syringe is filled with a liquid** (most commonly plain water) that has a temperature similar to that which would cause the painful sensation.

- The liquid is then expressed from the syringe onto the isolated tooth to determine whether the response is normal or abnormal.

- With heat testing, a **delayed response may occur,** so **waiting 10 seconds** between each heat test will allow sufficient time for the onset of symptoms

- **II-** Another method for heat testing is to **apply heated gutta -percha** or **compound stick** to the surface of the tooth.

- Heat can also be generated by the friction created when a **dry rubber-polishing wheel** is run at a high speed against the dry surface of a tooth.

- **Often a tooth that is sensitive to heat may also be responsible for some spontaneous pain, and the patient may present with cold liquids in hand just to minimize the pain**

- In such cases, the application of cold to a specific tooth may eliminate the pain and greatly assist in the diagnosis .

- **Typically ,a tooth that responds to heat and then is relieved by cold is found to be <u>necrotic</u>.**

Pulp Tests

II

Electrica test

Electric

- Electric pulp testers of different designs and manufacturers have been used for this purpose.

- Numeric readings on the pulp tester have significance only if the number differs significantly from the readings obtained from a control tooth tested on the same patient with the electrode positioned at a similar area on both teeth.

Common errors of responses obtained from Electric Pulp Testing
False-Positive (+ve) responses
Partial pulp necrosis Patient high anxiety Ineffective tooth isolation Contact with metal restoration
False-Negative (-ve) responses
Calcific obliterations in the root canals Recently traumatized teeth Immature apex Drugs that increase patient's threshold for pain Poor contact of pulp tester to tooth

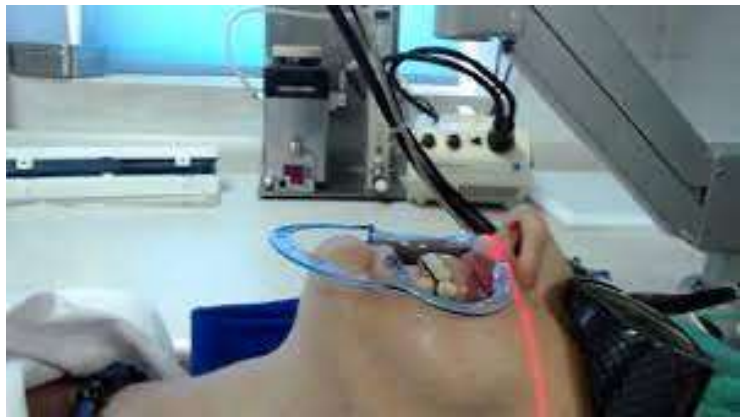
Pulp Tests

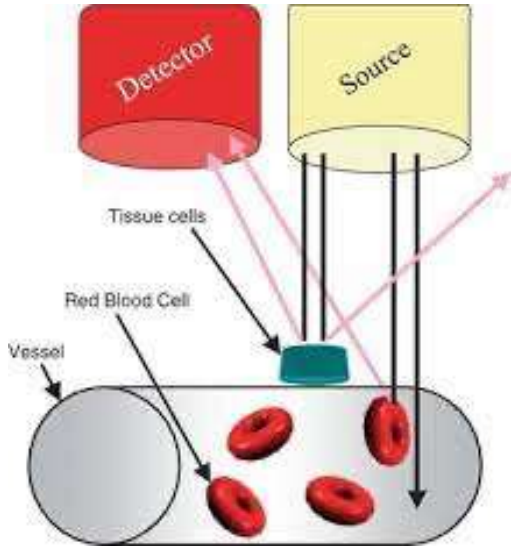
III

Test using devices

Laser Doppler Flowmetry

- **A diode** is used to project an **infrared light beam** through the crown and pulp chamber of a tooth.
- The infrared light beam is scattered as it passes through the pulp tissue.
- The Doppler **principle** states that the **light beam's frequency will shift when hitting moving red blood cells but will remain unshifted as it passes through static tissue .**
- The average Doppler frequency shift will measure the velocity at which the red blood cells are moving.
- This technology, however, is not being used routinely in the dental practice.





Pulse Oximetry

- The pulse oximeter is another **noninvasive device** widely used in medicine, it is designed to measure the **oxygen concentration** in the blood and the pulse rate.

- A pulse oximeter works by transmitting two wavelengths of light, red and infrared, through a translucent portion of a patient's body (e.g., a finger, earlobe, or tooth).

- Some of the light is absorbed as it passes through the tissue; the amount absorbed depends on the ratio of oxygenated to deoxygenated hemoglobin in the blood.

- On the opposite side of the targeted tissue, a sensor detects the absorbed light.

- On the basis of the difference between the light emitted and the light received, a microprocessor calculates the pulse rate and oxygen concentration in the blood.

Pulp Tests

IV

Special test

Bite Test

- Percussion and bite tests are indicated when a patient presents with pain while biting.

- The tooth may be sensitive to biting when the pulpal pathosis has extended into the periodontal ligament space (PDL), creating a symptomatic apical periodontitis, **or** the sensitivity may be present secondary to a crack in the tooth.

- A variety of devices have been used for bite tests, including **cotton tip applicators, toothpicks, orangewood sticks, and rubber polishing wheels**.

- There are several devices specifically designed to perform this test.

Test Cavity

- The test cavity method for assessing pulp vitality is not rotinely used since, by definition ,it is an invasive irreversible test.
- This method is used only when all other test methods are deemed impossible or the results of the other tests are undetermined.
- This is accomplished with a high-speed #1 or #2 round bur with proper air and water coolant.
- The patient is not anesthetized while this procedure is performed, and the patient is asked to respond if any painful sensation is felt during the drilling procedure.
- If the patient feels pain once the bur contacts sound dentin, the procedure is terminated and the class I cavity preparation is restored.
- If the patient fails to feel any sensation when the bur reaches the dentin, this is a good indication that the pulp is necrotic and root canal therapy is indicated.

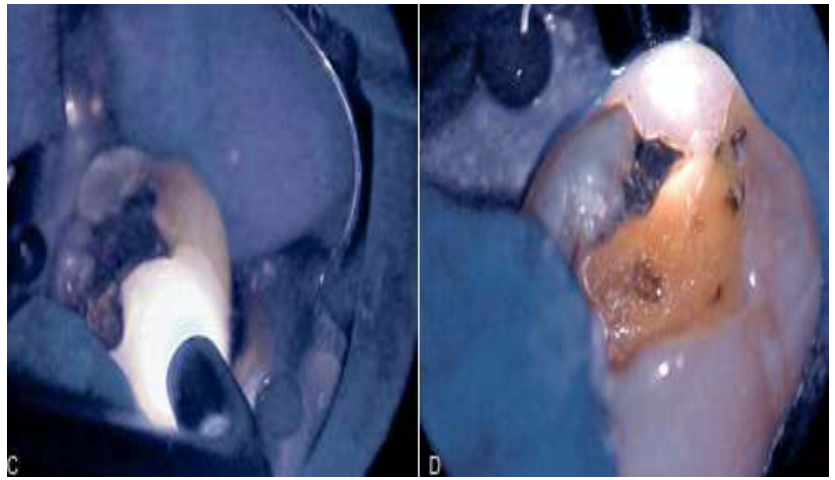
Staining and Transillumination

- To determine the presence of a crack in the surface of a tooth ,the application of a stain to the area is often of great assistance.

- It may be necessary to remove the restoration in the tooth to better visualize a crack or fracture.

- **Methylene blue dye**, when painted on the tooth surface with a cotton tip applicator, will penetrate into cracked areas. The excess dye may be removed with a moist application of 70% isopropyl alcohol. The dye will indicate the possible location of the crack.

- A high-intensity light directly on the exterior surface of the tooth at the cementum-enamel junction (CEJ) may reveal the extent of the fracture .
- Teeth with fractures block transilluminated light, the part of the tooth that is proximal to the light source will absorb this light and glow, whereas the area beyond this fracture will not have light transmitted to it and will show as gray by comparison.

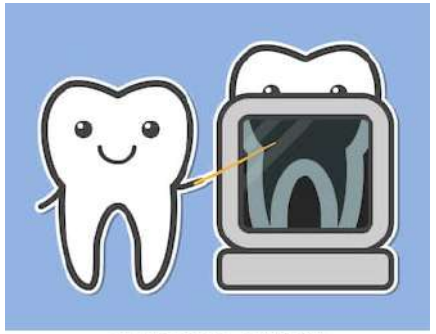


Selective Anesthesia

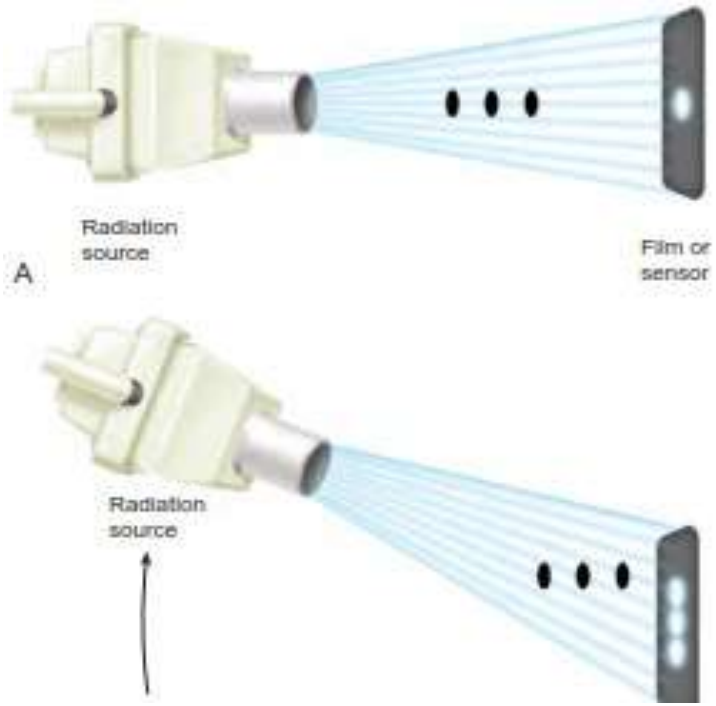
- When symptoms are not localized or referred, the diagnosis may be challenging.
- Sometimes the patient may not even be able to specify whether the symptoms are emanating from the maxillary or mandibular arch .
- In these instances, when pulp testing is undetermined, selective anesthesia may be helpful.
- This should be accomplished by using a **periodontal ligament (intraligamentary) injection.**
- The injection is administered to the most posterior maxillary tooth in the quadrant of the arch that may be suspected, starting from the distal sulcus.
- **If the pain is not eliminated after an appropriate period of time**, then the clinician should similarly repeat this technique on the mandibular teeth below.
- It should be understood that periodontal ligament injections may anesthetize an adjacent tooth and thus are more useful for identifying the arch rather than the specific tooth.

Radiographic Examination

- The radiographic interpretation of a potential endodontic pathosis is an integral part of endodontic diagnosis and prognosis assessment.
- For this reason, the clinician is sometimes tempted to prematurely make a definitive diagnosis based solely on radiographic interpretation
- When not coupled with a proper history and clinical examination and testing, the radiograph alone can lead to a misinterpretation of normality and pathosis.
- The clinician should not subject the patient to unnecessary multiple radiation exposures; two pretreatment images from different angulations are often sufficient.



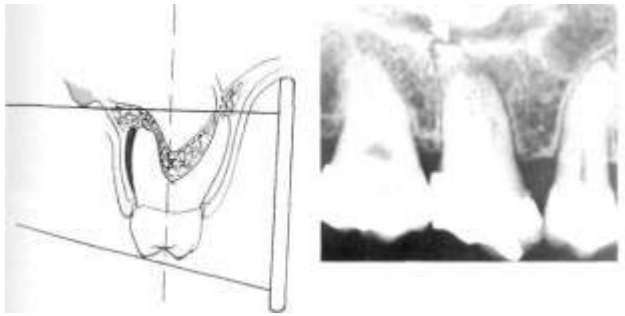
- The three-dimensional analyzing of the resulting two-dimensional image requires not only knowledge of normality and pathosis but also advanced knowledge of how the radiograph was exposed.
- By virtue of "casting a shadow" the anatomic features that are closest to the film (or sensor) will move the least when there is a change in the horizontal or vertical angulation of the radiation source.

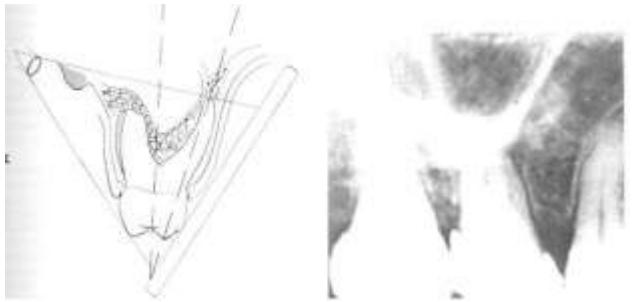


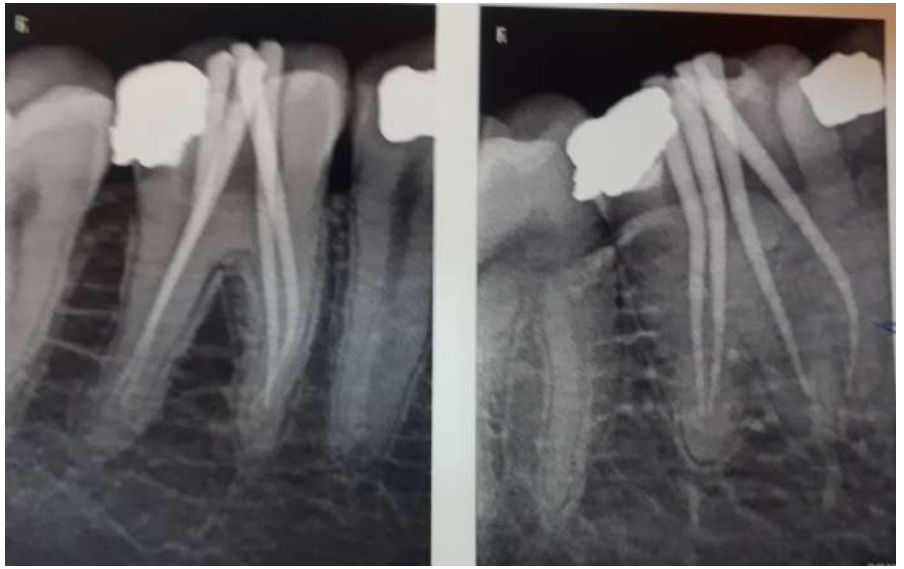
- Changes in the horizontal or vertical angulation may help elucidate valuable anatomic and pathlogic information; it also has the potential to hide important information.

- An incorrect vertical angulation may cause the buccal roots of a maxillary molar to be masked by the zygomatic arch .

- An incorrect horizontal angulation may cause roots to overlap with the roots of adjacent teeth, or it may incorrectly create the appearance of a one-rooted tooth, when two roots are actually present.

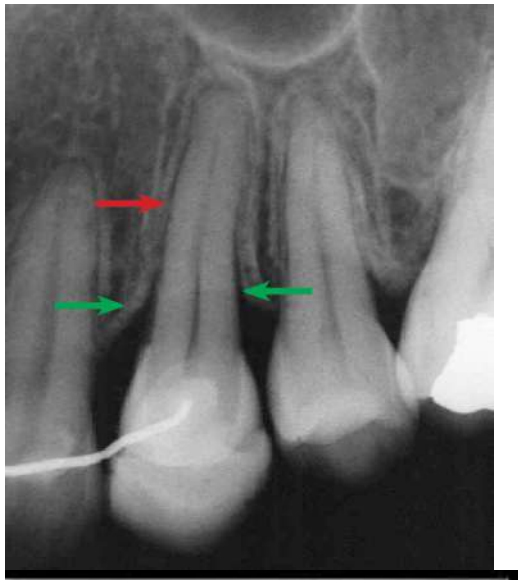






- In general ,when endodontic pathosis appears radiographically, it appears as bone loss in the area of the periapex.

- The pathosis may present merely as a widening or break in the lamina dura; the most consistent radiographic finding when a tooth is nonvital

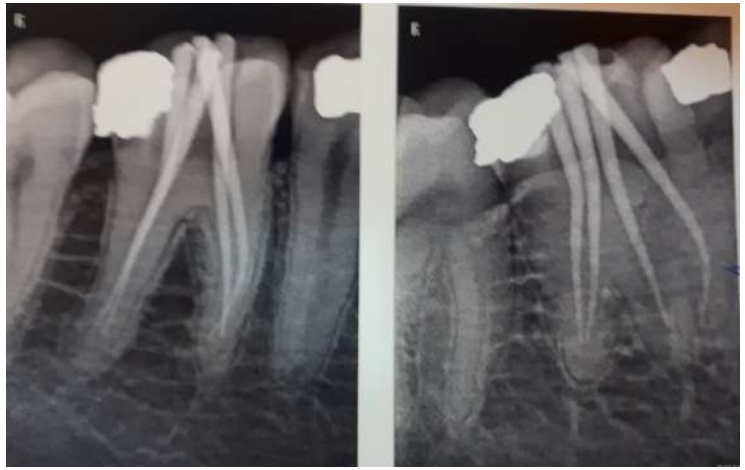


- Or it may present as a radiolucent area at the apex of the root or in the alveolar bone adjacent to the exit of a lateral or furcation accessory canal.

Two-dimensional dental radiography has two basic shortcomings :

1-The lack of early detection of pathosis in the cancellous bone ,because of the density of the cortical plates.

2- The influence of the superimposition of anatomic structures.



Many factors can influence the quality of the radiographic explantaion, including:

1. The ability of the person exposing the radiograph.
2. The skill with which the film is viewed.
3. The quality of the radiographic film.
4. The quality of the film processing.
5. The quality of the exposure source.

- Controlling all of these variables can be a difficult challenge but is paramount for obtaining an accurate radiographic interpretation.

Digital Radiography

- Digital radiography has been available since the late 1980s s and has recently been refined with better hardware and more user friendly software.

- Digital radiography uses no x-ray film and requires no chemical processing.
- Instead, a sensor is used to capture the image created by the radiation source.
- This sensor is either directly or wirelessly attached to a local computer, which interprets this signal and using specialized software, translates
- the signal into a two-dimensional digital image that can be displayed, enhanced, and analyzed.

- The image appears almost instantly, with no potential for image distortion from improper chemical processing .

- The clinician can magnify different areas on the radiograph and then digitally enhance the image in order to better visualize certain anatomic structures.

- In some cases the image can even be colorized, a useful tool for patient education.

- Digital sensors are much more sensitive to radiation than conventional x-ray film and thus require 50% to 90% less radiation in order to acquire an image, an important feature for generating greater patient acceptance of dental radiographs.

- The diagnostic quality of this expensive technology has been shown to be comparable to, but not necessarily superior to, perfectly exposed and perfectly processed conventional film-based radiography.

Cone-Beam Computerized Tomography

- Limitations in conventional two-dimensional radiography promulgated a need for three-dimensional imaging ,**known as cone-beam computerized tomography (CBCT)** also known as **cone-beam volumetric tomography [CBVT]** ; or as **cone-beam volumetric imaging [CBVI].**

- Most of these machines are similar to a dental panoramic radiographic device, whereby the patient stands or sits as a cone-shaped.

- Radiographic beam is directed to the target area with a reciprocating capturing sensor on the opposite side.
- The resulting information is digitally reconstructed and interpreted to create an interface whereby the clinician can three-dimensionally interpret "slices" of the patient's tissues in a multitude of planes.
- This is accomplished either in printed format or with portable and transferable software that can be used interactively by another clinician.

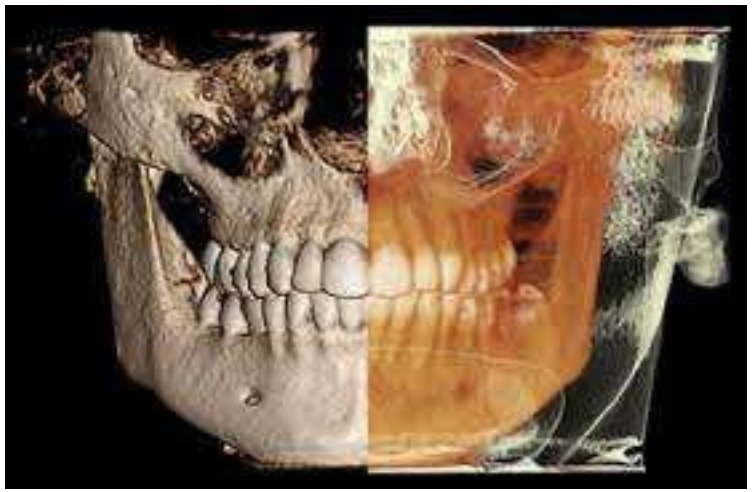
- **Compared with two-dimensional radiographs:**

1- CBCT can clearly visualize the interior of the cancellous bone without the superimposition of the cortical bone.

2- Studies show that CBCT is much more predictable and efficient in demonstrating anatomic landmarks , bone density ,bone loss , periapical lesions ,root fractures ,root perforations and root resorptions.

3- CBCT can **show great detail in many planes of vision but** can also leave out important details if the "slice" is not in the area of existing pathosis.

❖ **Cone-beam computerized tomography should not be seen as a replacement for conventional dental radiography, but rather as accessory diagnostic.**

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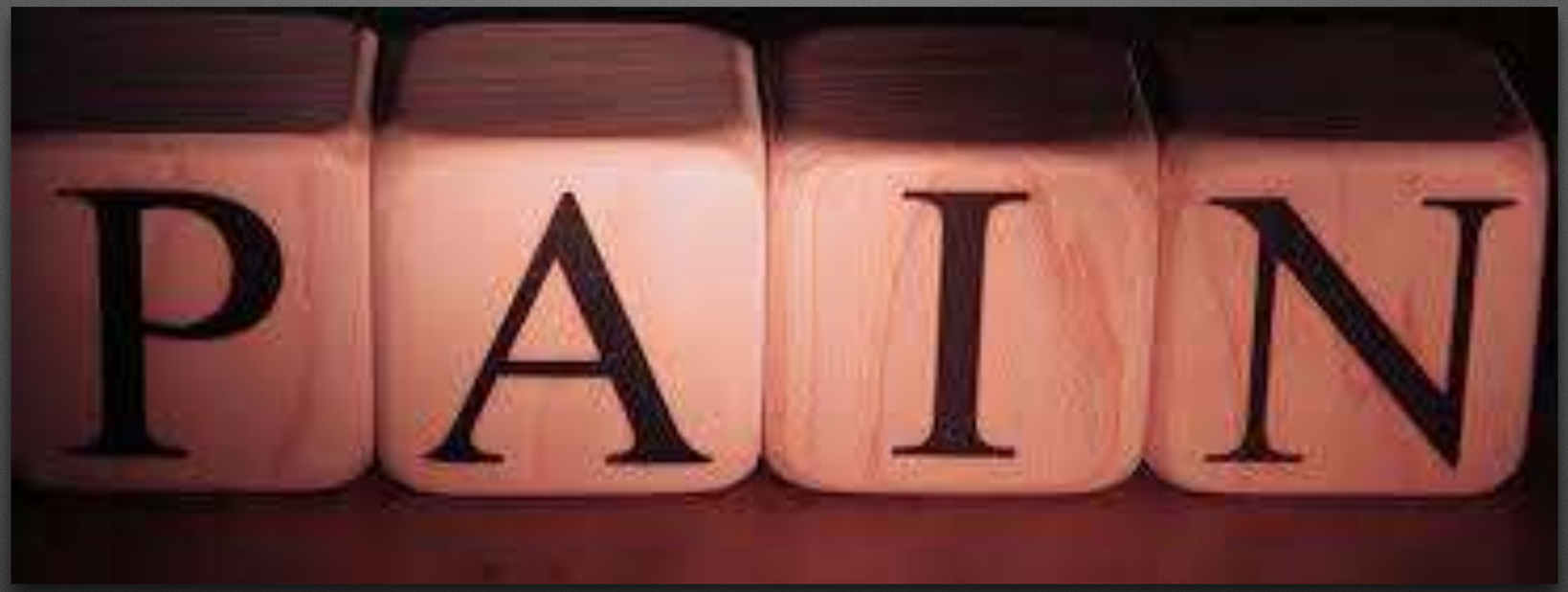

Pain Control in Endodontics

Dr.Ahmed Ibrahim Al-Jobory

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The pain reaction threshold (PRT) is defined as “that point at which a person will feel the pain”.

With endodontic therapy hyperresponse to stimulation is significantly increased.

Factors that lower the PRT include:

1. Presence of pain in the beginning of treatment.
2. Fatigue.
3. Fear and anxiety.

- By increase of pain sensation, blood level of catecholamine suddenly elevates with an increase in blood pressure and heart rate. This might induce fainting, angina pectoris, asthma and psychiatric reactions.
- To reduce the possibility of such conditions happening the anaesthesia has to be introduced slowly and in supine position.

Differential diagnosis of dental pain

Pain in the facial region may be of different origins as:

1. Dental: This type is due to reversible pulpitis, irreversible pulpitis and symptomatic apical infection.
2. Musculoskeletal: As temporomandibular joint disease.
3. Neuropathic: Pain may be due trigeminal neuralgia or herpes infection.
4. Inflammatory conditions: As migraine and sinusitis.
5. Systemic disorders: AS cardiac pain.
6. Psychogenic.

Dental pain

The "pain system" consists of:

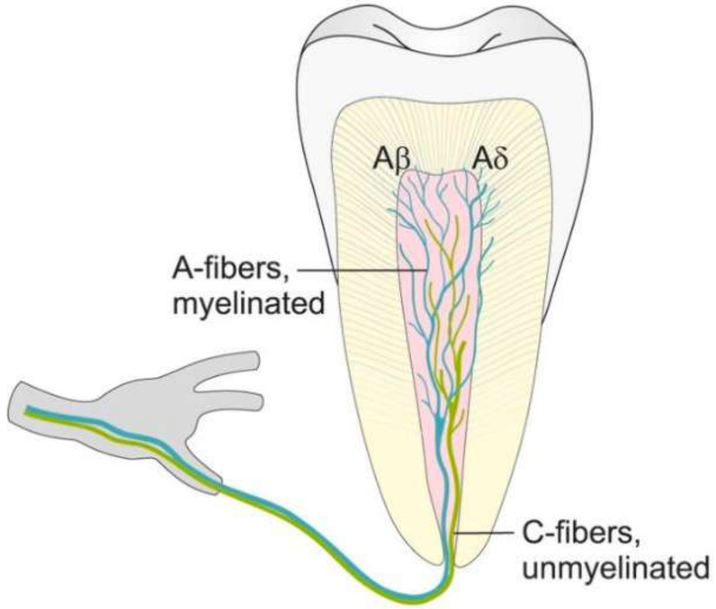
1-Nociceptors
2- Small diameter nerve fibers

A-delta (δ) fibers: Fast-conducting, sharp pain

C-fibers: Slow-conducting, dull throbbing pain

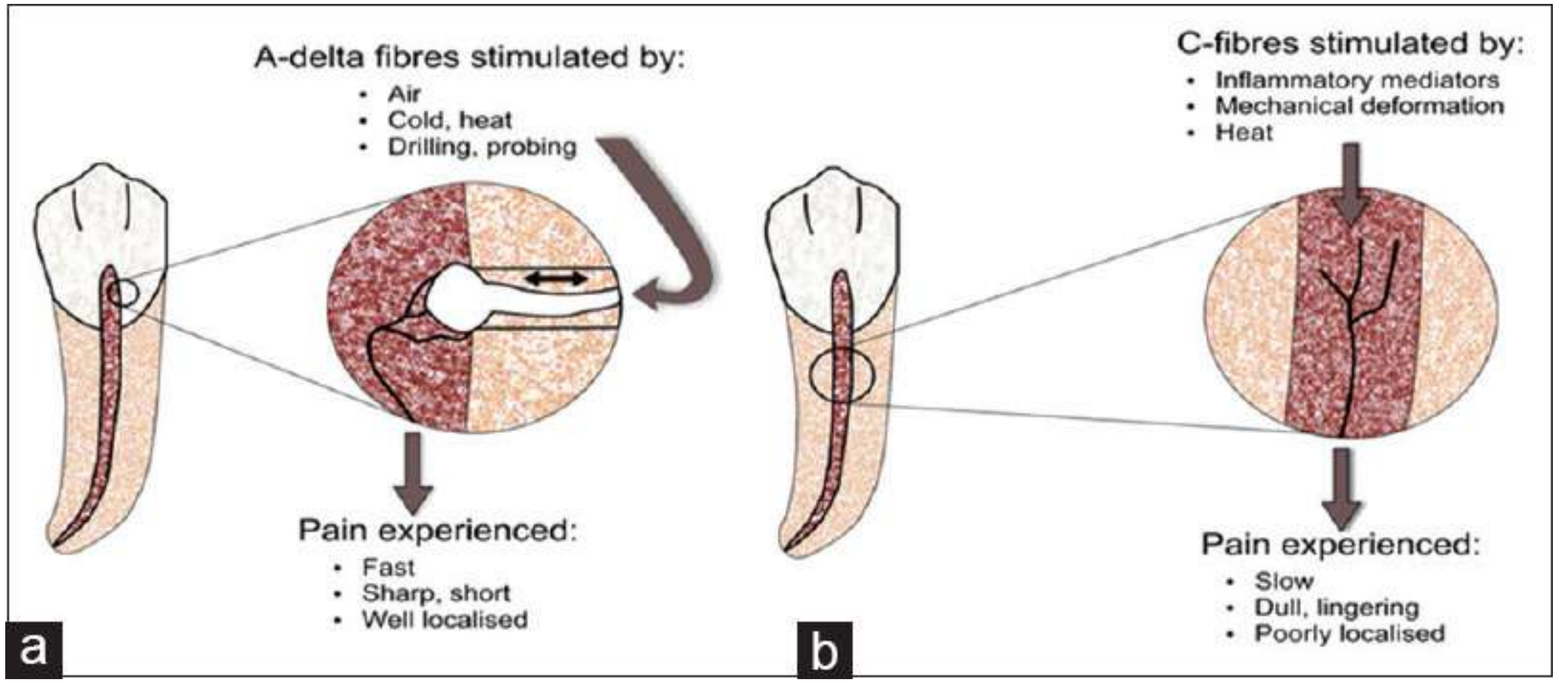
A-beta (ß) fibers: Not normally nociceptive but may be recruited due to central sensitization

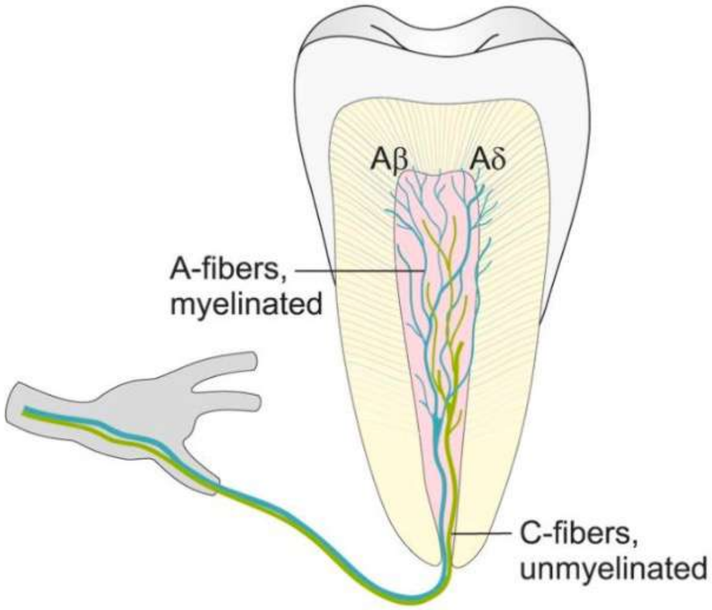
3-Tracts
4- Central processing areas



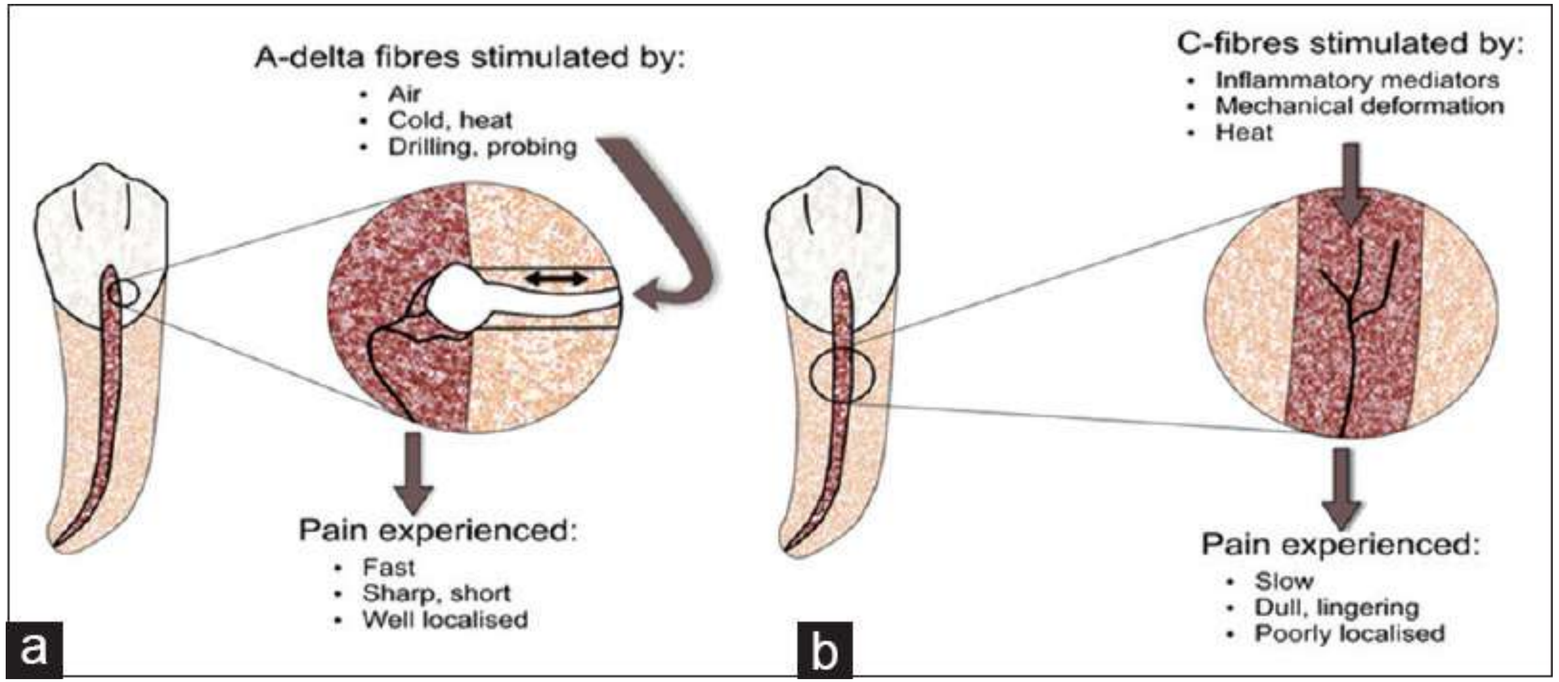
Type of Nerve Fibre	Information Carried	Myelin Sheath?	Diameter (micrometers)	Conduction Speed (m/s)
A-alpha	proprioception	myelinated	13 - 20	80 - 120
A-beta	touch	myelinated	6 - 12	35 – 90
A-delta	pain (mechanical and thermal)	myelinated	1 - 5	5 – 40
C	pain (mechanical, thermal, and chemical)	non-myelinated	0.2 - 1.5	0.5 - 2

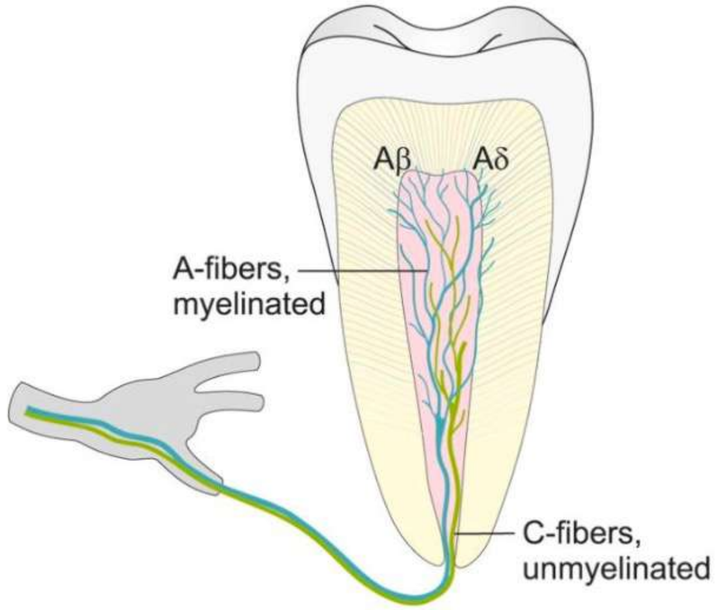
- A-fibres in the pulp are responsible for the sensitivity of dentine and thus for the mediation of the sharp pain induced by dentinal stimulation.
- Prepain sensations induced by electrical stimulation result from activation of the lowest threshold A-fibres some of which can be classified as A-beta-fibres according to their conduction velocities. Therefore in reversible pulpitis the A -fibres are sensitized.





- Intradental C-fibres are activated only if the external stimuli reach the pulp proper.
- Their activation may contribute to the dull pain induced by intense thermal stimulation of the tooth and to that associated with extensive pulpal inflammation.





Local Anesthesia

- It is “the temporary loss of sensation or pain in a certain part of the body produced by a topically applied or injected agent without depressing the level of consciousness”. Prevention of pain during dental procedures eliminates fear and anxiety.

- Knowledge of the anatomy prevents problems during anesthestic injection as muscle trismus, hematoma and intravascular injection.

There are 2 general types of local anesthetic chemical formulations:

1- Esters : as procaine, benzocaine.

2- Amides : as lidocaine, mepivicaine, prilocaine and articaine.

- Local anesthetics are vasodilators, absorbed in the circulation and have a systemic effect directly to the blood plasma level.

- Vasoconstrictors in the local anesthetic constrict the blood vessels to lower the absorption of the local absorption into the blood stream to prolong the anesthetic effect in the area and decreasing the possibility of toxicity. It may be used to stop bleeding by infiltration of few drops in the bleeding area.

- The condition of patients with hyperthyroidism, cardiovascular disease, diabetes and having drugs as tricyclic antidepressants and Monoamine Oxidase (MAO) inhibitors need a consultation with the physician before injection with a local anesthetic having vasoconstrictor.

- If the local anesthetic is injected in an infected area, its onset will be delayed.
- The inflammatory process in an area of infection lowers the pH of the extracellular tissue from its normal value 7.2-6.9 to 5-6 or lower.
- This low pH inhibits anesthetic action because little of the free base form of the anesthetic is allowed to cross into the nerve sheath to prevent conduction of nerve impulses.
- Inserting a needle into an active site of infection may spread the infection.

Topical Anesthesia

- It is effective to minimize surface discomfort of injection of the needle (2-3 mm in depth).

- This anesthetic is composed of benzocaine (up to 20%) of lidocaine as solution or ointment (5%) or spray (up to 10%).

Techniques for mandibular anesthesia

1- Inferior alveolar nerve block.

The site of deposition is near the mandibular foramen before the entry of the inferior alveolar nerve. It anesthetizes the mandibular teeth with the buccal and lingual soft tissues.

2- The Gow-Gates mandibular nerve block.

The site is the lateral aspect of the neck of the mandible condyle. It is a V3 nerve block anesthetizing all the mandibular teeth in the region with the buccal and lingual soft tissues. It provides sensory anesthesia of the buccal and mylohyoid nerve.

3- The Akinosi-Vazirani nerve block.

The site is the height of the mucogingival junction of the maxillary third molar near the maxillary tuberosity, This is used where there is limited mouth opening.

4- The Incisive nerve block.

The site is buccaly between the mandibular two premolars. It provides anesthesia to the premolars and anterior teeth in the region.

Techniques for maxillary anesthesia

1-The posterior superior alveolar nerve block.

The site is in buccal fold of the maxillary 2nd molar. It anesthetizes the maxillary molars and buceal soft tissues.

2-The middle superior alveolar nerve block.

It anesthetizes the maxillary premolars with occasional overlap to the canine and first molar. Approach:While retracting the lip, insert the needle into the intersection of the mucobuccal fold and the apex/center of the canine at a 45-degree angle, advancing the needle approximately 1-1.5 cm., slowly inject 2 mL of local anesthetic and massage for 10-20 seconds.

3-The anterior superior alveolar nerve block.

The site is the buccal fold of the first maxillary premolar and aimed at the infraorbital foramen. The areas anesthetized are the anterior teeth and premolars with overlying soft tissues.

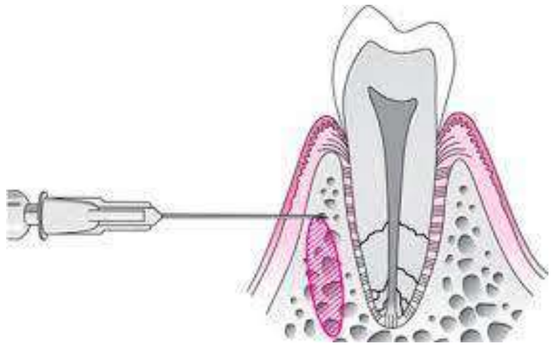
Supplemental injection techniques

1- Periodontal ligament (PDL) injection.

This technique is used when no other technique can be used. The needle is inserted between the tooth and PDL with bevel of needle toward the root. Anesthetic solution of 0.2 ml is placed per root. Onset of anesthesia is immediate but duration is variable.

2- Intraosseous anesthes.

Local anesthetic (LA) is directed into the bone surrounding the root, a small perforation is made in the cortical plate of bone with a small bur and the needle is inserted to introduce the LA.



3- Intrapulpal anesthesia.

When full anesthesia is not gained by other techniques, intrapulpal approach is used. The needle is inserted directly in the pulp and LA introduced with force. Onset is immediate.

Dental and referred pain

- Most of oral and dental pain can be traced to its source.
- There are cases whereby pain might be experience away from its source as the same side but other jaw, ears, eyes and sinus.
- Careful diagnosis reveals the affected tooth or related anatomic structure (in non dental pain).

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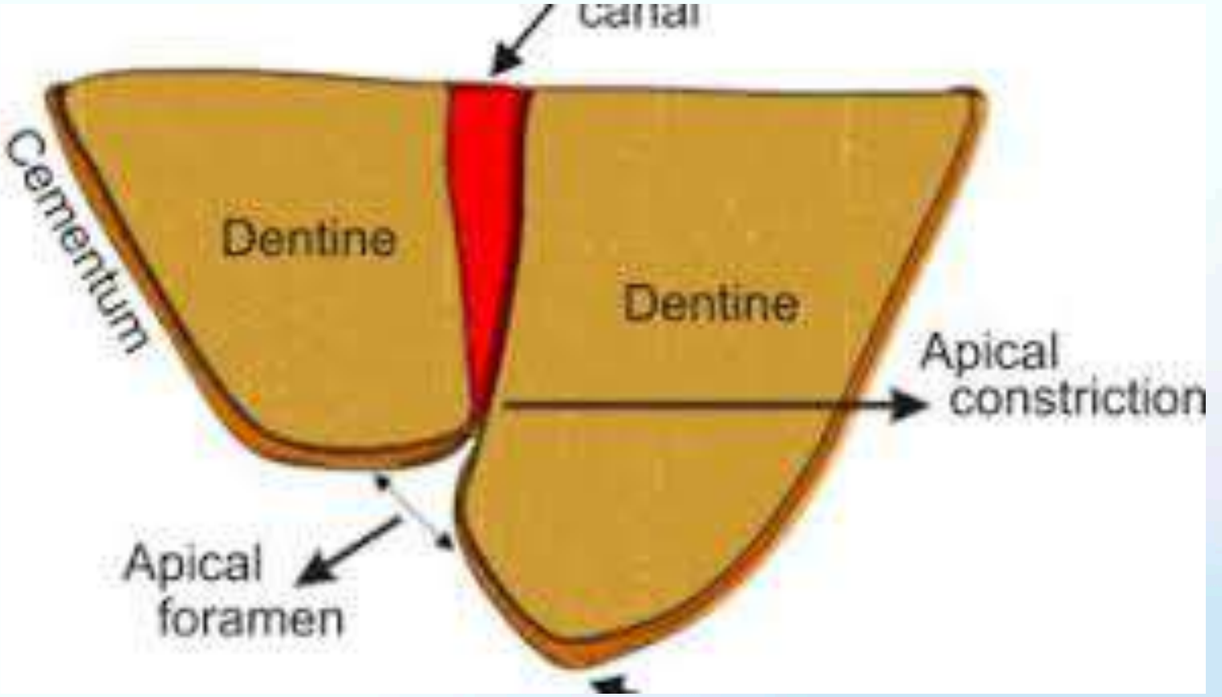
Determining the working length



Dr.Ahmed Al-Jobory

- **The determination of an accurate working length is one of the most critical steps of Endodontic therapy.**

- **The cleaning, shaping and obturation of the root canal system cannot be accomplished accurately unless the working length is determined precisely.**

Exploration for the canal orifice

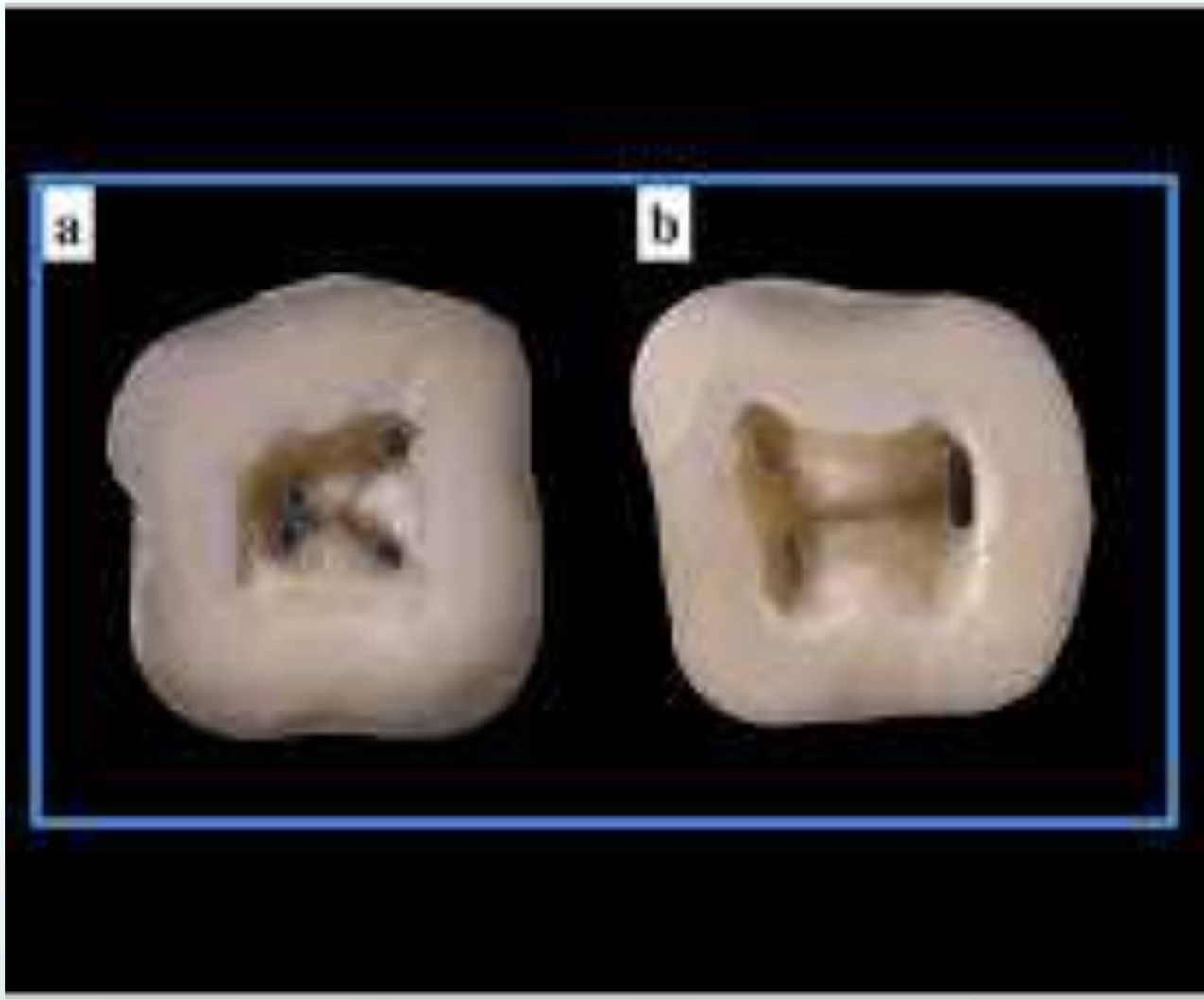
- Before the canals can be entered, their orifices must be found.

- In older patients, finding a canal orifice may be more difficult to find.

- The endodontic explorer is used to find the canal orifice and exploring the walls of the pulp chamber.

- When the orifices are found, a small size instrument as file size 10-15 is used to ensure canal patency.

- The pulp should be removed by a barbed broach which should enter to the canal without bending nor engagement with the canal walls.



Working length: - It is the distance from a coronal reference point to the point of which canal preparation and obturation should terminate which is called the apical stop.

1- **Apical constriction:-** It is the apical portion of the root canal having the narrowest diameter.

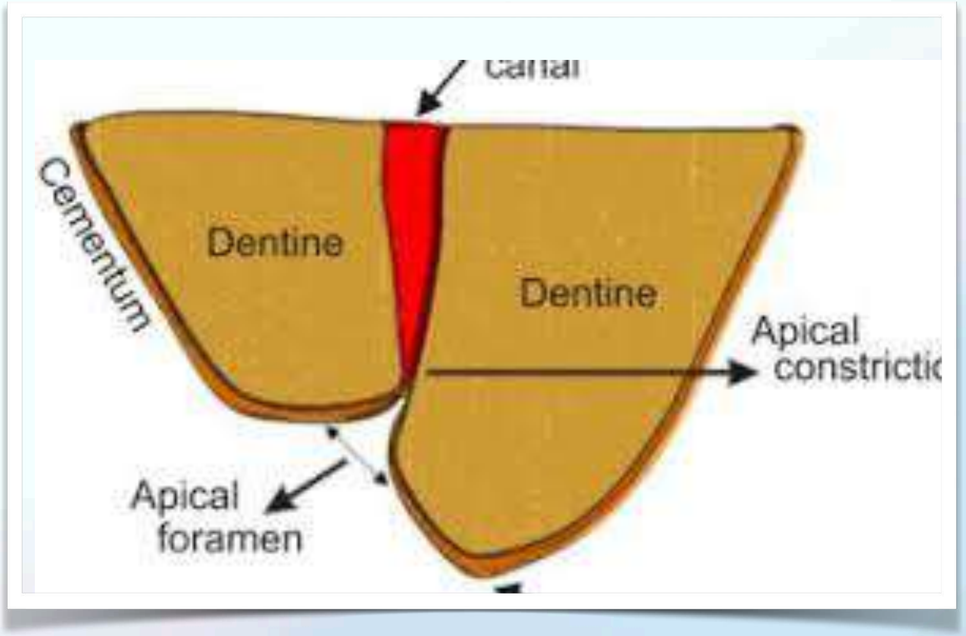
This position may vary but is usually 0.5 to 1.0 mm short of the center of the apical foramen.

2- **Apical foramen**: **-** It is the main apical opening of the root canal. The foramen is generally not in the center and may even be situated on the lateral side of the root.

3- **Radiographic apex**: - It is the end of the root determined radiographically.

4- **Anatomic apex: -** It is the end of the root determined anatomically,

5- **Cementodentinal junction:-** It is the area where the dentin and cementum are joined, the point of which the cemental surface terminates at or near the apex of the tooth.



Methods

Of determining working length

1-Radiographic Method.

2- Electric devices

Radiographic Methods

The following items are essential to perform this procedure:-

1) Undistorted preoperative radiographs showing the total length and surrounding structures.

2) Adequate coronal access to all canals.

3) Endodontic millimeter ruler.

4) Knowledge of the average length of all teeth.

5) A definite reference point.

Reference point:- It is the site on the occlusal or incisal surface from which measurement of the working length is made.

- This point is used throughout canal preparation and obturation.
- This should be a stable area that will not change during the course of treatment.

To establish the length of the tooth:

- a stainless steel reamer or file with an instrument stop on the shaft is needed.
- The exploring instrument size must be small enough to negotiate the total length of the canal but large enough not to be loose in the canal.

Method:-

1- Measure the tooth on the preoperative radiograph (initial measurement).
2- Place the file inside the canal to a length 1 mm less than the length from the preoperative radiograph
3- Adjust the rubber stopper on the reference point.
4- Take the x-ray by the bisecting angle or parallel techniques.
5- On the radiograph, measure the difference between the end of the instrument and the end of the root and adjust the working length accordingly.
6- From this adjusted length of tooth, subtract a 1.0 mm to calculate subjectively the position of the apical constriction.
7- If there is external root resorption there may be destruction of the apical anatomy therefore the length of the root canal should be shortened 2 mm.
8- Set the endodontic ruler at this new corrected length which will be the lenbth used during root canal treatment.

Significance of working length

- The working length determines the length of the tooth having the pulpal tissue.
- Endodontic treatment should be confined to this area.

Failure to accurately determine & maintain working length leads to:

A- Length too long can lead to:

1. Perforation through apical constriction.
2. Overfilling or over instrumentation.
3. Increased incidence of post operative pain.
4. Prolonged healing period.
5. Lower success rate.

B- Short working length can lead to:

1. Incomplete cleaning.
2. Underfilling.
3. Persistent discomfort.
4. Incomplete apical seal.
5. Lower success rate.

Electronic Methods

☑ The electronic principle is relatively simple and is based on **electrical resistance (R)** to determine canal length.

☑ How do apex locators work?

- The apical constriction has a specific electronic characteristic which is a resistance of 650 ohms.
- This finding was used to develop the first generation electronic apex locators.
- Based on Ohm's law (V = R x I), these devices are generators that deliver a direct current of a known **voltage (V)**, and include an ammeter that measures the **intensity (I)** of the current after its passage through the file and being recaptured by the labial hook.
- An electronic component calculates the ratio V/I and deducts the resistance at the level of the canal where the instrument is located. When the resistance is 650 ohms, the screen displays a '0' and the clinician then estimates that the tip of his instrument is at the apical constriction.
- The principle is based on the electrical resistance of different tissues.
- When the circuit is complete, resistance decreases and current begins to flow.
- Old types were affected by the presence of saliva, blood inside the canal while recent types are not affected by them and work efficiently in their presence.

Uses of apex locators:

1-They are useful in conditions where apical portion of canal system is obstructed by:

a-impacted teeth,

b-zygomatic arch,

c-excessive bone density,

d-tori,

e-overlapping roots,

f-shallow palatal vault.

In such cases, they can provide information which radiographs cannot.

2-They are useful in patient who cannot tolerate X-ray film placement because of gag reflex.

3-In case of pregnant patients, to reduce the radiation exposure, they can be valuable tool.

4-They can also be used in children who may not tolerate taking radiographs, disabled patients and patients who are heavily sedated.

5-They are helpful in root canal treatment of teeth with incomplete root formation, requiring apexification and to determine working length in primary tooth.

Contraindications:-

1. The use of apex locators are contraindicated for patients who have cardiac pacemakers.
2. Electrical stimulation to the pacemaker patient can interfere with pacemaker function.

- They are simple to use, but several precautions must be taken to ensure accuracy and reproducibility.

⍰ Remove any metallic parts from the crown of the tooth (amalgam, crown, etc) that could affect the flow of the current.
⍰ Initially, estimate the root length of the tooth by using the preoperative x-ray.
⍰ Prepare the access cavity, locate the canal openings, and clear the content from the pulp chamber.
⍰ Place the lip hook under the rubber dam, making sure the mucous membrane is damp.
⍰ Clip the second electrode of the locator on the hand instrument. Start the device.
⍰ Place the file in the canal and slowly advance toward the apex, using alternating 1/4 turns (watch winding motion).
⍰ Stop advancing when the locator displays ‘0’.
⍰ Check and confirm the measurement three times.
⍰ Confirm the working length during the procedure using digital or conventional radiography.

Generations of Apex Locators

First Generation.

- The first generation apex locators use resistance method for measuring the WL.
- The first apex locator was developed in 1969.
- When compared with radiographs, these devices were found to be unreliable.
- Patients also experienced pain due to high current machine.
- Presence of strong electrolytes such as endodontic irrigants, haemorrhage, pus or pulp tissue led to inaccurate results.

Second Generation

- Impedance (is the TOTAL resistance as seen by AC) was utilized instead of resistance.
- In 1971, an apex locator was developed which needed to be calibrated at the periodontal pocket of each tooth.
- Inaccurate readings were gained when electrolytes were present in the canals and even when the canals were dry.

Third Generation

- Multiple frequencies were used to measure the WL in the canals.
- The apex locators can measure WL of the canal even with the presence of electrolytes and have 90-100% accuracy.

Fourth Generation

- Similar to the third generation units, the apex locators use two separate frequencies 400 Hz and 8 kHz.
- The limitations of these apex locators are that they need to be performed in partially dried canals and in heavy exudates or blood where it becomes inapplicable.

Fifth Generation

- Fifth generation apex locators work on the basis of the comparisons of the data taken from the electrical characteristics of the canal and additional mathematical processing.
- These devices perform extremely well in the presence of blood and exudate but in dry canals they experience considerable problems.
- Hence, additional liquids inserted in the canals become necessary.

Sixth Generation

- Sixth generation adaptive type apex locator has been developed which combines the advantages of the fifth and fourth generation appliances.
- Measurement using the adaptive apex locator eliminates the necessity of drying or moistening of the canal, while also achieving high degree of measurement precision in the presence of blood, sodium hypochlorite or while manipulating dry canals.

MORITA

WOODPECKER

Thank you

Dr.Ahmed Al-Jobory

Intercanal instruments

Dr.Ahmed Al-Jobory
2022-2023

PART 1

Instruments play a very important role in the success of a root canal treatment therefore a basic knowledge of endodontic instruments is essential.

Classification of Endodontic instruments

According to Grossman

EXPLORING INSTRUMENTS:	DEBRIDING INSTRUMENTS:	CLEANING AND SHAPING INSTRUMENTS:	OBTURATING INSTRUMENTS:
to locate the canal orifice and determine patency of the root canal. E.g. endodontic explorers, smooth broaches (pathfinders).	to extirpate the pulp and remove any foreign debris. E.g. barbed broach.	to clean and shape the root canal laterally and apically e.g. reamers and files.	to cement and pack gutta-percha into the root. E.g. spreaders, pluggers and lentulospirals.

According to ISO – FDI (Based on use)

Group I: Hand Use only *eg. K-Files, H-Files*

Group II: Engine driven latch type *eg. Gates Glidden Drills, Peso reamers*

Group III: Engine driven Ni-Ti Rotary Instruments *eg. Profile, Protaper*

Group IV: Engine driven 3-D Adjusting Instuments *eg Self Adjusting File System*

Group V: Engine driven reciprocating Instruments *eg. WaveOne*

Group VI: Sonic and UltraSonic Instruments

They are divided into six groups:

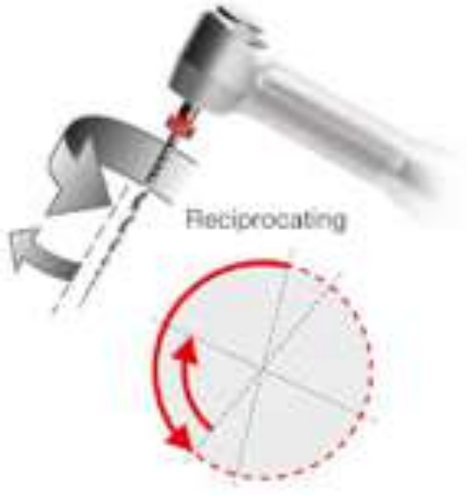
Group I

Group II

Group III

Group IV

Group V



Group VI

STANDARDIZATION OF ENDODONTIC INSTRUMENTS

Ingle's Original Recommendation

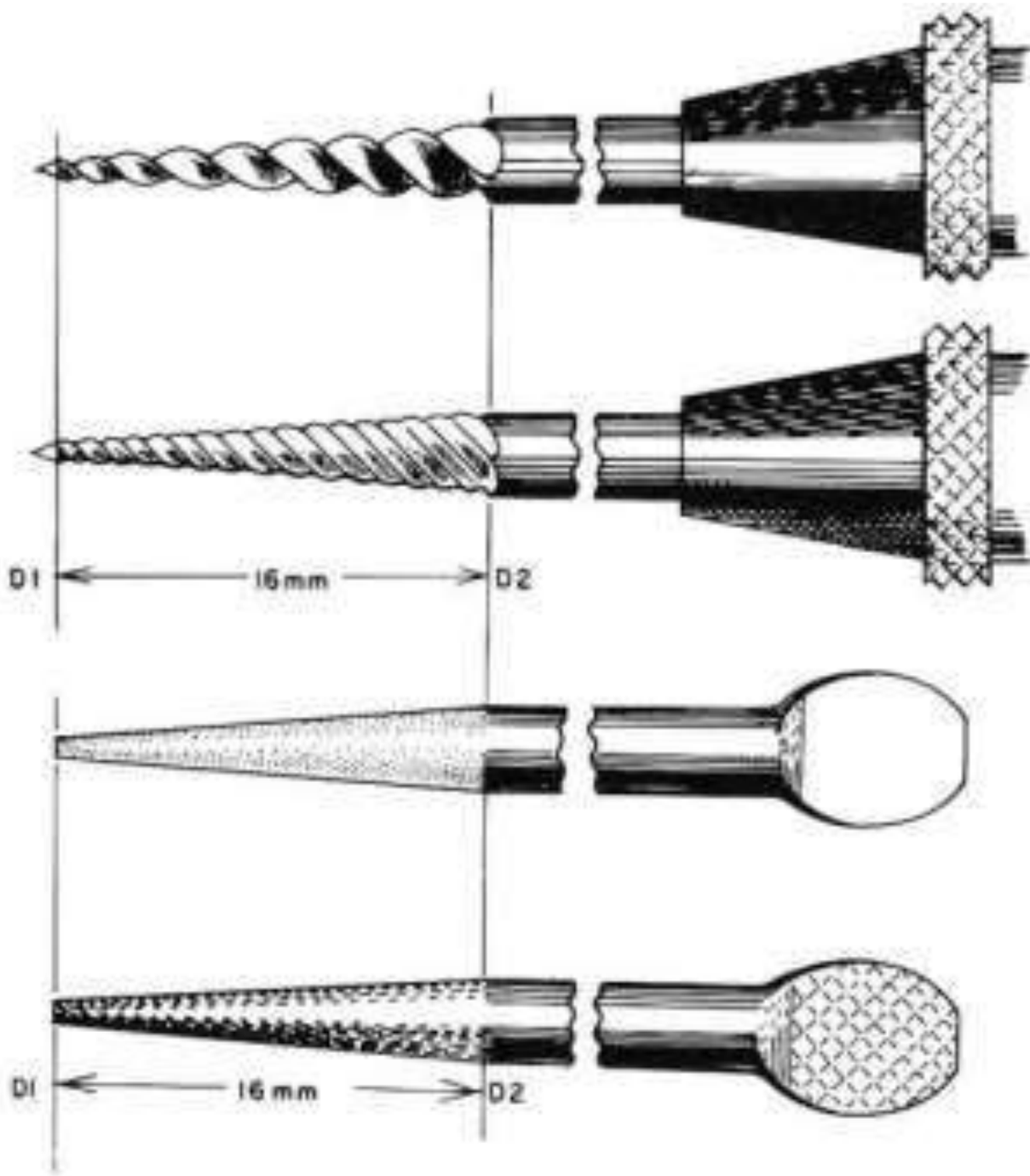
- **Cutting blades 16 mm in length .**

- **2 % Taper.**

- **The diameter of the instrument at tip (D1) is determined by size in hundredths of millimetres.**

- **Diameter 2 (D2) will be the taper of file greater than D1.**

- **Length- 21, 25, 31 mm.**



ISO-COLOR CODING

- With the exception of Pink, Gray and Purple, all the colors are repeated every six instruments.

#06	PINK ONLY AVAILABLE IN #06	
#08	GRAY ONLY AVAILBLE IN #08	
#10	PURPLE ONLY AVAILBLE IN #10	
#15	#45	#90
#20	#50	#100
#25	#55	#110
#30	#60	#120
#35	#70	#130
#40	#80	#140

DESIGN OF ENDODONTIC INSTRUMENTS

Components of file

1. TAPER
2. CORE
3. FLUTE
4. CUTTING EDGE
5. LAND
6. HELIX ANGLE
7. PITCH
8. RAKE ANGLE
9. CUTTING ANGLE
10. TIP DESIGN

Components of file

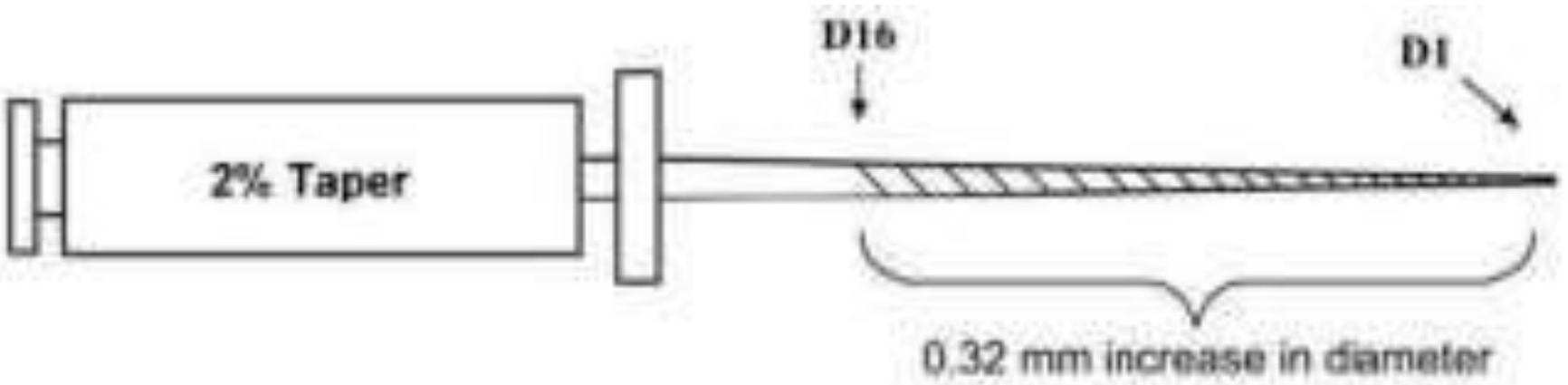
TAPER

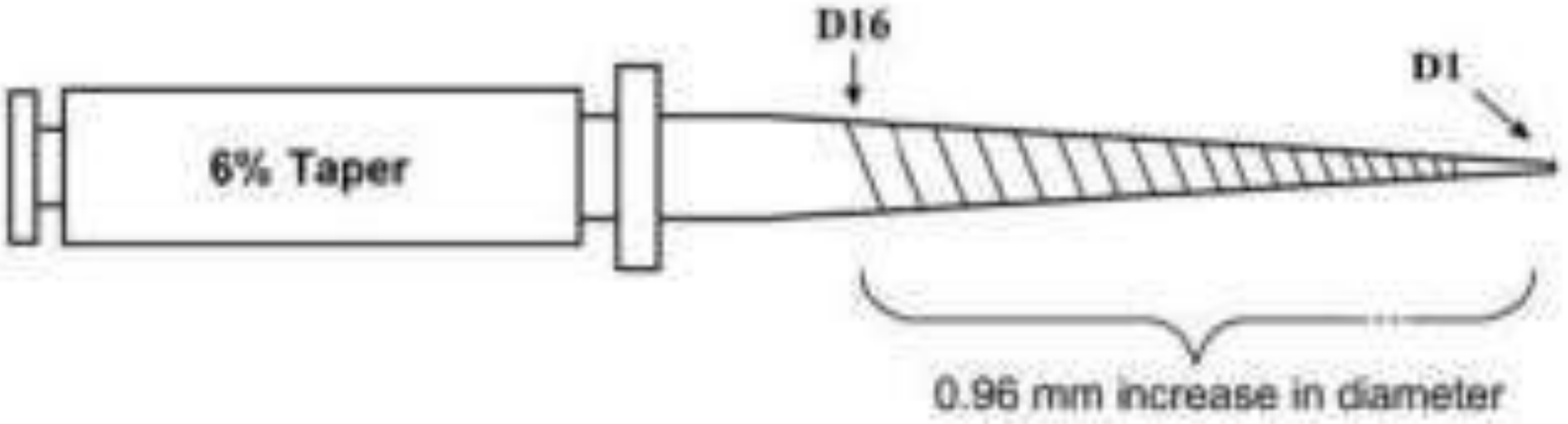
Eiffel Tower

Components of file

TAPER

- It is expressed as the amount of file diameter increases each millimetre along its working surface from the tip towards the file handle.

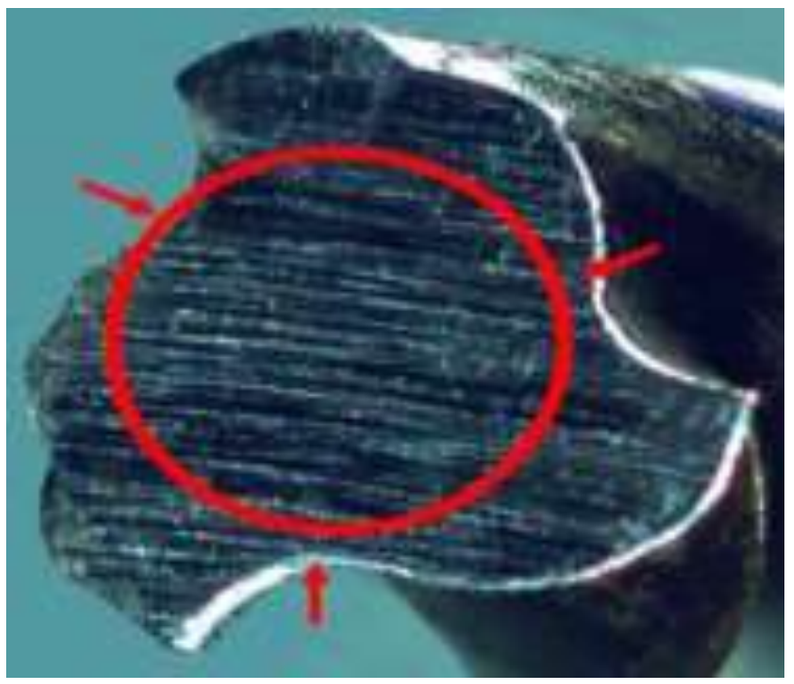




Components of file

CORE

- It is the cylindrical centre part of the file having its circumference outlined and bordered by the depth of the flutes.

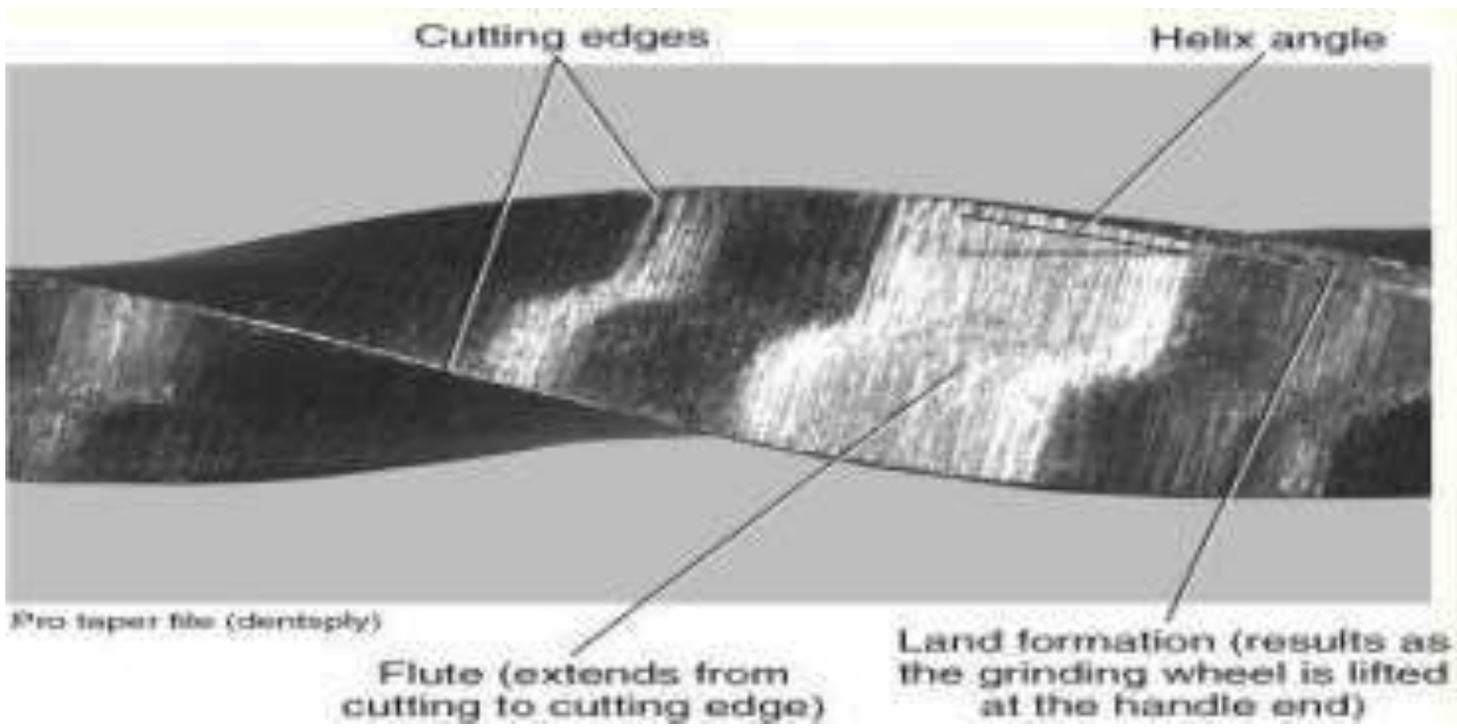


Components of file

FLUTE

- It is the **groove** in the working surface used to collect soft tissue and dentin chips removed from the walls of the canal.
- The effectiveness of the flute depends on its:

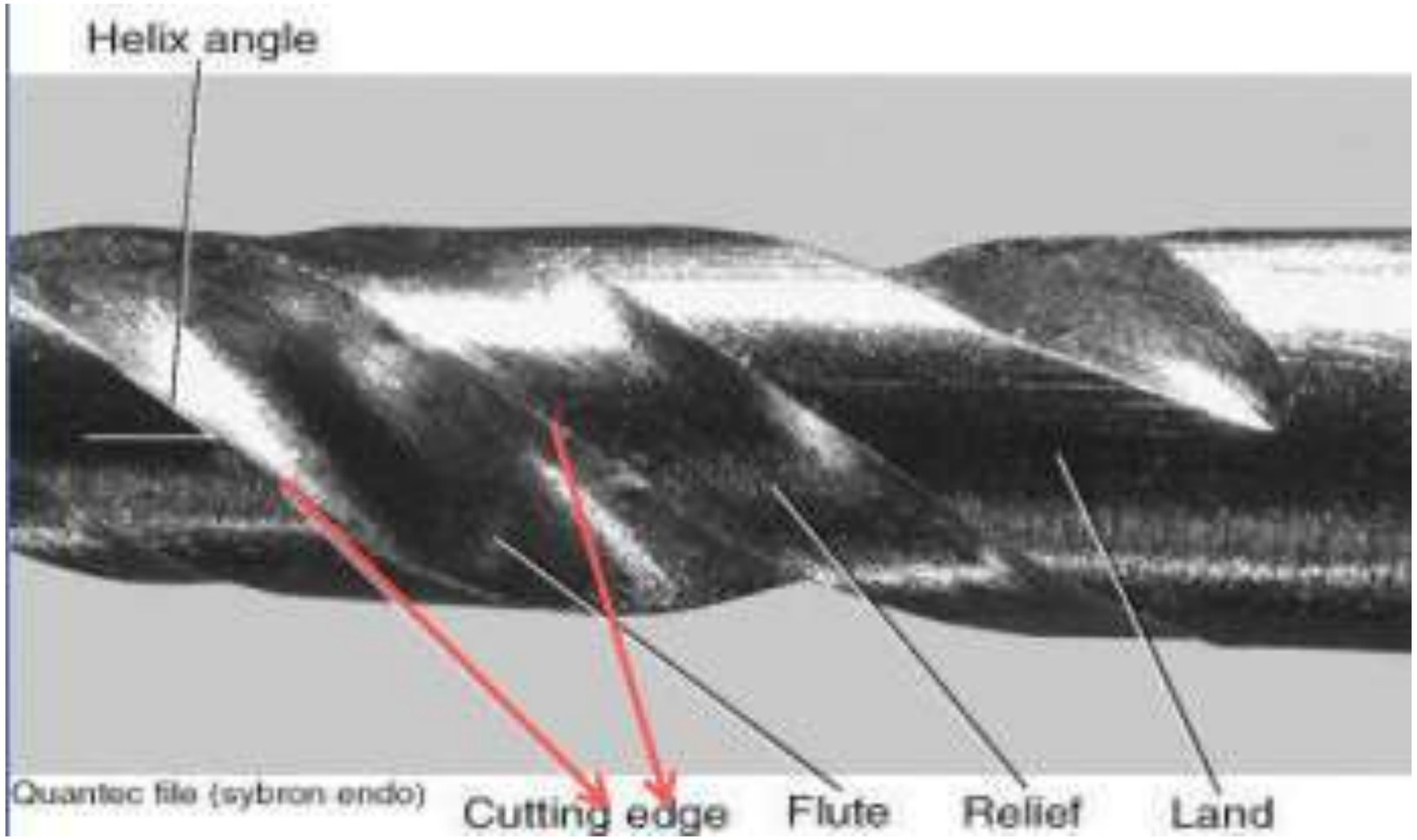
1- Depth.
2- Width.
3- Configuration.
4- Finishing of surface.



Components of file

CUTTING EDGE

- The surface with the **greatest diameter** that follows the groove (where the flute and land intersect) as it rotates, forms the *leading (cutting) edge, or the blade of the file*.



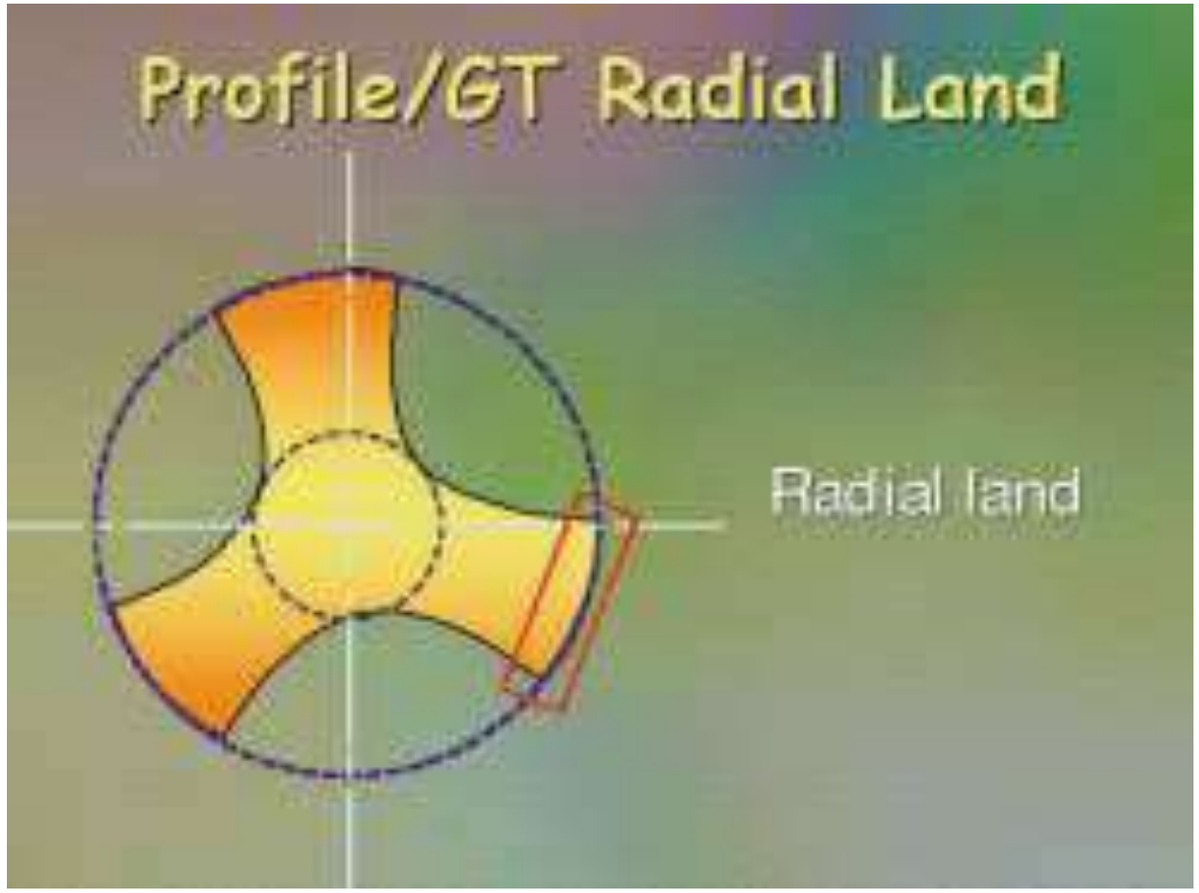
Components of file

LAND/MARGINAL WIDTH

- The surface that projects axially from the central axis as far as the cutting edge between the flutes

Function:

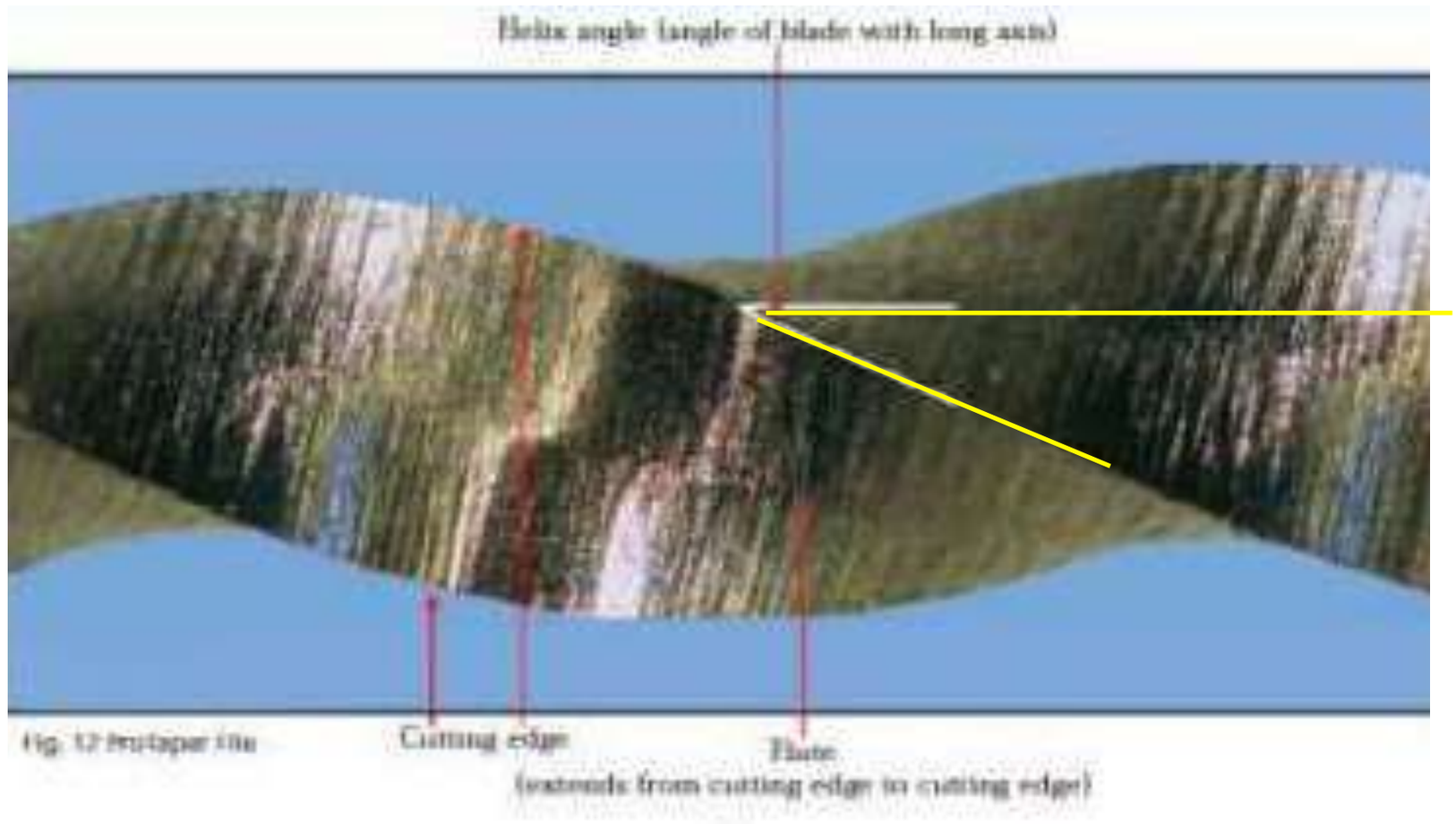
1. **Prevents “screwing in” of the file**
2. **Supports the cutting edge**
3. **Limits the depth of cut**
4. **Reduces the propagation of micro-cracks on its circumference.**
5. **Maintains the file in the centre of root canal.**



Components of file

HELIX ANGLE

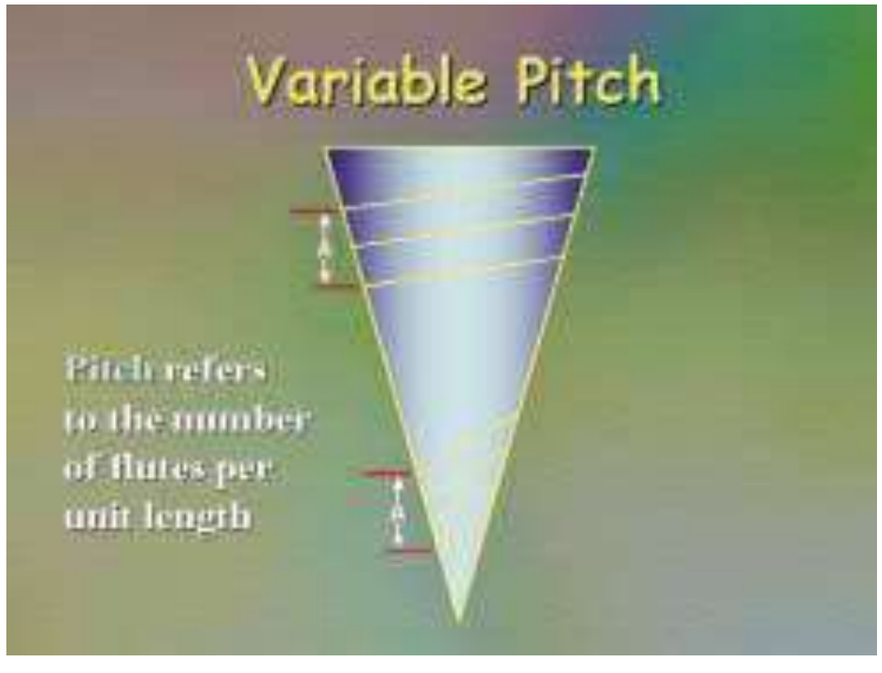
- The angle formed by the cutting edge with the long axis of the file.
- Helps in removing debris collected in the flute from the canal.



Components of file

PITCH

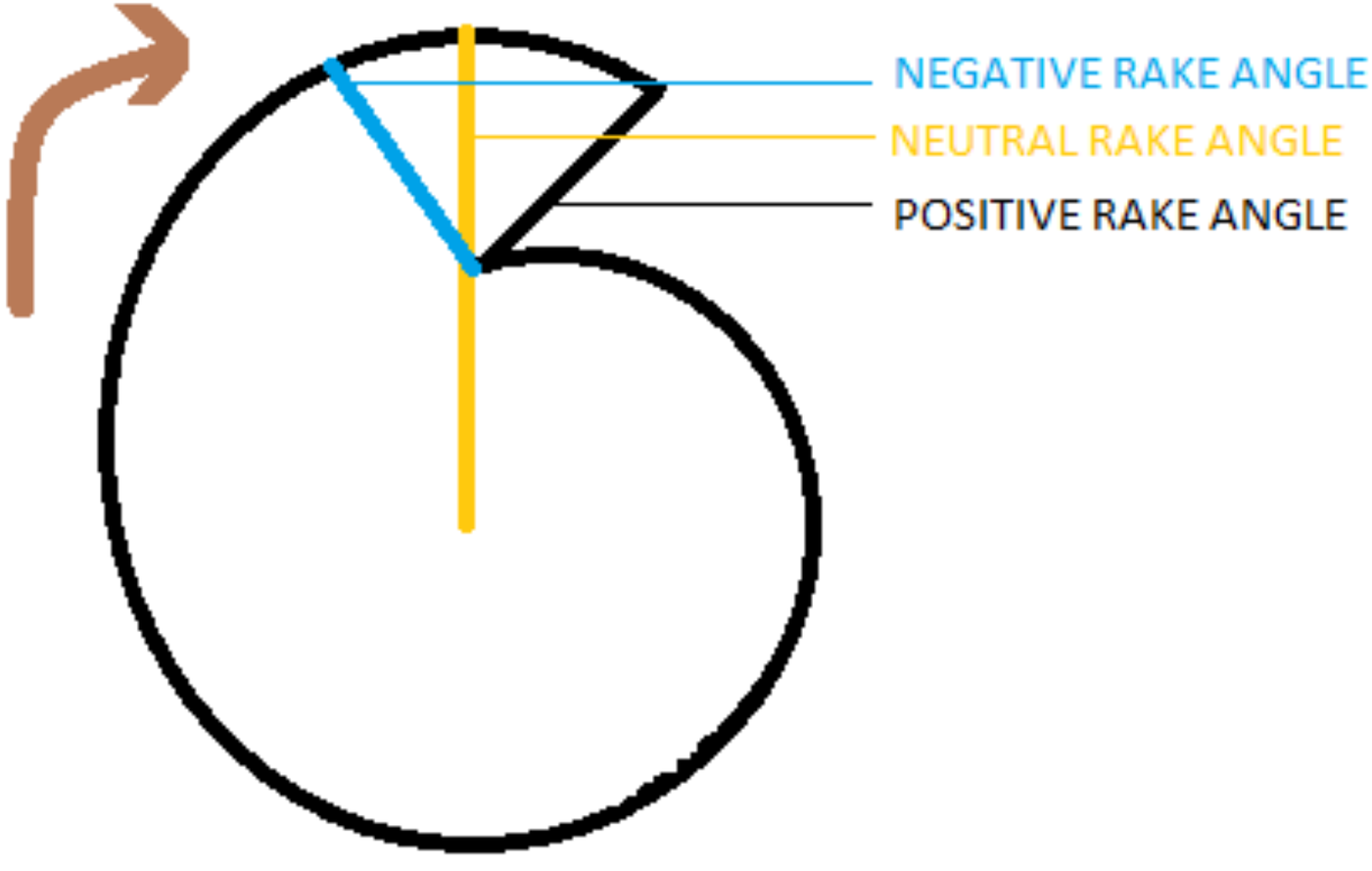
- Is the distance between a point on the leading edge and the corresponding point on the adjacent leading edge.
- The smaller the pitch or the shorter the distance between corresponding points, the more spirals the file has and the greater the helix angle.



Components of file

RAKE ANGLE

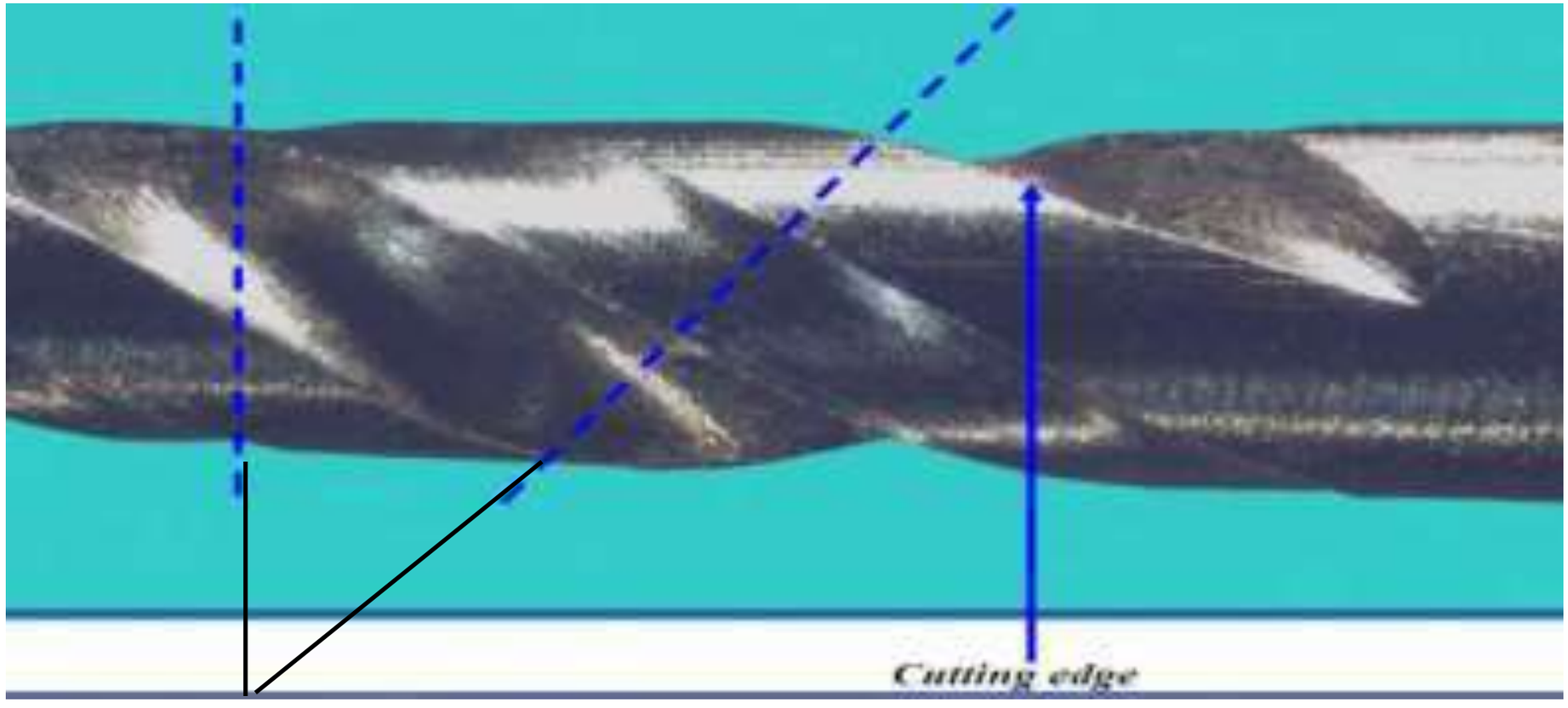
- The angle formed by the leading edge and the radius of the file when the file is sectioned perpendicular to its long axis.



Components of file

CUTTING ANGLE

- The cutting angle or effective rake angle is a better indication of the cutting ability of a file and is obtained by measuring the angle formed by the cutting (leading) edge and the radius when the file is sectioned perpendicular to its cutting edge.



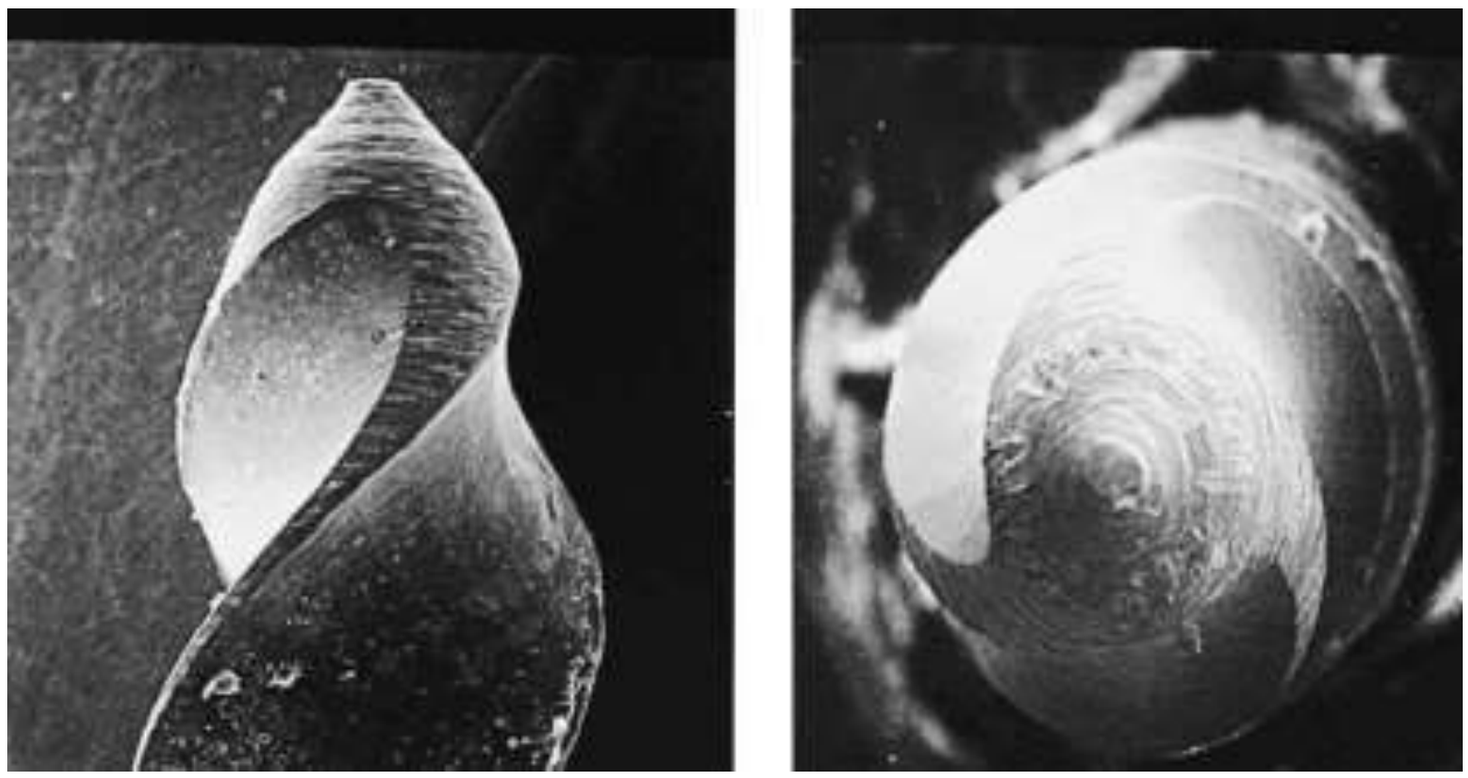
Components of file

TIP DESIGN

- It can affect file control, efficiency, and outcome in the shaping of root canal systems.
- The tip of the original K-file resembled a **pyramid.**
- Instrument tips have been described as cutting, non-cutting, and partially cutting, although no clear distinction exists among the three types

Components of file

- ***Powell et al*** pointed out that when this tip **“angle”** is reduced, the file stays centre within the original canal and cuts all sides (circumference) more evenly.
- This modified-tip file has been marketed as the **Flex-R-file**




Thank You!

Intercanal instruments

Dr.Ahmed Al-Jobory
2022-2023

PART 2

ENDODONTIC INSTRUMENTS (GROUPS)

GROUP 1: MANUALLY-OPERATED INSTRUMENTS

Barbed Broaches

- They were the earliest endodontic instruments used to extirpate the pulp.
- They are manufactured by hacking a round, tapered wire with a blade to form sharp projecting barbs that cut or snag tissue.
- A barbed broach does not cut or machine dentin; this instrument is mostly used to engage and remove soft tissue from the canal.
- It is an excellent tool for removing cotton or paper points that have accidentally become lodged in the root canal.

K-type instruments

- The K-file and K-reamer are the oldest useful instruments for cutting and machining dentin.
- They are made from a stainless-steel wire that is ground to a tapered square or triangular cross-section and then twisted to create either a file or a reamer.
- A file has more flutes per length until than a reamer, K-type instruments are useful for penetrating and enlarging root canals.
- The instrument works primarily by compression-and-release destruction of the dentin surrounding the canal.
- Generally, a reaming motion (constant file rotation) causes less transportation than a filing motion.
- Transportation is the excessive loss of dentin from the outer wall of a curved canal in the apical segment.
- As the instrument is increased in width its flexibility is decreased.

K-flex file

- It has a cross-section that is **rhomboid** in shape.
- It is a twisted instrument and has a series of cutting flutes.
- It has 2 acute edges and 2 obtuse edges.
- The acute angle cuts into the dentin while the obtuse angle provides more area for debris collection and removal.
- The cutting efficiency and flexibility are greater than the K-type file.

Flex-O-File

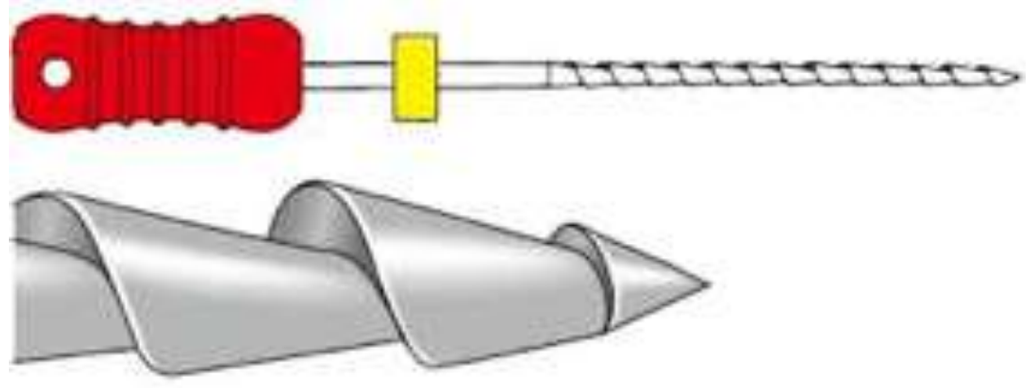
- This instrument resembles the K-type file but it is **triangular** in cross-section.
- These files are :
- Better cutting action.
- More room for the debris.
- Better flexibility.
- More resistance to fracture.
- The tip of the instrument is non cutting so no apical ledge formation is possible.

Flex-R-file

- The design of the tip of this instrument eliminates the possibility of ledge formation by removing the cutting surface of the tip's leading edge.
- This guides the instrument in the canal rather than cut.
- It has a **triangular** cross-section which increases its flexibility.
- It cuts more efficiently in anti-clockwise motion and can be used for filing action.

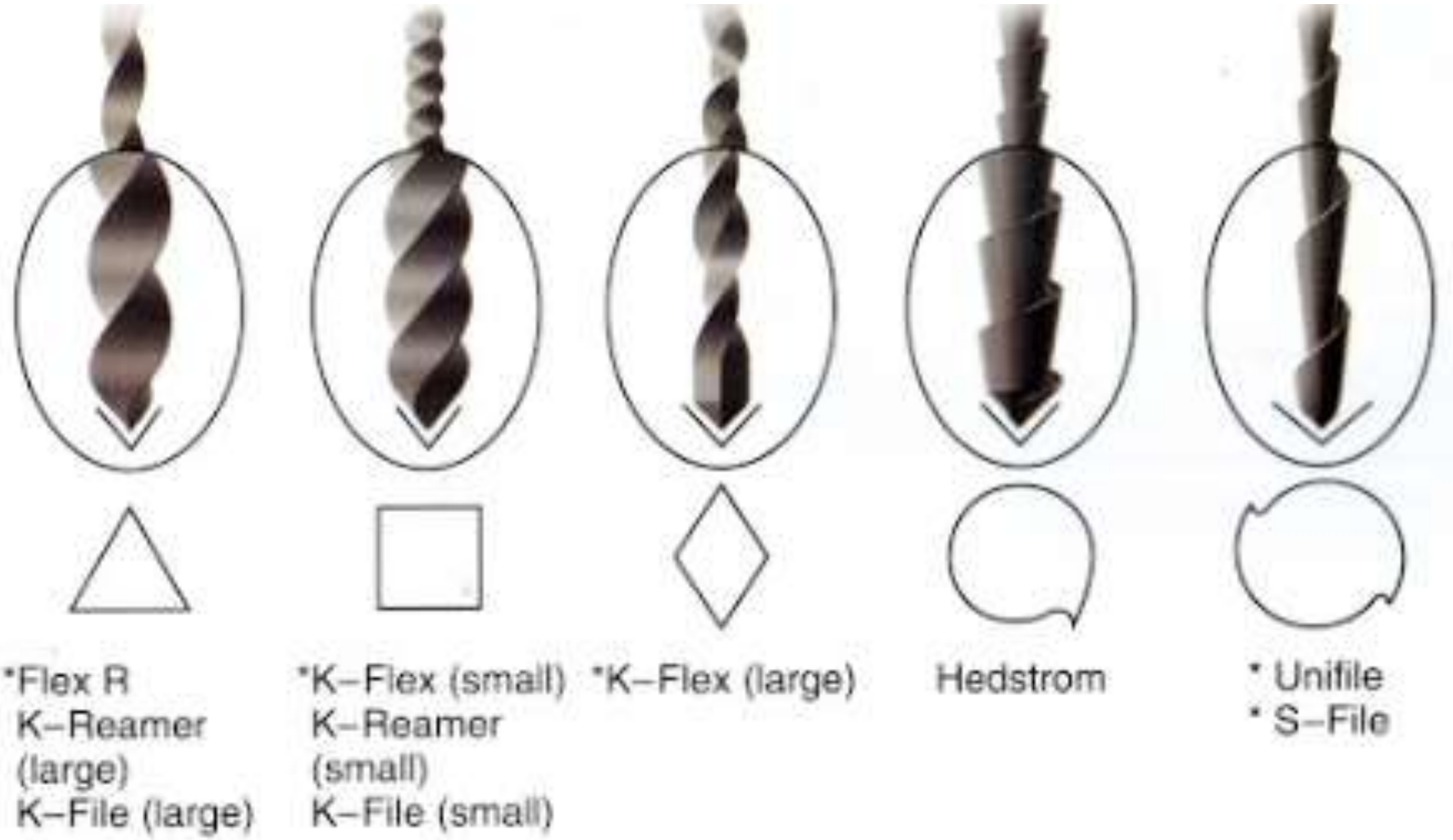
H-type instruments

- An H-type instrument has spiral edges arranged to allow cutting only during a pulling stroke. An example is a **Hedström file.**
- An H-type instrument is better for cutting than a K-type instrument, because it has a more positive rake angle and a blade with a cutting rather than a scraping angle.
- Bending a Hedström file results in points of greater stress concentration than occurs with K-type instruments. These concentration points can lead to the propagation of cracks and fatigue failure.
- All H-type instruments are ground from a tapered blank, while Hedström files are formed by grinding a single continuous flute.



S-file (Uni-file)

- This instrument is a ground **S-shaped** cross-section instrument.
- This is stiffer than the Hedström file.
- The cutting mode may be with filing or reaming action.



Traditional instruments modifications

1- Nickel titanium file

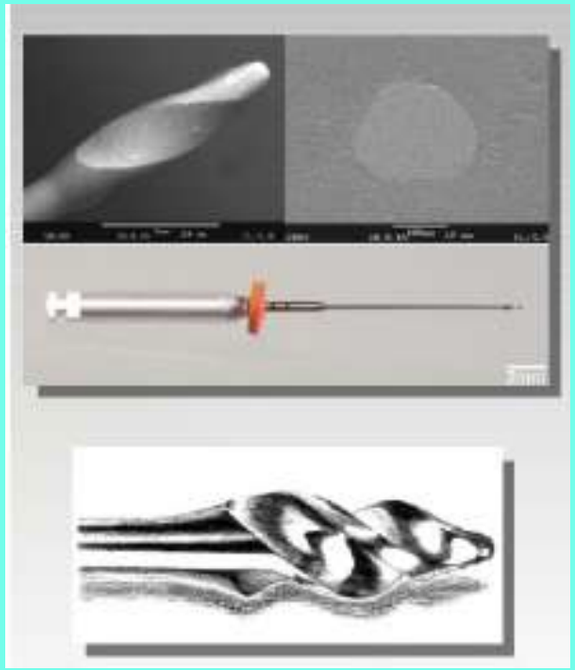
- Files made from nickel titanium showed greater (elastic flexibility) and (resistance) to fracture than stainless steel.
- These file has a non-cutting tip and it tends to maintain the curvature of the root canal.

2- Golden mediums

- These instruments are a series of intermediate size instruments.
- They correspond in size to halfway between standard ISO sizes and correspond to 12,17,22,27,32 and 37 in number.

3- Canal Master U

- This hand instrument is used to prepare the apical third of the canal.
- It has a non-cutting pilot tip, 1 mm length cutting blade and a narrow parallel sided shaft.
- It is used to allow for better cutting with more space for debris accumulation and further removal.
- It reduces the possibility of ledge or transportation.



GROUP II: LOW-SPEED ROTARY INSTRUMENTS

GATES – GLIDDEN DRILL

- This has a long, thin shaft ending in a flame-shaped head with a non-cutting safe tip to guard against perforation.

- It is made of hardened carbon steel.

- The **flame shaped head** cuts laterally and is used with a gentle, apically directed pressure.

- It has a modified safe tip i.e. non-cutting tip.

- These instruments come in sizes 1 to 6

PEESO- REAMER

- It has long sharp flutes with a safe tip connected to a thick shaft.
- It is most often used in preparing the coronal part of the root canal for a post and core.

GROUP III: ROTARY INSTRUMENTS FOR CANAL PREPARATION

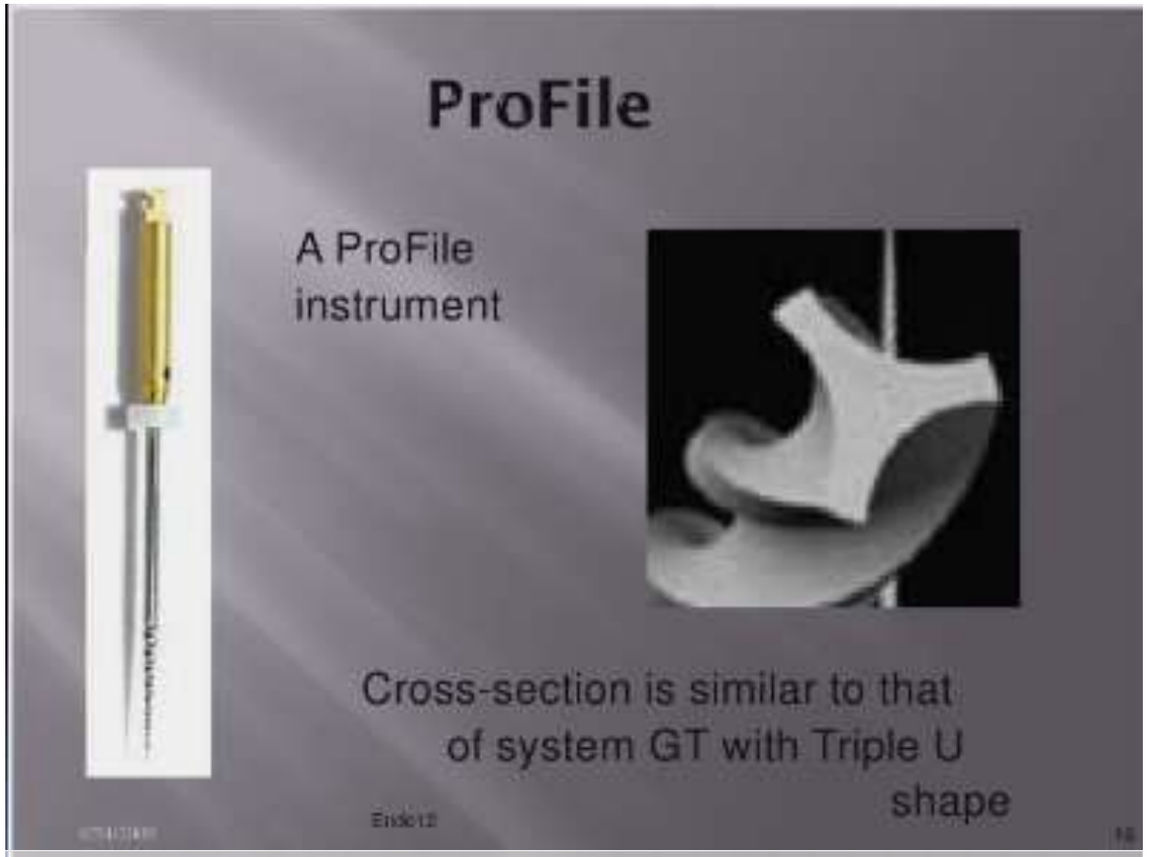
Profile system

- ☆ The Profile system was introduced in 1994.
- ☆ ProFile instruments have increased tapers compared with conventional hand instruments.

- ☆ The tips of the Profile Series rotary instruments had a constant proportion of diameter increments (29%).

- ☆ Cross section of a Profile instrument has a U-shape design with radial lands.

A ProFile Rotary File kit



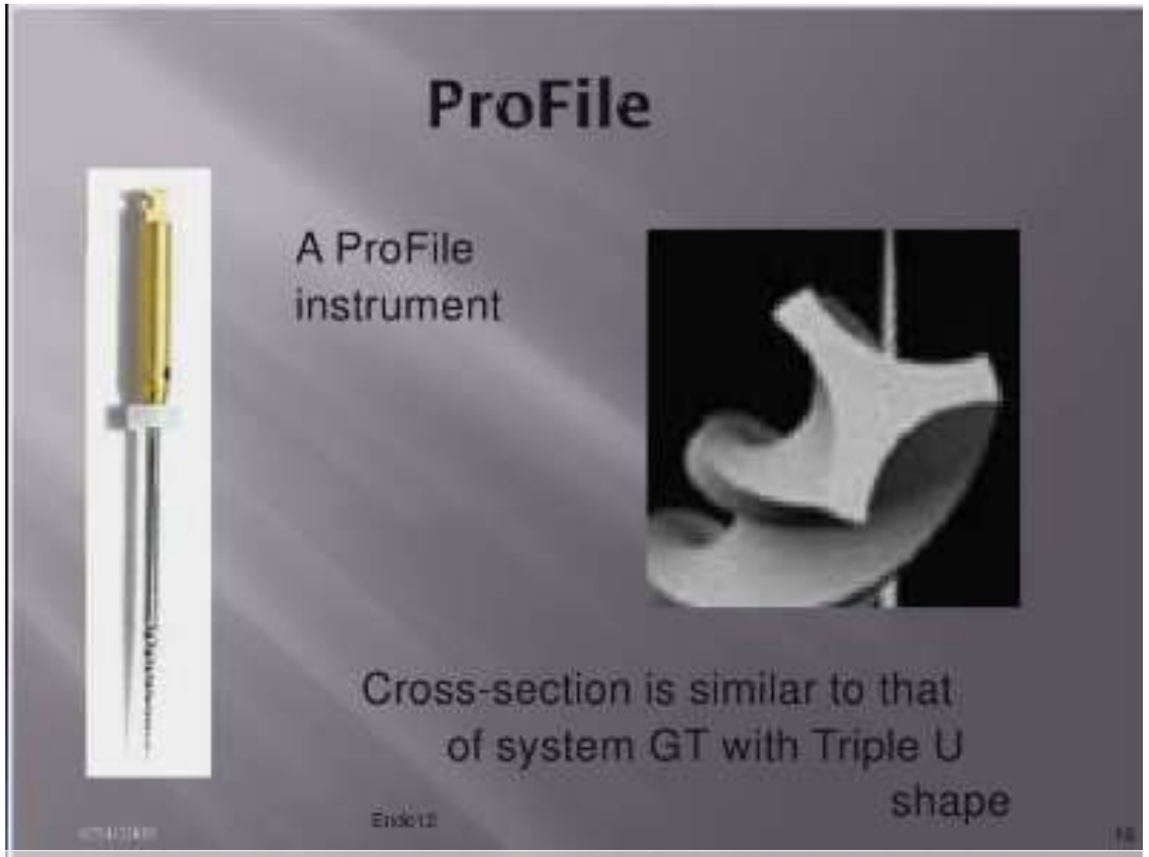
Profile system

- Lateral views show :

1- 20-degree helix angle.
2- Constant pitch.
3- Non-cutting tips.
4- Neutral or slightly negative rake angle.

- This configuration facilitates a reaming action.
- The preferred speed is **275-325 rpm.**

A ProFile Rotary File kit

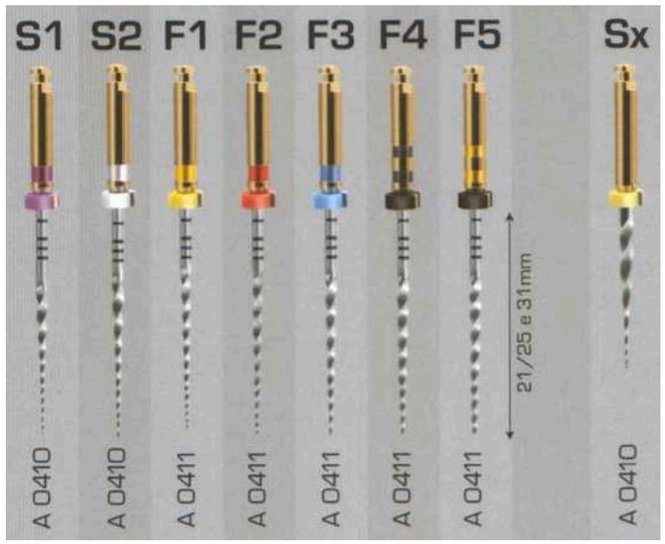


ProTaper Universal system

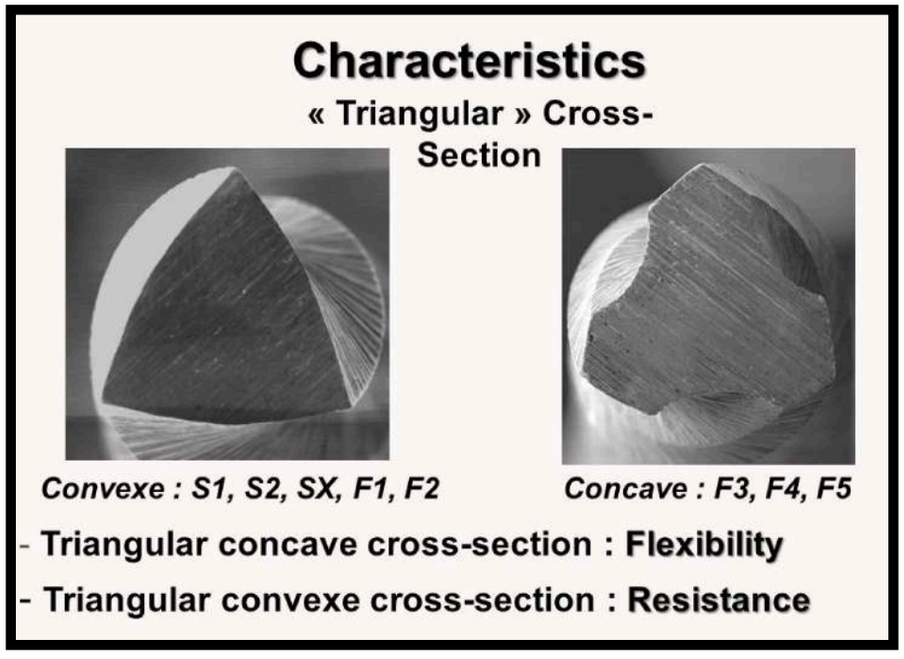
The ProTaper system is based on another concept and composed of six instruments:

1-Three shaping files.

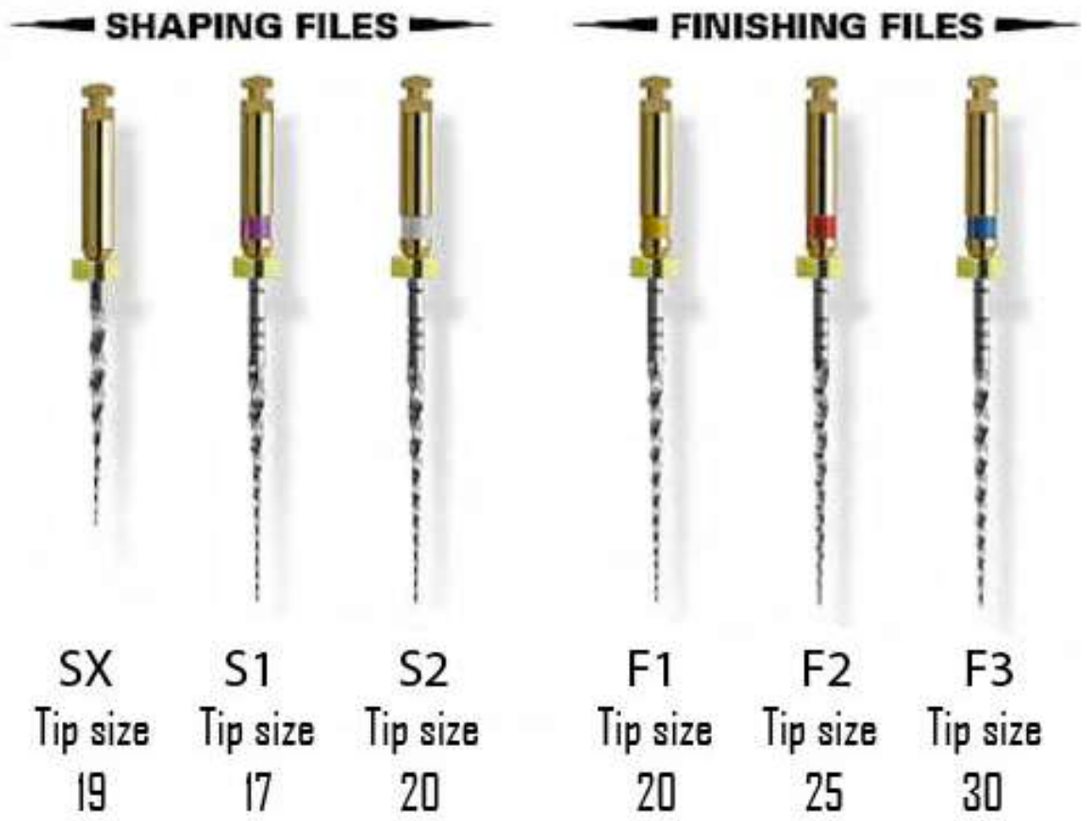
2- Three finishing files.

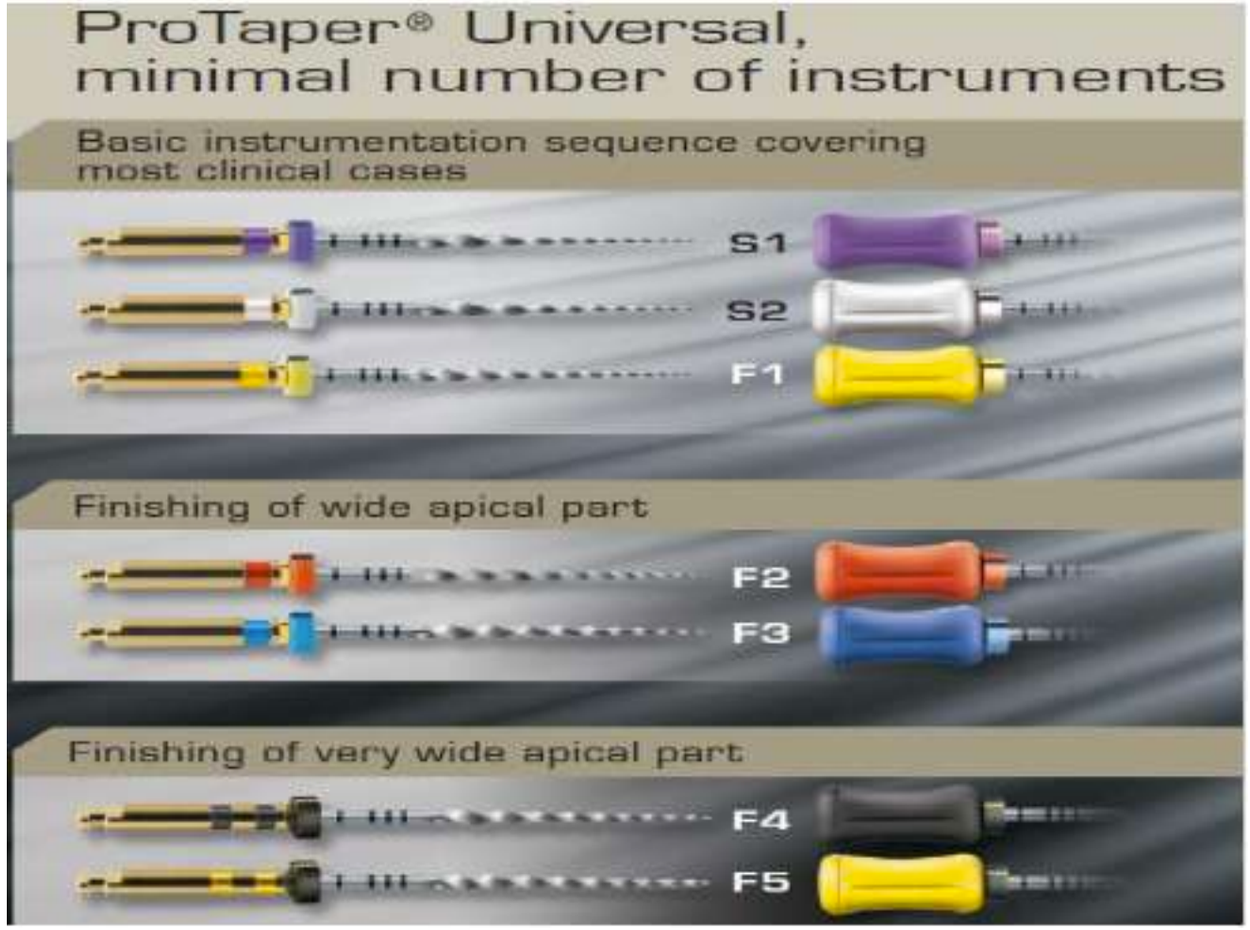


- This set is increased by two larger finishing files(F4&5) and a set designed for retreatment procedures.
- In cross section, ProTaper shows a modified K type file with sharp cutting edges and no radial lands; this creates a stable core and sufficient flexibility for the smaller files.
- The cross section of finishing files F3, F4, and F5 is slightly relieved for increased flexibility.
- The difference in design of this system is the varying tapers along the instruments' long axes.
- The three shaping files have tapers that increase coronally, and the reverse pattern is seen in the five finishing files.



- Shaping files S1 and S2 have tip diameters of 0.17 mm and 0.2 mm, respectively. 14-mm-long cutting blades. The diameters of these files at D14 are 1.2 and 1.1 mm. respectively. They are used in the coronal and middle third of the root canal.
- The finishing files (F1-F5) have tip diameters of 0.2, 0.25. 0.3, 0.4, and 0.5 mm, respectively, between DO and D3, and the apical tapers are .07, .08, .09, .06, and .05, respectively.
- The finishing files have rounded noncutting tips. They are used in the apical third of the root canal.





- The convex triangular cross section of ProTaper instruments reduces the contact areas between the file and the dentin.

☆ The greater cutting efficiency of this design has been improved by:

Balancing the pitch and helix angle, this lead to preventing the instruments from threading into the canal.

- ProTaper instruments can be used with **250 to 300 rpm**.

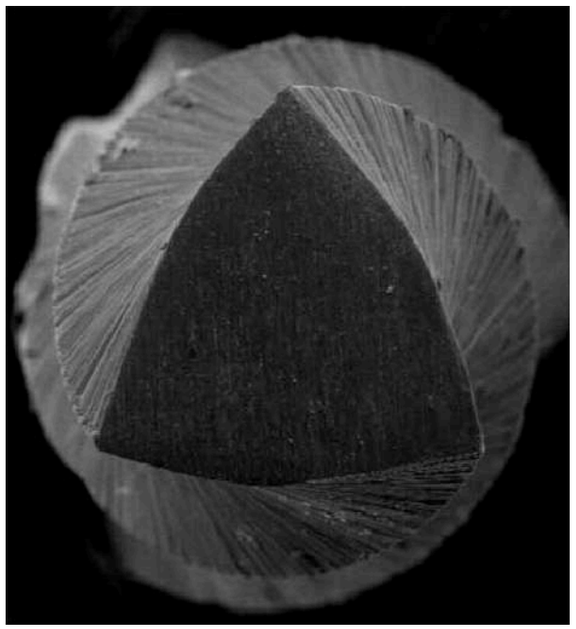
- Two usage characteristics are recommended for the ProTaper system:

1 -The preparation of a glide path.

2. The use of a more lateral "brushing" working stroke.

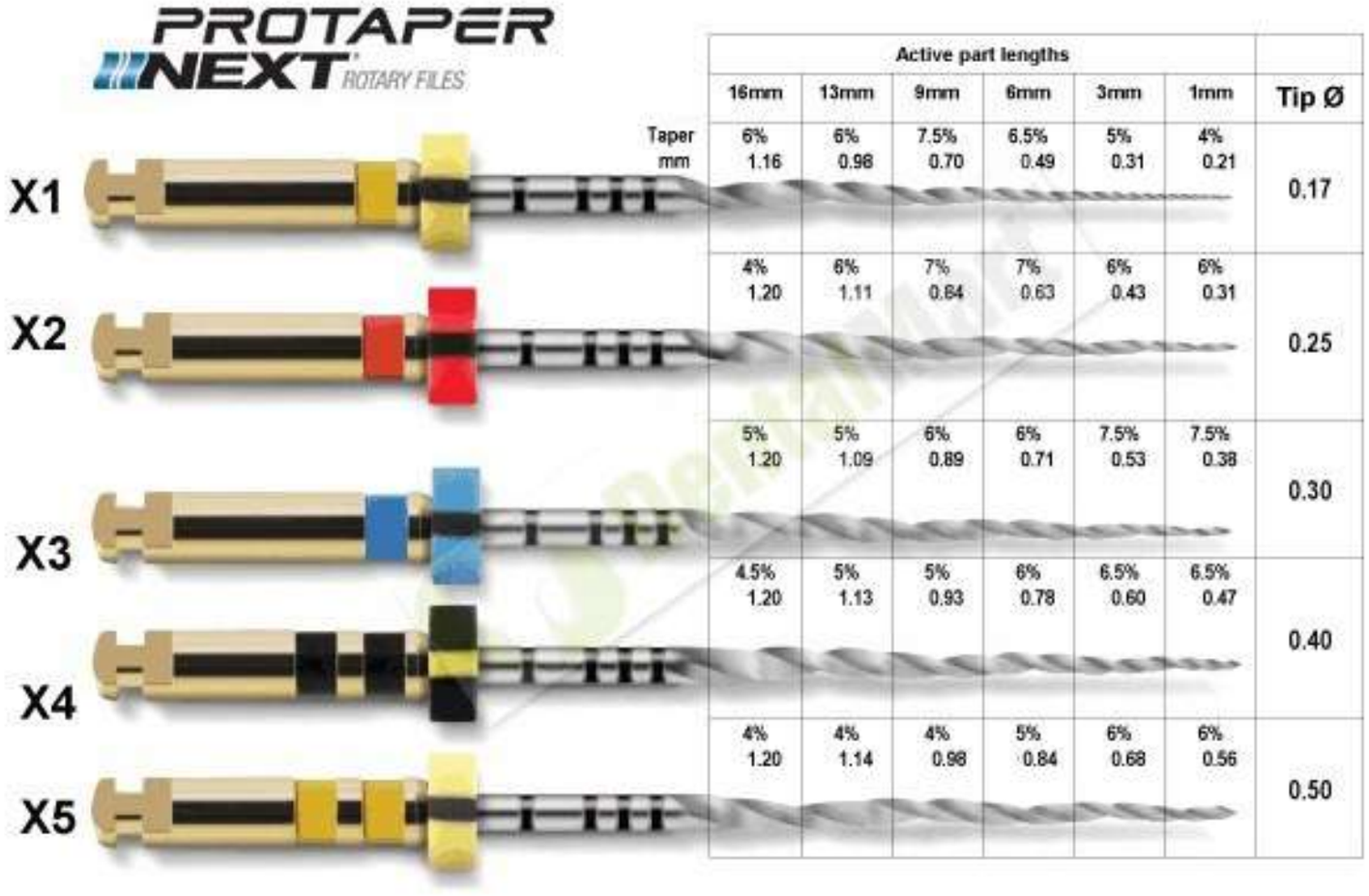
- Such a stroke allows the clinician to direct larger files coronally away from danger zones and counteract any "threading-in" effect

No. of instruments/set	Cross section	Tip sizes/tapers	Lengths
3 shaping files (SX, S1, S2)	Convex triangular	Sx (19/0.035)	19, 21, 25mm
5 finishing files (F1, F2, F3, F4, F5)		S1 (17/0.02)	
		S2 (20/0.04)	
		F1 (20/0.07)	
		F2 (25/0.08)	
		F3 (30/0.09)	
		F4 (40/0.06)	
		F5 (50/0.05)	



ProTaper Next

- This system is composed of 5 files, namely X1, X2, X3, X4 and X5.
- These files correspond to sizes 20/04, 25/06, 30/07, 40/06 and 50/06 respectively.
- The XI and X2 have variable tapered design whereas X3-X5 files have a fixed taper from DI-D3 then a decreasing percentage tapered design over the rest of their active portions.
- This system has a rectangular cross section that is off centered which allows 2 points contact with the dentin wall and the rest of the space free for storing debris which will be removed by the file swaggering motion.



	Active part lengths						
	16mm	13mm	9mm	6mm	3mm	1mm	Tip Ø
Taper	6%	6%	7.5%	6.5%	5%	4%	
mm	1.16	0.98	0.70	0.49	0.31	0.21	0.17
	4%	6%	7%	7%	6%	6%	
	1.20	1.11	0.84	0.63	0.43	0.31	0.25
	5%	5%	6%	6%	7.5%	7.5%	
	1.20	1.09	0.89	0.71	0.53	0.38	0.30
	4.5%	5%	5%	6%	6.5%	6.5%	
	1.20	1.13	0.93	0.78	0.60	0.47	0.40
	4%	4%	4%	5%	6%	6%	
	1.20	1.14	0.98	0.84	0.68	0.56	0.50

Two shape

- This system consists of two files which are:

1- TS1: The tip is #25 and a taper of 04.

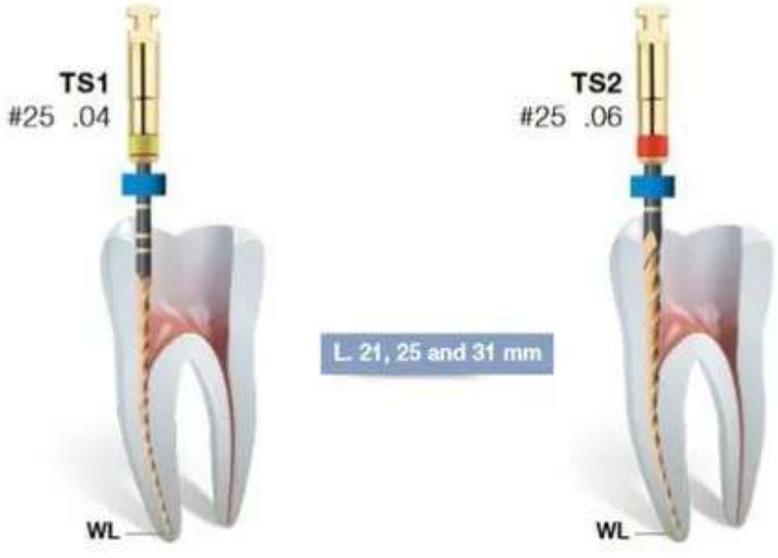
2- TS2: The tip is #25 and a taper of 06.

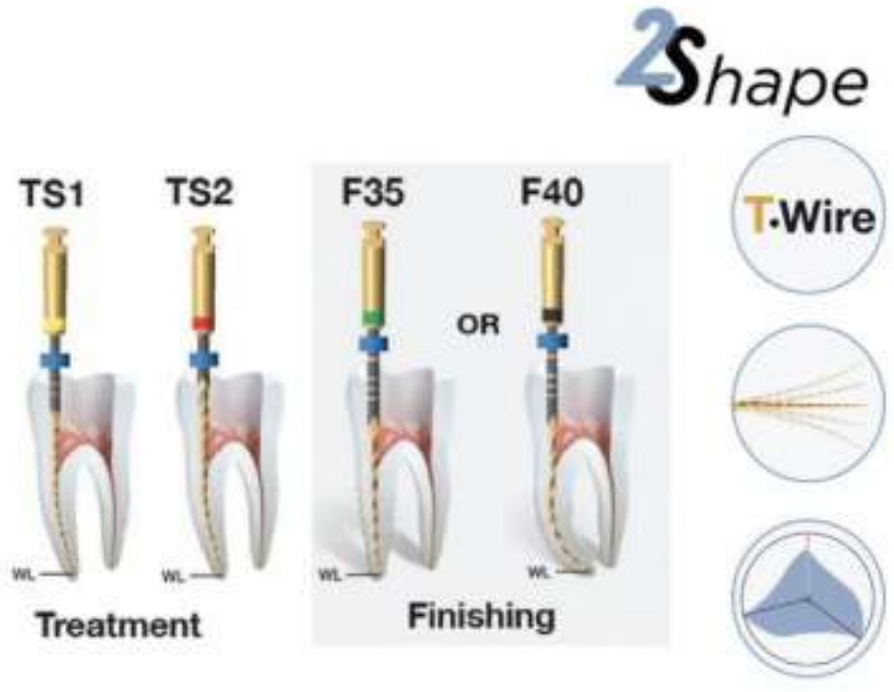
3- Apical finishing files (if needed in larger canals):

a) F35: The tip is 35 and a taper of 06.

b) F40: The tip is 40 and a taper of 04.

- The TS1 file enters the canal to widen it to apical diameter of size 25 and taper 04 (double taper of iso K-file).
- The TS2 widen the canal to 06 (three times the taper of iso K-file).
- This makes a funnel shaped canal with a wide orifice and an apex of width of size 25.





XP Endo shaper

- It is rotary file system made with **Max Wire alloy** which offers better:

1- Flexibility.

2- Fatigue resistance.

3- Ability to progress within the canals with ease, expanding or contracting according to the canal morphology.

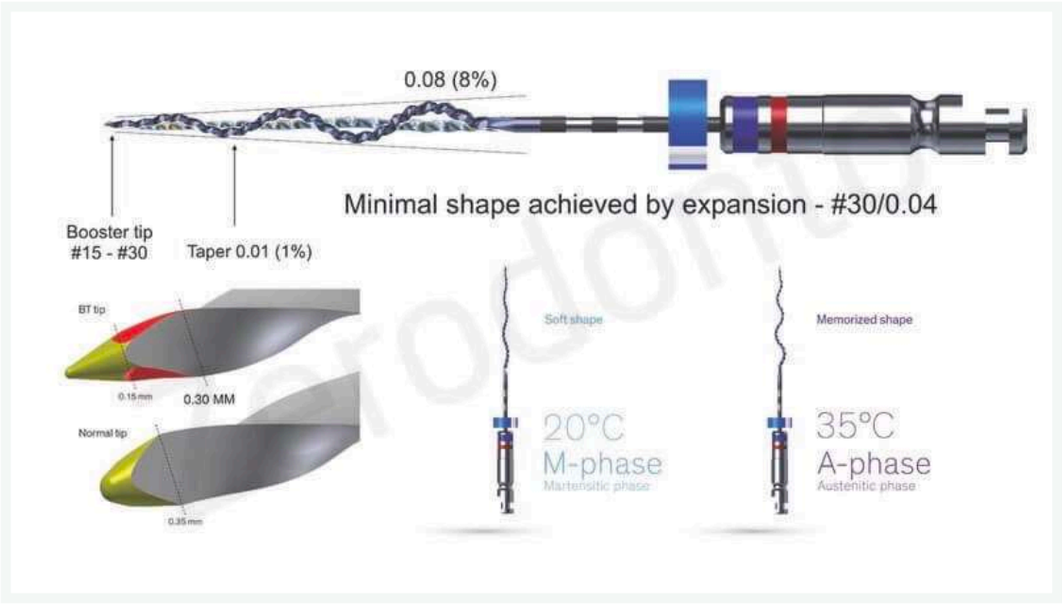
4- Shape memory principles enabling the instrument to take on a predefined shape at 35°C.

- The instrument has the **Booster Tip** which has the following properties:

1- Six cutting edges for optimal guidance.

2. Starts shaping at minimum ISO diameter 15 to achieve a final diameter of ISO 30 with only one instrument.

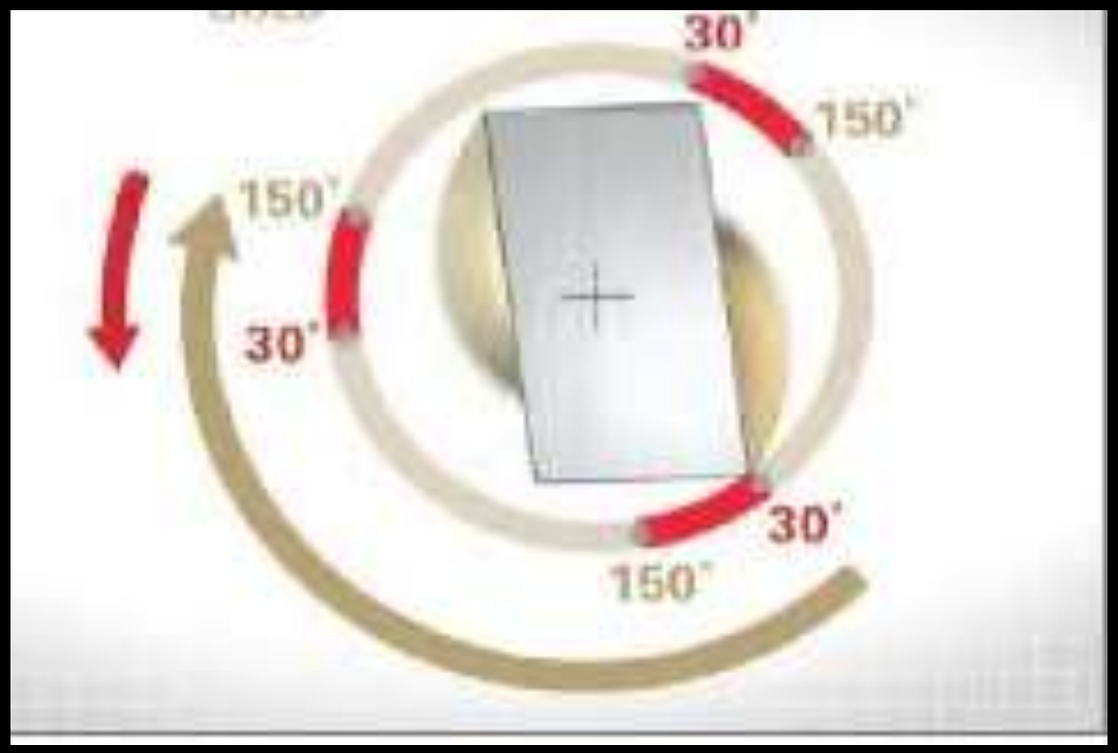
- It increases the taper from .01 to at least .04.
- It allows to reach a final canal preparation of minimum 30/.04 with only one instrument.



GROUP IV: ENGINE-DRIVEN THREE-DIMENSIONALLY ADJUSTING FILES (SELF-ADJUSTING FILE)

- The self-adjusting file (SAF) represents a new approach in file design and mode of operation.
- The file is a hollow device, designed as a cylinder of thin-walled. delicate NiTi lattice with a lightly abrasive surface.
- An initial glide-path is established with a 20 K-file to allow the insertion of the SAF file.
- The file compresses from its 1.5 mm diameter into dimensions equivalent to those of a #25 K-file.
- The handpiece generates in-and-out vibrations with 5000 vibrations per minute and 0.4 mm amplitude.
- The compressed file will adapt itself to the root canal walls, applying a uniform cutting action gradually removing a uniform dentin layer from the canal walls.
- There are a continuous flow of irrigant which removes the tissue debris and the dentin powder generated by the file.

GROUP V: ENGINE-DRIVEN RECIPROCATING INSTRUMENTS



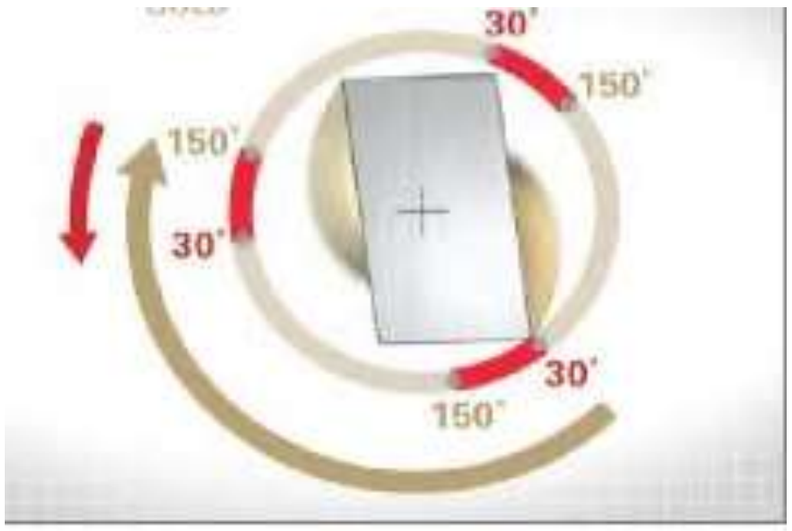
Wave One single file reciprocating system

- This system is a single-use, single file system to shape the root canal.

- In most cases, the technique only requires one hand file followed by one single Wave One file to shape the canal completely using the 150ccw reciprocation motion that engages and cut dentine in a 150-degree counter-clockwise (CCW) direction and then, before the instrument has a chance to taper lock, disengages 30 degrees in a clockwise (CW) direction.

- The net file movement is a cutting cycle of 120 degrees and therefore after three cycles the file will have made a reverse rotation of 360 degrees.

☆ The file is made with **M-wire technology** which improves strength and resistance to cyclic fatigue about four times the traditional rotary NiTi files.



☆ **The system is composed of:**

1. The Wave One small file is used in narrow canals.The tip has an ISO of 20 with a continuous taper of 6%
2. The Wave One primary file is used in the majority of canals. The tip has an ISO of 25 with an apical taper of 8% that reduces towards the coronal end.
3. The Wave One large file is used in wide canals. The tip has an ISO of 40 with an apical taper of 8% that reduces towards the coronal end.

☆ The instruments are designed to work with a reverse cutting action.

☆ All instruments have a modified convex triangular cross section at the tip end and a convex triangular cross section at the coronal end.

☆ This design improves instrument flexibility.

☆ The variable pitch flutes along the length of the instrument improve safety.

Wave One Gold

- To improve the Wave One system the Wave One Gold system was introduced.

- <u>It is composed of four tip sizes:</u>

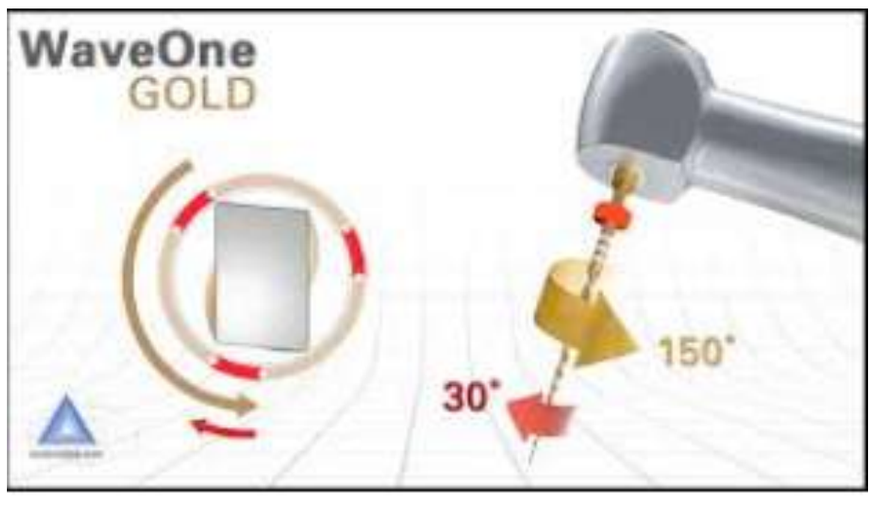
Small (20.07. yellow)
Primary (25.07, red)
Medium (35.06, green)
Large (45.05, white)

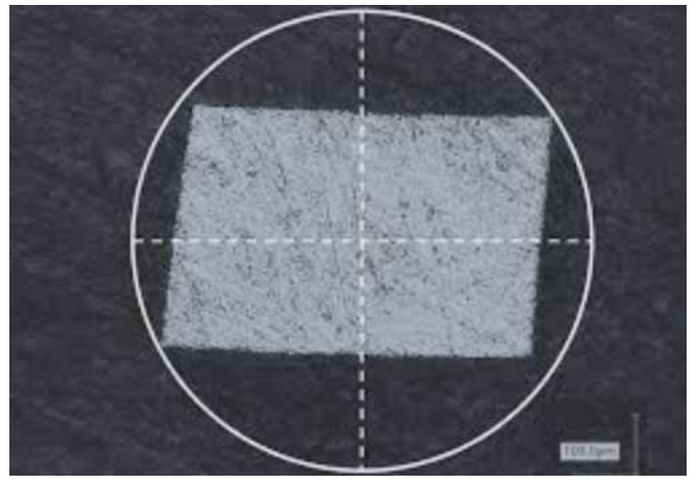
- The various tip sizes and tapers afford the clinician to prepare a wider range of apical diameters and endodontic anatomy.
- The cross-section of Wave One GOLD is a parallelogram with two 85-degree cutting edges in contact with the canal wall.
- Alternating with off-centered cross-section where only one cutting edge is in contact with the canal wall.

- Decreasing the contact area between the file and the canal wall reduces binding (taper lock) and in conjunction with a constant helical angle of 24 degrees along the active length of the instrument, ensures little or no screwing in.

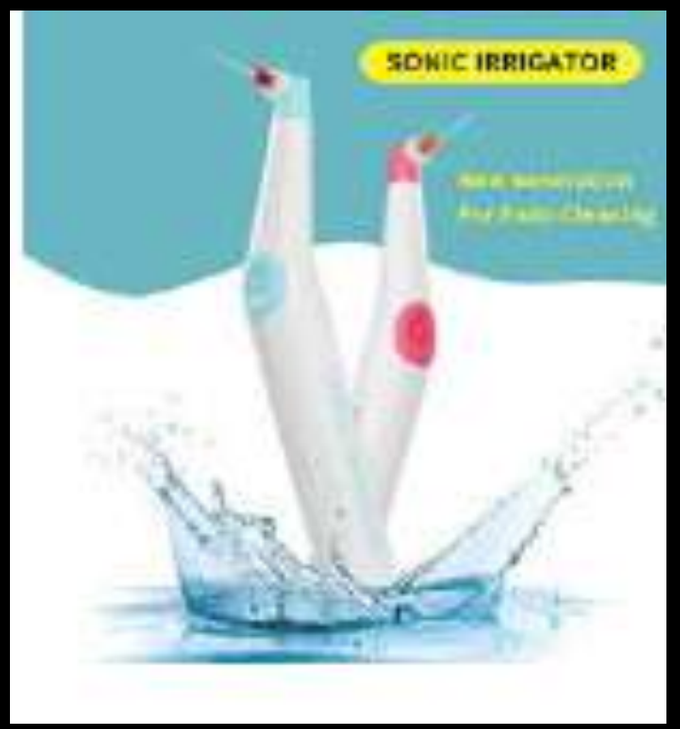
- The additional space around the instrument also ensures additional space for improved debris removal.

- The **tip** of Wave One GOLD is roundly tapered and semi-active, modified to improve its smooth and reproducible penetration into the canal.





GROUP VI: SONIC AND ULTRASONIC INSTRUMENTS



- ☆ Files or ultrasonic tips can be activated by electromagnetic ultrasonic energy.

- ☆ This energy activates an oscillating sinusoidal wave in the file with a frequency of up to 30 kHz.

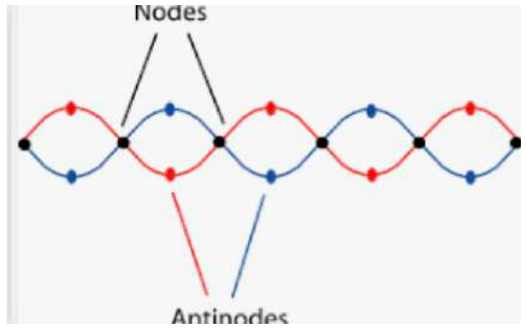
- ☆ **There are two types of such energy.**

***1. Ultrasonic*:** Devices which operate at 25 to 30 kHz, include the magnetostrictive and the piezoelectric, Ultrasonic devices use regular types of instruments (e.g. K-les).

***2. Sonic*:** Devices which operate at 2 to 3 kHz which may use metal files or plastic tips as Endoactivator.

- Although similar in function, piezoelectric units have some advantages over the magnetostrictive systems.
- For example, piezoelectric devices generate little heat, so no cooling is needed for the electric handpiece.

- The file in an ultrasonic device vibrates in a sinus wave like fashion.
- A standing wave has areas with maximal displacement (i.e., antinodes) and areas with no displacement (i.e., nodes).



- The tip of the instrument exhibits an antinode.
- Ultrasonic devices proved very efficient for irrigating root canal systems.

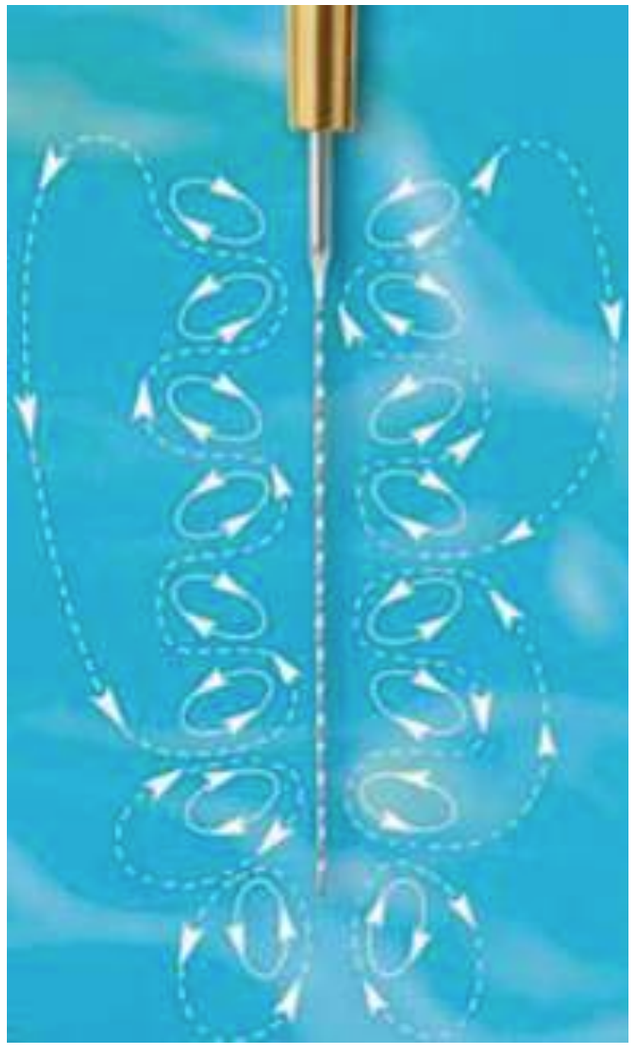
☆ During free ultrasonic vibration in a fluid, two effective physical effects are formed:

I-Cavitation.

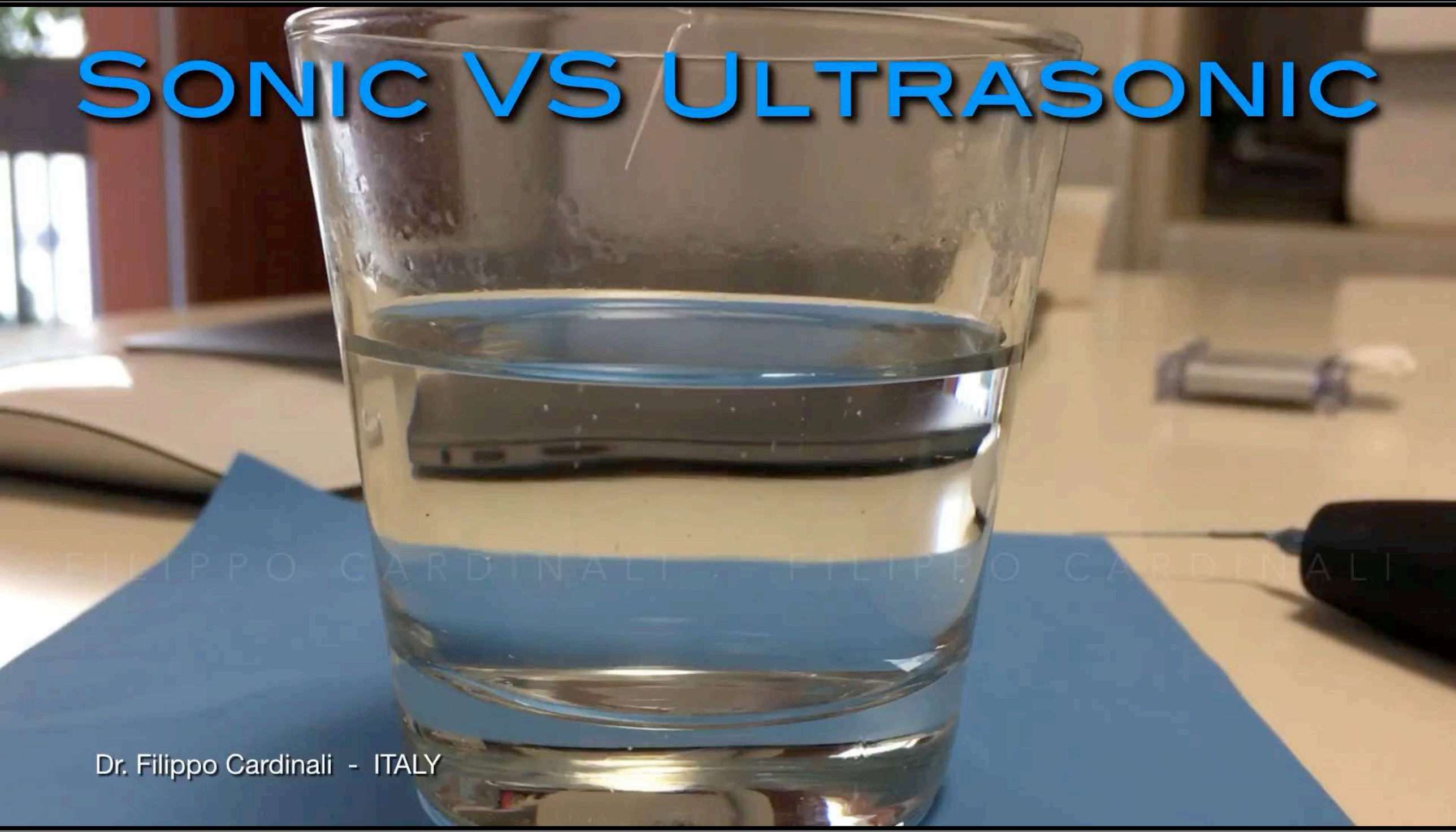
During oscillation in a fluid, a positive pressure is followed by a negative pressure causing implosion.

2. Acoustic streaming.

This is small intense, circular fluid movement around the instruments.



Sonic VS Ultrasonic



THANK

you

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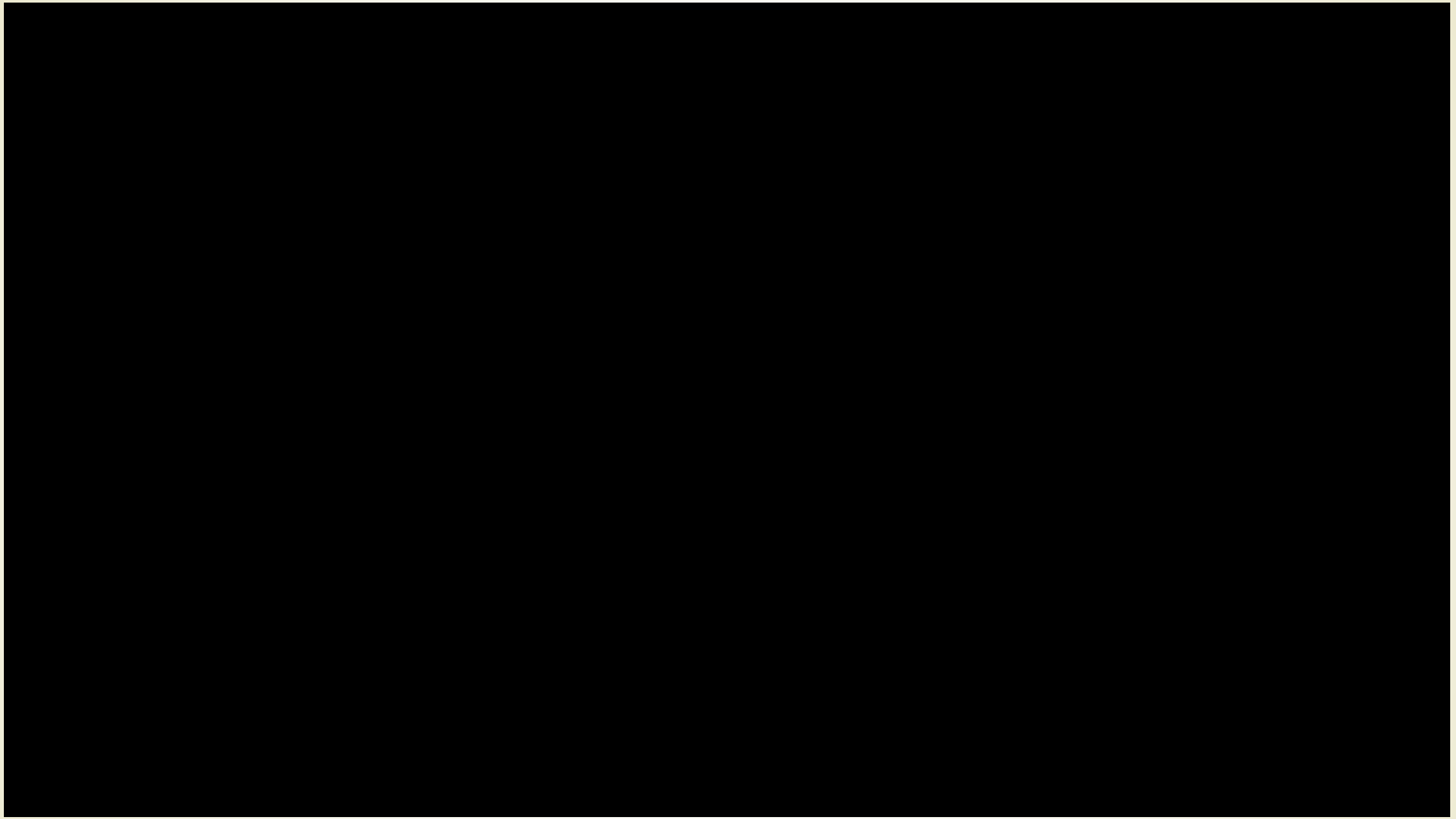
Member of Iraqi endodontics society

2023-2024

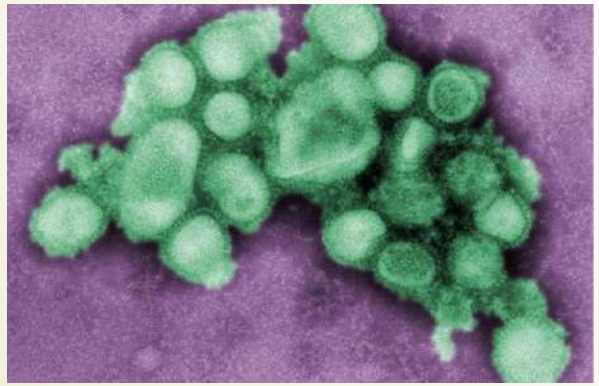
AHMAD
AL JOBORY

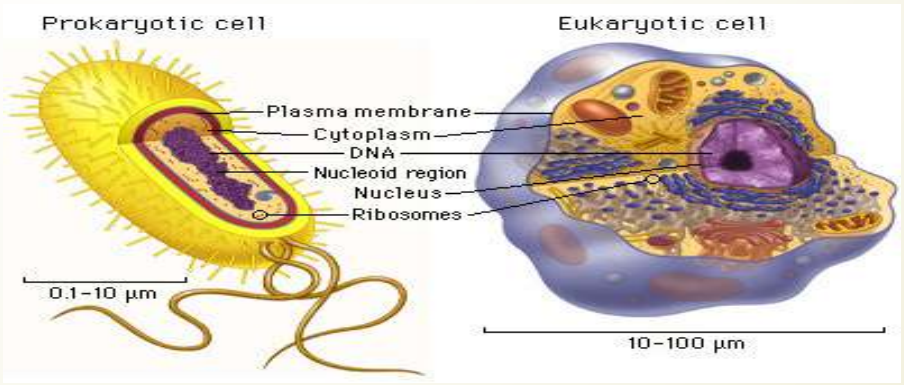
Microbiology in endodontics

The ultimate goal of the endodontic treatment is either to prevent the development of apical periodontitis or to create adequate conditions for periradicular tissue healing.



- Endodontic infections usually develop after pulpal necrosis or in cases in which the pulp was removed for treatment.
- Fungi and most recently archaea and viruses have been found in endodontic infections, but bacteria are the major microorganisms in the etiology of apical inflammation.
- **Bacteria** – prokaryotes, no membrane bound organelles
  - no nucleus, cell wall – peptidoglycan,
- **Fungi** – eukaryote
  - cell wall - chitin
- **Viruses** - exist as a protein coat or capsid, sometimes enclosed within a membrane, either DNA or RNA which codes for the virus elements, depends on host cell for replication.





- The combination of:
- caries,
- operative procedures,
- insertion of the restoration,
- the chemical irritation from the restoration
- the leakage of the restoration
- causes cumulative pulpal damage.

- This results varying in degrees of pulpal inflammation.
- Once the inflammation reaches a sufficient intensity, microbes are attracted (Anachoresis) then leads to chronic pulpitis and/or necrosis which necessary for endodontic intervention.

ROUTES OF ROOT CANAL INFECTION

- Under normal conditions, the dental pulp and dentin are sterile and isolated from oral microorganisms by overlying enamel and cementum.
- There are situations in which the integrity of these **protective layers is breaked** (e.g., as a result of caries, trauma-induced fractures and cracks, restorative procedures, scaling and root planning, attrition, or abrasion) **or naturally absent** (e.g., because of gaps in the cementoenamel junction at the cervical root surface).
- As a consequence, the dentin-pulp complex was exposed to the oral environment and put at risk of infection by oral microorganisms.
- Microorganisms from subgingival biofilms associated with periodontal disease or present in the circulation during bacteremia may also reach the pulp via ateral and apical foramina.

The main portals of pulp infection are:

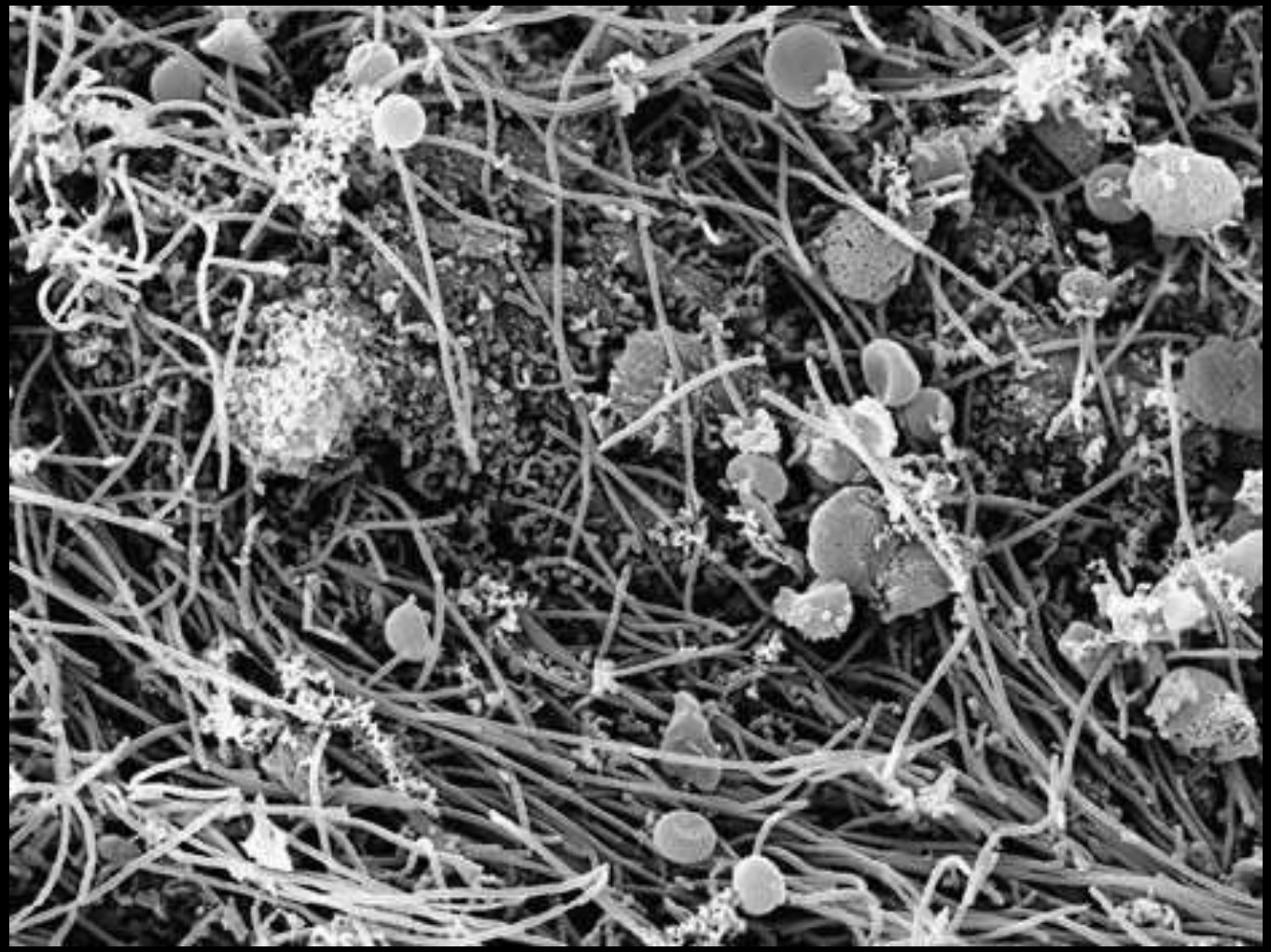
1. Dentinal tubules.
2. Direct pulp exposure.
3. Periodontal disease.
4. Anachoresis.

Dentinal tubules

- **Dentinal tubules** traverse the entire width of the dentin and have a conformation of inverted cones, with the smallest diameter in the periphery, near to enamel or cementum (**mean of 0.9 □m**). The smallest tubule diameter is entirely compatible with the cell diameter of most **oral bacterial species**, which usually ranges **from 0.2 to 0.7 □m**. Thus, one might well assume that once exposed, dentin offers an unimpeded access pathway for bacteria to reach the pulp via tubules.
- **However, this is not the cause, as long as the pulp is vital**, **dentinal exposure does not represent a significant route of pulpal infection, except when the pulp is necrotic**, exposed dentinal tubules can become true avenues for bacteria to reach and colonize the pulp.

Direct pulp exposure

- Direct exposure of the dental pulp to the oral cavity is the **most common route of endodontic infection**.
- Caries is the most common cause of pulpal exposure, but microorganisms may also reach the pulp via direct pulpal exposure as a result of restorative procedures or trauma.
- The exposed pulp tissue develops direct contact with oral microorganisms from carious lesions, saliva, or plaque accumulated onto the exposed surface.
- Almost invariably, exposed pulps will undergo inflammation and necrosis and become infected.
- The **time** elapsed **between pulp exposure and infection** of the entire canal is **unpredictable**, but it is usually a **slow process.**



Scanning electron micrograph showing bacteria in a carious lesion. Note the presence of different bacterial morphotypes.

Periodontal disease

- **Microorganisms in subgingival biofilms associated with periodontal disease** could reach the pulp by the same pathways that intracanal microorganisms reach the periodontium and thereby could exert harmful effects on the pulp.
- Nevertheless, it has been demonstrated that although degenerative and inflammatory changes of different degrees may occur in the pulp of teeth with associated periodontal disease, **pulpal necrosis as a consequence of periodontal disease only develops if the periodontal pocket reaches the apical foramen, leading to irreversible damage to the main blood vessels that penetrate through this foramen.**
- **Once the pulp becomes necrotic**, **periodontal microorganisms can reach the root canal system via exposed dentinal tubules**, **and apical foramina and establish an infectious process**.

Anachoresis

- **Anachoresis** is a process by which microorganisms are transported in the blood or lymph to an area of tissue damage, where they leave the vessel, enter the damaged tissue, and establish an infection.
- There is no clear evidence showing that this process can represent a route for root canal infection.
- It has been shown that **bacteria could not be recovered from unfilled root canals when the bloodstream was experimentally infected**, unless the root canals were **over-instrumented** during the **period of bacteremia**, which result in injury to periodontal blood vessels and blood seepage into the canal.
- Although anachoresis has been suggested to be the mechanism through which traumatized teeth with intact crowns become infected, current evidence indicates that the main pathway of pulpal infection in these cases is **dentinal exposure as a result of enamel cracks.**

What are the Pulpal pathway?

1. Through a **carious lesion** either directly or via dentinal tubules.
2. Through a **cavity preparation**, either when the pulp is directly exposed or via dentinal tubules.
3. As a results of **periodontal disease**, from pocket via lateral canals or dentinal tubules or apical blood vessels.
4. Through **enamel lamellae** and **dead tracts** in dentin.
5. From **periapical lesion**, via apical or lateral canals.
6. **Anachoresis**, which mean microbes present in the bloodstream (Bacteremia) can lodge in a traumatized or inflamed pulp.
7. From **heat and pressure** (e.g. compound copper band impressions) through dentinal tubules.
8. By **abrasion**, **erosion**, **attrition**, **fracture**, **or developmental anomalies**.

Host-Parasite interaction

- The results of host-parasite interaction depend on:

1. Microbial virulence factors.
2. Host resistance factors.

Microbial virulence factors

- these are **substances** that are inherent in or produced by microorganisms, they give the microorganisms the capability of causing tissue damage.
- If clinical disease is produced, the microbes are considered as **pathogenic**.
- Microbes associated with pulp and periapical disease are relatively a **virulent** (virulent and not yet pathogenic).
- The outcome of the host-parasite interrelationship is what decides whether infectious disease will result.
- Substances related to virulence may be:

1. **exotoxins**,
2. **endotoxins enzymes**,
3. **metabolic end products,**
4. **antigenic components**.

Host resistance factors

- The reaction of the host to the presence of microbes or their products may be detrimental to :

1. **Platelet factors** including beta-lysins, plakin, Basic polyamines, polypeptides and proteins (active against gram-positive microbes).
2. **Serum factors** including antibodies (IgG, IgM) active against bacteria; IgA-active against viruses; complement (active against gram-positive microbes); with lysozyme (active against gram-negative microbes).
3. **Leukocyte factors** like lysozyme, which hydrolyzes bacteria cell wall of gram-positive bacteria.
4. **Macrophages factors** which include lysosomal enzymes and proteins, which binds to several species of bacteria and promote the uptake of bacteria by phagocytic cells.
5. **Lymphocyte factors** including lymphotoxin and macrophages activating factors.
6. **Salivary factors** including lysozyme, antibodies(IgA); flow of saliva(removes microbes that are then swallowed or expectorated).
7. **Gastric acid-HCl** from stomach rapidly destroys swallowed oral microbes
8. **Fever with elevated body temperature** which causes destruction of gram-negative but not gram-positive microbes.

The endodontic microbial

- Studies using (culture-dependent) approaches have allowed recognition of several candidate endodontic pathogens.
- More recently, with the advent of (culture-independent molecular biology techniques), not only have the findings from culture studies been confirmed, but a great deal of new information has also been added to the knowledge of the microbiota associated with different types of endodontic infections.

- **Some of root canal microbes:**

1. Enterococci (E.faecalis).
2. Alpha-Hemolytic streptococci (S.mitis ; S.salivarius).
3. Staphylococci (S.epidermidis).
4. Corynebacterium species (diphtheroids).
5. Lactobacillus species.
6. Candida species (C.albicans).

Table 3-1

Bacterial Genera Represented in Endodontic Infections

GRAM-NEGATIVE BACTERIA		GRAM-POSITIVE BACTERIA	
Anaerobes	**Facultatives**	**Anaerobes**	**Facultatives**
Rods		**Rods**	
Dialister	*Capnocytophaga*	*Actinomyces*	*Actinomyces*
Porphyromonas	*Eikenella*	*Pseudoramibacter*	*Corynebacterium*
Tannerella	*Haemophilus*	*Filifactor*	*Lactobacillus*
Prevotella		*Eubacterium*	
Fusobacterium		*Mogibacterium*	
Campylobacter		*Propionibacterium*	
Synergistes		*Eggerthella*	
Catonella		*Olsenella*	
Selenomonas		*Bifidobacterium*	
Centipeda		*Slackia*	
		Atopobium	
		Solobacterium	
		Lactobacillus	
Cocci		**Cocci**	
Veillonella	*Neisseria*	*Micromonas*	*Streptococcus*
Megasphaera		*Peptostreptococcus*	*Enterococcus*
		Finegoldia	*Gramulicatella*
		Peptoniphilus	
		Anaerococcus	
		Streptococcus	
		Gemella	
Spirilla			
Treponema			

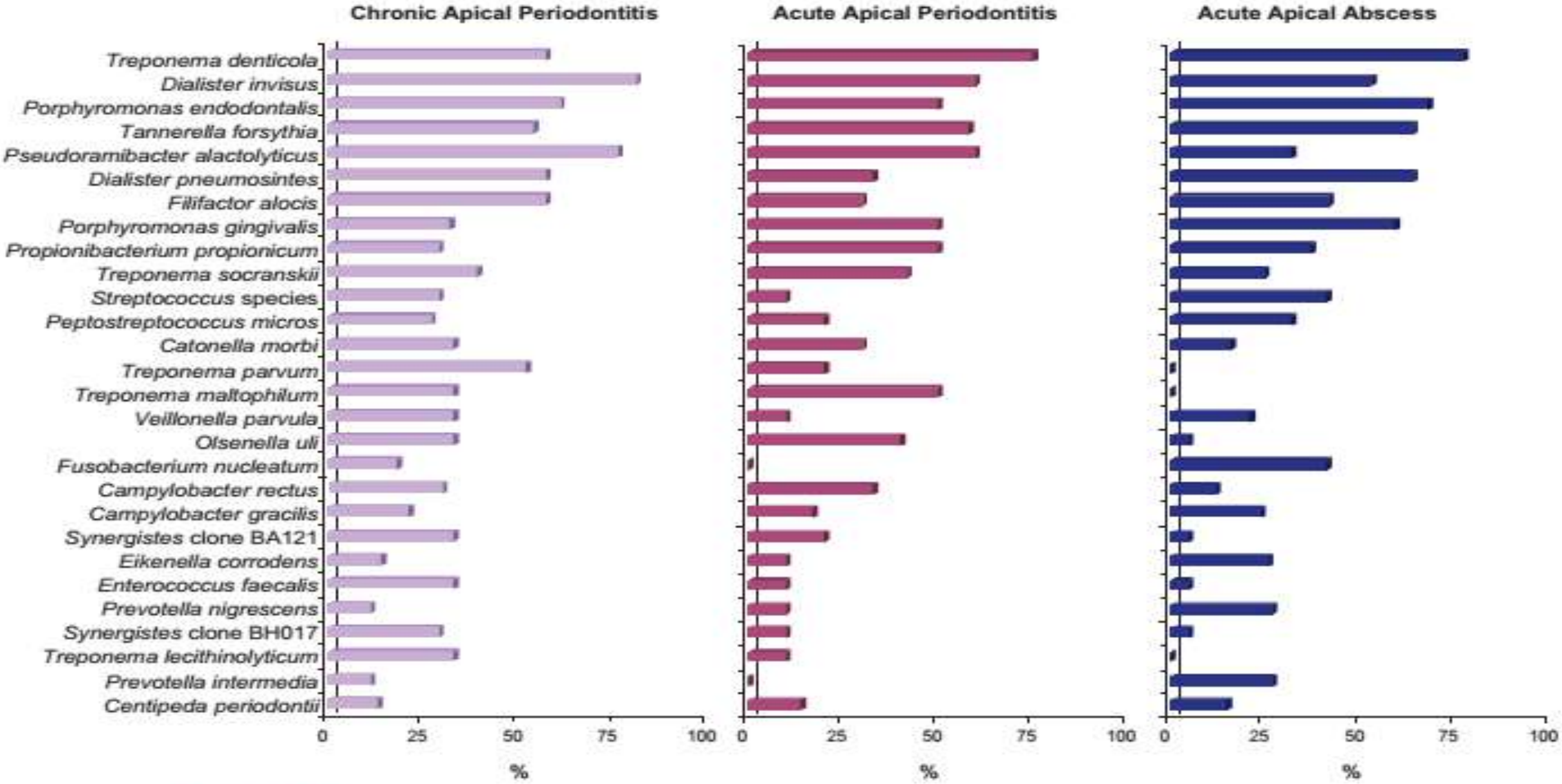


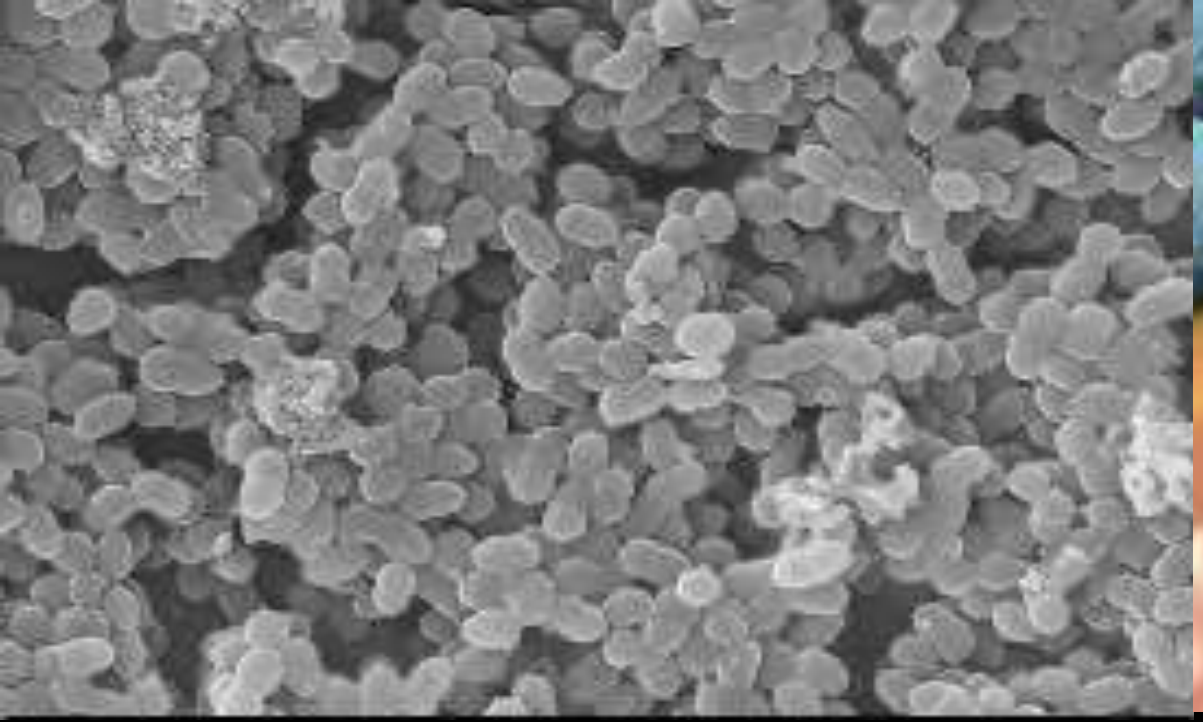
Figure 3-5 Prevalence of bacteria detected in primary endodontic infections of teeth with different forms of apical periodontitis. Compilation of data from authors' studies using a molecular biology technique.

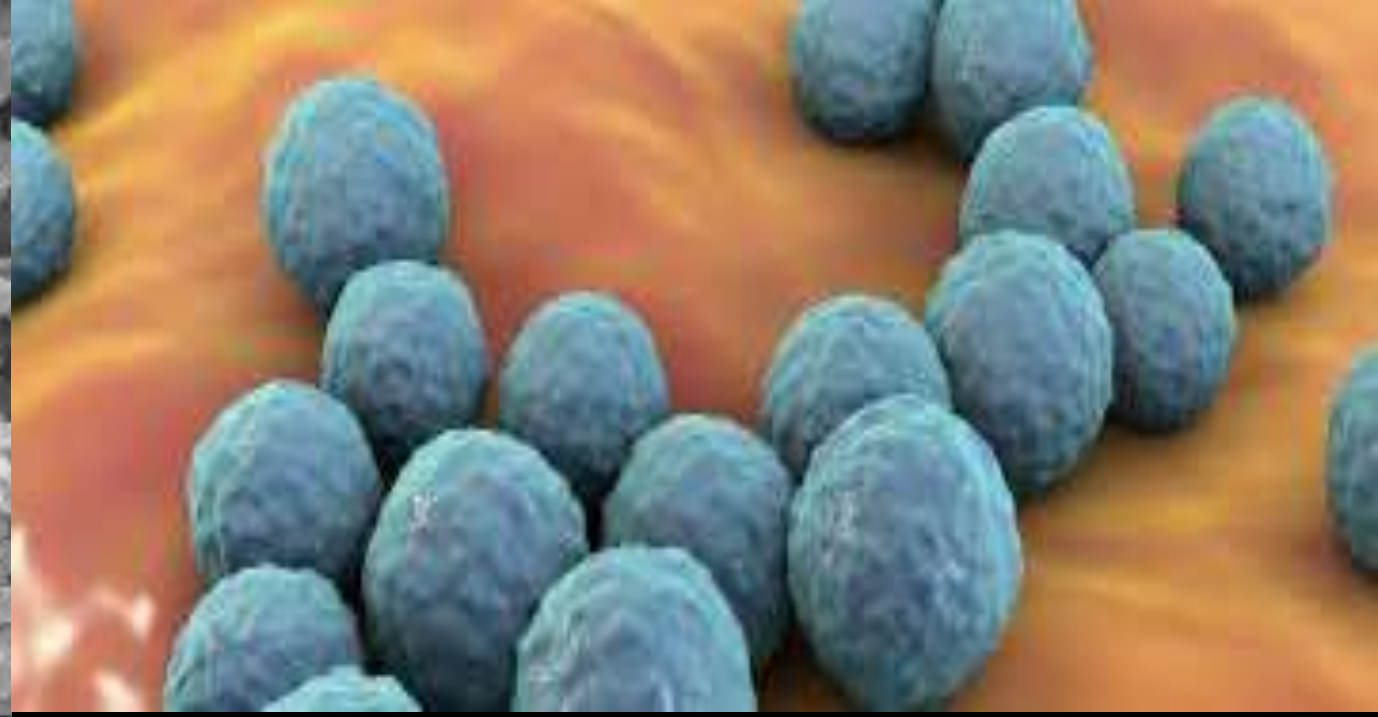
Microorganisms Detected in Root Canal–Treated Teeth Associated with Persistent Apical Periodontitis

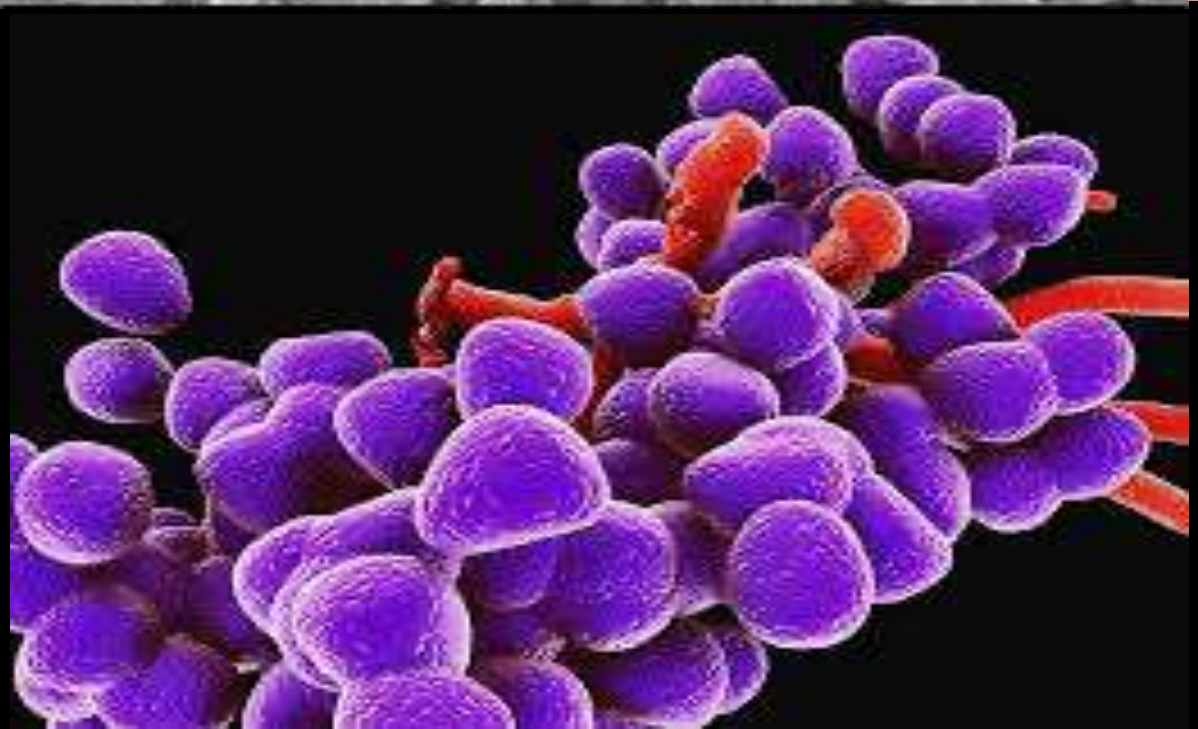
Taxa	Frequency (%)*
Enterococcus faecalis	77
Pseudoramibacter alactolyticus	55
Propionibacterium propionicum	50
Filifactor alocis	48
Dialister pneumosintes	46
Streptococcus spp.	23
Tannerella forsythia	23
Dialister invisus	14
Campylobacter rectus	14
Porphyromonas gingivalis	14
Treponema denticola	14
Fusobacterium nucleatum	10
Prevotella intermedia	10
Candida albicans	9
Campylobacter gracilis	5
Actinomyces radicidentis	5
Porphyromonas endodontalis	5
Micromonas micros	5
Synergistes oral clone BA121	5
Olsenella uli	5

Data from Siqueira JF, Jr., Rôças IN: *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 97:85, 2004; Siqueira JF, Jr., Rôças IN: *J Clin Microbiol* 43:3314, 2005.

*Percent of cases harboring each taxon.



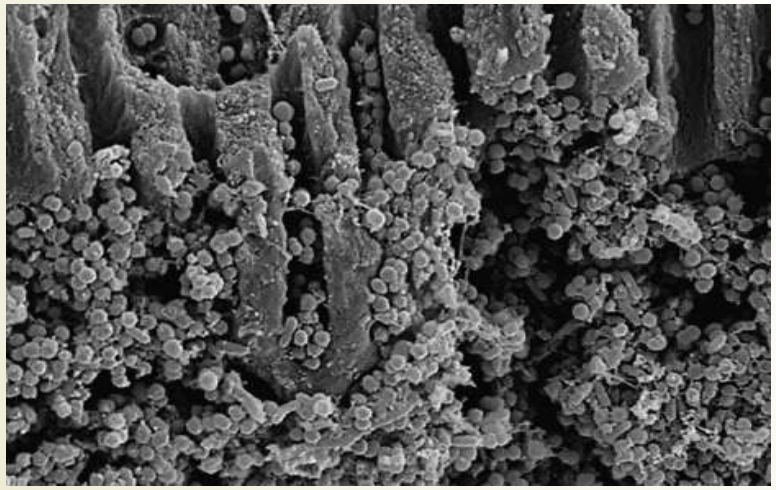




Enterococcus faecalis

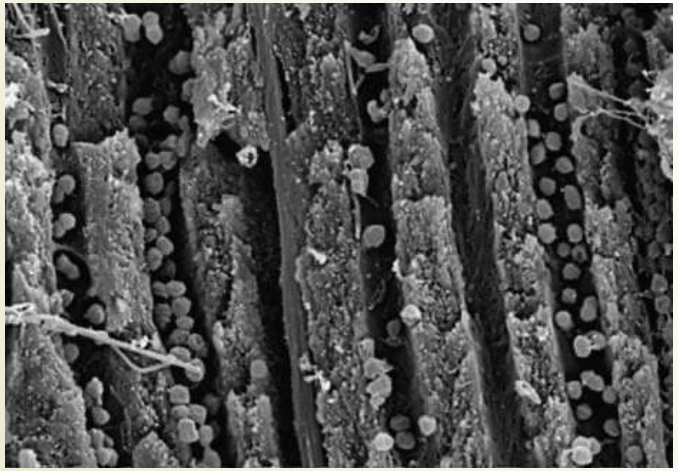
Patterns of Microbial Colonization

- A better understanding of the disease process and the development of effective antimicrobial therapeutic strategies depend on the knowledge of the anatomy of infection (i.e., the way microbial cells are distributed throughout the infected tissue).
- Bacteria in the root canal system can exist as planktonic (unattached) cells suspended in the fluid phase of the main root canal and as aggregates or coaggregates adhered to the root canal walls, sometimes forming multilayered **biofilms**.
- In long-standing root canal infections, microorganisms propagate in the entire root canal system. Lateral canals and isthmuses connecting main canals can be clogged with bacterial cells, primarily organized in biofilm structures. Bacteria forming dense accumulations on the root canal walls are often seen penetrating the dentinal tubules.

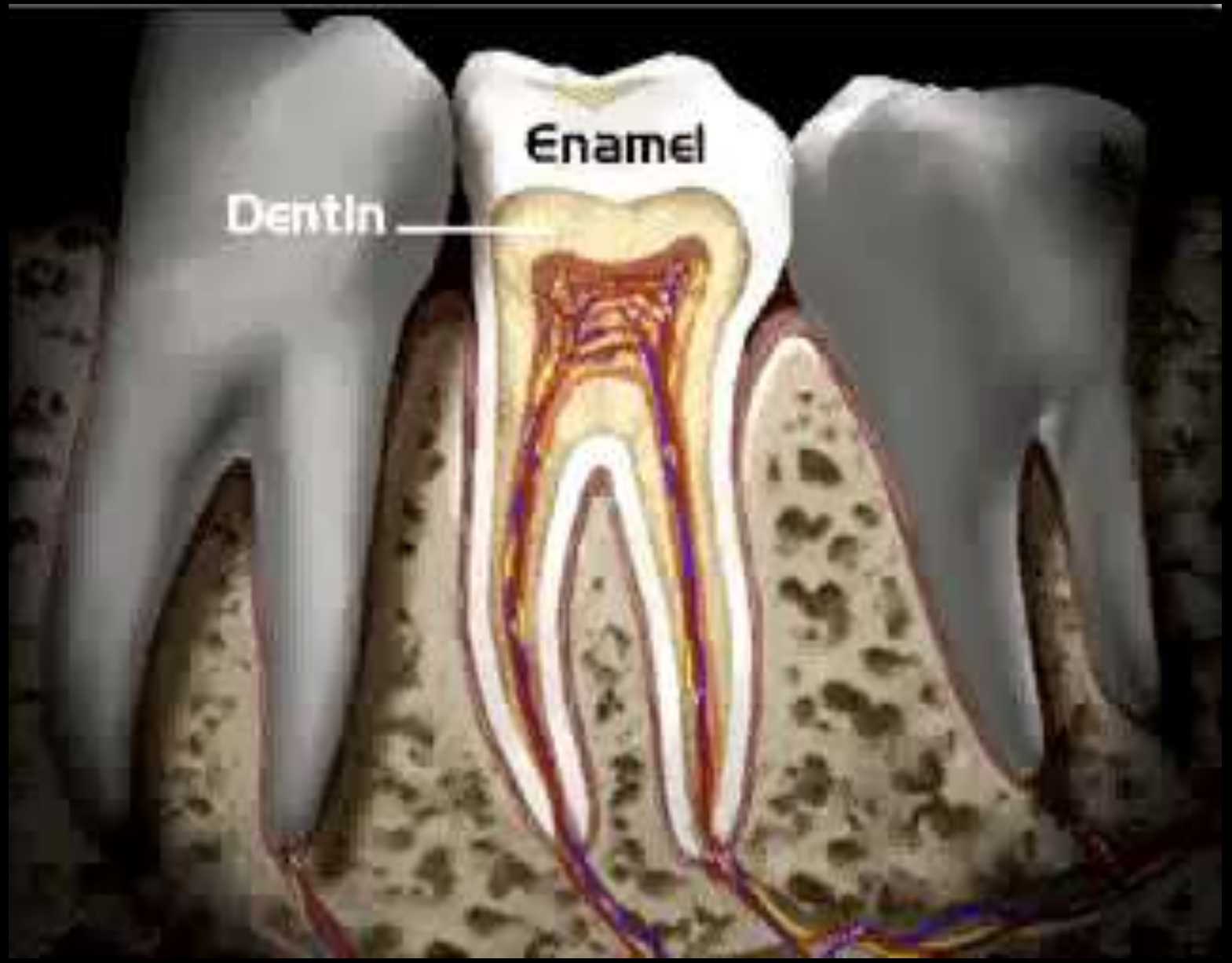


Heavy infection of the root canal walls mainly by cocci, but some small rods are also seen. Cocci are penetrating into dentinal tubules. (From Siqueira JF, Jr., Rôças IN, Lopes HP: *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 93:174, 2002.)

- The diameter of dentinal tubules is large enough to permit penetration of most oral bacteria, and tubular infection is observed in most teeth, evincing apical periodontitis lesions. Although a shallow intratubular penetration is more common, bacterial cells can be observed reaching approximately 300 µm in some teeth
- Since the ideal outcome of the endodontic treatment relies on elimination of the cause of apical periodontitis, effective antimicrobial strategies to eradicate endodontic infections should take into account the patterns of microbial colonization. Microorganisms present as planktonic cells in the main root canal can be easily accessed and eliminated by instruments and substances used during treatment. On the other hand, microorganisms present in biofilms adhered to the canal walls or located into isthmuses, lateral canals, and dentinal tubules are more difficult to be eliminated and may require special therapeutic strategies.



Cocci in dentinal tubules approximately 300 µm from the main root canal. Dividing cells are seen within tubules. (From Siqueira JF, Jr., Rôças IN, Lopes HP: *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 93:174, 2002.)


Enamel
Dentin

Oral pathways of infection

- Once infection occurs in the pulp, there are several possible pathways of infection which are:

1. It can remain in the pulp and stimulate the formation of granuloma, radicular cyst, or condensing osteitis.
2. It can perforate through the root apex and form either an acute apical abscess or an acute periapical granuloma or radicular cyst.
3. It can perforate through the root apex and penetrate the **nasal fossa** and form a nasal abscess or penetrate the **maxillary sinus** and form maxillary sinusitis.
4. It can have recurrent flare-ups and form a chronic apical abscess and then create a path through the alveolar mucosa or skin. This path is called either a **sinus tract** (if it is lined by granulomatous tissue) or **fistula** (if it is lined by epithelium).

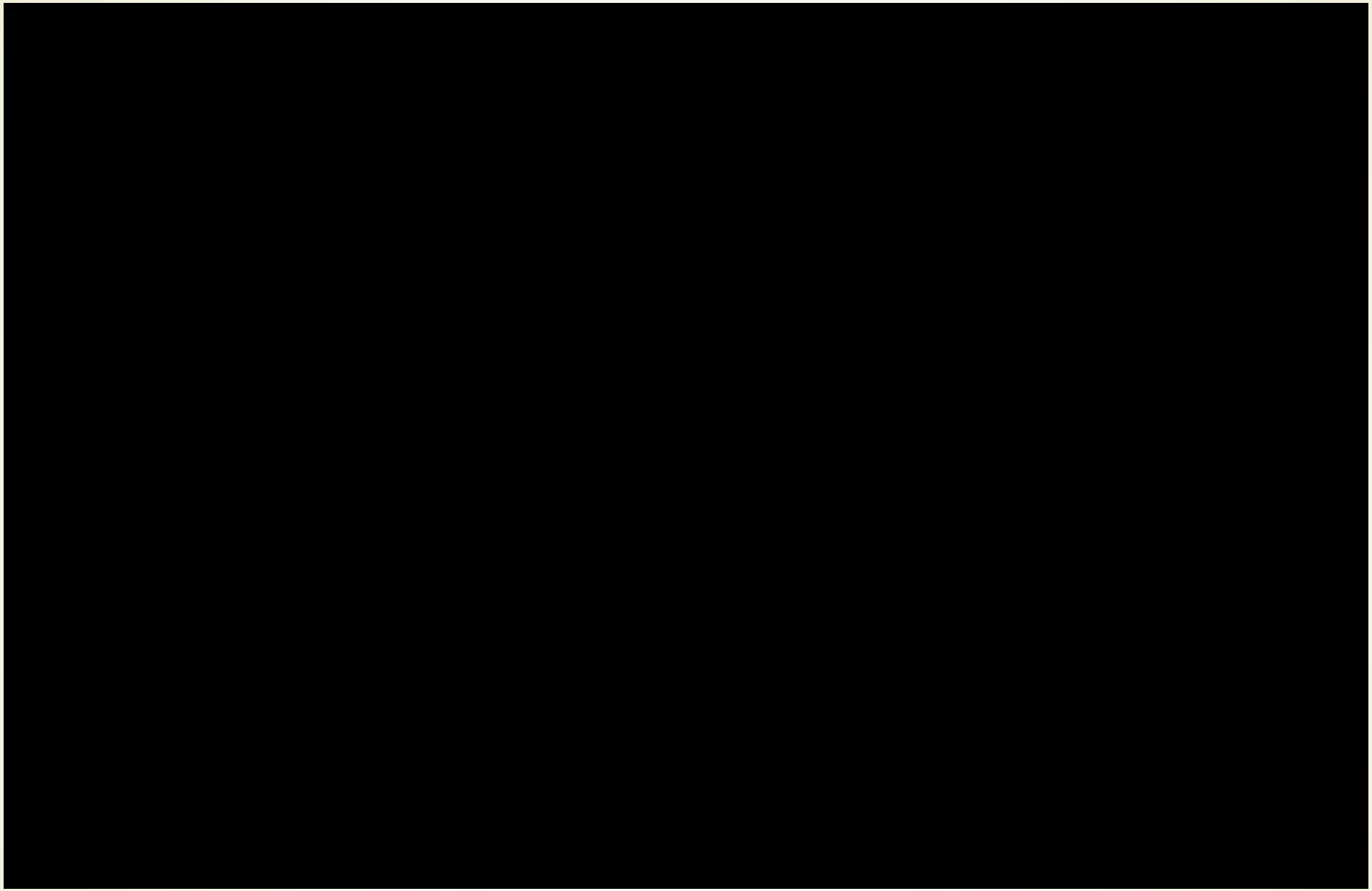
- These pathways can drain :

I. Through the labial(or buccal) or palatal (or lingual) mucosa into the oral cavity.
II. Into the gingival sulcus (or periodontal pocket)
III. Into the furcation region of molars.
IV. Through the skin of the face.
V. The infection can drain into the blood circulatory system and lymphatics.

Bacteremia, Septicemia and Cellulitis

Bacteremia

- Bacteria can be released into the bloodstream in the normal person following dental procedures, such as extraction, periodontal treatment and endodontic therapy.
- Bacteria in the bloodstream may lead to the serious infective endocarditis.
- In healthy person, the bacteria are disposed of within 10 minutes by body's blood-clearing mechanisms.
- In patients whose defense mechanisms are impaired by drugs, disease, vitamin deficiencies, malnutrition, lake of sleep…etc. microbes can multiply causing serious or fatal diseases.
- No surgical endodontics therapy within the confines of the root canals, is the least likely dental procedure to cause bacteremia.



Septicemia

- It is a serious, life-threatening bloodstream invasion by microbes and their noxious products.
- It generally **occurs** when **resistance is impaired** and/or **infection is sever**.
- It is associated with sever signs and symptoms.

Cellulitis

- It is an acute inflammation of the alveolar, loose connective tissues and also it is a diffuse, spreading type of inflammation.
- Cellulitis is the clinical manifestation of what is called a flare-up.
- As the result of the access preparation, **oxygen** enters the root canal system, which may facilitate facultative anaerobes to multiply ***and*** interact with force the an aerobes to produce inflammatory and edematous substances.
- Over instrumentation may force microbes through the apex and produces sever inflammation.

Bacteria culturing in endodontic practice

- **There are three reasons for culturing root canals:**

1. To determine the bacteriologic status of the root canal.
2. To assess the efficiency of the debridement procedure.
3. To isolate microbial flora for antibiotic sensitivity and resistance profiles in cases of persistent infections.

- For the following reasons a culture test is not useful for determining when to obdurate a root canal system:

I. There are many causes for a (**false-positive**):

1. Failure in sterilization of the operating field and instruments.
2. Rubber dam leaks.
3. Use of unsterile paper points.
4. Use of air, breath and hand contamination.
5. Root fracture.
6. Infected maxillary sinus.
7. Patent sinus tract.
8. Periodontal disease with exposure of lateral canals.
9. Incomplete seal of temporary restoration.

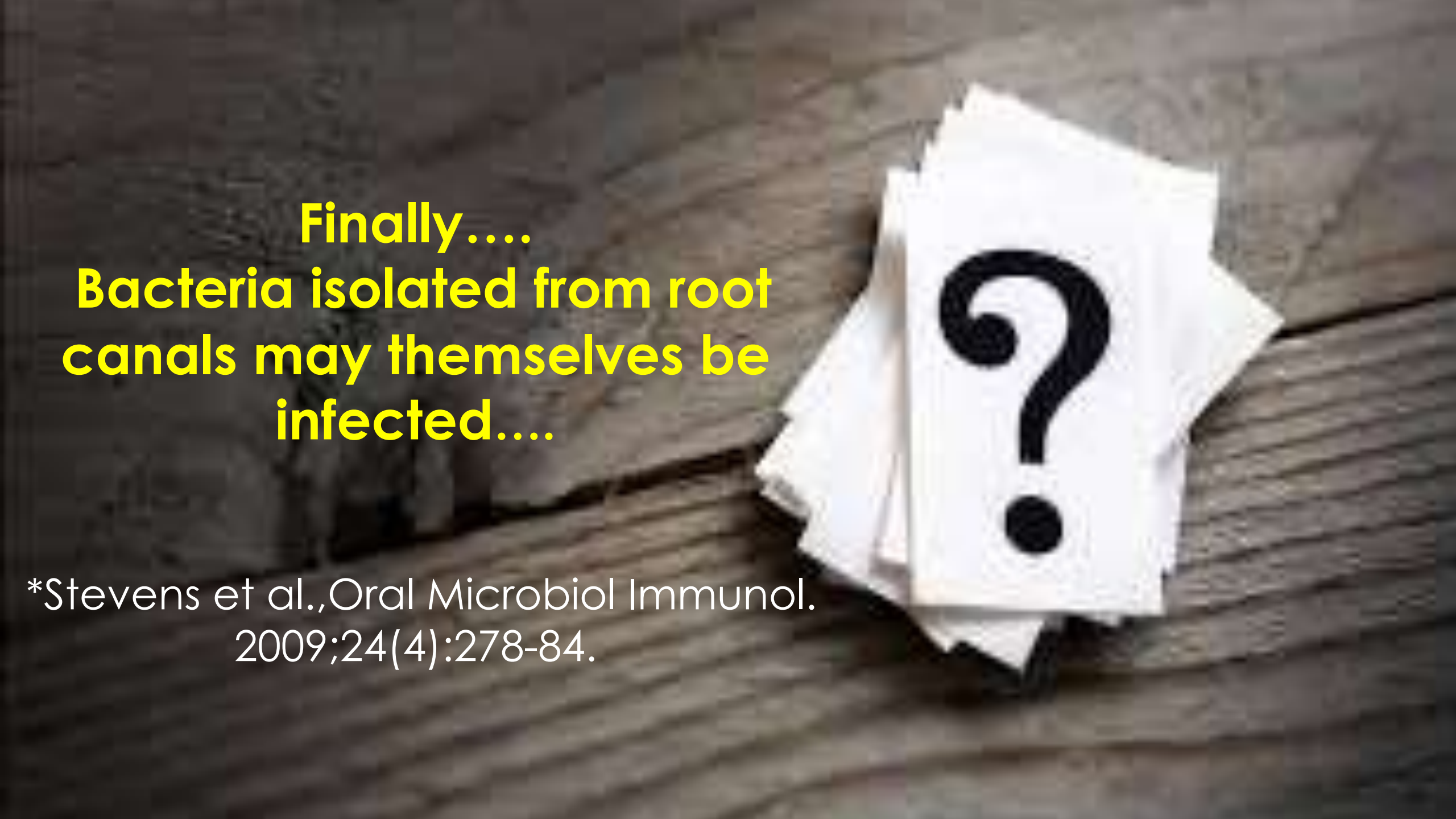
II. A (**false-negative**) culture can occur with the following:

1. Incomplete penetration of the paper point.
2. Use of the paper point that is too narrow.
3. A relatively dry canal.
4. Undetectable microbes(hidden in the dentinal tubules, accessory or lateral canals or cementum lacunae).
5. Culturing at the termination of the visit.
6. Phagocytes in the sample.
7. Dormant(non active) microbes in the sample.
8. Presence of antimicrobial materials in the canal and insufficient incubation time.

III. A culture test does **not reveal(discover)** the microbial virulence:

1. The microbial population.
2. Or the host's resistance.

❖ The host's response is of major importance in determining when to obturate a root canal system.


Finally….
Bacteria isolated from root canals may themselves be infected….
*Stevens et al.,Oral Microbiol Immunol. 2009;24(4):278-84.

So, if *E. faecalis* were to be cultured from a root canal, was the periapical lesion due to *Enterococcal* infection???

Who are we feeding?

THANK YOU

Dr.Ahmed Ibrahim Al-Jobory

Ph.D., M.Sc. B.D.S. Esthetic & Conservative Department/ Baghdad University
Member of Iraqi endodontics society

AHMAD
AL JOBORY

Intracanal medication

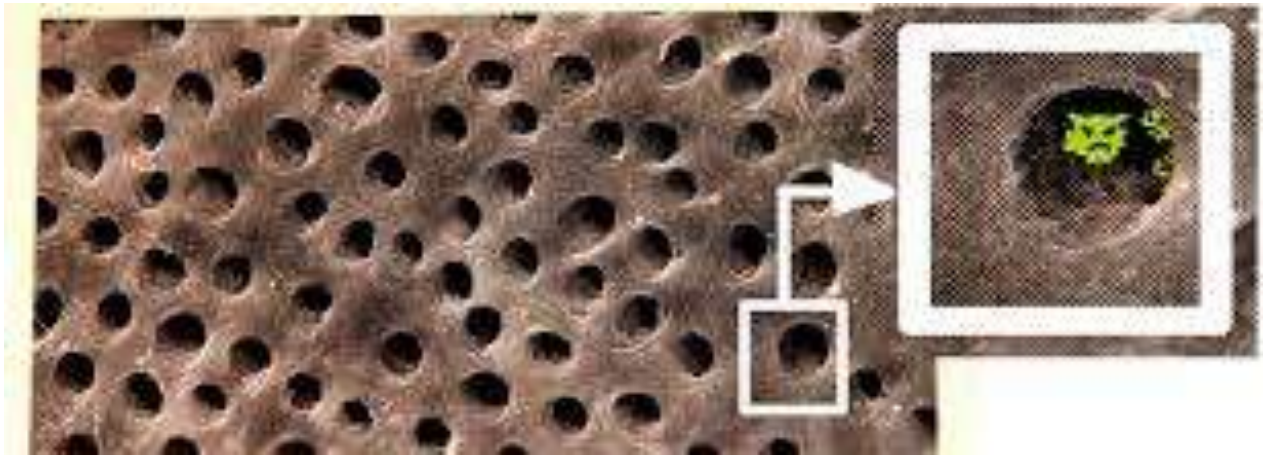

Camphor
Mono-Chlorophenol
15 ml
Camphor Mono-Chlorophenol (CMCP)


Tricresol & Formalin
Solution for root canal disinfection


CALCIUM HYDROXIDE PASTE
HEALIX MEDICO
CALCIUM HYDROXIDE PASTE

FUNCTIONS OF INTRA CANAL MEDICAMENT

- They disinfect the root canal system.
- To reduce the number of microorganism and prevent the growth of any new micro organisms in canal space.
- Prevention or control of post treatment pain.
- Control of periapical abscess (In weeping canal).



IDEAL REQUIREMENTS OF INTRACANAL MEDICAMENTS

1. It should be an effective germicide and fungicide.
2. It should be not irritating to the periapical tissues.
3. It should remain stable in solution.
4. It should be have prolonged antimicrobial effect.
5. It should be active in the presence of blood, serum and protein derivatives of tissues.
6. It should have low surface tension and easily diffusible.
7. It should not interfere with repair of periapical tissues.
8. It should not stain the tooth structure.
9. It should not induce a cell mediated immune response.
10. It should be easy to handle (mix & place and remove).
11. It should not be very expensive.

TYPES OF MEDICAMENTS:

- Phenolics
  - Eugenol
  - CMCP
  - Parachlorophenol
  - Camphorated parachlorophenol (CPC)
  - Cresol
  - Thymol
- Aldehydes: -
  - Formacresol
  - Glutaraldehyde
- Halides
  - Naocl
  - Iodine – potassium iodine
  - Chloramine T
- Steroids
- Heavy metal salts
- Ca (OH)2
- Antibiotics
- Combinations

- **Some types of intracanal medication**:

1- Phenol :

- is a protoplasm poison
- and produces necrosis of soft tissue
- is highly effective in 1% to 2% for controlling microbes
- at present it is rarely used as an ICM.

2- Eugenol :

- This is the chemical essence of oil of clove.
- It's antiseptic and an sedative.
- It is a constituent of most root canal sealer and used as a temporary sealing material.
- It inhibits intradental nerve impulses.
- at present it is rarely used as an ICM.

3- Camphorated phenol (CP) :

- is phenol liquefied in camphor.
-It is less toxic of the phenolic compounds.

4- Formocresol :

- Is combination of formalin and cresol.

-The formalin is strong disinfectant that combine with albumin to form insoluble, undecomposable substance and fixes the tissue.

- It is highly irritating and must be used cautiously in canal in a diluted (1:50) and almost dry form.

- It is non-specific bacterial medicament most effective against aerobic and anaerobic organisms found in root canals.

- Also it is mutagenic and carcinogenic.

- It must placed in cotton pellet in the pulp chamber of tooth and the vapors will penetrate the entire canal preparation.

5- Camphorated Mono-Chloro-Phenol (CMCP) :

- Is more toxic than phenol but it is also more active antiseptic.

- It is less irritating than formocresol.

- It also prolongs the antimicrobial effect.

6-Tri-cresol formalin :

- the compound used in endodontics is a mixture of three isomers.

7- Formaldehyde :

- has an antimicrobial effect similar to that of formocresol with less toxicity.

8.CALCIUM HYDROXIDE:

- Introduced by Herman in 1920.

- It is one of the commonly used ICM.

- It is a broad spectrum anti microbial agent.

- It s antiseptic action probably relates to its high pH and its leaching action on necrotic pulp tissue.

- It is best used in Weeping canals, where there is a constant clear or reddish exudate associated with large periapical lesion. The tooth will be often asymptomatic, culture will be usually - ve with no support of bacterial growth. In such cases calcium hydroxide is a excellent medicament to be used.

- Calcium hydroxide is best used in paste form when one anticipates an excessive delay between appointments.

- Calcium hydoxide has highest effect on endotoxin. i.e. inhibits lipopolysaccharides.

- Repair of periapical tissues after RCT of teeth periapical lesions was better when calcium hydoxide was used an ICM or dressing before obturation.

- In cases of apical periodontitis, root canal dressing with calcium hydroxide produce definite signs of healing after only few days .

- Calcium hydroxide can be used as a powder with various vehicles such as water, saline, L.A. Propleneglycol, glycerine etc. .Also now it’s came as syringe.


Antibiotics

Type of Antibiotics…

Bactericidal

(Fast Killing)

Bacteriostatic

(Slow Killing)

- If swelling is minor in degree and limited in scope and can relieved by root canal or soft tissue drainage, antibiotic are not necessary.
- If root canal or soft tissue drainage are not effective within 24 hours, then antibiotic should be used to prevent serious complications.
- With endodotically related infections, penicillin are the drugs of choice if no allergy exists.
- In case of allergy erythromycin is the drug of second choice.
- Broad-spectrum antibiotics, including ampicillin and tetracycline are less useful since endodontics infections are generally caused by gram-positive microbes which are usually susceptible to penicillin.
- Antibiotics usually should be given for approximately 5 days in order to eliminate the microbes.

Systemic drugs and supplements used in endodontics

Penicillin

- Incorporates Beta-Lactam in structure .
- Bactericidal.
- Short half life(regular doses).
- Accumulates in the kidney.
- Least Toxic Antibiotic.
- **Amoxicillin** Capsule 250mg OR 500mg,
  Oral suspension 125 and 250mg/5ml.
- **Ampicillin** Capsule 250mg OR 500mg.
  Oral suspension 100mg/ml, 125,250 and 500 mg/5 .....
- Dosage: In adults and children over 20 Kgs----250 to 500 mg/8 hrs upto 4-5gms/ day.
- In children 6-8 Kgs-----50 to 100 mg / 8 hrs

- **Augmentin----(Amoxicillin + Clavulanate potassium)** are given as 500 + 125 mg.

- Dosage: In adults and children over 20 Kgs----500+125 mg/6 hrs.
- In children and infants below 20 Kgs-----12.5 to 25 mg /Kg each 6 hrs

Cephalosporin

- Similar in penicillin in chemical structure.
- Incorporates Beta-Lactam in structure .
- Bactericidal.
- Wide spectrum.
- 1st ,2nd , 3rd ,4th and 5th generations.
- **Cefazolin** it's inj and comes with 250 mg, 500 mg, 1 gm and 10 gm as powder.
- Dosage: Adult 1-2 gms / 4-8 hrs.
- Infants over 3 months and children 100-200 mg /Kg / 8 hrs.

Consideration when using Penicillin and Cephalosporin

- Sever allergic reaction are rare with these group.
- If you are allergic to one then you could be allergic to other.
- Resistance to this group may happen.
- Beta-Lactamase Enzyme neutralizes them.
- Some antibiotics incorporate Clauvanic acid which make it resistance to enzyme.

Metronidazole

- Bactericidal.
- Mainly effects only anaerobic bacteria.
- Used in combination with other antibiotics like Amoxicillin and Augmentin.
- Cause stomach upset.
- Darkened urine.
- It come with 250, 400 and 500 mg as tab.
- Dosage : 2 gms as single dose or divided in two dose of 1 gm in 1 day (strong dose).
- Or 250 mg three times in day for 1 week.

Erythromycin

- Bacteriostatic.
- Kill same range of bacteria like penicillin.
- Drug of choice with penicillin allergy.
- It is coated capsule came with 125 mg, 250 mg and 500 mg.
- Dosage : Adult 250 mg/ 6 hrs (Or) 500 mg/ 12 hrs.

  Children 30 to 50 mg/ Kg/ 6 hrs

Clindamycin

- Bacteriostatic.
- Wide spectrum of action.
- Over growth of ***Clostridium difficile***
- Can cause ***pseudomembranous Colitis***. *(*inflammation of the large intestine resulting from infection with *Clostridium difficile*).
- penetrates well into Abscesses.

Tetracycline

- Bacteriostatic.
- Kills the broadest spectrum of bacteria.
- Excellent for Endo-Perio lesions.
- Not given to children, pregnant or lactating women which cause infant teeth discoloration.
- May cause Photosensitivity.
- It came as oral suspensions 125 mg/ 5 ml , Capsule 100, 250 and 500 mg; and also it come as inj i.v. 250 and 500 mg.
- Dosage : inj 250-500 mg / 6 hrs
- In adults and children more than 8 yrs 100mg / 8 hrs OR 250 mg once daily.

Analgesic used in endodontic

- Analgesics are drugs given for pain relief. The two major types of analgesics are **narcotics** and **nonnarcotics**.
- The narcotics act within the central nervous system and do cause addiction and produce tolerance.
- The nonnarcotics act principally at peripheral nerve endings by inhibiting the synthesis of prostaglandins. They do not produce addiction or tolerance and their toxicity is much less than that of narcotics.

CLASSIFICATION OF ANALGESIC DRUGS

Narcotic Analgesics	Non-Narcotic Analgesics
Morphine	Paracetamol
Diamorphine (Heroin)	Salicylate
Dihydrocodiene, codeine	Other anti inflammatory drugs e.g. Ibuprofen
Methadone	Mefenamic acid

- **Aspirin (acetylsalicylic acid)**
- It is widely used analgesic. It is contraindicated for patients receiving anticoagulants; those with gastric ulcer, asthma or allergic to it.
- A typical dose is one or two tablets(300mg-600mg) every 4 hours.

- **Acetaminophen**
- It is useful in patient with aspirin allergies.
- Unlike aspirin, it dose not affect the action of anticoagulants or cause gastrointestinal bleeding.
- Usual dosage is one to two tablets (500mg) every 4 hours.

- **Mefenamic acid**
- This drug is useful for patient with aspirin allergies.
- The usual dose is two tablets (500mg) at the onset, followed by one tablets (250mg) every 6 hours.

- The mefenamic acid should not be given to the following patient:

1. Those with intestinal ulcer, asthma, abnormal kidney function or gastrointestinal inflammations.
2. Children under 14 years of age.
3. Women in the child bearing age or who are pregnant.

- **Nutritional supplements**

- To aid in repair, the patient should be given sufficient proteins, minerals, vitamins A,C and B complex, and fluid (about 2.5 liters of water daily).
- It has been shown that stress depletes the vitamin C level in the blood, and most patients experience stress before, during or after endodontic therapy.
- Therefore, a good practice to give these patients vitamins C pre-endodontically and for a few days post-endodontically (500 mg twice a day, preferably in a sustained- or slow release capsule)


THANK YOU
FOR
LISTENING

DISINFECTION OF THE ROOT CANAL SYSTEM

By:

Dr.Ahmed Al-Jobory

2022-2023

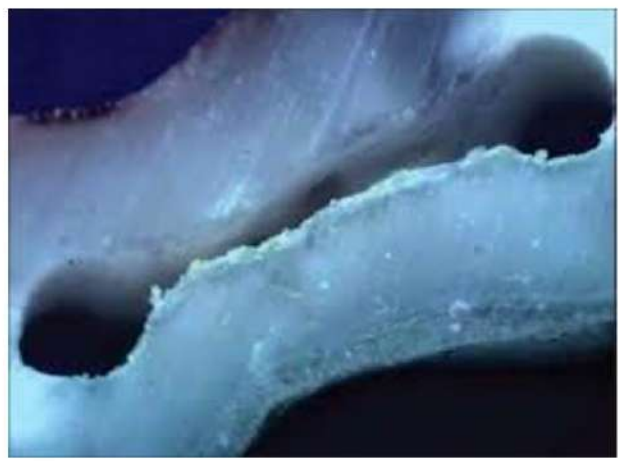
AHMAD
AL JOBORY

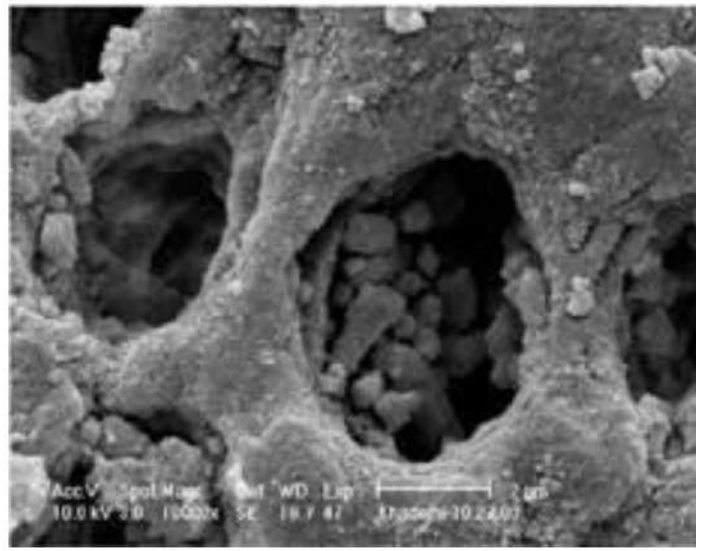
Irrigation is defined as “to wash out a body cavity or wound with water or a medicated fluid ”

Aspiration as “the process of removing fluids or gases from the body with a suction device. ”

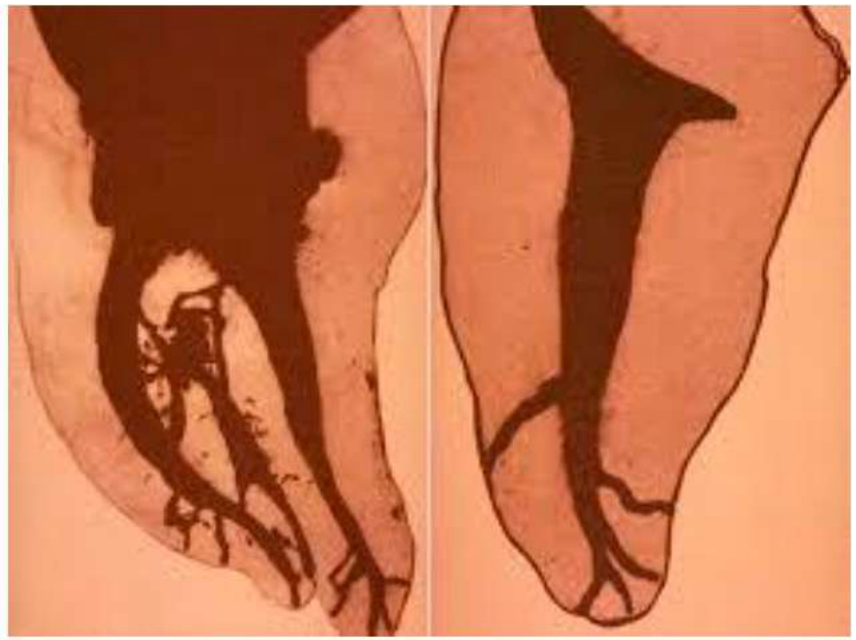
Disinfectant is defined as “an agent that destroys or inhibits the activity of microorganisms that cause disease “.

Why irrigation in endodontics





These pictures will answer



Eliminate infection from root canal by cleaning and shaping of entire root canal space.

The sequence of events and procedures in control of endodontic infections are:

1) Host defense system.
2) Systemic antibiotic therapy (rarely used, only with specific indications).
3) Instrumentation and irrigation (“cleaning and shaping”).
4) Intracanal medicaments (not always used) between appointments.
5) Permanent root canal filling.
6) Coronal restoration

IDEAL REQUIREMENTS OF ROOT CANAL IRRIGANTS:

1. Broad antimicrobial spectrum.
2. High efficacy against anaerobic and facultative microorganisms organized in biofilms.
3. Ability to dissolve necrotic pulp tissue remnants.
4. Ability to inactivate endotoxin.
5. Ability to prevent the formation or to dissolve the smear layer during instrumentation that formed.
6. Systemically nontoxic when they come in contact with vital tissues, non-caustic to periodontal tissues, and with little potential to cause an anaphylactic reaction.

Sodium Hypochlorite

NaOCl is the most commonly used irrigating solution because :

1- An antibacterial capacity.

2- Ability to dissolve necrotic tissue, vital pulp tissue, and the organic components of dentin and biofilms in a fast manner

- Sodium hypochlorite is a chemical compound with the formula NaOCl.
- Sodium hypochlorite solution commonly known as bleach ,is frequently used as a disinfectant or a bleaching agent.
- It is the medicament of choice during root canal treatments following its efficacy against pathogenic organisms and pulp digestion

Concentrations

- NaOCl is used in concentrations between 0.5 %and 5.25 % for root canal irrigation.
- Controversy exists over recommended concentrations of sodium hypochlorite during root canal treatment.
- Higher concentrations is more effective against Enterococcus faecalis and Candida albicans.
- NaOCl in higher concentrations has a better tissue-dissolving ability. However, in lower concentrations it can be equally effective.
- Higher concentrations of NaOCl are more toxic than lower concentrations, but higher concentrations have successfully been used during root canal treatment.

Mode of Action

1. Saponification reaction: Sodium hypochlorite acts as an organic and fat solvent that degrades fatty acids and transforms them into fatty acid salts (soap) and glycerol (alcohol), reducing the surface tension of the remaining solution.

2. Neutralization reaction: Sodium hypochlorite neutralizes amino acids (found in protoplasm of bacteria) by forming water and salt. With the exit of hydroxyl ions (OH-), the pH is reduced. HOCl (hypochlorous acid) will finished it's effect.

3. Solvent action: Sodium hypochlorite also acts as a solvent for organic tissues releasing **chlorine** that react with protein amino groups (NH) to form nitrogen formaldehyde and acetaldehyde; break peptide link and dissolve protein of bacteria (**Chloramination reaction**). Chloramines impede cell metabolism; chlorine is a strong oxidant and inhibits essential bacterial enzymes by irreversible oxidation of SH groups (sulfydryl group)

4. High pH: Sodium hypochlorite is a strong base (pH >11). The antimicrobial effectiveness of sodium hypochlorite, based on its high pH (hydroxyl ions action), is similar to the mechanism of action of calcium hydroxide. The high pH interferes in cytoplasmic membrane integrity due to:

1- Irreversible enzymatic inhibition.
2- Biosynthetic alterations in cellular metabolism.
3- Phospholipid degradation observed in lipidic peroxidation

Allergic Reactions to Sodium Hypochlorite

Although few reports have been published on allergic reactions to NaOCl.

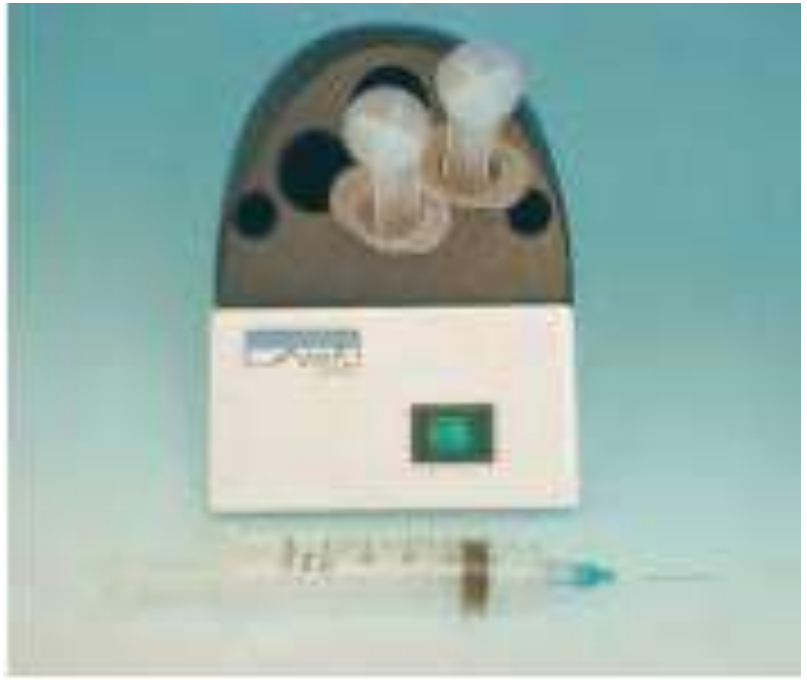
It must be remembered that the hypochlorous acid (active component of the sodium hypochlorite) is a chemical substance that is elaborated by neutrophils in the process of phagocytosis; it may create local tissue damage when it is produced in excess (liquefaction necrosis: purulent exudate) but does not cause allergic responses.

Nevertheless, hypersensitivity and contact dermatitis may occur in rare situations.

- When hypersensitivity to NaOCl is suspected or confirmed, chlorhexidine should not be used because of its chlorine content.

Temperature

- Increasing the temperature of low-concentration NaOCl solutions improves their immediate tissue-dissolution capacity.
- Furthermore, heated hypochlorite solutions remove organic debris from dentin shavings more efficiently.
- Some authors recommend heating of NaOCl. This can be done by activating ultrasonic or sonic tips to the NaOCl inside the root canal for a couple of minutes.



Time of exposure for optimal effect

Time are important factors for the effectiveness of NaOCl. The chlorine ion, which is responsible for the dissolving and antibacterial capacity of NaOCl, is unstable and consumed rapidly during the first phase of tissue dissolution, probably within 2 minutes which provides another reason for continuous replenishment .

Chlorhexidine

- Chlorhexidine (CHX) was developed in the UK and first marketed as an antiseptic cream, disinfection purposes and the treatment of skin, eye, and throat infections.

- CHX is a strongly basic molecule with a pH between (5.5 and 7).

- CHX digluconate salt is easily soluble in water and very stable.

- CHX has been extensively studied as an endodontic irrigant and intracanal medication.

Mode of Action

- Chlorhexidine; because of its cationic charges, is capable of electrostatically binding to the negatively charged surfaces of bacteria. Damaging the outer layers of the cell wall and rendering it permeable.

- CHX is a wide-spectrum antimicrobial agent, active against gram-positive, gram-negative bacteria and yeasts.

Mode of Action

- Depending on its concentration, CHX can have both bactericidal and bacteriostatic effects.
- **At high concentrations**, CHX acts as a detergent; and exerts its bactericidal effect by damaging the cell membrane and causes precipitation of the cytoplasm.
- **At low concentrations**, CHX is bacteriostatic, causing low molecular-weight substances (i.e., potassium and phosphorus) to leak out and the cell being permanently damaged .

Chlorhexidine as an Endodontic Irrigant

- The antibacterial efficacy of CHX as an irrigant is dependent on concentration.
- It has been demonstrated that 2% CHX has a better antibacterial efficacy than 0.12% CHX.
- When comparing with the effectiveness with NaOCl, controversial results can be found. NaOCl has an obvious advantage over CHX with tissue-dissolving ability and it does not remove the smear layer .

Allergic Reactions to Chlorhexidine

- ✓ Allergic responses to CHX are rare, and there are no reports of reactions following root canal irrigation with CHX.

Ethylenediamine Tetra-Acetic Acid (EDTA)

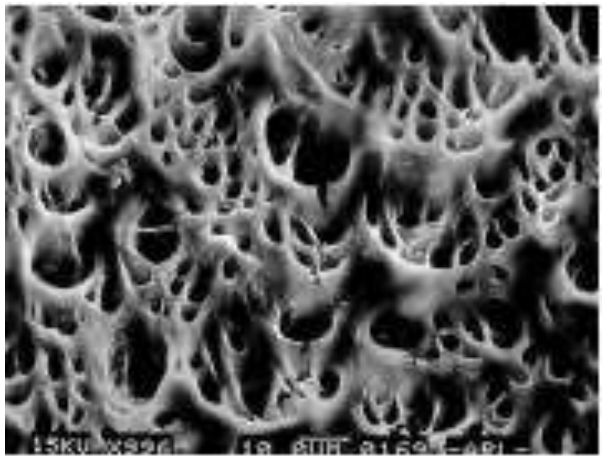
- The compound was first described in 1935 by Ferdinand.
- Chelating agents were introduced into endodontics as an aid for the preparation of narrow and calcified root canals , it is widely abbreviated as EDTA.
- *Why?* EDTA is often suggested as an irrigation solution **because** it can chelate and remove the mineralized portion of the smear layer.
- Its prominence as a chelating agent arises from its ability to sequester di- and tri- cationic metal ions such as Ca^{2+} and Fe^{3+} .

Mode of Action

- EDTA extracts bacterial surface proteins by combining with metal ions from the cell envelope, which can eventually lead to bacterial death.
- Chelators such as EDTA form a stable complex with calcium.
- When all available ions have been bound, equilibrium is formed and no further dissolution takes place; therefore, EDTA is self-limiting.

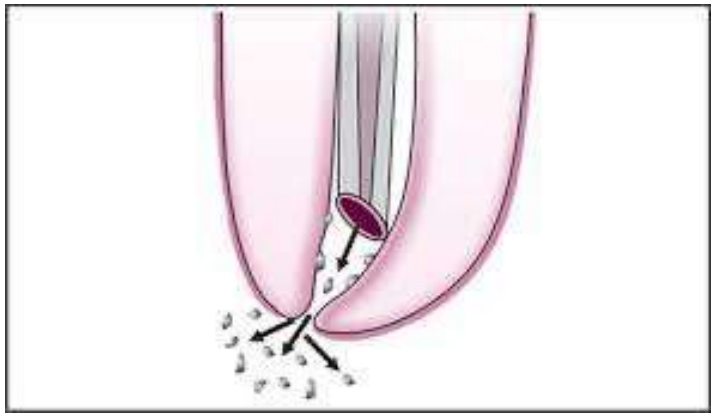
Applications in Endodontics

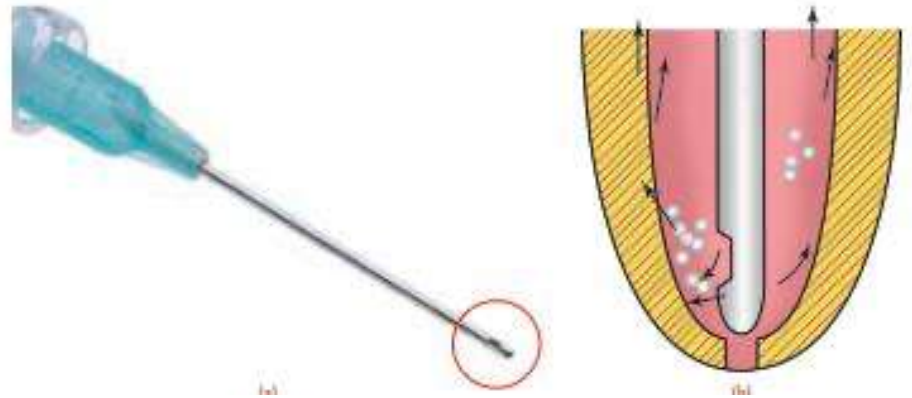
- EDTA alone normally cannot remove the smear layer effectively; a proteolytic component, such as NaOCl, must be added to remove the organic components of the smear layer.
- EDTA is normally used in a concentration of 17% and can remove the smear layers when in direct contact with the root canal wall for less than 1 minute.
- Even though EDTA has self-limited action, if it is left in the canal for longer or NaOCl is used after EDTA, erosion of dentin has been demonstrated.
- A comparison of bacterial growth inhibition showed that the antibacterial effects of EDTA were stronger than citric acid and 0.5% NaOCl but weaker than 2.5% NaOCl and 0.2%CHX.
- EDTA had a significantly better antimicrobial effect than saline solution.



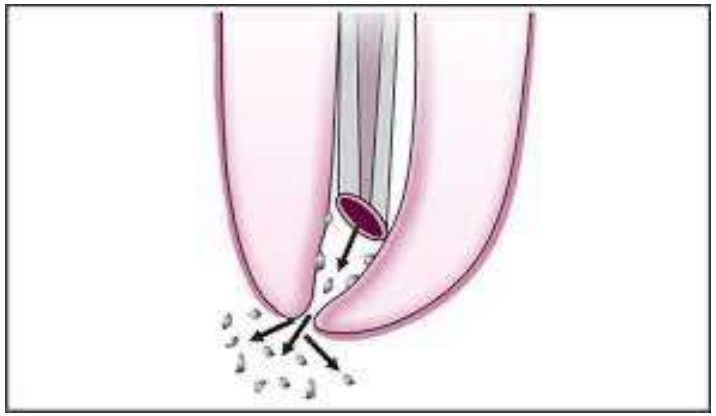
Irrigation guidelines

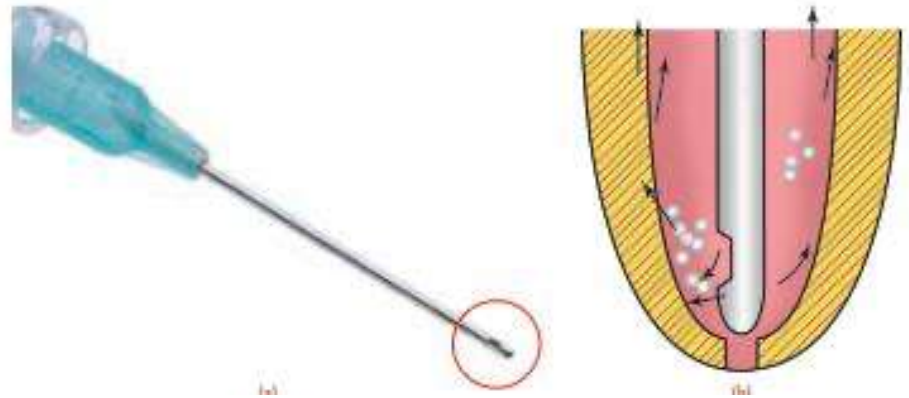
- The technique of irrigation is simple.
- The only instrument required is a disposable luer lock syringe with an endodontic blunt-ended side vented needle.
- The needle is inserted partway into the root canal.
- It should be passively inserted without binding into the root canal.
- Sufficient room between the needle and canal wall allows for the return flow of the solution and avoids forcing of solution into the periradicular tissues.



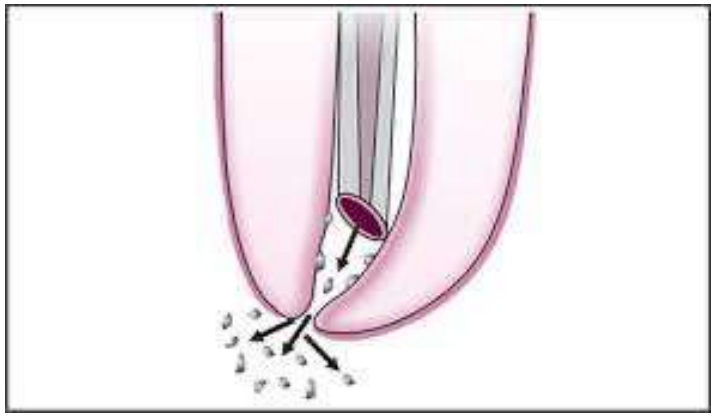


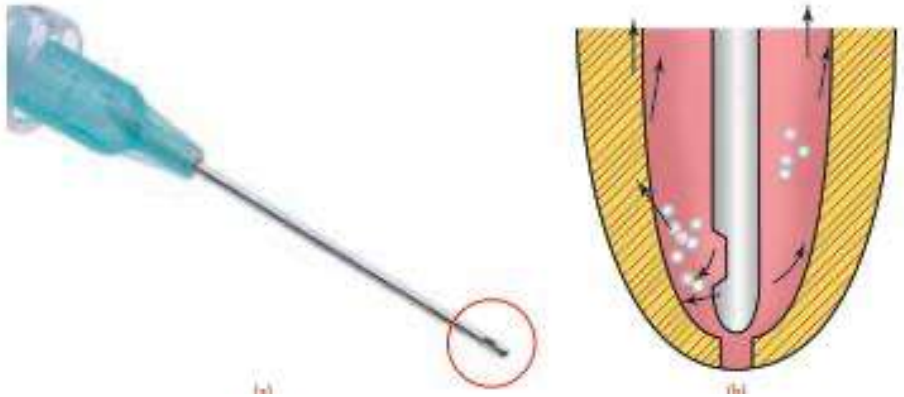
- In many cases, in the upper anterior teeth, the needle can be inserted for a distance few millimeter short of the working length without binding.
- When one is certain that the needle does not bind, the solution should be ejected from the syringe with little pressure on the plunger.
- The objective is to irrigate the canal and not to force the solution under pressure into the periradicular tissues.
- During the shaping and cleaning of the root canal, care should be taken that the canals are always full of fresh solution.





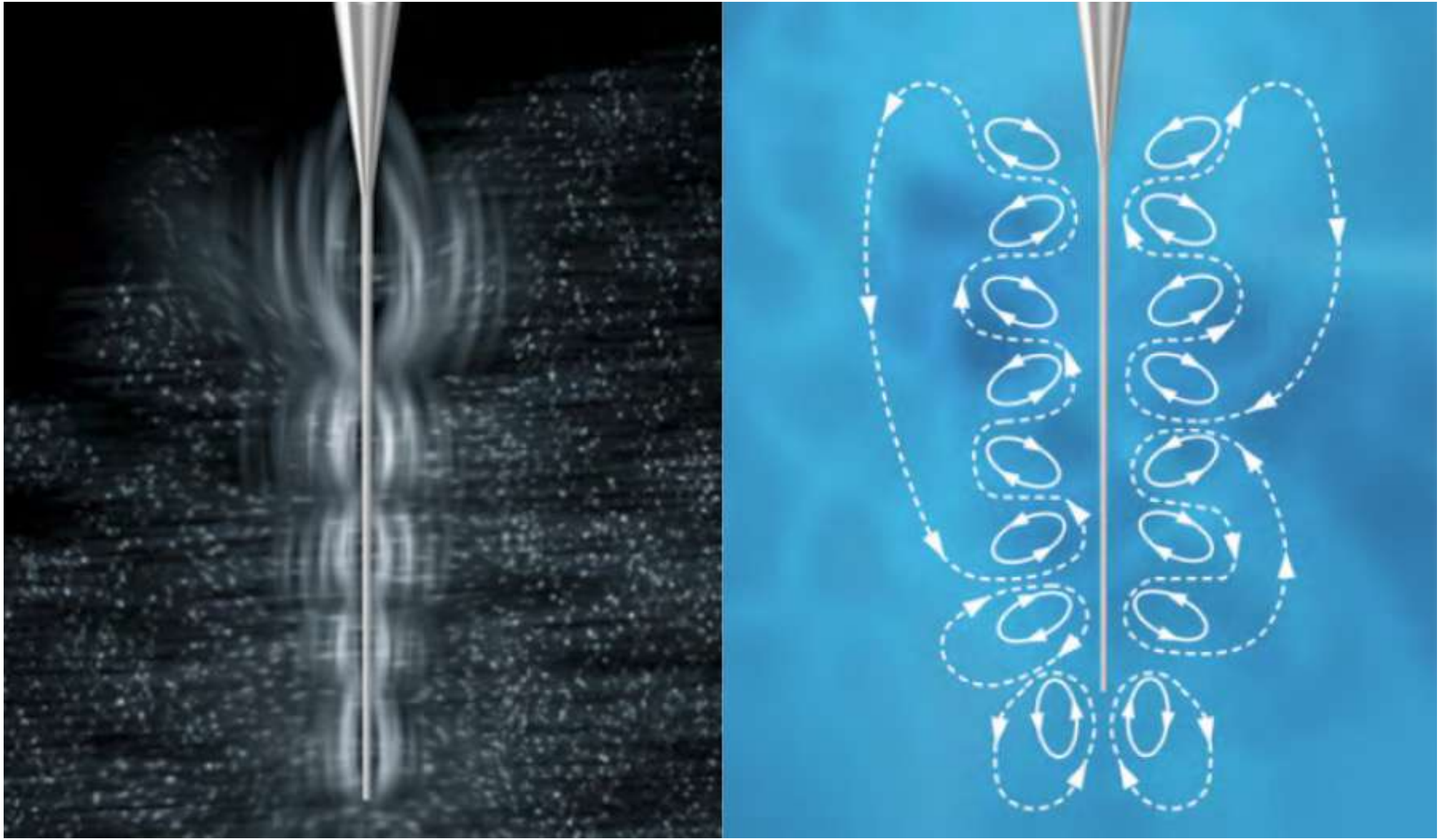
- In narrow root canals, the tip of the needle is placed near the root canal orifice and the irrigant is discharged until it fills the pulp chamber; the solution is then pumped into each root canal with a root canal file.
- The return flow of solution is caught on a gauze sponge or is aspirated.
- Irrigation should be followed by thorough drying of the root canals after the completion of shaping and cleaning.
- Most of the residual irrigating solution may be removed from the root canal by holding the needle of the syringe in the canal and with-drawing the plunger slowly.
- Final drying should be effected with absorbent points.





Irrígant
actívatíon

- is the process of activating an irrigant through the introduction of an instrument into the canal and moving it within the canal with a reciprocating, oscillating, or rotating action.



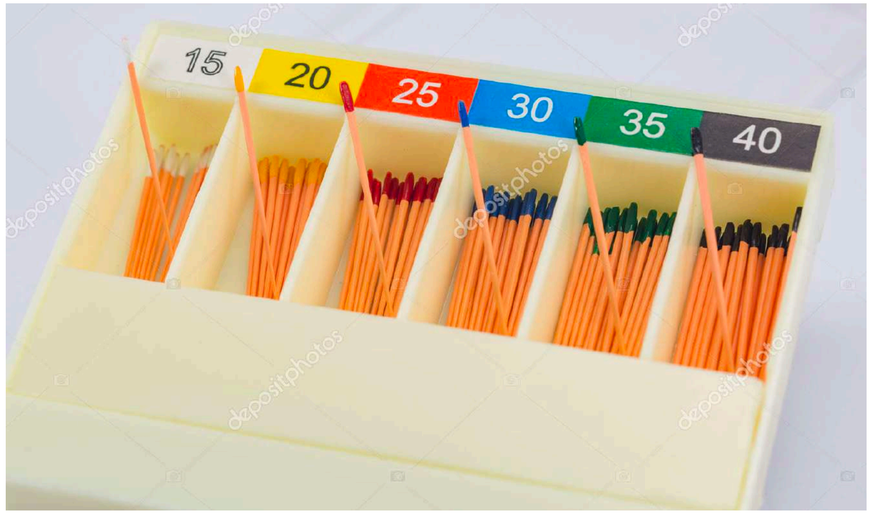
Efficiency of root canal irrigation in terms of debris removal and eradication of bacteria depends on several factors :

1. Penetration depth of the needle.
2. Diameter of the root canal.
3. Inner and outer diameter of the needle.
4. Irrigation pressure
5. Viscosity of the irrigant.
6. Velocity of the irrigant at the needle tip.
7. Type and orientation of the needle bevel.


THANK YOU

Root canal filling materials

DR. AHMED AL-JOBORY 2022-2023


15
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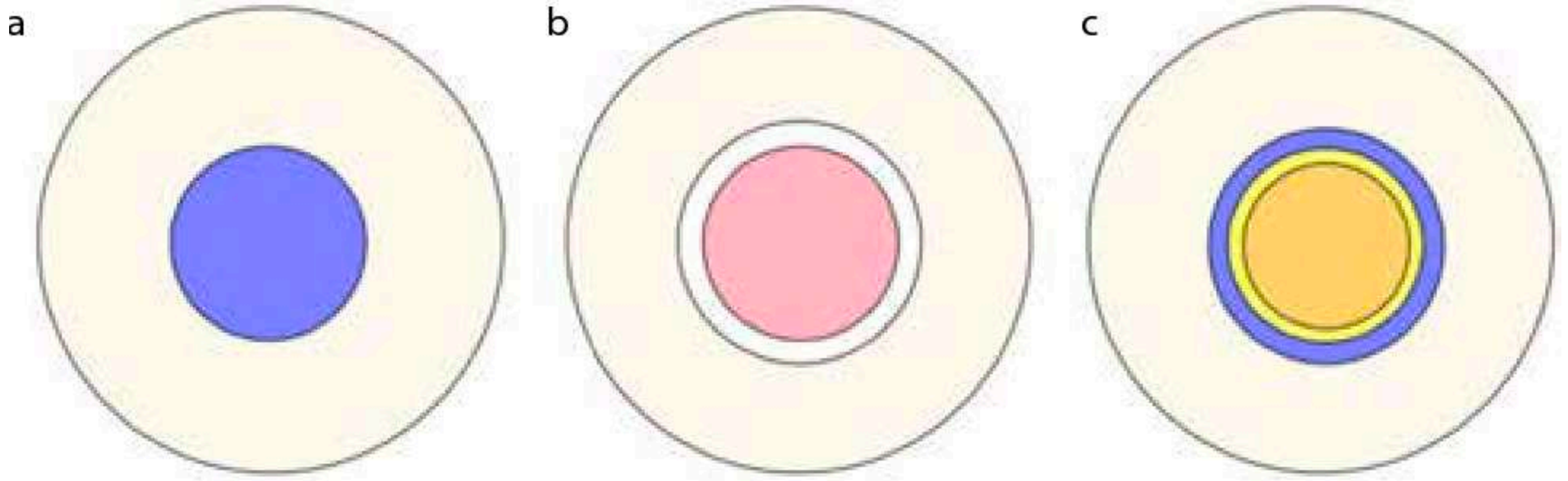
Endofill
Root canal filling material
with Dexamethasone
Ciment d'obturation
à la dexaméthasone
15 g powder
15 ml liquid
Endofill
Made in Switzerland


angelus
BIO-C
SEALER
2g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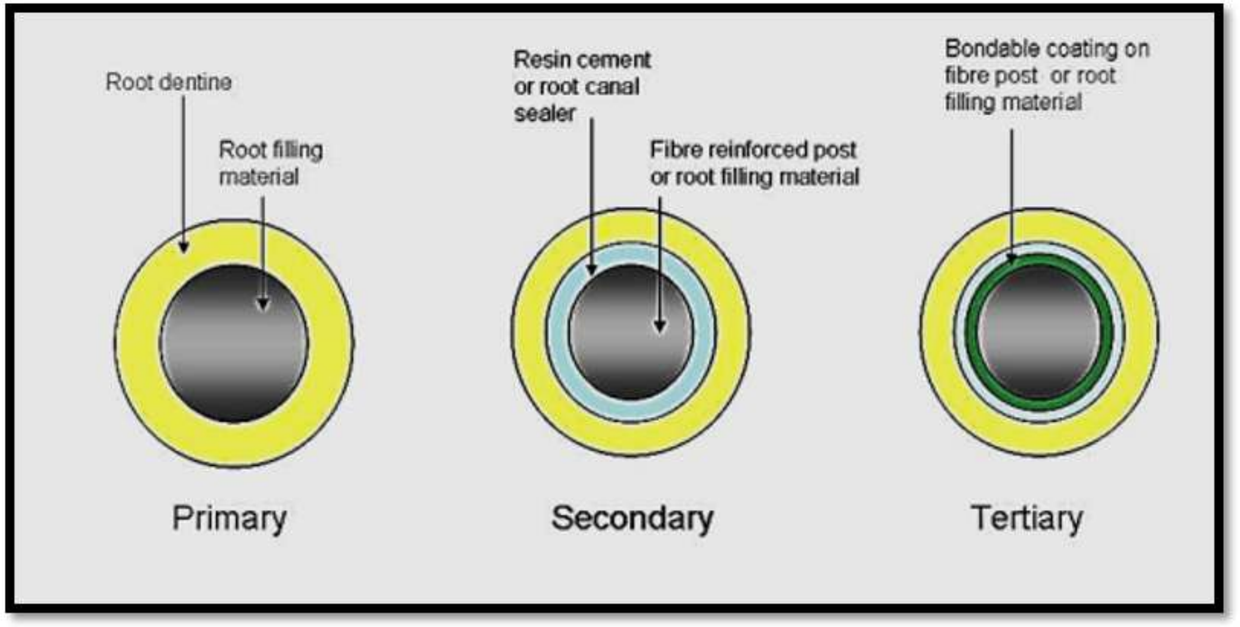

Root dentine
Root filling material
Resin cement or root canal sealer
Fibre reinforced post or root filling material
Bondable coating on fibre post or root filling material
Primary
Secondary
Tertiary

Sealer

Sealer

- They are paste like material that is essential to seal the space between the dentinal wall and the gutta percha.

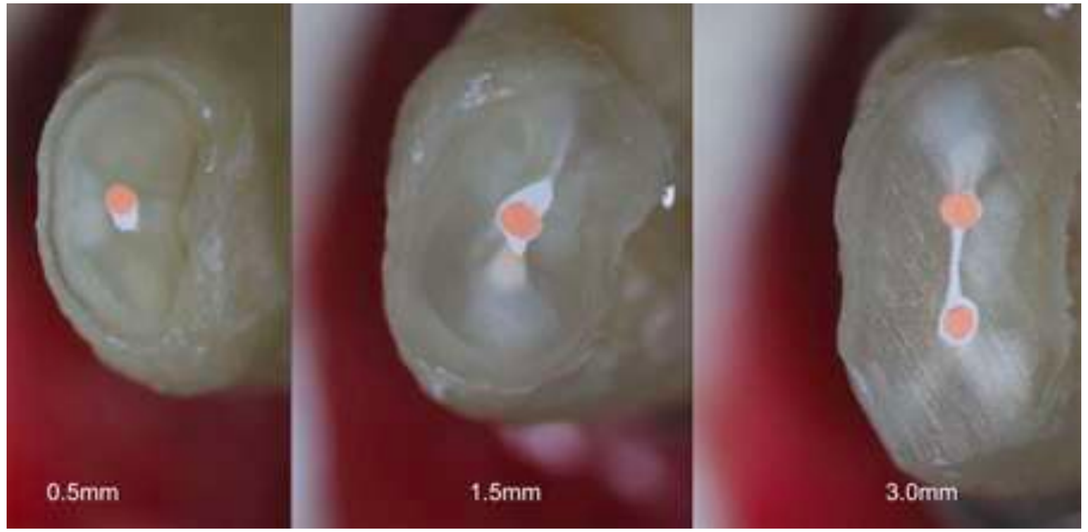
- ***Functions of the root canal sealer***

1- Cementing the core material to the canal wall.

2- Filling and marking irregularities that can not be filled by gutta percha (lateral and accessory canals).

3- Act as a lubricant to ease the placement of the master cone.

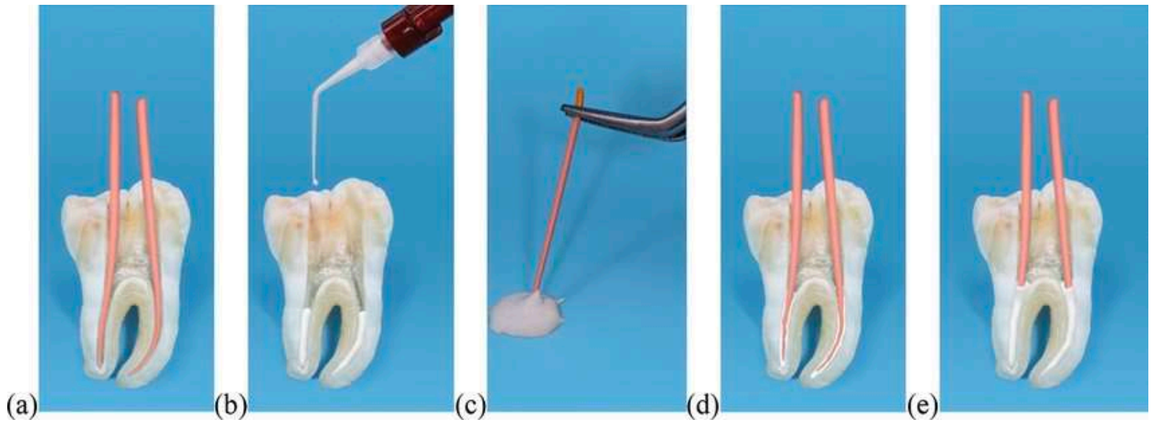
4- Act as a bactericidal agent.



Sealer

Properties of an Ideal Sealer

1- Exhibits tackiness when mixed to provide good adhesion.
2- Produce a hermetic seal.
3- Radiopaque.
4- Very fine powder to get a smooth mix with the liquid.
5- No shrinkage on setting.
6- No staining of tooth structure.
7- Bacteriostatic.
8- Exhibits a slow set.
9- Insoluble in tissue fluids.
10- Tissue tolerant.
11- Soluble in common solvents.



Zinc Oxide and Eugenol

- Zinc oxide–eugenol sealers have been used for many years.

- **<u>They have certain properties as:</u>**

1- Exhibit a slow setting time.

2- Shrinkage on setting.

3- Solubility especially when extruded outside the root canal.

4- Stain tooth structure.

5- It has antimicrobial activity.

<u>Types of zinc oxide eugenol sealers</u>

1- **Rickert sealer**. This powder/liquid sealer contains silver particles for radiopacity. It stains tooth structure if not completely removed. This sealer is popular when using thermoplastic techniques.

2- **Procosol sealer**. It is a modification of Rickert's formula in which the silver particles have been removed.

3- **Roth's sealer**. This is a modification of the Rickert' sealer as it is nonstaining.

4- **Tubli-Seal**. It is a catalyst/base zinc oxide–eugenol sealer. It has a faster setting time when compared with the liquid/powder sealers.

Calcium Hydroxide Sealers.

- They were developed for their antimicrobial activity and osteogenic–cementogenic potential.
- These actions were very limited.
- From the types of this group are Sealapex (catalyst/base system), Apexit and Apexit Plus.

Noneugenol Sealers.

- They are root canal sealers without the irritating effects of eugenol.

Glass Ionomer Sealers.

- The glass ionomers have been developed in root canal obturation because of their dentin-bonding properties.
- An example from this group is Ketac-endo.

- ***Properties of this group*:**

1- It enables adhesion between the material and the canal wall.
2- It is difficult to properly treat the dentinal walls in the apical and middle thirds with modify agents to receive the glass ionomer sealer.
3- It has minimal antimicrobial activity.

Resin sealers.

- These sealers provide adhesion, and do not contain eugenol.

Types of this group are:

1- **Ah-26.** It is a slow-setting epoxy resin that releases formaldehyde when setting.

2- **Ah Plus.** It is a modified formulation of Ah-26 in which formaldehyde is not released. It exhibits a working time of approximately 4 hours.

3- **EndoREZ**. It is a methacrylate resin with hydrophilic properties. When used with endoREZ resin-coated gutta-percha cones the dual cure endoREZ sealer bonds to both the canal walls and the core material.

4- **Diaket.** It is a polyvinyl resin sealer.

5- **Epiphany and RealSeal**. They were introduced for use with the resilon filling material.

Silicone Sealers.

1- **RoekoSeal** is a polyvinylsiloxane that is supposed to expand slightly on setting.
2- **GuttaFlow** is a cold flowable matrix that is triturated. It consists of gutta- percha added to roekoSeal. Sealing ability is comparable to other techniques.

Bioceramic sealers.

- It is composed of zirconium oxide, calcium silicates, calcium phosphate monobasic, calcium hydroxide, and various filling and thickening agents.

- ***Properties of this group:***

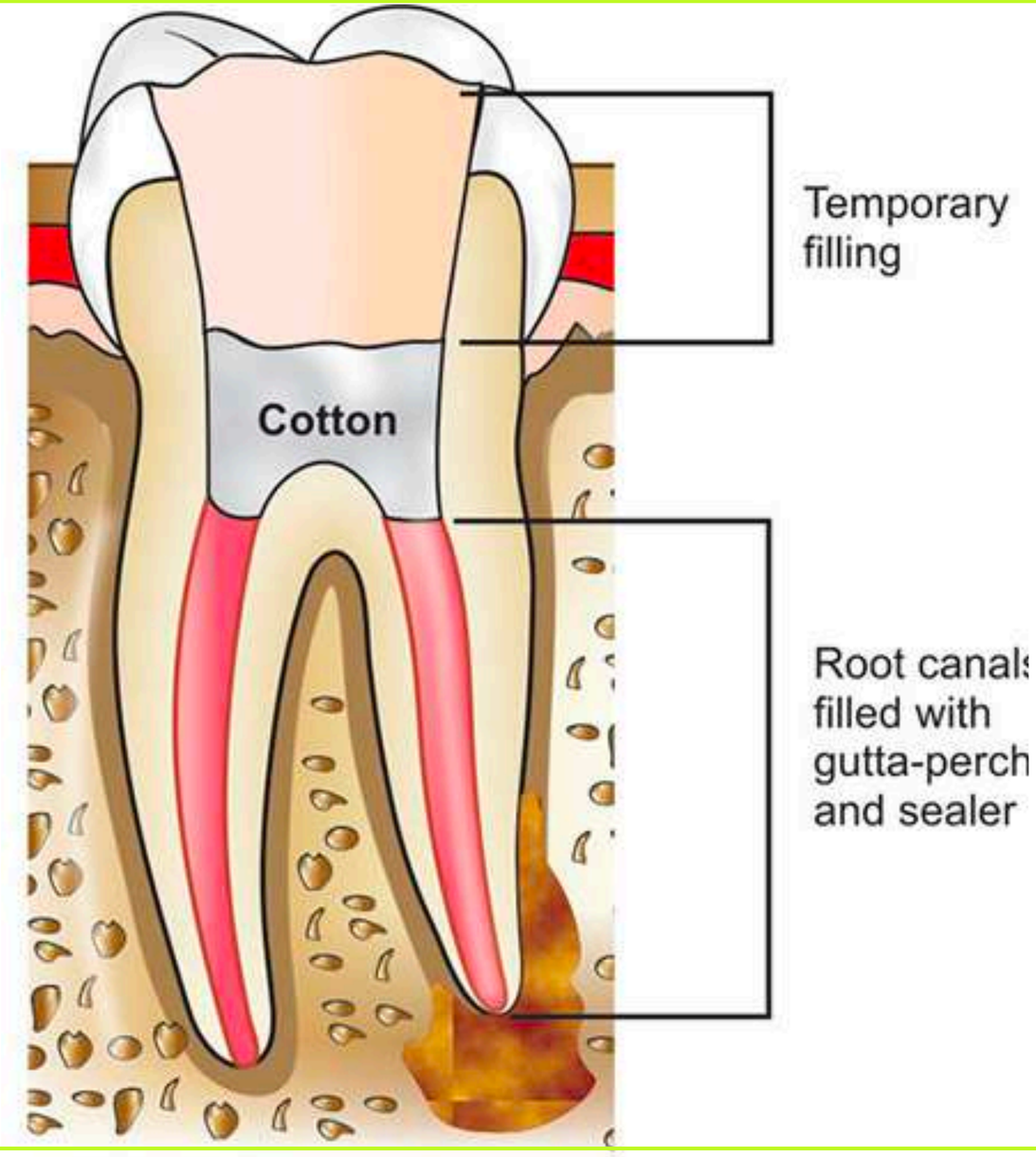
1- It is a hydrophilic sealer it utilizes moisture within the canal to complete the setting reaction.

2- It does not shrink on setting.

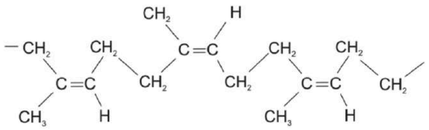
3- It is biocompatible.

4- It exhibits antimicrobial properties during the setting reaction.

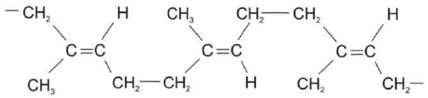
Semi Rigid types materials for obturation of the root canal



I- Gutta Percha



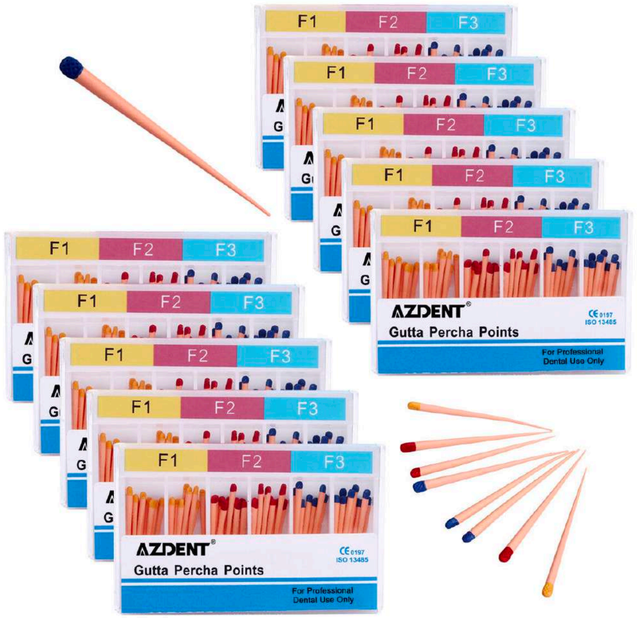
Natural rubber



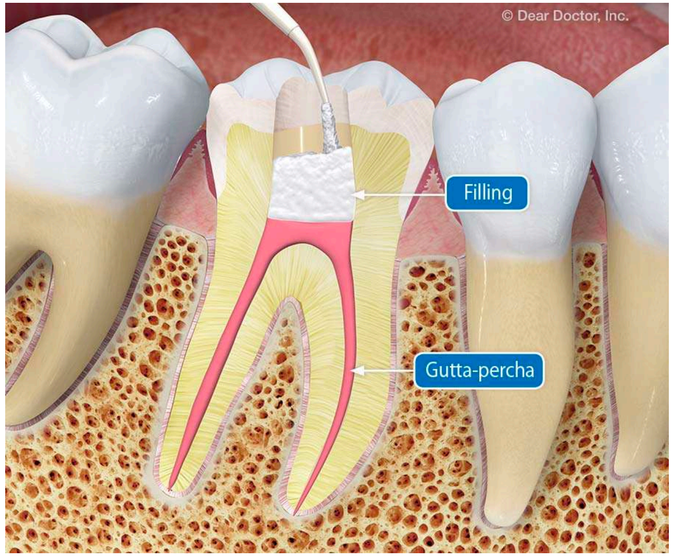
Gutta-percha

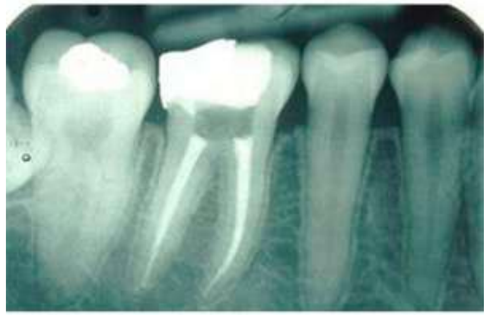
- Gutta-percha is the most commonly used root canal filling material.
- It is a linear crystalline polymer that melts at a set temperature, with a random but distinct change in structure resulting.
- It occurs naturally as 1,4- polyisoprene and is harder, more brittle, and less elastic than natural rubber.
- The crystalline phase has two forms, the alpha phase and the beta phase.
- The alpha form is the material that comes from the natural tree product.
- The processed, or beta, form is used in gutta-percha for root fillings.
- When heated, gutta-percha undergoes phase transitions.
- The transition from beta phase to alpha phase occurs at around 46° C. An amorphous phase develops at around 54° C to 60° C.

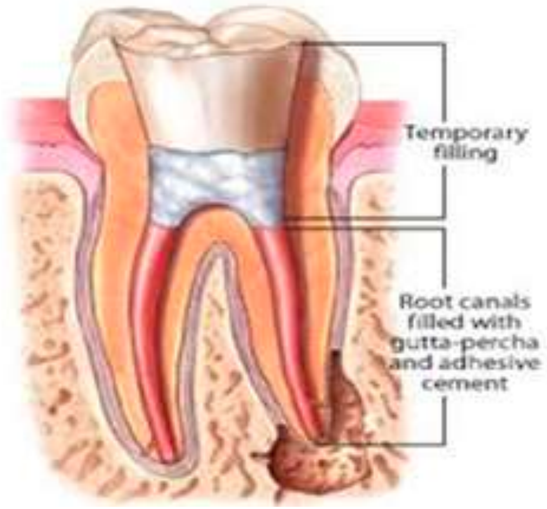
- When cooled very slowly gutta-percha crystallizes to the alpha phase.
- Normal cooling returns the gutta-percha to the beta phase.
- Gutta- percha cones soften at a temperature above 64° C.
- These cones can easily be dissolved in many solvents as chloroform, halothane and xylene.
- Modern gutta-percha cones that are used for root canal fillings contain only about 20% gutta-percha.
- The major component is zinc oxide (60% to 75%).
- The remaining 5% to 10% consists of various resins, waxes, and metal sulfate.
- Antiseptic gutta-percha with various antimicrobial agents as chlorhexidine and calcium hydroxide may be seen.



- Gutta-percha cannot be heat sterilized, therefore NaOCl can be used to disinfect the cones by dipping them for 1 minute. Pressure applied during root canal filling procedures does not compress gutta-percha, but rather compacts the gutta-percha cones to obtain a more three- dimensionally complete fill of the root canal system.
- After heating, while cooling, there is a slight shrinkage of approximately 1% to 2% when the gutta-percha has solidified.
- Gutta-percha cannot be used alone as a filling material; it lacks the adherent properties necessary to seal the root canal space. Therefore, a sealer is always needed for the final seal.
- Gutta-percha cones are available in tapers matching the larger tapered rotary instruments (#.02, #.04, and #.06).







Advantages of gutta percha

1- Inert
2- Dimensional stability
3- Non allergic
4- Antibacterial
5- Non staining to dentin
6- Radiopaque
7- Compactable
8- Softened by heat
9- Softened by organic solvents.

Disadvantages of gutta percha

1- Lack of rigidity
2- No adherence to dentin
3- No complete adaptation to narrow areas.

II- Resilon

- Gutta-perchaIt is a thermoplastic, synthetic, polymer-based root canal filling material.
- It was developed to create an adhesive bond between the solid-core material and the sealer.
- Resilon can be supplied in the same ISO sizes and shapes (cones and pellets) as gutta percha.
- When manufactured in cones, Resilon's flexibility is similar to that of gutta- percha.
- Based on polyester polymers, Resilon contains bioactive glass and radiopaque fillers (bismuth oxychloride and barium sulfate) with a filler content of approximately 65%.
- It can be softened with heat or dissolved with solvents such as chloroform.

III-Mineral trioxide aggregate (MTA)

- It was developed for use as a dental root repair material by **Dr. Mahmoud Torabinejad** and was formulated from commercial Portland cement combined with bismuth oxide powder for radiopacity.
  - **MTA is used for:**

1- Creating an apical plug during apexification.
2- Repairing root perforations during root canal therapy.
3-Treating internal root resorption.
4- Root-end filling material.
5- Pulp capping material.

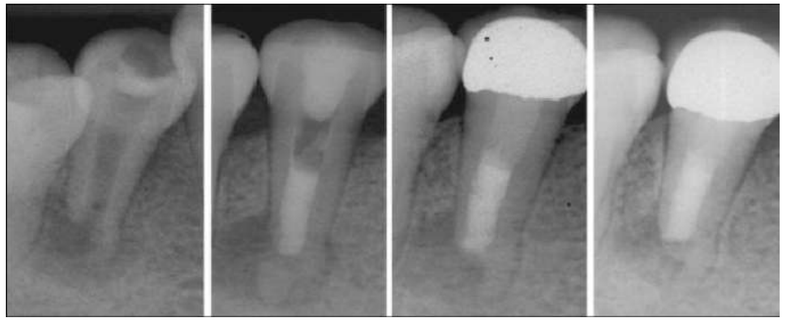
  - **MTA is composed of:**

1- Tricalcium silicate.
2- Dicalcium silicate.
3- Tricalcium aluminate.
4- Tetracalcium aluminoferrite.
5- Calcium sulfate.
6- Bismuth oxide.

The later 4 phases vary among the commercial products available.

Characteristics and products

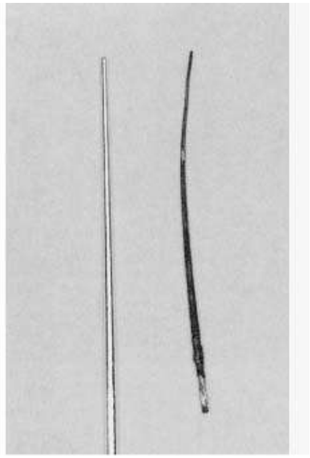
1. Biocompatible with periradicular tissues
2. Non cytotoxic to cells, but antimicrobial to bacteria
3. Non-resorbable
4. Minimal leakage around the margins.
5. Very basic AKA alkaline (high pH when mixed with water).
6. As a root-end filling material MTA shows less leakage than other root-end filling materials, which means bacterial migration to the apex is diminished.
7. Treated area needs to be infection free when applying MTA, because an acidic environment will prevent MTA from setting.
8. Compressive strength develops over a period of 28 days, similar to Portland cement. Strengths of more than 50 MPa are achieved when mixed in a powder-to-liquid ratio of more than 3 to 1.



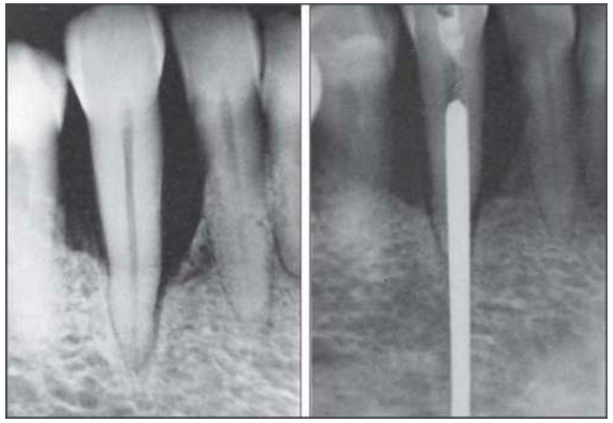
- **Originally,** MTA products required a few hours for the initial and final setting but newer materials are available that set more quickly and have added characteristics.

Solid types materials for obturation of the root canal

1- Semi rigid materials as silver cones which are not used now. They are flexible and fill narrow curved root canals. When silver cones contact tissue fluids or saliva, they corrode. The corrosion products are cytotoxic.



2- Rigid materials as Vitalium cones which are inflexible and were used as endodontic implants.




Thank
you!

Obturation Technique

Dr.Ahmed Ibrahim Al-Jobory

INTRODUCTION

- The aim of obturation is to establish a fluid- tight barrier with the aim of protecting the periradicular tissues from microorganisms that reside in the oral cavity.
- While a perfect airtight or hermatic seal is unachievable in reality, every effort should be made to reach this target.

- The establishment of a well obturated system would serve three main functions:

1. Prevent coronal leakage of microorganisms or potential nutrients to support their growth into the dead space of the root canal system
2. Prevent periapical or periodontal fluids percolating into the root canals and feeding microorganisms
3. Entomb any residual microorganisms that have survived the debridement and disinfection stages of treatment, in order to prevent their proliferation and pathogenicity.

CURRENT MATERIALS FOR OBTURATION

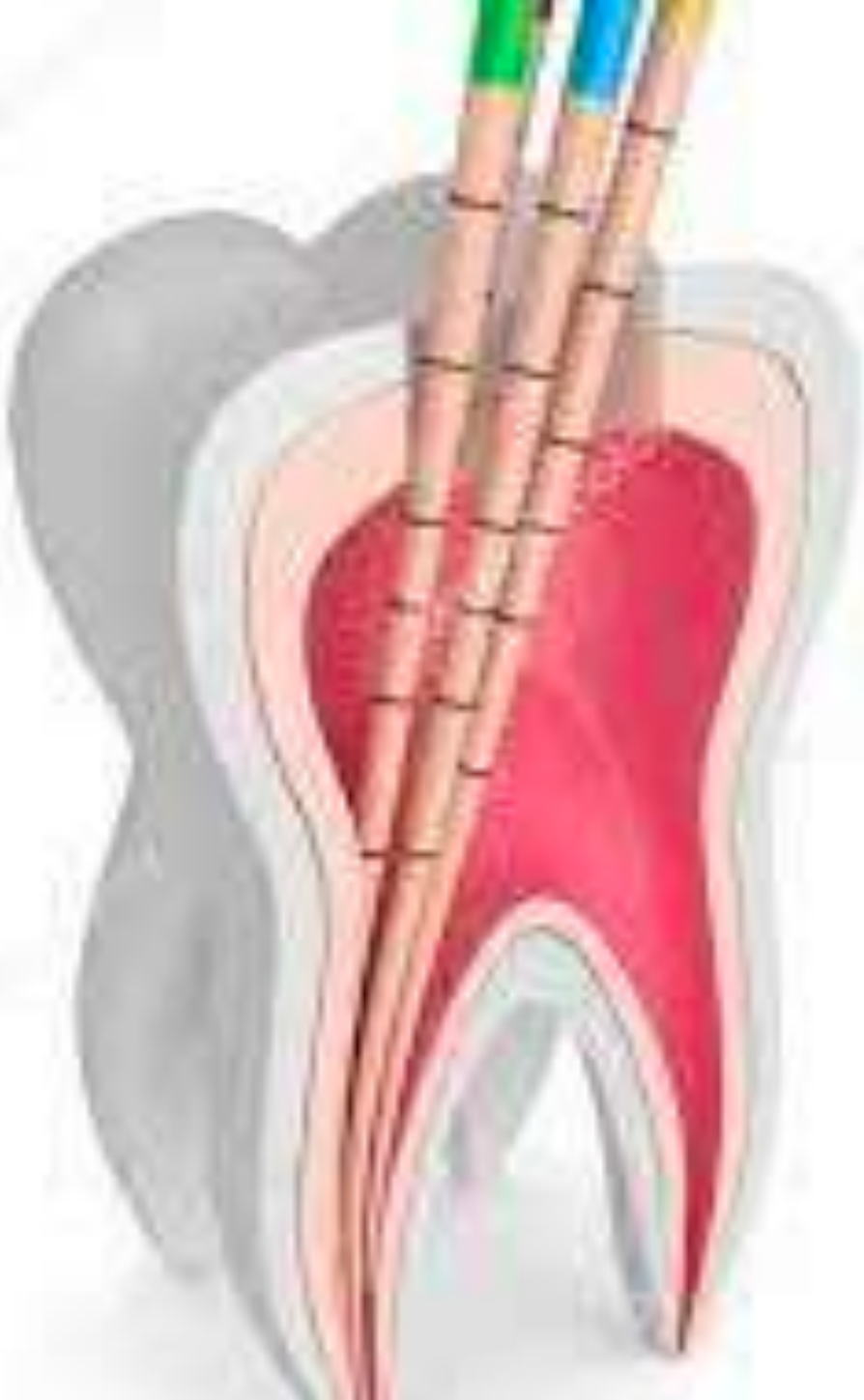
The materials most commonly used for obturation are a combination of semi- solid cores and a sealer.

Ideal properties of a root filling material by Grossman (in 1982) :

1. Easy handling and ample working time.
2. Seal the canal laterally and apically.
3. Conforming to the complex internal anatomy.
4. Dimensionally stable.
5. Non-irritant.
6. Does not stain the tooth structure.
7. Antimicrobial.
8. Secure and non-porous.
9. Unaffected by tissue fluid.
10. Radiopaque.
11. Easily removed.

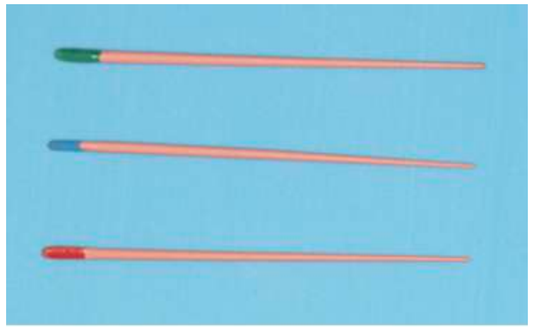
- However, at present no material can satisfy all of these demands.

Gutta Percha



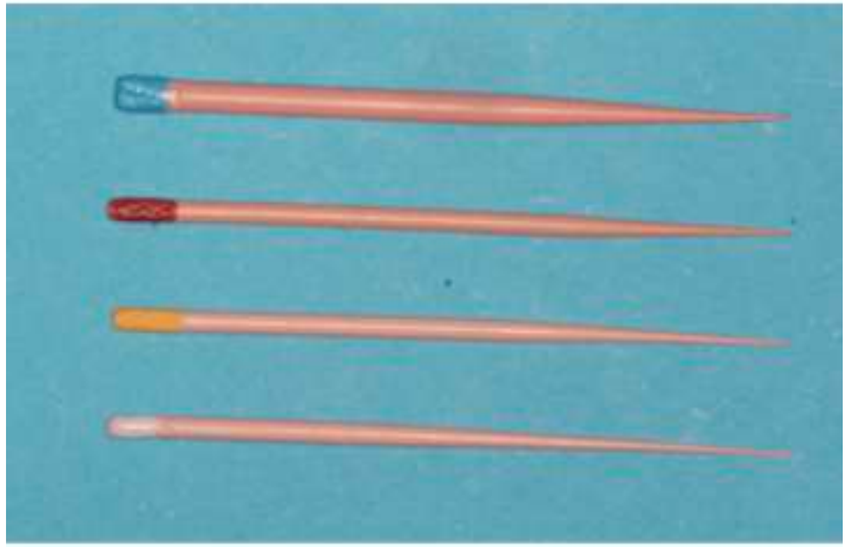
- Gutta percha (GP) is the most commonly used root filling material, it is a naturally occurring rubber with the chemical name trans-1,4-polyisoprene.
- GP in a traditional form contains zinc oxide (65%), gutta percha (20%), radio opacifier (metal sulphate) (10%) and plasticizer (5%) (percentages depend upon the manufacturer).
- GP principally occurs in two crystalline forms; alpha and beta phases.
- GP cones or points are produced in the beta phase.
- When heated to between 42-49°C it will be converted to the alpha phase and beyond these temperatures it will become amorphous.
- Upon cooling it will return to the beta phase and will shrinkage about 2% can occur.
- GP is offered in both cone and pellet forms.
- Cones are available in a range of different sizes, which include: ISO standardized 0.02 taper.

ISO standardized 0.02 taper.



GP in pellet forms

- And non- standardized in 0.04, 0.06, 0.08, 0.10, 0.12 taper with feathered or specified tip sizes.
- Non-standardized cones are also available to match various preparation systems such as ProTaper (Dentsply Maillefer, Switzerland) Recripoc (VDW, Germany) WaveOne (Dentsply Maillefer, Switzerland), and System Greater Taper (GT) (Dentsply Maillefer, Switzerland).



Gp non- standardized taper.

Obturation technique

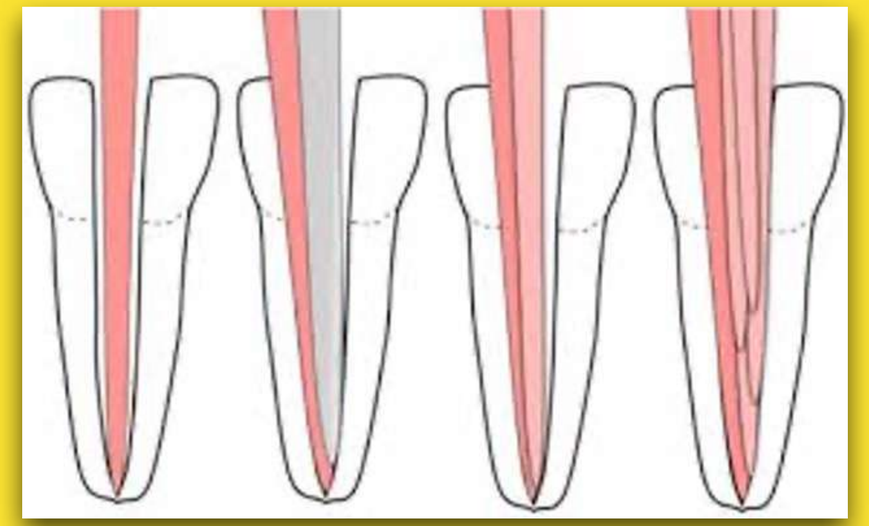
Dr.Ahmed Al-Jobory

- While there are many possible techniques for obturating the root canal system; this lecture aims to focus primarily on those most commonly employed.

- **<u>These includes:</u>**

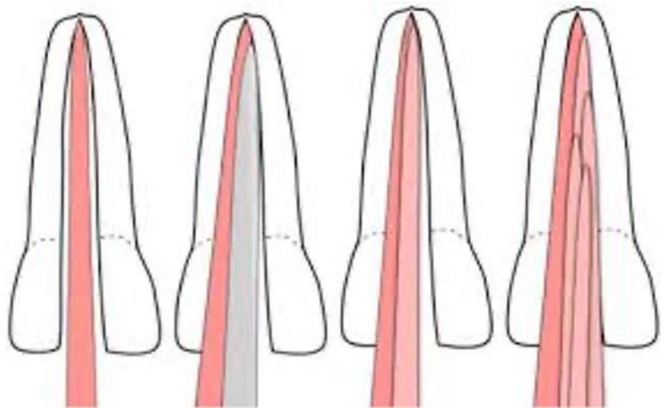
1. Cold lateral compaction.
2. Warm lateral compaction.
3. Vertical compaction (continuous and interrupted wave).
4. Thermomechanical compaction.
5. Carrier-based.
6. Single cone.

1- Cold lateral compaction



- Cold lateral compaction is still seen as the gold standard obturation technique and is always the standard against which others are measured against.
- It is relatively easy to carry out, allows for good apical control and is cost effective.
- ***The step by step technique is described below:***

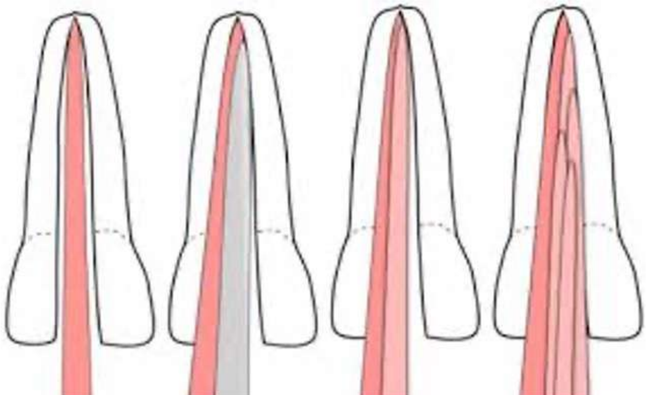
1. Use a spreader that can penetrate to working length (WL) without binding or being too loose.
2. Place a silicone stop on the spreader to mark this to 1 mm below from the WL.
3. Choose a standardized ISO taper (0.02) master GP point that fits snugly at working length with “tug back”. This may not correspond to the master apical file size.
4. Have approximately three accessory cones measured to 1 mm from the WL.
5. Dry the canal with paper points.



6. Coat the tip of the master cone with sealer and place into the canal coating the inside of the canal wall with sealer. Ensure the master GP point goes to working length.
7. Ease the finger spreader down to 1 mm from the WL.
8. Remove the finger spreader with a twist and place an accessory point precisely from where the spreader was removed and ensure it penetrates to 1 mm from the WL.

Important: use accessory cones that match your manufacturer's spreader size.

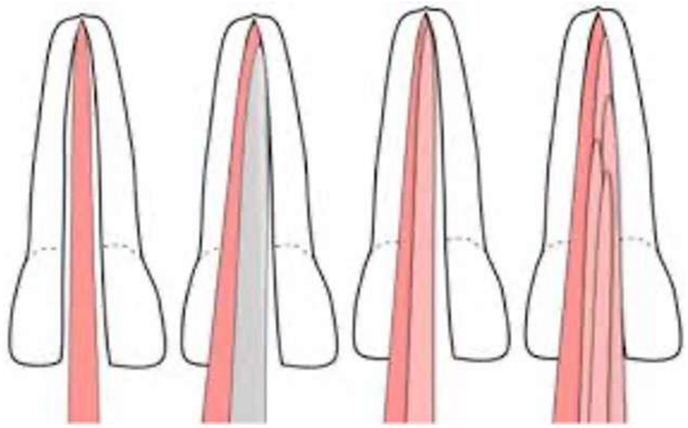
9. The second accessory point may not go entirely to 1 mm from the WL as the apical part of the canal is beginning to be filled. However, it is important to assess how far your spreader penetrates into the canal and ensure that each proceeding accessory cone reaches this same length.



10.After placing two to three accessory points take a mid-fill radiograph. This is carried out in place of a master GP cone radiograph. The mid fill radiograph will assess whether the master point has moved during placement of accessory points:

- if it has, the GP can be taken out and the apical fill repeated
- If the result is satisfactory continue to fill the rest of the canal with accessory points to just below canal orifice.

11.Once the obturation is complete seal the cones off at orifice level and vertically compact with a plugger.



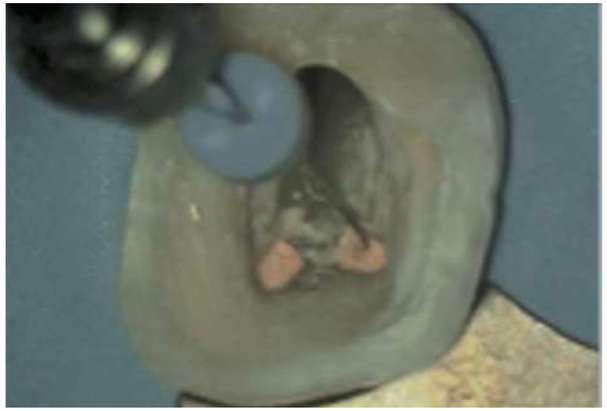
2- Warm lateral compaction Using ultrasonic (Energized spreading)

Energized spreading is a modification of cold lateral compaction and follows the same protocol as listed above.

A piezo electric ultrasonic unit is required, as well as a file adaptor and a k type of file.

File adaptor and K type file (picture courtesy of Graham Bailey and Stephen Cawte)

- The ultrasonic unit is set to a higher power setting and is activated only when the file comes into contact with the GP.

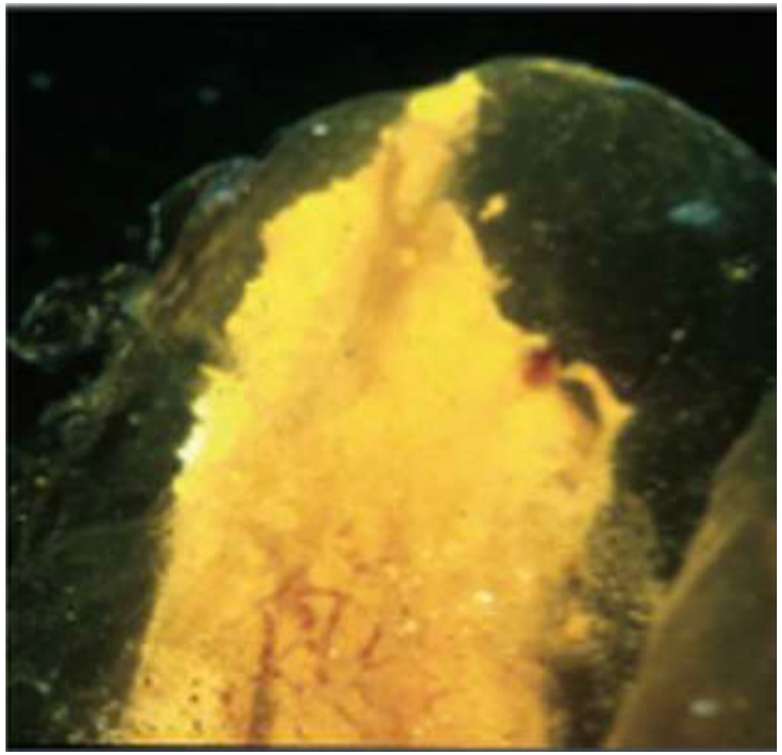


Energized file contacting GP (picture courtesy of Graham Bailey and Stephen Cawte)

- The file is then gradually introduced into the GP and heat is generated to soften it.
- The file should ideally pass to 1 mm from the working length while making a tract in the GP.

Energized file making a tract to 1 mm from working length (picture courtesy of Graham Bailey)

- A spreader is then placed into this tract to the same length, followed by a corresponding accessory point.
- This can be repeated two to three times.
- This technique has a slight advantage over cold lateral compaction, in that the thermoplasticised GP may flow into accessory anatomy and defects caused by internal resorption.
- It is considered a cost-effective technique.



Cross section of Energised spreading obturation (picture courtesy of Graham Bailey)

3- Warm vertical compaction

- Originally introduced by Schilder in 1967, modified versions of warm vertical compaction have come to be known as the continuous wave compaction technique and the interrupted wave compaction technique.

- The technique used in warm vertical compaction may make it possible for accessory apical anatomy and internal resorption defects to be filled using thermoplasticized GP.

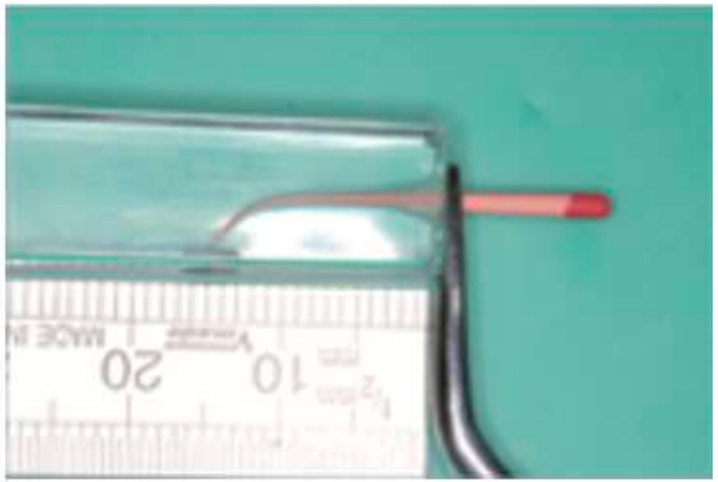
- Care and attention to detail with the technique can produce excellent results. However, <u>disadvantages include:</u>
  1. length control of the root filling.
  2. The initial cost of the equipment.

Step- by-step technique of obturation

I. The continuous wave compaction technique

A.Downpack:

1. Fit the master cone (either non- standardized cones or system matching cones) 0.5 mm from the WL in the canal until ‘tug-back’ is felt.



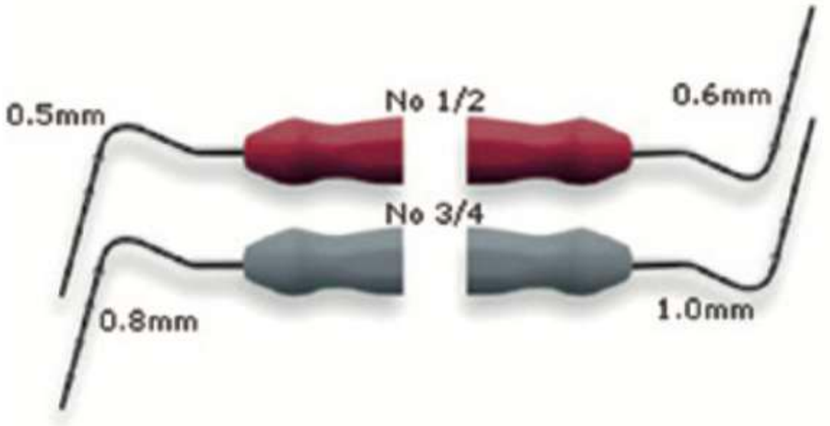
Fitting Master point for warm vertical compaction

2. The cone should be tried into a wet canal and the opportunity taken to agitate the irrigant; this is done by pumping the cone in and out of the canal so as to increase the movement of the irrigant.

3. Select a System B plugger (SybroEndo, Orange, USA). That binds gently in the prepared canal at about 5 to 7 mm from the WL and mark with a silicone stop.
4. Coat the master cone lightly with sealer and apply to the walls of the canal. Seat the master cone.
5. The System B; heat source is best used at a temperature of 200°C and a power setting of ten. The touch mode seems to be considered the easiest setting to use.
6. Activate the touch spring while driving the heated plugger smoothly through the GP over a maximum of three seconds to 5 to 7 mm from the WL.
7. Maintain firm apical pressure for a ten second sustained push to take up any shrinkage that might occur upon cooling of the apical mass of GP.
8. While still maintaining apical pressure, push the touch spring again for a full second. Release the switch, pause for another full second, and then quickly withdrawn the plugger. This should remove the surplus coronal portion of GP.

Downpack device

9. After removal of the System B plugger, use a Machtou plugger (Dentsply Maillefer, Switzerland).



or Buchanan plugger; to pack the apical portion of GP lifting any excess GP off the walls of the canal and packing it on to the apical mass.

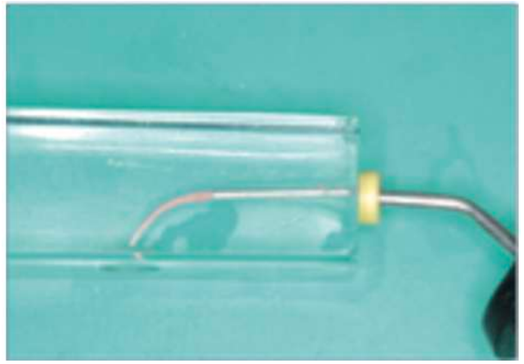
B.Back-filling with thermoplasticized GP

• Some devices capable of carrying out such a backfill technique include:

A: Obtura (SybroEndo, Orange, USA).

B: Obturator system (woodpecker, China)- included pen (down pack) and (gutta percha gun).

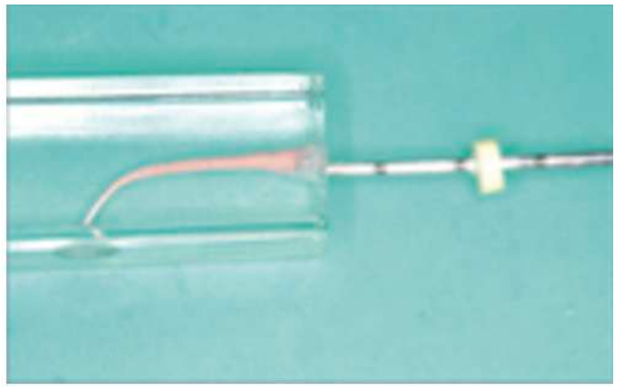
1. Lightly recoat the walls of the unfilled canal space with sealer.
2. Introduce the needle tip until it contacts the apical GP. Hold in place for several seconds, to allow the surface to plasticize slightly and fuse with the new GP.



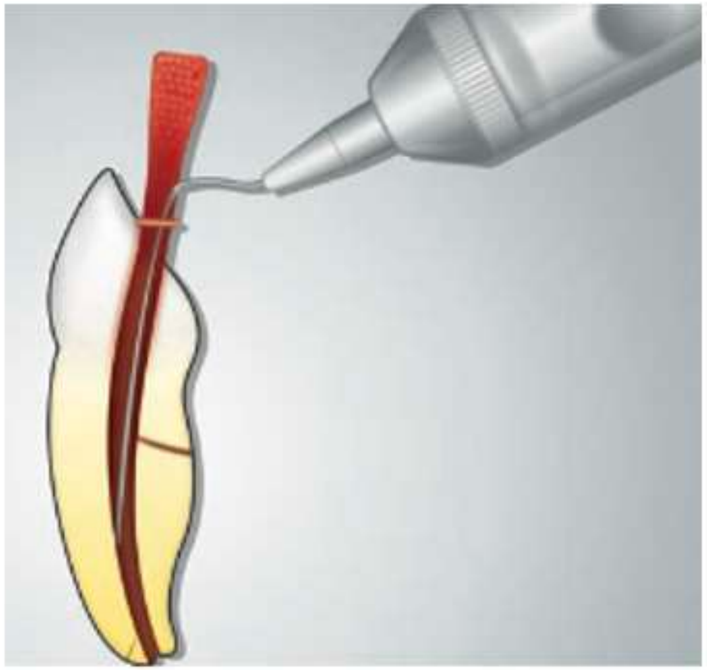
Needle to deliver thermoplastic GP in contact with downpack

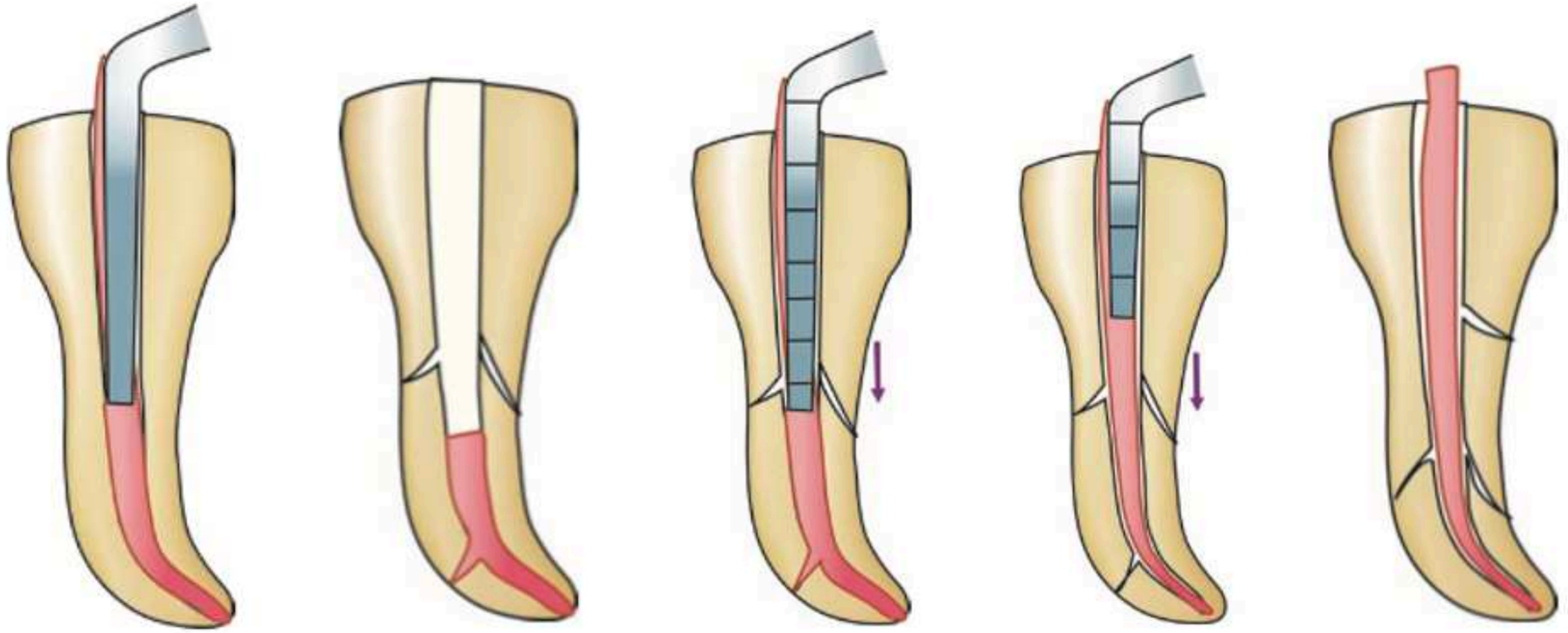
3. Squeeze the trigger until the gun starts to back out of the canal. Maintain light resistance while letting the needle drive coronally, still keeping it embedded in the mass.
4. Just before orifice level, withdraw the needle and immediately apply apical pressure with a hand plugger such as Machtou plugger or a Buchanan plugger. This will compensate for cooling contraction.

Machtou plugger packing the thermoplasticized GP



At last the summary for WVC

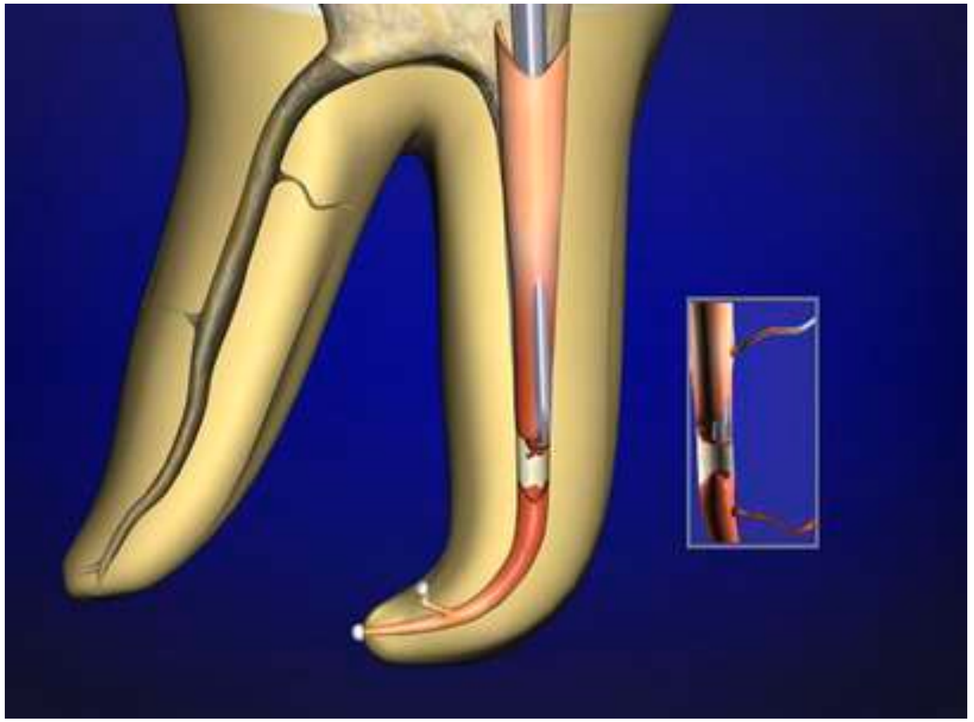




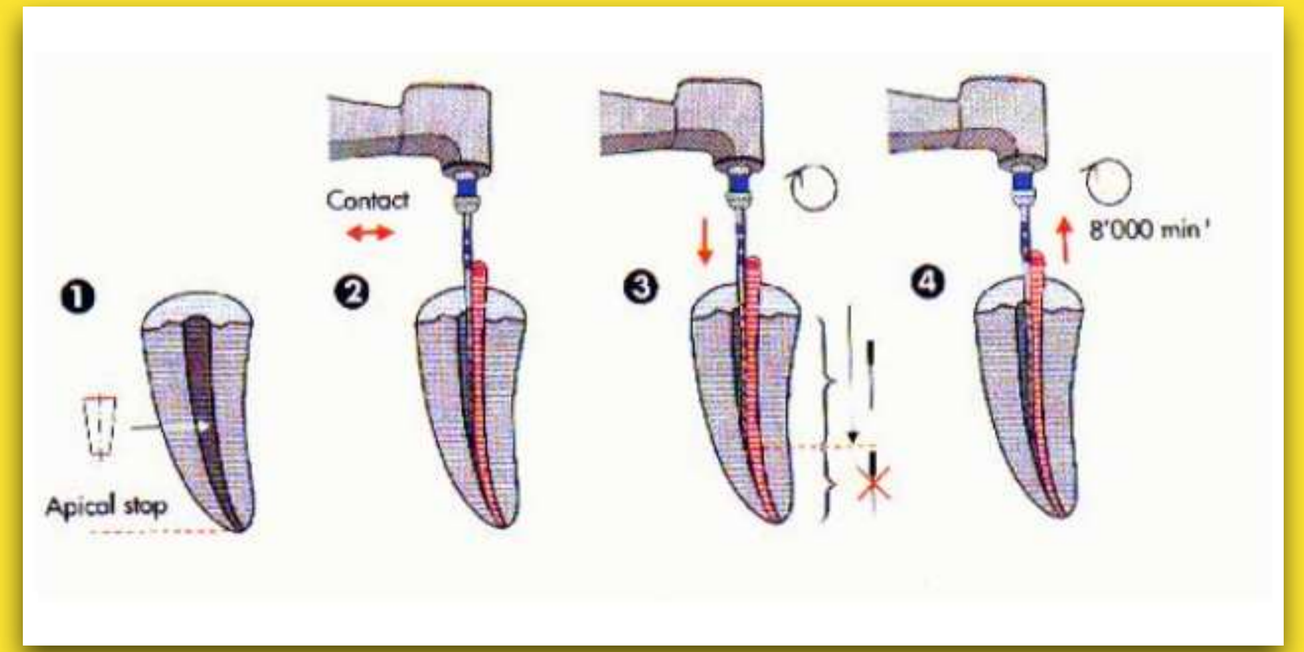
Cutting master gutta percha with downpen and compaction with plugger; then filling the canal with gutta percha by system B (gutta percha gun) and compaction with plugger till the canal is full.

II. The Interrupted wave compaction technique

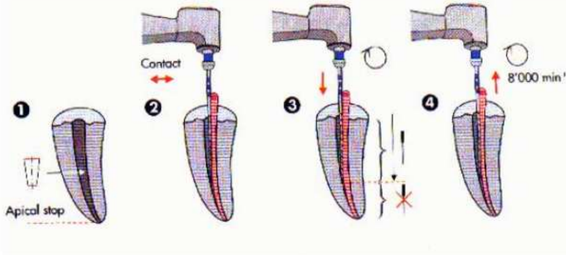
- The interrupted wave technique is very similar to the continuous wave, with the difference being that the downpack is carried out in multiple waves rather than one continuous wave as described above.
- This technique is recommended for wider canals.



4- Thermomechanical compaction

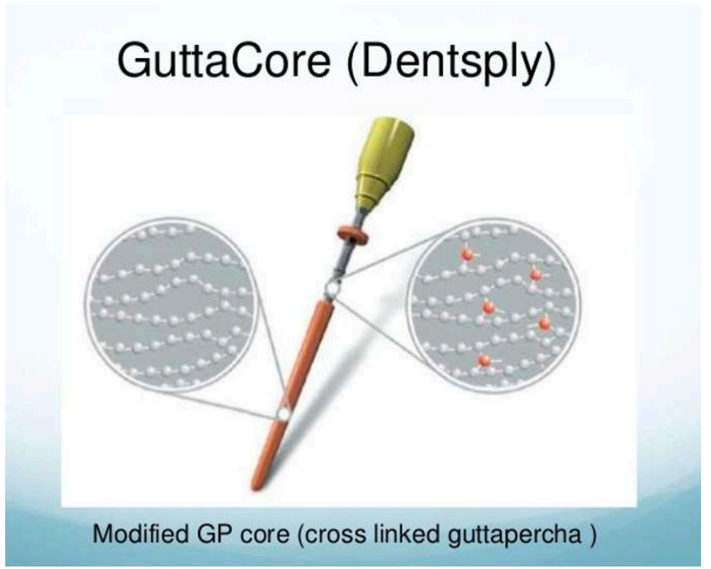


- Thermomechanical compaction uses heat generated from the friction created when a reverse Hedström file is driven with a slow handpiece into the GP.
- A master point is fitted with a sealer and the reverse Hedström file is placed 3 to 4 mm from the working length. The generated heat drives the GP apically and laterally, and, eventually the file itself is driven coronally.
- This technique can fill irregularities and is useful for backing filling after warm vertical condensation if there are defects.
- This technique can cause material to be extruded from the canal and it is possible for the reverse Hedström to separate in the canal.
- The Tagger technique is similar, but in the apical third/ half of the canal cold lateral condensation is used before insertion of the reverse Hedström file.
- There have been other modifications of thermomechanical compaction in which the gutta condenser is coated in flowable GP, for example Microseal (SybroEndo, Orange, USA) and then condensed. Unfortunately, despite promising results this system has now been discontinued.



5- Carrier-based

- Carrier based techniques consist of a carrier coated in GP.
- Traditionally the carriers were made from stainless steel and titanium .
- Thermafil (Dentsply Maillefer, Switzerland) are now only manufactured from plastic.

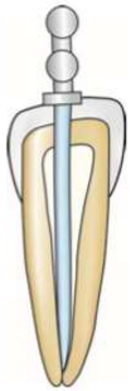


Thermafil (plastic carrier)

- Recently, a crosslinked GP carrier Gutta Core (Dentsply Maillefer, Switzerland), has been developed. This crosslinked GP carrier has the advantage of being more easily removed for post placement and for when retreatment is carried out.

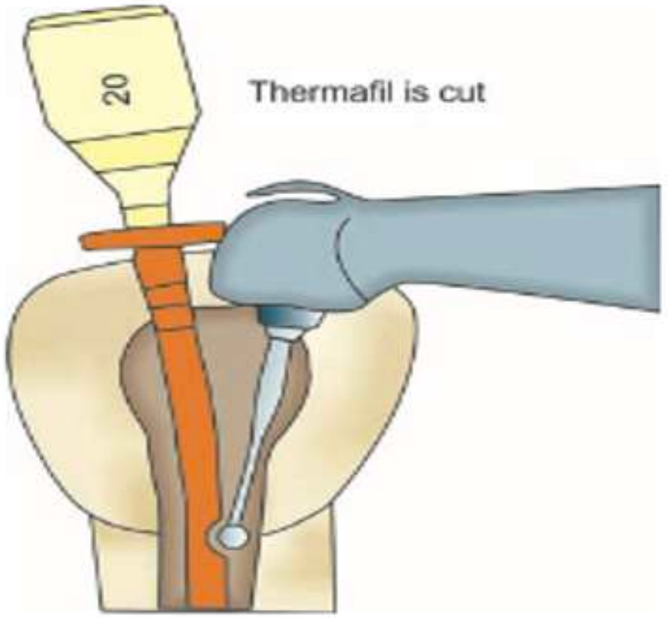
- The technique for each of these is the same; a verifier is used to check which size carrier should be employed.
- The carrier is then heated in a purpose designed oven for a specified time in order to soften the outer coating of GP.
- This oven is recommended for heating obturator because it offers a stable heat source with more control and uniformity for plasticizing the gutta-percha.

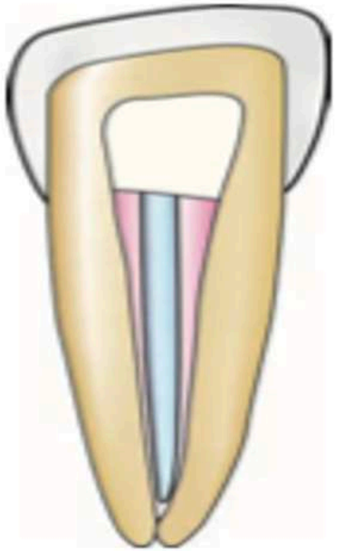
Check size of carrier by using verifier



Thermaprep2 from DENTSPLY

- The canal dry and coated with sealer and the warmed carrier is pushed to the working length. The handle from the carrier is then removed and the coronal GP condensed vertically.
- Do not use flame heated instrument to sever the plastic shaft because instrument cools too rapidly and thus may cause obturator displacement from the canal.
- There are matching carriers for systems such as ProTaper, Recripoc, Waveone, etc.
- Although this technique is time efficient, problems can arise in the form of length control and post-operative pain.

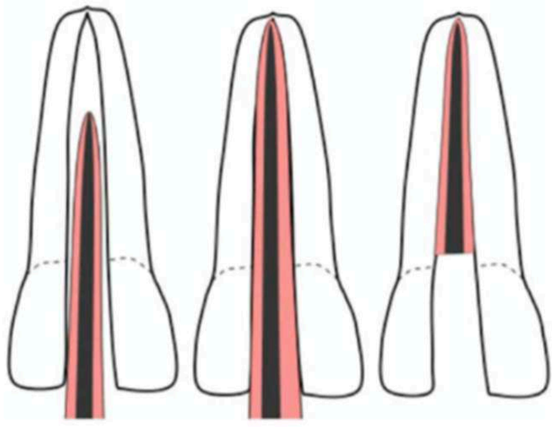




Complete obturation using Thermafil

6- Single cone

- The canal is prepared by any NiTi rotary system using the manufacturer's instructions.
- After completed instrumentation and irrigation protocol the canal dried with paper points.
- A single gutta-percha cone that matches the taper and size of the final rotary instrument is then selected and fitted to the designated working length with tug back.
- A root canal sealer mixed manually according to the recommendations of the manufacturer and applied into the root canal.
- The matched cone is then coated with additional sealer to the proper length.
- A heating instrument is used to cut the match point within 3 mm of the orifice, which is then condensed vertically using an endodontic plugger.
- Coronal seal performed using resin bonding material.
- Using a traditional standardized single GP point and sealer technique is not recommended, as it does not provide a good three-dimensional barrier from the coronal to apical aspect of the root.
- Recently, it’s very recommended with using bioceramic sealer.




thank
you

Endodontic Emergency Treatment

Dr.Ahmed Al-Jobory 2023

- A Emergency conditions in endodontics induce infection which is expressed as pain and/or swelling.
- Any irritation to the tissues results in inflammation and release of chemical mediators which with pressure induce pain.
- Chemical mediators cause pain by lowering pain threshold of the sensory nerve fibers or by increasing vascular permeability and producing edema.
- Increased fluid pressure resulting from edema directly stimulates the pain receptors.


AMBULANCE

Classification according to Walton or Torabinejad

A- Pretreatment

1. Dentin hypersensitivity
2. Pain of pulpal origin
    a. Reversible pulpitis
    b. Irreversible pulpiis
3. Acute apical periodontitis
4. Acute apical abscess
5. Traumatic injury
6. Cracked tooth syndrome

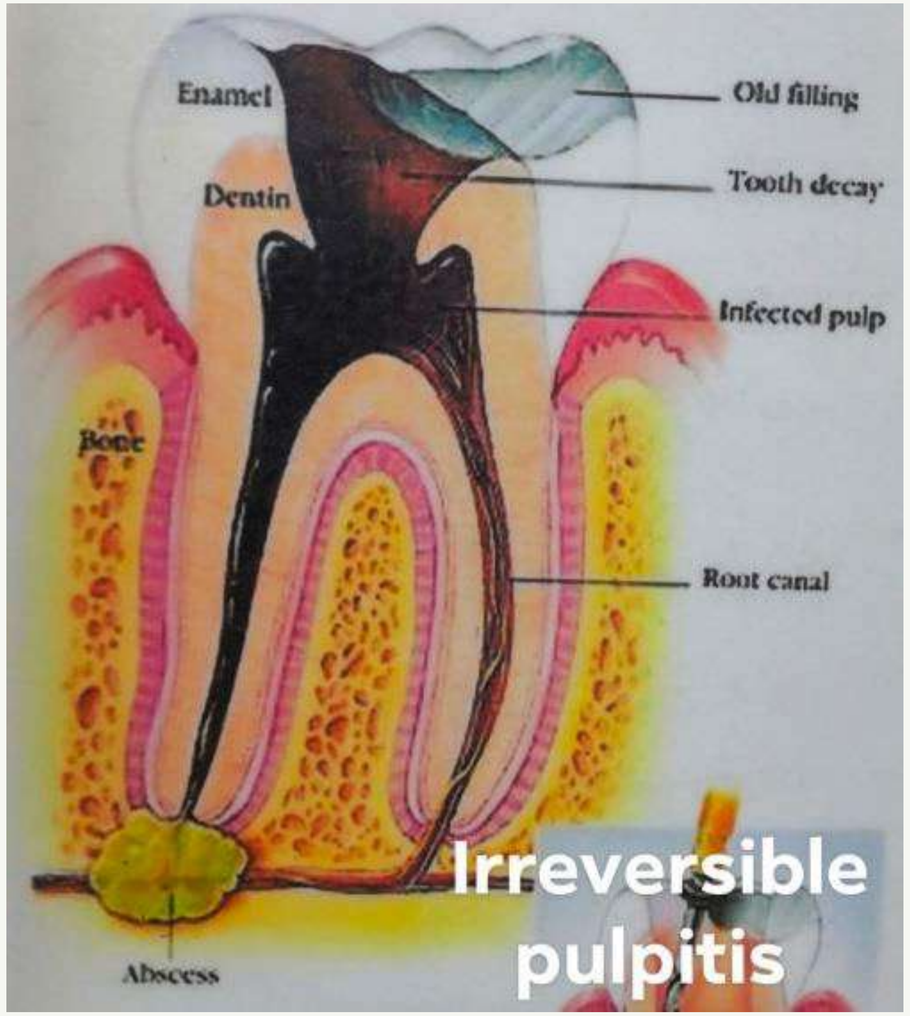
B-Patients under treatment

1. Mid treatment flare-up.
2. Exposure of pulp
3. Fracture of tooth
4. Recently placed restoration
5. Periodontal treatment

C-Post endodontic treatment

1. Overinstrumentation
2. Overextended obturation Underfilling
3. Fracture of root
4. High restoration

Irreversible acute pulpits



- The diagnosis of irreversible pulpitis can be subcategorized as:

- 1- Asymptomatic: Asymptomatic irreversible pulpitis means a tooth that has no symptoms, but with deep caries or tooth structure loss that, if left untreated, will cause the tooth to become symptomatic or nonvital.

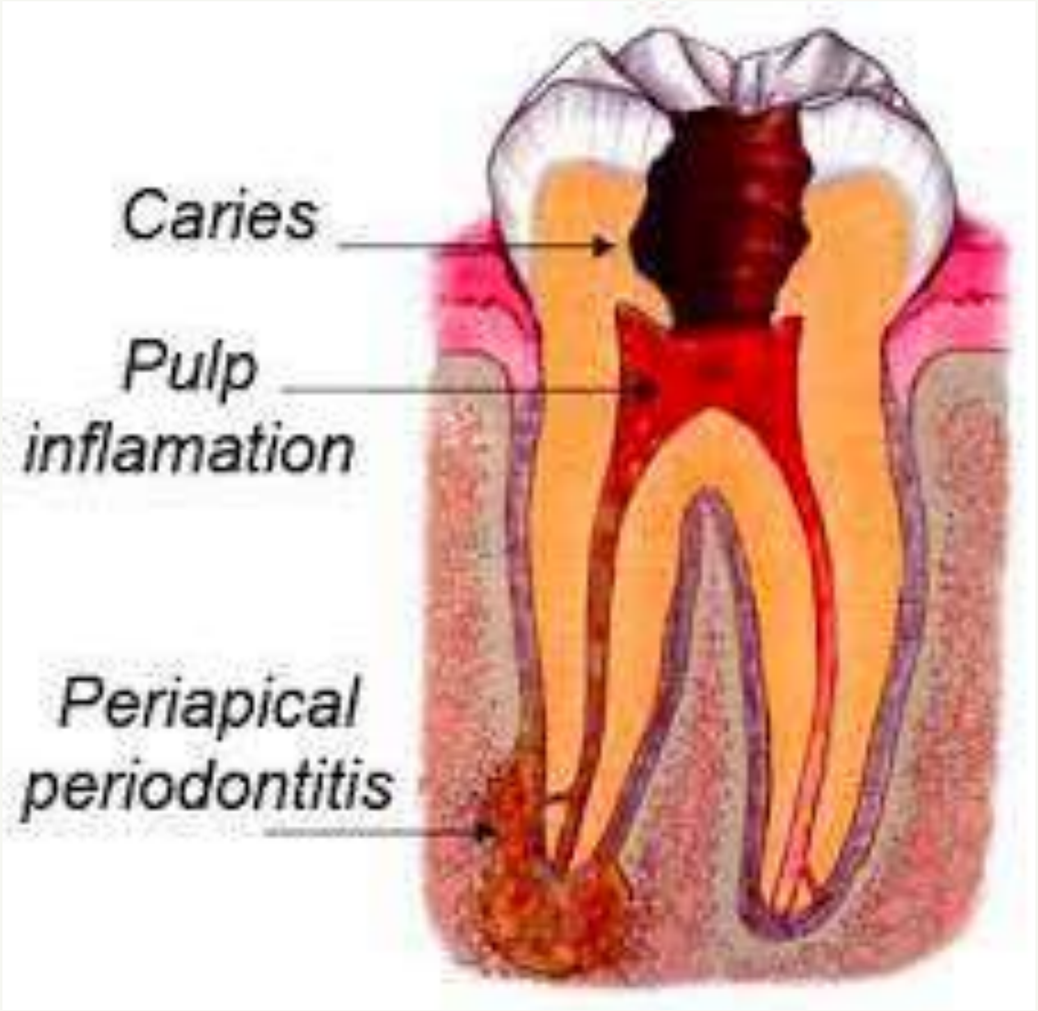
- 2- Symptomatic: Pain from symptomatic irreversible pulpitis is often an emergency condition that requires immediate treatment. These teeth exhibit intermittent or spontaneous pain, whereby exposure to extreme temperatures will elicit intense and prolonged episodes of pain, even after the source of the stimulus is removed.

- Teeth with irreversible pulpitis with definite periapical inflammatory extension, occlusal reduction is recommended.
- *Antibiotics are not recommended* for the emergency management of irreversible pulpitis.

Steps of treatment

1. Clean the root canal(s) to the working length.
2. Place a suitable medicament in the pulp canal and chamber (ex. Calcium hydroxide).
3. Close the access opening with a temporary filling.
4. Check occlusion of the tooth.
5. Prescribe a pain analgesic.

Acute apical periodontitis



- It is inflammation of the apical periodontal tissue caused from extension of pulpal infection periapically.

- It is **characterized by** the following features:

1- Elevated tooth from its socket because of build up in fluid pressure in the periodontal ligament.

2- Discomfort on biting.

3- Sensitivity to percussion.

Steps of management

1. Access opening preparation.
2. Total pulp extirpation.
3. Cleaning the root canal.
4. Thorough irrigation and dryness.
5. Placement of intracanal medicament as Calcium hydroxide.
6. Close the tooth with a temporary filling material.
7. Relieve occlusion.
8. Prescribe analgesics.

Acute periapical abscess

- Extrusion of bacteria from the root canal to the periapical area induces infection ending information of a collection of pus.

- Acute periapical abscess is characterized by the following features:

1- Clinically a swelling is evident with pain and a sensation of tooth elevation.
2- Radiographic evidence varies in size of lesion.
3- Systemic fever.

Steps of management

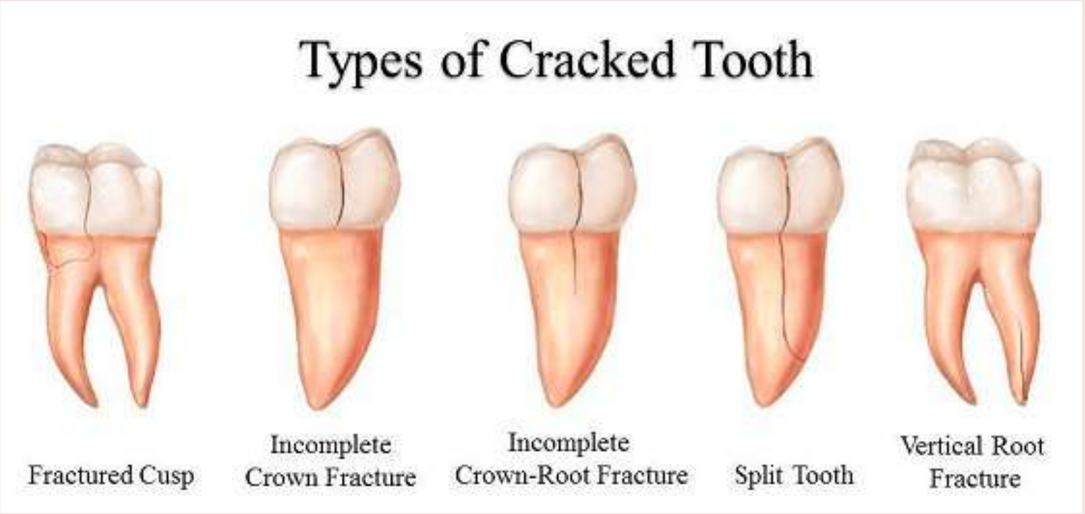
1. Pulp debridement of its contents.
2. Incision and drainage (if swelling is present).
3. If pus is oozing the tooth may be left open for 1 day for drainage.
4. Antibiotics may be prescribed only if systemic features are present as fever.
5. Relieve the tooth out of occlusion.
6. Analgesics should be prescribed.

Local anaesthetic is contraindicated to be used because:

1. Pain caused by injection in swollen area.
2. Chance of spread of microorganisms.
3. Ineffectiveness of local anaesthetics.

Cracked tooth syndrome

- It is incomplete fracture of a tooth with vital pulp.
- It is commonly seen with teeth with large restorations.
- Pain is experienced when the patient chews laterally on a cotton roll.



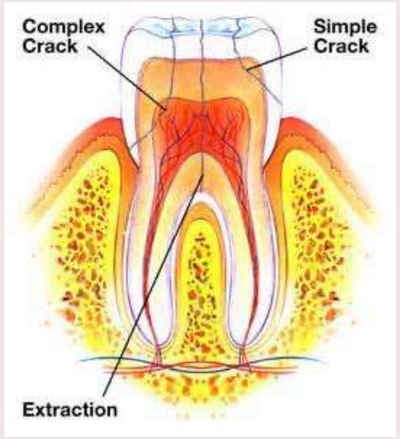
Steps of management

1- Immediately reduce the occlusal contact with the cracked area.

2- Analyze the extent of the crack to preserve the pulpal health.

3- If the pulp is involved and the crack is superfacial to the alveolar bone endodontic treatment is necessary.

4- If the crack is below the alveolar bone extraction of the tooth is necessary.



Intratreatment flare-up

- Flare-up is the occurrence of pain, swelling or both during the course of root canal treatment.

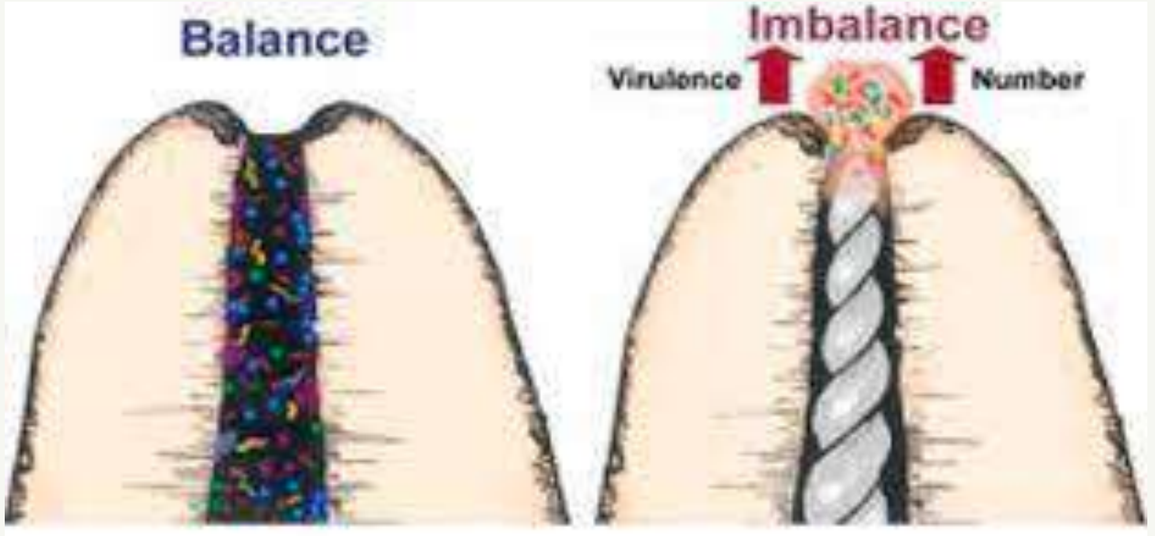
- **Risk factors** contributing to flare-ups:

1. Overinstrumentation and overobturation.
2. Inadequate debridement.
3. Periapical extrusion of debris.
4. Preoperative pain, percussion sensitivity and swelling.
5. One visit endodontics in cases of acute apical periodontitis.
6. Retreatment.
7. Apprehension.
8. History of allergies.

Steps of management

1. Reassurance of the patient
2. Complete debridement of the root canal with no overinstrumentation or extrusion of debris.
3. Establishment of drainage if pus is present.
4. Relief of occlusion.
5. Calcium hydroxide intracanal medication.
6. Analgesic and antibiotic prescription.

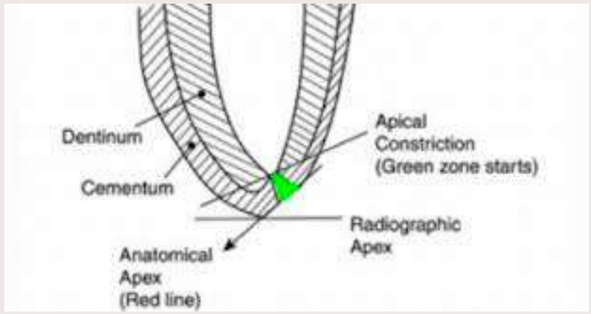
Overextended treatment beyond the apex



- Any extension of an instrument or filling material induces acute inflammation and with the presence of extruded debris will cause infection.
- **Pain** is magnified because of the limited area between the bone and the tooth.

Steps of management

1. Care should be taken in consideration not to extend instrumentation beyond the apex.
2. Reinstrumentation to the exact working length should be done to insure a apical stop area to prevent extrusion of gutta percha.
3. If gutta percha is extended beyond the apex then retreatment should be performed by special retreatment kits as ProTaper retreatment and D-Race systems.
4. Analgesic should be prescribed.



Fracture of tooth

- During the course of treatment or after it the tooth may be subjected to force and it might fracture.
- The treatment depends on the extent of the fractured area (in crown or including root).
- The steps of treatment resemble that of the cracked tooth syndrome.

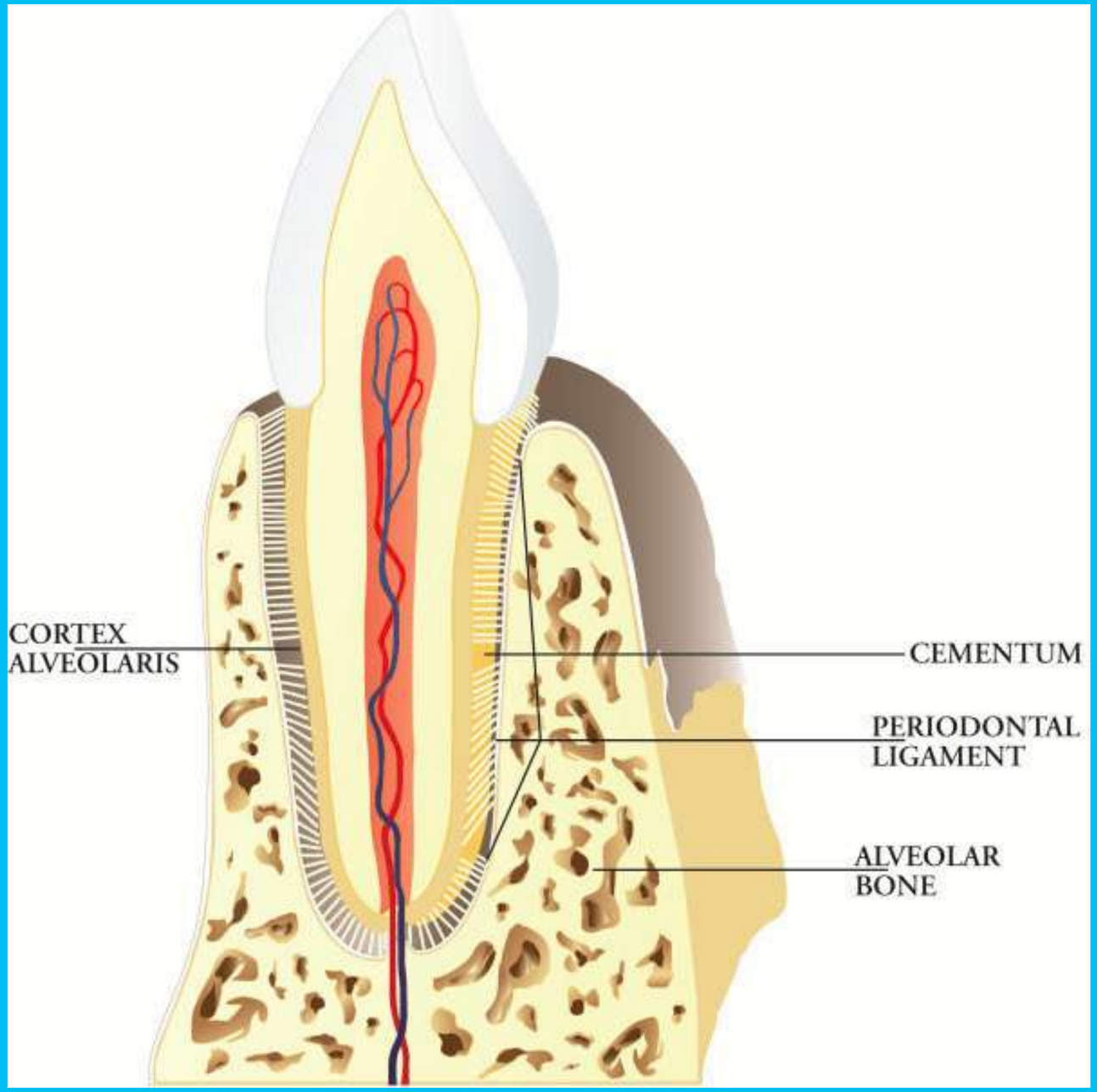
Thanks you

Dr. Ahmed Al-Jobory

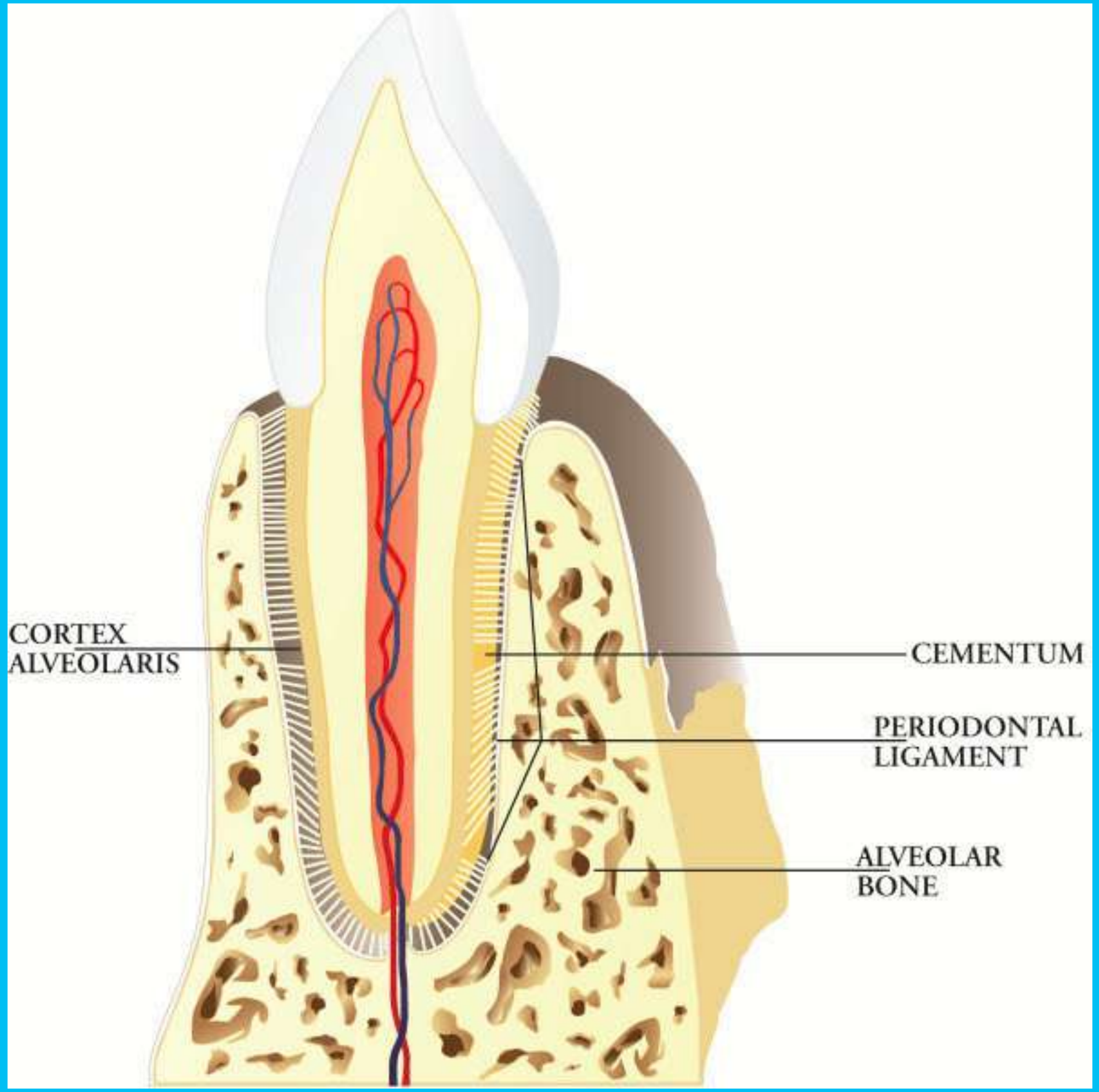
ENDODONTIC-PERIODONTAL RELATION

Dr. Ahmed Al-Jobory
2023

- The function of the tooth depends on the health of the periodontium (gingival, cementum, periodontal ligament and alveolar bone.

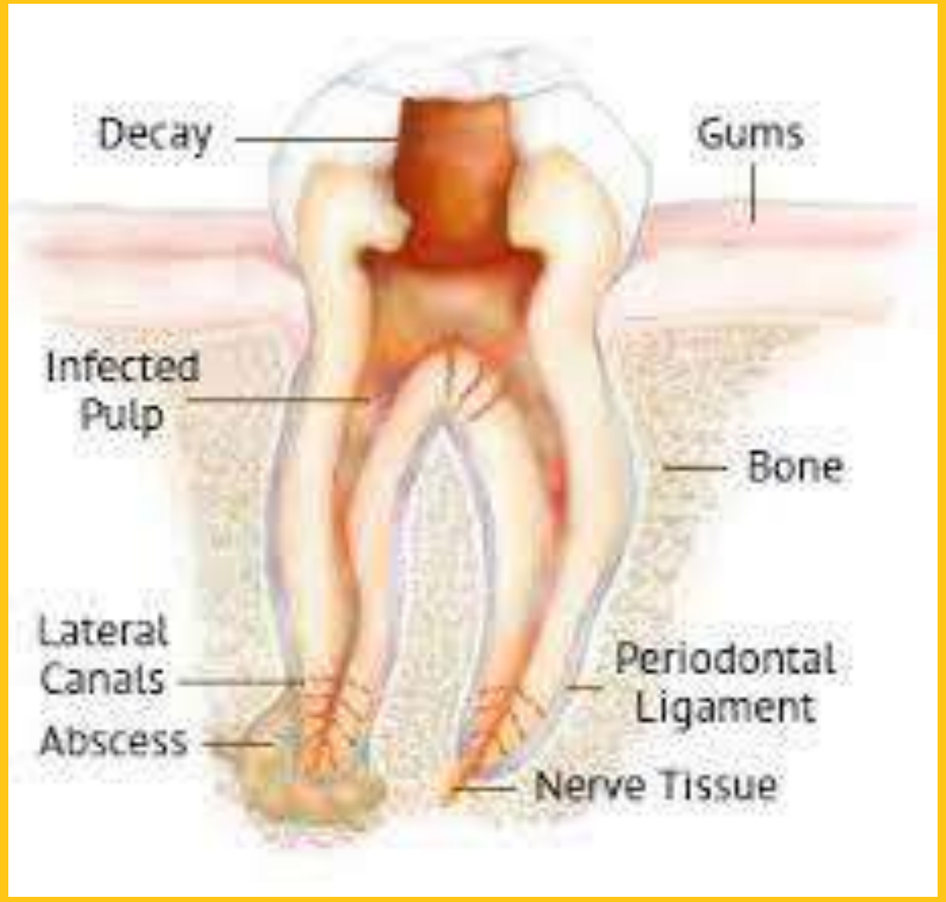


- Three main avenues for communication between the dental pulp and the periodontium are formed:
- (1) Dentinal tubules.
- (2) Lateral and accessory canals.
- (3) Apical foramen.

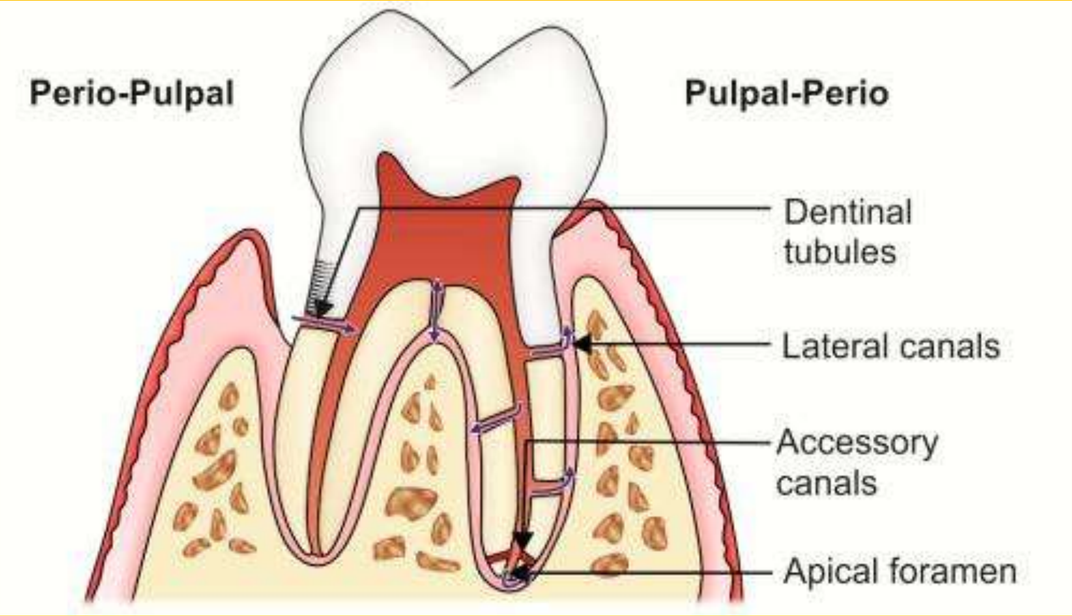


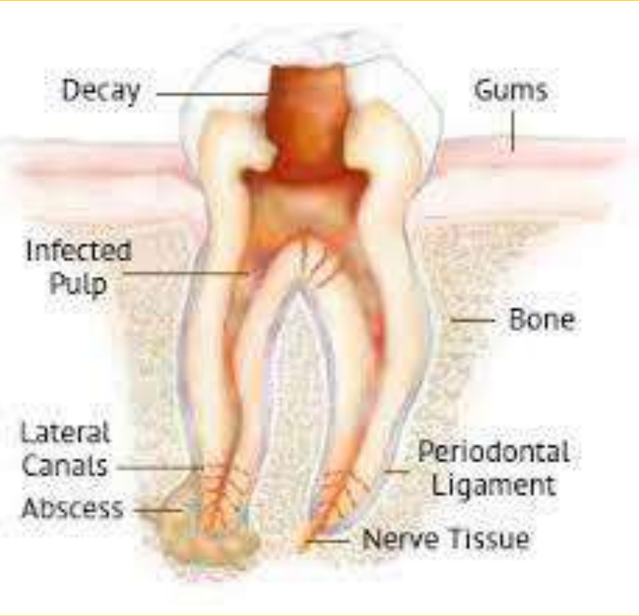
LATERAL CANALS

- They are normal anatomical landmarks in the root of a tooth.
- They differ in their incidence according to their location in the root.
- They are present more in the apical and bifurcation region.
- De-Deus in 1975 reported that 17% of the teeth examined presented lateral canals in the apical third of the root, about 9% in the middle third, and less than 2% in the coronal third.



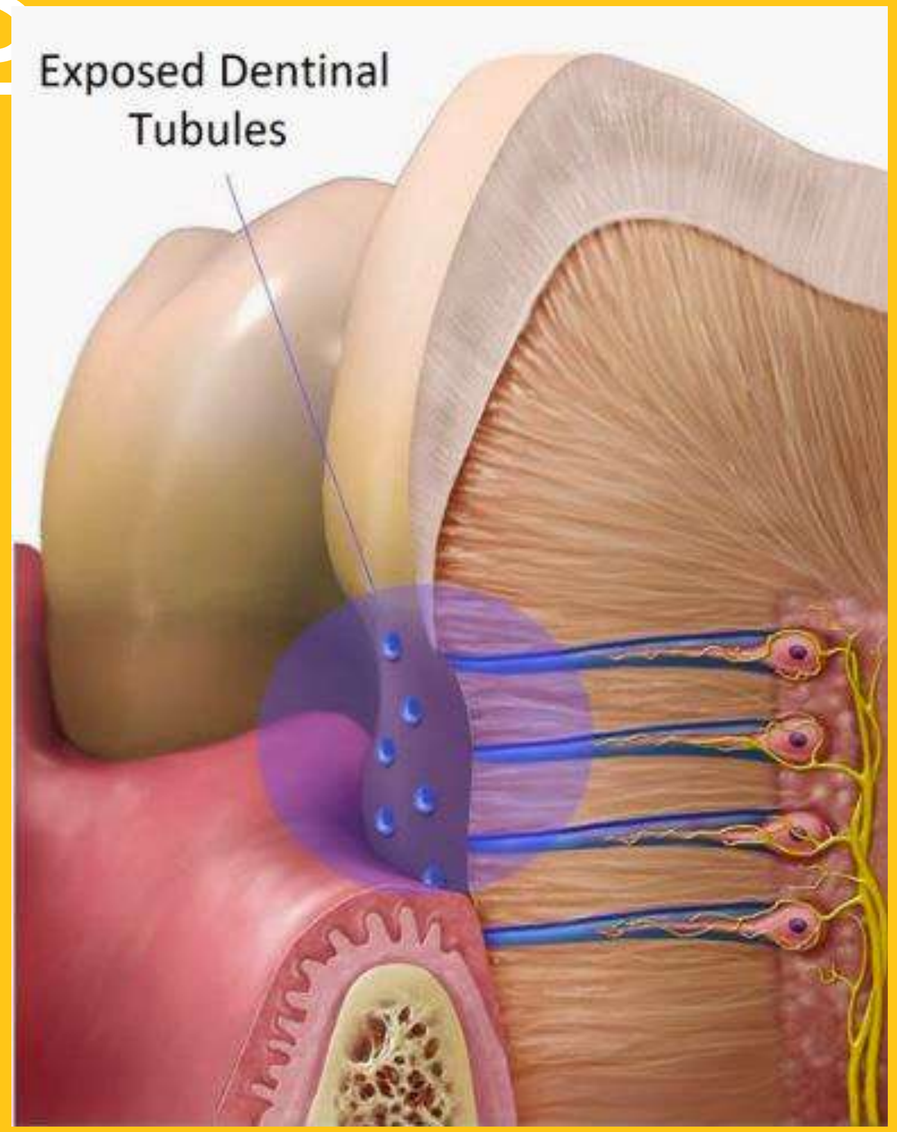
- They are a connection between the pulp and periodontal tissue therefore any infection happens in any of these tissues the inflammation spreads to the other.
- Radiographically the lesion may appear lateral to the root which may be extended coronally to the crestal area of the attachment apparatus or to the bifurcation area.





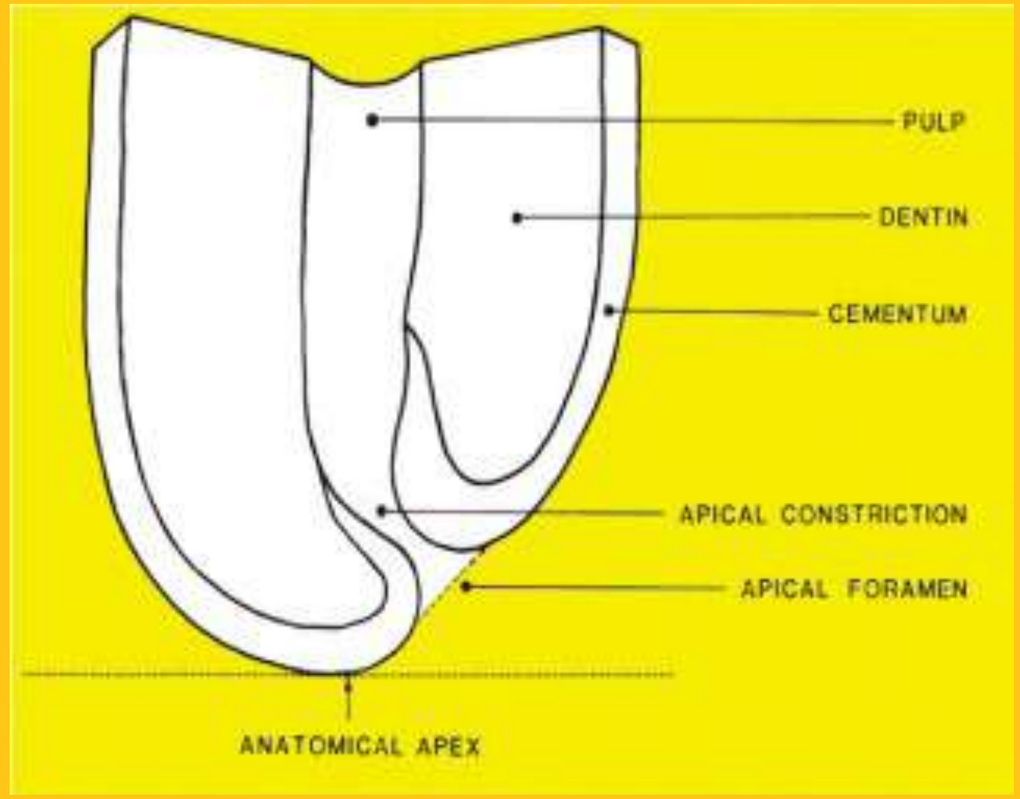
DENTINAL TUBULES

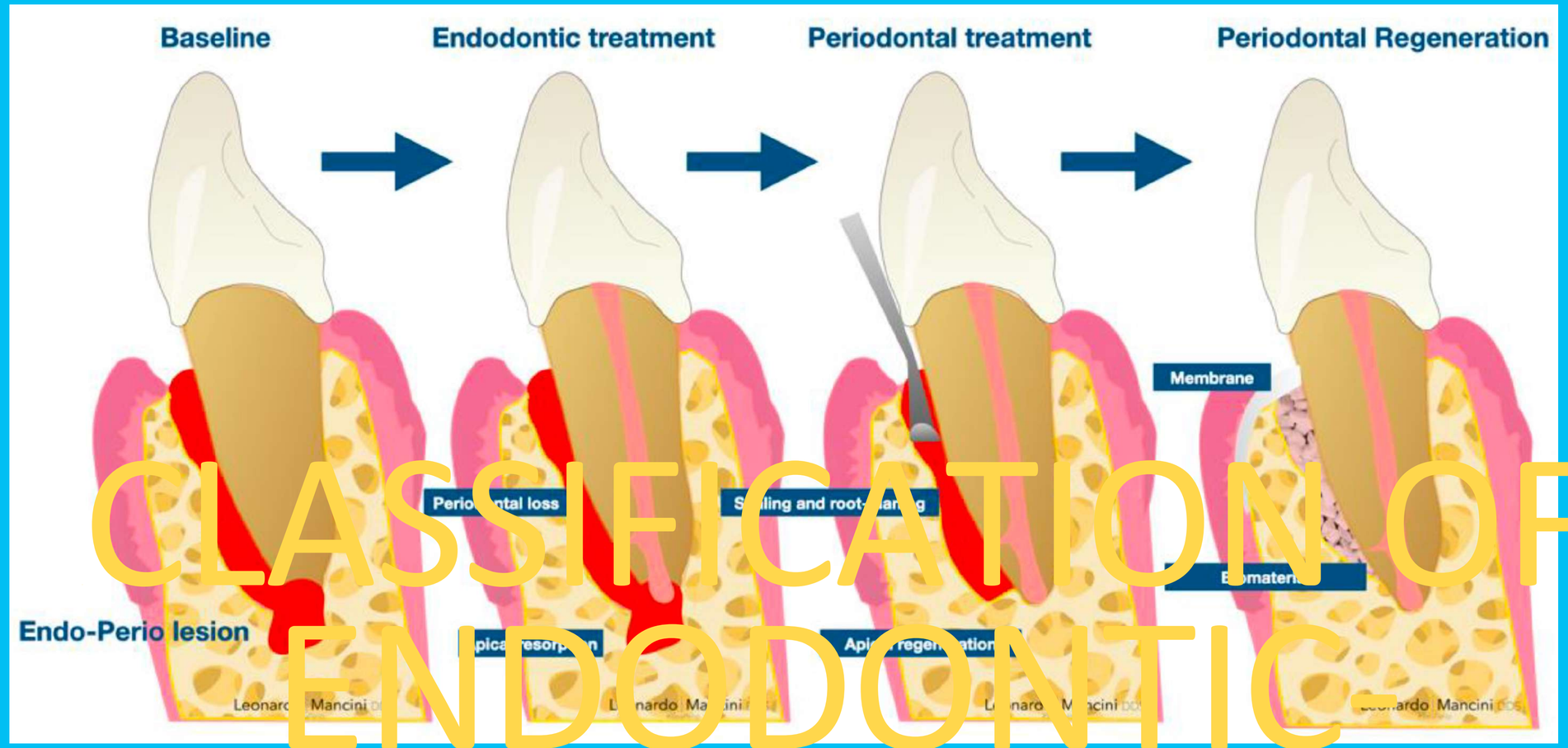
- Cementum acts as a protective barrier, but direct communication may be established between the pulp and the periodontium via patent dentinal tubules if the cementum is missing.
- The cementum may be missing as a result of developmental defects, disease processes, periodontal or surgical procedures.
- Exposed dentinal tubules in areas devoid of cementum may serve as communication pathways between the pulp and the PDL.



APICAL FORAMEN

- **The apical foramen is the principal route of communication between the pulp and periodontium.**
- **Infectious and inflammatory byproducts of a diseased pulp may permeate readily through the apical foramen, resulting in periapical pathosis.**
- **The apical foramen may also be a portal of entry of inflammatory elements from deep peri- odontal pockets to the pulp.**





CLASSIFICATION OF ENDODONTIC-PERIODONTAL LESIONS

SIMON,GLICK AND FRANK'S CLASSIFICATION (1972)

- Primary endodontic lesion .
- Primary periodontal lesion .
- Primary endodontic lesion with secondary periodontal involvement .
- Primary periodontal lesion with secondary endodontic involvement .
- True combined lesion.

1- PRIMARY ENDODONTIC LESION.
2- PRIMARY ENDODONTIC LESIONS WITH SECONDARY PERIODONTAL INVOLVEMENT.
3- PRIMARY PERIODONTAL LESIONS .
4- PRIMARY PERIODONTAL LESIONS WITH SECONDARY ENDODONTIC INVOLVEMENT .
5- TRUE COMBINED LESIONS

1- PRIMARY ENDODONTIC LESION.

- A sinus tract originating from the apex or lateral canal of the tooth may form along the root surface and exit or drains through the gingival sulcus.

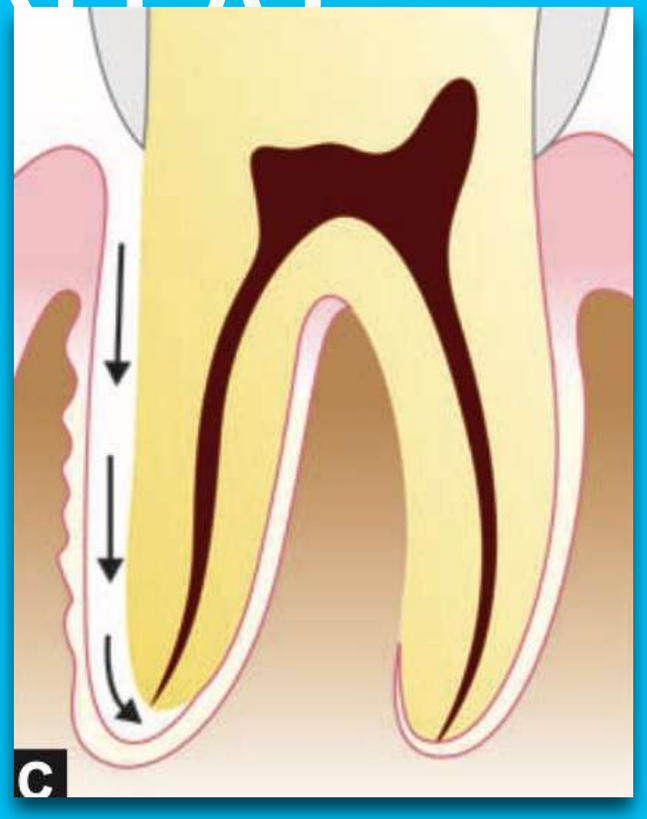
- Radiographically: This drainage is seen as a radiolucency along the side of the tooth or in the bifurcation area.

- **Clinically.** Pus oozing through the sulcus area with the presence of localized swelling in the ginigival area.
- The sulcus can be probed by gutta percha cone or periodontal probe to see the extent of bone loss and source of infection.
- Pain is not often experienced.
- Vitality tests should reveal necrotic tooth or in multirooted teeth one of the root canal necrotic.
- **Treatment:** Because the source is endodontic, root canal treatment is essential.

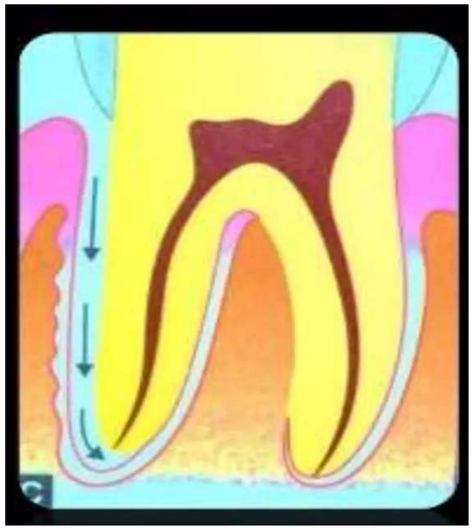
2- PRIMARY ENDODONTIC LESIONS WITH SECONDARY PERIODONTAL INVOLV

- If the primary endodontic lesion is untreated, it may become involved with periodontal infection.
- **Clinically:** There is a necrotic root canal with presence of plaque and calculus.
- **Treatment:** Both endodontic and periodontal treatment is necessary to completely heal the infected area.

3- PRIMARY PERIODONTAL LESIONS



- Periodontal disease has a progressive nature.
- It begins in the sulcus and migrates to the apex as deposits of plaque and calculus produce inflammation, causing loss of surrounding alveolar bone and supporting periodontal soft tissues.
- This leads to a loss of clinical attachment and formation of a periodontal pocket.
- Osseous lesions of periodontal origin are usually associated with tooth mobility, and the affected teeth respond positively to pulp testing.
- The bony lesion is usually more widespread and generalized than are lesions of endodontic origin.



- **Radiographically:** there is lateral bone loss indicating a periodontal pocket.
- **Treatment:** depends on the extent of the periodontitis and the prognosis depends exclusively on the outcome of periodontal therapy.

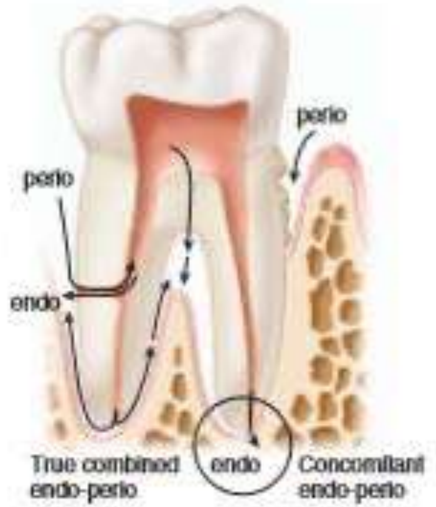
4- PRIMARY PERIODONTAL LESIONS WITH SECONDARY ENDODONTIC INVOLVEME

- Periodontal disease can have an effect on the pulp through dentinal tubules, lateral canals, or both.
- Primary periodontal lesions with secondary endodontic involvement differ from the primary endodontic lesion with secondary periodontal involvement only by the sequence of the disease processes.
- The tooth with primary periodontal and secondary endodontic disease exhibits deep pocketing, with a history of extensive periodontal disease.

- When the pulp is involved, the patient experiences pain and clinical signs of pulpal disease.
- This situation exists when the apical progression of periodontal disease is sufficient to open and expose the pulp to the oral environment by way of lateral canals or dentinal tubules.
- **Radiographically:** these lesions can not be distinguished from primary endodontic lesions with secondary periodontal involvement.
- **Treatment:** The prognosis depends on continuing periodontal treatment with endodontic therapy.

5- TRUE COMBINED LESIONS

- Pulpal and periodontal disease may occur independently or at the same time in and around the same tooth.
- Once the endodontic and periodontal lesions join, they may be clinically indistinguishable.
- The prognosis of multi-rooted teeth with combined pulpal and periodontal lesions depends on the extent of the destruction caused by the periodontal disease component.



Differential Diagnosis Between Pulpal and Periodontal Disease

	PULPAL	PERIODONTAL
CLINICAL		
Etiology	Pulp infection	Periodontal infection
Vitality	Nonvital	Vital
Restorative	Deep or extensive	Not related
Plaque/calculus	Not related	Primary cause
Inflammation	Usually Acute	Chronic
Pockets	Single, narrow	Multiple, wide coronally
RADIOGRAPHIC		
Pattern	Localized	Generalized
Bone loss	Wider apically	Wider coronally
Periapical	Radiolucent	Not often related
Vertical bone loss	No	Yes
HISTOPATHOLOGY		
Junctional epithelium	No apical migration	Apical migration
Gingival tissue	Normal	Some recession
TREATMENT	Root canal treatment	Periodontal treatment

OTHER PATHOLOGICAL

1- VERTICAL FRACTURE

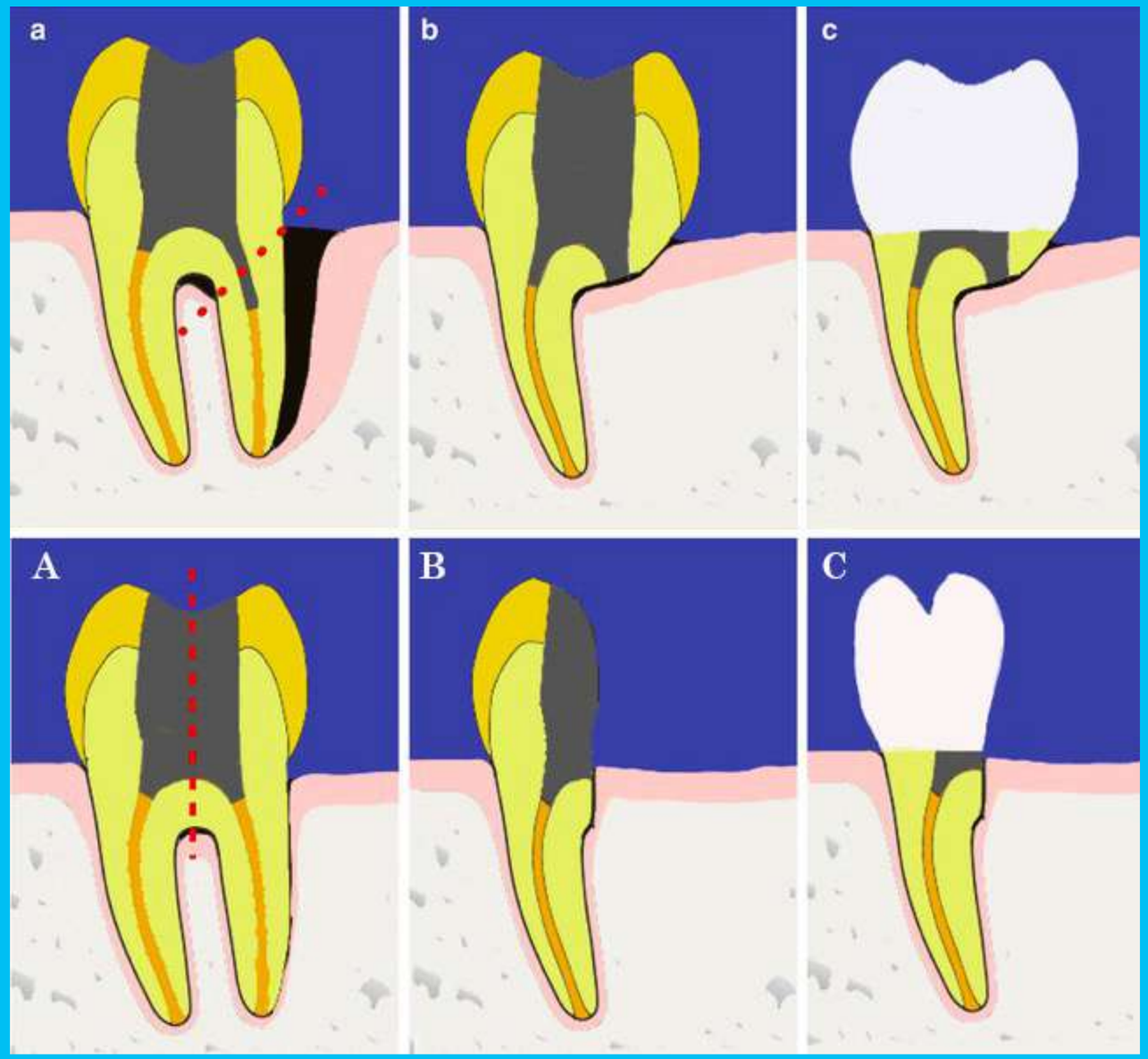
- A tooth with vertical fracture may have bone loss along the fracture line and affect the pulp and periodontal tissue.
- Treatment is extraction of the tooth due to poor prognosis of the condition.

2- DEVELOPMENTAL GROOVES.

- They are present mostly in the palatal surface of the maxillary lateral incisor.
- This groove extends apically therefore causing localized periodontitis and bone loss along the root surface.
- Clinically they are asymptomatic until the epithelial attachment is invaded by plaque and if it reaches the groove then periodontal infection extends rapidly. The pulp may be secondarily infected.
- Treatment Surgical correction of the groove and periodontal treatment. If the pulp is affected then endodontic treatment is necessary.

3- HEMISECTION AND ROOT AMPUTATION

- When part of a tooth is untreatable it is possible to extract this part and leave the rest of the tooth functional.

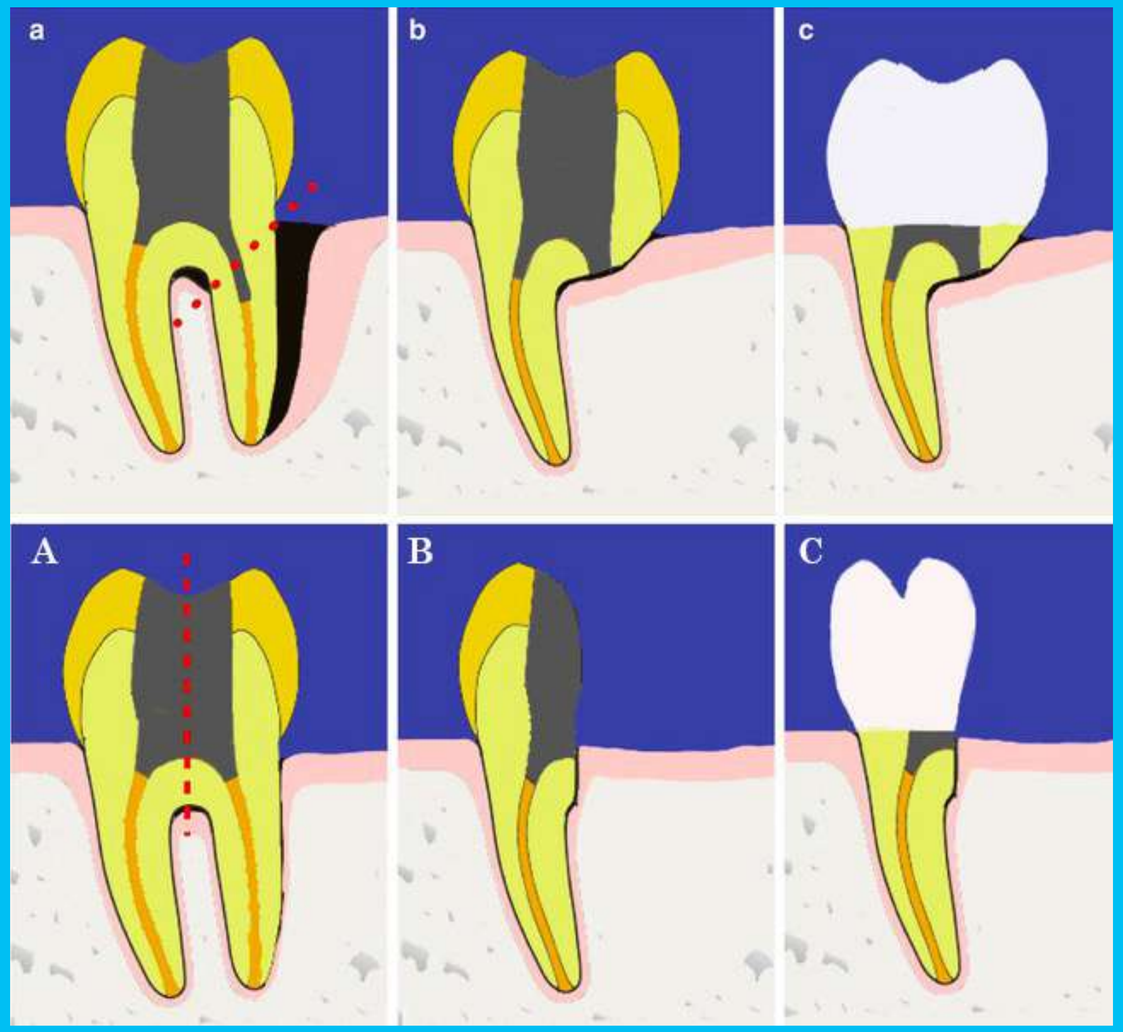


- These procedures are possible due to many reasons:

a) Endodontic reasons (separated instrument, root perforation and obstructed canals) .

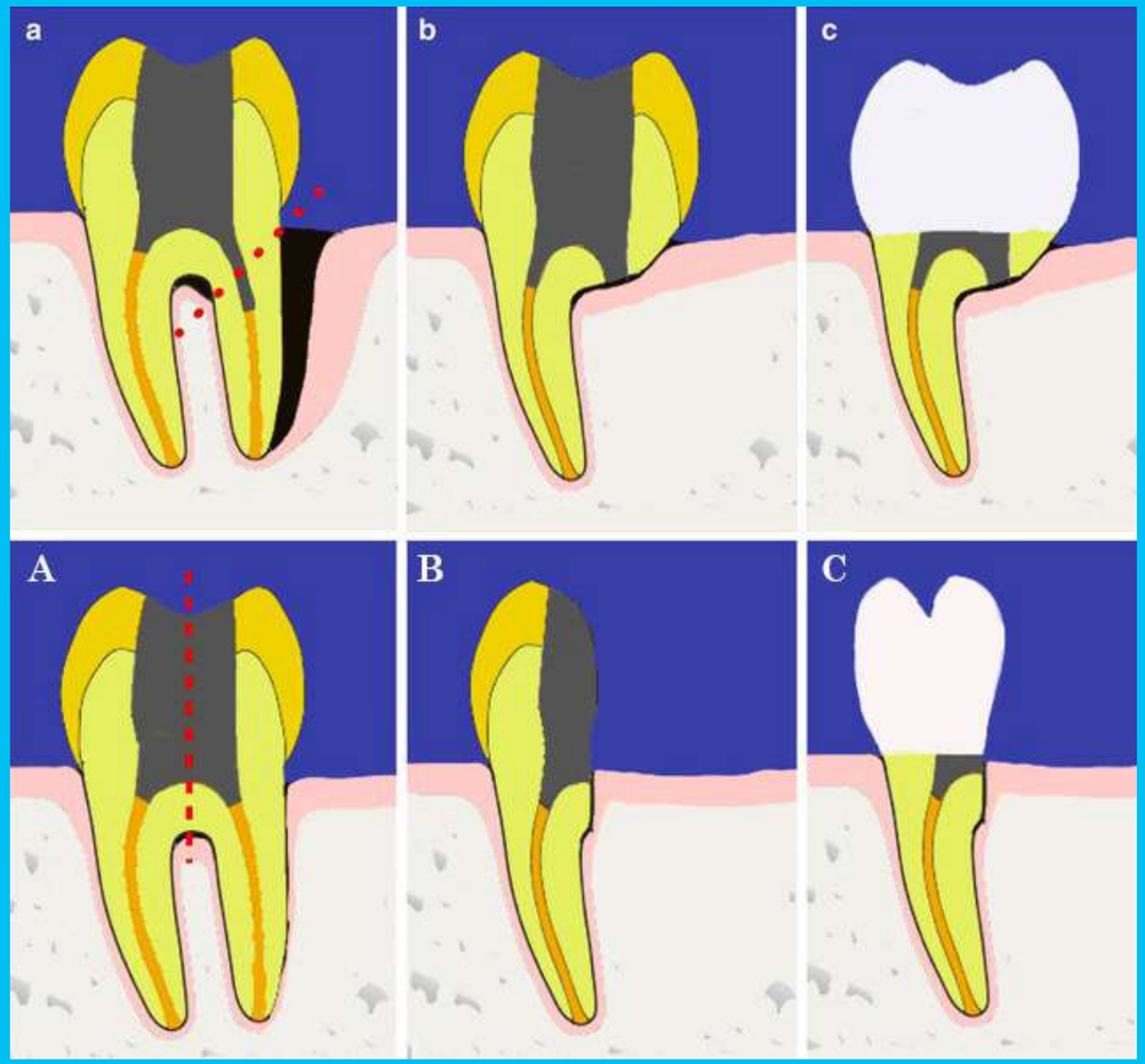
b) Periodontal reasons (furcation involvement, severe periodontal disease of one root) .

c) Restorative reason (caries destruction or erosion of a large portion of the crown and root, peforations during post endodontic preparation or fracture).



- Before starting with these procedures, a complete root canal treatment should be done.
- Hemisection means removal of half of a tooth as a mesial root of the mandibular first molar.
- In severe bifurcation involvement separation of the mesial and distal roots is possible and later on crowning is done to each root separately.
- This will ensure a good access for cleaning the furcation area.
- Root resection means removal of one root from multirooted teeth without removal any of the coronal tooth structure.
- This may be in the maxillary molars.

Root resection



Hemisection


THANK
YOU

RESTORATION OF ENDODONTICALLY TREATED TEETH

DR.AHMED AL-JOBORY

2023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AL JOBORY


Dr. Ahmed Al-Jobory
AHMAD
AL JOBORY

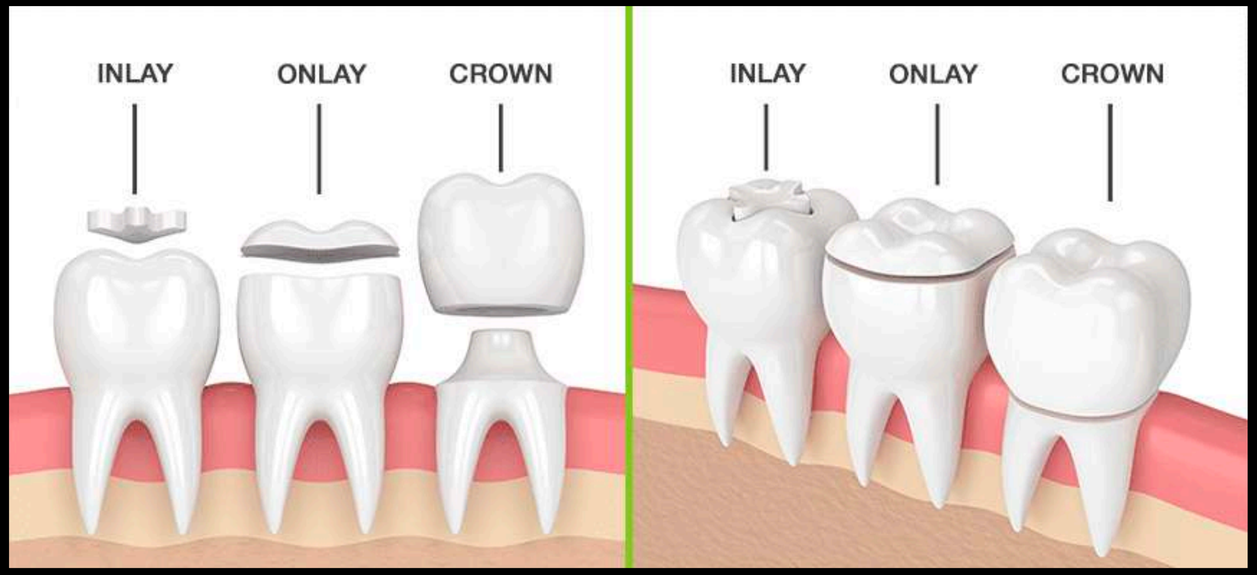
- After endodontic treatment, dentin is significantly weakened in shear strength and toughness. This is due to loss of moisture (9%) in dentin and brittleness of the tooth after loss of its vitality.
- Restoring a tooth after endodontic treatment needs to conserve as much remaining tooth structure as possible.
- Posterior teeth should be restored with restorations that cover and protect the occlusal surface of the tooth as onlay.
- Crown coverage of teeth is only indicated when the tooth has multiple large restorations or it lost great amount of tooth structure.

TYPES OF TREATMENTS ACCORDING TO TOOTH LOSS

1- DIRECT COMPOSITE RESTORATION.

2- INDIRECT RESTORATION: COMPOSITE OR CERAMIC INLAYS.

3- FULL CROWNS.



1- Direct Composite Restorations

- When a minimal amount of coronal tooth structure has been lost after endodontic therapy, a direct resin composite restoration can be done.
- Composites have compressive strengths of about 280 MPa, and the Young modulus of composite resins is generally about 10 to 16 GPa, which is close to that of dentin.

2- Indirect Restorations: Composite or Ceramic Onlays

- Ceramic or resin composite onlays can be used to restore endodontically treated teeth.
- Endocrowns combine the post in the canal, the core, and the crown in one component.
- Both onlays and endocrowns allow for conservation of remaining tooth structure, whereas the alternative would be to completely eliminate cusps and perimeter walls for restoration with a full crown.

- Onlays are constructed in the laboratory from either hybrid resin composite or ceramics.
- Onlays, overlays, and endocrowns can also be fabricated from resin composites processed in the laboratory.
- Using various combinations of light, pressure, and vacuum, these fabrication techniques may increase the conversion rate of the polymer and consequently the mechanical properties of the restorative material.

3- Full Crowns

- When a significant amount of coronal tooth structure has been lost by caries, restorative procedures and endodontics, a full crown may be the restoration of choice.
- The crown can be directly built on the remaining coronal structure which has been prepared accordingly.
- More frequently, the cementation of a post inside the root canal is necessary to provide retention for the core material and the crown.
- The core is anchored to the tooth by extension into the root canal through the post and replaces missing coronal structure.

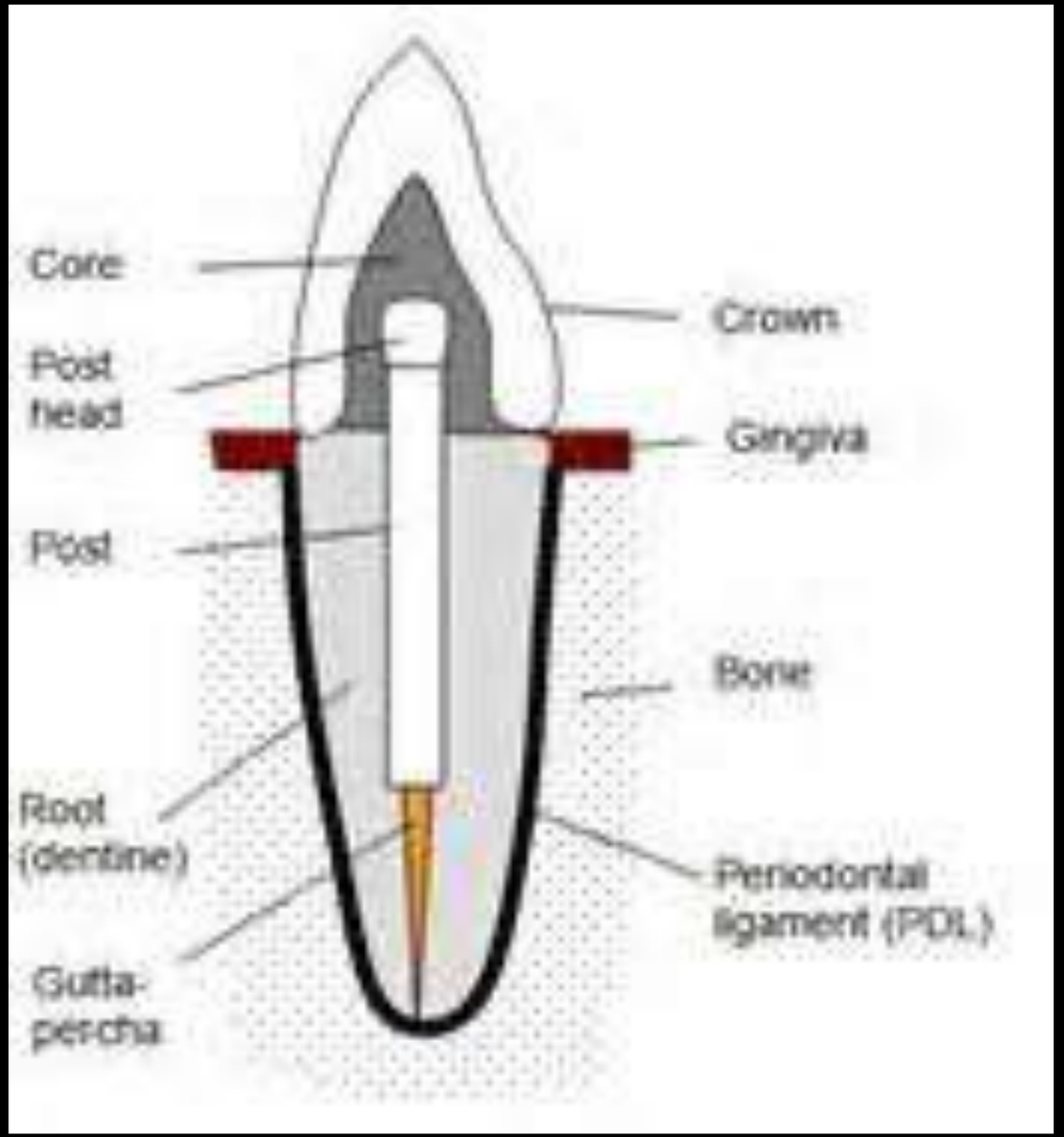
- The crown covers the core and restores esthetics and function of the tooth.
- An additional role of the post and core is to protect the crown margins from deformation under function therefore preventing coronal leakage.
- The post and its luting material used to cement it, the core and the crown will all influence the longevity of the tooth.

- When a post is needed it gives retention to the core but it does not strengthen the tooth against fracture especially metal posts.

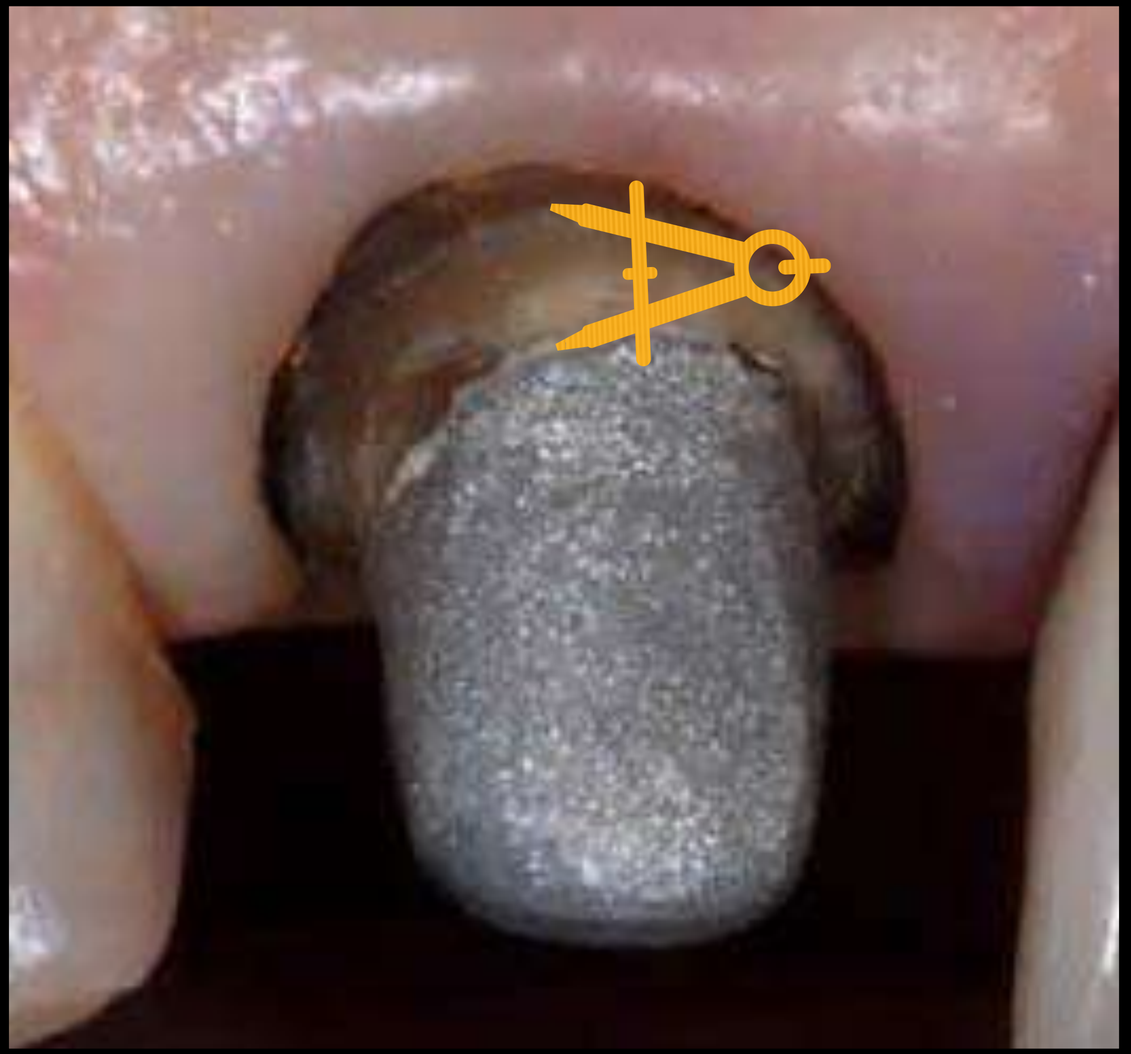
- Tapered posts are the least retentive posts and threaded posts are the most retentive but these threads increase the possibility of stress concentration at the edges of the post and end in root fracture.

CLINICAL GUIDELINES FOR POST DIMENSION

1. The post should be 3/4 the length of the root when treating long rooted teeth or keeping 5 mm of apical gutta percha.
2. The post should be confined to the straight part of the root canal.
3. Post width should be as wide as the width of the treated root canal without extra widening to keep as much tooth structure as possible.



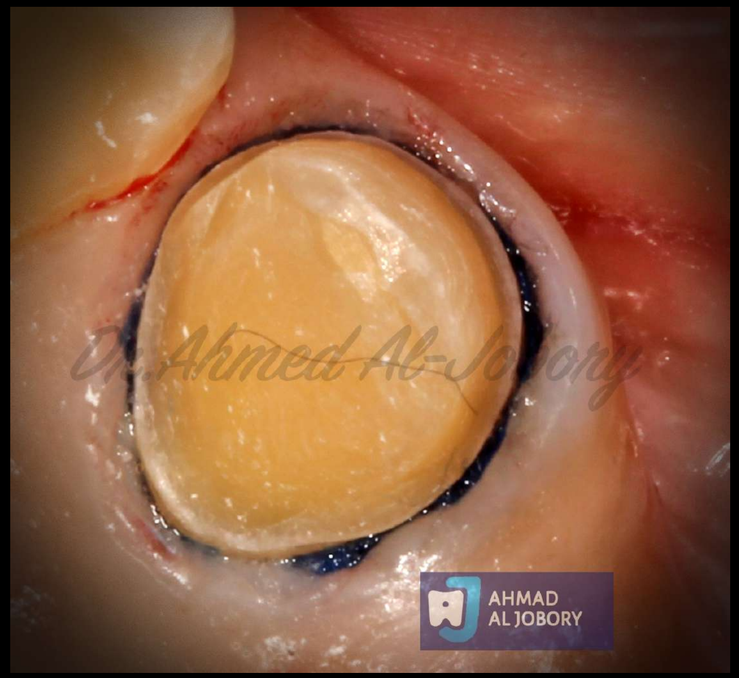
THE FERRULE

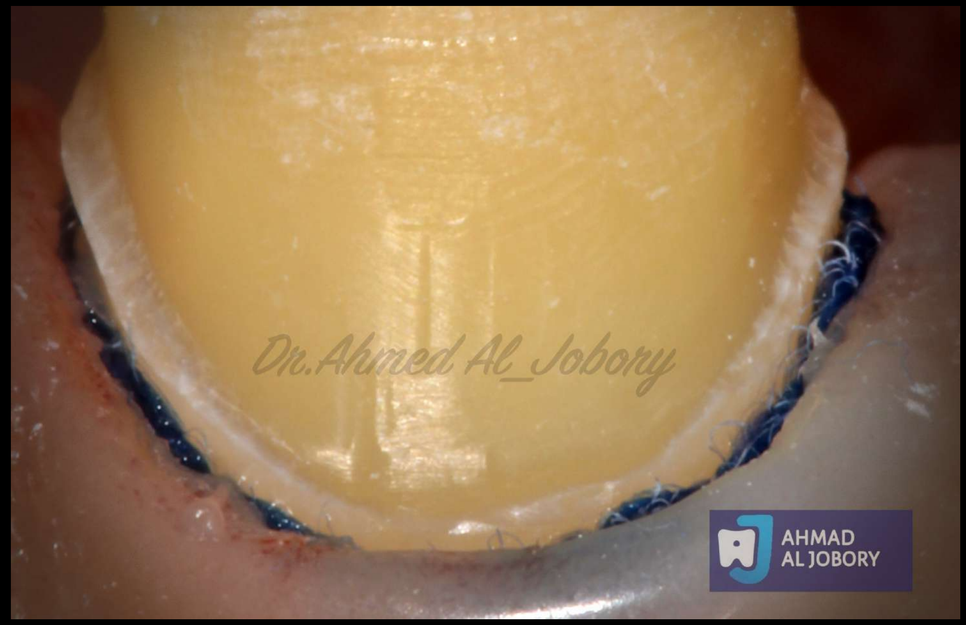


- The more tooth structure that remains, the better long-term prognosis of the restoration.
- The coronal tooth structure located above the gingival level will help to create a ferrule.
- The ferrule is formed by the walls and margins of the crown, encasing at least 2 to 3 mm of sound tooth structure.
- A properly made **ferrule** significantly reduces the incidence of fracture in endodontically treated teeth **by** :
- 1- Reinforcing the tooth at its external surface.
- 2- Disperse forces that concentrate at the narrowest circumference of the tooth.
- 3- Increases fracture resistance significantly.
- 4- Resists lateral forces from posts and influence from the crown in function.
- 5- Increases the retention and resistance of the restoration.

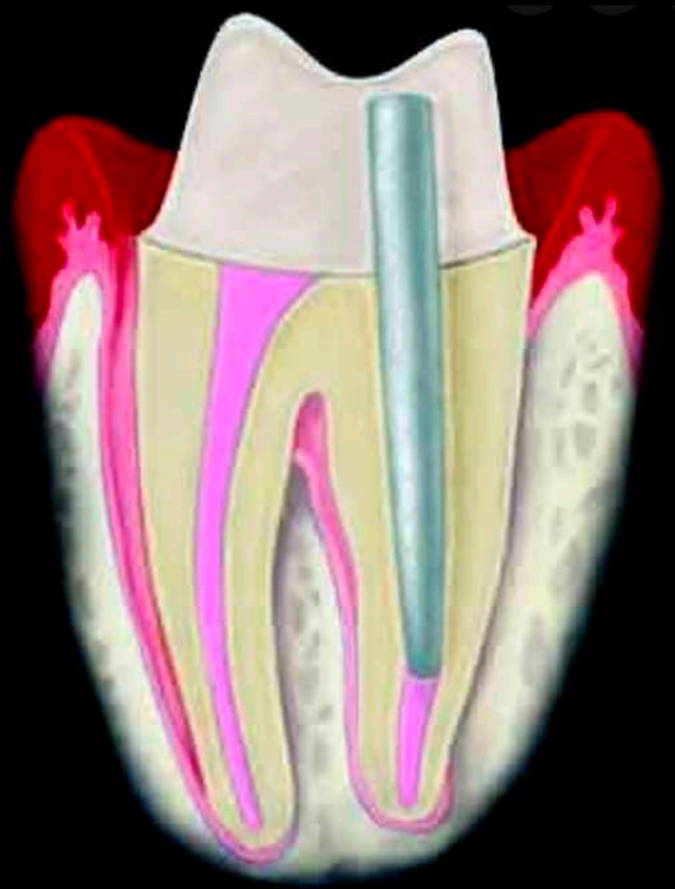
REQUIREMENTS OF CROWN SHAPE AND CROWN PREPARATION

1. The ferrule (dentin axial wall height) must be at least 2 to 3 mm.
2. The axial walls must be parallel.
3. The restoration must completely encircle the tooth.
4. The margin must be on solid tooth structure.
5. The crown and crown preparation must not invade the adjacent tissues.





POST



- Dentin has a degree of flexibility and posts can be flexible or stiff.
- Although no material can behave exactly like dentin, a post with functional behavior similar to that of dentin is beneficial when the post must be placed next to dentin.
- Fiber posts have a modulus of elasticity closer to dentin than that of the metal posts.
- An ideal post should be resilient enough to cushion an impact by stretching elastically, thereby reducing the resulting stress to the root. It would then return to normal without permanent distortion.
- Therefore, the perfect post would combine the ideal degree of flexibility and strength in a narrow-diameter structure.

CLASSIFICATION OF POSTS

1. CUSTOM MADE POSTS (GOLD OR BASE METAL ALLOYS).
2. PREFABARICATED POSTS.

a. METAL (GOLD, STAINLESS STEEL OR TITANIUM POSTS).
b. CARBON FIBER.
c. GLASS FIBER.
d. QUARTZ.
e. ZIRCONIA.

POSTS SHOULD PROVIDE AS MANY OF THE FOLLOWING CLINICAL FEATURES AS POSSIBLE

1. Maximal protection of the root from fracture.
2. Maximal retention within the root and retrievability.
3. Maximal retention of the core and crown.
4. Maximal protection of the crown margin seal from coronal leakage.
5. Pleasing esthetics, when indicated.
6. High radiographic visibility .
7. Biocompatibility.

PROCEDURE FOR POST SPACE PREPARATION AND POST PLACEMENT

1. Take an xray to evaluate the condition, length and width of the tooth.
2. Preserve as much as possible of the tooth structure coronally but at the same time offer an easy access of the Pesso drill to the root canal.
3. The gutta percha is removed by the Pesso drill with as minimum tooth structure removal as possible.
4. A suitable sized post should be placed to fit the space in the root canal.
5. The post is cemented in the root canal with a luting agent (composite luting cement or glass ionomer cement) in the root canal.
6. The core is built up with a suitable material as composite or amalgam.


THANK YOU

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BLEACHING AND WHITENING OF TEETH

Bleaching History - timeline

1800s	Bleaching found in journals
1864	Bleaching of nonvital teeth - chlorinated lime
1868	Bleaching of vital teeth - oxalic acid
Late 1800	Dentists mixed their own bleaching agents
1918	Light used to raise Temp and accelerate process
WWI & II	Tooth whitening reemerged
1961	Walking bleach technique – Internal bleaching
1963	Substituted water for 30% H_2O_2
1968	At-home method of bleaching - 10% carbamide peroxide
1989	At-home bleaching affordable to public

Bleaching

"Application of a chemical agent to oxidize the organic pigmentation in the tooth".

(Sturdevent. C.M)

A etiology of tooth discoloration

1. Extrinsic discoloration
2. Intrinsic discoloration

- **Extrinsic discoloration**

1. Diet-Related Stains
2. Bacterial Stains
3. Gingival Hemorrhage
4. Chlorhexidene mouth wash
5. Smoking
6. Dental Caries

- **Intrinsic discoloration**

PATIENT-RELATED

1. **Pulp necrosis**
2. **Intrapulpal hemorrhage**
3. **Dentin hyper calcification**
4. **Age**
5. **Tooth formation defects:**

*A. **Developmental defects***

*B. **Drug-related defects***

DENTIST-RELATED

Endodontically related

1. Pulp tissue remnants
2. Intracanal medicaments
3. Obturating materials

Restoration related

1. Amalgams
2. Metal pins and posts
3. Composites

Extrinsic discoloration

- **Diet-Related Stains**

  Strong tea ,coffee, orange , grapefruit juice, Blackcurrant juice, cola drinks **act** by both **etching** and **staining** the tooth structure .

- **Bacterial Stains**

Chromophilic bacteria frequently seen in the deciduous or mixed dentition can cause a dotted or black-line stain.

- **Gingival Hemorrhage**

  Chronic gingivitis may induce staining from the breakdown of blood in the gingival sulcus.

- **Chlorhexidene**

Chlorhexidene acts in reducing plaque formation by altering the chemistry of the primary pellicle by disturbing matrix formation. This altered pellicle attract more extrinsic stain. not readily removed by tooth brushing.

- **Smoking**

Smoking tobacco produces a yellowbrown discoloration, especially on the lingual aspects of the teeth.

Chewing tobacco causes a black-brown stain that is most noticeable on the buccal surfaces of the mandibular posterior teeth.

- **Dental Caries**

Dental caries is the most common cause of external and internal discoloration of enamel and dentin.

Intrinsic discoloration

• PATIENT-RELATED

- **Pulp necrosis**

Bacterial, mechanical, or chemical irritation to the pulp may result in tissue necrosis and release of disintegration byproducts that may penetrate tubules and discolor the surrounding dentin.

- **Intrapulpal hemorrhage**

Intrapulpal hemorrhage and lysis of erythrocytes are a common result of traumatic injury to a tooth.

Blood disintegration products, likely iron sulfides, flow into the tubules and discolor the surrounding dentin.

- **Dentin hyper calcification**

Excessive formation of irregular dentin in the pulp chamber and along canal walls may occur following certain traumatic injuries.

A temporary disruption of blood supply occurs→ destruction of odontoblasts →replaced by undifferentiated mesenchymal cells → rapidly form irregular dentin on the walls of the pulp lumen→ translucency of the crowns giving rise to a **yellowish** or **yellowbrown** discoloration.

- **Age**

Color changes occur physiologically, a result of excessive dentin apposition, thinning of the enamel, and optical changes.

Food and beverages, also cracking and incisal wear of the enamel and underlying dentin.

In addition, amalgam and other coronal restorations that degrade over time cause further discoloration.

- Tooth formation defects

1. Developmental *defects*

Discoloration may result from developmental defects during enamel and dentin formation, either

hypocalcification enamel or **hypoplastic enamel.**

2. Drug-related defects

- *Tetracycline* **and** *Endemic Fluorosis*

- # DENTIST-RELATED
- **Endodontically related**

Pulp tissue remnants

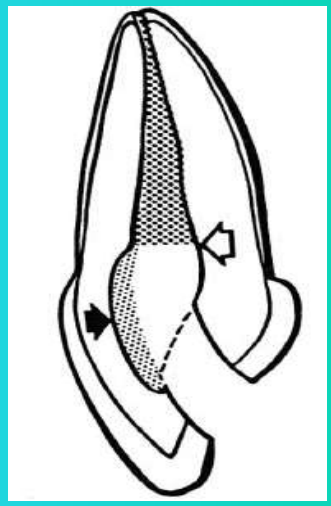
Tissue remaining in the pulp chamber disintegrates gradually and may cause discoloration(Pulp horns).

Intracanal medicaments

Phenolics or iodoform-based medicaments sealed in the root canal and chamber are in direct contact with dentin sometimes for long periods, allowing penetration and oxidization. These compounds have a tendency to discolor the dentin gradually.

Obturating materials

Incomplete removal of obturating materials and sealer remnants in the pulp chamber, mainly those containing metallic components, often results in dark discoloration.



- **Restoration related**

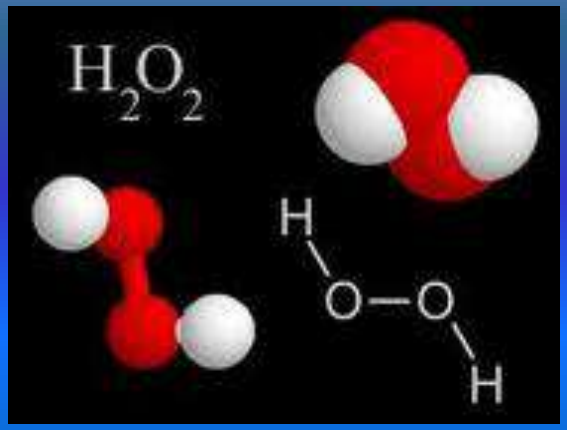
Amalgams

Composites

Metal pins and posts

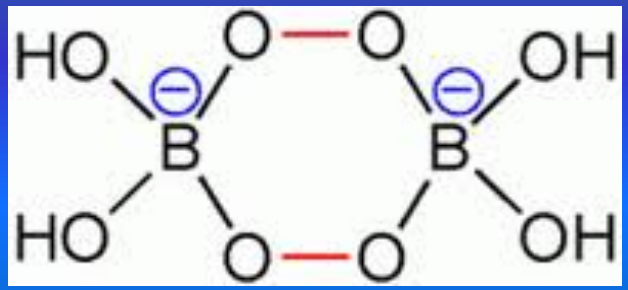
BLEACHING MATERIALS

- **Hydrogen Peroxide**
- 30 to 35% stabilized aqueous solutions are the most common. some of them activated by a composite curing light .
- Hydrogen peroxide is caustic and burns tissues on contact, releasing toxic free radicals, perhydroxyl anions, or both.

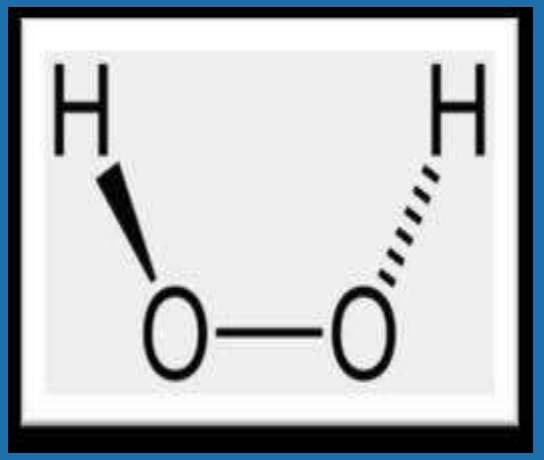


- **Sodium Perborate**

When fresh, it contains about **95% perborate**, corresponding to **9.9%** of **oxygen**. Sodium perborate is stable when dry.
In the presence of acid, warm air, or water, it decomposes to form **sodium metaborate**, **hydrogen peroxide**, and **nascent oxygen**.
Three types are available: monohydrate, trihydrate and tetrahydrate.
They differ in oxygen content, which determines their bleaching efficacy.

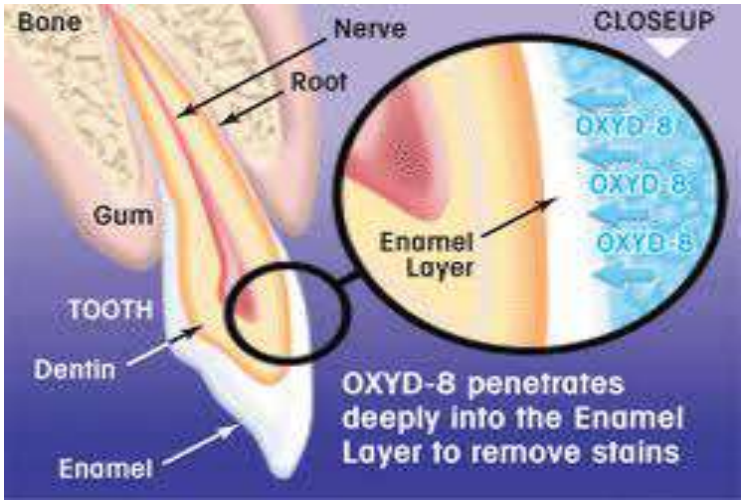


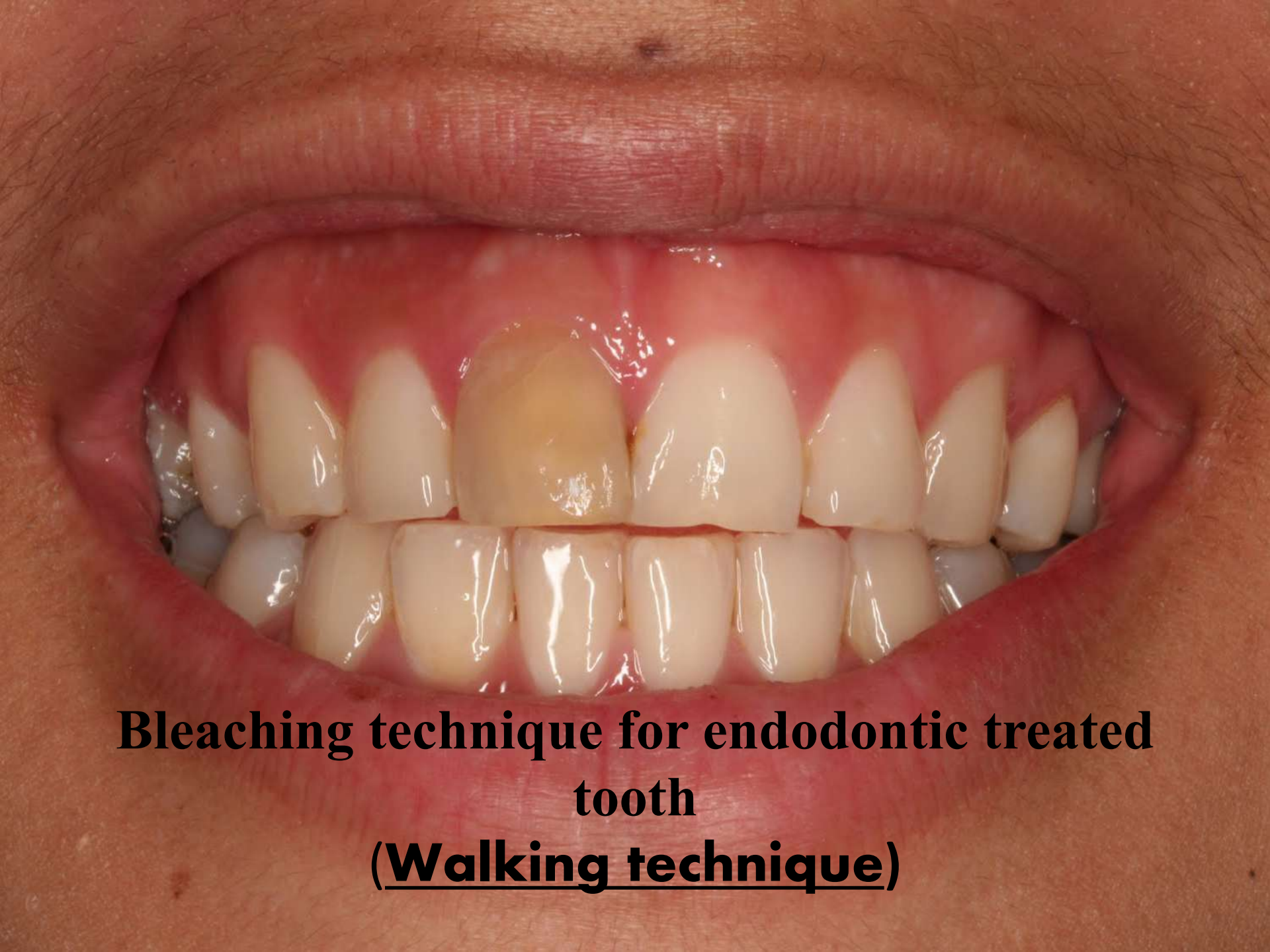
- **Carbamide Peroxide**
- This agent, also known as **urea hydrogen peroxide**, is available in the concentration range of **3 to 45%.**
- However, popular commercial preparations contain about **10%** carbamide peroxide with a **mean pH of 5 to 6.5**.
- Solutions of 10% carbamide peroxide break down into **urea**, **ammonia**, **carbon dioxide**, and approximately **3.5% hydrogen peroxide**.



Mechanism of Bleaching

- reduction reaction that occurs during bleaching is known as a **redox reaction.**
- The unstable peroxides →**convert to**→ unstable free radicals{These free radicals may **oxidize** (remove electrons from) or **reduce** (add electrons to) other molecules}→ **mainly oxidizers** → act on the organic structure of the dental hard tissues(organic)→→ slowly degrading them into chemical by-products, such as carbon dioxides, that are lighter in color.
- (These free radicals open the highly pigmented carbon rings and converting them into chains, which are lighter in color).

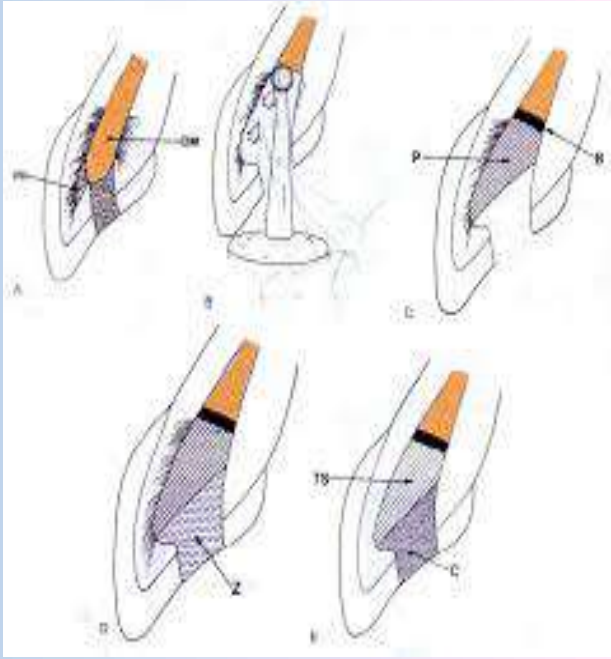




Bleaching technique for endodontic treated tooth

(Walking technique)

- Remove all restorative material from access cavity and expose dentin.
- Remove all material to level just below the labial gingiva margin.
- Apply a thick layer at lest 2mm of protective white cement such as glass ionomer cement to cover endodontic obturation.
- Mix the sodium perborate(bleaching material) to thick consistency, then fill the pulp chamber with paste and remove excess liquid with cotton.
- Apply a good sealed temporary filling, at least 3mm thick.
- Evaluate the patient 2 week later and if necessary repeat procedure several times.




KEEP SMILING!!


Thank You