# Obturation of root canal system

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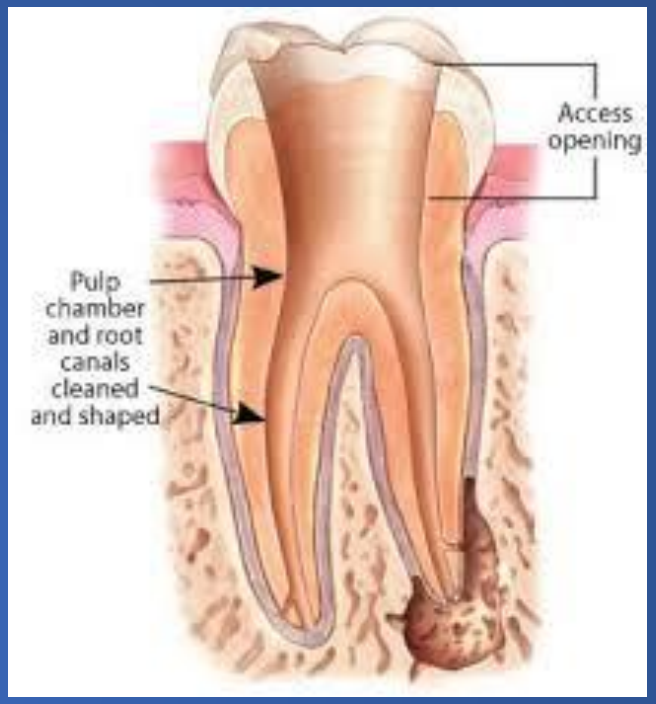
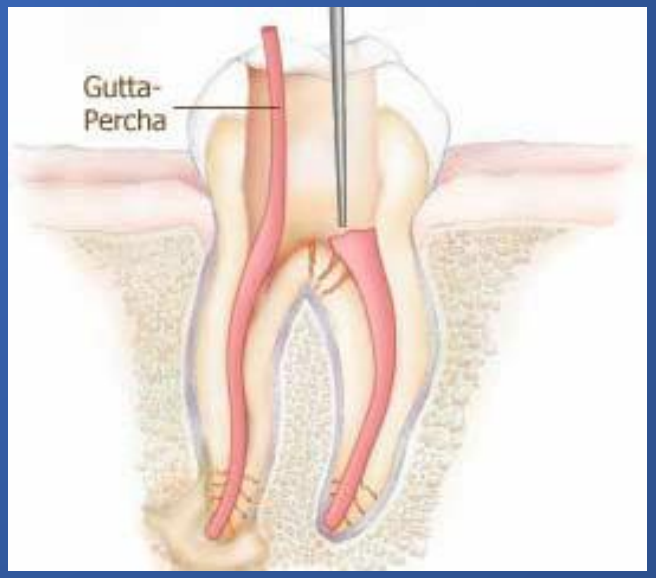
After chemo-mechanical debridement of root canal system, the next step is complete (3 dimensional) obturation of root canal space to maintain the tooth functional within the dental arch.

The remaining non-vital pulp within incompletely debrided root canal will undergo autolysis and the disintegrated by products will diffuse into the surrounding tissue.

Main aim of obturation is to provide 3 dimensional hermetic seal of root canal space to prevent the leakage from or into root canal system.

In obturation a solid or semisolid core material is used with a sealer to produce the fluid tight seal, by filling the main root canal(s), the accessory canals, voids, spaces and irregularities



# Aims of root canal obturation

The achievement of 3 dimensional obliteration of the root canal space to prevent ingress of bacteria and body fluids into root canal space, as well as egress of bacteria or their toxins out of the root canal.

To provide fluid tight seal within all regions of root canal space to prevent microleakage.

The replacement of the root canal space filled with necrotic tissue by an inert filling material to create a favourable healing environment and avoid recurrent infection.

To provide adequate coronal seal with proper coronal restoration to obtain long term success of root canal therapy.

# Timing of obturation

*Patient symptoms:* the sensitivity to percussion indicative that the inflammation of the periapical periodontal ligament is present. Therefore the obturation has to be postponed until the inflammation subside. In cases of irreversible pulpitis with no tenderness to percussion present, the root canal treatment can be completed in a single visit as soon as the cause of the pain and inflammation has been removed.

*Canal wettability:* presence of wet canal with purulent exudate, blood or pus is a strong evidence that the periradicular inflammation is still present. Obturation of the root canal at this stage increase the pressure within periradicular region and subsequent tissue destruction may proceed rapidly. Therefore, in cases of active periradicular infection, delaying obturation until all signs and symptoms of inflammation have to be subside is extremely recommended.

*Negative culture:* most of the endodontist do not relay on this test because researches have approved that the false negative results inaccurately assess the intracanal microbial flora. Furthermore, the positive results is not an indicative for the potential bacterial pathogenicity.

# Features of an ideal root canal obturation

1. Complete 3 dimensional obturation from the coronal orifice of the root canal until CDJ.
2. Radiographically, the root filling should be within 0.5- 0.75 mm from radiographical apex.
3. The root canal should be completely filled, mainly with root filling material with a minimum amount of sealer.

*Underfilling:* occur when the root canal filling is shorter that total root canal space. This definitely provide an environment for initiation, persistence or recurrence of periradicular infection.

*Overfilling:* occur when the root filling material extended beyond the CDJ. According to Ng et al. 2007 the extrusion of root canal filling is considered to be acceptable within 2mm beyond the radiographical apex, if it is associated with 3 dimensional sealing of root canal system.

# Characteristics of an ideal root filling material

1. Easily introduced in the root canal.
2. Provide an apical and lateral sealing of the root canal.
3. Dimensionally stable after usage.
4. Impervious to moisture.
5. Bacteriostatic or at least should not encourage bacterial growth.
6. Radiopaque.
7. Non staining to tooth structure.
8. Non irritating
9. Sterile or easily sterilized.
10. Removed easily from canal if required.

## Materials used for obturation

- Plastics: Gutta-percha, resilon
- Solids or metal cores: Silver points, Gold, stainless steel, titanium and irridio-platinum.
- Cements and pastes:
  - Hydron
  - MTA
  - Calcium phosphate
  - Gutta flow

# Gutta percha

Gutta percha is a natural material extracted as a dried coagulated extract from a Brazilian trees (Palaquium). Its molecular structure is close to natural rubber. Chemically gutta percha is available into two crystalline forms: alpha (α) and beta (β).

β-form is composed of the following:

Organic: gutta percha 20% + waxes and resins 3%

Inorganic: zinc oxide filler 66% + heavy metal sulfates as radioopacifiers 11%

The β-form is produced as gutta percha points (cones) which is available commercially into different sizes and tapering as follow:

1. Standard cones of the same size and shape of the ISO endodontic instruments (tapered 2%).
2. Greater taper gutta percha points: available with taper 4%, 6%, 8% and 10%.
3. Auxiliary points non-standard cones.

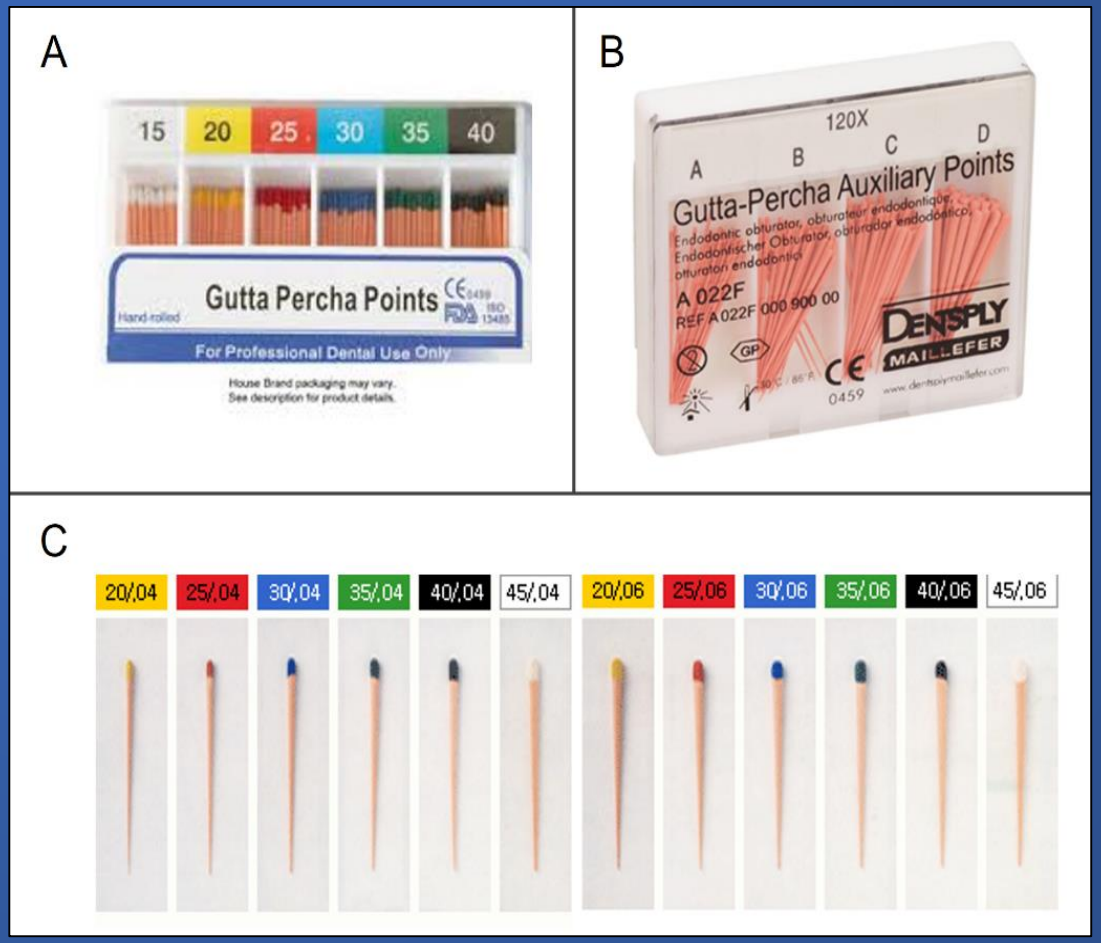



**Figure: Gutta percha forms. (A) Standard cones, (B) auxiliary cones, (C) greater taper cones, which shows (size / taper) above each gutta percha cone.**

# Properties of gutta percha

- Gutta percha expand on heating and increase volume which could be advantageous to compact into root canal spaces. However, Gutta percha shrink on cooling. Therefore, vertical pressure should be applied on warm gutta percha to compensate for volume loss after cooling.
- Heat sterilization is inapplicable with gutta percha. For disinfection, gutta percha points can be immersed in ethanol alcohol (96%) for one minute prior to its use.
- Because gutta percha has no adherence property, it should always be used with sealers to seal the root canal space.
- Gutta percha can be dissolved in certain chemical solvent such as chloroform eucalyptus oil, etc. The chemically plasticized property of gutta percha is important in soften gutta percha points for better filling or in easily removal of gutta percha from the canal during re-endodontic treatment.

***Advantages of gutta percha:***

1. Compatibility: adaptation to the canal wall.
2. Inertness: do not interact with the tissue.
3. Tissue tolerance.
4. Dimensionally stable.
5. Radiopacity.
6. Plasticity: can be soften either with heat or using chemical solvent.

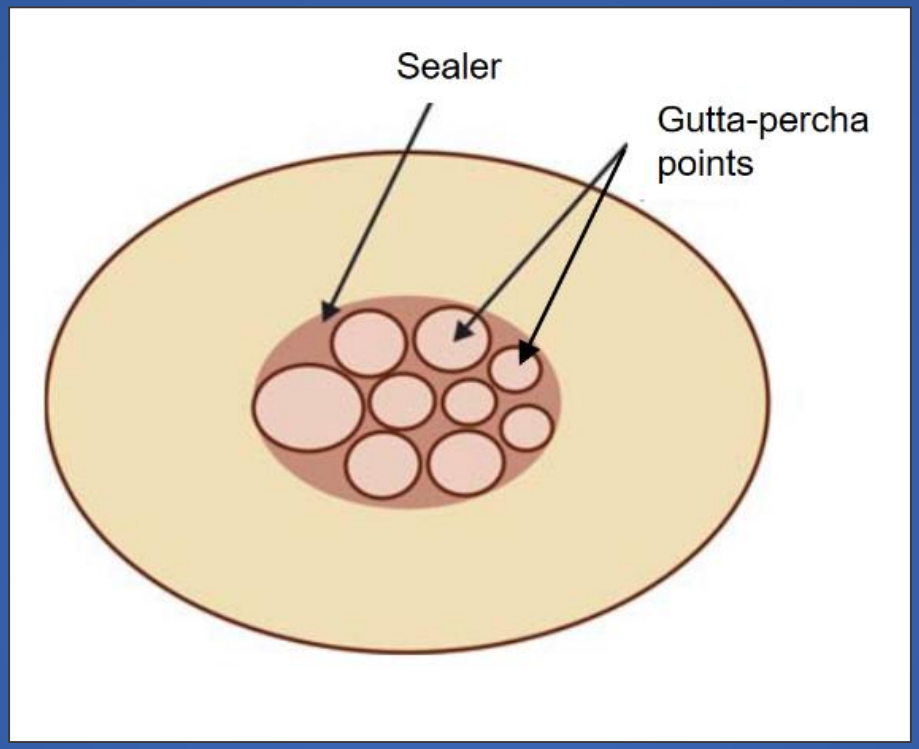
***Disadvantages:***

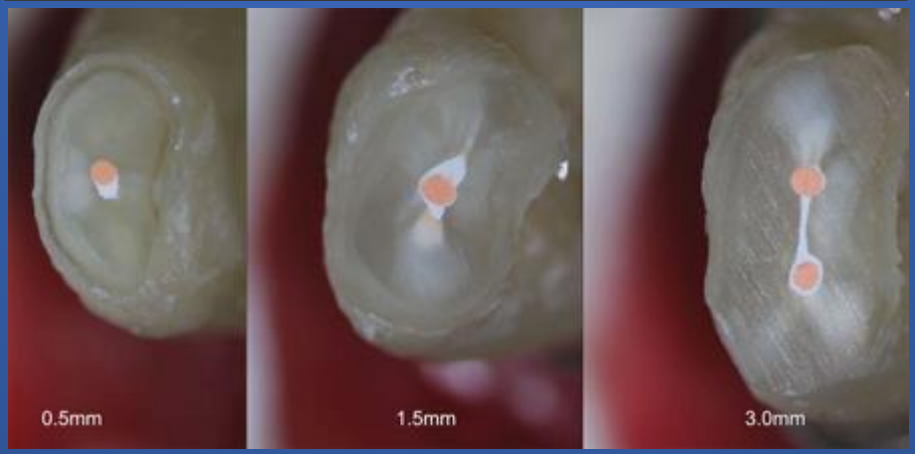
1. Lack of rigidity: can be bend easily with pressure which make its application difficult especially in narrow canals.
2. Lack of adhesiveness so it should always be used with sealers and cements.
3. Easily displaced by pressure.

# Silver points

- Old endodontic filling points which were made from silver.
- They are stiff points with rounded cross section which can be easily used in rounded and narrow canals.
- Because of their sliver corrosive products which are toxic in nature, their use have been declined nowadays.
- In addition, silver points are not compatibles, lacking plasticity, and cannot adhere to the canal wall.

# Root canal sealers



# Sealers can serve several functions

1. Lubricate and aid the seating of gutta percha cones.
2. Bonding between gutta percha and root canal walls.
3. Filling gaps and anatomical spaces.
4. The Sealer and primary filling effectively increase the fluid tight seal and prognosis of endodontic treatment. Some sealers (cements) that can be used as obturating material without gutta percha.
5. Antimicrobial agent: immediately after placement.
6. Radiopacity: identifying the auxiliary canals, resorption regions, root fracture, and the shape of apical foramen.

## Different types of sealers are available

Zinc oxide–eugenol formulations

Glass ionomers

Silicon sealers

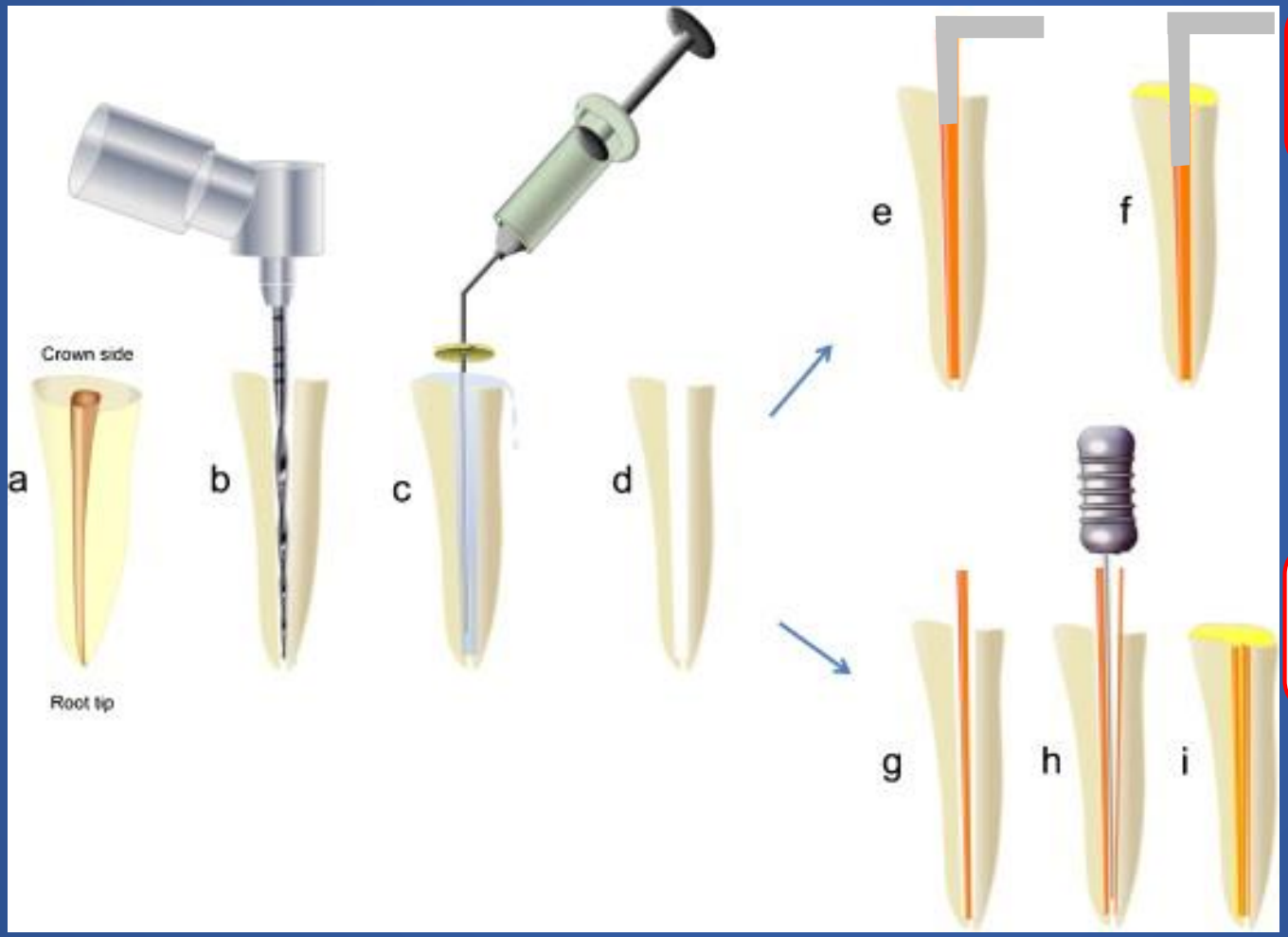
Bioceramics

Calcium hydroxide sealers

Medicated sealers

Epoxy resin sealers

# Obturation Techniques




Vertical Compaction

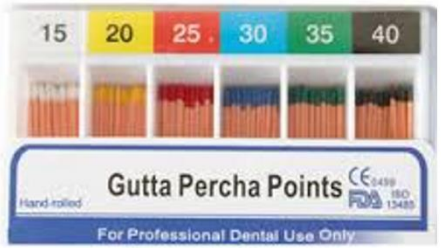
Lateral Compaction

# Armamentarium

- Primary and auxiliary (accessory) cones of gutta percha.
- Absorbent paper point for dryness of the root canal after irrigation complete. These point are available with different sizes and tapering matching that of gutta percha cones.
- Spreaders and pluggers for compaction of gutta percha. These instrument also available in different sizes to fit the size of the prepared canal. The spreaders are either hand or finger spreaders with pointed tips and sizes starting from ISO size 20 to 45 or 50. The pluggers are mainly available with handles and flat tips to vertically compact the soften gutta percha. The tip sizes are available from 0.4 to 1.2mm.
- Endodontic ruler for measuring the length of gutta percha point.
- Scissor for cutting gutta percha points during fitting inside the canal.
- Heating device such as spirit lamp or gas torch.
- Heating instrument such as spoon excavator.

**Figure: Armamentarium of obturation.**
**(1) ISO sizes gutta-percha points,**
**(2) auxiliary gutta-percha,**
**(3) absorbing paper points,**
**(4) endodontic ruler,**
**(5 A) hand spreader, (B) finger spreader,**
**(6)endo-pulgger.**

1




2


3

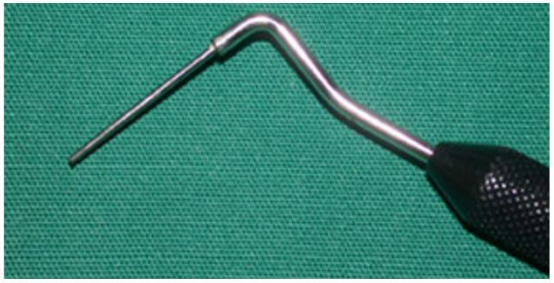
4


5

A

B

6



# Lateral compaction technique

The most common obturation compaction technique.

It involves the placement of the master gutta-percha point and accessories under lateral pressure against the canal walls by using a spreader.

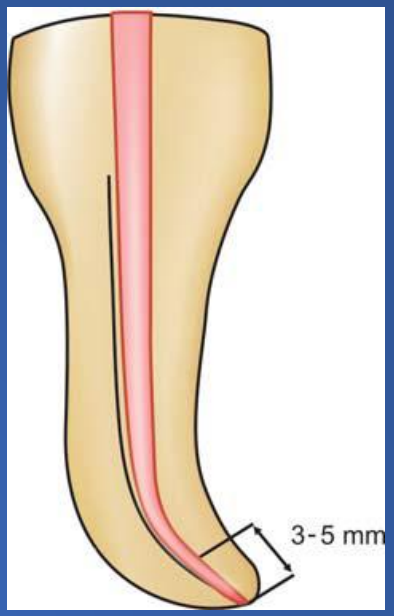
The canal should be continuously tapered shape with a definitive apical stop.

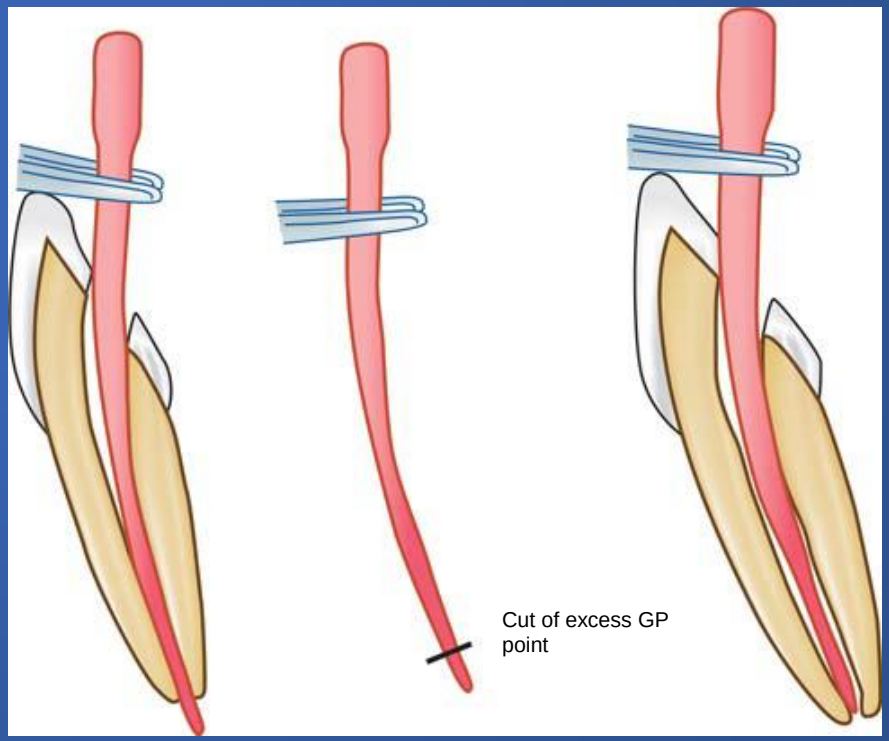
# Procedure of lateral compaction obturation:

1. Select master cone gutta-percha cone, whose size is consistent to the size of the largest file used in instrumentation up to the full working length (similar to the size of master apical file). This gutta-percha cone is called master apical cone (MAC). This cone have to:

a. Fit to the full WL of the canal.

b. Should feel resistance when you pull the cone out of the canal. This resistance comes from the engagement of MAC between walls of the apical region of the prepared canal (3-5mm of the apical canal region). This feeling of resistance is called tugback. If the MAC fit the entire WL but no tugback, you can either choose larger cone size or cut 0.5 to 1mm from the cone tip until a tugback has to be felt. After that mark the WL on the MAC at the level of incisal or occlusal reference point. This can be done by making a notch on the MAC at this level.

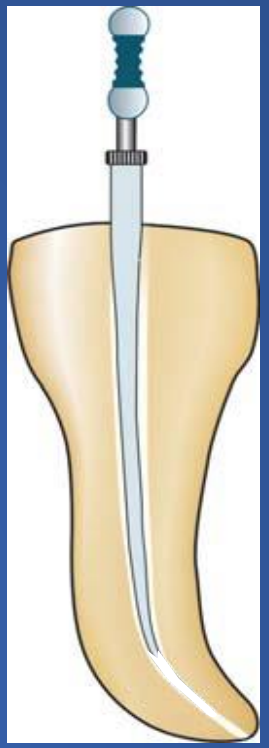


c. Check the fit of MAF radiographically.

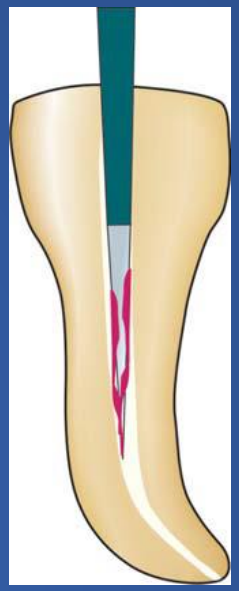
- If the master cone fit within canal WL, remove the cone from the canal and place it over a piece of cotton socked in either sodium hypochlorite or 96% ethanol.
- If the MAC fits shorter of the WL, check for any canal blocking by dentin chips, ledge or canal curvature and treat them accordingly.
- If the MAC going beyond the apical foramen, either select larger cone size or cut the cone to the WL (Fig 2 B).
- If the tip of MAC shows “S” shape in radiograph this means that the cone is too small for the canal. A larger size can be selected to fit the canal.

2- Select suitable size of a spreader to be used for lateral compaction, which should reach 1-2mm shorter of the canal WL.

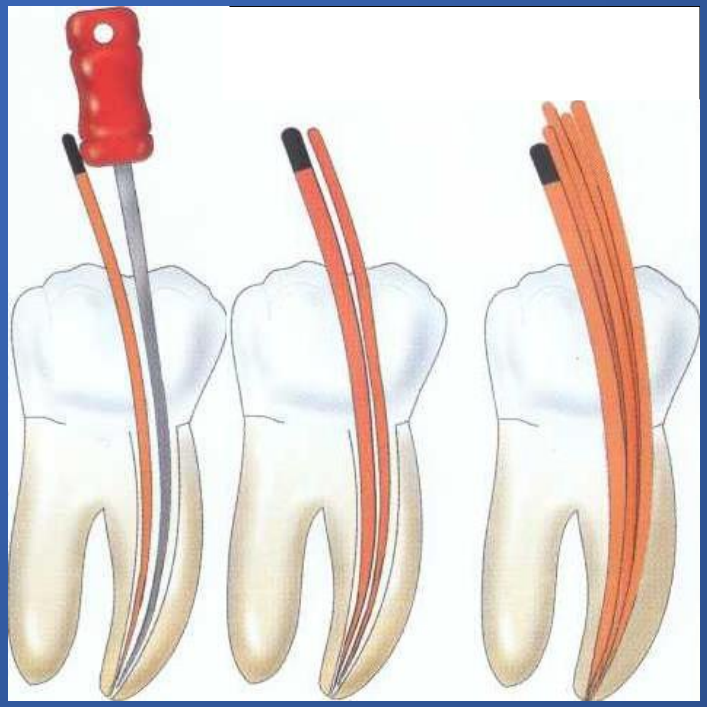


3- Dry the canal completely with paper point.

4- Mix the sealer according to the manufacturer instruction and apply it within the canal either by a paper point or a clean file with counter clockwise rotation inside the canal.



5- Coat MAF with small amount of sealer and place it inside the canal. The spreader then placed into the canal alongside the MAF with vertical gentle pressure. The spreader will act as a wedge to compact gutta percha laterally under vertical pressure on the wall of the canal.

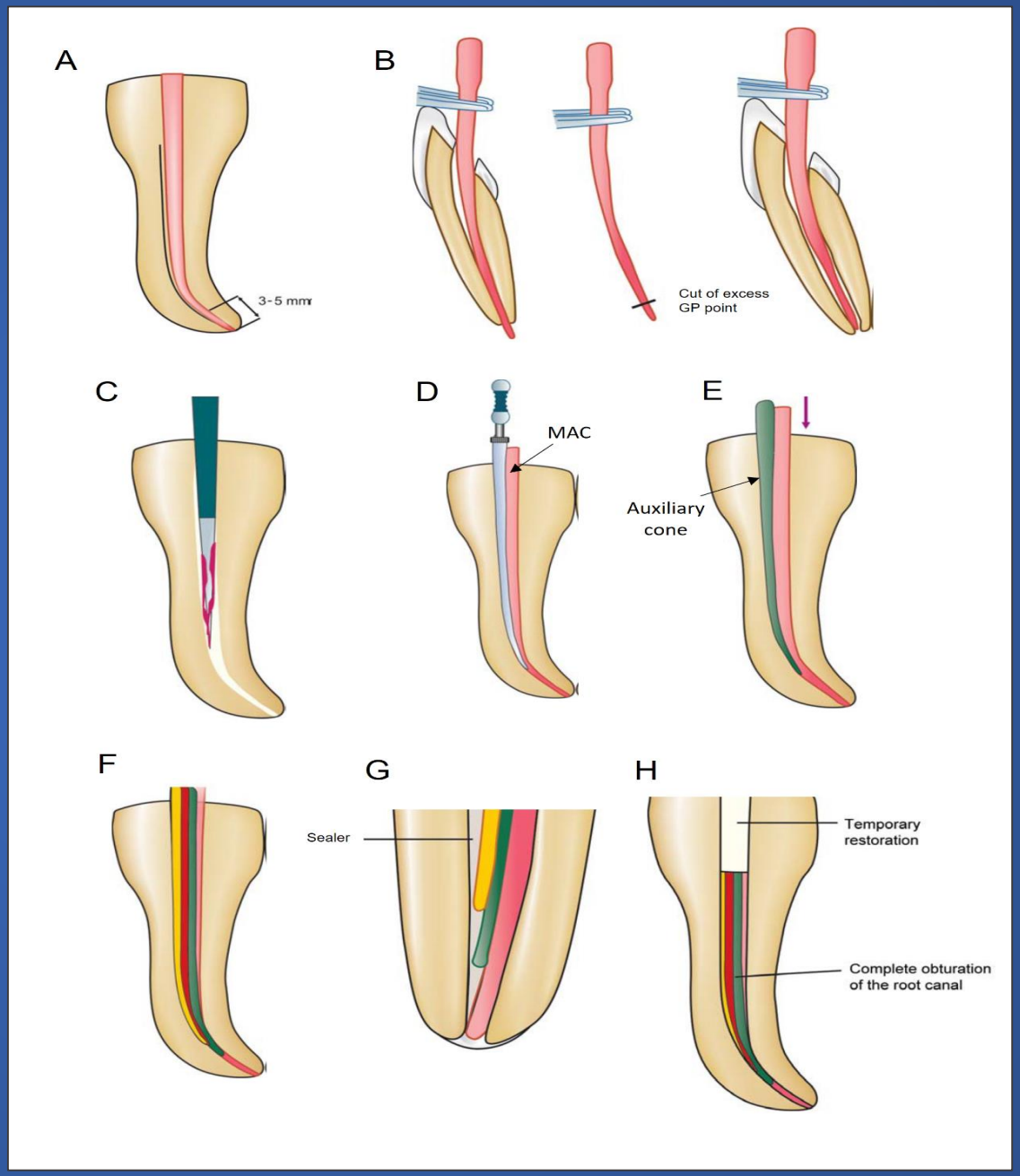


6. After that the spreader can be removed from the canal by rotating it back and forth. This will leave a space alongside the MAF for the accessory gutta percha.

7. An accessory cone can then be placed into the left space and the above procedure is repeated until the spreader can no longer penetrate beyond the cervical line.

8. Finally the cut the protruded parts of gutta percha points with hot instrument such as spoon excavator of the endo plugger. A gentle vertical compaction can also be done by the plugger to seal the coronal orifice of the canal with the melted gutta percha.

Figure: Lateral compaction technique. A and B is fitting of MAC, C is application of sealer by paper point, D is lateral compaction of MAC by spreader, D-G is lateral compaction od axillary cones, H is complete obturation.



***Advantages of lateral compaction:***

1. It can be used with the most routine clinical situations.
2. During lateral compaction, it provides length control with less chance of overfilling and post-operative pain.

***Disadvantages:***

1. May not sufficiently fill the irregularities within the canal.
2. Does not produce homogenous mass.
3. Voids and spaces may exist between accessory and master cones.

# Vertical compaction technique

This technique was introduced to overcome the drawbacks of lateral compaction technique.

It uses hot plugger with vertical pressure to compact the heat soften gutta percha to flow into canal irregularities.

The prepared canal that can be filled by this technique should have:

- A funnel shape with continuous tapering to the apex.
- Good apical stop region (apical constriction is as small as possible).

# Procedure for vertical compaction obturation:

1. Select the master cone gutta percha which should fit the canal size and taper, and check its fitness by radiograph. The tugback is not necessary for the master cone.

2. Dry the canal completely with paper point.

3. Select the sizes of pluggers according to the size and taper of the canal. Pluggers should be prefitted at 5 mm intervals in order to capture maximum cross section area of the softened gutta percha

4. Coat the canal lightly with sealer by a paper point.

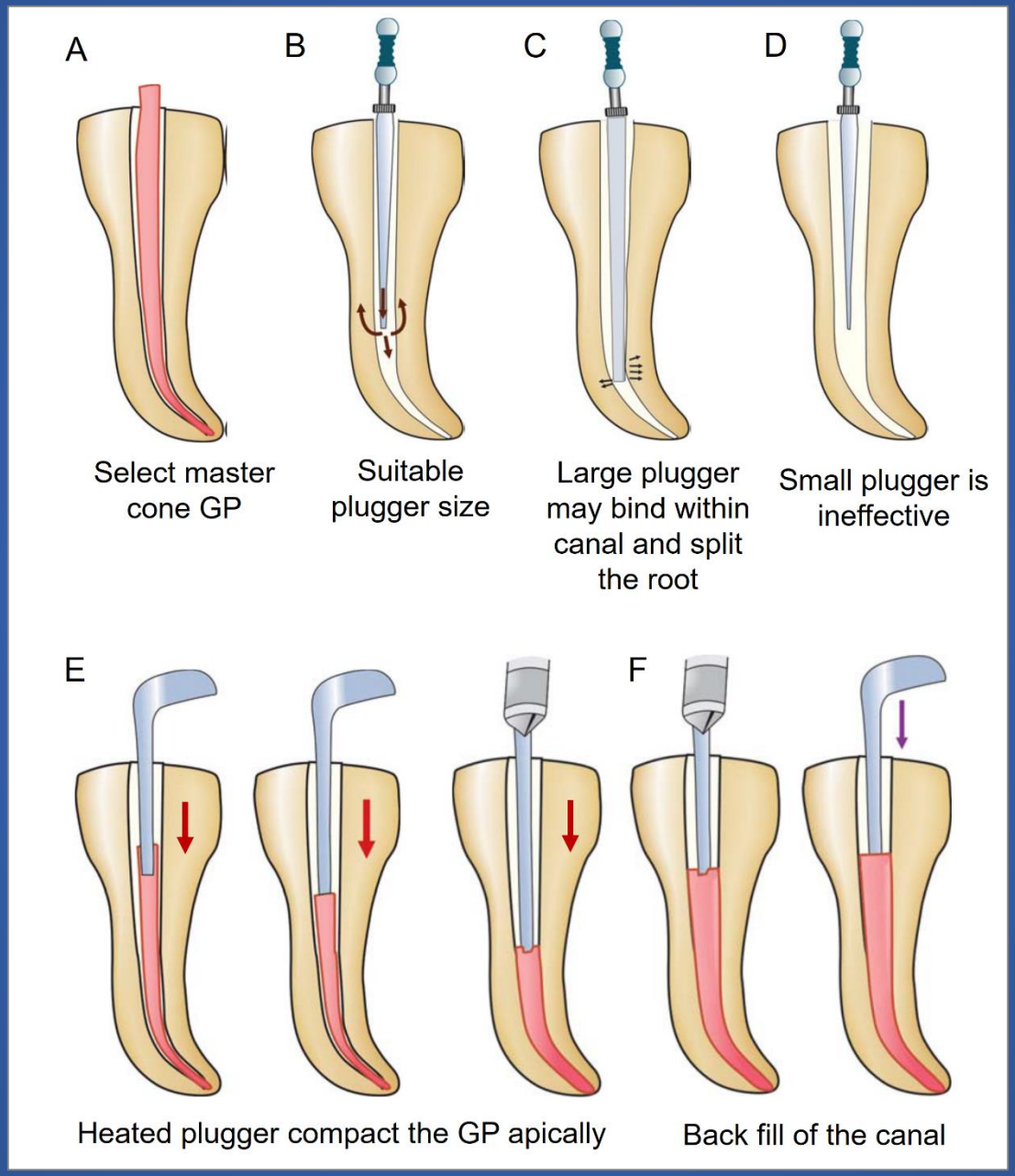
5. Cut the coronal end of the gutta percha cone at the incisal or occlusal reference point.

6. Use the heated plugger to vertically force the master cone into the canal. Fold the soften gutta-percha inward to fit apically and laterally. If the soften gutta-percha stuck into the plugger tip, just slight rotate the plugger to loosen it. This vertical compaction will free 2-3 mm of space coronally to allow adding more gutta-percha

7. After finish the apical filling, complete obturation by doing backfilling. This can be done by heating small segment of gutta-perch and carrying them into the canal using heated larger pluggers.

8. Be careful not to overheat the gutta-percha to facilitate its handling.

9. After completion, clean the pulp chamber from the excess of sealer and gutta-percha by a piece of cotton socked in alcohol then put the temporary or final restoration.


A
B
C
D
Select master cone GP
Suitable plugger size
Large plugger may bind within canal and split the root
Small plugger is ineffective
E
F
Heated plugger compact the GP apically
Back fill of the canal

***Advantages of vertical compaction:***

Provide excellent sealing of the canal apically and laterally with filling of the lateral and accessory canals.

***Disadvantages:***

1. Increase the risk of vertical root fracture.
2. Overfilling and apical extrusion of the gutta-percha and sealer periapically.
3. Time consuming procedure.

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