

Obturation Materials

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REFERENCES

- PATHWAYS OF THE PULP text book (10th Ed, Ch 8 and 10)
- Endodontics; Principles and Practice (4th Ed)
- Dental Materials textbooks

Introduction

- Obturation materials
 - CORE → Gutta Percha, Resin based (Resilon), Silver points
 - SEALERS → ZnO-E based, Calcium hydroxide based, Resin based, Silicone Based, Glass Ionomer based, and Bioceramics

Obturation Materials

- Ideal Properties of a Root Filling Material (Grossman 1978)
- Technical Properties:
 - It should not shrink.
 - It should be impervious to moisture.
 - It should have good adhesion/adaptation to dentine & associated root filling materials.
 - It should not strain tooth structure.

Obturation Materials

- Ideal Properties of a Root Filling Material (Grossman 1978)
- Biological Properties:
 - It should not irritate the periradicular tissues.
 - It should be bacteriostatic or at least not encourage bacterial growth.
 - It should be sterile or easily and quickly sterilized immediately before insertion.
 - It should cause no general health problems or allergies for patients and dental personnel.
 - It should stimulate the periapical healing process.

Obturation Materials

- Ideal Properties of a Root Filling Material (Grossman 1978)
- Handling Properties:
 - It should be easily introduced into a root canal.
 - It should be easily removed from the root canal if necessary.
 - It should be radiopaque.
 - It should set in an adequate time, allowing sufficient time for obturation & possible immediate removal if needed.

Gutta Percha

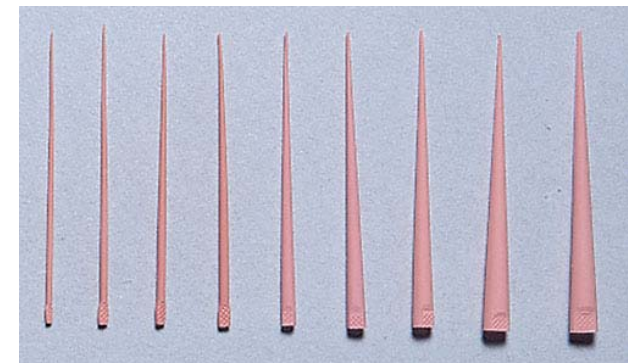
- Most commonly used core obturation material
- Made of a trans isomer of polyisoprene (Natural rubber)
- Harder, brittle and less elastic than natural rubber
- Two crystalline forms α and β
- α \longleftrightarrow β



Eucommia ulmoides
(Gutta-Percha Tree)

Gutta Percha

- Consists of *(Ch. 10 Pathways of the Pulp, P. 363)*
 - 20% GP
 - 65% ZnO
 - 10% radiopacifiers
 - 5% waxes, resins, and metal sulfates (plasticizers)
- Available in standardized and non-standardized (conventional) sizes



Gutta Percha Advantages

- Acceptable biocompatibility.
- Radiopaque.
- Dimensionally stable.
- Relatively easy to handle



Gutta Percha Advantages

- Easily softened by heat, compressed & packed to more closely adapt to the irregular shapes of the canal walls.
- Easily removable from the root canal system.
- Anti-bacterial properties (Very minimal)
 - Zinc-oxide - proven anti-bacterial properties & shown to provide cytoprotection to tissue cells



Gutta Percha Disadvantages

- Lack of adhesion to Dentin, therefore a sealer is necessary to fill the spaces around the filling material.
- Shrinkage upon cooling (after heating) about 1-2% (α phase shrinks less than β phase after heating)

Gutta Percha

- To sterilize/disinfect the GP cones prior to use clinically:

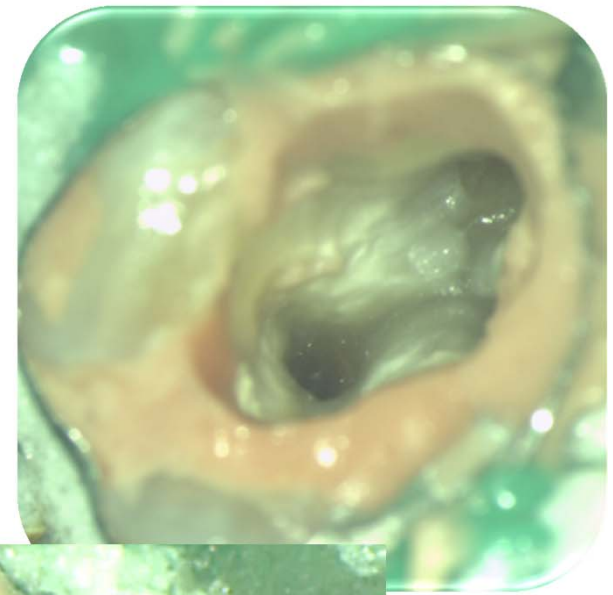
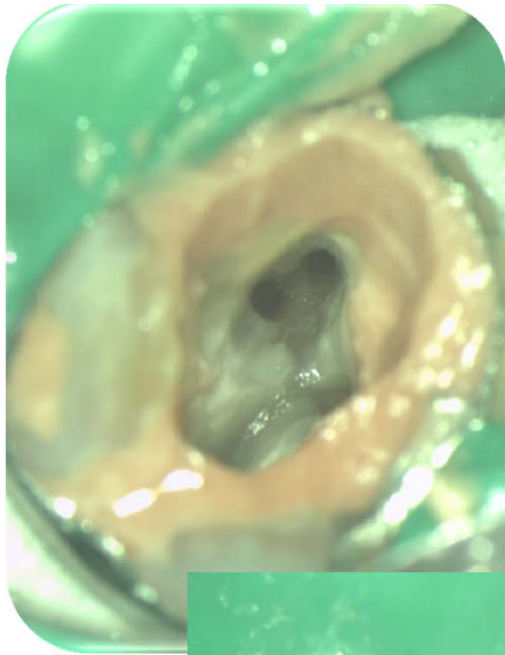
Heat?

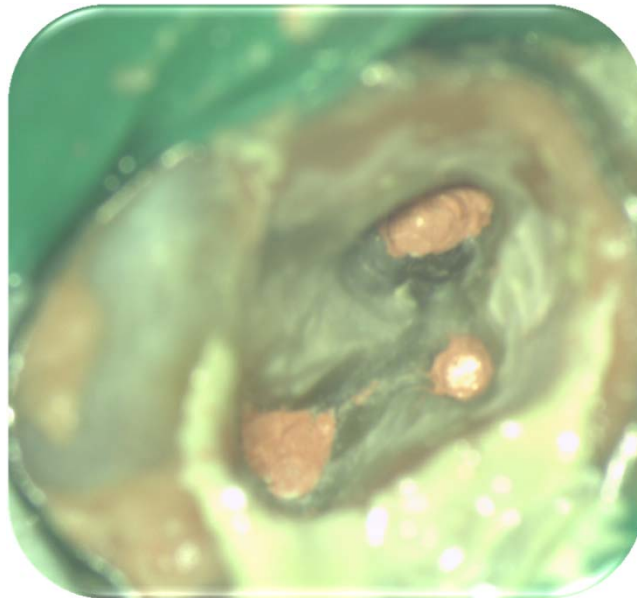
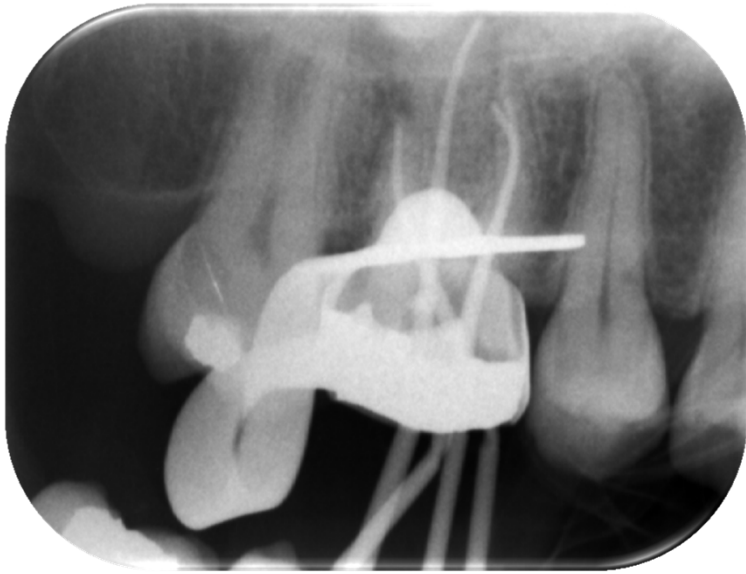


- Chemically → by use of 5.25% NaOCl for 1-2 minutes followed by Ethyl Alcohol rinse.

Gutta Percha







Gutta Percha

- Modifications to standard GP
 - Addition of medications, disinfectants → showed variable results, and when effective → showed increased cytotoxicity
(e.g. CH, CHX*, Iodoform, metronidazole, and other ABs)
 - need more clinical tests and trials
 - consider dimensional changes on release of such medications

Gutta Percha

- Modifications to standard GP
 - Coating the GP with resins or glass ionomer (ActivGP) to enhance bonding to corresponding sealer
 - Some showed good results, and others showed no benefits
 - In general, not commonly used as there is no clinical studies/evidence.

Silver Points



- Historical type of metal filling popular in 50s & 60s
- More rigid than GP & able to be easily pushed into tightly fitting canals or around curves.
- Due to their solid physical characteristics, cannot closely conform to the dimensions of the root canal.

Silver Points



- Corrosion due to moisture from either periapical tissue fluids or saliva has been reported.
- Corrosion products are toxic & also increase the possibility for microleakage.

Resin Based Cores - Resilon®



- Introduced dentine bonding technology to root canal obturation.
- Thermoplastic synthetic polymer based on polymers of polyester.
- Contains bioactive glass, difunctional methacrylate resin, bismuth oxychloride & barium sulfate.
- Filler content is 65% by weight.
- Clinically appears & handles like Gutta-percha.
- To be used with Epiphany® Sealer



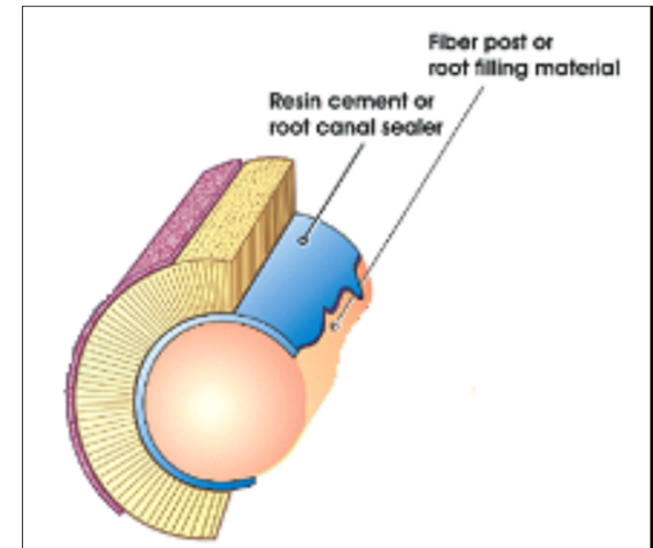
Resin Based Cores-Resilon[®]

Resilon based obturation system:

- Biocompatible
- Biodegradable by enzymes or high alkalinity
- Nonmutagenic, non toxic
- Similar seal created as with GP based obturation (controversial)
- Clinical studies (limited) shows similar outcome to that of GP and sealer cases

Resin Based Cores-Resilon[®]

- Resilon been marketed as a material that “strengthens” the roots due to the creation of a “monoblock”
 - Been proven otherwise (does not strengthen the root)
 - Failure happens at the interface between sealer and dentin (and some specimens showed failure at the sealer- resilon core interface)



Sealers

- Core materials lack the ability to adhere to dentin walls → to create a seal, a paste or cement material is needed to bond the two together → called a sealer

Sealers

- Grossman 1982 proposed properties of and criteria for an ideal sealer:
 - Should be tacky when mixed to provide good adhesion between it and the canal wall when set.
 - Should create a hermetic seal.
 - Should be radiopaque.
 - Should not shrink upon setting.

Sealers

Ideal sealer properties, cont'

- should not stain tooth structure.
- Should be bacteriostatic
- Should set slowly (adequate working time).
- Should be insoluble in tissue fluids.
- Should be non-toxic/ should be biocompatible.
- Should be soluble in a common solvent.

Sealers

- Types
 - Zinc-Oxide Eugenol (ZnO-E) based sealers
 - Calcium hydroxide based sealers
 - Resin based sealers (Methacrylates, and Epoxy resins)
 - Silicone based sealers
 - Glass ionomer based sealers
 - Bioceramics

Zinc Oxide-Eugenol based Sealers

- Rickerts sealer, Tubliseal, Roth sealer, Pulp canal Sealer (Kerr), Grossman's sealer.
- Based on zinc oxide powder mixed with Eugenol,
- Numerous proprietary variations to enhance qualities such as dentine adhesion, reducing inflammation, or antibacterial action.
- Setting reaction is by formation of Zinc Eugenolate crystals embedded with zinc oxide. Some unreacted Eugenol is released.
- Ample working time, but will set faster in the presence of body temperature, humidity, high alkalinity (calcium hydroxide).
- Some antibacterial activity of their own, but will also exhibit toxicity when placed directly on vital tissues.

Zinc Oxide- Eugenol based sealers

- Advantages:
 - Slow setting time
 - Antimicrobial activity
- Disadvantages
 - Shrinkage on setting
 - Soluble in tissue fluids
 - Staining (Due to Silver content, original formula-now Barium sulfates and Bismuth Subcarbonates)
 - Release of free Eugenol (non reacting) → irritation

Calcium Hydroxide based Sealers

- e.g. SealApex, Apexit etc
- Catalyst-base system → depends on proprietary formula
 - e.g. SealApex
 - Base= ZnO+ Calcium hydroxide+ Butyl Benzene
 - Catalyst/activator= Barium Sulfate+ Titanium Dioxide (Radiopacifiers)+ resins+ etc

Calcium Hydroxide based Sealers

- Thought to induce biological sealing with calcified tissue deposition over the apical foramen → shown not to happen when used as a sealer
- Any therapeutic effect is dependent on the calcium hydroxide being in an ionized form, and hence partly soluble.

Calcium Hydroxide based Sealers

- Disadvantages
 - Mild antimicrobial activity (less than ZnO-E based ones)
 - Poor cohesive strength
 - No Calcium Hydroxide release when set (no calcified tissue induction)
 - Easily disintegrates in tissue fluids resulting in chronic inflammation

Resin based Sealers

- Resin based sealers can be
 - Epoxy Resin based sealers
 - Methacrylate Resin based sealers

Epoxy Resin Based Sealers

- Epoxy resin consisting of a base bisphenol A-epoxy (Bis GMA) and a catalyst hexamethylene-tetramine.
- e.g. AH 26 and AH plus
- Bismuth oxide for radiopacity.
- Good handling properties with long working time, good flow, low solubility, dimensionally stable and good adhesion to dentine.

Epoxy Resin Based Sealers

- AH 26 (powder-Liquid system)
 - Setting time up to 24-36 hours
 - In a fresh mix- showed high toxicity (Formaldehyde release)
 - In a Set mix- showed lowest toxicity of all sealers
- AH plus (Two paste system)
 - Setting time about 8 hours
 - Less solubility than AH 26
 - More radiopaque
 - Better flow
 - No formaldehyde release on setting (less cytotoxicity than AH26)
 - Does not contain Silver

Methacrylate Resin Based Sealers

- UDMA (Urthane Dimethacrylate) based sealers



— EndoRez



— Epiphany

EndoRez

- Hydrophilic properties
- Good Sealing ability
- Biocompatibility
- Good Radiopacity
- To be used with Resin coated GP

Epiphany

- Dual-curable dentin resin sealer to be used with Resilon.
- Matrix is a mixture of ethoxylated glycidylmethacrylate & Bisphenol A epoxy (Bis-GMA), urethane dimethacrylate (UDMA), and hydrophilic difunctional methacrylates.
- Total filler content is 70% by weight - calcium hydroxide, barium sulfate, barium glass & silica.
- Biocompatible

Epiphany

- Etching & priming of the dentine surface is required to achieve a chemical bond.
- Primer is a self-etch primer containing sulfonic acid terminated functional monomer, hydroxyethyl methacrylate (HEMA), water, and polymerization initiator.
- Presence of sodium hypochlorite & peroxide must be eliminated:
 - Negative effects of sodium hypochlorite on primer & peroxide on the setting of the resin.
 - CHX reduced bond strength

Epiphany

- Showed decreased apical seal with time due to gap formation (Dentin-Sealer interface)

Silicone Based Sealers

- e.g. RoekoSeal
- Polyvinylsiloxane
- Expands slightly on setting
- Setting time is short 25-30 minutes, inconsistent due to NaOCl
- Not very popular

Bioceramic Sealers

- e.g. BC sealer
- Contains Zirconium Oxide, Calcium Silicate, Calcium Phosphate, Calcium hydroxide, fillers and thickening agents
- Does not shrink on setting
- Hydrophilic (uses moisture in the canal to set)
- Antimicrobial properties during setting reaction

Thanks 😊