DIFFERENT MATERIALS IN ENDODONTICS: IRRIGATION MATERIALS, INTRACANAL MEDICAMENTS AND ROOT CANAL FILLING MATERIALS
AIM OF ROOT CANAL TREATMENT

- Inhibiting the pulpal, and periapical infections.
- Inhibiting the progression of bacterial infections.
- The success highly depends on the desinfection of the root canal system.
- Aim is to eliminate „dead space” for colonisation of microorganisms.
Chemomechanical cleaning:
- aim: removing infected soft and hard tissues
  elimination of microorganisms
  creating optimal shape
  preserve healthy tissues

- materials: irrigation solutions
  medicines (dressing)
IRRIGATION SOLUTIONS

- Desinfection
- Smear layer
- Eliminate dentin debris (dentin plug!).
- Elimination of microorganisms.
- Blood, inflammatory fluid and organic tissue elimination.
Bicompatible
Not to cause soft tissue irritation
Lubricant
Desinfection
Tissue solvent
Hemostatic
Long lasting effect
Easy to use
Cheap
IRRIGATION SOLUTIONS

- Saline solution
- Sodium hypochlorite (NaOCl)
- Chlorhexidine (CHX)
- EDTA
- Hydrogen peroxide (H2O2)
SALINE SOLUTION

- No desinfection effect
- No tissue dissolution effect
- For final irrigation before root canal (does not disturb the root canal filling materials setting)
SODIUM HYPOCHLORITE

- 0.5 - 5.25% concentration solution (delution with sterile distilled water)
- 2.5% concentration solution recommended
- Processing time: 5 minutes
- Continuous applying
- Desinfection effect
- Organic tissue dissolvent
- Low-cost
- Available
- Easy to use
SODIUM HYPOCHLORITE

Side effect:

- In higher concentration (>5.25%) highly toxic.
- Tissue irritation periapically: pain, bleeding, oedema.
- Oral mucosa irritation.
CHLORHEXIDINE (CHX)

- Recommended concentration: 2%
- In low concentration: bacteriostatic high concentration is bactericide
- Good effect against enterococci and fungi
- No tissue solving capacity
- Using alternate with sodium hypochlorite has wider range of effect
- Recommended in case of sodium hypochlorite allergic patients
EDTA (ETHYLENE-DIAMINE-TETRAACETIC ACID)

- Recommended concentration: 15-17%
- Chelating agent, good ability to bind Ca $^{2+}$ ions - solves hard tissues
- Removes smear layer, desinfect dentin wall
- Weak antibacterial, and antifungal effect
- Using EDTA alternating with NaOCl solution
- As a part of the final irrigation before root canal filling
HYDROGEN PEROXIDE (H$_2$O$_2$)

- Weak antimicrobial effect
- Reaction of superoxide ions produce hydroxyl radicals
- Mainly used in 3% concentration
- Hemostatic effect
- Contaminating with blood releases oxygen (foam)
INTERACTIONS

- CHX+NaOCl > orange-brown precipitate (para-chloroaniline) can occlude dentin tubules

- EDTA+NaOCl > EDTA causes NaOCl to lose its tissue solving capacity – no free chlorine is available

- EDTA+CHX > white, foggy precipitate
Surviving microorganisms are possible after the chemomechanical root canal cleaning.

Perfect elimination of bacteria is not possible, but the number of germs should be reduced drastically.
IDEAL(MEDICINE) DRESSING MATERIAL

- Biocompatible
- Non toxic
- Non allergic
- Non specific disinfection ability – wide spectrum
- Pain-relieving
- Long-lasting effect
- Non leakable
- Indicate hard tissue production
- Easy to use
- Low-cost
CALCIUM HYDROXIDE CA(OH)$_2$

- Ideal medicament in the root canal between the appointments
- Disinfection effect.
- Hard-tissue formation.
- Easy to use.
- Strongly alkaline -> pH 12,5.
- In solution dissociates to Ca$^{2+}$, an OH ions.
- Can be used together with other additional antimicrobial agents to complete the effect.
OH- radical:
- reaction with bacterial proteins, lipids, nuclein acids
- lipid peroxidation, increasing membrane permeability, protein denaturation, enzym inactivation, DNA damage
  -> kill microorganism

Ca2+ ion:
- effect for the hard tisse recovery
- start cell proliferation, cell differentiation, cell migration
  -> tissue reparative process (periapical involvement)
IDEAL ROOT CANAL FILLING MATERIAL PROPERTIES I. TECHNICAL REQUIREMENTS

• Good adhesion to dentin wall and other root canal filling materials
• No shrinkage
• Not to be soluble in tissue fluids
• Do Not discolour the tooth
• Setting in humid environment
IDEAL ROOT CANAL FILLING MATERIAL PROPERTIES II. BIOLOGICAL REQUIREMENTS

- Non-toxic
- Sterile or easily sterilizable
- Do not damage the tooth and periapical tissues
- Antimicrobial effect (at least bacteriostatic)
- Help the periapical healing process
Radioopacity
- Adequate setting time
- Hermetical sealing
- Easy application (mixing etc.)
- Easy insertion into the root canal
- Easily removable, soluble
ROOT CANAL FILLING MATERIAL CLASSIFICATION

- Cones
- Sealers
- Combination of the two
Most widespread root canal filling material

Natural origin (extracted from *Isonandra percha* tropical tree)

It is a high-molecular-weight polymer based on the isoprene monomer

Two forms of guttapercha are relevant for dental products: alpha-and the beta form

The beta form is used in most guttapercha cones
GUTTAPERCHA

- High molecule weight polymer
- 2 main forms of GP: \( \alpha \) and \( \beta \), which can transform into each other depending on the temperature
- Recently for thermoplastic gp techniques \( \alpha \) form is used (smaller shrinkage)

GP:
- 19-22% guttapercha
- 59-75% zinc-oxide
- 10% Metal salts
- Waxes
- Antioxidants
- pigments
ADVANTAGES OF GUTTAPERCHA

- Bioinert, non irritating to the periapical tissue
- Dimensionally stable
- Radiopaque
- Easy inserted and removed
- Good plasticity, guttapercha adapts with compaction to irregulates in prepared canals
- Dose not discolor the tooth
- Solubility in chloroform
Lack of adhesion to dentin and a slight elasticity, which causes a rebound and pulling away from the canal walls. Therefore a sealer must be used to fill and seal the spaces between the guttapercha cones and the guttapercha and the canal wall.

DISADVANTAGES OF GUTTAPERCHA
OTHER POINTS

- Silver points: - easier insertion into curved, narrow canals
  - good radiopacity
  - bacteriostasic
  - nonadaptability
  - toxicity from corrosion
  - difficult to remove
- Titan points: - biocompatible, no corrosion
- Gold points: - expensive
- Plastic points: - has no radiopacity
Tissue tolerance
No shrinkage with setting
Slow setting time
Adhesiveness
Radiopaque
Bakteriostatic properties
Absence of staining
Creation of seal
Solubility in solvent
Easy to remove
TYPES OF SEALERS

- ZnOE-based
- Polyketone sealers
- Epoxi resin sealers
- Glass ionomer
- those containing Calcium-hydroxide
ZNOE SEALERS

- Have been used for many years.
- Sealing ability and biological properties are in general inferior compared with other root canal sealers.
- Formaldehyde containing types shouldn’t be used because of their toxicity potential.
- Adhesion to guttapercha cones is sufficient.
- Relatively high solubility.
- Easy to handle.
- Slow setting time.
- Removal with organic solvent.
- Good radiopacity.
**POLYKETONE SEALERS**

- Sufficient strength
- Low shrinkage
- Good adhesion to dentine
- Lower microleakage than ZnOE
- Short setting time: advantage when sealer is used for apical filling, disadvantage in case of lateral condensation of multirooted teeth
- Good radiopacity
- The material is only moderately toxic and apparently does not actively stimulate the healing of apical tissue

Diaket
EPOXI-RESIN SEALERS

- Good mechanical and sealing properties
- No systemic toxic effect
- Antimicrobial
- Citotoxicity is moderate to low
- Good radiopacity
- Excellent adhesion to dentine
- After initial expansion, shrinkage
- After setting the sealer is very difficult to remove

For example: AH26, AHPlus
- the silver in AH26 may lead to tooth discoloration, newly developed AH Plus does not contain silver
- Setting time: 1-2 days.
- AH26 is able to flow into the orifices of the dentin tubules
Newly developed AH Plus is also based on epoxy resin but contains a different catalyst.

- Setting time: 8 h.
- Excellent adhesion to dentine.
Main problems of the GIC sealer are related to leakage due to moisture sensitivity during setting.

- Chemical bonding to dentine.
- After setting minimal citotoxicity
- For optimal setting the correct water balance is necessary.
- Easy to handle.
- Short setting time, 7min.
- Radiopacity is sufficient.
- Can’t be removed from the canal.
- Recommended for single cone technique.
CALCIUM HYDROXIDE SEALERS

- Stimulate apical healing and hard tissue formation (root-end closure).
- Antimicrobial effect.
- Not so good mechanical properties.
- Long-lasting stability is not good.
- The bond to dentine is weak.
- After longer time disintegration.
- High solubility.
- Radiopacity is regarded as sufficient.
- Removable material.
- Handling properties are adequate.