

Root canal treatment: cleaning of the canal

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Root canal cleaning

Way we have to clean the root canal?

Remove the existing debris

- Bacteria, bacterial byproducts
- Necrotic tissue
- Organic debris, vital tissue
- Salivary byproducts
- hemorrhage



Root canal cleaning

Chemo-mechanical preparation

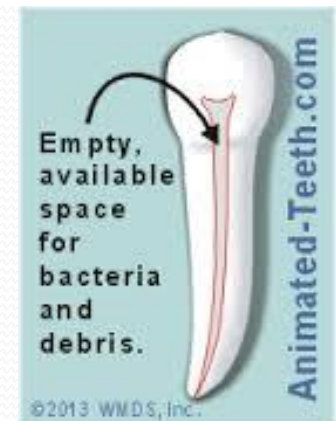
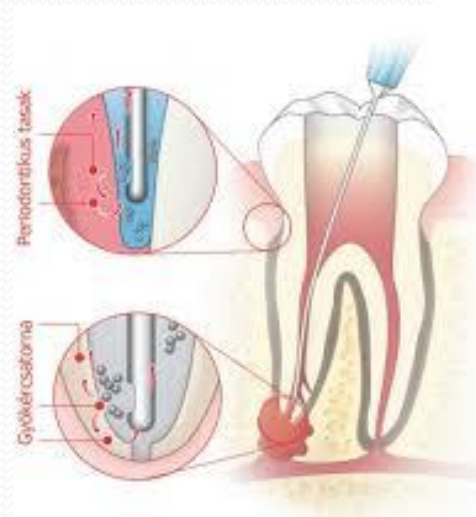
Mechanical

Root canal hand and rotary instruments (instruments contact and plane all walls)

Chemical

Irrigants:

- Dissolve pulp tissue
- Eliminate bacteria
- Inactivate endotoxin
- Flush debris



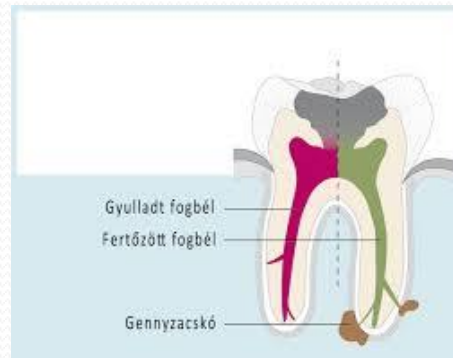
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Root canal cleaning

Complete debridement is impossible in spite of chemo-mechanical preparation!

A root canal is a complex environment

Anatomical variations, side canals, delta apicale



Proper use of instruments.

Development of instruments (material, edge systems, etc ...)

Root canal cleaning

Biofilm properties

- Extracellular polysaccharide (EPS) (matrix: vertical structures empty spaces).
- The presence of transport routes and its localization variables (age, thickness, quantity of food, ambient effects).
- EPS complicates and slows the disinfect agents, antibiotics, antibodies and the effect of diffusion.
- Prevents against phagocytosis.

Due to the physical properties of the biofilm it can cause indirect resistance activity against antimicrobial agents.

Root canal cleaning

Strategy against matrix should be kept in mind.

Difficulties

- viscoelastic properties
- cohesive force
- adhesion strength

Irrigation has to cope with these agents.

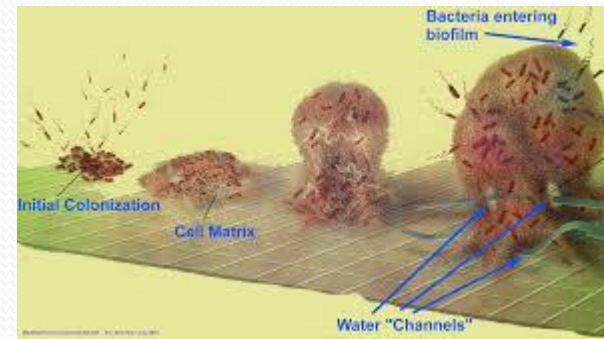
What can we do against biofilm?

Mechanical breakdown

- Canal shaping (spaciousness, conical)
- Thickness of the needle used for irrigation,
- Ending of the needle
- Moving fluid (ultrasound, laser application)

Chemical breakdown

- Best antibacterial effect
- Higher concentrations
- Longer exposure times



Root canal cleaning

Properties of the ideal irrigation

- Good antibacterial effect
- Tissue dissolving effect
- Low surface tension (*better penetrating ability*)
- Lubricating effect (*easier handling of the instruments*)
- Chelate-forming effect (smear layer removal, removal of Ca)
- Low toxicity
- Moderate cost
- Easy user
- Durability, storage

Root canal cleaning

Problems

- Antibacterial, tissue dissolving, chelating effects are not present at the same time

not known:

- The proper concentration
- The adequate contact time
- Tearing off force against biofilm
- Power created by irrigation agents

Sodium hypochlorite

- Henry Drysdale Dakin(chemist) and Alexis Carrel (surgeon) used in World War I for wound cleaning 0.5% solution ("Dakin's solution")
- in root canal flushing first was used in 1936

Sodium hypochlorite (NaOCl) is an inorganic compound
degradable material
decomposes to (NaCl), and nascent oxygen ('O') strong oxidant → very reactive

What happens when NaOCl and organic tissue are on contact?

- the surface tension decreases
- the amino acids neutralizing → water and salt is forming
- the pH value is reducing
- Cl releases from HClO-
- in contact with amino group chloramine is forming it inhibits the cell metabolism

Properties of sodium hypochlorite

- **Disinfects, bleaches, destroy the tissues** (O release is time-consuming)
*Due to the tissue destroying effect use of 5.25% should be considered
Because of periapical problem safer to use 2.5% concentration !*
- Its effectiveness depends on the temperature and concentration
*5.25% NaOCl is effective after 40 ms
rise with 25° C its temperature the efficiency increase 100%*

Disadvantages:

higher concentration → greater cytotoxicity!

no chelate-forming effect (the smear layer is not removed)

Properties of sodium hypochlorite

- should be avoided rinsing with NaOCl after EDTA or citric acid → erosive lesions in dentin wall!
- 5.25% NaOCl solution has harmful effect on the elasticity and tensile strength of dentin!
- vertical root fracture increase due to proteolytic activity in the dentin collagen matrix!
- Combined use with CHX increase the toxic PCA (parachloro-aniline) (brown precipitate)

Chlorine dioxide

hyper-pure chlorine dioxide solution
Solumium Dental 0.12% (1200 ppm)



- decomposes very slowly
- **effective against: bacteria, viruses, fungi and protozoa**
- **oxidising biocide** (*prevent through cell wall metabolism transport*)
- **no resistance** to it (*it reacts with 4 amino acids (cysteine, methionine, tyrosine, and tryptophan),*
- **it has tension** → *penetrates into slide canals and dentinal tubules*
- **volatile** → *not leave residual material* → *does not need to be neutralized and flush the canal before root canal filling !!!*
- **nontoxic** to 3000 ppm,
- **no tissue irritation and dissolving** (*it is good but also a bad property!)* effect
- no discolouration of teeth

Chlorine dioxide

How to use?

0.5 ml of undiluted and after it
20x dilution of 2 ml

- Use it as a first flush in case of infected teeth (due to substantial elimination of bacteria)
- For final flush is also recommended (additional sterilization, no need to rinse)

Neomagnol

The active substance: chlorogen or chloramine B or N-chloro-benze-sulfonamide,-sodium salt

organic compound, a white powder or crystal, comprising 25-27% active Cl.

Properties

- Antibacterial effect due to chlorine gas release
- Tissue dissolving
- No chelating effect
- 3 to 5% solution is used

Hydrogen peroxide

- **Antimicrobial** and **tissue dissolving** (it has weaker effect compare to the effect of NaOCl)
- When used with NaOCl bubbles forming → reduces the effectiveness of NaOCl
- 3-5% solution is used

H₂O₂ mechanism of action

- quickly dissociates to H₂O and O '.
- , O 'reacts with catalase and peroxidase enzymes → bactericidal effect (short time effect, organic debris reduce its effect)
- in the presence of organic debris: O 'is released quickly → bubbling, → necrotic debris washing
- reacts with the hydrogen sulphide group of bacterial enzymes → inhibits the metabolism
- heat and light can decomposes it
- no more effective than other flushing fluid

Clorhexidine

Active ingredient: biguanide, a type of synthetic drug
Insoluble in water → used as chlorhexidine gluconate

Properties

- **Antibacterial** (depending on pH between 5.5-7.0 is the most ideal)
- **No tissue dissolving effect**
- **No chelate formation**
The presence of organic matter decomposes rapidly
- **Long-term, protracted effect** (bind to inorganic molecules)
- Combined use with NaOCl increases the amount of toxic PCA (parachloro-aniline) (brown precipitate)
- no erosive effect
- 2% solution is in used

Chlorhexidin

Mechanism of action

- lipophilic groups of chlorhexidine results disorientation of the cell membrane → osmotic ability of the cell membrane is damaged
- it surrounds the cells surface and with active or passive transport enters into the cell → destruction of the cell membrane
- metabolism through the bacteria cell membrane is impeded

Chelators

EDTA ethylene-diamine-tetra-acetic acid

- forms chelates with the calcium ions of the dentin (at neutral pH is the most effective)
- No antibacterial effect
- A 15-17% solution is used

Mechanism of action

- It demineralizes the intertubular dentin (In case of increased contact time the dentin weakening perforation)
- Using with NaOCl → the tissue dissolving capacity of NaOCl reducing
NaOCl release the organic matrix dissolution from the open tubules → to avoid the erosion use 3% EDTA

Chelators

Citric acid

Maleic acid

- weak organic acid (adhesive technique, removing smear layer 7% conc.)
- use of its 10% concentration cause demineralization of the dentin wall
- its smear layer removal effect stronger than 17% EDTA in the apical third of the root canal
- It creates a micro-mechanical clamping force between sealer and dentin

Hydroxy-ethylidene-bisphosphonate (HEBP)

- does not react with NaOCl
- 5% NaOCl solution + 18% HEBP → optimal bond strength with epoxy resins (AH Plus)

A smear layer

Root canal instrumentation produces a layer of organic and inorganic material called the *smear layer* that may also contain bacteria and their by-products

Important to remove!!!

- allows access to the dentinal tubules
- the disinfectants are able to reach the hidden bacteria and explain their impact
- sealer has a higher adhesion to the wall and able to penetrate in the tubules

Other irrigants

Solvidont

- Dekvalinium acetate
- Broad-spectrum chemotherapeutic
- 0.05% solution is used
- Chelate formation, well diffuses

Desiccant agent

- alcohol

Ozone

- ozonized water

Combination containing products

Tetraclean

Doxycycline cyclate, acid, detergent

- effective against anaerobic and facultative anaerobic bacteria
- The final rinse of five minutes will allow the elimination of microorganisms and smear layer removal and opening of the dentinal tubules.
- low surface tension → be easy adaptation to the dentin surface

MTAD

tetracycline, acetic acid, detergent (Tween 80)

- doxycilin in the MTAD i has equivalent antibacterial activity than 5.25% NaOCl
- effect on pulp and dentin similar to EDTA.
- Due to precipitation effect worsens the physical properties of dentin,
- It reduces the bonding strength of the resin-based and calcium hydroxide-based sealers

Qmix

biszbiquadin, poliamino-carboxil acid, chelator

- As proposed final rinse after rinsing with NaOCl
- avoid too deep dentin erosion

Naturel irrigants

neem wood (*Azadiracta indica*)

- antioxidant and antimicrobial

Curcuma

- anti-inflammatory, antioxidant, antibacterial, antifungal, antiviral (also active against *E.faecalis*)

Licorice (*Glycyrrhiza glabra*)

- antibactericid (*also against E.faecalis-sal*)

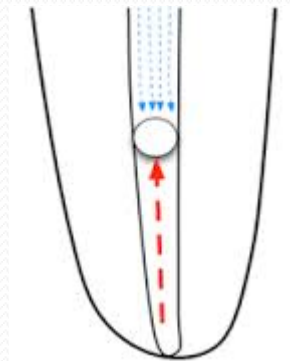
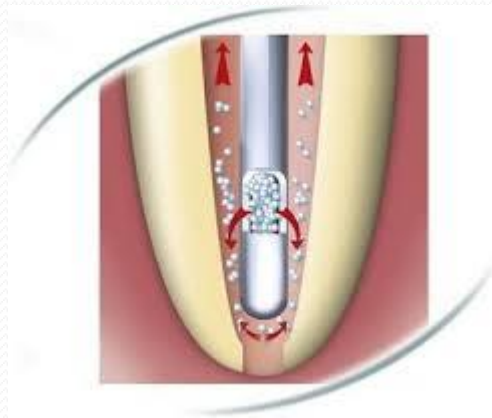
noni (*Morinda citrofolia*)

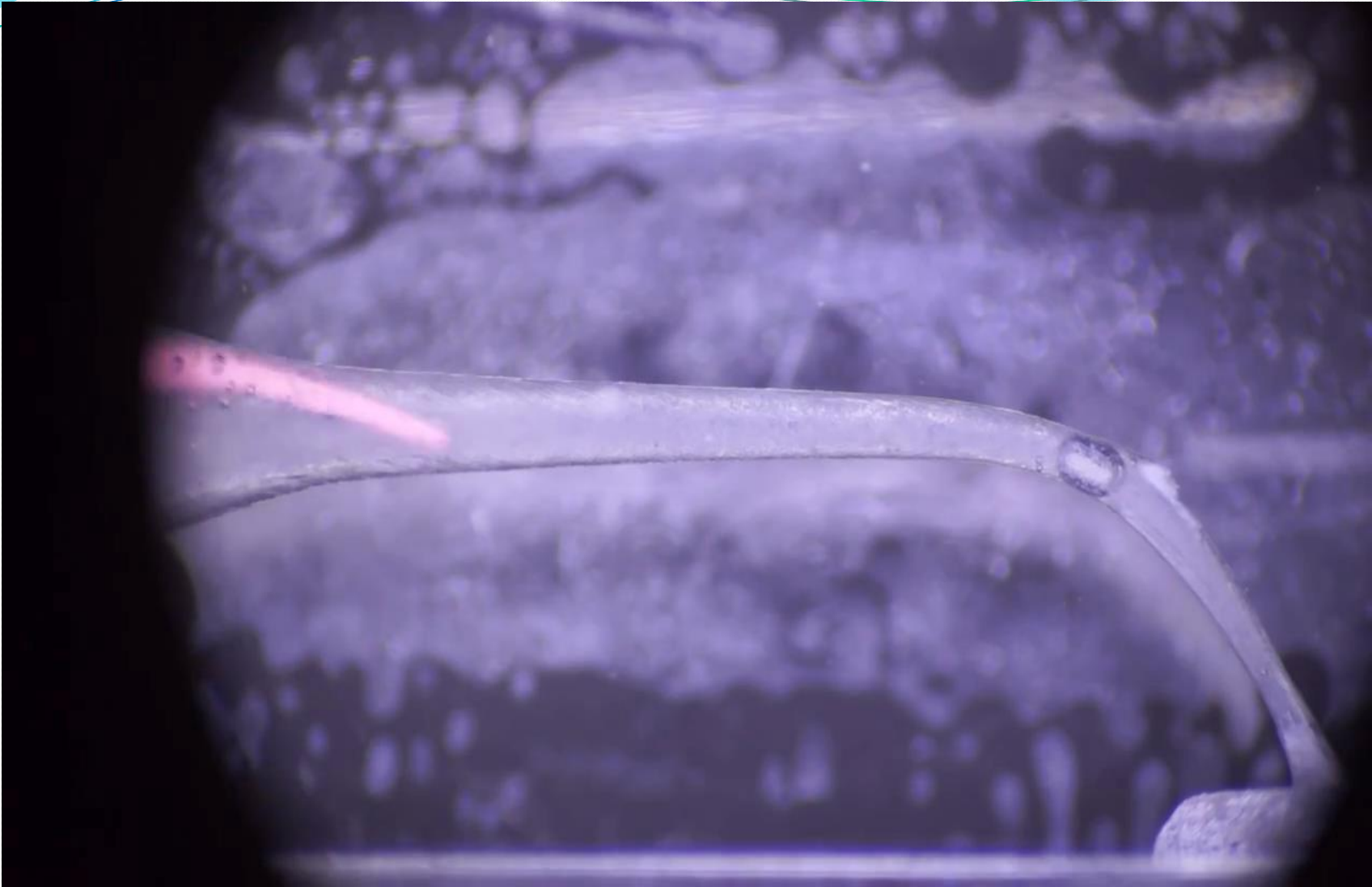
- antibactericid

ozone

Construction of irrigation

Solutions from open-ended needle to 2-3 mm, from side open-ended needle to 1 mm reach





Construction of irrigation

EndoVac system

- connect to exhauster
- The syringe files and absorbs simultaneously the liquid → ensuring the circulation
- the macro cannula: provides the exhaustion from the upper part
- the micro cannula: provides the exhaustion from the lower third part



Construction of irrigation

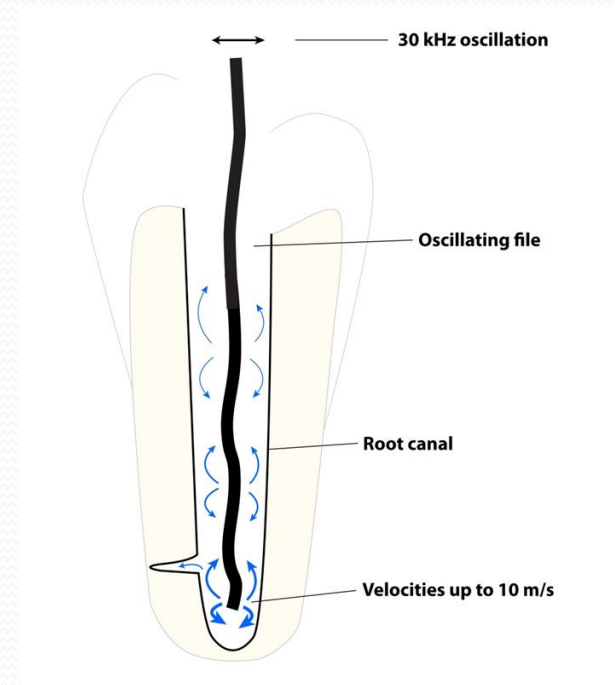
New tools: Oscillator, laser ultrasound

Ultrasound:

- acoustic flow
- Acoustic cavitation (stable, inertia)

Laser:

- The pulsating energy helps the liquid (bubbles) to reach the end of the needle.
- The bubbles are forming and collapsing with 1m /s speed of





**PUI-Passive Ultrasonic Irrigation / Irrisonic
Bueno / Fontana / Arruda / Pelegrine**



Medication of the root canal

Goal

- To eliminate those bacteria which are inaccessible with chemo-mechanical preparation.
- Help to make the teeth "sterile"
- Help to make the teeth asymptomatic

What we wait from the drugs ?

- Penetrate into dentinal tubules
- Good antimicrobial effect
- Antitoxicity, biocompatibility

Medication of the root canal

Phenol

Advantage: a strong antiseptic

Disadvantage: necrotising

Chlumsky solution (camphor, carbolic acid, alcohol 6: 3: 1)

Advantage: a strong antiseptic

Disadvantage: reduces sealer adhesion to the wall

Paraformaldehyde

Advantage: a strong antiseptic, formalin steam penetrate into the dentin canals

Disadvantage: tissue irritant effect

N₂ MEDICAL (Universal)

Advantage: a strong antiseptic, dries the channel due to the ZOE content

Medication of the root canal

Antibiotics

It is effective in combination (Grossman paste (penicillin, bacitracin, streptomycin, caprilacid-sodium

Disadvantage: may cause resistance

- **Solvidont 0.5% paste**

Advantage: broad-spectrum, high penetration capability, non-irritating to tissues

- **Germident:** Prednisolon, Neomycin, Chloramphenicol

Iodine content past(allergy!!!!)

Metronidasol

Advantage: strong anaerobic killing, proposed to use in purulent infections

Ca (OH) ₂

Advantage: a strong base with a pH of 12.5 to 12. it hydrolyses in aqueous solution

Disadvantage: The presence of dentine rapidly inactivates , close the end of the channel → working length shortening

Thanks for your attention

