Preventive endodontics: significance of the pulp protection. Endodontal diagnostics

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References:

Luc van der Sluis, Edwina Kidd, Rene Gruythuysen, Linda Peters: **Preventive endodontics – an argument for avoiding root canal treatment.** ENDO (Lond Engl) 2013;7(4):259–274

Árpád Fazekas: Megtartó fogászat és endodoncia; 2006

Introduction

- the healing of an apical periodontitis (AP) depends on a lot of factors (canal anatomy, microorganisms, etc.)
- exclusively by means of a periapical radiograph, no exact diagnosis can be made
- the success rate of endodontic treatment is lower than expected, and it is both time-consuming and expensive

Introduction

- Due to the root canal treatment (RCT), the physiological functions of the pulp are missing (pulpal sensation, odontoblast activity, etc.)
- Differential diagnosis of reversible and irreversible pulpitis is of great importance
- since elimination of AP is difficult, it is logical to try to prevent it


DISEASE
PREVENTION AREA
STOP
AUTHORIZED PERSONNEL
ONLY

Prevention: Indications for the usage of different materials under the final restauration

- It protects against: heat, electrical stimuli, mechanical- and chemical effects

- In case of metals (amalgam, metal inlays/onlays): if the thickness of dentine is lower than 1-1.5 mm, base material is needed for the protection of the pulp against heat

- In case of adhesive materials: when the cavity is too deep (indirect pulp capping (old-school): the pulp is covered with a thin layer of dentin, but the pink color of the pulp is already visible through the dentin. New-school: we do not have to use any indirect pulp capping even in this latter case, as the pulpal circulation is able to compensate the impact of acid-etching even if there is only 40-50 µm thick dentin wall left.

Prevention: Indications for the usage of different materials under the final restauration

- varnishes: 1-50 µm thick layers. They seal the dentinal tubules, and give protection against chemical agents, but not against physical effects (e.g.: heat).
- liners: 0.2-1 mm thick layers. $Ca(OH)_2$ and glass ionomers.
- base materials: 1-2 mm thick layers (zinc phosphate, zinc oxide eugenol, polycarboxylate, $Ca(OH)_2$, calcium phosphate, glass ionomer, etc.).

Prevention: Methods

- indirect pulp capping: demineralised dentin surrounding the pulp is left in place to avoid pulp exposure and is covered with a biocompatible material. Only in case of patients without any symptom

- vital pulpectomy (pulp amputation /coronal pulp!/; partial/total; not suggested, no satisfactory prognosis. Only in case of unclosed apex, where the completion of RCT with a perfect apical seal can not be accomplished yet!!!)

Prevention: Methods

- indirect pulp capping: mostly performed on children or young adults, but it also can work in the older patient. Although the expensive and complex restaurations should be postponed in this latter case.

  The phylosophy of indirect pulp capping: the preservation of pulpal dentin reduces the chance of exposure, possibly facilitating pulpal regeneration. Avoiding pulpectomy/RCT reduces treatment time and cost, and preservation of the tooth and root structure may increase the longevity of the tooth.

Prevention: Methods

- direct pulp capping: the pulp tissue is uncovered, the material is placed directly on the pulp, so as to create dentin bridge (reparative dentin). Max. 1 mm^2 wound surface, no bleeding, rather in case of teeth with more than one root canal

  Prerequisite: cross-infection of the pulp has to be avoided during the treatment for the sake of good prognosis -> rubber dam (pulp opening due to trauma or accidental perforation during the preparation: better prognosis as in case of deep cariotic lesion)

Prevention: Materials

Which material should cover the nonexcavated dentin surfac
or the exposed pulpal tissue?

- traditionally, calcium hydroxide ($Ca(OH)_2$) is used

  - alkaline
  - biocompatible
  - induces dentine remineralisation

Prevention: Materials

Which material should cover the nonexcavated dentin surface or the exposed pulpal tissue?

- The self-setting type could dissolve in time (as the material releases $Ca(OH)_2$ continuously), perhaps hampering the seal of the restoration by allowing microbial leakage.
- The mechanical properties of this type are also unsatisfactory (e.g.: even the acetone based adhesives are able to dissolve the material) -> it should be covered with a more resistant cement (like glass ionomer).
- Light-curing types are commonly used nowadays, they can be applied on their own (low solubility and better mechanical properties, although the disinfectant and reparative dentin building properties are reduced).

Prevention: Materials

Glass ionomer cements seem to have advantag

- biocompatibility
- no dissolution reported
- a bio-active material with the potential to remineralise residual carious dentine
- electron probe microanalysis (EPMA) demonstrated that both fluorine and strontium ions from glass ionomer cement can penetrate the underlying demineralised dentine

Prevention: Materials

Glass ionomer cements seem to have advantages:

- the sealing ability of glass ionomer is good on moist dentine due to its hydrophilic character (if we overdry the cavity, the glass ionomer will not have any adhesion!)

- resin-modified glass ionomer cement is absolutely compatible with dental bonding agents (later restauration)

Prevention: Materials

Other restorative materials on the market:

- Mineral Trioxide Aggregate (MTA):
  - biocompatible
  - induces the formation of hydroxylapatite
  - exhibits good sealing ability
  - promotes the release of cytokines and growth factors that are encapsulated in the dentin
  - direct pulp capping
  - perforation closing
  - retrograde RCT
  - results in a higher pH
  - antimicrobial effect

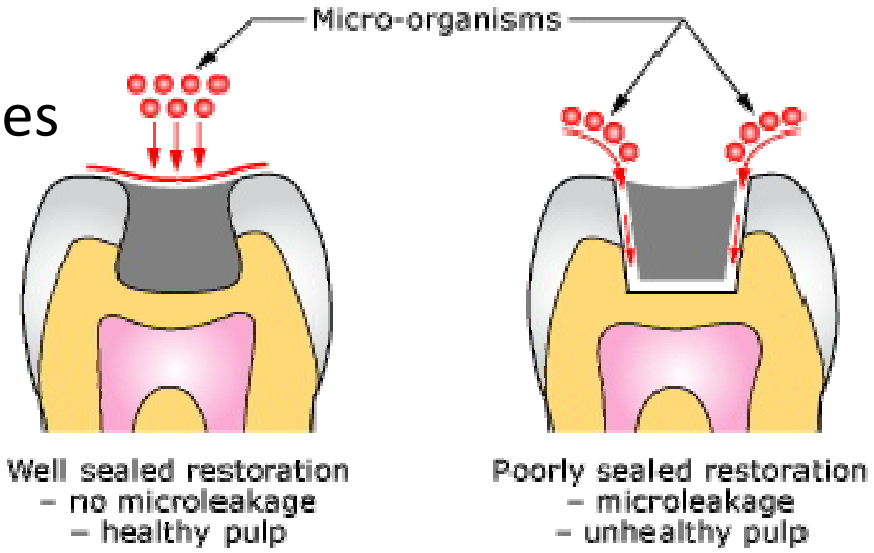
Prevention: Materials

Other restorative materials on the market:

- Biodentine®:
  - temporary enamel restoration
  - permanent dentin restoration
  - deep or large carious lesions
  - deep cervical or radicular lesions
  - pulp capping
  - perforation closing

Prevention: Materials

- According to the literature, it is very possible that the factor of overriding importance is not the material over the pulp, but the cavity seal of the restoration, which ideally should hinder the passage of substrates to the microorganisms (microleakage: incomplete seal!!!)
- Importance in the sealing of dentinal tubules
- Demineralisation -> remineralisation
- Antibacterial effect



The problem of microleakage

Endodontal diagnostics

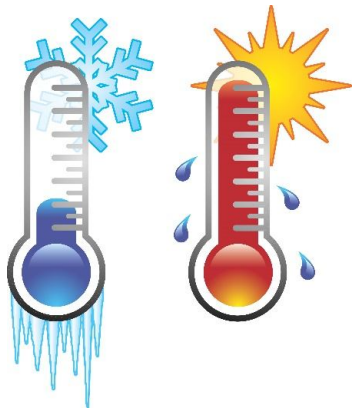
- Anamnesis (general, dental)

- Can the patient locate the pain? (radiating pain: irreversible pulpitis)
- When did the complaints start? (e.g.: the patient says to have pain on chewing, but previously he or she had sudden, strong pain)
- Might the complaints be in connection with a dental treatment performed recently? (e.g.: exponation of the pulp, periodontal treatment -> exponation of lateral canals)
- Nature of the pain? (sharp, dull, stitching, fluttering, radiating)

Endodontal diagnostics

- How long does it take? (sec, min, hours)

- Can the pain be provoked? (…or spontaneous? Horizontal position? Cold/warm stimuli?)



- Has the patient used painkillers?

Endodontal diagnostics

- Clinical examination (as soon as the patient steps in the office, e.g.: swelling on the face, sleep-deprived)
- Extraoral investigation (in the head- and neck region, e.g.: asymmetry, lymph nodes, fistula)

Intraoral investigation (inspection, palpation, percussion)

-inspection: general dental, periodontal and mucosal status
-palpation: sensitive periapical area for finger-pressure; parallel (control) tooth should also be examined! Fluctuation, crepitation
-percussion: vertical, horizontal (also on neighbouring teeth!)
-provoked pain on bite

Endodontal diagnostics

- Dental Pulp Testing (sensibility test)

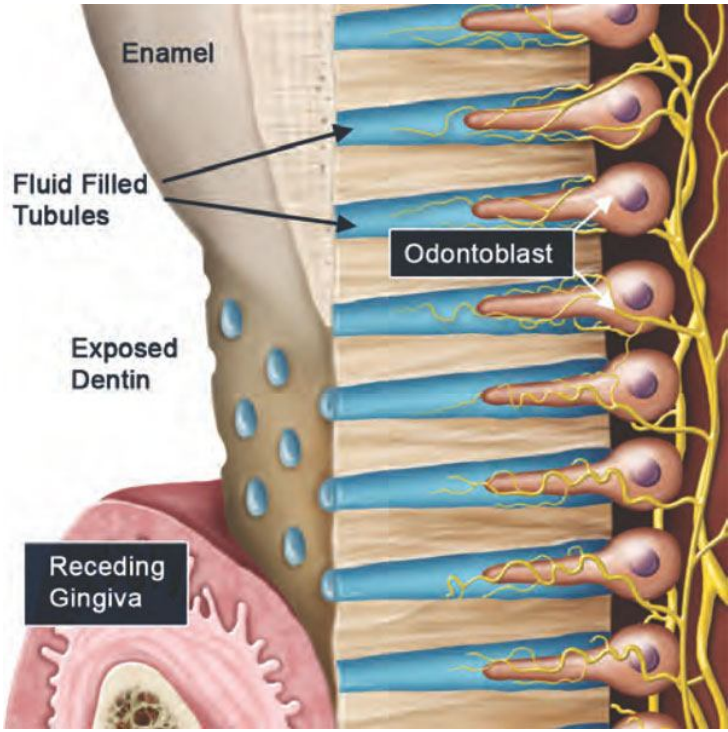
  -thermal stimulus:
  The concept: healthy pulp reacts for thermal (cold/warm) stimuli with sensitivity or mild pain, which ceases immediately after the stimulus

  Inflammation: increased reaction

  Reversible pulpitis: increased reaction, which ceases after the stimulus (immediately or in 10 seconds)

  Irreversibel pulpitis: increased reaction, which lasts further (minutes, hours), even after the stimulus is gone

Endodontal diagnostics



- Dental Pulp Testing (sensibility test)

  -thermal stimulus:

  Explanation for the reaction in case of thermal stimulus:

  Altered liquid flow in the dentinal tubules.

  Pulpal necrosis: no response for thermal stimuli
  (N.B.: exception!: closed pulp with necrosis -> expansion of the gases towards the nerves of the periapical area -> pain)

Endodontal diagnostics

- Dental Pulp Testing (sensibility test)

  -thermal stimulus:

  Cold: Chloraethyl spray (between -10 °C and -25 °C), with cotton pellet

  Warm: seldom (heated guttapercha, polishing bur with high-speed)

Endodontal diagnostics

- Dental Pulp Testing (sensibility test)

  -thermal stimulus:

  False negative, false positive (e.g.: tooth anatomy, touching the gingiva, calcification in the pulp, retraction of the pulp, etc.)

Endodontal diagnostics

- Dental Pulp Testing (sensibility test)

  -electrical stimulus:

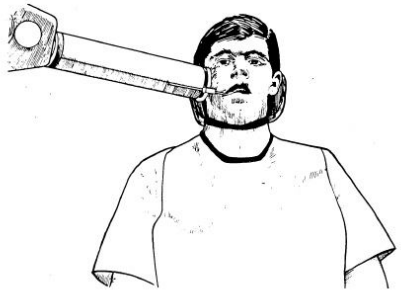
  High frequency AC or DC. One (wetted) electrode comes to the buccal surface of the tooth, the other one comes to the buccal mucosa of the patient.

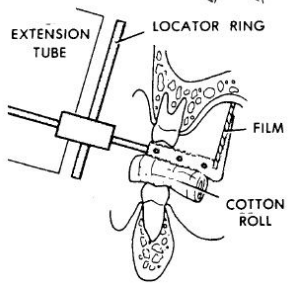
  Increasing the voltage -> current intensity increases -> pulpal reaction.

  Positive answer: there are excitable fibers in the pulp.

  False positive answer: metal filling, metal crown -> short-circuit

Endodontal diagnostics





- X-Ray

  Obligatory for the diagnosis (in case if endodontal indication), together with the clinical examination.

  Long cone periapical x-ray.

  What can we see on the x-ray?

  - extension of the pulp chamber
  - whether if the tooth is root canal treated or not. Quality of the RCT
  - how many roots and how many canals are there
  - curvature of the canal (the evaluation depends on the projection as well!)
  - is there any obliteration (denticulus, hypercementosis) in the canal
  - deep caries, large filling
  - internal/external resorption
  - state of the periapical periodontium
  - chronic procedures
  - estimated length of the tooth

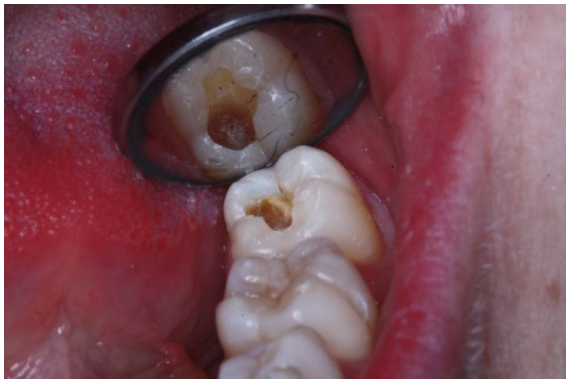
Endodontal diagnostics

- X-Ray

  What can we NOT see on the x-ray?

  - reversible and irreversible pulpitis
  - granuloma or cyst (differential diagnosis: biopsy)

Endodontal diagnostics



- Further diagnostic procedures

  - test cavity preparation: without anaesthetics. Only in case when the vitality of the tooth is still questionable and exchange of the previous filling and/or caries removal with cavity preparation would be needed anyway.

  - selective anaesthesia: anaesthesia of the questionable tooth (e.g.: irradiating pain because of irreversible pulpitis, several cariotic procedures / crowns, bridges in the same region). Disadvantage: solo anaesthesia of the tooth in question is usually unattainable.

  - fiber optic examination: light transmittance of the necrotic teeth is lower. Noninvasive method.

  - circulation measurement (velocimetry): Laser Doppler, technique of using the Doppler shift (frequency) in a laser beam to measure the velocity of blood.

Thank you for your kind attention!