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Endodontic pain management

Position Paper of the German Society of Endodontology and Dental Traumatology

Summary: Pain of endodontic origin usually requires dental intervention as soon as possible. In the ideal case, this should represent the first step of regular dental treatment afterward.
Full pulpotomy without root canal instrumentation is the first-line therapy for managing pain in symptomatic irreversible pulpitis. In exceptional cases, complete root canal preparation with the placement of intracanal dressings can be performed. Both treatment approaches reliably result in freedom from pain within 24 hours. In the case of symptomatic apical periodontitis, the mechanical root canal preparation up to a size that permits irrigation of the canals over their entire length is required. If orthograde access to the periradicular tissue appears impossible or very risky (e.g. root canal filled tooth with an intracanal post or instrument fragment), the administration of analgesics with additional long-term anesthesia may be indicated in order to enable causal treatment the following day with sufficient treatment time. For acute periradicular abscesses, the primary goal of pain management is to ensure the adequate drainage of pus. A simple incision without the trepanation of the affected tooth does not represent an adequate causal therapy. In exceptional circumstances, when the trepanation of the tooth is not possible, it should ensue promptly (ideally within 24 hours) after the incision.
In the management of endodontic pain, medication can be considered as an adjunct to, but not a substitute for, the causal therapy indicated in each case.

Keywords: irreversible pulpitis, apical periodontitis, periradicular abscess, pulpotomy, trepanation

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1. Introduction

In principle, patients who experience tooth pain are legally entitled to dental treatment. Strictly speaking, pain of endodontic origin, with the exception of acute periradicular abscesses with the tendency to spread, does not represent an emergency, but it usually requires dental intervention as soon as possible [48].

Toothache is the most common pain presenting in the orofacial region [26]. Approximately 60% of toothaches are attributable to endodontic causes [51], and in 90% of cases, toothaches are caused by symptomatic pulpitis or apical periodontitis [8, 14]. Carious lesions are the main cause of these pathologies.

Pain afferents consist of slow, unmyelinated C- and fast, myelinated Aδ-fibers [5], which are transmitted via the spinoreticular tract to the reticular formation. At this level, reflex responses of the body are triggered. In general, pain can be triggered by thermal, mechanical or chemical stimuli; in addition, so-called spontaneous pain also exists.

The treatment of the cause of pain should always be the primary focus of pain management. For this purpose, the cause of pain must be carefully determined and other possible causes must be excluded based on differential diagnoses (e.g. non-odontogenic pain). Moreover, in the management of pain, invasive treatment should not be performed without a reliable and well-founded diagnosis. Preferably, the diagnoses for the condition of the pulp and the periradicular tissue should be recorded separately. In general, a causal therapy should be chosen to alleviate the symptoms. The frequently observed practice of prescribing antibiotics alone without further corresponding treatment [22] is not indicated. Ideally, causal pain management should be the first step of the regular dental treatment afterward. Subsequent to pain management, if the definitive restoration was not placed on the affected tooth during the treatment of pain, the patient should be informed that further treatment will be required in the near future. The fact that the patient has been informed should be recorded.

In general, rubber dam should be used consistently to maintain aseptic working conditions, even in the context of pain management [43]. For the treatment concepts described below, the application of rubber dam provides protection against the aspiration or ingestion of instruments and/or irrigation solutions [4]. It also reduces the chance that invading microorganisms from the oral cavity spread into the endodontic space, thus contributing to an improved likelihood of treatment success [2, 16]. Furthermore, rubber dam reduces the average bacterial load in the aerosols due to treatment by 90–98% [9]. In this respect, rubber dam is considered one of the most effective methods for germ reduction in dental practice [12].

2. Symptomatic pulpitis

If the clinical and radiologic diagnoses indicate that vital pulp therapy appears possible [11, 25], trepanation of the affected tooth should not be considered a first-line therapy option, even in the context of pain management. Treatment measures in cases of "reversible pulpitis", according to the classical system for diagnosing pulpal diseases, aim to remove the irritating noxa (mostly carious lesions and/or defective coronal restorations), while simultaneously preserving pulp vitality. In contrast, pulpal diseases that are classified as "irreversible pulpitis" require root canal treatment according to previous concepts.

2.1. Preservation of pulp vitality

Diagnosis:

- Pulp sensitivity test to cold: positive
- Stimuli that trigger pain: thermal, osmotic and tactile
- Pain duration corresponds to stimulus duration; no spontaneous pain
- Sharp, throbbing pain, mostly well localized

Treatment:

- Anesthesia
- Removal of irritating noxa: caries excavation, removal of leaky coronal restorations, sealing of exposed dentinal tubules [43]
- Covering of the deep dentin layer close to the pulp or vital pulp therapy in case of pulp exposure using aqueous calcium hydroxide suspensions or a hydraulic calcium silicate cement [11, 13]
- Bacteria-tight coronal seal with definitive or provisional restoration

2.2. Preservation of pulp vitality is no longer possible

Diagnosis:

- Pulp sensitivity test to cold: positive; sometimes intensely positive
- Stimuli that trigger pain: heat
- Pain outlasts the duration of the stimulus; spontaneous pain, possibly permanent pain
- Pulsating, throbbing pain; frequently, its precise localization is difficult
- Pain at night
- Cold alleviates the pain

Basic emergency treatment:

- Anesthesia (ensure sufficient degree of anesthesia)
- Excavation of carious dentin if necessary [40]
- Trepanation of the affected tooth and full pulpotomy (removal of the coronal pulp) under aseptic conditions [29]
- No root canal instrumentation or extirpation of the radicular pulp [35]
- Irrigation of the pulp chamber with sodium hypochlorite and hemostasis
- Application of anti-inflammatory and pain-relieving medicament (corticosteroid & antibiotic paste; pure corticosteroid) [23]. The maximum time interval until further treatment is 4–6 weeks in the case of an adequate coronal seal [29].
- Bacteria-tight coronal seal; adhesive restoration is preferable if the maximum time interval until further treatment may be reached
- With regard to the effectiveness of pulpotomy as a definitive treatment, reference should be made to the current position paper of the German Society of Endodontology and Dental Traumatology (DGET) "Is pulpotomy a valid treatment option for irreversible pulpitis?" [25].

Enhanced emergency treatment:

In exceptional cases, complete root canal treatment with the placement of intracanal dressings can be performed [43, 48].

- Anesthesia; additional injection techniques (e.g. intraligamentary or intrapulpal anesthesia) may be required in order to achieve a sufficient level of anesthesia.
- Rubber dam
- Excavation of carious dentin if necessary [40]
- Trepanation and visualization of the root canal orifices
- Determination of the working length
- Complete extirpation of the radicular pulp and mechanical preparation of all root canals up to a size that allows irrigation of the canals over their entire working length (using hand instruments at least up to ISO size 30/35; using engine-driven nickel-titanium instruments at least up to size 25/4% taper) [52].
- Root canal irrigation and application of an intracanal dressing (preferably an aqueous calcium hydroxide suspension)
- Bacteria-tight coronal seal
- Reduction of occlusal contacts if necessary [3, 32]
- Analgesics if necessary (see below)

Using either treatment option, freedom from pain can be achieved in the patient within 24 hours in approximately 98–99% of cases [51].

3. Symptomatic apical periodontitis

Diagnosis:

- Pulp sensitivity test to cold: mostly negative
- Palpation: sometimes tenderness to pressure at the level of the root apex
- Radiologic imaging: mostly periradicular lesion or widened periodontal space
- Percussion test: positive
- Tooth mobility: sometimes increased in acute cases; tooth may be elongated.
- Pain anamnesis: pain on biting and on touch; sometimes constant pain

3.1. Teeth with apical periodontitis and no root canal filling

Symptomatic apical periodontitis is a purulent inflammation that is caused by an infection of the root canal system. In this respect, causal treatment must aim to immediately eliminate the cause (infected necrotic pulp tissue) [43].

- Anesthesia if necessary (if the tooth is very sensitive to touch)
- Rubber dam
- Excavation of carious dentin if necessary [40]
- Trepanation and visualization of root canal orifices
- Determination of the working length
- Mechanical preparation of all root canals up to a size that allows irrigation of the root canals over their entire working length (using hand instruments at least up to ISO size 30/35; using engine-driven nickel-titanium instruments at least up to size 25/4% taper) [52].
- Root canal irrigation and application of an intracanal dressing (preferably an aqueous calcium hydroxide suspension)
- Bacteria-tight coronal seal
- Reduction of the occlusal contacts if necessary [3, 32, 41]
- Analgesics if necessary (see below)

3.2. Teeth with already filled root canals and apical periodontitis

Even in the case of an already root canal filled tooth, the cause is either a persistent or newly occurring (re)infection of the root canal system. In this respect, causal treatment is no different than the procedure described previously [43].

- Anesthesia if necessary (if the tooth is very sensitive to touch)
- Rubber dam
- Complete excavation of carious dentin if necessary [40]
- Repeated trepanation and visualization of the root canal filling
- Removal of the root canal filling: if the root canal system responsible for the acute symptoms can be identified with sufficient probability based on radiologic imaging (e.g. only one root is associated with a periradicular lesion), only the retreatment of all of the canal systems in the respective root may be sufficient as the first-line pain treatment.
- Further procedure analogous to first-line treatment

If orthograde access to the periradicular tissue appears impossible or too risky (e.g. intracanal posts, instrument fragments), the administration of an analgesic (see below) with additional long-term anesthesia (e.g. bupivacaine) may be indicated in order to permit causal treatment the following day along with sufficient treatment time [23, 30, 37, 39].

4. Acute periradicular abscess

Diagnosis:

- Pulp sensitivity test to cold: negative
- Extraoral and/or intraoral swelling
- Radiologic imaging: mostly periradicular lesion or widened periodontal space
- Percussion test: positive
- Tooth mobility: sometimes increased; tooth may be extruded
- Pain anamnesis: pain on biting and on touch; persistent and tense pain
- Restricted mouth opening is possible, complaints when swallowing
- The patient's general health condition is possibly impaired (fever, circulatory system complaints)

4.1. Teeth with acute periradicular abscess and no root canal filling

Treatment:

Besides causal treatment to eliminate the cause (infected necrotic pulp tissue), drainage to ensure adequate pus discharge constitutes a primary goal of pain management [42]. A meta-analysis indicates that immediate drainage is the first-line treatment [28]. Drainage can be established through the affected tooth and/or through an incision. An exclusive incision without the trepanation of the affected tooth does not represent adequate causal therapy. If the tooth's trepanation is not possible immediately, in exceptional cases (e.g. severely restricted mouth opening), it should be performed promptly (ideally within 24 hours) after the incision [48].

- Anesthesia because of the mostly pronounced sensitivity of the tooth to touch [8]
- Rubber dam
- Excavation of carious dentin if necessary [40]

- Trepanation and access to the root canal orifices: often, pus spontaneously flows out of the endodontium afterward. If the pus does not drain, thin, sterile instruments (ISO sizes 08 to 15) can be used to widen the apical root canal segment, so as to allow the pus to flow out. However, deliberate over-instrumentation should be avoided [7, 8].
- Determination of the working length
- Mechanical preparation of all root canals up to a size that allows irrigation of the root canals over their entire working length (using hand instruments at least up to ISO size 30/35; using engine-driven nickel-titanium instruments at least up to size 25/4% taper) [52]. The crown-down technique of preparation is preferable in order to reduce the incidence of undesired extrusion of infected canal contents into the periradicular tissue [43].
- Large-volume root canal irrigation (cave: the high risk of apical extrusion of irrigants should be taken into account)
- Drying of the root canal to check if exudation from the endodontium has subsided. An intracanal dressing is applied (preferably an aqueous calcium hydroxide suspension).
- Bacteria-tight coronal seal
- Reduction of the occlusal contacts [3, 32, 41].
- Adjunctive analgesics if necessary (see below)

In exceptional cases, in which the exudation of pus or secretions from the endodontium does not subside within approximately 15–20 minutes, consideration may be given to leave the tooth open for a maximum of 24 hours notwithstanding the general recommendations [40, 48]. In order to avoid the problem of biofilm formation in the endodontium due to the migration of microorganisms from the oral cavity, which is subsequently difficult or impossible to remove, chemo-mechanical preparation of all root canals in combination with the necessary bacteria-tight coronal seal should be performed within the subsequent 24 hours. Routinely leaving a tooth open or leaving it open for a longer period of time must be avoided at all costs [42].

Trephination (so-called Schröder ventilation) does not represent an adequate pain management solution for non-vital teeth associated with periradicular inflammation [21, 33].

Extensive odontogenic abscesses, especially in combination with the patient's general feeling of malaise (e.g. fever), may be an indication for hospitalization [40, 42].

4.2. Teeth with already filled root canals and acute periradicular abscess

Also in this scenario, the primary therapeutic goal is the need to establish drainage. If, as described in 3.2, orthograde access to the periapical tissue appears to be possible with an acceptable amount of effort – again limited to the canal system responsible for the periradicular abscess if necessary – the further treatment procedure after removal of the root canal filling corresponds to that of first-line treatment.

In exceptional cases which are well-warranted, an initial incision of the abscess may be considered. The treatment can then be continued within the next 24 hours in the form of an orthograde retreatment or necessary surgical measures (e.g., apicoectomy, extraction) [15, 43]. Since the cause is not treated immediately in these exceptional cases, care must be taken to ensure adequate incision depth and length; if necessary, additional drainage of the incision via strips, rubber bands, or tubes is recommendable. In the maxilla, care should be taken to ensure that the incision does not hinder any plastic covering that may potentially be required after a subsequent extraction of the affected tooth. In addition, the administration of analgesics (see below) with supplementary long-term anesthesia (e.g., bupivacaine) may be indicated to bridge the short time interval until the initiation of causal treatment [23, 30, 37, 39].

5. Adjunctive drug therapy

Any adjunctive drug therapy – even under the greatest time pressure – must not be regarded as a substitute for the causal treatment that is indicated in each respective case. In endodontic pain management, drugs can be a supplement, but never the sole treatment [23, 48].

5.1. Antibiotics

Pain per se is never an indication for antibiotic administration [18]. There is no evidence to support that antibiotics relieve pain in the treatment of symptomatic pulpitis [20] or symptomatic apical periodontitis [10].

Localized odontogenic infections with no tendency to spread, in which drainage of the pus could be established, are not an indication for antibiotic administration, as long as general health-related risk factors do not exist [42]. If the risk for abscessing infections to disseminate along communicating spaces exists (e.g. fossa canina, perimandibular, submandibular or perimandibular space abscesses), the additional use of systemic antibiotics in endodontic pain management is warranted [1, 42, 44]. This also applies when fever (temperature >38 °C), trismus, swallowing difficulties, or general health-related risk factors are present [42, 44].

The antibiotics of choice are penicillin or amoxicillin, whereas in cases of a penicillin allergy, clindamycin may be used [42]. In severe cases or abscesses with the tendency to spread, the combination of an aminopenicillin and a beta-lactamase inhibitor (amoxicillin/clavulanic acid) is the drug of choice [42]. This preparation should also be prescribed when an odontogenic infection has already been treated previously with a penicillin or aminopenicillin and no beta-lactamase inhibitor [42].

5.2. Analgesics

As part of adjuvant therapy in causal pain management, nonsteroidal anti-inflammatory drugs (NSAIDs) represent the analgesics of first choice for several reasons [6, 19, 47]. In both symptomatic pulpitis as well as symptomatic apical periodontitis, prostaglandins in particular are considered to be the chief inflammatory mediators responsible for the development of pain. NSAIDs are very effective at inhibiting prostaglandin synthesis [19]. Ibuprofen seems to have the greatest efficacy of all NSAIDs when it comes to the management of pain [36].

When metamizole (Novalgin) is administered, it should be taken into consideration that agranulocytosis can occur in 1:1439 prescriptions, with a lethality of approximately 23% [24].

The administration of 400–600 mg ibuprofen 30–60 minutes before performing an inferior alveolar nerve block significantly increases the depth of anesthesia according to several meta-analyses [31, 38, 46]. It has been suggested that the administration of 600 mg appears to be superior to 400 mg [31].

5.3. Glucocorticoids

Meta-analyses have corroborated that the systemic administration of corticosteroids (e.g. dexamethasone p.o. or as a local injection) is suitable for preventing postoperative pain in symptomatic pulpitis, as corticosteroids reduce pain significantly for up to 24 hours after treatment [34, 45, 49]. Moreover, a randomized double-blind study demonstrates a significant reduction of pain for up to 24 hours after the treatment of symptomatic apical periodontitis [50].

It is important to note that glucocorticoids are not allowed to be administered in combination with NSAIDs since their combination significantly increases the side effects of glucocorticoids and results in an increased risk of gastrointestinal bleeding and ulceration [17, 27].

Conflicts of Interest

The authors declare that there is no conflict of interest within the meaning of the guidelines of the International Committee of Medical Journal Editors.

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