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**ЛЕЧЕНИЕ ПУЛЬПИТА ВРЕМЕННЫХ
И ПОСТОЯННЫХ НЕСФОРМИРОВАННЫХ ЗУБОВ**

**TREATMENT OF PULPITIS IN PRIMARY
AND IMMATURE PERMANENT TEETH**

Учебно-методическое пособие



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ETIOLOGY OF PULPITIS

Nowadays, dental caries and its complications are the most common chronic disease in children around the world. Etiology of pulpitis in children are described in table 1.

Table 1

Etiology of pulpitis in children

| | | | |
|--|----------------|---|-----------------------------------|
| Traumatic factors (traumatic pulpitis) | Acute trauma | <p>1) iatrogenic trauma:</p> <ul style="list-style-type: none"> – <i>mechanical</i> — damage to the pulp with excessively strong probing, dissection, removal of an adjacent tooth or antagonist tooth; – <i>chemical</i> — applying to the bottom of the deep carious cavity of strong substances; – <i>thermal</i> — overheating from the preparation without water cooling, overheating when the polymerization regime is disturbed; <p>2) household trauma</p> | Primary acute forms of pulpitis |
| | Chronic trauma | Overstatement of restoration, excessive pressure of orthodontic devices, anomalies of occlusion. Harmful habits in the presence of carious lesions of the teeth | Primary chronic forms of pulpitis |
| Infectious factors (pulpitis as a result of caries) | Orthograde | Biogenic amines — a product of the vital activity of cariogenic bacteria through wide dentinal tubules can cause primary inflammation in the pulp and cause the development of pulpitis <i>before</i> the penetration of bacteria into the pulp | Primary chronic forms of pulpitis |
| | | Bacteria from carious cavity: Hemolytic, nonhemolytic streptococci, diplococci, staphylococci, gram-positive rods, lactobacilli, fungi | |
| | Retrograde | Bacteria from periodontal pockets, from the focus of periapical inflammation of the adjacent tooth, on the upper jaw in permanent teeth — from the maxillary sinus, less often — hematogenous and lymphogenous in sepsis | |

CLASSIFICATION OF PULPITIS

Goffung Classification (1927):

1. Acute pulpitis:
 - partial;
 - total;
 - suppurative (purulent) pulpitis.
2. Chronic pulpitis:
 - simple (fibrous);
 - hypertrophic;
 - gangrenous.

International classification ICD-10:

K 04 Diseases of pulp and periapical tissues

K 04.0 Pulpitis

K 04.00 Initial (hyperaemia)

K 04.01 Acute

K 04.02 Suppurative [pulpal abscess]

K 04.03 Chronic

K 04.04 Chronic, ulcerative

K 04.05 Chronic, hyperplastic [pulpal polyp]

K 04.08 Other specified pulpitis

K 04.09 Pulpitis, unspecified

K 04.1 Necrosis of pulp

Pulpal gangrene

K04.2 Pulp degeneration

Denticles

Pulpal calcification

Pulpal stones

K04.3 Abnormal hard tissue formation of pulp

K04.3x secondary or irregular dentine

excludes: pulp calcifications (K04.2)

pulpal stones (K04.2).

FEATURES OF PRIMARY AND PERMANENT TEETH

There is a correlation between the clinical manifestations of pulpitis and the structure of the hard tissue, of the pulp, of the periodontal tissue of primary teeth and the bone in children.

Features of the structure of the hard tissues of primary teeth: a thin layer of dentin; low level of mineralization of the dentine; dentinal tubules are short and wide; large tooth cavity. As a result: inflammation of the pulp often occurs in the teeth with the small carious cavity; rapid penetration of bacteria and their toxins in the pulp; development of primary chronic pulpitis; the prevalence of chronic forms over acute, ones.

Features of the pulp of primary teeth: the prevalence of the cellular elements; a small amount of collagen fibers; abundance of amorphous material; many blood and lymphatic vessels; immature barrier formations of the pulp; there is no border between the coronal and root pulp. As a result: the rapid spread of the inflammatory process from the coronal to root pulp; a short period of acute partial pulpitis; the rapid development of exudative process; rapid transition of inflammation from one stage to another (from serous to purulent);

frequent mismatching of morphological changes in the pulp with clinical manifestations.

Features of the periodontal tissue: wide communication between pulp and periodontal tissue; a friable conjunctive tissue; a large number of cellular elements, blood and lymph vessels. As a result: the rapid development of the inflammatory process with the involvement of surrounding tissues.

Features of the bone: sponginess and low mineralization level of the cortical plate; thin bone ravine; wide bone marrow space. As a result: the rapid development of the periodontitis and periostitis, accompanied with impairment of general condition and swelling of the surrounding soft tissues.

Features of young permanent teeth (immature permanent teeth): surfaces of teeth are covered with pronounced enamel rods and perikymata; no attrition present, mammelons clearly visible; surface of enamel works like a semipermeable membrane; slow passage of water from surrounding and substances having small molecular size pass through pores. Primary dentine which is composed of mantle and circumpulpal dentine is present. Young permanent teeth are those recently erupted teeth in which normal physiological apical root closure has not occurred: normal physiological apical root closure of permanent teeth may take 2–3 years after eruption; young permanent teeth are in developmental stage in children from 6 years of age until mid-teens; human tooth with immature apex is a developing organ, the proliferation and differentiation of various cells are activated especially in the apical region of the young tooth to make it complete. Young pulp has a high number of undifferentiated mesenchymal cells: high cellular content, high vascularity, low calcium and phosphorus content.

FEATURES OF PULPITIS IN CHILDREN

Features of pulpitis in children:

1. Inflammation of the pulp develops in teeth with small carious cavity.
2. The process is distributed very quickly.
3. Acute process through a small period of time becomes chronic, so children have more common chronic pulpitis or its exacerbation.
4. The symptoms of pulpitis are highly dependent on the stage of formation of the tooth.
5. Frequent inflammation of tissues surrounding the tooth.
6. General reaction (fever, drowsiness, headache, leukocytosis and increased erythrocyte sedimentation rate in blood).

The clinical features of acute pulpitis in children. Acute pulpitis is very rare, diagnosed in somatically healthy children. This form is found only in teeth with fully formed root. Most often, the process develops at the age of 3–6 years. Partial

pulpitis is rarer than the total. Pulp cavity is always closed and with light infected dentin in the carious cavity. Serous pulpitis very quickly becomes purulent. Acute pulpitis is often accompanied by a deterioration of general condition of the body the more often outcome of acute pulpitis is pulp necrosis.

The main symptoms of acute inflammation:

- the sudden emergence of a strong toothache, often in the evening or at night;
- pain is worse from cold or warm (if tissue is filled with pus, the pain becomes stronger from hot and cold calms it down);
- pain during the clenching of the jaws, getting food on the tooth;
- there may be mild soft tissue swelling and swollen lymph nodes;
- acute pulpitis occurs in the tooth with a small carious cavity.

With the development of acute purulent inflammation the pain is so strong that the child cannot precisely specify a sick tooth, and sometimes the side of the jaw. Differential diagnosis of acute pulpitis in children is described in table 2.

Table 2

Differential diagnosis of acute pulpitis in children

| Symptoms | Acute serous pulpitis | Acute suppurative pulpitis | Acute suppurative pulpitis |
|-------------------------|--|--|--|
| Onset of the disease | Acute | Acute | Long lingering |
| Features of pain | Spontaneous, long-term pain with short intervals | Long-term pain, which is radiating to motor branches of trigeminal nerve | Acute pain during relapses |
| Reaction to temperature | Pain from the cold, heat can reduce pain | Pain from the hot, cold can reduce pain | Pain is provoked, long-term, aching or sharp and it persists after elimination of stimulus |
| Percussion | Can be painful | Painful | Pain from cold or hot |
| Tooth cavity | Closed | Closed | Can be painful |
| Probing bottom cavity | Painful around (across) the bottom | Painful to the depth of the tooth cavity | Open or covered with softened dentin |

The clinical features of chronic pulpitis in children:

- chronic forms of pulpitis in children are very common and are developing as primary chronic;
- chronic pulpitis is usually asymptomatic and often diagnosed during routine oral inspection;
- often develops as an asymptomatic process;
- often occurs in not deep cavities (with pigmented infected dentin into the carious cavity) and tooth with a filling;

– in 40–60 % of cases there is an inflammatory reaction of the tissues surrounding the tooth, so it is recommended to refine the treatment plan to make an X-ray;

– the pain at this form of pulpitis appears during the stimulus — getting food in a cavity, cold drinks on the street;

– the most common form of chronic pulpitis is fibrous pulpitis, then gangrenous and less hypertrophic;

– proliferative pulpitis can occur in children with a closed pulp chamber.

Differential diagnosis of chronic pulpitis in children is described in table 3.

Table 3

Differential diagnosis of chronic pulpitis in children

| Symptoms | Chronic fibrous pulpitis | Chronic proliferative pulpitis | Chronic gangrenous pulpitis |
|---------------------------------------|---|--|--------------------------------------|
| Spontaneous pain | Absent | Absent | Absent |
| Reaction to temperature: – to hot; | Long paroxysmal, dull pain | Prolonged paroxysmal, dull pain, which increases when patient is passing from cold to a warm place | Prolonged paroxysmal, dull pain |
| – to cold | Pain increases | No pain | No pain |
| Tooth cavity (pulp chamber) | Open or covered with softened dentin | Open (often there is a pulp polyp) | Open or covered with softened dentin |
| Probing of cavity bottom | Painful probing at one point of the cavity bottom | Painful, pulp bleeds | Just deep probing is painful |

The main symptoms of chronic inflammation:

– pain during the meal, the children is trying not to eat at the «sick» side (when viewed on that side will be more plaque);

– sometimes there is pain from the cold water, when you hit it on the tooth;

– in chronic gangrenous pulpitis the pain is absent or occurs from hot;

– the tooth often changes color (grey, dark) and differs from others;

– a patient may have a feeling of heaviness in the tooth, a feeling of fullness or «tooth “not like”». There is an unpleasant smell from the tooth;

– chronic hypertrophic pulpitis is rare and is manifested in the form of overgrowth of pulp tissue in carious cavity, when «naked» pulp is exposed to constant mechanical irritation. The crown of the tooth is badly damaged.

DIAGNOSTIC OF PULPITIS IN CHILDREN

The main stages of diagnosis of pulpitis in children:

1. General health of the children.
2. Dental history.
3. History of pain.
4. Extraoral examination.
5. Intraoral examination.
6. X-ray investigation.

PHYSICAL CONDITION OF THE PATIENT

Although local observations are of extreme importance in the selection of cases for vital pulp therapy, the dentist must also consider the physical condition of the patient.

In seriously ill children, extraction of the involved tooth after proper pre-medication with antibiotics, rather than pulp therapy, should be the treatment of choice. Children with conditions that render them susceptible to subacute bacterial endocarditis or those with nephritis, leukemia, solid tumors, idiopathic cyclic neutropenia, or any condition that causes cyclic or chronic depression of granulocyte and polymorph nuclear leukocyte counts should not be subjected to the possibility of an acute infection resulting from failed pulp therapy. Occasionally, pulp therapy for a tooth of a chronically ill child may be justified, but only after careful consideration is given to the prognosis of the child's general condition, the prognosis of the endodontic therapy, and the relative importance of retaining the involved tooth.

DIAGNOSIS OF PULPAL STATUS IN PRIMARY TEETH

As with any dental procedure, a thorough medical history must be completed, and any implications related to treatment must be considered. A child with systemic disease might necessitate different treatment than a healthy one. The examination should begin with a thorough history and characteristics of any pain, because these are often important in helping to determine pulpal status and eventual treatment. Whereas pain usually accompanies pulpal inflammation, extensive problems might arise without any history of pain.

If possible, a distinction between provoked and spontaneous pain should be ascertained. Provoked pain that ceases after removal of the causative stimulation is usually reversible and indicative of minor inflammatory changes. Stimuli include thermal, chemical, and mechanical irritants and many times are due to deep caries, faulty restorations, soreness around a primary tooth nearing exfoliation, or an eruption of a permanent tooth.

Spontaneous pain is a constant or throbbing pain that occurs without stimulation or continues long after the causative factor has been removed. In a well-controlled histologic study of primary teeth with deep carious lesions, Guthrie et al. demonstrated that a history of spontaneous toothache is usually associated with extensive degenerative changes extending into the root canals. Primary teeth with a history of spontaneous pain should not receive vital pulpal treatments and are candidates for pulpectomy or extraction.

The clinical examination might produce evidence of pulpal pathosis. Redness, swelling, fluctuation, severe dental decay, defective or missing restorations, and draining parulis might indicate pulpal involvement. Percussion sensitivity might be valuable to the diagnosis, but it is complicated by the reliability of the child's response because of the psychological aspects involved. Tooth mobility might be present normally because of physiologic resorption, and many pulpally involved teeth have no mobility.

Electric pulp tests are not valid in primary teeth. Laser Doppler flowmeter might be of greater help in determining vitality, but this equipment has not been perfected, and the price is prohibitive. Thermal tests are usually not conducted on primary teeth because of their unreliability.

After the clinical examination, radiographs of good quality are essential. Like permanent teeth, periapical radiolucencies appear at the apices in primary anterior teeth. In primary molars, pathologic changes are most often apparent in the bifurcation or trifurcation areas. Consequently, bite-wing radiographs are often best to observe pathologic changes in posterior primary teeth.

Pathologic bone and root resorptions are signs of advanced pulpal pathosis that has spread into the periapical tissues and is usually treatable only with extraction. Mild, chronic pulpal irritation such as seen in caries might stimulate the deposition of tertiary reactionary dentin over the pulp. With acute or rapid onset as the disease reaches the pulp, calcified masses might form away from the exposure site. Such calcified masses are always indicative of advanced pulpal degeneration extending into the root canals. Primary teeth with such calcified masses are candidates for only pulpectomy or extraction. Internal resorption in primary teeth is always associated with extensive inflammation. Because of the thinness of the primary molar roots, if internal resorption can be seen radiographically, a perforation usually exists, and the tooth must be extracted.

HISTORY OF PAIN

The history of either the presence or the absence of pain may not be as reliable in the differential diagnosis of the condition of the exposed primary pulp as it is in permanent teeth. Degeneration of primary pulp even to the point of abscess formation without the child recalling pain or discomfort is not uncommon.

Nevertheless, the history of a toothache should be the first consideration in the selection of teeth for vital pulp therapy. A toothache coincident with or immediately after a meal may not indicate extensive pulpal inflammation. The pain may be caused by an accumulation of food within a caries lesion, by pressure, or by a chemical irritation to vital pulp protected by only a thin layer of intact dentin. A severe toothache at night usually signals extensive degeneration of the pulp and calls for more than conservative pulp therapy. A spontaneous toothache of more than momentary duration occurring at any time usually means that pulpal disease has progressed too far for treatment, even with a pulpotomy.

CLINICAL SIGNS AND SYMPTOMS

A gingival abscess or draining fistula associated with a tooth with a deep caries lesion is an obvious clinical sign of an irreversibly diseased pulp. Such infections can be resolved only by successful endodontic therapy or extraction of the tooth. Abnormal tooth mobility is another clinical sign that may indicate a severely diseased pulp. When such a tooth is evaluated for mobility, the manipulation may elicit localized pain in the area, but this is not always the case.

If pain is absent or minimal during manipulation of the diseased mobile tooth, the pulp is probably in a more advanced and chronic degenerative condition. Pathologic mobility must be distinguished from normal mobility in primary teeth near exfoliation. Sensitivity to percussion or pressure is a clinical symptom suggestive of at least some degree of pulpal disease, but the degenerative stage of the pulp is probably of the acute inflammatory type. Tooth mobility or sensitivity to percussion or pressure may be a clinical sign of other dental problems as well, such as a high restoration or advanced periodontal disease. However, when this clinical information is identified in a child and is associated with a tooth having a deep caries lesion, the problem is most likely to be caused by pulpal disease and possibly by inflammatory involvement of the periodontal ligament.

PULP TESTING

Historically the value of the electric pulp test in determining the condition of the pulp of primary teeth has been viewed as questionable. Although it will give an indication of whether the pulp is vital, the test does not provide reliable evidence of the degree of pulpal inflammation. A complicating factor is the occasional positive response to the test in a tooth with a necrotic pulp if the content of the canals is liquid. The reliability of the pulp test for the young child can also be questioned sometimes because of the child's apprehension associated with the test itself.

Thermal tests also have reliability problems in the primary dentition. The lack of reliability is possibly related to the young child's inability to understand

the tests. However, Hori and colleagues have found the electric pulp test to be reliable in diagnosing the pulp status in primary teeth. Comparing the electric pulp test with thermal testing, they found the highest accuracy for the former, followed by heat and then cold tests. Several noninvasive techniques have been developed and advocated for recording the blood flow in human dental pulp. Two of these methods include the use of a laser Doppler flowmeter and transmitted-light photo plethysmography. These methods essentially work by the transmission of a laser or light beam through the crown of the tooth; the signal is picked up on the other side of the tooth by an optical fiber and photocell. A distinct advantage of this technique is its noninvasive nature, particularly in comparison with electric pulp testing. Not only is there inaccuracy in the response of the pulp to electric stimuli but also the electric pulp tester may elicit pain. Because the testing may be uncomfortable for young patients, further dental treatment may be affected. A study by Miwa and colleagues suggested that the transmitted-light technique can detect pulpal blood flow in young permanent teeth and is thus applicable to the assessment of pulp vitality. Recent research has looked at the use of pulse oximetry measured oxygen saturation levels of the dental pulp. Although the technique may not be ready for routine clinical use, it is a promising new area of study.

RADIOGRAPHIC INTERPRETATION

Interpretation of radiographs of primary teeth is always complicated by the presence of the succedaneous tooth and surrounding follicle. Misinterpretation of the follicle can easily lead to an erroneous diagnosis of periapical pathology. Superimposition of the permanent tooth might obscure visibility of the furca and roots of the primary tooth, causing misdiagnosis. Added to this is the normal physiologic resorption process.

Radiographs might also reveal evidence of:

- previous pulpal treatment;
- calcification changes in pulp chambers and root canals;
- oversized canals indicative of cessation of root formation and pulpal necrosis;
- after trauma, root fractures, bone fractures, displacement of teeth, imbedded tooth fragments, or foreign bodies in soft tissues.

A recent X-ray film must be available to examine for evidence of periradicular or periapical changes, such as thickening of the periodontal ligament or rarefaction of the supporting bone. These conditions almost always rule out treatment other than an endodontic procedure or extraction of the tooth.

Radiographic interpretation is more difficult in children than in adults. The permanent teeth may have incompletely formed root ends, giving an impression of periapical radiolucency, and the roots of the primary teeth undergoing even nor-

mal physiologic resorption often present a misleading picture or one suggestive of pathologic change. The proximity of caries lesions to the pulp cannot always be determined accurately in the X-ray film. What often appears to be an intact barrier of secondary dentin protecting the pulp may actually be a perforated mass of irregularly calcified and carious material. The pulp beneath this material may have extensive inflammation. Radiographic evidence of calcified masses within the pulp chamber is diagnostically important. If the irritation to the pulp is relatively mild and chronic, the pulp will respond with inflammation and will attempt to eliminate the irritation by blocking (with irregular dentin) the tubules through which the irritating factors are transmitted. If the irritation is intense and acute, and if the caries lesion is developing rapidly, the defense mechanism may not have a chance to lay down the reparative dentin barrier, and the disease process may reach the pulp. In this instance the pulp may attempt to form a barrier at some distance from the exposure site. These calcified masses are sometimes evident in the pulp horn or even in the region of the pulp canal entrance. A histologic examination of these teeth shows irregular, amorphous masses of calcified material that are not like pulp stones. The masses bear no resemblance to dentin or to a dentinal barrier and are always associated with advanced degenerative changes of the coronal pulp and inflammation of the tissue in the canal.

DIFFERENTIAL DIAGNOSIS

Clinical signs for differential diagnosis of different forms of pulpitis in primary teeth are described in table 4.

Table 4

Clinical signs for differential diagnosis of different forms of pulpitis in primary teeth

| Diagnostic test | Pulp condition | | |
|---|-----------------------------------|-----------------------|---------------|
| | Reversible pulpitis | Irreversible pulpitis | Pulp necrosis |
| Tooth mobility | – | + | + |
| Reaction to vertical percussion | – | + | Often |
| Sensitivity to stimulus | + | – | Rarely |
| Changes on the X-ray | – | Often | + |
| Bleeding from the pulp (during pulpotomy) | – | Often | + |
| Pain | Sometimes when exposed to stimuli | + | Often |
| Fistula | – | Possible | Possible |
| Collateral edema | – | Possible | Possible |

VITAL PULP THERAPY TECHNIQUES

For many centuries, and probably from almost the beginning of time for humans, there has been a search for the best (safe and effective) methods of managing pulpal disease and traumatic pulpal exposure. These efforts have generated considerable controversy and debate as proponents of specific materials and methods attempt to justify their chosen techniques. Despite many impressive scientific advancements, these controversies remain unsettled here in the twenty-first century. The identification of the best formulations of ingredients and techniques for producing predictable pulpal healing remains elusive. To complicate this issue further, the predominant belief is that pulp therapies appropriate for permanent teeth may not always be equally effective in treating similar conditions in primary teeth.

Evaluation of treatment prognosis before pulp therapy. The diagnostic process of selecting teeth, that are good candidates for vital pulp therapy, has at least two dimensions. First, the dentist must decide that the tooth has a good chance of responding favorably to the pulp therapy procedure indicated (table 5). Second, the advisability of performing the pulp therapy and restoring the tooth must be weighed against extraction and space management. For example, nothing is gained by successful pulp therapy if the crown of the involved tooth is not restorable or the periodontal structures are irreversibly diseased. By the same rationale, a dentist is likely to invest more time and effort to save a child with unerupted first permanent molars than to save a pulpally involved first primary molar in an 8-year-old child.

Table 5

**The following criteria are characteristic for reversible
(Syn: hyperemia, inflamed-reversible) or irreversible pulpitis**

| Criteria | Reversible pulpitis | Irreversible pulpitis |
|---------------------|---|---|
| Reaction to cold | Extremely increased | Normal, decreased |
| Reaction to heat | Normal | Extremely increased |
| Percussion | Negative | Positive |
| Pain | – recent onset; – mild to moderate pain; – non-lingering pain to temperature or osmotic changes | – onset some time ago; – severe pain, intense, lingering pain to temperature changes; – spontaneous pain; – diffuse or referred pain |
| Floor of the cavity | Closed, no caries | Open, affected by caries, soft |
| Caries | Exposed dentin | Deep caries |

During diagnosing pulpitis in children we should not use diagnostic methods that cause pain:

- probing in the depth of the carious cavity before anesthesia;
- sharp percussion;
- temperature tests.

Other factors to consider include the following:

1. The level of patient and parent cooperation and motivation in receiving the treatment.
2. The level of patient and parent desire and motivation in maintaining oral health and hygiene.
3. The caries activity of the patient and the overall prognosis of oral rehabilitation.
4. The stage of dental development of the patient.
5. The degree of difficulty anticipated in adequate performance of the pulp therapy (instrumentation) in the particular case.
6. Space management issues resulting from previous extractions, preexisting malocclusion, ankylosis, congenitally missing teeth, and space loss caused by the extensive carious destruction of teeth and subsequent drifting.
7. Excessive extrusion of the pulpally involved tooth resulting from the absence of opposing teeth. These examples, in any combination, illustrate the almost infinite number of treatment considerations that could be important in an individual patient with pulpal pathosis.

TREATMENT OF THE PULPITIS IN PRIMARY TEETH

Methods of treatment of the pulpitis in primary teeth:

1. Conservative (fig. 1):
 - biological method;
 - indirect pulp capping;
 - direct pulp capping.
2. Surgical:
 - pulpectomy: non-vital, vital;
 - pulpotomy: non-vital, vital.

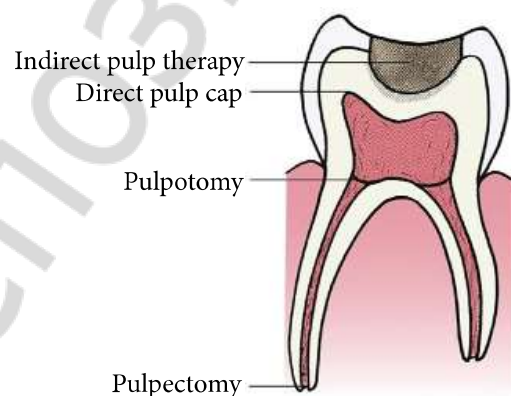


Fig. 1. Pulp therapy progression

THE BIOLOGICAL METHOD

Indications:

- partial acute serous pulpitis;
- chronic fibrous pulpitis (in children from health groups I and II);
- accidental opening of the tooth cavity during the treatment of dental caries.
- additional condition: The patient must be contact.

Procedure of the biological method

First visit:

1. Anesthesia.
2. Isolation.
3. Preparation of cavities (must not be traumatic for pulp, that is why it is carried out by layer, alternated with washing with antiseptic solutions. When approaching to the pulp, the drill is changed for a sterile one, here an electric drill should be used, which works on fewer turns.
4. Multiple antiseptic treatment (a sterile solution of antibiotic, antiseptic or medicinal combination of drugs).
5. Drying the cavity by sterile cotton balls.
6. The imposition of a cotton ball with antibiotic in combination with the proteolytic enzymes or corticosteroid in to the cavity.
7. Temporary filling.

The second visit (in 1–2 days) (if no complaints of spontaneous pain, pain from thermal, chemical and mechanical stimuli):

1. Isolation.
2. Removal of temporary seals.
3. Antiseptic treatment (see the first visit).
4. Covering of the bottom of the cavity with ZOE or calcium hydroxide paste.
5. Temporary filling.

Third visit (in 7–14 days) (if no complaints and objective symptoms of complications from the pulp and periodontal):

1. Isolation.
2. Removal of temporary seals.
3. Insulating laying.
4. Tooth restoration.

INDIRECT PULP TREATMENT

The procedure in which only the gross caries is removed from the lesion and the cavity is sealed for a time with a biocompatible material is referred to as indirect pulp treatment. Teeth with deep caries that are free of symptoms of painful pulpitis are candidates for this procedure. The clinical procedure involves remov-

ing the gross caries but allowing sufficient caries to remain over the pulp horn to avoid exposure of the pulp.

The walls of the cavity are extended to sound tooth structure because the presence of carious enamel and dentin at the margins of the cavity will prevent the establishment of an adequate seal (extremely important) during the period of repair. The remaining thin layer of caries at the base of the cavity is covered with a radiopaque biocompatible base material and sealed with a durable interim restoration. While waiting 6 to 8 weeks for the placement of a final restoration has been suggested in the past (a two-step process), there is no conclusive evidence that this is necessary.

Indications:

- deep caries;
- hyperemia of the pulp in primary teeth with incomplete root formation with no signs of clinical and / or radiographic pulp exposure.

Deep caries lesion:

- remove the gross caries allowing sufficient caries to remain over the pulp horn to avoid exposure of the pulp;
- cover thin layer of caries with a radiopaque biocompatible base material and seal with a durable interim restoration;
- after 6–8 weeks — complete the removal of caries. During this time the caries process in the deeper layer is arrested.

Procedure of the indirect pulp capping:

1. Anesthesia.
2. Good isolation.
3. Removal of all caries.
4. Judicious removal of soft deep carious dentine (using slowly rotating large round steel bur) around the cavity margins.
5. Gentle excavation on the pulpal floor, removing as much as softened dentine as possible without exposing the pulp.
6. Placement of appropriate lining material such as a hard-setting calcium hydroxide or zinc oxide eugenol.
7. Temporary filling.

In 6–8 weeks – 6 month:

8. Removal of the filling material, laying, excavation of the softened dentin.
9. Antiseptic treatment.
10. Covering of the bottom of the cavity with calcium hydroxide or zinc oxide eugenol laying, insulating laying.
11. Definitive restoration to achieve optimum external coronal seal (ideally an adhesive restoration or preformed crown).

DIRECT PULP CAPPING

Although the routine practice of indirect pulp therapy in properly selected teeth will significantly reduce the number of direct pulp exposures encountered, all dentists who treat severe caries in children will be faced with treatment decisions related to the management of vital pulp exposures. The appropriate procedure should be selected only after a careful evaluation of the patient's symptoms, results of diagnostic tests, and conditions at the exposure site. The health of the exposed dental pulp is sometimes difficult to determine, especially in children, and there is often lack of conformity between clinical symptoms and histopathologic condition.

Size of the exposure and pulpal hemorrhage. The size of the exposure, appearance of the pulp, and amount of bleeding are valuable observations for diagnosing the condition of the primary pulp. Therefore the use of a rubber dam to isolate the tooth is extremely important; in addition, with the rubber dam the area can be kept clean and the work can be done more efficiently. The most favorable condition for vital pulp therapy is the small pinpoint exposure surrounded by sound dentin. However, a true carious exposure, even of pinpoint size, will be accompanied by inflammation of the pulp, the degree of which is usually directly related to the size of the exposure. A large exposure — the type that is encountered when a mass of leathery dentin is removed — is often associated with a watery exudate or pus at the exposure site. These conditions are indicative of advanced pulp degeneration and often of internal resorption in the pulp canal. In addition, excessive hemorrhage at the point of carious exposure or during pulp amputation is invariably associated with hyperemia and generalized inflammation of the pulp. When the latter is observed, endodontic therapy or extraction of the tooth is the treatment of choice.

Indications:

- it's a method for treating vital pulp exposures;
- pulp-capping procedures should be limited to small (< 1 mm) exposures that have been produced accidentally by trauma or during cavity preparation;
- absence of pain (may be discomfort after intake of food);
- no bleeding at the exposure site or bleeding in a small amount.

Procedure of the direct pulp capping:

1. Anesthesia.
2. Good isolation.
3. Evaluation of the pulp exposure.
4. Washing the cavity with isotonic saline (warmed to body temperature).
5. Careful drying with sterile cotton balls.
6. Placement of appropriate lining material such as a hard-setting calcium hydroxide or MTA.
7. Placement of insulating laying.
8. Tooth restoration.

PULPOTOMY

Pulpotomy is the extirpation of vital inflamed pulp from the coronal chamber followed by medicament placement over radicular pulp stumps to fix (mummification) or stimulate repair of the remaining vital radicular pulp (fig. 2). Signs or symptoms of inflammation extending beyond the coronal pulp is a contraindication for a pulpotomy.

Rationale: the radicular pulp tissue is healthy, and can either heal after the surgical amputation of the coronal pulp, or be fixed/mummified.

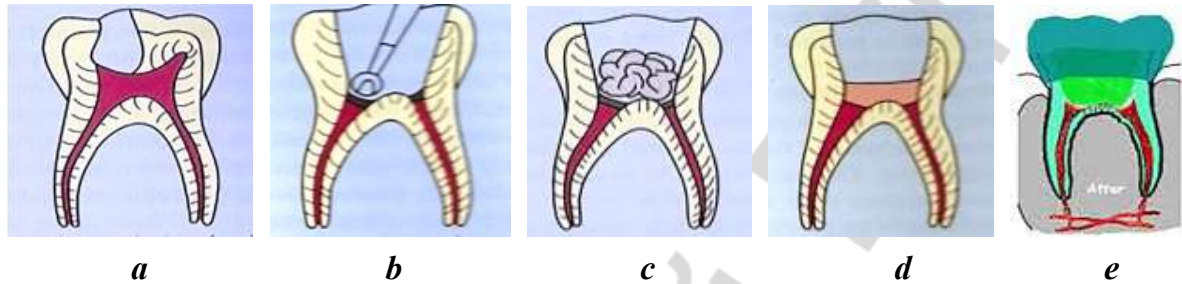


Fig. 2. Pulpotomy procedure:

a — preparation; *b* — pulpotomy; *c* — hemostasis; *d* — pulp capping; *e* — vital pulp

Indications:

- when the pulp is exposed (either through carious exposure or through trauma);
- when it is desirable to maintain tooth (primarily for space, function, guidance of permanent teeth);
- asymptomatic tooth or only transient pain;
- large proximal carious lesion with 1/3rd or more involvement of the marginal ridge in an otherwise restorable tooth.

Procedure:

1. Pre-Radiography.
2. Anesthesia.
3. Isolation.
4. Removal of caries.
5. Opening of the pulp chamber and de-roof.
6. Pulpotomy.
7. Hemorrhage control with cotton balls moistened with saline / ferric sulfate (fig. 3) / formocresol.
8. Placement of MTA/ZOE/ZOE.
9. Tooth restoration.

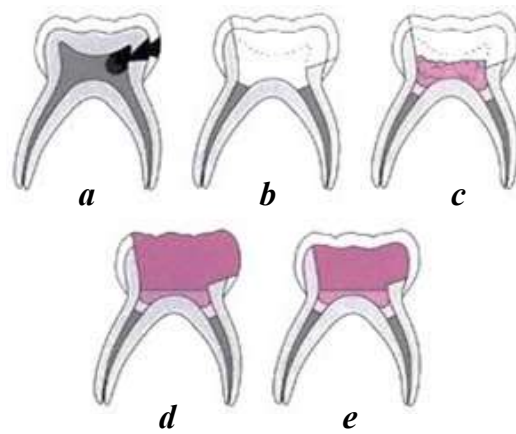


Fig. 3. Pulpotomy with ferric sulfate:

a — the spread of the infection, necrosis of the coronal pulp; *b* — pulpotomy; *c* — arrest of bleeding with ferric sulfate; *d* — placement of zinc oxide-eugenol cement; *e* — restoration of the crown

The non-vital pulpotomy

Indications:

- partial acute serous pulpitis (very rare);
- total acute serous pulpitis;
- chronic fibrous pulpitis (chronic ulcerative pulpitis, chronic pulpitis);
- chronic hypertrophic pulpitis (chronic hyperplastic pulpitis);
- exacerbation of chronic pulpitis without signs of acute periodontitis.

Procedure

First visit:

1. Pre-Radiography.
2. Anesthesia or without anesthesia.
3. Isolation of the tooth.
4. Judicious removal of soft deep carious dentine, expose the pulp.
5. Placement of devitalization paste on the exposed pulp (in an amount equal to the size of the spherical bur № 3–5), cover with a dry cotton ball.
6. Temporary filling.

The second visit (in 7–14 days):

1. Isolation.
2. Removal of temporary filling.
3. The final cavity preparation.
4. Opening of the pulp chamber and de-roofing, pulpotomy (adequate devitalization pulp looks like grayish-white tissue).
5. Placement of mummification paste.
6. Placement of insulating laying.
7. Tooth restoration.

PULPECTOMY

A pulpectomy may be performed on primary teeth when the coronal pulp tissue and the tissue entering the pulp canals are vital but show clinical evidence of hyperemia or if the root canals show evidence of necrosis (suppuration). It is unwise to maintain untreated infected primary teeth in the mouth. They may be opened for drainage and often remain asymptomatic for an indefinite period. However, they are a source of infection and should be treated or removed. The morphology of the root canals in primary teeth makes endodontic treatment difficult and often impractical.

Indications:

- acute purulent pulpitis;
- chronic gangrenous pulpitis;
- acute and exacerbation of chronic pulpitis with signs of acute periodontitis;
- chronic and exacerbation of chronic pulpitis with signs of radiological changes in bone tissue in the furcation or apical parts of the roots;
- irreversible pulpitis involving both the coronal and radicular pulp;
- primary molars with radiographic evidence of furcation pathology.

One stage pulpectomy procedure (fig. 4):

1. Pre-operative radiograph showing all roots and apices.
2. Local anesthesia and good isolation is achieved.
3. Accessment of pulp chamber and identification of root canals.
4. Irrigation with normal saline (0,9 %), Chlorhexidine solution (0,4 %) or sodium hypochlorite solution (0,1 %).
5. Estimation of working lengths of root canals keeping 2 mm short of the radiographic apex.
6. Insertion of small files (no greater than size 30) into canals and file canal walls lightly and gently.
7. Irrigation of the root canals.
8. Drying of canals with pre-measured paper points, keeping 2 mm from root apices.
9. Obturation of root canals by injecting or packing a resorbable paste e. g. slow-setting pure zinc oxide eugenol and iodoform paste.
10. Filling of the pulp chamber with a cement and restoring with stainless steel crown or with restorative material.

Two stage pulpectomy (fig. 5):

1. If active infection is present and there is presence of an exudate that does not allow proper drying of the canal, two-stage technique is considered.
2. All the steps are the same as that of one stage pulpectomy up till removal of radicular pulp. After filling the canals, if there is the presence of a discharge and/or is associated with a sinus, the root canals are dressed with non-setting calcium hydroxide and temporized. Systemic antibiotic maybe prescribed.

3. Alternatively, a small cotton pledget moistened in formocresol or Ledermix (steroidal antibiotic paste) is sealed in the pulp chamber with GIC or IRM for 7 to 14 days. This technique is also known as desensitizing pulp therapy. It is also used in case of a hyperalgesic pulp or when the tooth is too sensitive to remove the entire roof of the pulp chamber.

4. In the second visit, the pledget is removed, the canals are cleaned and obturated followed by a stainless steel crown or with restorative material.

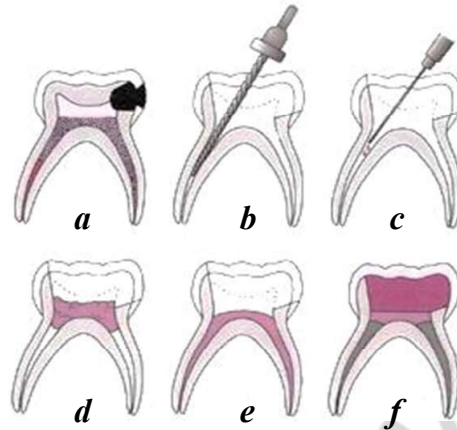


Fig. 4. Pulpectomy in primary tooth:

a — the spread of the infection, necrosis of the coronal pulp; *b* — files operation in the root canals; *c* — irrigation of the root canals; *d* — desensitization if necessary; *e* — obturation of root canals with resorbable pastes; *f* — restoration of the crown

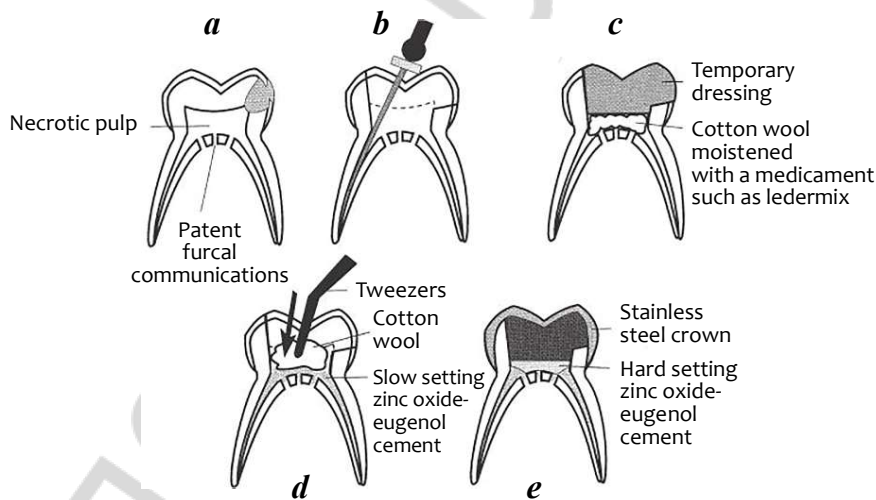


Fig. 5. Non-vital pulpectomy in primary tooth:

a — a carious, but restorable, non-vital primary molar; *b* — caries is eliminated and access made to the pulp. Gentle canal debridement is undertaken with small files and irrigation; *c* — disinfection of the canal system. A pledget of cotton wool barely moistened with ledermix is sealed into the pulp chamber for 7–10 days; *d* — the tooth is reopened at a second visit, and, after irrigation and drying, a soft mixture of slow-setting zinc oxide-eugenol cement is gently packed into the canals with the cotton-wool pledget; *e* — the pulp chamber is packed with accelerated zinc oxide-eugenol cement before definitive restoration of the tooth

CRITERIA OF EFFECTIVENESS OF TREATMENT OF PULPITIS IN PRIMARY TEETH

Criteria of effectiveness of treatment of pulpitis:

1. Clinical success:
 - preservation of functional tooth value;
 - absence of: complaints, postoperative pain, sinuses, pathological mobility of the tooth, gingival inflammation.
2. Radiographical success:
 - preserve the integrity of the cortical plate rudiment of permanent tooth, physiological root resorption;
 - absence of: pathological root resorption (internal or external), bone destruction.

NON-VITAL METHODS

Currently, the use of devitalizing materials in the practice of a child's dentist is not appropriate for the following reasons:

1. Treatment of pulpitis in one visit using modern methods (pulpotomy, pulpectomy) is more preferable than treatment in two visits.
2. The application of devitalizing paste in children is associated with a greater risk of drug leakage and formation of a necrosis zone in the gum and alveolar bone.
3. Difficulties in determining the timing of devitalizing paste exposure in connection with the variability of root resorption of primary teeth in pulpitis, which can lead to the development of toxic periodontitis.
4. The application of devitalizing pastes on the exposed pulp without anesthesia is unacceptable at the present stage of development of dental care.

TREATMENT OF THE PULPITIS IN PERMANENT TEETH

The choice of treatment case in young patients is presented in fig. 6.

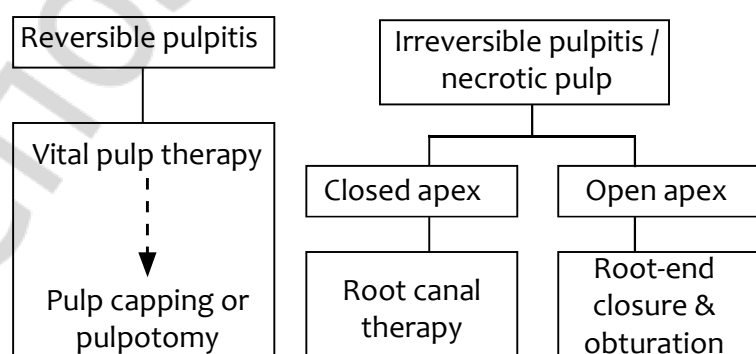


Fig. 6. Case selection in young patients

MATERIALS FOR THE TREATMENT OF THE PULPITIS IN PERMANENT TEETH

I. Materials containing calcium hydroxide (table 6, 7, fig. 7).

Calcium hydroxide for the treatment of pulpitis was first used by Hermann (1930) and Zander (1939), is still widely used today. The material containing calcium hydroxide is used for both direct, indirect pulp capping, pulpotomy and pulpectomy.

Table 6

Main properties of materials containing calcium hydroxide

| Group | Properties | Solubility and resorption ability | Odontotropic properties | Resistance to mechanical stress |
|--|------------|-----------------------------------|-------------------------|---------------------------------|
| Non-hardening calcium hydroxide pastes | | +++ | +++ | + |
| Salicylate cements with calcium hydroxide | | ++ | ++ | ++ |
| Light curing liners with calcium hydroxide | | ++ | + | +++ |

Table 7

Calcium hydroxide-based materials

| Non-hardening pastes based on calcium hydroxide | Hardening pastes based on calcium hydroxide | Light curing liners with calcium hydroxide |
|---|---|--|
| Calcipulpe (Septodont) | Calcimol (VOCO) | Calcimol LC (VOCO) |
| Calxyd paste (Spofa Dental) | Dycal (Dentsply) | Reocap E (Vivadent) |
| Multi-Cal (Pulpdent) | Life (Kerr) | Ultra-Blend Plus (Ultradent) |
| Pulpdent Paste (Pulpdent) | Septocalcine Ultra (Septodont) | Кальцесил LC (ВладМиВа) |
| Supracal (R&S) | Кальцесил (ВладМиВа) | Cavalite (Kerr) |
| Ultracal XC (Ultradent) | Радопласт (Радуга) | |
| Апексдент (ВладМиВа) | | |
| Кальрадент (Радуга-Р) | | |
| Calasept | | |

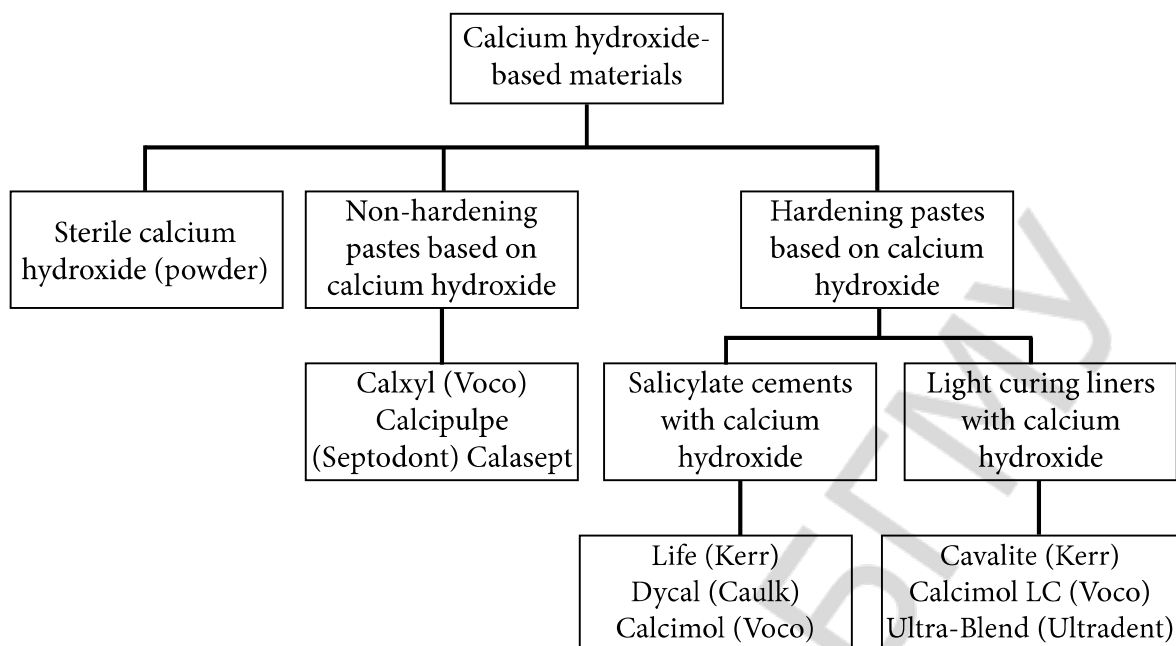


Fig. 7. Calcium hydroxide-based materials

The materials containing calcium hydroxide can be:

- for the indirect pulp capping: «Calcimol», «Septocal L. C.», «Кальраидент» (Kalradent), «Кальцесил» (Kaltsesil), «Кальцесил L. C.» (Kaltsesil L. C.);
- for the direct pulp capping: «Calcicur», «Metapaste», «Metapex», «Calasept», «Vitapex», «Apexdent», «Biocalex», «Endocal»;
- universal materials: «Dycal», «Life», «Alkaliner Mini Tip», «Ultracal XS», «Calcipulp», «Contrasil», «Septocalcine ultra», «Calxid», «Кальцевит» (Kaltsevit).

II. MTA (Mineral Trioxide Aggregate) was introduced by Mohmoud Taorabinejad at Loma Linda University, California, USA in 1993. MTA has potential and one of the most versatile materials of this century in the field of dentistry. During endodontic treatment of primary and permanent tooth MTA can be used in many ways.

MTA is available in two types based on the color known as gray and white MTA. Immediately after mixing MTA has a pH of 10,2. After 3 hours of setting the pH increased to 12,5. MTA materials have been shown to have a biocompatible nature and have excellent potential in endodontic use. MTA materials provide better microleakage protection than traditional endodontic repair materials using dye, fluid filtration, and bacterial penetration leakage models. In both animal and human studies, MTA materials have been shown to have excellent potential as pulp-capping and pulpotomy medicaments.

MTA is chemically very similar to Portland cement and has similar handling and physical properties (table 8).

Chemical and elementary composition of MTA

| Chemical composition of MTA, % | | Elementary composition of MTA, % | |
|------------------------------------|-------|----------------------------------|------|
| CaO | 44,23 | O | 38,0 |
| SiO ₂ | 21,20 | Ca | 37,1 |
| Bi ₂ O ₂ | 16,13 | Si | 6,5 |
| Al ₂ O ₃ | 1,92 | Al | 0,6 |
| MgO | 1,35 | S | 0,9 |
| SO ₃ | 0,53 | K | 0,0 |
| Cl | 0,43 | Mg | 0,1 |
| FeO | 0,40 | Fe | 0,1 |
| P ₂ O ₅ | 0,21 | Bi | 16,9 |
| TiO ₂ | 0,11 | | |
| H ₂ O + CO ₂ | 14,49 | | |

MTA is a mixture of:

- tricalcium silicate;
- dicalcium silicate;
- tricalcium aluminate;
- tetracalcium aluminoferrite;
- calcium sulfate and bismuth oxide.

Materials containing MTA:

- «ProRoot MTA» (Dentsply);
- «Триоксидент» (ВладМиВа);
- «MTA-Angelus»;
- «Biodentine» (Septodont);
- «Рутсил» (Belarus);
- «Радоцем П» (Радуга-Р, Russia);
- «Рутдент» (Tehno Dent, Russia).

BIOLOGICAL METHOD

Indications:

- partial acute serous pulpitis;
- chronic fibrous pulpitis (in children from health groups I and II);
- accidental opening of the pulp chamber during caries treatment;
- exacerbation of chronic fibrous pulpitis (not more than 1–2 times per year);
- exacerbation of chronic fibrous pulpitis (first emerged).
- additional condition: The patient must be contact.

Procedure: the technique does not perform fundamental differences in temporary and in immature permanent teeth and described in detail above.

INDIRECT PULP CAPPING

Indications:

- deep caries;
- hyperemia of the pulp in immature permanent teeth without signs of clinical and/or radiographic pulp exposure.

Procedure: the technique does not perform fundamental differences in temporary and in immature permanent teeth and described in detail above.

DIRECT PULP CAPPING

The goal of the treatment — saving of vital pulp. PH of $\text{Ca}(\text{OH})_2$ in the liners is 12,5. Therefore necrosis of the pulp occurs in the zone of its contact with the paste. The rest of the pulp is healthy. The dentinal bridge is formed in the region of the contact $\text{Ca}(\text{OH})_2$ and the pulp.

The treatment success depends on:

- the condition of the pulp;
- the kind of the liner for pulp therapy;
- full isolation of the pulp after the tooth restoration.

Indications:

- it's a method for treating vital pulp exposures;
- pulp-capping procedures should be limited to small (< 1 mm) exposures that have been produced accidentally by trauma or during cavity preparation.
- additional condition: absence of pain (may be discomfort after intake of food); no bleeding at the exposure site or bleeding in an amount.

Procedure: the technique does not perform fundamental differences in temporary and in immature permanent teeth and described in detail above.

PULPOTOMY

Pulpotomy is the extirpation of inflamed vital pulp from the coronal chamber followed by medicament placement over radicular pulp stumps to fix or stimulate repair of the remaining vital radicular pulp (fig. 8).

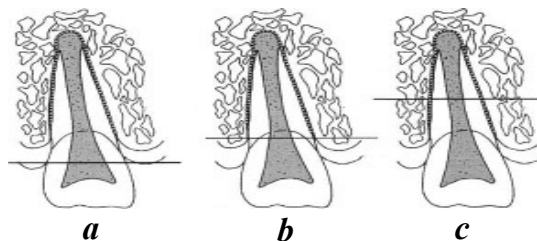


Fig. 8. Pulpotomy:

a — partial pulpotomy; b — pulpotomy; c — deep pulpotomy

Indications for vital pulpotomy:

- acute serous pulpitis without signs of acute periodontitis;
- chronic pulpitis;
- exacerbation of chronic pulpitis in case of 2–3 exacerbations per year;
- chronic hyperplastic pulpitis;
- unsuccessful treatment by indirect pulp capping or direct pulp capping.

Indications for non-vital pulpotomy:

- acute serous pulpitis without signs of acute periodontitis;
- chronic pulpitis (including its exacerbation);
- chronic hyperplastic pulpitis.

Contraindications:

- acute suppurative pulpitis;
- acute and exacerbation of chronic pulpitis;
- chronic ulcerative pulpitis;
- bone resorption in apex or furcation;
- internal resorption.

Procedure:

1. Pre-Radiography.
2. Anesthesia.
3. Isolation.
4. Caries removal.
5. Opening of pulp chamber and de-roofing.
6. Pulpotomy.
7. Hemorrhage control with cotton balls moistened with saline.
8. Ca(OH)₂ / MTA application.
9. Temporary tooth restoration.
10. After the apexogenesis may be two tactics of the treatment:
 - extirpation of the root pulp and filling root canals with gutta-percha pins and crown restoration of a tooth (The rationale for this tactic is: obliteration of the root canal may occur after vital pulpotomy.);
 - not to carry out the preventive endodontic treatment (The rationale for this tactic is: obliteration of the root canal occurs infrequently and endodontic treatment in young patients is associated with many difficulties.).

PULPECTOMY**Indications:**

- acute suppurative pulpitis;
- acute and exacerbation of chronic pulpitis;
- chronic ulcerative pulpitis;
- bone resorption in apex or furcation.

Procedure:

1. Pre-operative radiograph showing all roots and apices.
2. Local anesthesia and good isolation.
3. Access to pulp chamber and identification of root canals.
4. Irrigation with normal saline (0,9 %), Chlorhexidine solution (2–3 %) or sodium hypochlorite solution (2,5–3 %).
5. Estimation of working lengths of root canals keeping 1,5–3 mm short to the radiographic apex.
6. Files operation. *It is necessary to insert files into canals and file canal walls lightly and gently.*
7. Irrigation of the root canals.
8. Drying of canals with pre-measured paper points, keeping 1,5–3 mm from root apices.
9. Obturation of root canals with $\text{Ca}(\text{OH})_2$ paste (Calcur, Metapaste, Metapex, Calasept, Vitapex, Apexdent, Biocalex, Endocal) keeping 1,5–3 mm short to the radiographic apices.
10. Temporal tooth restoration with restorative material.

After the root formation:

11. Final obturation of root canals with gutta-percha and sealer.
12. Final tooth restoration.

An alternative approach to pulpectomy:

1. Pre-operative radiograph showing all roots and apices.
2. Local anesthetic and good isolation.
3. Access to pulp chamber and identification of root canals.
4. Irrigation with normal saline (0,9 %), Chlorhexidine solution (2–3 %) or sodium hypochlorite solution (2,5–3 %).
5. Estimation of working lengths of root canals keeping 1,5–3 mm short to the radiographic apex.
6. Files operation. It is necessary to insert files into canals and file canal walls lightly and gently.
7. Irrigation of the root canals.
8. Drying of canals with pre-measured paper points, keeping 1,5–3 mm from root apices.
9. Filling with MTA of the apical root part (2–4 mm) of an open apex of the tooth (without first having to use long-term dressing of calcium hydroxide).
10. At least 24 the root canal can be filled with gutta-percha pins and sealer.
11. Final tooth restoration.

NON-VITAL TREATMENT METHODS

The use of devitalizing pastes in modern dentistry has serious limitations and it is possible to use them only if adequate anesthesia is not possible. When a devitalizing paste is applied, possible complications are:

1. Increased pain after applying devitalizing paste.
2. Development of acute medication periodontitis.
3. Necrosis of the gingival papilla.
4. Chemical burn of the oral mucosa.
5. Lack of devitalization of the pulp (painfulness of the pulp during probing after removal of the temporary filling).

It is especially important to remember that devitalizing paste can cause death of the root growth zone of the tooth, and as a result a violation of root formation.

It is inappropriate to apply devitalizing pastes in the treatment of permanent unformed teeth!

CRITERIA OF EFFECTIVENESS OF TREATMENT OF PULPITIS IN IMMATURE PERMANENT TEETH

Criteria of effectiveness of treatment of pulpitis in immature permanent teeth:

1. Clinical success:
 - preservation of functional value of the tooth;
 - the color of the tooth crown is not changed;
 - absence of: complaints, postoperative pain, sinuses, pathological tooth mobility, gingival inflammation.
2. Radiographical success:
 - continued root formation (root growth in length, closing apex, narrowing of root canal);
 - dentin bridge formation;
 - there is no internal and external root resorption and no destructive changes in the apical area in the bone.

Follow-up Examination after treatment of pulpitis in immature permanent teeth:

- duration — until the completion of the root formation;
- clinical examinations — every 3 months;
- X-ray examination — every 6 months.

Choosing the method of treatment for different forms of pulpitis is described in table 9.

Table 9

Choosing the method of treatment for different forms of pulpitis

| Cause | Symptomatic | Pulp Condition | Treatment | |
|--|---|--|--|---|
| | | | Primary teeth | Immature permanent teeth |
| Fracture of single-root teeth with pulp exposure | No | Mechanical damage to the area adjacent to the line of fracture | Pulpotomy | Partial pulpotomy |
| Accidental pulp exposure during cavity preparation | At immediate detection — only visual signs | Mechanical damage to the part adjacent to the exposed area | Pulpotomy | Direct pulp capping, partial pulpotomy |
| Caries — deep cavity without pulp exposure | Only when the cavity is located in the 1st and 5th classes according to the Black | Primary (nonbacterial) inflammation of the coronal pulp | Indirect pulp capping | Indirect pulp capping |
| Caries — deep cavity with pulp exposure | - short-term pain from stimuli; - no pathological mobility; - no changes on the X-ray | Inflammation in coronal pulp, vitality of the root pulp | Pulpotomy | Pulpotomy |
| | - spontaneous pains; - pathological mobility; - edema and hyperemia of the mucosa | Irreversible pulpitis | Desensitization* + pulpotomy or pulpectomy | Desensitization* + pulpotomy |
| | Prolonged bleeding from the root pulp during pulpotomy | Irreversible pulpitis with destruction of the root pulp | Pulpectomy | High pulpotomy |
| | Distinguished severe pain, collateral edema, lymphadenitis, fever, intoxication | Irreversible pulpitis | Tooth extraction | The purpose of anti-inflammatory and antipyretic drugs. Local — Desensitization* + high pulpotomy |

| Cause | Symptomatic | Pulp Condition | Treatment | |
|--|--|-----------------------|------------------|--|
| | | | Primary teeth | Immature permanent teeth |
| Significant carious destruction of the crown part of the tooth | Impossibility of therapeutic treatment | Irreversible pulpitis | Tooth extraction | High pulpotomy, temporary restoration, pulpectomy after completion of the apexogenesis and restoration of the crown part with pins |

* Desensitization — is a pulpitis treatment stage aimed at removing symptoms of acute inflammation in the pulp before performing pulpotomy or pulpectomy.

Indications:

1. Exacerbation of chronic pulpitis.
2. Low co-operation of the child in the first visit.
3. Hypersensitivity of the pulp — the inability to conduct adequate analgesia in the long course of the inflammatory process.

Used drugs:

- rockle's solution Septodont;
- septomixine Septodont;
- pulpomixine Septodont;
- ledermix Riemser;
- cresofen Septodont (only before using Formocresol or Pulpotec).

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