Possibility to control anxiety and pain in endodontic dental treatment – review

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ABSTRACT

Modern dentistry aims to limit the unpleasant feeling of pain, associated with dental procedures during treatment in the dental office. There are many ways to reduce pain during dental procedures. Endodontic treatment, necessary in irreversible pulpitis, should be completed during one visit. Removal of the inflamed pulp from cavity and root canals is often accompanied by pain. The study aimed to introduce, based on literature, methods of relieving anxiety and pain accompanying dental treatment procedures, including endodontic treatment, as well as the description of applied measures. According to the modern literature, this research compares methodology and results of the anesthetic and anxiety treatment in the dental office, especially in endodontic treatment.

Keywords: Anesthesia, endodontic treatment, pulpitis

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INTRODUCTION

Until the 20th century, carious lesions were treated without anaesthesia, whereas pulpitis was treated with the use of devitalization methods which almost always was accompanied by pain and possible local or general complications [1].

Modern dentistry aims to limit the unpleasant feeling of pain, associated with dental procedures used during treatment in dental offices. Endodontic treatment necessary in irreversible pulpitis should be completed during one visit. Removal of the inflamed pulp from cavity and root canals is often accompanied by pain.

Pain control in dental practice involves the use of known anaesthetics and application of anaesthesia techniques in a safe and effective way. Most patients are afraid of conservative treatment, including endodontic treatment. Firstly, the dentist should try to calm the patient down, only then an appropriate anaesthesia ought to be applied which will ensure that the procedure is painless.

Anxiety control, or sedation of the patient, can be achieved with the use of pharmacological and non-pharmacological methods. Non-pharmacological methods include iatrosedation and hypnosis. On the other hand, premedication can be achieved with pharmacological drugs administered orally, intravenously or intramuscularly, as well as with medicaments administered via inhalation (nitrous oxide sedation) [2].

MORTAL TREATMENT OF THE PULP

In 1878, the method of partial pulp extirpation was first introduced, called mortal amputation. The method found wide application in treating multi-root teeth. A major criticism of the mortal amputation method appeared only in the past twenty years. Analyses of the large clinical data, conducted by multiple authors, showed that in the majority of cases the method leads to periapical inflammation. That is because the necrotic tissue left in the root canals cannot be sterilized completely. All materials used to cover the pulp remains to lose their bactericidal effect over time. As a result, necrotic tissue left in the canals becomes the perfect medium for microbial growth. Leaving necrotic tissue in the body is contradictory to the best medical practices regarding the allergic theory of focal infection. As a result of the aforementioned criticism, mortal amputation of the pulp was dismissed as a treatment method in multiple countries. In cases where conservative treatment of pulpitis fails, the only acceptable method is now complete extirpation of the pulp. For permanent teeth, the method should be considered interim; after the roots have formed, treatment by pulp extirpation should be initiated. Mortal amputation should then be considered a stage of extirpation treatment, rather than a separate method. In other cases of pulpitis, the mortal amputation method may be applied only to multi-root teeth, if the root canals are blocked due to excessive curvature. In such cases, the combined method should be applied, i.e. extirpation of the pulp from patent root canals, and amputation to the curvature site in curved canals. Treatment should be performed in line with the principle that the more necrotic pulp is removed, the lower the risk of periapical lesions [1].

Iatrosedation is a way of the Doctor's behaviour which positively affects a patient's psyche and facilitates contact with the patient so that he or she would cooperate during dental procedures. It is based on a selection of appropriate vocabulary, intensity and tone of voice. The patient should be informed of the course of the planned activities and their duration. Iatrosedation is a method which is good to be used in every case, only when it is not sufficient other methods should be also applied. Good contact with patients and earning their trust is often enough to substitute the application of pharmacological measures [2]. Ruth Freeman in her paper stated that a therapeutic alliance is not only a development of a real relationship, but it has an impact on the patient's fears and concerns regarding the acceptance of dental treatment [3].

Hypnosis is a state of intense concentration on the hypnotist or any attention focusing point. Suggestions are used to achieve this, the more a person being hypnotised is concentrated, the more he or she is susceptible to suggestion. With the appropriate depth of hypnosis, it is possible to reduce patient's anxiety, increase relaxation, as well as mitigate sensitivity to pain. The use of this method requires a completion of special training. However, not every patient is susceptible to hypnotic suggestions [2]. Kent G. confirmed that hypnosis in dental treatment reduces anxiety through relaxation, especially in people with dental phobias [4].

Pharmacological methods of anxiety reduction aim to adapt the patient's emotional state to better tolerance of dental procedures. However, they do not relieve the pain. Premedication is indicated in hyperactive patients who do not control their reflexes and experience fear of dental procedures, which they are unable to overcome. There is no age limitation for premedication. The most commonly administered anxiolytics are midazolam and hydroxyzine. Midazolam is a benzodiazepine with calming and hypnotic effects It acts anticonvulsively and reduces muscle tension. After administering the drug, sedation is carried out within 3-5min. Hydroxyzine additionally has an antiemetic, antipruritic, and to some extend analgesic effects. It is recommended to administer orally, which can be commenced the day before

a procedure. Premedication on the day of procedure should be performed in a dental office (not home) which allows the doctor to control the patient's behavior on the drug and gives possibility to start treatment at the right time. Usually, the medication should be administered 30-60 min before the procedure [2].

In the nitrous oxide inhalation sedation method, a mixture of nitrous oxide and oxygen is used. At a concentration of 30%-40% nitrous oxide and 60-70% oxygen, lower sensitivity to pain and elimination of anxiety before executing the procedure are achieved. Under the influence of nitrous oxide the patient becomes relaxed and calm. During inhalation sedation the patient retains the basic defensive reflexes, awareness and the ability to speak, thus the contact with the doctor is maintained. The doctor at all times should control whether the patient has swallowing capacity, maintains a wide open mouth, can initiate verbal contact and whether their respiratory system is not obstructed. The inhalation sedation is very effective in treating children. It is effective in the case of children who are anxious, but cooperate with the dentist. The advantage of nitrous oxide is a quick achievement of sedation effect and its similarly quick (approx. 5 min.) disappearance after stopping administering the gas. Side effects can also appear, such as tingling of the tongue, lips, fingers, or the entire body, as well as a feeling of heat diffusing in the body. Patients may also experience nausea, vomiting, dysphagia, malaise and respiratory hypoxia. To prevent this, oxygen at a concentration of 100% should be administered after the finished procedure for 3-5 minutes [5]. The use of inhalation sedation is indicated in patients who experience a strong fear of dental procedures, patients with increased vomiting reflex, patients with systemic diseases, such as epilepsy (it reduces the risk of an attack), heart disease (it eliminates harmful stress). A contraindication for the use of inhalation sedation is obstruction of the respiratory tract, lung diseases, severe mental illnesses, multiple sclerosis, Porphyria, alcoholism, I trimester of pregnancy, the lack of possible cooperation with the patient, e.g. in the case of children under 4 years of age [2,6]. Becker and Rosenberg found that nitrous oxide is the most commonly used inhalational anaesthetic in dentistry and is widely used in rescue centres and outpatient surgeries. When applied alone, it is not capable of inducing general anaesthesia reliably, but can be combined with other inhalational and/or intra-venous factors in deep sedation / general anaesthesia techniques. However, as an individual factor, it has impressively safe and ideal for providing minimal and moderate sedation for anxious dental patients [7].

Anaesthesia used in dental treatment can be divided into local and general. In conservative therapy, including endodontic treatment of permanent and deciduous teeth, the following types of local anaesthesia are used:

- topical,
- infiltration,
- block,
- intraligamentary,
- intrapulpal,
- intraosseous.

Bahl defines local anaesthesia as loss of sensation in a limited space of the body through the depression of excitation in nerve endings or an inhibition of conduction process in peripheral nerves. In clinical practice, a localized loss of pain sensation is desirable. Some ideal properties of local anaesthetics are as follows: specific action, reversible effects, rapid onset of action, appropriate duration, active, applied topically or injected, do not cause stagnation or permanent damage, systemic toxicity, high ratio of therapeutic effect, stable chemically and long shelf life [8].

Topical anaesthesia relies on the application of an anaesthetic in the form of an ointment, gel or spray, directly on the mucosa. It is used for painless injection of a needle before performing injection anaesthesia, before an incision of the submucosal abscess, before installation of matrixes for the reconstruction of cavities reaching gums [2,5].

Infiltration anaesthesia consists in introducing an anaesthetic to submucosal tissue. It is most often used as a basic anaesthesia. Malamed confirms that infiltration anaesthesia belongs to the most common dental injections and it is always recommended when a treatment of a tooth inside the jaw is planned [9].

Block anaesthesia depends on injecting anaesthetic in the vicinity of the nerve trunk. This type of anaesthesia is most commonly performed in the mandible, in the mandibular foramen to numb the inferior alveolar nerve. Within the maxilla, an anaesthesia administered into tuberosity of maxilla or greater palatine foramen is often used. In the anterior region of the maxilla, an anaesthesia administered into the incisive foramen is effective in order to numb the nasopalatine nerve.

Intraligamentary anaesthesia involves introduction of anaesthetic directly into a periodontal gap, the place of injection is gingival groove near the interdental papilla. This causes the penetration of the anaesthetic into the bone forming the alveolar septum. Anaesthetic is delivered to nerve fibres of the pulp, mainly through the blood vessels, infiltrating from the bones into periodontal space. Injection is done with the use of a specially designed pressure syringe. The advantages of intraligamentary anaesthesia include:

- small amount of anaesthetic (approx. 0.3 ml/1 tooth), which reduces the risk of toxic reactions,
- quick effect of anaesthesia (up to several

dozens of seconds),

- optimal duration of anaesthesia with a possibility of extension,
- limitation of anaesthesia to a single tooth.

Indications for intraligamentary anaesthesia:

- as a basic anaesthesia, when infiltration or block anaesthesia is contraindicated, e.g. in patients with haemophilia (this type of anaesthesia reduces the risk of extensive haemorrhage of blood or persistent bleeding), and in patients who do not tolerate block or infiltration anaesthesia,
- as an additional anaesthesia in all groups of teeth with irreversible pulpopathia treated with extirpation method or formocresol amputation,
- as diagnostic anaesthesia for determining which tooth is causing the pain symptoms.
- Contraindications to intraligamentary anaesthesia are:
- bad oral hygiene,
- inflammations of the marginal periodontium with the presence of deep alveolar pockets,
- acute purulent inflammation of periapical tissues with emerging abscesses,
- teeth with unformed roots,
- teeth with reversible pulpitis intended for a biological treatment of direct pulp capping method or intravital amputation.

Complications which can arise after this type of anaesthesia include:

- transient hypersensitivity to percussion and biting,
- hyperaemia and swelling of interdental papilla continuing for a few days,
- necrosis of interdental papilla, appearance of periodontal abscess and dispersion of bacteria [2,5,10]. The effectiveness of intraligamentary anaesthesia was demonstrated in clinical trials which involved a total of 474 deciduous and permanent teeth in children and adults, and it ranged from 79% in the case of pulpotomy, to 95% in extraction, all of these studies demonstrated greater effectiveness of this type of anaesthesia for extraction. For comparison, computer-controlled application of local anaesthetic into periodontal gap with the help of The Wand STA system, turned out to be effective in 89% which was demonstrated in a study that included 159 of first and second deciduous molar teeth anaesthetised by this technique [11].

Intrapulpal anaesthesia consists in direct placement of the needle in the pulp of a tooth and application of anaesthetic. It is used as an additional anaesthesia. First and foremost, you need to perform trepanation of the chamber near the outlet of the widest canal and anaesthetize pulp chamber, then open wide the chamber to do an amputation of the pulp chamber and anaesthetize the root pulp. It is a painful technique, but the unpleasant feeling doesn't last long. The condition for success is performing the injection at high pressure - passive application of anaesthetic is a medical error because the solution would not diffuse properly to the whole pulp. Most difficult teeth in a state of irreversible inflammation to anaesthetize are in order: mandibular molars, mandibular premolars, maxillary molars, maxillary premolars, mandibular incisors, maxillary incisors. [2,6,12,13].

Intraosseous anaesthesia is a direct introduction of anaesthetic into the cancellous bone surrounding the tooth root after preliminary anaesthesia of the mucous membrane and drilling a small hole in the cortical plate of alveolus. This way of application ensures immediate effect of anaesthesia which lasts for 30 minutes in a strictly limited area. Anaesthesia requires the use of special devices, e.g. QuickSleeper and it is rarely used [2,5,13].

In the majority of cases during endodontic treatment, the application of one type of anaesthesia do not fully eliminate the feeling of pain in pulp tissue. The most difficult is to obtain complete anaesthesia of the pulp in a state of diffused inflammation which covers its apical part (especially in the mandibular teeth). In such situations the application of supplementary anaesthesia is very useful. In respect of the foregoing, anaesthesia can also be divided into basic, optional and supplementary. Infiltration and block anaesthesia are the basic type. Basic anaesthesia, according to Walton, should: completely eliminate the feeling of pain, show quick anaesthetic effect, ensure long enough duration needed for performing a procedure, not cause pain during injection or any complications thereafter, as well as it should not cause changes in periodontium, cement and tooth pulp. Optional techniques are those that allow to eliminate pain as effectively, but constitute a modification of the basic anaesthesia. This type of anaesthesia include among others block anaesthesia into the tuberosity of maxilla, block anaesthesia into the incisive foramen, and anaesthesia into the mental foramen. Özer et al. in their thesis proved that although intraosseous injection is a useful technique, commonly used during various dental procedures and the duration of injection lasts longer than conventional techniques, there is a possibility of clogging the tip of the needle, then the duration of the anaesthesia is insufficient for long-term dental

procedures [14].

Supplementary anaesthesia are: intraligamentary, intrapulpal, and intraosseous [2,5]. Some patients require endodontic treatment under **general anaesthesia**. These are:

- people intellectually disabled,
- people with mental illnesses,
- dental phobia, which is a pathological fear of dental treatment or trypanophobia - fear of injections,
- people allergic to local anaesthetics,
- patients insensitive to the effects of local anaesthetics [2].

INSTRUMENTS FOR LOCAL ANAESTHESIA

To perform local anaesthesia, various devices are used for injecting anaesthetic into the tissues. These are conventional syringes and disposable needles type Luera, carpule, special needle-free syringes - Injex, high pressure syringes type Citoject, Paroject, Aspiject (used for intraligamentary anaesthesia) or computer-controlled devices for anaesthesia. The available systems for computer-controlled injections are: Wand, QuickSleeper, SleeperOne and Anaeject [2, 15].

System Wand is a portable device consisting of a microprocessor controlled feeder, foot switch, and disposable sterile tips with needles of 0.3 mm diameter. This system is designed for all kinds of local anaesthesia. It turned out to be especially useful in intrapulpal and intraligamentary anaesthesia. Application of the anaesthetic occurs under the control of microprocessor, thus the application speed is adapted to the physiological absorption rate of anaesthetic. Low pressure and low application rate eliminate the feeling of distension, which is typical for using a syringe. Injection sites are similar to those in conventional methods. In this method, the aspiration system automatically turns on at the beginning of injection. Activation of the control pedal shortly before the injection will result in a leakage of the anaesthetic which by anaesthetising mucosa will provide painless or slightly painful puncture. Advantages of this method are less pain during anaesthesia, good anaesthetic effect with a relatively small amount of anaesthetic, no signs of distortion of the patient's face caused by the anaesthetic [2,5,15].

Ran and Peretz have written a paper whose aim was to compare the reaction of children who received local anaesthesia with the usual buccal infiltration and injection into periodontal fiber with the use of a computer device (Wand); Evaluated was also the effectiveness of anaesthesia and the reaction of children after treatment. The study involved 96 children aged 2 to 4 years. All children were subjected to hydroxyzine and nitrous oxide sedation. Children were randomly assigned to PDLs (intraligamentary anaesthesia) with Wand or conventional infiltration. There was no significant difference in treatment efficacy between boys and girls. More children responded negatively to conventional infiltration injection, while children who received anaesthesia using the Wand system reacted more positively. The difference was statistically significant. In none of the methods a significant difference in the effectiveness of anaesthesia was observed. 80% of children who received the conventional buccal infiltration of the cheeks, were scratching the nose or upper lip after the treatment, while none of the children who received PDL showed any signs of discomfort. The children showed better behaviour when receiving local anaesthesia using the Wand system, than in the case of conventional infiltration. The same efficacy of anaesthesia was achieved with both methods [16].

Other observations were presented by Tahmassebi et al. who in their paper concluded that there is no difference in pain and fear experienced by children in both conventional and Wand system groups [17]. At the same time Ashkenazi says that during more than eight years of clinical application of Wand system, he had only two patients who complained about discomfort after application of anaesthesia [11].

QuickSleeper system differs from other anaesthetic systems by having electronically controlled system of perforation, i.e. the rotation of the needle perforates easily and painlessly a nerve-free cortical plate. This is especially useful while applying intraosseous anaesthesia, which can be achieved in a short time (3min.) [12].

REMEDIES USED FOR LOCAL ANAESTHESIA IN ENDODONTICS

In anaesthesia for endodontic purposes, the most commonly used are amide compounds, such as: lidocaine, mepivacaine, articaine, bupivacaine, prilocaine. These remedies demonstrate high efficiency and a sufficiently long duration. They relatively rarely cause allergic reactions. The mentioned anaesthetics occur in a "pure" form, as well as with the addition of compounds constricting blood vessels, such as adrenaline, noradrenaline, alpha-metyloadrenaline and phenylephrine in a concentration from 1:200 000 to 1:50 000. Addition of vasoconstrictor medications reduces the blood flow which in turn reduces bleeding and gives a stronger and longer anaesthesia effect. The use of vasoconstrictor agents is contraindicated in people:

- with heart diseases (cardiomyopathies, coronary artery disease, paroxysmal tachycardia);
- with cardiovascular diseases (atherosclerosis, hypertension);

- with hyperthyroidism;
- with glaucoma;
- with uncontrolled diabetes;
- treated with MAO inhibitors or tricyclic antidepressants.

In generally healthy patients there are no contraindications to the use of vasoconstrictor agents. A contraindication to the use of anaesthetics is a confirmed hypersensitivity. A medical interview is required, as well as an allergic test given subcutaneously [2].

Lidocaine (lidocaine hydrochloride) is used in all types of anaesthesia. For block anaesthesia it is in the form of gels, ointments, creams or sprays in concentrations: 0.5%, 2%, 4%, 5%, 10%; for inhalation anaesthesia in solution 0.25%-0.5%; in block anaesthesia as solutions 1-2%. It shows effects after 5-15 minutes after the ductal administration and lasts 60-90min. Addition of vasoconstrictor agent prolongs its effects by 50%. The maximum single dose of "pure" lidocaine for a healthy adult patient is 200 mg (3mg/kg of body weight), and with the addition of vasoconstrictor medication is 7 mg/kg of body weight, up to 500 mg. It is characterized by reduced tendency to cause allergies and slight toxicity. Care should be taken while using in elderly patients with atrioventricular conduction disorders and liver diseases [2,5]. Claffey et al. in his research paper conducted comparison of the efficacy of anaesthesia using 2% lidocaine with 1:100 000 epinephrine and 4% articaine with 1:100 000 epinephrine. The success was defined as lack or mild pain while performing endodontic access. The success for the inferior alveolar nerve while using articaine was 24%, and for lidocaine it was 23% [18].

Mepivacaine (mepivacaine hydrochloride) is characterized by a similarly strong anaesthetic effect as lidocaine. However, it works faster and longer (approx. 90-180 minutes). They have minimal vasodilatation capabilities, thanks to which they have a deep anaesthetic effect without the addition of vasoconstrictive agents. They most often occur in solutions of 2% and 3% [2,5]. Reprogle et al. during the administration of 3% mepivacaine did not find a significant increase in the heart rate of patients. There were no significant differences in mean diastolic, mean systolic or mean arterial blood pressure between patients receiving 2% lidocaine with 1: 100 000 adrenaline and those who received 3% mepivacaine [19]. Ashkenazi and Ram thanks to their observations of clinical application of mepivacaine concluded that vasoconstrictive agents are required to ensure the effectiveness of intraligamentary anaesthesia, as well as for the anaesthesia of a single tooth [20].

Articaine (articaine hydrochloride) is available as a 4% solution with addition of 1: 100 000 or 1: 200 000 adrenaline. Anaesthesia occurs after 1.5-3.5 minutes. The estimated time of anaesthesia for the pulp is 60 minutes, and for soft tissue 3-5 hours [2,5]. Bigby et al. in their paper evaluated the effectiveness of anaesthesia and the patient's heart rate while using 4% articaine in the ratio of 1:100 000 adrenaline. The medicament was administered intraosseously in the are of posterior teeth of the mandibula to patients who were diagnosed with irreversible pulpitis. According to the authors, the effectiveness of anaesthesia was obtained in 86% of patients [21].

Bupivacaine (bupivacaine hydrochloride) works the longest and is most potent of all anaesthetics, at the same time demonstrating the most toxicity (mainly cardiotoxic). It is available in solutions with concentrations of 0.25% and 0.5%. Addition of a vasoconstrictor agent reduces the toxicity. The maximum dose of bupivacaine is 2 mg/kg of body weight. (approx. 150 mg) [2]. Bartold-Kuryś et al. in a literature review concluded that a minimum necessary dose should be applied to obtain adequate anaesthesia: for infiltration anaesthesia maximum 60 ml 0.25% r-r or max. 30 ml of 0.5% solution [22].

Prilocaine (prilocaine hydrochloride) works longer than lidocaine and is less toxic. It is most often used for topical anaesthesia of the skin and mucous membranes in the form of EMLA cream, which is a eutectic mixture of 2.5% prilocaine and 2.5% lidocaine. It is also available in a "pure" form, in concentration of 4% and 4% concentration with 1:200 000 adrenaline [2,5]. Jeffcoat et al. in their thesis presented a conclusion that the use of prilocaine in a dose of 25 mg/g while performing scaling and smoothing the root surface might be an alternative to using infiltration anaesthesia [23]. Haas et al. compared the effect of articaine and prilocaine (Citanest forte). The success of anaesthesia was determined by measuring sensitivity to electrical stimulation of the tooth. The results showed that anaesthesia of the pulp of mandibular canines using articaine reaches 65%, whereas using prilocaine 50%. Using the Chi-square test, no statistically significant differences between the effects of both measures were found [24].

CONCLUSIONS

Modern dentistry every year becomes more and more convenient for patients and tries to offer as most comfortable and painless treatment as it can be. Currently, the dentist has many options to control pain and fear in patients. A wide range of pharmacologic measures allows to customize the effects and nature of anaesthesia to the patient's clinical needs. There are also many methods that allow you to muffle the emotions of a patient and to eliminate anxiety.

Conflicts of interest

None declared.

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