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**CHOOSING THE OPTIMAL TREATMENT METHOD TAKING INTO ACCOUNT  
THE NATURE OF INFLAMMATORY CHANGES IN THE DENTAL PULP**

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This study presents the results of determining the optimal method of treating pulpitis, depending on the nature of inflammatory changes in the dental pulp. For this purpose, 115 people with various pulpitis were under observation. The diagnosis was carried out according to the classification adopted by WHO in 1997 – K04 Diseases of pulp and periapical tissues, according to which the examined were divided into three groups. In group I of 40 patients, the biological method carried out the treatment. In group II, 35 patients underwent pulpotomy; in group III, 40 patients underwent pulpectomy. The results of a 2-year follow-up in groups of patients showed that pulpectomy was successful in 80.0 % of cases and unsuccessful in 20.0 %. In this group of patients, the PAI index after 2 years was  $1.10 \pm 0.5$  points. In the biological treatment group, 75.0 % of cases were successful, and only 25.0 % experienced complications. 2 years after treatment in periapical tissues, PAI was  $1.13 \pm 0.64$  points. In the group of patients where pulpotomy was used, the treatment was successful in 37.1 % of cases and complications were noted in 62.9 % of cases. Modified PAI totaled  $1.17 \pm 0.73$  points. The study showed that in the treatment of patients with pulpitis, depending on the prevalence of the inflammatory process in the dental pulp, pulpectomy and the biological method of treatment turned out to be the most effective and reliable.

**Key words:** acute pulpitis, chronic pulpitis, biological method of treatment, pulpotomy, pulpectomy.

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**ВИБІР ОПТИМАЛЬНОГО МЕТОДУ ЛІКУВАННЯ З ОГЛЯДУ  
НА ХАРАКТЕР ЗАПАЛЬНИХ ЗМІН У ПУЛЬПІ ЗУБА**

У даному дослідженні представлені результати визначення оптимального методу лікування пульпітів залежно від характеру запальних змін у пульпі зуба. З цією метою під наглядом перебували 115 осіб із різними формами пульпіту. Діагностика проводилася згідно з класифікацією прийнятої ВООЗ у 1997 році – К04 хвороби пульпи та періапикальних тканин, відповідно до якої обстежені були поділені на 3 групи. У I групі хворих, що склали 40 осіб, лікування проводили біологічним методом, у II групі у 35 осіб провели пульпотомію, у III групі хворих 40 осіб був застосований метод пульпоектомії. Результати 2-х літніх спостережень у групах хворих показали, що пульпоектомія у 80.0 % випадків виявилася успішною та у 20.0 % безуспішною. У цієї групи хворих показник PAI через 2 роки становив  $1.10 \pm 0.5$  бала. У групі, де провели біологічне лікування, у 75 % результат був успішним і тільки у 25 % спостерігалися ускладнення. Через 2 роки після лікування в періапикальних тканинах PAI становив  $1.13 \pm 0.64$  бали. У групі хворих, де була застосована пульпотомія у 37.1 % випадків лікування виявилось успішним та у 62.9 % випадків відзначалися ускладнення. Зміни PAI становили  $1.17 \pm 0.73$  бали. Дослідження показало, що при лікуванні хворих на пульпіт залежно від поширеності запального процесу в пульпі зуба найбільш ефективними та достовірними виявились пульпоектомія та біологічний метод лікування.

**Ключові слова:** гострий пульпіт, хронічний пульпіт, біологічний метод лікування, пульпотомія, пульпоектомія.

In the medical literature of recent years, there have been numerous reports on the widespread prevalence of pulpitis and periodontitis among the population [2, 3], errors made in the diagnosis [12, 15], and complications arising after treatment [6, 8]. Despite the significant development of endodontic treatment methods and the availability of modern equipment, apparatus, and medications for dentists, unresolved problems in this area are still relevant. Domestic and foreign researchers provide data on the insufficiently high level of endodontic treatment [7, 11].

Pulp diseases of an inflammatory nature are treated by various methods depending on the nature and level of inflammation [1, 5]. Currently, in case of inflammation of the pulp, preference is given to biological methods of treatment, which involve the preservation of the coronal and root pulp. In this aspect, several studies are devoted to the study of relief in the course of the inflammatory process in the pulp with modern drugs [13, 14]. The success of treating pulpitis by the biological method and pulpotomy depends on the correctness of the diagnosis made before treatment, the properties, the therapeutic agents used and adequate isolation of the pulp. Depending on the specified diagnostic and therapeutic measures, processes from the regeneration of pulp tissue with highly differentiated defence mechanisms to its necrosis can occur. As a result of such complications, destructive changes occur in the periapical tissues. Thus, the above literature data analysis shows that improving the quality of treatment of pulpitis and preventing complications that occur after treatment are topical issues in therapeutic dentistry.

**The purpose** of the study was to provide the choice of the optimal method of treatment of pulpitis, depending on the nature of inflammatory changes in the tooth's pulp.

**Materials and methods.** This study presents the results of determining the optimal method of treating pulpitis, depending on the nature of inflammatory changes in the dental pulp. Because of the foregoing, 115 patients in the age range of 10–60 years were examined for the implementation of high-quality treatment of pulpitis per the purposes. The diagnosis was carried out according to the classification adopted by WHO in 1997 – K04 Diseases of pulp and periapical tissues, according to which the examined were divided into three groups. The group of patients with a diagnosis of "initial pulpitis" (K04.00) included patients whose tooth cavity was opened during the preparation of a carious cavity or trauma to the tooth crown. They noted that exposure to a hot and sweet stimulus caused them to feel toothache for 1–2 minutes and the pain disappeared after the cessation of irritation. Patients reported that the pain in the teeth appeared for the first time, there were no night pains, they avoided eating on the side of the diseased tooth.

The group diagnosed with acute pulpitis included patients in whom treatment with direct pulp capping was unsuccessful, patients with acute pulpitis (K04.01) and purulent pulpitis (K04.02). These patients complained of spontaneous, paroxysmal, radiating and nocturnal toothache. In the initial phase of the disease, the attacks lasted 10–15 minutes. The breaks were long as inflammation developed in the pulp, and the duration and intensity of pain attacks increased.

In patients diagnosed with chronic pulpitis (K04.03, K04.04, K04.05), the clinical manifestations of the disease were mild, and the disease was almost asymptomatic. Patients noted the absence of nocturnal and paroxysmal pains characteristic of acute pulpitis, but prolonged pain persists after the cessation of stimuli. X-ray examinations performed in these patients showed changes in the periapical tissues of the roots of the teeth.

The biological method of pulpitis treatment was used in group I – 40 people; in group II we used pulpotomy in 35 people; in group III, treatment was performed by pulpectomy in 40 people. In case of accidental opening of the pulp during the preparation of the carious cavity in group I of patients during biological treatment, after antiseptic treatment, MTA (Dentsply, USA), "Calcepulpe" (Septodont, France) or Biodentine therapeutic pad (Septodont, France) were applied to the bottom of the cavity. These patients were observed in dynamics from 2 to 6 months, depending on the size of the opened cavity, and sometimes longer. In the absence of complaints, the Calcepulpe therapeutic dressing was replaced with a more stable one – "Life" (Kerr Hawe, USA).

In group II of patients, the treatment was carried out by pulpotomy. The root pulp was removed at the level of the orifices of the canals and the viable root pulp was kept. After applying a preparation containing  $\text{Ca}(\text{OH})_2$  to the orifices of the canals, ionomer cement was used as an insulating material, after which the tooth crown was restored with a composite material. The patients were under dynamic observation for a certain time.

Group III patients were treated by pulpectomy or vital pulp extirpation. During pulpectomy, the root pulp was dissected at the level of the apical foramen, and all inflamed tissues were removed. The canals were obturated by lateral condensation after mechanical and drug treatment. The formed treatment groups were monitored for 2 years.

When diagnosing patients with pulp inflammation and evaluating the effectiveness of various treatment methods, anamnesis, examination, probing, and data from electrometric and thermometric tests, a modified PAI index according to A.M. Solovieva [9] was used, revealing changes in the periapical tissues of the teeth. Statistical processing of the obtained data was carried out on a personal computer using an Excel spreadsheet editor and the Statistica 7.0 package.

**Results of the study and their discussion.** In group I – 40 people treated as a result of accidental opening of the pulp during dissection or with a pulp injury (K04.00), the effectiveness of the biological method was high and amounted to  $80.0 \pm 12.65\%$ , and only  $20.0 \pm 12.65\%$  had complications. In the same group, the treatment of patients diagnosed with acute pulpitis (K04.01, K04.02) was successful in  $81.3 \pm 9.76\%$  of cases and complications were observed in  $18.7 \pm 9.76\%$ . In patients of this group with chronic forms of pulpitis (K04.03, K04.04, K04.05), treatment was effective in  $64.3 \pm 12.81\%$  of cases, and complications were observed in the remaining  $35.7 \pm 12.81\%$  of cases.

In conclusion, it should be noted that the biological method of treatment was effective in  $75.0 \pm 6.85\%$  of cases, and complications were observed in the remaining  $25.0 \pm 6.85\%$  of cases.

In group II, in 35 patients treated for the accidental opening of the tooth cavity (K04.00), treatment was successful in  $62.5 \pm 17.12\%$  and unsuccessful in  $37.5 \pm 17.12\%$ . If in patients with acute pulpitis (K04.01, K04.02), treatment success was  $35.7 \pm 12.81\%$ , then  $64.3 \pm 12.81\%$  of cases were ineffective. Despite the positive results of pulpotomy ( $23.1 \pm 11.69\%$ ) in group II patients treating chronic pulpitis (K04.03, K04.04, K04.05),  $76.9 \pm 11.69\%$  of cases were not effective (Table 1).

The effectiveness of treatment of patients with pulpitis, depending on the different treatment methods used in the groups

Pulp diseases	Opening of the tooth cavity			Acute pulpitis			Chronic pulpitis			Total		
	Number of patients	Effectiveness of treatment	Complications	Number of patients	Effectiveness of treatment	Complications	Number of patients	Effectiveness of treatment	Complications	Number of patients	Effectiveness of treatment	Complications
Biological method	10	8 80.0± 12.65 %	2 20.0± 12.65 %	16	13 81.3± 9.76 %	3 18.8± 9.76 %	14	9 64.3± 12.81 %	5 35.7± 12.81 %	40	30 75.0± 6.85 %	10 25.0± 6.85 %
Pulpotomy	8	5 62.5± 17.12 %	3 37.5± 17.12 %	14	5 35.7± 12.81 %	9 64.3± 12.81 %	13	3 23.1± 11.69 %	10 76.9± 11.69 %	35	13 37.1± 8.17 %	22 62.9± 8.17 %
Pulpectomy	10	8 80.0± 12.65 %	2 20.0± 12.65 %	16	14 87.5± 8.27 %	2 12.5± 8.27 %	14	10 71.4± 12.07 %	4 28.6± 12.07 %	40	32 80.0± 6.32 %	8 20.0± 6.32 %

The results of treatment in group II in total 37.1±8.17 % of cases were successful, and 62.9±8.17 % of patients were unsuccessful.

In 40 people who made up group III, the results of treatment with pulpectomy showed that in case of accidental opening of the pulp cavity (K04.00) in 80.0±12.65 % of cases, the treatment was effective and in 20.0±12.65 % of cases it was unsuccessful. Pulpectomy was successful in 87.5±8.27 % of patients with acute pulpitis (K04.01, K04.02) and ineffective in 12.5±8.27 % of cases. Despite the positive result of pulpectomy – 71.4±12.07 % in the same group, obtained in patients with chronic pulpitis (K04.03, K04.04, K04.05), complications amounted to 28.6±12.07 %. Thus, pulpectomy performed in group III was effective in 80.0±6.32 % of cases and unsuccessful in 20.0±6.32 % of cases.

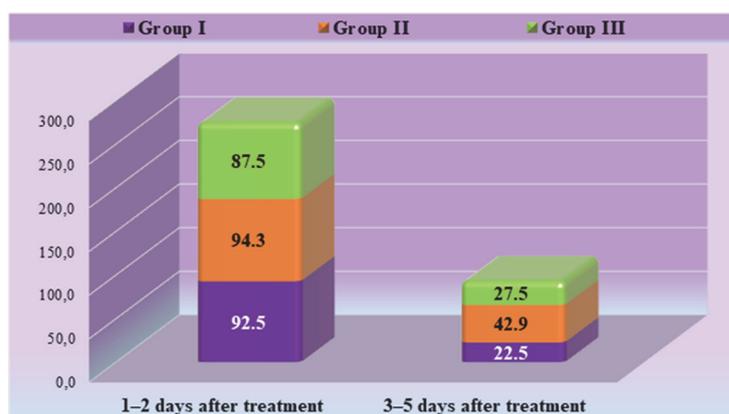


Fig. 1. Complaints of patients with pulpitis in different groups depending on treatment

after treatment in patients treated with a biological method. Pain when pressing on the tooth was observed within 1–2 days after medical manipulations

The number of cases when pressure pain on the causal tooth lasted 3–5 days after treatment decreased and amounted to 27.5±7.6 %. Group II patients who underwent pulpotomy in 94.3±3.92 % of cases noted pain on the pressure within 1–2 days after treatment. In this group, there is also a decrease in the duration of pain within 3–5 days after treatment (42.9 %). These indicators, compared to the data of group I for the same observation period, were relatively high.

In contrast to the previous groups, in group III patients, where pulpectomy was performed, the pain after therapeutic measures with pressure lasted 1–2 days in 87.5±5.23 % of cases. The patients' complaints that occurred within 3–5 days decreased and amounted to 27.5±7.60 %, which is significantly lower than in groups I and II.

Evaluation of the effectiveness of the treatment in patients of groups I, II and III who were under observation for two years was also carried out based on the dynamics of the PAI index according to A.M. Solovieva – the index of changes in bone density in the periapical region. The results of 2-year studies allow us to note the positive dynamics of changes in the PAI index. Thus, the PAI index in Group I patients before biological treatment was 1.80±0.125 points; 6 months after treatment - 1.68±0.104 points; 1 year after treatment – 1.20±0.073 (p<0.001) and two years later, these indices decreased to 1.13±0.014 points.

Our studies revealed that in all 3 groups of patients who received the appropriate treatment – by the biological method, pulpotomy and pulpectomy, complications were noted after treatment, among which it should be noted weak aching pain in the tooth, pain during percussion, during chewing. Among patients' complaints, a prominent place was occupied by complaints of pain when pressing on the causative tooth (Fig. 1).

In 87.5±5.23 % of cases, similar pains lasted from 1–2 days to 3–5 days

The PAI data obtained were equivalent to those of group II (pulpotomy) but significantly exceeded those in group III (pulpectomy) (Table 2).

Table 2

**Dynamics of PAI index changes in different groups of patients with pulpitis depending on the treatment method**

Groups	Before treatment	Follow-up periods		
		6 months	12 months	24 months
Group I Biological method 40	1.80±0.125	1.68±0.104*	1.20±0.073*	1.13±0.064*
Group II Pulpotomy 35	1.11±0.055	1.03±0.050	1.09±0.048	1.17±0.065
Group III Pulpectomy 40	1.13±0.073	0.98±0.067*	1.05±0.050	1.10±0.070

Notes:  $p < 0.05$  – the statistical significance of the difference relative to the indicators before treatment. In the second group of patients where pulpotomy was applied, the PAI index before treatment was  $1.03 \pm 0.050$  points; after 1 year –  $1.09 \pm 0.048$  points and after 2 years –  $1.17 \pm 0.073$  points. These PAI values were significantly higher compared to group III's observation period.

In group III, where the pulpectomy method was used, PAI indicators changed as follows: before treatment –  $1.13 \pm 0.073$  points; 6 months after treatment significantly decreased –  $0.98 \pm 0.067$  points; in 1 and 2 years after treatment, it increased slightly and amounted to  $1.05 \pm 0.050$  and  $1.10 \pm 0.070$ , respectively. Compared with similar indicators of the same period, these values are significantly lower than those of groups I and II.

Patients with various forms of pulpitis treated with biological methods, pulpotomy and pulpectomy, were followed up for two years. From groups I, II and III of patients treated depending on the nature of inflammatory changes in the dental pulp, the best results were achieved in group III, where the pulpectomy was used. The applied method was successful in 80.0 % of cases. In patients with this group of pulpitis, compared with patients of the previous groups, complications in the form of complaints with pressure on the causative tooth decreased significantly. The number of cases with complaints of pain lasting 3–5 days after treatment was 27.5 %. These values are significantly lower than the data of group I and II. The recovery of periapical tissues in this group was  $1.10 \pm 0.5$ . The high effect of the treatment in this group of patients is associated with the complete elimination of the inflamed pulp and high-quality endodontic treatment. The use of the pulpectomy with appropriate indications reduces the risk of complications.

Positive results were also obtained in group I. In this group of patients, local inflammation in the area closest to the carious cavity did not pose a danger to the entire pulp. The applied biological method of treatment was successful in 75.0 % of cases. 10 out of 40 patients (25.0 %) had complications. The number of post-treatment complaints arising from pressure on the causative tooth for 3–5 days was  $22.5 \pm 7.6$  %. 2 years after treatment, periapical changes amounted to  $1.13 \pm 0.064$  points ( $p \leq 0.001$ ), which is equivalent to the PAI values of the same period in group II and slightly higher than those in group III. In this group, patients with an opened pulp chamber made up an insignificant part. However, the treatment was effective if they consulted a doctor within 24–48 hours. The high effect of treatment in this group is associated with the initial condition of the pulp – a healthy pulp, the absence of inflammation, as well as the replacement of “Calcipulpe” for 1–1.5 times a month in the dynamics of treatment, the formation of replacement dentin. It should be noted that the results obtained in the treatment of pulpitis by the biological method after 1 year compared with the indicators before treatment are statistically significant ( $p \leq 0.001$ ). The success of the biological method of treatment in group I of patients using a paste containing calcium hydroxide also depended on the size of the opened pulp chamber, the localization of the defect, and the age of the patient.

The use of the pulpotomy in group II patients, in comparison with the methods of treatment in groups I and III, proved to be insufficiently effective. Thus, in group II, treatment success was noted in 37.1 % of cases and complications were observed in 62.9 % of cases. In this group, where pulpotomy was performed, the number of complaints of 3–5 days of pain after treatment significantly decreased, and only  $42.9 \pm 8.36$  % had pain. It is significantly higher than groups I and III indicators for the same observation period. As a result of complications, destructive changes in periapical tissues amounted to  $1.13 \pm 0.073$ . This indicator is equivalent to the data of group I for the same observation period and is much higher than the same indicators in group III. The relatively low treatment effectiveness in group II patients is associated with a long-term deep carious cavity and the transition of the pulp from a healthy state to an inflammatory one. With a long-existing deep carious cavity, the pulp should be evaluated as inflamed. In this case, despite the treatment with effective drugs, the conditions of pulp regeneration worsen due to irreversible morphological changes occurring in the pulp.

Pulpitis is a common disease in dental practice and, according to various authors, differs in the frequency of occurrence of the disease and the structure of complications. So, according to L.A. Dmitrieva and Yu. Maksimovsky, pulpitis makes up 14–30 % of patients seeking dental care [2]. According to the

results of studies conducted in Kazan, caries and its complications in children amounted to 76.8 %. Among the examined children, 60.8 % had complications of caries, of which pulpitis was found in 55.5 % [10]. In the course of clinical and epidemiological studies performed in Baku, 625 people underwent a dental examination, among which periodontitis was detected in 23.89 % of cases, restoration defects in 30.3 % of cases, various forms of pulpitis in 16.7 % [4]. From 2015–2018, we analysed the medical records of 500 patients who received treatment at the AMU Dental Clinic in Baku [11]. According to the results of our study, 17.6 % (88 people) of the applicants had pulpitis,  $19.6 \pm 1.70$  % had caries, and  $24.0 \pm 1.91$  % (120 people) had periodontitis. Our studies revealed complications of pulpitis in  $30.7 + 3.76$  % (46 people) of 150 patients treated with a diagnosis of moderate caries, and in 130 patients treated with a diagnosis of pulpitis, complications of various categories. Comparing the latest data with the results of our research, we can trace a different picture of the indicators. Thus, in the group where the pulpectomy was used, complications were noted in 20.0 % of patients, and successful treatment was 80.0 %. In patients with the biological method of treatment, complications were in 25.0 % of cases, and success was in 75.0 %. The pulpotomy method led to complications in 62.9 % of patients in the group and had a positive result in 37.1 % of cases.

### Conclusions

1. In the group where the pulpectomy method was applied, treatment effectiveness was 80.0 %, and complications were noted in 20.0 % of patients. 2 years after treatment, the periapical changes determined by the PAI index according to A.M. Solovieva amounted to  $1.10 \pm 0.5$  points.

2. A successful result of 75.0 % was achieved in the group where the treatment was carried out by a biological method, and complications were noted in 25.0 % of patients. Two years after treatment, the changes in the PAI index amounted to  $1.13 \pm 0.64$  points.

3. The pulpotomy method proved less effective than pulpectomy and biological treatment. Thus, 37.1 % of patients who used this treatment method had positive results, and complications occurred in 62.9 % of cases. As a result of complications, changes determined by the PAI index amounted to  $1.17 \pm 0.73$  points.

As a result, in 2-year observations, it was proved that with initial pulpitis (accidental opening of the tooth cavity, pulp hyperemia, traumatic pulpitis), the use of the biological method (direct and indirect pulp capping); with the spread of inflammation to the coronal pulp (acute pulpitis) – pulpotomy; when inflammation spreads to the coronal and root pulp (purulent pulpitis, chronic hyperplastic pulpitis, chronic hyperplastic pulpitis) pulpectomy is the most effective and reliably justified methods of treatment of inflammatory pulp pathologies.

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