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ABSTRACT

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CLINICAL AND RADIOLOGICAL ASPECTS OF REVERSIBLE AND IRREVERSIBLE PULPITIS OF PRIMARY TEETH

The development of clinical guidelines and standards for the provision of medical dental care to the pediatric population in Ukraine is based on the principles of evidence-based medicine, modern international classifications and is consistent with the generally accepted worldwide diagnostic terminology of the main dental diseases. Therefore, the purpose of the study was to determine the frequency, clinical and radiological characteristics, diagnostic criterias for reversible and irreversible pulpitis of primary teeth.

Materials and methods: 328 children aged 3 to 7 years were examined at the Dental Medical Center of the Bogomolets National Medical University. All participants underwent a clinical examination of the condition of the hard tissues in primary teeth, a cold test, radiological examination of the carious lesion depth and an intraoperative assessment of bleeding from the pulp.

Results: A high prevalence (92.7%) and mostly asymptomatic course (83.2%) of primary teeth pulpitis in children aged 3 to 7 years was revealed. The frequency of irreversible pulpitis was 2.1 times higher than the similar indicator of reversible pulpitis ($p < 0.001$). From the age of 5, a statistically significant decrease in the number of primary teeth with reversible pulpitis was observed, in parallel with the increase of this indicator in case of irreversible inflammation of the pulp. Lesions of molars were registered in the vast majority of cases compared to the anterior teeth. Most often, pulpitis was diagnosed in the first primary molars of the lower jaw ($p < 0.01$). Cold test was informative in cooperative children (25.7%), mostly 6-7 years old. Significant differences in the radiological depth of carious lesions in reversible and irreversible pulpitis of primary teeth were revealed. Intraoperative assessment of bleeding and achievement of hemostasis after vital pulpotomy indicated the absence of the radicular pulp inflammation.

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Conclusions: Clinical evaluation of the depth of carious defects does not allow making determination the thickness of the dentin lesion and the proximity to the pulp, except in cases of its carious exposure. Cold test for the sensitivity of the pulp in preschool age was not accurate enough due to the high probability of false positive answers. The most informative methods of preoperative diagnosis of pulpitis include radiological examination, which characterizes the depth of the carious lesion and its proximity to the pulp. Reliable radiological signs of irreversible pulpitis were connection with the pulp chamber, destruction of the cortical plate of the alveolus, translucency of the spongy bone in the furcation and periapical areas. However, radiological diagnostics does not reflect the prevalence of inflammation in the pulp. Therefore, the intraoperative assessment of bleeding and the achievement of hemostasis after vital pulpotomy are decisive criteria for the absence of inflammation in radicular pulp and the possibility of its preservation. So, differential diagnosis of reversible and irreversible pulpitis of primary teeth should be based on a combination of preoperative and intraoperative research methods.

Due to the high prevalence of pulpitis in children aged 6-7 years, primary prevention of early childhood caries should be the primary task of pediatric dentistry.

Keywords: children, pulpitis, primary teeth, clinical diagnosis, radiological examination.

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КЛІНІКО-РЕНТГЕНОЛОГІЧНІ АСПЕКТИ ОБОРОТНОГО І НЕОБОРОТНОГО ПУЛЬПІТУ ТИМЧАСОВИХ ЗУБІВ

Розробка клінічних настанов та стандартів надання медичної стоматологічної допомоги дитячому населенню України ґрунтується на засадах доказової медицини, сучасних міжнародних класифікаціях та узгоджується з загальноприйнятою в світі діагностичною термінологією основних стоматологічних захворювань. Тому метою дослідження було визначення частоти, клініко-рентгенологічних характеристик, критеріїв діагностики оборотного та необоротного пульпіту тимчасових зубів.

Матеріали і методи: Обстежено 328 дітей у віці від 3 до 7 років у Стоматологічному медичному центрі Національного медичного університету імені О. О. Богомольця. Всім учасникам проведено клінічне обстеження стану твердих тканини зубів, перевірку чутливості пульпи до холодового подразника, рентгенологічне дослідження глибини каріозного ураження, інтраопераційну оцінку кровотечі з пульпи.

Результати: Виявлено високу поширеність (92.7%) і переважно безсимптомний перебіг (83.2%) пульпіту тимчасових зубів у дітей віком від 3 до 7 років. Частота необоротного пульпіту в 2,1 рази перевищувала аналогічний показник оборотного пульпіту ($p < 0.001$). Із 5-річного віку спостерігалось статистично значуще зменшення кількості тимчасових зубів із оборотним пульпітом паралельно зі зростанням цього показника у разі необоротного запалення пульпи. Ураження молярів було зареєстровано у переважній більшості випадків порівняно з передніми зубами.

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Найчастіше пульпіт було діагностовано в перших тимчасових молярах нижньої щелепи ($p < 0.01$). Холодовий тест виявився інформативним у позитивно налаштованих, здатних до співпраці дітей (25.7%) здебільшого 6-7-річного віку. Визначено суттєві відмінності рентгенологічної глибини каріозних уражень при оборотному і необоротному пульпіті тимчасових зубів. Інтраопераційна оцінка кровотечі і досягнення гемостазу після вітальної пульпотомії свідчили про відсутність запалення кореневої пульпи.

Висновки: Клінічна оцінка глибини каріозних дефектів не дозволяє визначити товщину ураження дентину і близькість до пульпи за виключенням випадків її каріозного оголення. Холодовий тест на чутливість пульпи у дошкільному віці був недостатньо точним внаслідок високої вірогідності хибнопозитивних відповідей. До найбільш інформативних методів передопераційної діагностики пульпіту належить рентгенологічне дослідження, що характеризує глибину каріозного ураження і його близькість до пульпи. Надійними рентгенологічними ознаками незворотного пульпіту були сполучення з порожниною зуба, деструкція кортикальної пластинки альвеоли, просвітлення губчастої кістки у фуркаційній та періапікальній ділянках. Однак, рентгенологічна діагностика не відображає поширеність запалення в пульпі. Тому інтраопераційна оцінка кровотечі і досягнення гемостазу після вітальної пульпотомії є вирішальними критеріями щодо відсутності запалення кореневої пульпи та можливості її збереження. Отже, диференційна діагностика оборотного і необоротного пульпіту тимчасових зубів повинна ґрунтуватися на поєднанні передопераційних та інтраопераційних методів дослідження.

У зв'язку з високою поширеністю пульпіту у дітей 6-7-річного віку першочерговим завданням дитячої терапевтичної стоматології повинна стати первинна профілактика раннього дитячого карієсу.

Ключові слова: діти, пульпіт, тимчасові зуби, клінічна діагностика, рентгенологічне дослідження.

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ABBREVIATIONS

UD – first primary molars of the upper jaw

UE – second primary molars of the upper jaw

LD – first primary molars of the lower jaw

LE – second primary molars of the lower jaw

INTRODUCTION

A necessary condition for the integration of domestic pediatric dentistry into the international dental community is the standardization of dental care in Ukraine on the basis of evidence-based medicine. Clinical guidelines and standards for providing dental care to children should be consistent with modern classifications and diagnostic terminology of the main

dental diseases, take into account recognized global approaches to their prevention and treatment.

Today, the classification of pulp diseases, approved at the consensus conference of the American Association of Endodontics (AAE, 2009), is generally accepted. It distinguishes normal pulp with physiological characteristics of viability without any pathological symptoms; reversible pulpitis - benign inflamed pulp

capable of healing; irreversible pulpitis (symptomatic, asymptomatic) - vital inflamed pulp that is not able to healing; pulp necrosis; previously treated tooth with sealed root canals; tooth with incomplete treatment of pulpitis [1]. The recommendations provided by the conference present the typical clinical and radiological characteristics necessary for the diagnosis of each form of pulpitis. Based on these diagnostic criteria, the Council on Clinical and Scientific Work of the American Academy of Pediatric Dentistry developed clinical guidelines for the pulp therapy of primary and immature permanent teeth in children.

Clinical methods for evaluating the state of the pulp in the practice of a pediatric dentist should be painless, non-invasive, objective, reliable, simple and quick to use. Therefore, not all of them can be used for the diagnosis of pulpitis in primary teeth due to the high probability of false positive answers due to fear, anxiety and the risk of negative behavior of preschool children [2-4].

THE AIM OF THE STUDY

To determine the frequency, clinical and radiological characteristics, diagnostic criterias for reversible and irreversible pulpitis of primary teeth.

MATERIALS AND METHODS

The study was conducted at the Dental Medical Center – the clinical base of the Faculty of Dentistry of the Bogomolets National Medical University during 2022–2023. 328 children aged 3 to 7 years who asked for help because of dental caries and endodontic complications were examined. They were divided into 5 age groups: 3 years (n=62), 4 years (n=76), 5 years (n=78), 6 years (n=62) and 7 years (n=50).

All parents gave voluntary informed consent for dental examination and treatment and completed a questionnaire regarding the general health status of their children at the time of examination. According to the information received, all study participants were healthy.

The dental examination included the collection of anamnesis, clinical and radiological examination. The clinical examination included a visual assessment of the carious lesion depth, percussion, palpation, cold test and mobility check up of the primary teeth. In younger children, a modified technique of percussion with the help of a fingertip was used. Cold test used mostly for children 6-7 years old with high level of cooperation. Clinical tests were started with the unaffected contralateral or adjacent teeth to acquaint the child with the normal reaction to mechanical and cold stimuli.

The depth of the carious lesion, the presence of pulp exposure, the furcation and apical radiotranslucency of the bone tissue, and signs of internal or external root resorption were evaluated using radiological examination.

The following criteria were used to diagnose reversible pulpitis [5-7]:

- possible short-term pain from cold and sweet, which disappears after the elimination of the stimulus within a few seconds;
- there is no spontaneous and nocturnal pain;
- there is no sensitivity to hot;
- sensitivity to a cold test lasting up to 30 seconds;
- comparative percussion is painless;
- there is no radiological connection with the tooth cavity;
- there are no radiological changes in the furcation and periapical areas.

The criteria for the diagnosis of irreversible pulpitis were [5-7]:

- possible complaints of spontaneous and night pain;
- possible long-term pain from irritants;
- clinically visualized deep carious lesions;
- the presence of a clinical carious connection with the pulp cavity is possible;
- sensitivity to a cold test exceeding 30 seconds;
- the thickness of the dentin separating the pulp cavity from the carious cavity is equal to or less than 1 mm;
- radiological connection with the tooth cavity is possible;
- radiological translucency is possible in the furcation and periapical areas.
- pathological radiological external or internal root resorption is possible.

To confirm the clinical diagnosis and the state of the pulp, an intraoperative assessment of bleeding during vital pulpotomy was performed. The light red color of the blood in the case of minor bleeding was considered a sign of reversible pulpitis. Prolong bleeding of a dark color indicated in favor of irreversible pulpitis [8-10]. The achievement of hemostasis after vital pulpotomy was considered a clinical indicator for a potentially non-inflamed state of the radicular pulp [1].

Pulpitis was diagnosed in 1128 primary teeth: reversible (n=365), symptomatic irreversible (n=80), asymptomatic irreversible (n=683).

Exclusion criterias: traumatic pulp exposure and pulp necrosis of primary teeth, previously treated primary teeth with obturated root canals and incomplete treatment of pulpitis.

Clinical examination and treatment under general or local anesthesia were carried out by pediatric dentists of the Dental Medical Center and researchers of Bogomolets National Medical University. In case of reversible pulpitis, indirect pulp capping was used, if pulp exposure was not exposed after caries excavation. If after the excavation of the carious dentin the pulp was exposed, vital pulpotomy was performed on the condition that

hemostasis of the radicular pulp was achieved, as well as the absence of radiological translucency (furcation, apical) and pathological root resorption (external, internal). Indications for non-vital pulp therapy (pulpectomy) had irreversible pulpitis with signs of inflammation of the radicular pulp and radiological translucency [5, 11-14].

Statistical Analysis

Statistical data processing was carried out in the EZR package (Free statistical software: EZR on Rcommander: RFoundation for Statistical Computing, Vienna, Austria) [15].

Categorical data were described as percentages. They characterized the prevalence of pulpitis, the specific gravity of pulpitis (reversible and irreversible) in different groups of primary teeth in children aged 3-7 years. The normality of the quantitative data distribution was assessed by the Shapiro-Wilk test. The distribution differed from the normal one, so the median (Me) and interquartile range (QI - QIII) were calculated to represent the quantitative characteristics. Comparison of central tendencies for two independent samples was performed using the Wilcoxon-Mann-Whitney W-criterion. The independent variables were different groups of primary teeth of children aged 3 to 7 years affected by pulpitis (reversible, irreversible). The evaluation of multiple comparisons for quantitative data was carried out in two stages: by conducting Kruskal-Wallis rank univariate analysis and posterior

comparisons according to Dunn's test. The chi-square test and posterior comparisons using Fisher's exact test with Bonferroni correction were used to compare qualitative data. Differences at $p < 0.05$ were considered statistically significant.

When calculating the minimum sample volume, the number of primary teeth affected by reversible and irreversible pulpitis was compared according to the non-parametric Wilcoxon-Mann-Whitney test. A significant effect (effect size, $d=0.8$) was considered clinically significant. The calculation was carried out for the probability of a type one error of $\alpha=0.05$ and a power of 90%, based on the ratio of sample volumes with respect to reversible and irreversible pulpitis of primary teeth of 1:2. The minimum sample size is 315 people. Calculations were performed in the G*Power 3.1.9.6 package (Heinrich-Heine-Universität Düsseldorf, 1992-2020) [16]. Based on them, 328 children were included in the study.

RESULTS

The results of the study indicate a high prevalence of pulpitis of primary teeth in children aged 3 to 7 years ($n=304$) – 92.7%. Only 7.3% ($n=24$) participants had caries of dentine.

The prevalence of pulpitis of primary teeth in different age groups is shown in Figure 1. A significant increase in the frequency of pulpitis was determined starting from the age of 5 years – 96.2% ($n=75$), compared to 3-year-old children – 83.9% ($n=62$).

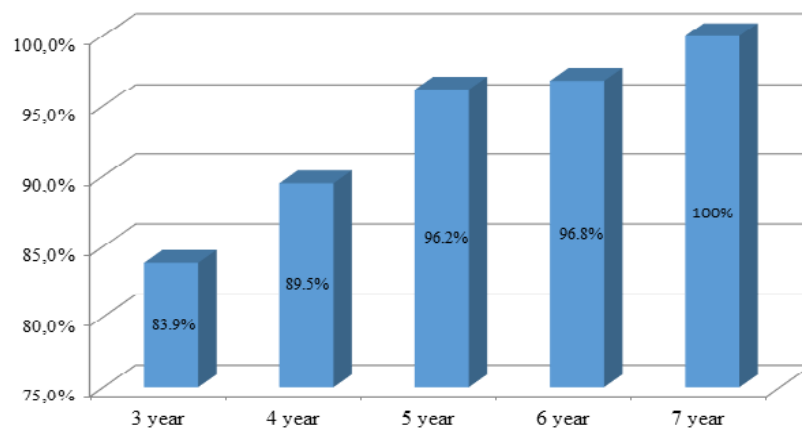


Figure 1 – Prevalence of pulpitis in primary teeth in children aged 3-7 years

The frequency of irreversible pulpitis in primary teeth was 2.1 times higher than reversible pulpitis – 67.6% ($n=763$) and 32.4% ($n=365$), respectively ($p < 0.001$). The lowest percentage of irreversible pulpitis was observed at 3 years of age, and the highest at 7 years of age (Figure 2). This indicates an increase in the frequency of irreversible pulpitis with age.

A significantly higher median number of primary teeth with reversible pulpitis was registered in 3-year-old children compared to 5-year-old, 6-year-old and 7-year-old participants (Table 1). We found no difference between these indicators in 3-year-old and 4-year-old children ($p > 0.05$). The analysis of the results indicates a significant decrease in the frequency of reversible pulpitis of primary teeth from the age of 5.

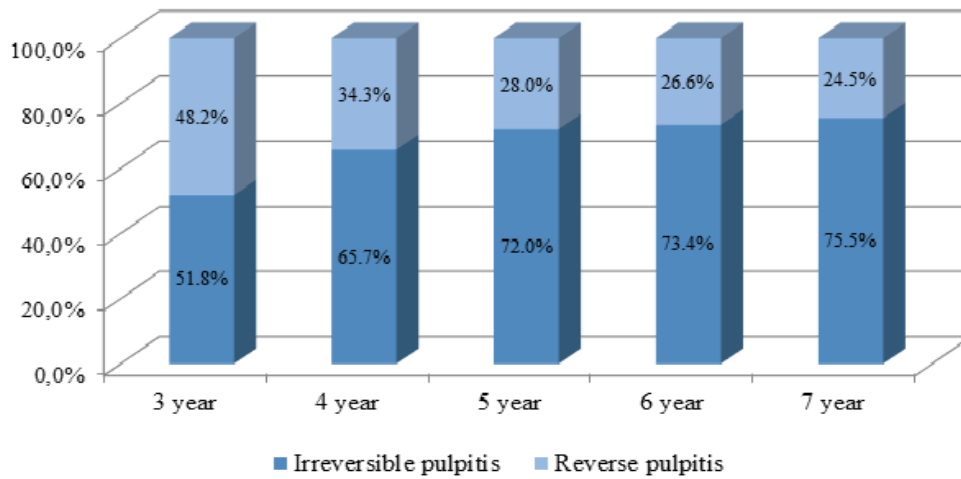


Figure 2 – Frequency distribution of reversible and irreversible pulpitis in children aged 3-7 years

Table 1 – Quantitative distribution of reversible pulpitis in primary teeth in children aged 3-7 years

Group	Age (years)	The number of affected teeth (n=365)	Reversible pulpitis (Me)	p*
№ 1	3	96	2 (0 – 3) ^{3,4,5}	< 0.001
№ 2	4	97	1 (0 – 2) ⁵	
№ 3	5	73	1 (0 – 1) ¹	
№ 4	6	58	1 (0 – 1) ¹	
№ 5	7	41	0 (0 – 1) ^{1,2}	

Notes: The median value of the indicator (Me) and the interquartile range (QI-QIII) are presented. The Kruskal-Wallis* test was used for comparison, and posterior comparisons were made using the Dunn test:

- ¹ – difference from group 1 is statistically significant, $p < 0.05$;
- ² – difference from group 2 is statistically significant, $p < 0.05$;
- ³ – difference from group 3 is statistically significant, $p < 0.05$;
- ⁴ – difference from group 4 is statistically significant, $p < 0.05$;
- ⁵ – difference from group 5 is statistically significant, $p < 0.05$

Table 2 – Quantitative distribution of irreversible pulpitis in primary teeth in children aged 3-7 years

Group	Age (years)	The number of affected teeth (n=763)	Irreversible pulpitis (Me)	p*
№ 1	3	103	1 (0 – 3) ^{2,3,4,5}	< 0.001
№ 2	4	186	2 (1 – 4) ¹	
№ 3	5	188	2 (1 – 4) ¹	
№ 4	6	160	2 (1 – 4) ¹	
№ 5	7	126	2 (1 – 4) ¹	

Notes: The median value of the indicator (Me) and the interquartile range (QI-QIII) are presented. The Kruskal-Wallis* test was used for comparison, and posterior comparisons were made using the Dunn test:

- ¹ – difference from group 1 is statistically significant, $p < 0.05$;
- ² – difference from group 2 is statistically significant, $p < 0.05$;
- ³ – difference from group 3 is statistically significant, $p < 0.05$;
- ⁴ – difference from group 4 is statistically significant, $p < 0.05$;
- ⁵ – difference from group 5 is statistically significant, $p < 0.05$

The median number of primary teeth with irreversible pulpitis in 3-year-old children differed significantly from similar indicators at 4 years, 5 years, 6 years and 7 years (Table 2). There was no significant difference between the values of this indicator in other age groups. This indicates a probable increase in the frequency of irreversible pulpitis of primary teeth, starting from the age of 4 years.

A statistically significant difference was found between the median number of primary teeth with irreversible and reversible pulpitis starting at 4 years of age ($p < 0.01$), (Table 3). The obtained data confirm the difference between the frequency of reversible and irreversible pulpitis in children, as well as the dependence of these indicators on age.

The quantitative distribution of pulpitis in different groups of primary teeth in children aged 3-7 years were analyzed (Figure 3). It was most often diagnosed in the first primary molars of the lower jaw (LD) – 29.3% ($n=330$) ($p < 0.01$). The second and third places in terms of frequency were occupied by second primary molars of the lower jaw (LE) and first primary molars of the upper jaw (UD): 23.8% ($n=269$) and 16.8% ($n=190$), respectively ($p < 0.01$). Pulpitis of the anterior group of teeth compared to molars was observed in a significantly lower number of cases ($p < 0.01$). We did not find a significant difference in the frequency of damage to the central incisors, lateral incisors and canines of the upper jaw.

Table 3 – Quantitative distribution of reversible and irreversible pulpitis in primary teeth in children aged 3-7 years

Group	Age (years)	The number of affected teeth (n)	Reversible pulpitis (Me) (n=365)	Irreversible pulpitis (Me) (n=763)	p
№ 1	3	199	1.5 (0 – 3)	1 (0 – 3)	> 0.05
№ 2	4	283	1 (0 – 2)	2 (1 – 4)	< 0.01
№ 3	5	261	1 (0 – 1)	2 (1 – 4)	< 0.01
№ 4	6	218	1 (0 – 1)	2 (1 – 4)	< 0.01
№ 5	7	167	0 (0 – 1)	2 (1 – 4)	< 0.01
In total		1128	1 (0 – 2)	2 (1 – 4)	< 0.01

Notes: The median value of the indicator (Me) and the interquartile range (QI-QIII) are presented. The Wilcoxon-Mann-Whitney test was used for comparison

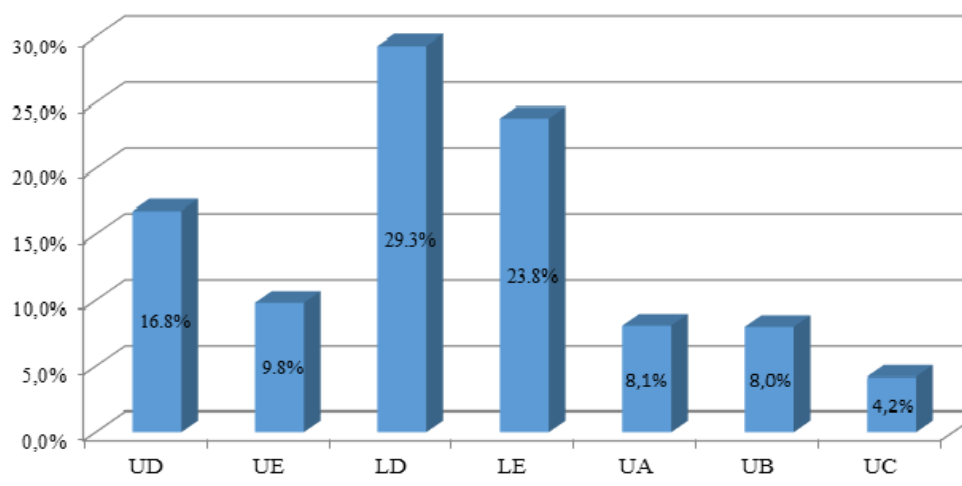


Figure 3 – Frequency distribution of pulpitis in different groups of primary teeth in children aged 3-7 years

A statistically significant difference was found between the median number of primary molars affected with pulpitis: UD, UE, LD, LE in children 3-7 years old (Table 4). The highest value was registered in LD in all

age groups. This indicator was lowest in UE in children aged 3-4 years.

According to the results of the clinical examination, the vast majority of parents and children with pulpitis

complained about the destruction of primary teeth – 83.2% (n=253) and only 15.5% (n=47) of cases with irreversible pulpitis complained of pain during meal ($p < 0.001$). Most of them were children aged 5-7 years –

11.2% (n=34). This indicates a mostly asymptomatic course of pulpitis in primary teeth, especially in children aged 3 to 5 years.

Table 4 – Quantitative distribution of pulpitis in different groups of primary molars in children aged 3-7 years

Group	Age (years)	The number of affected teeth (n)	UD (Me) (n=190)	UE (Me) (n=111)	LD (Me) (n=330)	LE (Me) (n=269)	p*
№ 1	3	118	0 (0 – 1) ²	0 (0 – 0) ^{1,3,4}	1 (0 – 2) ^{2,4}	0 (0 – 1) ^{2,3}	< 0.001
№ 2	4	233	0 (0 – 1) ^{3,4}	0 (0 – 0) ^{3,4}	1.5 (1 – 2) ^{1,2}	1 (0 – 2) ^{1,2}	< 0.001
№ 3	5	205	0 (0 – 1) ^{3,4}	0 (0 – 1) ^{3,4}	1 (0 – 2) ^{1,2}	1 (0 – 1) ²	< 0.001
№ 4	6	186	0 (0 – 1)	0 (0 – 1) ³	1 (0 – 2) ²	1 (0 – 1)	= 0.026
№ 5	7	158	0.5 (0 – 1) ²	0 (0 – 1) ^{1,4}	1 (0 – 2) ¹	1 (0 – 2) ²	= 0.004
In total		900	0 (0 – 1) ^{2,3,4}	0 (0 – 1) ^{1,3,4}	1 (0 – 2) ^{1,2,4}	1 (0 – 1) ^{1,2,3}	< 0.001

Notes: The median value of the indicator (Me) and the interquartile range (QI-QIII) are presented. The Kruskal-Wallis* test was used for comparison, and posterior comparisons were made using the Dunn test:

¹ – the difference from UD is statistically significant, $p < 0.05$;

² – the difference from UE is statistically significant, $p < 0.05$;

³ – the difference from LD is statistically significant, $p < 0.05$;

⁴ – the difference from LE is statistically significant, $p < 0.05$

During the objective examination of reversible pulpitis, cavitated carious were found. In the proximal carious defects, a dark shadow of altered dentin was visible through the damaged enamel. In such cases, the marginal ridge of the primary molars was usually preserved. Clinically visualized deep carious lesions were determined in all teeth with irreversible pulpitis. In the case of proximal localization of carious cavities in primary molars, destruction of the marginal ridge was observed. In 4.7% (n=36) of teeth, a carious pulp exposure was detected during visual inspection. It should be noted that the visual assessment of the depth of carious defects does not allow making fully determination the thickness of the affected dentin and the proximity to the pulp.

Cold test of the pulp was informative in highly cooperated children, mostly 6-7 years old – 25.7% (n=78). In the case of reversible inflammation, the sensitivity of the pulp to the cold test did not exceed 20-30 seconds. While testing teeth with irreversible pulpitis, the reaction to a cold stimulus lasted longer than 30 seconds. The cold test for the sensitivity of the pulp in primary teeth in preschool children is not accurate enough due to the high probability of false-positive answers. This is usually due to the anxiety and fear of children before the actual testing procedure. It is advisable to use the cold test if the child has the ability to cooperate in combination with other methods of diagnosis, primarily radiological.

An analysis of radiological signs of pulpitis of primary teeth was carried out. In the case of reversible pulpitis, the radiological depth of the carious cavity did not exceed 1/2 of the dentine thickness. There were no pathological changes in the furcation and periapical areas. With irreversible pulpitis, the radiological depth of the carious lesion reached 2/3 of the dentin thickness. In the majority of observations (74.4%, n=568), the dentin thickness between the carious cavity and the pulp chamber did not exceed 1 mm. Radiological connection with the pulp chamber was determined in 25.6% (n=195) of cases. In 9.4% (n=72) of teeth with irreversible pulpitis, destruction of the cortical plate of the alveolus and translucency of the spongy bone was observed mainly in the furcation area of the primary molars of the lower jaw. There were no signs of pathological external or internal root resorption in the affected teeth. The obtained results testify to the important role of radiological criteria in the diagnosis of the depth of the carious lesion in relation to the pulp of primary teeth, especially in the case of its asymptomatic inflammation.

The state of the radicular pulp after pulpotomy was analyzed by visual intraoperative assessment of bleeding. If the bleeding is light red, hemostasis of pulp stamp was achieved in all teeth within 4-5 minutes. In the case of profuse bleeding of a dark color, it did not stop within the specified time. This was mostly the case for LD and LE with immature roots. Intraoperative

assessment of bleeding from the pulp and the ability to achieve hemostasis may indicate a potentially healthy condition of the radicular pulp. Therefore, it is advisable to use these criteria to determine the final diagnosis and choose an adequate method of treatment of pulpitis of primary teeth.

DISCUSSION

As a result of the study, a high prevalence of pulpitis in children aged 3 to 7 years was found – 92.7%. A significant increase in the frequency of pulpitis in primary teeth was registered at the age of 5-7 years. A similar peak in the prevalence of diseases of the pulp and periapical tissues in the age group of 5-9 years was observed by Cheng and Chiang [17]. According to Soh et al. [18] the frequency of pulpitis of primary teeth reaches its highest level at the age of 5 years, and then gradually decreases from 6 to 11 years. Such discrepancies can be explained by the absence of statistically significant differences in the prevalence of pulpitis in the mentioned publication.

The advantage of the current study is the analysis of the frequency, clinical and radiological features of the course of two different forms of pulpitis: reversible and irreversible. A statistically significant difference was found between reversible and irreversible pulpitis of primary teeth in children aged 3-7 years. The frequency of irreversible pulpitis was 2.1 times higher than the frequency of reversible pulpitis: 67.6% and 32.4%, respectively. The number of clinical manifestations of irreversible pulpitis in primary teeth varied from 0 to 8, reversible – from 0 to 5. Similar results were obtained by other author groups. The prevalence of primary teeth irreversible pulpitis in children aged 4-6 years in China exceeded 50% [18]. The number of clinical manifestations of irreversible pulpitis in children of the same age in Bulgaria varied from 0 to 8, which, according to the authors' conclusions, indicated a high prevalence [19]. Pulpitis of primary teeth in children aged 6-7 according to the Caries Assessment Spectrum and Treatment index was observed less often: 26.2% in Poland [20], 2.9–10.5% in Iran [21]. The frequency of diseases of the pulp and periapical tissues among children aged 5 to 9 years in Taiwan was also low – 12.76% [17]. Differences in prevalence of pulpitis may be associated with the use of different assessment methods and criteria, in particular with the lack of radiological diagnosis in the aforementioned studies. They could also arise as a result of the strengthening of the adverse influence of socio-economic factors [22], which is connected with the introduction of the legal regime of martial law in Ukraine during the years 2022–2024.

A feature of our study is the determination of statistically significant differences in the frequency of

pulpitis in different groups of primary teeth. LD lesions were most often observed, followed by LE and UD. The obtained data to some extent coincide with the results of Soh et al. [18] regarding the high frequency of pulpitis in the first and second primary molars. Babaei et al. [21] observed a predominant lesion of the first primary molars. The reason for such discrepancies may be the absence of a statistically significant difference between the indicators in the cited publications.

According to the results of the current study, a mostly asymptomatic course of pulpitis in primary teeth was registered, especially in 3-4-year-olds – 83.2%. This statement is consistent with the data of other authors regarding the absence of pain complaints in reversible and irreversible pulpitis of primary teeth in the vast majority of children [4, 23].

Testing the sensitivity of the pulp to a cold stimulus turned out to be reliable only in 25.7% of cooperative children, mostly 6-7 years old. The obtained data are consistent with the recommendations of other researchers regarding the limited use of pulp sensitivity tests in primary teeth due to the high probability of conflicting results and the risk of negative behavior in children [3-4, 7]. At the same time, in other publications, testing the sensitivity of the pulp in primary teeth is recognized as reliable in cooperative children aged 6-8 years [24-25].

Significant differences in the radiological depth of carious lesions in reversible and irreversible pulpitis of primary teeth were revealed. The most important prognostic criterias of irreversible inflammation of the pulp include radiological connection with the pulp chamber, destruction of the cortical plate of the alveolus, and the translucency of the spongy bone in the furcation and periapical areas. The presented features of the symptoms of various forms of pulpitis confirm the importance of radiological diagnostics for determining the proximity of carious defects to the pulp, which is consistent with the conclusions of other authors [2, 14].

In order to determine the final diagnosis, a visual intraoperative assessment of bleeding from the pulp was performed in the current study. In our opinion, the ability to achieve hemostasis after vital pulpotomy is a more reliable criterion for determining the state of the radicular pulp, compared to the cold sensitivity test and radiological examination. This statement is consistent with the results of other researchers that the color and intensity of bleeding can reflect the degree of inflammation of the pulp [9], and the achievement of hemostasis indicates in favor of reversible pulpitis [14]. In the publication of Mutluay et al. [26] it is stated that the control of bleeding and the achievement of hemostasis does not provide a reliable assessment of the state of the pulp and cannot be used as a criterion for

pulpotomy. However, the laboratory method used in this study to determine the level of cytokines in the radicular pulp is not available to the general public of clinicians.

CONCLUSIONS

Clinical assessment of the carious depth did not reflect the degree of dentin damage and proximity to the pulp, with the exception of cases of its carious exposure. Cold test in preschool children turned out to be insufficiently accurate due to the high probability of false-positive answers. The most informative method of preoperative diagnosis of pulpitis should be considered radiological examination, which characterizes the depth of the carious lesion and the proximity of its location to the pulp. Reliable predictors of irreversible pulp inflammation were radiological connection with the pulp chamber, destruction of the cortical plate of the

alveolus, translucency of the spongy bone in the furcation and periapical areas. However, radiological diagnostics does not allow making determination the degree of inflammation in the pulp. Criteria that indicate the absence of inflammation of the radicular pulp are the intraoperative assessment of bleeding and the achievement of hemostasis after vital pulpotomy. Therefore, differential diagnosis of reversible and irreversible pulpitis in primary teeth must be carried out on the basis of preoperative and intraoperative research methods. In view of the high prevalence and mostly asymptomatic course of irreversible pulpitis in primary and mixed dentition, the priority direction of pediatric dentistry should be the primary prevention of early childhood caries.

PROSPECTS FOR FUTURE RESEARCH

Nowadays, in Ukraine, the question of choosing methods and evaluating the effectiveness of treatment of reversible and irreversible pulpitis of primary teeth remains open.

AUTHOR CONTRIBUTIONS

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A – Work concept and design,

B – Data collection and analysis,

C – Responsibility for statistical analysis,

D – Writing the article,

E – Critical review,

F – Final approval of the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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