DENTIN CARIES IN CHILDREN WITH CEREBRAL PALSY

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Study of the dental status of children with infantile cerebral palsy (ICP) is indicative of a high occurrence and intensity of damage of the hard dental tissue. To plan and carry out therapeutic and preventive measures concerning dental caries in children with ICP it is necessary to assess damage to teeth by dentin caries applying modern impartial criteria including International Caries Detection and Assessment System (ICDAS) II.

***Objective** – to assess damage of teeth by dentin caries in children with cerebral palsy applying ICDAS II criteria.*

***Material and methods.** 122 children (mean age 8.8±3.7 years) with spastic forms of cerebral palsy who were treated at the Regional Center for Medical and Social Rehabilitation of Children with Organic Nervous System Damage in Chernivtsi were examined. Children were divided into groups according to the Extended and Revised Gross Motor Function Classification System (GMFCS E&R). Group 1 (23 children – 18.9%) children walking without restrictions, Group 2 – 26 (21.3%) children walking with physical assistance; Group 3 – 26 (21.3%) children walking with manual mobility devices; Group 4 – 25 (20.5%) children walking with physical assistance or using mechanized mobility devices or walkers; Group 5 – 22 (18.0%) children who were transported in a manual wheelchair. The comparison group was formed from 80 practically healthy children. The intensity of caries was studied separately in children with cerebral palsy with temporary occlusion (37 children aged 3-6 years, middle age – 4.3±1.1 years), with variable occlusion (43 children aged 7-12 years, middle age – 9.1±1.4 years) and with permanent occlusion (42 children aged 13-17 years, middle age – 13.6±1.7 years). Criteria for inclusion in the group of children with organic damage to the nervous system: age (3-17 years); diagnosis of "cerebral palsy" established by a pediatric neurologist; availability of informed consent of parents or official guardians for all types of examinations and treatment; the physical ability of the child and parents to participate in all stages of the study. Criteria for excluding children from the study: the presence of concomitant severe somatic pathology (thyrotoxicosis, diabetes mellitus, etc.); the presence of epileptic seizures; doubts in the classification of the form of the underlying disease; age up to 3 years. The study was conducted in accordance with the provisions of the Declaration of Helsinki and approved by the Biomedical Ethics Commission of the Bukovina State Medical University (protocol No. 20 dated 02/18/2026). Statistical processing of the results was carried out using the MS® Excel® 2010 TM application program, Biostat®, Statistika® 7.0 using paired and unpaired Student t-tests.*

***Results.** Dentin caries was found in 18,42 % of teeth of the examined children with ICP. The frequency of detection of ICDAS II code 4 tended to increase in all the age groups of children with ICP in comparison with similar indexes in healthy children. The frequency of detection of ICDAS II code 5 in children with ICP was 3,7 times higher than that of healthy ones; code 6 –7,5 times higher. There is an increase in the frequency of detection of codes 5 and 6 with increasing severity of motor disorders, especially in groups 4 and 5, where these parameters differed reliably from the parameters of healthy children, and even of those from group 1. Relative frequency of detection of open caries cavities (code 5) among all the dentin damage in percentage does not practically differ depending on the group. However, as the severity of movement disorders increases, the proportion of deep cavities increases significantly (code 6). Instead, the proportion of hidden caries cavities decreases (code 4). It may be indicative of an extremely rapid development of dentin caries already at the stage of hidden caries, which leads to the formation of significant open lesions almost immediately after destruction of the enamel.*

***Conclusion.** Much higher intensity of carious process in the dentin is observed in children with severe motor disorders according to the Scale of Gross Motor Function Classification System. Deep open dentin caries lesions are found more frequently in children with ICP having severe motor disorders (ICDAS II codes 5 and 6) against the background of a decrease in the share of hidden cavities (ICDAS II code 4).*

***Keywords:** infantile cerebral palsy, dental caries, ICDAS II index.*

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КАРІЄС ДЕНТИНУ У ДІТЕЙ ІЗ ДИТЯЧИМ ЦЕРЕБРАЛЬНИМ ПАРАЛІЧЕМ

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Key words: *дитячий церебральний параліч, карієс зубів, індекс ICDAS II.*

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Вивчення стоматологічного статусу дітей із дитячим церебральним паралічем (ДЦП) свідчить про високу частоту та інтенсивність ураження твердих тканин зуба. Для планування та проведення лікувально-профілактичних заходів щодо карієсу зубів у дітей із ДЦП необхідно оцінювати ураження зубів карієсом дентину, застосовуючи сучасні об'єктивні критерії, включаючи Міжнародну систему виявлення та оцінки карієсу (ICDAS) II.

Мета *– оцінити ураження зубів карієсом дентину у дітей із дитячим церебральним паралічем, застосовуючи критерії ICDAS II.*

Матеріали та методи. *Обстежено 122 дитини (середній вік 8,8±3,7 років) зі спастичними формами ДЦП, що перебували на лікуванні в Обласному центрі медико-соціальної реабілітації дітей з органічним ураженням нервової системи у м. Чернівці. Дітей розподілено на групи відповідно до Розширеної та переглянутої Системи класифікації великих моторних функцій (GMFCS E&R). 1-ша група 23 дитини (18,9%), які ходять без обмежень, 2-га група – 26 (21,3%) дітей, які ходять із фізичною допомогою; 3-тя група – 26 (21,3%) дітей, які ходять із використанням ручних пристроїв для пересування; 4-та група – 25 (20,5%) дітей, які ходять із фізичною допомогою або використовуючи механізовані пристрої для пересування чи ходунки; 5-та група – 22 (18,0%) дітей, яких перевозили в інвалідному візку з ручним керуванням. Групу порівняння сформували з 80 практично здорових дітей. Інтенсивність карієсу досліджували окремо у дітей із дитячим церебральним паралічем із тимчасовим прикусом (37 дітей віком 3-6 років, середній вік – 4,3±1,1 років), зі змінним прикусом (43 дитини віком 7-12 років, середній вік – 9,1±1,4 років) та з постійним прикусом (42 дитини віком 13-17 років, середній вік – 13,6±1,7 років). Критерії включення в групу дітей з органічним ураженням нервової системи: вік (3-17 років); встановлений дитячим неврологом діагноз «дитячий церебральний параліч»; наявність інформованої згоди батьків або офіційних опікунів на всі види досліджень і лікування; наявність фізичної можливості участі дитини і батьків у всіх етапах дослідження. Критерії невключення дітей у дослідження: наявність супутньої тяжкої соматичної патології (тиреотоксикоз, цукровий діабет та інші); наявність епілептичних нападів; сумніви в класифікації форми основного захворювання; вік до 3-х років. Дослідження проведене відповідно до положень Гельсінкської декларації та схвалене комісією з питань біомедичної етики Буковинського державного медичного університету (протокол №20 від 18.02.2026). Статистичне опрацювання результатів проводили за допомогою прикладної програми MS® Excel® 2010 тм, Biostat®, Statistika® 7.0 із використанням парних та непарних t-критеріїв Стьюдента.*

Результати. *Карієс дентину виявлено у 18,42 % зубів обстежених дітей із ДЦП. Частота виявлення коду ICDAS II 4 мала тенденцію до зростання у всіх вікових групах дітей із ДЦП порівняно з аналогічними показниками у здорових дітей. Частота виявлення коду ICDAS II 5 у дітей із ДЦП у 3,7 раза, а коду 6 – у 7,5 раза вища, ніж у здорових. Спостерігається збільшення частоти виявлення кодів 5 та 6 зі збільшенням тяжкості рухових порушень, особливо в групах 4 та 5, де ці параметри достовірно відрізнялися від параметрів здорових дітей і навіть дітей 1-ї групи. Відносна частота виявлення відкритих каріозних порожнин (код 5) серед усіх пошкоджень дентину у відсотках практично не відрізняється у групах. Однак зі збільшенням тяжкості рухових порушень, частка глибоких порожнин значно зростає (код 6). Натомість частка прихованих каріозних порожнин зменшується (код 4). Це може свідчити про надзвичайно швидкий розвиток карієсу дентину вже на стадії прихованого карієсу, що призводить до утворення значних відкритих уражень майже одразу після руйнування емалі.*

Висновок. *Значно вища інтенсивність каріозного процесу в дентині спостерігається у дітей із тяжкими руховими порушеннями згідно зі Шкалою класифікації великих моторних функцій. Глибокі відкриті каріозні ураження дентину частіше трапляються у дітей із ДЦП, які мають тяжкі рухові порушення (коди ICDAS II 5 та 6) на тлі зменшення частки прихованих порожнин (код ICDAS II 4).*

Introduction

Dental caries in children significantly affects their quality of life. This especially applies to children with general diseases, and neurological ones in particular. Intensity and occurrence of dental diseases in such children is usually higher than in healthy ones. One of the most common neurological pathologies most frequently leading to disability in patients at the age under 18 years is infantile cerebral palsy (ICP) [5, 12]. One of the major clinical symptoms of ICP is motor function disorders associated with developmental disorders, wrong formation of static and kinetic reflexes, pathology of the muscular tonus, and paresis [15].

Motor and mental disorders in children with ICP complicate considerably individual care of the oral cavity and the process of giving dental aid. It explains high occurrence and intensity of lesions of the hard dental and periodontal tissues [1, 4, 10]. If enamel caries can be treated conservatively to a certain extent, the treatment of dentin caries in all cases needs surgical treatment, requiring special conditions in this category of children. To plan and carry out therapeutic and preventive measures concerning dental caries in children with ICP it is necessary to assess damage to teeth by dentin caries applying modern objective criteria including International Caries Detection and Assessment System (ICDAS) II.

Objective – to assess damage of teeth by dentin caries in children with cerebral palsy applying ICDAS II criteria.

Material and methods of research

122 children were examined (an average age 8,8±3,7 years) with spastic forms of ICP, who were treated at the Regional Medical-Social Rehabilitation Center for Children with Organic Disorders of the Nervous System (Chernivtsi). The children were distributed into groups according to Gross Motor Function Classification System. Expanded and Revised (GMFCS E&R) [7, 11]. Group 1 (23 children - 18,9 %) included children walking without limitations, group 2 – 26 (21,3 %) children walking with physical assistance; group 3 – 26 (21,3 %) children walking with hand-held mobility devices; group 4 – 25 (20,5 %) children walking with physical assistance or using powered mobility or a body support walker; group 5 – 22 (18,0 %) children transported in a manual wheelchair. The group of comparison included 80 practically healthy children. Caries intensity was examined separately in the children with ICP with temporary occlusion (37 children at the age of 3-6 years, an average age 4,3±1,1), with changing occlusion (43 children at the age of 7-12 years, an average age 9,1±1,4) and with permanent occlusion (42 children at the age of 13-17 years, an average age 13,6±1,7). Criteria for inclusion in the group of children with organic damage to the nervous system: age (3-17 years); diagnosis of "cerebral palsy" established by a pediatric neurologist; availability of informed consent of parents or official guardians for all types of examinations and treatment; the physical ability of the child and parents to participate in all stages of the study. Criteria for excluding children from the study: the presence of concomitant severe somatic pathology (thyrotoxicosis, diabetes mellitus, etc.); the presence of epileptic seizures; doubts in the classification of the form of the underlying disease; age up to 3 years.

The study was conducted in accordance with the provisions of the Declaration of Helsinki and approved by the Biomedical Ethics Commission of the Bukovinian State Medical University (protocol No. 20 dated 02/18/2026). The parents of children were informed, and they gave their written consent.

The state of dental caries lesions was determined in all the children applying the criteria of the International Caries Detection and Assessment System (ICDAS II) [0, 10, 13]. ICDAS II 4,5 and 6 codes were considered, since they indicate damage to the dentin in order of increasing depth. Code 4 means a dark shadow of the afflicted dentin, code 5 – an obvious carious cavity with exposed dentin, code 6 – an obvious big carious cavity with exposed dentin.

Absolute and relative amount of teeth possessing ICDAS II codes 4, 5 and 6 was assessed in different groups of children, as well as the ratio of detection frequency of these codes in children from different groups. It enables to determine a prevailing character of dentin lesion in the examined groups of children, and in a certain way to direct recommendations regarding therapeutic and preventive measures.

Statistical processing was carried out by means of the applied program MS® Excel® 2010 тм, Biostat®, Statistika® 7.0 using paired and unpaired Student t-tests.

The study was carried out within the research and development of the Department of Nervous Diseases, Psychiatry and Medical Psychology named after S.M. Savenka Bukovinian State Medical University "Modern aspects of diagnostics and treatment of patients with mental and/or neurological disorders" (implementation deadline 2025-2029).

Results and discussion

Oral examination of children with organic lesions of the nervous system found that dental caries occurrence was 100 %, compared to healthy children from the group of comparison, whose index was 68,7 %. The average value of the intensity of dental caries according to the indices of df, DMF+df, DMF in children with ICP was 6,27±1,19, that was 2,3 times higher than the similar index in healthy children (2,72±1,17; p =0,038).

In general dentin caries was found in 5,70 % of healthy children and in 18,42 % of children with ICP.

Analysis of dentin caries lesions according to ICDAS II criteria in children with ICP demonstrated the following.

The frequency of detection of ICDAS II code 4 tended to increase in all the age groups of children with ICP in comparison with similar indexes in healthy children (Table 1). Thus, the frequency of hidden carious cavities in the dentin of temporary teeth in children with ICP was 1,4 times higher than that of healthy children (4,34 against 3,18); the same regularity was preserved in the mixed occlusion (1,7 times – 6,35 against 3,73). At the same time, in permanent occlusion the frequency of code 4 detection in children with ICP in comparison with healthy ones was 2,8 times higher (4,42 against 1,58). On the one hand, it is indicative of rapid dentin destruction in the immature permanent teeth in this group of children with enamel preserved, and on the other hand, it is indicative of a complicated surgical treatment requiring a

separate stage of carious cavity opening, since it cannot be performed by means of minimum invasive methods.

The frequency of detection of ICDAS II code 5 in children with ICP was 3,7 times higher than that of healthy ones and it was 5,91±1,97% against 1,58±0,84% (p=0,042). The difference was reliable in all the age groups, but the most pronounced it was in children with temporary and permanent occlusion (7,63 against 1,67 and 3,14 against 0,19 respectively). Similar regularity was observed in the detection of frequency of code 6 (Table 1), but more significant difference was found between the groups of children with changing occlusion (9,01 against 1,14, which is 7,9 times higher) and permanent occlusion (3,48 against 0,19 – 18,3 times higher). The data obtained are indicative of quicker destruction of the dentin and caries progress in children with ICP compared to the healthy ones, which mostly refer to permanent teeth.

The frequency of detection of ICDAS II 4, 5 and 6 codes was analyzed depending on the group a child belongs to according to Gross Motor Function Classification System, that is, depending on severity of motor disorders (Table 2). There is an increase in the frequency of detection of codes 5 and 6 with increasing severity of motor disorders, especially in groups 4 and 5, where these parameters differed reliably from the parameters of healthy children, and even of those from group 1. Considering detection of hidden carious cavities of the dentin (code 4), the frequency of its detection increases gradually in children from groups 1, 2 and 3. It differed reliably in children from group 3 from the similar index of healthy children. It decreased in children from groups 4 and 5 probably at the expense of progressing destruction of the teeth and increasing frequency of detection of open carious cavities (codes 5 and 6). Therefore, it can be stated that the difference between the prevalence of high codes in children of the main and control groups is registered mostly due to the indicators of children with gross motor disorders.

The results of the analysis concerning the ratio of frequency detection of different codes in all the teeth afflicted with dentin caries in different groups of the children examined are interesting (Fig. 1, 2, 3).

Table 1

Comparative characteristics of dentin caries intensity according to ICDAS II in children with ICP and practically healthy children

ICDAS II codes	Number of afflicted teeth (%) among all the teeth examined					
	Teeth in children with ICP (n=2948)			Teeth in practically healthy children (n=1860)		
	temporary (n=740)	changing occlusion (n=1032)	permanent (n=1176)	temporary (n=660)	changing occlusion (n=696)	permanent (n=504)
4	4,34±0,97	6,35±1,65	4,42±1,91	3,18±1,10	3,73±0,56	1,58±0,92
5	7,63±1,98 (p<0,05)	6,96± 2,43 (p<0,05)	3,14±1,50 (p<0,05)	1,67±0,90	2,87±1,08	0,19±0,55
6	9,07±3,76 (p<0,05)	9,01± 2,67 (p<0,05)	3,48±1,58 (p<0,05)	1,67±0,78	1,14±0,87	0,19±0,47

Note: n – number of teeth examined; 4, 5, 6 –ICDAS II codes.
p – reliability of the difference of the indicator from the similar one in healthy children

Table 2

Comparative characteristics of dentin caries intensity according to ICDAS II in children with ICP depending on severity of motor disorders

ICDAS II codes	Groups according to severity of motor disorders					Healthy
	1 (n=552)	2 (n=632)	3 (n=632)	4 (n=620)	5 (n=632)	(n=1860)
4	2,75±1,37	4,68±1,49	6,97±1,86 (p<0,05)	6,61±1,68 (p=0,05)	4,12±0,98	2,83±0,86
5	3,75±2,03	4,67±1,80	3,89±2,09	7,88±1,82 (p<0,05)	9,33±2,15 (p<0,05)	1,57±0,84
6	3,97±1,99	3,04±2,68	3,25±2,61	8,08± 3,18 (p<0,05)	11,83±2,69 (p<0,05) (p*<0,05) (p**<0,05)	1,01±0,70

Notes: n – number of teeth examined; 4, 5, 6 – ICDAS II codes.
p – the reliability of the difference of the indicator from the similar one in healthy children; p – the reliability of the difference of the indicator from the similar one in children from group 1; p** – the reliability of the difference of the indicator from the similar one in children from group 2*

Thus, in healthy children a portion of open carious cavities (codes 5 and 6) decreases with age due to the change of teeth and it is minimal with permanent occlusion compared to a portion of hidden cavities marked by the code 4 (Fig. 1). At the same time, a portion of open dentin cavities in children with ICP prevails significantly a portion of hidden cavities (code 4) in all the periods of occlusion, which may be indicative of a rapid destruction of the enamel followed by the formation of advanced open dentin cavities in children with ICP due to uncontrolled caries situation (Fig. 2).

Detection of the features of caries development in children with ICP depending on the severity of neurological symptoms is an important factor to determine the areas of therapeutic-preventive measures in this group of children.

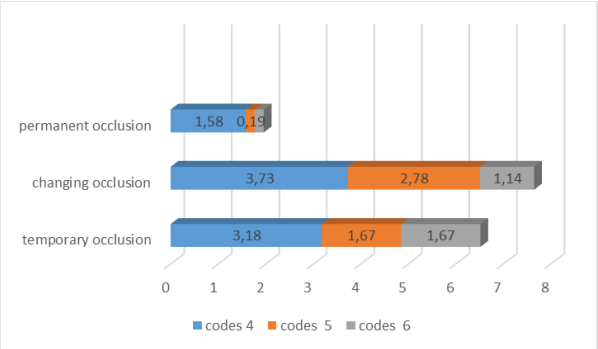

Fig 1. Relative frequency of detection of codes 4, 5 i 6 according to ICDAS among all the dentin caries cases in the teeth of healthy children

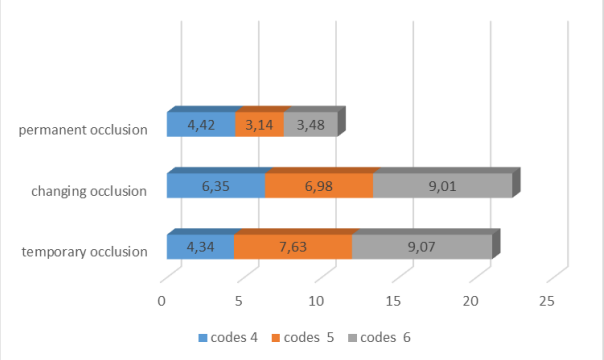

Fig 2. Relative frequency of detection of codes 4, 5 i 6 according to ICDAS among all the dentin caries cases in the teeth of children with ICP

Analysis of a portion of detection of different codes in different groups of sick children according to the classification of motor disorders is indicative of the fact that a relative frequency of detection of open carious cavities (code 5) among all the dentin lesions in percentage does not practically differ in the groups. Nevertheless, with increasing severity of motor disorders the portion of deep cavities increases significantly (code 6), while the portion of hidden carious cavities decreases (code 4). It may be indicative of an extremely rapid development of dentin caries at the stage of hidden caries, which leads to the formation of significant open lesions almost immediately after destruction of the enamel. The results obtained are obvious considering the fact that due to the lack of proper individual oral hygiene, lack of regular oral cavity sanation and preventive measures, in children with severe motor disorders the progression of caries with its transition from hidden to open forms is extremely rapid. At the same time, a portion of hidden cavities tends to increase in children from groups 2 and 3 compared to group 1, which may indicate a gradual deterioration of interdental hygiene associated with advanced motor disorders (Fig. 3).

It should be noted that if occurrence of dental caries, its dependence on the nature and degree of severity of the underlying disease were studied by researchers from different [2, 4], then the study of the nature of lesion affecting the volume of surgical treatment is found in fragmentary works [6]. High occurrence of dentin caries [6, 14] and caries-afflicted molars are admitted [3]. At the same time, to plan the volume of therapeutic manipulations with the purpose of oral cavity sanation one should realize the depth of lesion, its access to

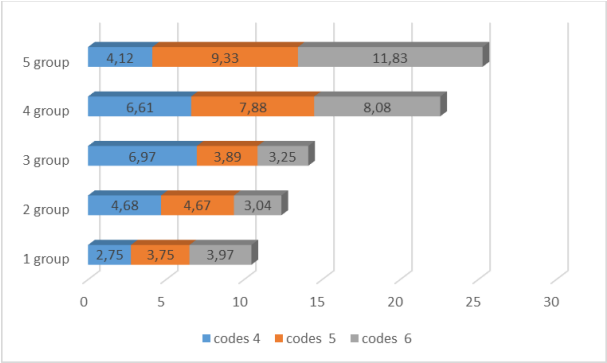

Fig 3. Relative frequency of detection of codes 4, 5 i 6 according to ICDAS among all the dentin caries cases in the teeth of children with ICP from different groups according to Motor Function Classification

perform dissection, which determines the choice of a therapeutic method, necessary pain relief, and management of child's behavior. Thus, high frequency of hidden dentin caries with a significant portion of approximal caries, promotes more attention to interdental oral hygiene in children requiring motivation and education of their parents. Special attention should be paid to regular visits to the dentist with the aim of preventive examinations and initiation of preventive measures. As a rule, hidden dentin lesions do not allow application of minimum invasive methods of surgical treatment of caries, since they require enamel removal by means of a high-speed drill, which should be considered in planning oral cavity sanation in this group of children.

Conclusions

Dentin caries was found in 18,42 % of teeth of the examined children with ICP. Much higher intensity of carious process in the dentin is observed in children with severe motor disorders according to the Scale of Gross Motor Function Classification System. Deep open dentin caries lesions are found more frequently in children with ICP having severe motor disorders (ICDAS II codes 5 and 6) against the background of a decrease in the share of hidden cavities (ICDAS II code 4). The nature of dentin caries lesions should be considered in planning therapeutic-preventive measures in children with ICP.

Prospects for further research

In our opinion, further study and development of comprehensive treatment and prevention of dental caries in children with cerebral palsy, taking into account the severity of motor disorders in this group of children, is promising.

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declare that they did not use artificial intelligence or related technologies to generate text, visualizations, or collect and analyze data for this article.

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