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## PERIODONTAL INDICES IN CHILDREN WITH INSULIN-DEPENDENT DIABETES MELLITUS DURING THE TREATMENT OF GINGIVITIS

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The oral manifestations of diabetes mellitus are observed in the vast majority of patients, and some dentists indicate 100 % damage to the tissues of the oral cavity. We analyzed the data of hygienic and periodontal indices before and during the treatment in the group of children with chronic catarrhal gingivitis and type 1 diabetes mellitus. We have found a statistically significant difference in a month since the treatment completes, and in 3 month, 6 month, and a year follow-up period. Oral hygiene indices before the treatment demonstrated unsatisfactory level of oral hygiene, but they considerably improved since the treatment had started. Periodontal indices evidenced a moderate degree of the inflammatory process. These values decreased significantly and pointed out mild inflammation in 1 month after the treatment. In 3 months, 6 months and a year follow up period the above indices slightly increased, but, nevertheless, were twice as lower than before the treatment. The use of the proposed treatment scheme had a positive effect on the clinical course of periodontal diseases and contributed to the improvement both in the immediate and long-term follow up.

**Keywords:** chronic catarrhal gingivitis, oral hygiene indices, periodontal indices, type 1 diabetes mellitus.

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## ПАРОДОНТОЛОГІЧНІ ІНДЕКСИ У ДІТЕЙ З ІНСУЛІНОЗАЛЕЖНИМ ЦУКРОВИМ ДІАБЕТОМ В ДИНАМІЦІ ЛІКУВАННЯ ГІНГІВІТУ

Стоматологічні прояви цукрового діабету відзначають у переважної більшості пацієнтів, а деякі фахівці-стоматологи вказують на 100% ураження тканин порожнини рота. При аналізі даних гігієнічних та пародонтологічних індексів до лікування та в динаміці в групі дітей, хворих на хронічний катаральний гінгівіт на фоні цукрового діабету I типу статистично значима різниця була виявлена і через 1 місяць, і через 3 місяці, і через 6 місяців, і через рік. Гігієнічні індекси до лікування відповідали незадовільній гігієні порожнини рота, а після лікування досягли рівня хорошої. Пародонтологічні індекси свідчили про середній ступінь запального процесу. Через 1 місяць після лікування ці значення значно зменшились і відповідали легкому ступеню запалення. Через 3 місяці, 6 місяців та через 1 рік вищевказані індекси незначно збільшились, проте були в середньому вдвічі нижче, ніж до лікування. Таким чином, застосування запропонованої лікувально-профілактичної схеми позитивно вплинуло на клінічний перебіг захворювань пародонту та сприяло покращенню як у найближчий, так і у віддалені терміни спостереження.

**Ключові слова:** хронічний катаральний гінгівіт, індекси гігієни порожнини рота, пародонтологічні індекси, цукровий діабет I типу.

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Type 1 diabetes mellitus is an autoimmune disease in genetically susceptible individuals that leads to the destruction of pancreatic  $\beta$ -cells and thus results in absolute insulin deficiency. The World Health Organization (WHO) and the United Nations (UN) have identified diabetes mellitus (DM) as the most dangerous challenge to the entire world in the 21st century [1, 5, 14]. Oral manifestations of diabetes are observed in the vast majority of patients, and some dental specialists indicate 100 % damage to oral organs and tissues [7, 10, 11].

Type 1 diabetes mellitus in children is known as the main risk factor for the occurrence of inflammatory periodontal diseases, which result from impaired metabolism in the periodontal tissues. Metabolic disorders considerably contribute to the progression of oral inflammatory and degenerative processes. At present diabetes mellitus is being proven as producing a statistically significant impact in the course of gingivitis, periodontitis and pro-inflammatory conditions [6, 12, 15]. Hyperglycemia can promote the destruction of the periodontal tissues in several ways, primarily by affecting the immune response mechanisms, non-enzymatic glycosylation, and by intensifying oxidative stress [2, 13]. Endocrine and periodontal diseases share some of common features including angiopathy (namely at the level of microcirculatory bed), metabolic disorders, changes in lipid peroxidation, auto aggression, and occurrence of secondary immunodeficiency.

Better understanding of the etiological factors and pathogenetic mechanisms of periodontal diseases in diabetes mellitus is one of medical and healthcare priorities, which will enable to elaborate more effective approaches on the prevention and treatment of oral diseases [8, 15].

**The purpose** of this study was to assess the state of periodontium in children of primary school age with type 1 diabetes mellitus and to evaluate the efficacy of the treatment scheme we elaborated in the treatment of chronic catarrhal gingivitis.

**Materials and methods.** The study involved 82 children aged 6 to 12 years. 56 patients were diagnosed as having type 1 diabetes mellitus (diagnosis was established by endocrinologists of the Children's Municipal Clinical Hospital No. 3, Poltava) and 26 primary schoolchildren without type 1 diabetes mellitus. The children were divided into such groups:

- Group 1 included 13 children with healthy periodontium and no concomitant diseases;
- Group 2 – 13 children without concomitant diseases, who had chronic catarrhal gingivitis;
- Group 3 – 26 children with 1 type diabetes mellitus without periodontal inflammation;
- Group 4 – 30 children with 1 type diabetes mellitus and chronic catarrhal gingivitis.

We determined the oral hygiene index (OHI) according to Fedorov-Volodkina (1968) and the simplified oral hygiene index OHI-S (Green-Vermillion, 1964). Also, we studied the PMA index (papillary–marginal–alveolar index) modified by Parma (1960); the gingival index (GI) was determined according to Loe and Silness (1967), the bleeding index (BI) was assessed by Muhleman H.R. (1971) [3, 8, 9].

The exclusion criteria included children who had had orthodontic treatment in resent medical history, or were undergoing orthodontic treatment; who had eruptive gingivitis at the time of examination, antibiotic treatment in the previous 6 months, other systemic diseases except for diabetes mellitus. We also excluded children with diabetes mellitus and any other complications except periodontal inflammation.

We taught all 82 children how to perform oral hygiene routine properly. We recommended using soft toothbrushes, toothpaste, and mouth rinse with extracts of medicinal plants “BIOMED SENSITIVE” (STS Holding Group LTD, Bulgaria) for all the participants [3]. We treated chronic catarrhal gingivitis in children of group 2 following the protocols in the specialty “Pediatric Dentistry” approved by the Ministry of Health of Ukraine.

The management of the children with chronic catarrhal gingivitis and type 1 diabetes mellitus (group 4) combined therapeutic and hygienic measures. Following the examination and diagnosis confirmation, the children received professional oral hygiene and educated how to keep oral hygiene properly. The one-month course included our recommendation to use the toothpaste mentioned above and the mouth rinse with grape extract. The children were also prescribed to take the antioxidant “Askorutin” (LLC Agrofarm, Ukraine) 1 tablet twice a day for 1 month [4]. To normalize oral microbiota, we recommended the patients to rinse the mouth with an antiseptic solution “Sangiva” (JSC Pharmaceutical firm “Darnitsa”, Ukraine) twice a day for 5 days and to take the probiotic “BioGaia Prodentis” (BioGaia AB, Sweden) 1 tablet once a day for 10 days. The evaluation of treatment results was carried out in immediate follow up period, a month since the completion of the full course of treatment for chronic catarrhal gingivitis, and in the remote follow-up period, in 3, 6, and 12 months.

The materials of our research comply with the rules of the Tokyo Declaration of the World Medical Association, the Helsinki Declaration of Human Rights, the Council of Europe Convention on Human Rights and Biomedicine, the legislation of Ukraine, the requirements of the Doctor’s Ethical Code of Ukraine, and orders of the Ministry of Health of Ukraine.

The findings obtained were statistically processed using Microsoft Office Excel 2016 software pack. The Student’s t-test was used to compare independent samples. The difference was considered statistically significant at  $p < 0.05$ .

**Results of the study and their discussion.** The values of oral hygiene indices in the control group (group 1) evidenced a good level of oral hygiene. The children of this group had an intact periodontium, thus their periodontal indices were equal to zero. Oral hygiene indices according to Fedorov–Volodkina and Green, Vermillion equaled  $1.48 \pm 0.05$  and  $0.69 \pm 0.06$  scores.

Our study has shown a statistically significant difference between oral hygiene and periodontal indices before and after the treatment in the group of the non-diabetic children with chronic catarrhal gingivitis (table 1).

Oral hygiene indices according to Fedorov-Volodkina and Green-Vermillion before the treatment approximated to  $1.84 \pm 0.06$  and  $1.60 \pm 0.06$  scores. They indicated a satisfactory level of oral hygiene. The above indices reached the level of good hygiene in a month period ( $1.50 \pm 0.04$  scores according to Fedorov-Volodkina and  $0.48 \pm 0.07$  points according to Green-Vermillion) following the therapy and remained stable in 3-month and 6-month follow-up periods. No statistically significant difference in oral hygiene indices was found in 1 year follow up period, the level of oral hygiene was assessed as satisfactory.

So, we can say that the level of oral hygiene of the above group of children returned to the initial values registered a year ago.

Table 1

**Oral hygiene and periodontal indices in non-diabetic children with gingivitis and children with diabetes mellitus and healthy periodontium before and after the treatment (in dynamics), (M±m)**

	Non-diabetic children with chronic catarrhal gingivitis (group 2) n=13					Children with type 1 diabetes mellitus and healthy gums (group 3) n=26	
Term	OHI (F-V), scores	OHI-S (GV), scores	PMA,%	GI (SL), scores	BI, scores	OHI (F-V), scores	OHI-S (GV), scores
Before treatment	1.84±0.06 * ** ***	1.60±0.06 * ** *** ****	20.52±0.83 * ** *** ****	0.84±0.05 * ** *** ****	0.71±0.05 * ** *** ****	1.65±0.07 * ** ***	0.88±0.07 * ** ***
In 1 month after treatment	1.50±0.04 p=0.00012	0.48±0.07 p=2.71E <sup>-12</sup>	12.22±0.69 p=7.02E <sup>-08</sup>	0.41±0.04 p=7.40E <sup>-07</sup>	0.32±0.05 p=3.20E <sup>-05</sup>	1.41±0.03 p=0.0027	0.38±0.03 p=7.55E <sup>-08</sup>
In 3 months after treatment	1.51±0.04 p=0.00014	0.60±0.05 p=1.50E <sup>-12</sup>	12.69±0.73 p=2.80E <sup>-07</sup>	0.49±0.06 p=5.99E <sup>-05</sup>	0.28±0.06 p=9.770E <sup>-06</sup>	1.40±0.03 p=0.0025	0.38±0.03 p=6.41E <sup>-08</sup>
In 6 months after treatment	1.56±0.04 p=0.0011	0.57±0.05 p=3.61E <sup>-13</sup>	12.23±0.50 p=1.03E <sup>-08</sup>	0.64±0.05 p=0.0055	0.40±0.04 p=0.0001	1.41±0.02 p=0.0020	0.40±0.03 p=2.19E <sup>-07</sup>
In 1 year after treatment	1.74±0.06 <b>p=0.23</b>	1.28±0.05 p=0.00033	13.35±0.78 p=1.73E <sup>-06</sup>	0.53±0.04 p=4.42E <sup>-05</sup>	0.37±0.04 p=5.14E <sup>-05</sup>	1.70±0.03 <b>p=0.47</b>	0.72±0.07 <b>p=0.12</b>

Note: \* – the difference is significant between indices before the treatment and in a month following the treatment, if  $p \leq 0.05$ ; \*\* – the difference is significant between indices before the treatment and in 3 months following the treatment, if  $p \leq 0.05$ ; \*\*\* – the difference is significant between indices before the treatment and in 6 months following the treatment, if  $p \leq 0.05$ ; \*\*\*\* – the difference is significant between indices before the treatment and in a year following the treatment, if  $p \leq 0.05$ .

PMA, gingival index (GI) according to Loe, Silness, and bleeding index according to Muhleman H.R. in the children of group 2 pointed out the mild gingival inflammation. The PMA index decreased in 1.68 times in a month since the treatment had started. It remained at the same level over the year. PMA made up 13.35±0.78 % in a one-year period that was 1.54 times less than before the treatment. Gingival index (GI) according to Loe, Silness in group 2 lowered in 2.05 times and made up 0.41±0.04 scores in a month after the treatment. PMA remained unchanged in 3 months. This index slightly increased over 6 months and 1 year, and approximated to 0.64±0.05 scores and 0.53±0.04 scores, respectively. The dynamics of the bleeding index according to Muhleman was as follows: it demonstrated nearly double fall (in 2.22 times) and approximated to 0.32±0.05 scores in 1 month following the treatment. It was at the same level and equaled to 0.28±0.06 scores in 3-month follow-up period. Then it grew slightly and approximated to 0.40±0.04 and 0.37±0.04 scores in 6 months and a year, respectively.

The children of group 3 with an intact periodontium demonstrated periodontal indices, which equaled to 0 points. Oral hygiene by Fedorov-Volodkina index and by Green-Vermillion index before the treatment in this group approximated to 1.65±0.07 and 0.88±0.07 scores that evidenced a satisfactory oral hygiene. A statistically significant difference was found in 1 month, 3 month, and 6 month periods. No statistically significant difference was observed in one year follow-up period. The values of oral hygiene indices according to Fedorov-Volodkina and Green-Vermillion decreased, respectively, to 1.41±0.03 scores and 0.38±0.03 scores in a month follow up and indicated a good level of oral hygiene. These indices did not change significantly in 3 and 6 months. The absence of a statistically significant difference in this group in one year follow up shows that the oral hygiene indices in this group returned to the values that were at the beginning of the study.

A statistically significant difference was found in 1 month and in 3 months, in 6 months, and in a year, when we analyzed the data of oral hygiene and periodontal indices before the treatment and their dynamics changes in the group 4 (table 2).

The oral hygiene according to Fedorov-Volodkina index and Green-Vermillion index before the treatment demonstrated an unsatisfactory level of oral hygiene and approximated to 2.20±0.08 and 1.87±0.05 scores, respectively. The oral hygiene in these children improved to a good level in 1 month. The level of oral hygiene according to Fedorov-Volodkina index and Green-Vermillion index became stabilized and continued to remain at the same level (good hygiene) in 3 and 6 months. In a year, these

indices slightly increased and corresponded to a satisfactory level of oral hygiene, approximating  $1.75 \pm 0.03$  scores by Fedorov-Volodkina and  $1.27 \pm 0.05$  scores by Green-Vermillion, i.e. they were 1.26 and 1.47 times lower than they were before the treatment.

Table 2

**Oral hygiene and periodontal indices in children with 1 type diabetes mellitus and gingivitis before and after treatment (in dynamics), ( $M \pm m$ )**

Children with 1 type diabetes mellitus and chronic catarrhal gingivitis (group 4) n = 30					
Term	OHI (F-V), scores	OHI-S (GV), scores	PMA,%	GI (SL), scores	BI, scores
Before treatment	$2.20 \pm 0.08$ * ** *** ****	$1.87 \pm 0.05$ * ** *** ****	$40.47 \pm 0.96$ * ** *** ****	$1.83 \pm 0.04$ * ** *** ****	$1.07 \pm 0.05$ * ** *** ****
In 1 month after treatment	$1.35 \pm 0.02$ $p=4.64E^{-14}$	$0.38 \pm 0.03$ $p=3.31E^{-34}$	$9.20 \pm 0.85$ $p=4.01E^{-30}$	$0.64 \pm 0.05$ $p=1.135E^{-24}$	$0.48 \pm 0.05$ $p=2.559E^{-11}$
In 3 months after treatment	$1.27 \pm 0.02$ $p=1.01E^{-15}$	$0.40 \pm 0.03$ $p=6.86E^{-35}$	$18.65 \pm 0.60$ $p=3.24E^{-24}$	$0.65 \pm 0.05$ $p=3.298E^{-26}$	$0.63 \pm 0.05$ $p=8.315E^{-08}$
In 6 months after treatment	$1.35 \pm 0.02$ $p=2.52E^{-14}$	$0.42 \pm 0.04$ $p=8.50E^{-32}$	$25.85 \pm 0.85$ $p=3.446E^{-14}$	$1.41 \pm 0.04$ $p=3.8999E^{-09}$	$0.67 \pm 0.05$ $p=9.825E^{-07}$
In 1 year after treatment	$1.75 \pm 0.03$ $p=5.29E^{-06}$	$1.27 \pm 0.05$ $p=1.39E^{-12}$	$19.03 \pm 0.67$ $p=3.005E^{-23}$	$1.39 \pm 0.04$ $p=9.889E^{-11}$	$0.63 \pm 0.05$ $p=2.285E^{-07}$

Note: \* – the difference is significant between indices before the treatment and in a month following the treatment, if  $p \leq 0.05$ ; \*\* – the difference is significant between indices before the treatment and 3 months following the treatment, if  $p \leq 0.05$ ; \*\*\* – the difference is significant between indices before the treatment and in 6 months following the treatment, if  $p \leq 0.05$ ; \*\*\*\* – the difference is significant between indices before the treatment and a year following the treatment, if  $p \leq 0.05$ .

The PMA index in the group of children with chronic catarrhal gingivitis and type 1 diabetes mellitus was  $40.47 \pm 0.96$  %. It indicated a moderate degree of the inflammatory process. This value decreased more than 4 times and approximated to  $9.20 \pm 0.85$  % (mild inflammation). The above index slightly went up in 3 months, 6 months, and in a year, but, on average, remained twice as lower than before the treatment started. Gingival index (GI) according to Loe, Silness and bleeding index according to Muhleman H.R. before the treatment equaled  $1.83 \pm 0.04$  and  $1.07 \pm 0.05$  scores. They indicated mild inflammation in a month. These indices decreased on average by a half to the level of mild inflammation. These indices were unchanged at the level of mild inflammation in 3 months, 6 months, and in a year. The values of periodontal indices in a year for this group of children were as follows: PMA lowered in 2.13 times, gingival index (GI) according to Loe, Silness went down in 1.32 times, bleeding index according to Muhleman H.R. decreased in 1.7 times, compared with the data obtained before the treatment.

Several studies have shown the prevalence of gingival disease in diabetic patients. Hygienic indices, periodontal indices, bleeding indices – all these indicators grow in groups of children with type 1 diabetes [7, 10, 11]. Our study confirms the earlier findings in the literature and indicates the relationship between type 1 diabetes mellitus and gingivitis [9, 12, 15].

It is known that hyperglycemia in individuals with type 1 diabetes mellitus leads to an increase in oxidative stress [4, 6]. Therefore, we included some agents with antioxidant properties to our treatment scheme. One of them is resveratrol, known as a natural biologically active polyphenolic compound extracted from dark grapes and grape seeds and possessing anti-inflammatory, antioxidant properties. Resveratrol displays potent antibacterial and antifungal activity. Moreover, it is also known as an inducer of the enzyme NO-synthase, and can causes a decrease in NF-kB mediated signaling that leads to a decrease in the inflammation intensity [3]. We should stress that such potent substances as ascorbic acid [4] and rutin induce the stimulation of antioxidant proteins, considerably reduce oxidative stress, as well as lower oxidative lipid metabolism and the level of reactive products of lipid peroxidation [1].

Many authors evidence that periodontal monocytes, macrophages, fibroblasts, and endothelial cells respond to microorganisms, lipopolysaccharides, and other antigens of dental plaque, they secrete numerous chemokines and inflammatory agents [2, 3, 8]. The microbial biofilm is reported as one of the most important pathogenetic contributors in the occurrence of gingivitis in children with type 1 diabetes mellitus. Therefore, the choice of antiseptic plays a critical role in the treatment of periodontal inflammation [7]. We have chosen the medication including 3 active substances, which provide antibacterial, antifungal, anti-inflammatory, and analgesic effects: hexetidine, choline salicylate, and chlorobutanol. The combination of these active ingredients improves the permeability of the oral mucosa and increases the effectiveness of the antiseptic through the extended duration of its effect and the

enhancement of its antiseptic action [10]. Normalization of the oral microflora composition by using oral probiotics was the next step in the treatment of chronic catarrhal gingivitis in children with type 1 diabetes mellitus. Oral probiotics consists of numerous microorganisms, which affect the causative agents of periodontitis, gingivitis, and other oral infections. This effect enables to reduce inflammation and, thus, to lessen the gingival bleeding [14].

The results obtained have proven the treatment scheme of chronic catarrhal gingivitis in children with type 1 diabetes mellitus we elaborated is quite effective. We have observed the positive changes in the condition of the periodontium and the improvement in the level of oral hygiene in the children. The effectiveness of the treatment described can be explained by the effect each component produces on leading chains in the pathogenesis of periodontal diseases in patients with insulin-dependent diabetes mellitus.

#### Conclusion

The elaboration of individualized and specific schemes for the prevention and treatment of periodontal diseases in children with 1 type diabetes mellitus should be based first and foremost on the endocrinological status of children.

Etiological factors and pathogenetic mechanisms of periodontal diseases should be considered as basic when making individualized treatment plan for children with type 1 diabetes mellitus with chronic catarrhal gingivitis that implies meticulous evidence-based selection of medicinal agents. We recommend including antiseptic solutions and oral probiotics for normalizing oral microflora. Using medications with antioxidant properties seems to be quite effective for children with chronic catarrhal gingivitis and type 1 diabetes mellitus. Another fundamental contributive factor in the efficacy of the therapy for gingival diseases is proper in-office and home oral care. Thus, the application of the treatment scheme we elaborated produces a positive effect on the clinical course of periodontal diseases and contributes to the improvement both in the immediate and long-term treatment outcomes.

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