# Efficiency of the Algorithm of Examination, Treatment and Rehabilitation of Dental Patients with Comorbid Pathology

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**Abstract**

Inflammatory periodontal diseases, diabetes and diseases of the cardiovascular system are comorbid diseases. The application of the developed algorithm for the examination, treatment and rehabilitation of comorbid dental patients allowed to increase the frequency of revealed cardiometabolic disorders and improve the results of complex treatment.

The algorithm of diagnostic measures included differential diagnosis of galvanosis and inflammatory diseases of the oral mucosa of a different origin; screening questionnaires to determine disorders of carbohydrate metabolism and Laser Doppler Flowmetry (LDF) of periodontal vessels and the skin of the palmar surface of the terminal phalanx of the IV finger of the left hand to identify the risk of cardiovascular diseases (CVD). In patients at risk of diabetes, the level of glucose in the gingival blood was determined. Patients with revealed disorders of the LDF-gram and elevated blood glucose level were referred for examination to clinicians (therapist, endocrinologist, cardiologist).

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## Introduction

It is known that all pathological processes occurring in the human body are accompanied by disorders of neurohumoral, metabolic, immune and mineral metabolism and cannot but affect the soft and hard tissues of the oral cavity[1]. High prevalence of dental caries and periodontal diseases is registered in all countries of the world[2,3]. Most often, patients visit a dentist for dental treatment and prosthetics, not paying attention to inflammation and bleeding of the gums and not knowing the dental signs of somatic diseases[4,5]. Many people do not pay attention to the symptoms of cardiovascular and endocrine diseases for a long time, which can worsen the results of treatment of dental pathology[6,7]. It is known that inflammatory periodontal diseases and cardiometabolic disorders are comorbid conditions that tend to mutually increase in the severity of diseases[8,9].

The prevalence of comorbidity, according to a study by many authors, ranges from 69 % in young patients to 93 % in middle-aged people and up to 98 % in older patients. Most often in the work of a doctor there are combinations of two and three diseases, but in isolated cases, up

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to 6-8 diseases are combined simultaneously in one patient[10]. Therefore, it is so important to identify and treat comorbid pathology in dental patients in a timely manner, as well as to sanitize the oral cavity and eliminate chronic inflammation in the periodontium in persons with somatic disease. The absence of a unified comprehensive scientific approach to the assessment of comorbidity leads to gaps in clinical practice. To improve the quality of medical care, it is necessary to develop and implement standards and algorithms that ensure the effectiveness of therapeutic and preventive measures in dental patients[11].

Objective: to evaluate the results of applying the algorithm for the examination, treatment and rehabilitation of dental patients with comorbid pathology**.**

## Materials and methods

The study, after receiving written informed consent, included 441 patients (322 – women, 119 – men) aged 35-65 years (average 47 years), who went to the dental clinic for various purposes, but all after a standard examination were found to have chronic generalized inflammatory periodontal diseases. The algorithm of diagnostic measures included differential diagnosis of galvanosis and inflammatory diseases of the oral mucosa of a different origin; screening questionnaire to detect carbohydrate metabolism disorders and laser Doppler flowmetry (LDF) of periodontal vessels and skin of the palmar surface of the terminal phalanx of the IV finger of the left hand to identify the risk of cardiovascular diseases (CVD).

In patients at risk of diabetes mellitus, the level of gingival blood glucose was determined[12,13]. Patients with revealed disorders of the LDF-gram and elevated blood glucose levels were referred for examination to clinicians (therapist, endocrinologist, cardiologist). From 195 patients (137 women, 58 – men) with identified disorders of carbohydrate metabolism and cardiovascular disease treatment and rehabilitation measures include a combination of professional oral hygiene (including the appointment of the objects and means of personal hygiene and training in their use), rehabilitation, a course of periodontal treatment, prosthetic treatment, treatment of identified somatic diseases, advice on nutrition and lifestyle. Repeated examinations, correction of removable prostheses and maintenance therapy were performed 3, 6 and 12 months after prosthetic treatment. The results of the developed algorithm were evaluated by the indicators of oral hygiene (OHI-S) and dentures, the state of periodontal tissues (PMA index, Muhlleman-Cowell gum bleeding index), the achievement of target blood pressure and blood glucose levels by patients[14].

## Results

Based on the results of diagnostic screening measures, cardiometabolic risks were identified in 343 (77.8%) examined dental patients: in 174 (39.4%) patients – carbohydrate metabolism disorders combined with an increased glucose content in the gingival blood on an empty stomach, in 138 (31.3%) – deviations from the standard parameters of LDF-grams of periodontal vessels, in 31 (7.0%) – all of the above disorders. No corresponding risks were identified in 98 (22.2%) patients.

Recommendations to be examined by an endocrinologist were received by 205 patients, by a cardiologist – 169 (38.3%). 205 patients underwent endocrinological examination, 117 patients underwent cardiological examination (100% and 69.2% of those referred, respectively). After a dilated endocrinological examination, a disorder of glucose tolerance was diagnosed in 123 patients (60.0% of the examined), they were given recommendations on nutrition and lifestyle. Cardiological examination revealed diseases of the cardiovascular system in 79 patients (67.52% of the examined), and appropriate treatment was prescribed. The implementation of the diagnostic part of the algorithm confirmed the possibility of forming risk groups among dental patients for the revealing of DM and CVD.

Control of the treatment and rehabilitation measures of the developed algorithm showed that 61.5% of patients followed the recommendations of dentists and clinicians: after passing a three-stage screening and a specialized examination, they began to monitor the revealed diseases and perform appointments (group 1). The remaining 38.5% of patients, after screening, refused further follow-up by clinicians, and were critical of the prescriptions and recommendations of doctors (group 2). At the first examination, according to the OHI-S index, the state of oral hygiene in patients was

satisfactory (70.0%) or poor (30.0%). After rehabilitation and periodontal treatment, oral hygiene improved in patients of both groups, to a greater extent in group 1 than in group 2: 46.7% and 25.3% of patients had a good level of hygiene, p<0.001, satisfactory-53.3% and 74.7%, respectively, p<0.001. However, after 3, 6 and 12 months after prosthetics, oral hygiene indicators gradually deteriorated, especially in group 2. After 12 months, the level of oral hygiene in group 2 was poor in all patients, in group 1 - only in 12.5%.

Quality of cleaning of removable dentures (n=32) in patients of the 1st group during the entire follow – up period after prosthetic treatment was, as a rule, excellent or satisfactory: after 3 months – 78.1% and 21.9%, 6 months – 46.9% and 50.0%, 12 months - 31.2% and 50.0%, respectively. Poor hygiene of prostheses was recorded only after 6 months in 3.1% of cases, 12 months - 18.7%. In group 2, the hygiene of removable dentures (n=31) gradually deteriorated: after 3 months, it was satisfactory in 64.5% of cases, poor - 35.5%, 6 months-58.1% and 41.9%, 12 months - 38.7% and 61.3%, respectively (Table 1). The differences between the groups were significant statistically (p<0.001).

| Observation period | Oral hygiene, according to OHI-S | Number ( % ) of cases in the group | | Hygiene of dentures | Number ( % ) of cases in the group | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | | 1 | 2 |
| 3 months | good | 8,33 | 0,00* | excellent | 78,12 | 0,00* |
| | satisfactory | 91,67 | 100* | satisfactory | 21,87 | 64,52* |
| | poor | 0,00 | 0,00 | poor | 0,00 | 35,48* |
| 6 months | good | 0,00 | 0,00 | excellent | 46,87 | 0,00* |
| | satisfactory | 89,16 | 14,66* | satisfactory | 50,00 | 58,06 |
| | poor | 10,83 | 85,33* | poor | 3,13 | 41,94* |
| 12 months | good | 0,00 | 0,00 | excellent | 31,25 | 0,00* |
| | satisfactory | 87,50 | 0,00* | satisfactory | 50,00 | 38,71 |
| | poor | 12,50 | 100* | poor | 18,75 | 61,29* |

**Table 1**.Oral hygiene and hygiene of removable dentures in patients after prosthetic treatment.
* significance of differences p<0.01-0.001 between groups.

Inflammatory changes in periodontal tissues (according to the PMA data) were defined in all patients at the first examination: mild – 3.6%, average – 85.6%, severe - 10.8%. After rehabilitation and periodontal treatment in both groups, the number of patients with mild gum inflammation increased to 72.0%, with moderate and severe degrees of inflammation decreased in the 1st group to 25.8% and 2.5%, the 2nd - 25.3% and 25.7%, respectively. After prosthetic treatment for 12 months, most patients of the 1st group showed a decrease in the severity of gum inflammation, in 2nd group negative dynamics of indicators were observed (Table 2).

| Observation period | The degree of gingivae inflammation, according to the PMA index | Number ( % ) of cases in the group | | The degree of gum bleeding, according to Muhllemann-Cowell index | Number ( % ) of cases in the group | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | | 1 | 2 |
| 3 months | absent | 0,0 | 0,0 | 0 | 47,5 | 14,7* |
| | mild | 81,7 | 29,3* | 1 | 45,0 | 42,7 |
| | moderate | 18,3 | 68,0* | 2 | 5,8 | 32,0* |
| | severe | 0,0 | 2,7 | 3 | 1,7 | 10,7* |
| 6 months | absent | 0,0 | 0,0 | 0 | 49,2 | 0,0* |
| | mild | 82,5 | 14,7* | 1 | 45,0 | 13,3* |
| | moderate | 16,7 | 81,3* | 2 | 4,2 | 70,7* |
| | severe | 0,8 | 4,0 | 3 | 1,7 | 16,0* |
| 12 months | absent | 0,0 | 0,0 | 0 | 48,3 | 0,0* |
| | mild | 80,8 | 0,0* | 1 | 41,7 | 6,7* |
| | moderate | 19,2 | 84,0* | 2 | 6,7 | 64,0* |
| | severe | 0,0 | 16,0* | 3 | 3,3 | 29,3* |

**Table 2**. The condition of the gingivae in patients after prosthetic treatment in patients after prosthetic treatment.
* significance of differences p<0.01-0.001 between groups.

In all patients, during the initial examination, bleeding of the gums of various degrees of severity was recorded (according to the Muhlleman-Cowell index): the 1st degree – 8.7% of cases, the 2nd – 18.5%, the 3rd-72.8%. After rehabilitation and periodontal treatment, gum bleeding decreased in both groups. The first degree of gum bleeding was defined in patients of groups 1 and 2 in 53.3% and 52.0% of cases, the second – 9.2% and 10.7%, the third-2.5% and 2.7%, bleeding was not noted-35.0% and 34.7%, respectively. After prosthetic treatment in group 1, during the entire follow – up period, gum bleeding was not defined in almost half of the patients, the 1st degree of bleeding was defined in more than 40.0%, the 2nd and 3rd-in less than 10% of patients. In group 2, negative dynamics was revealed, after 6 and 12 months, all patients had gum bleeding, more often than the second (70.7% and 64.0%) and third (16.0% and 29.3%) degrees (Table 2).

Before the beginning of treatment and rehabilitation measures, all patients had blood glucose levels higher than normal, and blood pressure was not monitored. A complete examination of patients by clinicians in a somatic clinic, determining the target values of glycemia and blood pressure took several weeks, then patients began to take the medications prescribed by clinicians and adhere to the recommended lifestyle and diet. After 6 months, blood glucose levels corresponded to the target values in the majority (89.2%) of patients in group 1, in group 2-28.0%, p<0.001, after 12 months-86.7% and 17.3%, respectively, p<0.001. Blood pressure indicators after 6 months corresponded to the target values in group 1 in 93.3% of patients, in group 2-34.7%, p<0.001,

after 12 months-91.7% and 26.7%, respectively, p<0.001. Commitment to the implementation of the recommendations of doctors in accordance with the developed algorithm of diagnostic and treatment-rehabilitation measures.

## Discussion

The implementation of the diagnostic part of the algorithm confirmed the possibility of forming risk groups among dental patients for revealing of DM and CVD. Control of the treatment and rehabilitation measures of the developed algorithm showed that the majority of patients followed the recommendations of dentists and clinicians (group 1). The remaining patients refused further follow-up by clinicians (group 2). In the first group of patients, during the entire follow-up period, there were higher hygienic indicators, high-quality cleaning of removable dentures, and a decrease in bleeding gums. Blood pressure and blood glucose values were more consistent with the target values in patients who followed the recommendations of general practitioners.

## Conclusions

Thus, the developed algorithm of diagnostic and treatment-rehabilitation measures increased the motivation of dental patients to be examined by clinicians and to control the identified somatic diseases, and allowed to improve the indicators of dental and general health in patients with comorbid pathology. Commitment to the implementation of the recommendations of doctors in accordance with the developed algorithm of diagnostic and therapeutic and rehabilitation measures has significantly improved the results of treatment of dental patients.

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## Declaration of Interest

The authors report no conflicts of interest pertaining to any of the products or companies discussed in this article.

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