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## EVALUATING OF THE EFFECTIVENESS OF DENTAL TREATMENT BY ANALOG AND DIGITAL METHODS

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**Abstract.** 50 patients with generalized periodontitis IA, IB under the conditions of a continuous dentition took part in our study. The state of the periodontal tissues was assessed using indices – PMA index, CPI, the Green-Vermillion hygienic index. The study of occlusion-articulation relationships was carried out with the help of Bausch articulating paper with a thickness of 100 microns. Selective diagnostic grinding was performed on gypsum casts in the articulator. Diagnostics and correction of premature occlusal contacts was carried out with the help of the T-scan 10 device. The following results were obtained - after our algorithm of prosthetic examination and occlusal correction, an improvement in the indicators of tooth mobility was established within 1 week and 6, 12 months after grinding. A change in the indicators registered on the T-scan device (the balance between the right and left sides became at the level of 55%-45% in 70% of patients, and 60%-40% in 30% of patients, the average disocclusion time was  $0.44 \pm 0.05$  seconds, time of occlusion -  $0.25 \pm 0.05$  sec.). The index assessment of the state of the periodontal tissues after the treatment showed a significant decrease in inflammation in the gums and improvement of oral hygiene. The obtained results indicate that improving the process of prosthetic examination of patients with generalized periodontitis and the tactics of selective grinding with our method allows to improve the effectiveness of controlling of occlusal-articulation relationships.

**Key words:** generalized periodontitis, occlusal-articulation relationships, digital method, analog method, partial tooth loss, occlusion correction.

### Introduction.

The problems of marginal periodontal disease are still actual at the current stage of development of science and practice. It is conditioned by the fact that inflammatory periodontal disease along with caries and its complications are the main reasons of tooth loss. According to the literature, 40-75% of the population aged 35-49 years have inflammatory marginal periodontal disease accompanied by loss of bone volume [1; 2].

In the development of inflammatory processes the leading role is assigned to microorganisms, periodontopathogens, toxins and enzymes that have not only a direct damaging effect on the tissue, but also indirectly initiate endogenous mechanisms in the development of inflammation [3].

An important role in the pathogenesis of marginal periodontal disease is played by microcirculatory disorders, hypercoagulation and vascular thrombosis. The greatest changes are noted at the capillary level, as a result of which the blood flow rate decreases, tissue hypoxia develops, disorganization of the connective tissue of the periodontal complex occurs, which leads to the formation of secondary autoantigens and eventually to the development of osteonecrotic and osteolytic processes.

In the diagnosis of marginal periodontal pathology special attention is now given to functional physical criteria for comparative diagnosis of bone tissue structure and identification of abnormalities of the occlusal plane, occlusal load [4; 5].



Studies have shown that the correction of pathological processes must be carried out from the results of a comprehensive diagnostic analysis. It has been established that a single highly effective means, local diagnostic factor or method is not sufficient for the complex topical correction of therapeutic measures. In this connection the use of modern diagnostic criteria, allowing objective standardisation of quantitative changes of periodontal tissues is an urgent and promising trend.

In the era of evidence-based medicine great importance is given to objective standardised evaluation of damaging factors that allow in dynamics to analyse the state of the marginal periodontium before treatment, during treatment, to characterise the slowing down or progression of chronic disease, which finally characterises the rationality of the conducted treatment methods, including the quality of life of patients.

Modern new methods of diagnostic monitoring - digital scanning of the oral cavity and dental model of patients in the 3D plane, allows to substantiate the main regularities of the action of damaging factors, effectively and safely standardise the conditions of the real clinical picture in patients with chronic inflammatory processes in the periodontium [6].

However, a comprehensive quantitative diagnostic characterisation of alveolar periodontal tissue changes without taking into account various combinations of qualitative changes is insufficient.

The practical use of orthopantomography as a method of objective diagnosis of the condition of the alveolar processes of the jaw, to date finds absolute confirmation [7].

The researches of the last years have determined the basic laws of X-ray examination of patients and discovered the expediency of analyzing not only the total volumetric changes of bone condition along the whole thickness of the alveolar process, but also the necessity of detailing the X-ray symptoms depending on the depth and volume of lesions. This allows for a comprehensive assessment of the topical diagnostic and clinical picture of the periodontium, rationally outlining and optimising treatment methods and tools with an in-depth understanding of the structural change of the periodontium in the various sites.

Thus optimisation of radiological examination of patients, especially in the period of secondary adentia with subsequent prosthetic rehabilitation, allows to estimate comprehensively the efficiency and safety of combined methods of orthopaedic restoration of masticatory load on periodontium.

In real clinical practice, the use of computed tomography of the alveolar processes is justified. Analysis of qualitative changes of the periodontal complex in patients with chronic periodontitis and establish the significance of this method for the correct choice of prosthodontic treatment as an optimization and rehabilitation method based on methods of directional correction of the occlusal plane and masticatory efficiency.

The principle of an in-depth understanding of pathogenesis, when predetermining the condition, is essential in these patients.

Serious progress [8; 9].

Studies of the functional load on the detection of traumatic nodules, the periodontium are obtained using the T-scan method.

Thus, modern automated systems for functional and structural examination of the



periodontium of patients with chronic periodontitis require a comprehensive analysis. This involves objectivisation of the resolution of each method, which allows studying the accuracy and diagnostic significance of various methods of periodontal assessment in patients with chronic inflammatory process in the periodontium, to detect both local changes and systemic status in the oral cavity [7; 9].

In this regard, there is a clear need for further research to investigate the standardisation of a set of methods. Determination of the discrepancy between instrumental and automated standard examinations depending on the jaw, dental segment, tooth surface taking into account the anatomical and functional features will make it possible to identify the dynamics of changes in pathological processes in the periodontium [7; 8; 9].

### **Main text**

#### **Object and research methods.**

The 80 patients were involved into investigation about chronic generalized periodontitis (CGP) of the I-II types. The diagnosis was established according to the current systematization of periodontal diseases, edited by Prof. M. F. Danilevsky (1994). The average age of patients was  $36.0 \pm 6.8$  years. The control group ( $n=20$ ) was as comparable as possible in age and sex to the patients examined. The standard of clinical examination included the collection of complaints, a history of life and illness, an objective examination – the determination of periodontal indices of inflammation, the depth of periodontal pockets, tooth mobility, which made it possible to combine these patients into one nosologically homologous series. To determine the violation of occlusive ratios and to carry out a comparative morpho-functional state of periodontium, digital scanning, T-scan and X-ray examination (orthopantomography and computed tomography) were performed. All studies were carried out at the Dental Medical Center of the Bogomolets National Medical University, Kyiv city, Ukraine.

Methods for assessing occlusive ratios of dentition were carried out on the T-scan apparatus of the American company Tekscan. This computer analysis system made it possible to evaluate data on the sequence of contacts, the time of occurrence of the first contact and its localization, the sequence of contacts in real time, the force of compression of the dentition over a certain period, to follow the change in occlusive ratios of dentition from the first contact to the maximum intertubercular contact, followed by video recording in color differential scales. This contributed to the objectification of the identified violations with the full standardization of the survey method in dynamics with a comparative time mode, and made it possible to present graphically obtained results.

Intraoral scanning method. Scanning of recession and dehiscence areas before and after treatment using the Medit i500 intraoral scanner (MEDIT Corp., Seoul, Korea) (FOV scanning –  $14 \times 13$  mm, scan accuracy –  $(4.2 \pm 0.49)$  microns, scanning precision –  $(2.1 \pm 0.58)$  microns, scanning depth range – 1221 mm). Further analysis of recession and dehiscence sites was carried out by Medit Link v2.6 software based on the scanner manufacturer's digital platform (MEDIT Corp., 88 Seoul, Korea) using available functions to diagnose the initial clinical characteristics and their changes achieved as a result of the treatment.

Computed tomography. Statistical calculations were carried out using the



Microsoft Excel Statistics for Windows application package. The reliability of the differences was determined by the Student's criterion, at  $p \leq 0.05$ .

### **Research results.**

It was established that the chronic generalized periodontitis of I-II types in 99.7% of patients is accompanied by the presence of signs of chronic inflammation in the gums, recession, dehiscence, fenestration, exposure of anatomical necks and roots of teeth up to 1/3–1/2 length ( $P < 0.01$ ).

In the clinical assessment of the state of inflammation of the gums, anatomical disorders were identified, in particular deformations of the marginal edge in the form of recessions from 1 to 4 mm, with exposure of the anatomical teeth and roots of the teeth up to 1/3–1/2, displacement of teeth in the mesio-distal and vestibule-oral direction, uneven abrasion of tubercles or cutting edge, wedge-shaped defects ( $p < 0.01$ ). The presence of periodontal pockets of different depths up to 4 mm was indicated by different levels of quantitative and qualitative destruction of the alveolar shoots of the upper and lower jaw, which occurred due to the vertical, uneven type of resorption. During clinical examination of periodontal pockets, all patients have a point release of hemorrhagic-serous exudate, uneven moderate edema, poorly defined redness of the mucous membrane within the interdental spaces ( $p < 0.01$ ). Uneven changes in the exposure of teeth, the severity of signs of inflammation in the gums contributed to the formation of a more differentiated, in-depth comprehensive examination of patients to identify determinant destabilization of the dentition functional state and jaw system, and further control of structural changes. All documents regulating the strategy and phasing of treatment of this group of patients, firstly, professional hygiene and the appointment of local anti-inflammatory therapy, provide for the consistent elimination of traumatic occlusion, which is aggravated primarily by the mobility of the teeth and the destruction of the spongy bone of the interdental membranes.

In this regard, the sequence and choice of methods for restoring occlusive balance and chewing efficiency will be determined by multi-link, standardized, objective comprehensive study of periodontal tissues, with the identification of topical multi-level damage.

Due to this, we have proposed an algorithm for a comprehensive standardized automated modern examination of a periodontal tissues state comple. Comparing the data of digital intraoral scanning with X-ray methods (orthopantomography and computed tomography) of alveolar shoots, an ambiguous interpretation was found regarding the ratio of structural, quantitative, and qualitative changes ( $p < 0.01$ ).

Digital intraoral scanning – as a method of visualizing the structural external manifestations of CGP is not quite sufficient to determine the severity of existing objective structural changes in periodontium. There is an absolute correspondence between reliability relative to the degree of recession, fenestration ( $p < 0.01$ ).

However, determining the degree of resorption of the interdental membranes, osteolytic bone destruction is not the main criterion for the final choice of using method for further treatment and the restoration of chewing efficacy. A mandatory assessment of qualitative changes in bone tissue is necessary, which is more accurately reflected in computed tomography. Dental panoramic radiography suggests the level of



osteolysis, while the qualitative characteristics of the osteonecrosis in the form of varying degrees of severity of osteoporosis are leading, but not sufficiently in-depth and correctly ( $p < 0.05$ ) are visualized in the orthopantomogram.

Probably local heel osteoporosis should be considered primarily as a sub- and decompensatory process due to peripheral circulatory disorders. Therefore, conversion as a rejection of the proposal to conduct only traditional orthopantomography, and the use of modern standardized methods for diagnosing functional disorders using T-scan, morphological comparative computed tomography for the qualitative characterization of the altered structure of interdental membranes. At the present stage, medical complex diagnostics is a necessary and argumentative fact.

The main indications for conversion are:

1) Anatomical features of each individual patient (determined by the primary analysis of clinical manifestations and necessarily complemented by holistic visualization due to intraoral scanning of dentition, which is a duct of reliable examination of the patient in dynamics)

2) Changes in the objective assessment of the severity between the external manifestation of the jaw ridge bone and the functional pathophysiological activity of the process (this is manifested by the discrepancy between the visualization of intraoral scanning data and the state of the occlusal plane, taking into account the adaptive and complex rebuilding in the area of traumatic nodes – sequence, occlusal contact force level, the presence of tubercle contacts, the duration of closure, which is objectively recorded by the "T-scan" device.

3) Insufficient resolution of orthopantomography in terms of step-by-step qualitative changes in bone tissue and periodontium around interdental membranes (this is due to the impossibility of determining the reliable and objective analysis of osteoporosis and changes in bone architectonics around traumatic nodes).

The objectivity of the functional changes is assumed when carrying out complex method for assessing the occlusive ratios of dentition "T-scan". Without these data, the doctor, due to the low resolution of the visual apparatus, cannot indicate the preservation of the balance between true osteoporosis and bone osteonecrosis (pic. 1). An uneven step-by-step change in the architectonics of bone tissue in the integral volume of the interdental membrane is an objective fact in 97.5% without considering the cut depth of the study plane.

The analysis of orthopantomogram indicates that it is impossible to detect the degree of osteoporosis within the interdental shades ( $P < 0.01$ ) (pic. 2). With this mechanism, the imbalance of osteoporosis, depending on the step-by-step study of the interdental membrane, is consistent with our data.

Thus, the peripheral conversion index at the current level of diagnosis varies. This indicates the preservation of a balance between the main functional-structural mechanism, which determines the pathophysiological activity of inflammatory-destructive processes.

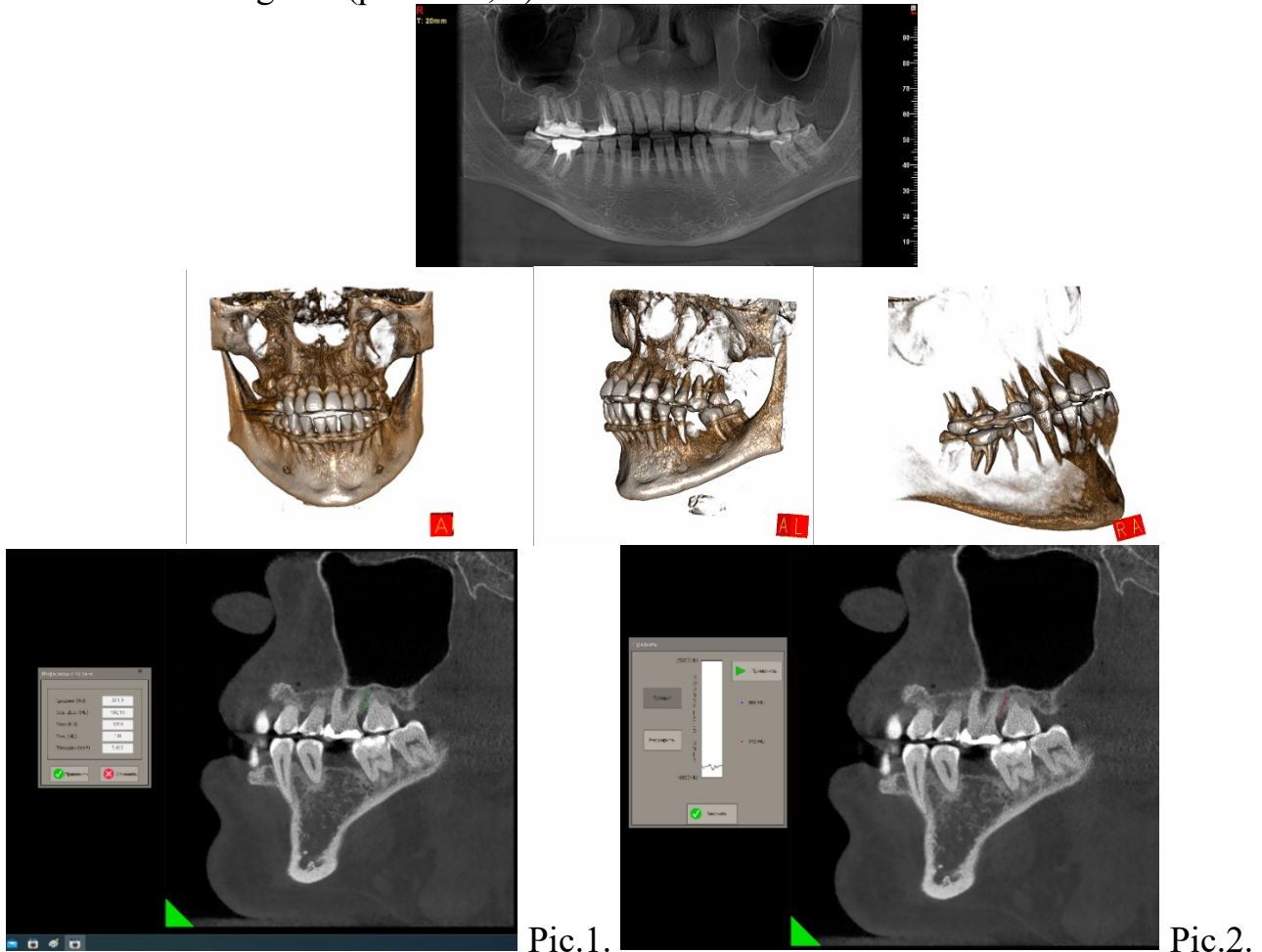
Summarizing, standardized hardware examination of periodontal tissues for chronic generalized periodontitis of I-II types will allow an objective assessment of the functional and structural changes complex to detail topical disorders, to determine methods, directions of pathogenetic treatment, predicting the course disease (pic. 3).



To confirm, a comprehensive additional study of patients diagnosed with chronic generalized periodontitis of the I-II types will be possible by using the auxiliary digital intraoral scanning, T-scan, orthopantomography, computed tomography of alveolar shoots. We have presented several clinical examples.

Pictures

Patient K. Age 41 (picture 1, 2).

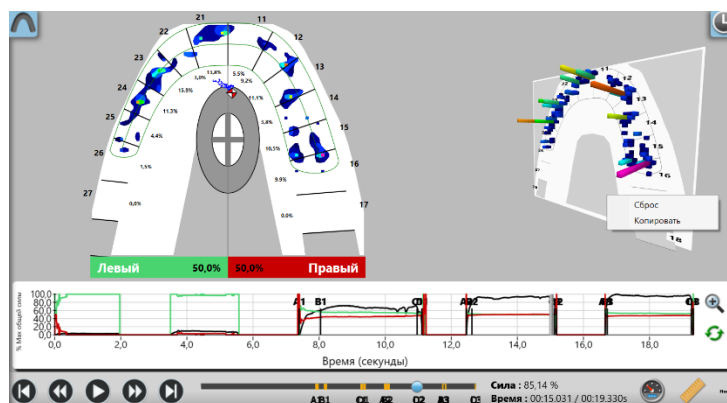


Pic.1.

Pic.2.

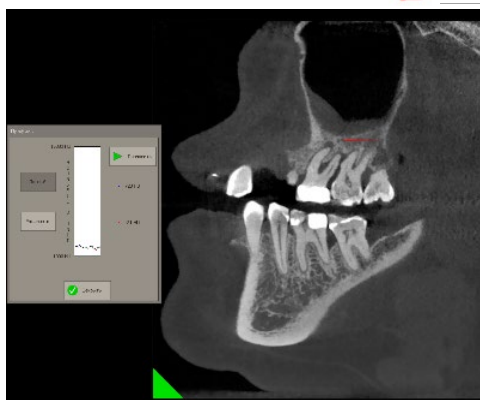
Picture 1.

Area within 26-27 teeth, histogram, densitometry. Hounsfield unit average value 621,9 un, within osteoporosis 138 un, maximum density 1089 un.



Picture 3.

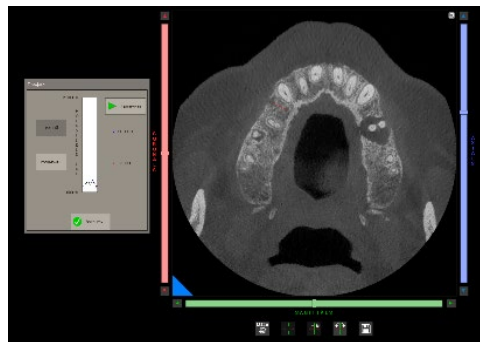
T-Scan . Different level of occlusal load during primary occlusion of teeth. Patient V. Age 43 (picture 3).



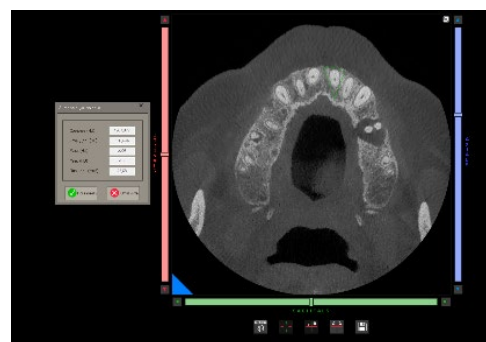
Pic.1.



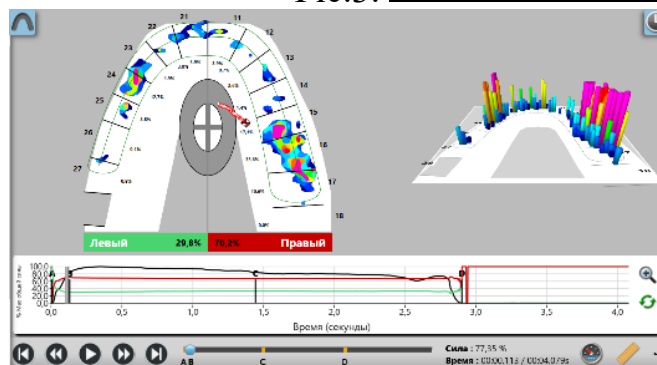
Pic.2.



Pic.3.



Pic.4.



Pic.5.

Picture 2.

**Sagittal projection. Area within 16-17 teeth, histogram, densitometry. Hounsfield unit average value 484,6 un, within osteoporosis 150 un, maximum density 897 un.**



### Summary and conclusions.

1. A comprehensive study of periodontal tissues, which includes digital intraoral scanning, T-scan, orthopantomography, computed tomography of the alveolar germs of the jaws, is a mandatory standardized automated study.

2. This diagnostic complex can allow to identify functional and structural changes, which in turn involves minimizing errors in objective diagnostics, to correct and predict treatment methods depending on the individual characteristics of the course of the disease.

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