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ELECTRO-MYOGRAPHIC CHARACTERISTICS OF THE CHEWING MUSCLES OF PERSONS WITH PERIODONTAL TISSUE DISEASES COMLICATED BY PARTIAL TOOTH LOSS

ABSTRACT

Diseases of periodontal tissues complicated by defects of the tooth rows are accompanied by functional changes of the dental system, which are accompanied by disturbances of bioelectrical activity of chewing muscles.

The degree of functional change of chewing muscles is directly related to the clinical form of parodontitis and the size and topography of the defects of the tooth rows.

*The **purpose** of our research was to study the electromyographic characteristics of chewing muscles in persons with periodontal tissue diseases, complicated by partial loss of teeth of different size and localization.*

***Materials and methods.** In order to achieve this goal, we have conducted clinical and electro-myographic studies of chewing muscles (m. Masseter) in 82 people between 30 and 69 years of age with periodontal tissue diseases, complicated by partial loss of teeth of different size and localization, including the control group of the same age with 10 patients with intact tooth rows and physiological forms of bite without clinically diagnosed diseases of periodontal tissues. Electromyographic research was carried out with the help of the computer neuroelectrical romograph M-Test, the production of the combination of the «DH-system» (Ukraine) and the computer system for the analysis of electromyographic records.*

***Results and discussion thereof.** The results of electromyographic studies showed the prolongation of the chewing period, the reduction of the chewing rhythm, the deterioration of chewing efficiency under generalized parodontitis, compared to the norm, which increased in dynamics. The relationship between excitating and braking processes deteriorated sharply with the increase of the activity time due to the shortening of the relative bioelectric rest period. The biopotency amplitude decreased*

relative to the norm, with severe dysfunctional chewing muscles in general.

Conclusions. *The results of the electromyographic studies of chewing muscles make it possible to determine the degree of functional change in the neuromuscular apparatus of the dental system of patients with generalized parodontitis of different degrees of severity compared to the norm, indicating a decrease in chewing efficiency and progression of functional disorders, which are increasing in dynamics.*

Keywords: *generalized parodontitis, electromyography, chewing muscles.*

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ЕЛЕКТРОМІОГРАФІЧНІ ХАРАКТЕРИСТИКИ ЖУВАЛЬНИХ М'ЯЗІВ ОСІБ ІЗ ЗАХВОРЮВАННЯМИ ТКАНИН ПАРОДОНТА, УСКЛАДНЕНИМИ ЧАСТКОВОЮ ВТРАТОЮ ЗУБІВ

Резюме.

Захворювання тканин пародонта, ускладнені дефектами зубних рядів супроводжуються функціональними змінами зубощелепної системи, які супроводжуються порушеннями біоелектричної активності жувальних мязів.

Ступінь функціональних змін жувальних м'язів знаходяться у прямій залежності від клінічної форми пародонтиту та величини й топографії дефектів зубних рядів

Метою *нашого дослідження було вивчення електроміографічних характеристик жувальних м'язів у осіб із захворюваннями тканин пародонта, ускладненими частковою втратою зубів різної величини та локалізації.*

Матеріал і методи*. Для досягнення мети нами було клінічно обстежено та проведено електроміографічні дослідження жувальних м'язів (m. masseter) у 82 осіб віком від 30 до 69 років із захворюваннями тканин пародонта, ускладненими частковою втратою зубів різної величини та локалізації, у тому числі і контрольну групу цього ж вікового періоду у кількості 10 пацієнтів з інтактними зубними рядами та фізіологічними формами прикусу без клінічно діагностованих захворювань тканин пародонта. Електроміографічні дослідження проводили за допомогою комп'ютерного нейроелектроміографа M-Test, виробництва об'єднання «ДХ-системи» (Україна) та комп'ютерної системи для аналізу електроміографічних записів.*

Результати та їх обговорення. *Результати електроміографічних досліджень засвідчили подовження терміну жування, зниження ритму жування, погіршення жувальної ефективності при генералізованому пародонтиті, порівняно з нормою, які наростали в динаміці. Співвідношення між збуджувальними та гальмівними процесами при цьому різко погіршувалася зі збільшенням терміну активності за рахунок скорочення терміну відносного біоелектричного спокою. Величина амплітуди біопотенціалів також знижувалася відносно норми із серйозним порушенням координації жувальних м'язів в цілому.*

Висновки. *Результати електроміографічних досліджень жувальних м'язів дозволяють визначити ступінь функціональних зміни нервово-м'язового апарату зубощелепної системи пацієнтів з генералізованим пародонтитом різного ступеня тяжкості, порівняно з нормою, які вказують на зниження жувальної ефективності та прогресування функціональних порушень, які зростають в динаміці.*

Ключові слова: *генералізований пародонтит, електроміографія, жувальні м'язи.*

Relevance of research. Periodontal diseases are accompanied by significant both morphological and functional disorders of the dental system, especially in the case of partial tooth loss. Functional disorders in the form of changes in the bioelectrical activity of the masticatory muscles and biodynamic balance are directly dependent on the clinical form of periodontitis and the size and topography of dentition defects. The study of electromyographic characteristics of masticatory muscles allows to establish the degree of functional changes in various pathological conditions of the masticatory system and further control the degree of functional rehabilitation of patients after prosthetics [1-6], which determines the relevance of our studies.

The aim of our research was to study the electromyographic characteristics of the masticatory muscles in individuals with periodontal disease complicated by partial loss of teeth of different sizes and locations.

Material and methods. To achieve this goal, we clinically examined and conducted electromyographic studies of the masticatory muscles (m. Masseter) in 82 people aged 30 to 69 years with periodontal disease of varying severity, complicated by partial loss of teeth of different sizes and topography, including control group of the same age period in the number of 10 patients with intact dentitions and physiological forms of occlusion without clinically diagnosed periodontal diseases.

All studies were conducted in accordance with the Council of Europe Convention on the Protection of Human Rights and Human Dignity in Respect of the Application of the Advances in Biology and Medicine: Convention on Human Rights and Biomedicine (ETS № 164) of 4 April 1997 World Medical Association (2008). Each patient signed an informed consent to participate in the study.

Patients were determined the functional state of the masticatory muscles by electromyography, which consisted of recording the bioelectric potentials of the muscles before prosthetics.

Electromyographic examination was performed using a computer neuroelectromyograph M-Test, produced by the association «DH-system» (Ukraine)

and a computer system for analysis of electromyographic records. The method of the study involved fixation on the motor points of the right and left masticatory muscles (m. Masseter) of cutaneous silver electrodes with a diameter of 5 mm with a constant interelectrode distance of 15 mm, on which the gel was applied for electrophysiological studies. Bread was used as a food stimulus, volume 1 cm^3 and weight 1.5 g. Electromyograms were recorded in the following sequence: calibration signal – the position of relative physiological rest - volitional three-second compression of the jaws - the position of relative physiological rest – arbitrary chewing – swallowing.

The bioelectrical activity of the masticatory muscles was assessed qualitatively and quantitatively during electromyographic studies. In particular, the nature of the involvement of motor units in the functioning of the masticatory muscles, the lack of bioelectrical activity in a state of relative physiological rest, the nature of alternating periods of bioelectrical activity and periods of relative physiological rest in the process of chewing were determined. Quantitative processing of electromyograms took into account such indicators as the maximum amplitude of compression and chewing (in mcV); time of bioelectrical activity (msec.); the duration of the phase of relative physiological rest (msec.) and the coefficient "K".

Results and discussion. According to the results of clinical examination, depending on the severity of the pathological process of the examined persons were divided into two clinical groups: I group – 35 patients with generalized periodontitis I – II degree of severity, complicated by defects of the dentition; Group II – 37 patients with generalized periodontitis II – III degree of severity, complicated by defects of the dentition. Group III – control included 10 patients with intact dentition and physiological forms of occlusion without clinically diagnosed forms of periodontal disease.

Analysis of the size and topography of dentition defects showed that the nature of dentition defects differed both in age and was dependent on the clinical form of periodontitis. Thus, if in persons aged 30 to 44 years generalized periodontitis (GP) I – II degree of severity was diagnosed in 68 % of the total number of subjects, then in the age group of 60 years and older prevailed GP II – III degree of severity (61 %).

A characteristic feature of the pathological process is also determined by the increase in GP II – III degree of severity of the number of persons with medium and large defects of the dentition of different types and locations.

Patients with GP of the third degree of severity complicated by partial tooth loss were not included in the study, because in most cases the clinical picture was accompanied by significant loss of masticatory efficiency, defects of dentitions of significant size, accompanied by dental deformities with loss of tooth antagonists and impossibility of completeness, which made it impossible basically to conduct functional tests «maximum compression of the dentition in the position of central occlusion» and «random chewing».

Patients of I, II clinical groups and control III groups were determined the functional state of the masticatory muscles by functional electromyography, which consisted in the registration of bioelectric potentials of the muscles before prosthetics.

Analyzing the degree of functional disorders of the coordinated activity of the masticatory muscles caused by generalized periodontitis complicated by defects of the dentition, we, of course, proceeded from the physiological norm. The results of electromyographic studies in the control group showed that the maximum three-second volitional compression of the jaws in the norm was characterized by instantaneous inclusion of motor units, which in the recording structure was expressed by high-amplitude oscillations of biopotentials of approximately one value. Muscle relaxation was represented by a rapid transition to a state of relative physiological rest. Arbitrary chewing was characterized by a clear dismemberment of the structure of electromyograms, ie a pronounced alternation of «volleys» of bioelectric activity with periods of relative physiological rest. In this case, the amplitude of biopotentials gradually increased to the middle of the volleys and gradually decreased at the end, and high-amplitude fluctuations in the bioelectrical activity of the masticatory muscles at the beginning of the functional test at the end of chewing were replaced by less pronounced. One of the main features of random chewing in patients of the control group was the reflex change of the sides of chewing in the process of one chewing sample. Reflex changes in the masticatory sides during one functional test indicated a high degree of coordinated masticatory muscle activity.

In patients with generalized periodontitis of the I and II groups of observation, there was a prolongation of the chewing period, a decrease in the rhythm of chewing and deterioration of masticatory efficiency, which correlated with the size and topography of dentition defects. Particularly noticeable changes took place within individual dynamic cycles: the ratio between excitatory and inhibitory processes deteriorated sharply with increasing duration of activity due to a decrease in the period of relative bioelectric rest, and the magnitude of biopotentials decreased relative to normal.

The bioelectrical activity of the masticatory muscles deteriorated sharply in the presence of bilateral defects of the dentition of medium size.

To determine the degree of functional disorders of the masticatory muscles of patients with generalized periodontitis of varying severity, complicated by defects of the dentition, a quantitative analysis of the obtained electromyographic parameters was conducted, the average values of which are given in table 1.

As can be seen from table 1, patients in the control group during the test of three-second volitional compression of the jaws on the EMG were observed high-amplitude oscillations of biopotentials of approximately one value. In the control group, the average amplitude of compression was, respectively, for the right and left masticatory muscles – 773±21.9 mcV and 792±27.4 mcV, while in GP complicated by dentition defects there was a significantly lower difference of 528±11.5 mcV and 544±10.1 mcV, respectively, for the right and left masticatory muscles of group I and 380±14.8 mcV and 391±12.9 mcV, respectively, for the right and left masticatory muscles of group II.

Table 1

Electromyographic parameters of the masticatory muscles of the study groups at maximum jaw compression and random chewing

Experimental chewing EMG index	Masticatory muscle	Average figures Group III (control) (n = 10)	Patients with generalized periodontitis complicated by dentition defects			
			I group (n=35)	Probability of differences with the control group (P)	II group (n=37)	Probability of differences with group I (P)
Average amplitude compression (mcV)	Right	773±21.9	528±11.5	<0.01	380±14.8	<0.01
	Left	792±27.4	544±10.1	<0.01	391±12.9	<0.01
Average amplitude chewing (mcV)	Right	805±19.5	568±18.2	<0.01	515±12.3	<0.01
	Left	814±22.3	581±15.4	<0.01	498±13.8	<0.01
Frequency of oscillations during compression (Hertz)	Right	289±11.5	334±7.4	<0.01	371±9.6	<0.01
	Left	280±9.4	341±8.1	<0.01	365±8.1	<0.01
Frequency of oscillations during chewing (Hertz)	Right	279±9.2	299±6.8	<0.01	312±9.2	<0.01
	Left	272±8.5	303±7.4	<0.01	315±8.3	<0.01
Phase duration activity (msec.)	Right	297±13.8	441±8.4	<0.01	489±9.6	<0.01
	Left	299±14.3	429±7.6	<0.01	494±8.1	<0.01
The duration of the resting phase (msec.)	Right	281±14.4	233±6.3	<0.01	219±8.2	<0.01
	Left	276±12.9	240±7.4	<0.01	216±9.1	<0.01
«K»	Right	1.03±0.05	1.59±0.03	<0.05	1.75±0.06	<0.05
	Left	1.04±0.04	1.55±0.02	<0.05	1.81±0.05	<0.05

The average amplitude of biopotentials during normal chewing was 805±19.5 mcV and 814±22.3 mcV, respectively, in the right and left masticatory muscles with significant deterioration to 515±12.3 mcV and 498±13.8 in patients of group II .

In general, the analysis of the conducted researches showed that at persons of both the first and second groups of research had corresponding functional changes in activity of masticatory muscles – decrease in bioelectrical activity and average amplitude of their biopotentials both at carrying out functional test of compression, and at carrying out functional test of «Random chewing». During the maximal compression test, different amplitudes of bioelectric potentials of the right and left masticatory muscles were determined, with loss of individual biopotentials, significant decrease in EMG recording, lack of clear alternation of phases of bioelectrical activity and relative physiological rest, which was reflected in the coefficient, and indicating pronounced functional changes in the activity of the dental system.

The analysis of indicators obtained in persons of group II shows that these patients chewed food for a much longer time, the duration of the phase of bioelectrical activity of masticatory muscles during the

random chewing test significantly exceeded the duration of relative physiological rest, there was uneven amplitude of bioelectrical activity. The loss of biopotentials was often observed during the volitional compression test, which is confirmed by a statistically significant difference. The values of the coefficient «K» significantly exceeded the control group, which showed a significant negative dynamics of functional bioelectrical activity – 1.75±0.06 and 1.81±0.05 for the right and left masticatory muscles, respectively, against 1.03±0.05 and 1.04±0.04, respectively, of the right and left masticatory muscles in patients of the control group.

Conclusions. The results of electromyographic studies of the masticatory muscles allow to determine the degree of functional changes in their activity in patients with generalized periodontitis of varying severity complicated by dentition defects. In particular, in patients with generalized periodontitis in both the first and second groups of the study, compared with the norm, there was a prolongation of chewing, change in the rhythm of chewing and reduced masticatory efficiency, deterioration of the relationship between excitatory and inhibitory processes, the masticatory muscles of both sides generally function irrationally. The bioelectrical activity of the masticatory muscles deteriorated sharply in the presence of bilateral defects of the dentition of medium size.

The results indicate a relationship between the severity of generalized periodontitis and the degree of functional disorders of the masticatory muscles.

Prospects for further research. Prospects for further research are the need for further in-depth study of functional changes in the masticatory muscles on the background of generalized periodontitis in order to find optimal ways to rehabilitate such patients and control the quality of orthopedic treatment.

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