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TIME AND GRAPHIC PARAMETERS OF MASTICATORY MOVEMENTS OF SUBJECTS WITH TEMPOROMANDIBULAR JOINT AND MASTICATORY MUSCLES DYSFUNCTION

ABSTRACT

Chewing is the one of the most important functions of the human stomatognathic system. We have done the research of the volunteers with in the period from 2014 till 2015 years with an aim of receiving information about the parameters of chewing with signs of pathological changes in the temporomandibular joint (TMJ), which are characterized for patients with TMJ and masticatory muscles disfunction syndrome. Registration of the chewing moves on the habitual and non-habitual sides of chewing was made by using electronic gnatograph Jaw tracker 3D (Bioresearch, USA) and software BioPAK 7.2. by the standard method as recommended by the equipment manufacturer. As a result of this work was identified time and graphical parameters of chewing moves, which are characterized for subjects with pathological changes in the TMJ. Comparative analysis of the time parameters of chewing moves on the habitual and non-habitual sides of chewing with using Wilcoxon signed rank criterions allowed to determine: the absence of significant differences in the average duration of the opening mouth phase (Z= -1,6; p=0,11), an average duration of the occlusion phase of dentition (Z= -1,5; p=0,139), average duration of the closing mouth phase (Z= -1,4; p=0,173), average duration of the one masticatory cycle (Z= -1,7; p=0,086), variability of the duration of the opening mouth phase (Z= -1,4; p=0,155), variability of the average duration of the occlusion phase of dentition (Z= -0,9; p=0,342), variability of the duration of the closing mouth phase (Z= -1,4; p=0,155), variability of the duration of the one masticatory cycle (Z= -0,5; p=0,635). When the patient chewing on the habitual and non-habitual sides of chewing, there were found the absence of significant differences between variability of the duration of the opening mouth phase and the variability of the duration of the closing mouth phase (Z= -1,4; p=0,155 for the habitual side, Z= -1,8; p=0,086 for non-habitual side), the variability of the duration of the closing mouth phase and variability of the duration of the occlusion phase of dentition (Z= -0,3; p=0,767 for the habitual side, Z= -1; p=0,314 for non-habitual side).

Keywords: temporomandibular joint disfunction syndrome, masticaciography, electronic gnatography, masticatory cycle.

INTRODUCTION

The role of chewing in the process of digestion determines the value of this function for the existence of the body [1]. The researching of this function received considerable attention of the foreign researchers [5, 10]. There are some different ways of chewing researching. They are: the analysis of parameters of moves of the lower jaw [2], the analysis of the bio potentials of chewing muscles [4], chewing tests, connected with the measuring of the chewed particles of food [11].

In many sources the great attention devoted to the analysis of parameters of moves of the lower jaw in the process of chewing [6, 7, 8]. According to the opinion of the specialists using of such method of researching allows to receive information about the functional condition of the chewing muscles, occlusion and the articulation of the dentition, the TMJ [12].

The analysis of the parameters of chewing of the patients with temporomandibular joint and the chewing muscles dysfunction syndrome (TMD syndrome) represents a great science interest. This occurs because the information, received in a result of using this method of searching, can allow to detect the level of severity formed pathological and functional changes in the masticatory organ, and also determine the degree of involvement of the main elements of system in a disease pathogenesis [9].

An aim of our researching was receiving information about the parameters of chewing, which is characterized to the patients with TMD.

Objectives of the study:

1. To determine the time and graphic parameters of the masticatory movements of the subjects with TMD.
2. To determine the influence of the side of chewing to the time and graphic parameters of chewing moves of subjects with TMD.

MATERIALS AND METHODS

In the period from 2014 to 2015 was done the survey of 52 volunteers aged from 18 to 46 years old. The criteria for participation in the researching were: age from 18 years old, a wish to participate in a research and informed consent to participate in it. The criteria for non-participation in the researching was: age till 18 years old, the presence of large extent defects on the dentition or total loss of teeth of a volunteer at the treatment time, bone defects of the upper and / or lower jaw, exacerbation of existing chronic somatic diseases, mental or other disorder determining the incapacity of a volunteer, finding a volunteer at the time of treatment in the active phase of orthodontic treatment, treatment due to the presence of tumors, post-myocardial infarction or cerebral stroke in the history of treatment in the previous half of year, carrying out surgery on the TMJ in the anamnesis, unwillingness of a volunteer to take part in the researching and the absence of informed consent to participate in the researching.

On the basis of the survey (by the “Hamburg” reducing scheme) and collection information to the anamnesis, 45 volunteers were included in the researching. Among included people were

30 men and 15 women. Registration of the chewing moves was made by the using electronic gnatograph Jaw tracker 3D (Bioresearch, USA) and software BioPAK 7.2.

Registration of the chewing moves was made by the standard method as recommended by the equipment manufacturer. Recording was carried out in a sitting position. It is defined by the fact that this position is typical for a patient in the implementation of the act of chewing. At least 10 masticatory cycles were subjected to recordings on the habitual chewing side and on the opposite side. As a bolus (piece of food) was used soft chewing gum in the form of plates. In the interface of the computer program was done processing of received information: selection of the cycles for the analysis, determination of the time characteristics of masticatory cycles, were defined the types of patterns (stereotypes) of the chewing movements.

The information, which was received in the process of the survey, was subjected to the statistical analysis using IBM SPSS Statistics 21 software.

RESULTS AND DISCUSSION

The analysis of graphical parameters of chewing moves of the volunteers let us to know the following: in the process of chewing on the habitual side the first type of front projection of chewing movements of the pattern detected in 66.7% of cases, the second - in 22.2%, the third - in 11.1%. The first type of sagittal projection of chewing movements of the pattern detected in 77.8% of cases, the second - in 22.2%. The first type of the horizontal projection of chewing movement of the pattern was detected in 100% of cases. The first type of the opening speed of the pattern detected in 22.2% of cases, the second – in 11.1%, the third - in 66.7%. The first type of the closing speed of the pattern was detected in 100% of cases.

In the process of chewing on the non-habitual side of the volunteers the first type of the front projection of chewing movements of the pattern detected in 44.4% of cases, the second - in 44.4%, the fourth – in 11.1%. The first type of the sagittal projection of chewing movements of the pattern detected in 88.9% of cases, the second - in 11.1%. The first type of the horizontal projection of chewing movement of the pattern was detected in 77.8% of cases, the second - in 22.2%. The first type of the opening speed of the pattern was detected in 22.2% of cases, the third - in 77.8%. The first type of the closing speed of the pattern was detected in 88.9% of cases, the second - 11.1%.

Table 1

The parameters of the distribution of temporal characteristics of masticatory cycles on the habitual side of chewing the subjects having symptoms of TMJ pathology and masticatory muscles (mc, n = 45)

The time parameter	Average	Standard deviation	The standard error of the average
An average duration of the mouth opening phase	339	47	15,7
The variability of duration of the mouth opening phase	72,7	38,6	12,9
An average duration of the occlusion phase of dentition	177,4	30,3	10,1
The variability of duration of the occlusion phase of dentition	54	47,6	15,9
An average duration of the closing mouth phase	324,8	42,7	14,2
The variability of duration of the closing mouth phase	49,2	16,4	5,5
An average duration of the one masticatory cycle	841,1	105	35
The variability of duration of the one masticatory cycle	126,3	52,7	17,6

Table 2

The parameters of the distribution of temporal characteristics of masticatory cycles on the non-habitual side of chewing the subjects having symptoms of TMJ pathology and masticatory muscles (mc, n = 45)

The time parameter	Average	Standard deviation	The standard error of the average
An average duration of the mouth opening phase	354,3	71,4	23,8
The variability of duration of the mouth opening phase	96,7	45,9	15,3
An average duration of the occlusion phase of dentition	207,6	76,7	25,6
The variability of duration of the occlusion phase of dentition	70,4	40,1	13,4
An average duration of the closing mouth phase	350,8	102,4	34,1
The variability of duration of the closing mouth phase	55,7	16,4	5,5
An average duration of the one masticatory cycle	912,8	196,8	65,6
The variability of duration of the one masticatory cycle	142,0	78,6	26,2

The time characteristics of masticatory cycles of the volunteers are shown in the Table 1,2.

The comparative analysis of the time parameters of chewing movements on habitual and non-habitual sides of chewing of the volunteers has allowed to reveal the following (using Wilcoxon signed rank criterions for data processing). There are no significant differences in the average phase of the mouth

opening (Z = -1,6; p = 0,11), the average duration of the occlusion phase of the dentition (Z = -1,5; p = 0,139), the average duration of the mouth closing phase (Z = -1,4; p = 0,173), the average duration of the one masticatory cycle (Z = -1,7; p = 0,086), the variation of duration of mouth opening phase (Z = -1,4; p = 0,155), the variability of the average duration of the occlusion phase of dentition (Z = -0,9; p = 0,342), the variability of duration of the mouth closing phase (Z = -1,4; p = 0,155), the variability of the duration of one cycle of chewing (Z = -0,5; p = 0.635). Perhaps the available functionally and morphological disorders in the TMJ and in the masticatory muscles of the volunteers in this group are not formed in isolation on the one of the sides but determined symmetrical bilaterally lesion of the complex of the masticatory muscles of the TMJ. The result of this is a comparable change in the time characteristics of phases of masticatory cycles on habitual and non-habitual sides of chewing.

It is important to said that during chewing as on the habitual, as on non-habitual sides of chewing there are no significant differences between the variation of duration of mouth opening phase and the variability of duration of the occlusion phase of dentition (Z = -1,4; p = 0,155 for the habitual side, Z = -1,8; p = 0,086 for non-habitual side), the variability of the duration of the phase of closing of the mouth and the variability of the occlusion phase of dentition (Z = -0,3; p = 0,767 for the habitual side, Z = -1; p = 0,314 for the non-habitual side).

The differences between the variability of the duration of the mouth opening phase and the variability of duration of the mouth closing phase on the habitual side also are not important (Z= -1,8; p=0,086). In our opinion, the lack of significant differences for these parameters defined by the central regulation of masticatory cycles and the possible influence is equivalent to changing in the process of mastication of the characteristics of bolus. It is important to note that the identified differences between the variability of the duration of the of mouth opening phase and the variability of duration of mouth closing phase on the non-habitual side of chewing was important (Z= -2,5; p=0,012). This is probably related to the presence of obstacles for excursions to the TMJ elements in the form of dislocated meniscus.

The significant differences in the graphical parameters of chewing movements for the volunteers on habitual and non-habitual sides of chewing were absent (using Wilcoxon signed rank criterions for data processing). For the front projection of the pattern chewing movements Z = -1,1; p = 0,257, sagittal - Z = -0,6; p = 0,564, horizontal - Z = -1,4; p = 0,157. For the pattern of the mouth opening speed Z = -0,4; p0705, closing - Z = -1; p = 0,317.

CONCLUSIONS

1. The subjects who have symptoms of TMJ and masticatory muscles pathology, chewing side has no effect on the duration of the phases of masticatory cycles.
2. The subjects who have symptoms of the TMJ and masticatory muscles pathology, the chewing side does not affect to the graphical parameters of the chewing movements.
3. The subjects with symptoms of the TMJ and masticatory muscles pathology, the chewing side has no effect on the variability of the masticatory cycle phases.

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