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Research Article

Method of Diagnosis of the Temporomandibular Joint Disorders - ∂

Karelina A.N[1]*, Geletin P.N[2], Ginali N.V[3] and Romanov A.S[4]

[1]*Assistant of the Department of Children's Dentistry with the orthodontic course. Smolensk State Medical University. Russia*
[2]*Associate Professor of the Department of Propaedeutic Dentistry of the State Medical University of Smolensk. Russia*
[3]*Professor and the head of the Department of Children's Dentistry with the orthodontic course*
[4]*Resident of the department of propaedeutic dentistry of the State Medical University of Smolensk "Smolensk State Medical University"*

***Address for Correspondence:** Karelina A.N, Assistant of the Department of Children's Dentistry with the orthodontic course, Smolensk State Medical University, Russia, E-mail: A.karelina82@mail.ru

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ABSTRACT

Study of Electromyography (EMG) data in patients with Temporomandibular Joint (TMJ) disorders is very important in successful diagnostic of this disease. The aim of study was to determine a specific EMG status of patients with TMJ disorders. Materials and methods of the study involved 70 patients (aged 18-55) with TMJ disorders accompanied with pain syndrome. 20 healthy individuals without signs of TMJ pathology were included in a control group. Comprehensive examination scheme consisted of basic clinical techniques and a number of special additional procedures such as cone-beam computed tomography of temporomandibular joint, investigation of occlusal contact with individual articulator, EMG of masseteric muscles, assessment of psycho-emotional status and pain. EMG study was performed using 4 tests: relative physiological rest, compression standard cotton cushions, maximum contraction of the jaws and function of chewing. Index of symmetry of masseters, temporal muscles and TORC index were valued. Results. Specific features of EMG status of patients with TMJ disorders were revealed. The levels of index of symmetry of masseters, temporal muscles as well as TORC in patient with TMJ disorders were significantly higher compared with healthy individuals. Index of symmetry of masseters varied from 38 to 162%, temporal muscles from 41 to 159%, TORC index from 34 to 166%. In patients of control group all index varied from 80 to 120%. So EMG may be use for diagnostic of functional condition of masseteric muscles in patients with TMJ disorders.

Keywords: Pain Dysfunction Syndrome of the Temporomandibular Joint; Diagnosis of Pain Dysfunction Syndrome of the Temporomandibular Joint; Surface Interference Electromyography; the Electrical Activity of Muscles.

INTRODUCTION

Nowadays one of the urgent problems of dentistry is dysfunction of the Temporomandibular Joint (TMJ), this is a high prevalence of this pathology among the population, the lack of common views on the etiology and pathogenesis of the disease, as well as algorithms for complex diagnosis and therapy of patients with dysfunction of the temporomandibular joint.

Patients with the temporomandibular joint pathology require complete and adequate diagnosis of the dentoalveolar system to determine the volume and sequence of therapeutic and rehabilitation measures [1]. The complex of diagnostic measures includes a thorough clinical examination, as well as a number of additional research methods, the leading of which is the diagnosis of the functional state of the chewing musculature, which is an important parameter of the functioning of the dento-jaw system as a whole [2,3].

AIM OF THE STUDY

The aim of the study was to analyze absolute and relative parameters of the masticatory muscles electromyography in patients with the temporomandibular joint pain syndrome in the complex diagnostic system.

MATERIALS AND METHODS

To solve the task at the base of the department of propaedeutic dentistry of the SSMU on the four-channel computer neuromyographic analyzer "Synapsys", 90 people were examined in the dental unit: 70 patients with the diagnosis of the temporomandibular joint pain syndrome and 20 persons without signs of temporomandibular joint pathology. The age of the patients varied from 18 to 45 years.

Recording of electromyography was performed in a sitting position without head supporting. The patient retained his natural position. The activity of the chewing musculature was recorded from two groups of muscles from two sides at the same time - the masseters and the anterior tufts of the temporal muscles. Surface cup electrodes were used for the registration of electromyograms. They were fixed in the area of the motor points of the examined muscles after skin decreased by 70% alcohol with an adhesive plaster with an interelectrode distance in 1 cm. "Unigel" was used as an electrically conductive substance. Bioelectric signals from the muscle through the electrodes are transmitted to the computer, where they are amplified, cleaned and visualized on the monitor screen in real time.

The data obtained during the conducted electromyography examination were recorded in the computer database.

The procedure began with the study of the bioelectric activity of muscles in a state of relative physiological dormancy. Then, a standardized recording was performed with maximum compression of 2 standard cotton-like rollers with a diameter of 10 mm located between the second premolars and the first molars symmetrically on both sides. Further, the bioelectrical activity of the muscles were analyzed with arbitrary voluntary compression of the dentition in the habitual occlusion, and also with the chewing function.

We analyzed the average amplitude of the bioelectrical signal and compared electromyography signals of paired muscles with the use of the Index of Symmetry of Masticatory Muscles (ISMM) and the Index of Symmetry of The Temporal Muscles (ISTM).

ISTM = (Amp av. Ts /Amp av. Td)*100%

ISMM= (Amp av. Ms /Amp av. Md)*100%,

Amp. av. Ts - the average amplitude of electromyography signal of the left temporal muscle;

Amp av. Td - the average amplitude of electromyography signal of the right temporal muscle;

Amp av. Ms - the average amplitude of the electromyography signal of the left masseter;

Amp av. Md - the average amplitude of the electromyography signal of the right masseter;

These indices gave information on which side of the group of masseters and temporal muscles the average amplitude of the signal was higher.

The index of lateral displacement of the lower jaw (TORC index).

TOPC= ((Amp av Ts+Amp av Md)/(Amp av Td+Amp av Ms))*100%

Masseters and temporal muscles on the opposite side form a muscular couple (for example, right temporal and left masseter). If one pair of muscles is activated, unbalanced by contraction of the other muscle pair from the opposite side, there is a potential lateral displacement.

At the first stage an electromyography study was performed in 20 healthy persons without signs of TMJ pathology and its history

in order to determine the mean values of the analyzed parameters in the control group. Then, 70 patients with a diagnosis of the TMJ pain syndrome were examined.

The diagnosis of the temporomandibular joint pain syndrome was confirmed by clinical studies (patient complaints, history of the disease and clinical examination) and additional research methods: functional analysis of models in the individual full regulated articulator, computer tomography of the temporomandibular joint with closed and maximally open mouth, complex psychological testing and assessment of the severity of pain based on a 10-point visual-analog scale, McGill pain questionnaire.

The obtained results were statistically processed. Statistical significance of differences between qualitative variables was assessed using Fisher's exact test or to calculate 95% confidence intervals for the odds ratios and the use of asymptotic criteria (Chi-square or Pearson's, Chi-square test of validity). For comparison of mean values in two groups were used heteroscedastic version of the Student's criterion (the criterion of Satterthwaite).

This study has been approved by the Ethics Committee at Smolensk state medical university, protocol № 12 from 26.04.2014.

RESULTS

At primary EMG study of muscles of the maxillofacial region in patients of the main group and individuals of the control group the average amplitude of the EMG signal (Amp. av., μv) was evaluated (table 1)

The total bioelectrical activity of the masseters in patients with TMJ pain syndrome in a state of relative physiological rest was increased on 6.4 μv (12%), the electrical activity of the temporal muscles was increased on 5.7 μv (9.8%) in comparison with the control group.

Bioelectrical activity of the masseters and temporal muscles in patients of the main group compared to individuals of control group during maximum volitional contraction of the jaw was reduced (statistically significant difference): the average amplitude of the bioelectrical signal of masseters was reduced by 100.8 μv (38,6%), temporal muscles - in 146,0 μv (61.8 %)

Then an analysis of electromyography parameters in persons of the control group was carried out. In the examined subjects, the symmetry index of the temporal muscles and masseters, as well as the index of lateral displacement of the mandible, were in the range of 80% to 120%. In most cases the same indexes in patients with the temporomandibular joint pain syndrome were significantly different from those of the control group. The differences were statistically significant (criterion U-Mann-Whitney for independent samples for the TOPC index (p= 0.003), ISTM (p= 0.007) and ISMM (p= 0,048)). The average deviation index of the symmetry of the temporal muscle from 100% in patients with TMJ pain syndrome was recorded 60,0 ± 10,05%. This fact indicates on the asymmetrical working of the temporal muscles of the left and right sides in the examined individuals. Only 11 patients (15.7%) had this index within the norm variants. The symmetry index of the masticator muscles also varied significantly. The norm variants of the symmetry index of the masticatory muscles was fixed in 15.7% of patients. The average deviation index of the symmetry of the masseters from 100% in patients with TMJ pain syndrome was 57,69 ± 6,98%. The index of lateral displacement of the lower jaw (TORC index) within the limits of the norm was noted only in 5 patients, which amounted to 7.1% of patients with the syndrome of painful dysfunction of the temporomandibular joint. The average deviation index of the symmetry of the masseters from 100% in patients with TMJ pain syndrome was 53,54 ± 3,77%. In 92.9% of examined patients, this index exceeded the norm, which indicates on violation of symmetry in the muscles in the system temporal right + masseter left / temporal left + masseter right (increased activity of one pair of muscles, unbalanced activity of the other muscle pairs). The obtained data confirm the asymmetric activity of the masticatory muscles in patients with the temporomandibular joint pain syndrome.

For example, electromyograms of healthy person (Figure 1) and a patient with TMJ pain disorder (Figure 2).

Table 1. The average amplitude of the bioelectrical signal of masticatory muscles in patients of the main group and the control group.

Test	Main group				Control group			
	Td	Md	Ts	Ms	Td	Md	Ts	Ms
Amp. Av., μv Test1	53,11 ± 1,69	51,88 ± 2,01	56,11± 2,75	52,65± 1,74	52,35± 2,75	45,85± 1,11	52,65± 3,03	48,20± 1,49
Amp. Av., μv Test2	220,32 ± 12,81	289,41± 31,01	207,22*± 15,48 (p = 0,04)	298,10± 22,63	288,00± 49,57	337,85± 60,38	289,90*± 49,04 (p = 0,04)	348,95± 57,85
Amp. Av., μv Test3	242,11* ± 14,43 (p = 0,002)	262,15± 29,59	231,97± 14,96 (p = 0,01)	263,84± 23,45 (p = 0,04)	376,30*± 53,86 (p = 0,002)	344,50± 48,43	389,45± 59,28 (p = 0,01)	382,60± 67,46 (p = 0,04)

Test1- relative physiological rest
Test2 - compression standard cotton cushion
Test3 - the maximum volitional contraction of the jaw

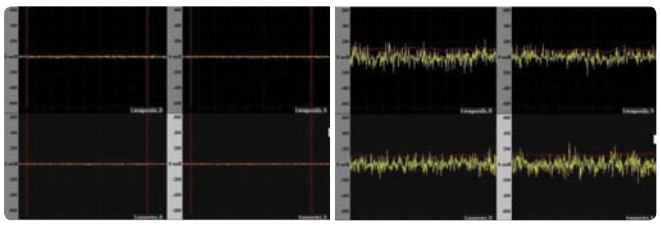

Figure 1: Electromyography of masseters and temporal muscles of the person A. without TMJ patology (A - relative physiological rest, B – volitional maximum compression of the jaws).

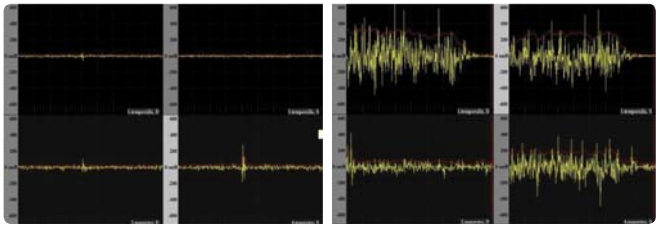

Figure 2: Electromyography of masseters and temporal muscles of the patient M. with TMJ pain dysfunction (A - relative physiological rest, B – volitional maximum compression of the jaws).

In persons without TMJ patology isoline was reaveled during relative physiological rest. The average amplitude of the bioelectrical signal of the masseters was 359,6/362,3 μv (right/left), temporal musceles 329,8/322,8 μv (right/left), ISMM 110%, ISTM 105%, TOPC-index 98%)- that was consistent with the norms.

Another situation was in patient with TMJ pain disorder. The outbursts of spontaneous bioelecrical activity was recorded at relative physiological rest. When the volitional maximum compression of the jaws an asymmetric distribution of bioelectrical activity was recorded: ISTM=146%, ISMM=41%, TORC-index=152%

DISCUSSION

As a result of the study, patients with a painful dysfunction syndrome of the temporomandibular joint showed characteristic disorders in the functional state of the chewing muscles, such as 1) increase of the total bioelectrical activity of the masseters and temporal muscle during the relative physiological rest (the spontaneous bioelectrical activity), 2) decrease of the total bioelectrical activity of the masseters and temporal muscle during the maximum volitional contraction of the jaw 3) asymmetric distribution of bioelectrical activity of the masseters and temporal muscles and muscles displacing the lower jaw.

In our opinion, such changes of functional condition of the masticatory muscles in patients with TMJ pain disorders associated with existing chronic pain that is muscular etiology and localized mainly on one side.

In this way surface interference electromyography of masticatory muscles with an index estimation of their bioelectrical activity can be used as an element of complex diagnostics of the syndrome of painful dysfunction of the temporomandibular joint, as well as evaluating the effectiveness of the therapy and the clinical examination of this group of patients.

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