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## ***Evaluation in EMG-activity of masticatory muscles in the functional correction in adolescent girls with disorders of sexual development***

**Abstract:** This article is devoted to changes in the EMG-activity of masticatory muscles in adolescent girls with disorders of sexual development. The publication focuses on functional correction of these changes and improvement of values of EMG-activity as objective evaluation of treatment results.

**Keywords:** adolescent girls, EMG-activity, masticatory muscles, disorders of sexual development.

Temporomandibular disorder (TMD) is usually defined as a collective term that embraces a number of clinical problems that involve the masticatory muscles, the temporomandibular joint (TMJ) and the associated structures and forms the most prevalent clinical entity afflicting the masticatory apparatus [1, 2]. There are two basic concepts regarding the causes of TMD. The first one explains, that the cause of TMJ is a malocclusion and a violation of dental occlusion [3, 4]. The second concept is called myogenic that sees the reason for TMJ in violations of the masticatory muscles by forming zones of hyperactivity [5, 6].

Surface electromyography (sEMG) of masticatory muscles is a modern noninvasive technique for recording muscle activity that may be employed in the assessment of TMD [7, 8, 9]. In combination with a collecting detailed medical history and clinical examination, sEMG can provide objective, evidence and individual assessment of functional status of masticatory muscles [10]. At the same time it is important to estimate adjustment of bioelectrical activity of muscles during functional therapy by occlusal splints. This question is not displayed enough in the scientific literature.

The purpose of this study was to determine the criteria for the assessment of EMG-activity of masticatory muscles in patients during functional therapy.

### **Materials and methods**

The study comprised 57 female adolescents, including 32 girls with with violations of sexual development which was the study group and 25 healthy girls, matched by age, who composed the control group. The average age of girls in the study group was  $14,66 \pm 0,3$ , in the control group –  $14,48 \pm 0,33$  years. All subjects were evaluated according to the Research Diagnostic Criteria for TMD [11]. They had permanent dentition without crossbite, no dental pain or periodontal problems, previous or current traumas in the head and neck region. The girls did not have orthodontic treatment previously. Patients with TMD were examined before and after functional treatment by occlusal splint. Recording of sEMG of masticatory muscles was performed according to the recommendations Sforza et al. and Tartaglia et al [12, 13]. The masseter and anterior temporal muscles of both sides (left and right) were examined. Disposable silver/silver chloride bipolar surface electrodes (diameter 10 mm, interelectrode distance  $21 \pm 1$  mm; Neurosoft, Russia) were positioned on the muscular bellies parallel to muscular fibers [14]. A disposable reference electrode was applied to the forehead. sEMG activity was recorded using a computerized instrument Synapsis and software by Neurotech (Russia). The analog EMG signal was amplified and digitized. Patients were sitting in a natural position without muscular tension, arms, legs were not crossed, head was held equally without support. Lips were kept closed slightly, tooth – in physiological rest. To avoid the effect of fatigue, there was three minutes-rest between each test.

EMG-activity was recorded in 3 tests, lasted 10s for each one. The first test or the maximum voluntary clenching (MVC) of the teeth on both sides was registered for evaluation of symmetry of the muscles of the left and right sides. The second and third tests were one-side constriction for evaluation of EMG-activity of masticatory muscles on working and balancing sides.

EMG-activity of masticatory muscles was compared with the results of sEMG in patients of the control group.

The obtained data was statistically analyzed using the Student's t-test and the Fisher's criterion  $X^2$ . The hypotheses were verified at the level of significance  $p < 0,05$ .

**Results.** 32 (100,0%) patients of the study group were diagnosed TMD according to RDC/TMD (group Ia, Ib of muscle disorders). All girls had the skeletal

first skeletal class of malocclusion by Angle, distinguished by overbite and the anomalies of individual teeth position. The data on the results of sEMG of masticatory muscles of adolescent girls in both groups are presented in Table 1.

**Table 1. EMG-activity of temporalis and masseter muscles  
in the tests in girls of both groups**

Test	EMG activity	M.temporalis dextra		M.temporalis sinistra		M.masseter dextra		M.masseter sinistra	
		SG	CG	SG	CG	SG	CG	SG	CG
MVC	MA, $\mu$ V	2481,78± 136,35	767,32± 31,57	2434,88± 131,67	762,24 ±45,67	2331,13± 139,86	972,44± 30,03	2859,78± 184,39	952,84± 30,77
		p<0,001		p<0,001		p<0,001		p<0,001	
	AA, $\mu$ V	331,81± 19,10	188,04± 9,23	398,16± 87,81	189,80 ±8,93	318,09± 16,52	212,76± 7,92	358,47± 17,15	223,60± 9,12
		p<0,001		p<0,05		p<0,01		p<0,01	
RSC	MA, $\mu$ V	1838,31± 122,83	1033,28± 31,47	1887,56 ±8,63	708,28± 37,65	1900,94± 115,91	1052,72± 31,48	2166,34± 08,72	763,72± 31,48
		p<0,001		p<0,001		p<0,001		p<0,001	
	AA, $\mu$ V	244,13± 14,45	189,56± 7,55	250,31± 9,48	152,4± 7,2	238,94± 13,82	203,00± 8,45	281,03± 12,88	172,92± 8,23
		p<0,01		p<0,01		p<0,05		p<0,001	
LSC	MA, $\mu$ V	1720,03± 95,63	778,16± 54,53	1935,34 ±70,85	1034,28 ±55,59	1973,41± 113,11	845,16± 46,77	2145,78± 120,36	1065,68± 43,40
		p<0,001		p<0,001		p<0,001		p<0,001	
	AA, $\mu$ V	268,38± 21,61	147,64± 9,15	287,56± 21,37	188,76± 10,01	293,22± 4,51	183,56± 1,98	336,84± 8,94	202,28± 11,15
		p<0,001		p<0,001		p<0,001		p<0,001	

MVC - maximum voluntary clenching, RSC – right side clenching, LSC – left side clenching, MA – maximum amplitude, AA – average amplitude

Neuromuscular balance that recording as symmetrical EMG-activity was determined in patients of the control group without TMD.

At maximum compression teeth bioelectric activity of the temporal and proper chewing muscles recorded the same and symmetrical, the maximum amplitude contractions of each muscle does not exceed 1000 MW.

EMG-activity of temporal and masseter muscles on the left and right during maximum constriction side was the same and symmetrical. The maximum amplitude of each muscle did not exceed 1000 MkW.

In test of one-side clenching there was observed increased EMG-activity of masticatory muscles on the working side and decreased EMG-activity on balance side. During left-side clenching values of maximum and average amplitude of temporal and masseter muscles on the left side were greater, then on the right side. Prevalence of EMG-activity of the masticatory muscles on the right side was found during right-side clenching. These statistical significant differences between EMG-activity on working and balancing sides is due to the presence of occlusal contacts on the working side, ensuring the normal function of the masticatory muscles.

Patient of the study group with TMD was found asymmetrical EMG-activity on the side with symptoms and on the opposite side. It indicates on disorders on motor behavior of masticatory muscles on the both sides.

Increased and asymmetrical temporalis and masseter muscle activity was determined on the right and left sides at MVC. Significant prevalence of EMG-activity of masseter muscle on the left side and temporalis muscle on the left in this test.

In right side clenching we observed disorders in muscle activity, accompanied by increased EMG-activity of the muscles on the left side (balancing) compared to the muscles of the right side - working. In left side clenching EMG-activity of the muscles on the right side were significant higher, than values of the masticatory muscles activity of the right side.

For functional correction we applied occlusal splint on the upper jaw made of soft thermoplastic material. Occlusal surface of splint was performed with considering supercontacts identified using Brux-chesker.

In a month after using the occlusal splint sEMG was made to assess the restructuring of motor behavior of masticatory muscles (Table 2).

**Table 2. EMG-activity of temporalis and masseter muscles in a month after functional correction**

Test	EMG activity	Study group			
		TD	TS	MD	MS
MVC	MA, $\mu$ V	1153,62 $\pm$ 144,45*	1125,38 $\pm$ 134,23*	1105,0 $\pm$ 124,06*	1189,0 $\pm$ 133,06*
	AA, $\mu$ V	219,69 $\pm$ 21,0	223,85 $\pm$ 22,06	231,54 $\pm$ 18,62	253,31 $\pm$ 22,02
RSC	MA, $\mu$ V	1229,08 $\pm$ 76,16**	1038,0 $\pm$ 68,97***	1250,31 $\pm$ 87,23***	1094,08 $\pm$ 66,97*
	AA, $\mu$ V	225,69 $\pm$ 25,01	205,69 $\pm$ 20,63	223,23 $\pm$ 23,06	222,38 $\pm$ 21,24
LSC	MA, $\mu$ V	978,08 $\pm$ 58,84*	1199,08 $\pm$ 56,14***	1106,31 $\pm$ 72,85**	1377,15 $\pm$ 5671*
	AA, $\mu$ V	183,46 $\pm$ 14,39*	203,38 $\pm$ 12,97***	210,38 $\pm$ 17,50*	227,31 $\pm$ 16,72*

\* – statistical significance  $p < 0,001$       \*\* – statistical significance  $p < 0,01$

\*\*\* – statistical significance  $p < 0,05$

MVC- maximum voluntary clenching, RSC – right side clenching, LSC – left side clenching, MA – maximum amplitude, AA – average amplitude

sEMG results after functional correction was different from data before occlusal treatment. Thus, in MVC test symmetrical EMG-activity of the temporal and masseter muscles on the right and left sides was observed. The maximum amplitude decreased significantly and was within the normal range.

In test of one side constriction prevalence of EMG-activity of masticatory muscles was determined on working side compared to the balancing side. (The prevalence of EMG-activity of right temporalis and masseter muscles was found on right side clenching, on left-side clenching there was found prevalence of left temporalis and masseter muscle).

**Conclusion.** According to the results, the signs and symptoms of TMD, decreased or disappeared entirely during the month of functional therapy. Control of reconstruction of muscle activity of masticatory muscles was performed using sEMG after 1 month, 3 months. Significant reduction of maximum, average amplitude and eliminate of asymmetry of masticatory muscle activity was found in a month after functional therapy by occlusal splint.

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