

Zieliński Grzegorz, Byś Aleksandra, Filipiak Zuzanna, Baszczowski Michał, Ginszt Michał, Suwała Marta, Szkutnik Jacek, Majcher Piotr. Comparison of resting masticatory muscle activity among women of different ages. *Journal of Education, Health and Sport*. 2018;8(12):79-86 eISSN 2391-8306. DOI <http://dx.doi.org/10.5281/zenodo.1921782>  
<http://ojs.ukw.edu.pl/index.php/johs/article/view/6345>

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part b item 1223 (26/01/2017).  
1223 Journal of Education, Health and Sport eissn 2391-8306 7

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 02.10.2018. Revised: 18.10.2018. Accepted: 04.12.2018.

## **Comparison of resting masticatory muscle activity among women of different ages**

**Grzegorz Zieliński<sup>1</sup>, Aleksandra Byś<sup>1</sup>, Zuzanna Filipiak<sup>2</sup>,  
Michał Baszczowski<sup>1</sup>, Michał Ginszt<sup>1</sup>, Marta Suwała<sup>1</sup>, Jacek Szkutnik<sup>3</sup>,  
Piotr Majcher<sup>1</sup>**

<sup>1</sup>Chair and Department of Rehabilitation, Physiotherapy and Balneotherapy, Medical University of Lublin, Poland

<sup>2</sup>Students' Scientific Group, Department of General Pediatrics, Medical University of Warsaw, Poland

<sup>3</sup>Department of Functional Masticatory Disorders, Medical University of Lublin, Poland

Corresponding author:

Michał Ginszt

Address:

Magnoliowa 2

20-143 Lublin, Poland

+48602533723

michal.ginszt@umlub.pl

Acknowledgments

The results of the present study do not constitute an endorsement of the product by the authors or the journal.

## Conflict of interest

The authors declare that they have no conflict of interest.

## ABSTRACT

**Background:** Surface electromyography is one of the test methods allowing to evaluate the bioelectric activity of muscles using the excitability of some tissues. One of the components of the electromyographic study is the recording of resting muscle activity, referred to as passive skeletal muscle tension. The main function of resting tension is to maintain posture with minimal energy costs. The aim of this study was to compare resting masticatory muscle activity between women of different ages.

**Materials and methods:** 75 women were invited to the study, 27 women were admitted after applying the exclusion criteria (average age 22 years  $\pm$  2 years). Qualified women were divided into three groups depending on their age: 1st group - 20-year-olds, the 2nd group - twenty-two-year-olds and 3rd group - twenty-four-year-olds. The study involved an 8-channel BioEMG III<sup>TM</sup> surface electromyography apparatus with BioPak Measurement System (BioResearch Associates, Inc. Milwaukee, WI, USA). The surface electrodes were distributed bilaterally to the muscle fibre direction of temporal and masseter muscles. The nonparametric U Mann-Whitney test was used for statistical calculations. Statistical significance was determined at 5%.

**Results:** An increase in the resting activity of temporal muscle and a decrease in the resting activity of masseter muscles depending on age were observed. Differences in resting activity were not statistically significant  $p > 0.05$ .

**Conclusions:** The results suggest that there are no significant relationships between age and masticatory muscle activity among healthy young women. However, due to the small research group, we recommend further research in this direction.

**Key words:** sEMG, women, temporal muscle, masseter muscle

## INTRODUCTION

Surface electromyography is one of the methods of electrophysiological examination allowing the assessment of the bioelectrical activity of muscles using the excitability of some tissues [1]. Excitability is defined as the ability of living cells and tissues to respond to stimuli [2]. One of the components of the electromyographic test is the recording of the resting activity

of muscles [3] referred to as passive skeletal muscle tone or tonus [4]. This voltage results from the muscle's ability to maintain a constant difference of electrical potentials between the environment and the interior of the cell, which guarantees the maintenance of polarization of the cell membrane [2]. The main function of resting tension is to maintain posture with minimal energy costs [4].

Over the years, sEMG has begun to be used in many new clinical and research fields [5]. In dentistry, it is most often used in the diagnosis of cranial nerve disorders, dystonia, neuromuscular disorders or observation of orthodontic treatment and malocclusion [6]. Increasingly, the electromyographic examination is a component of the temporomandibular disorders (TMD) diagnosis [5]. Surface electromyography is also a diagnostic tool in dysfunctions caused by abnormal muscle tone or asymmetry in muscle tone, such as tinnitus or formation of myofascial trigger points [7,8,9]. To date, in studies of persons with TMD, higher resting tone of masticatory muscles has been proven [6]. Moreover, in patients with TMD is observed a higher muscular asymmetry in masseter and temporal muscles in comparison to healthy individuals [6]. Surface electromyography is also used to evaluate the effects of TMD therapy, e.g. using the splint or biofeedback [10].

Psychological factors such as stress, anxiety disorders or depression, age, and sex may influence muscle activity. Hence the above components should be taken into consideration when studying bioelectric tensions [6,11,12].

The aim of this study was to compare resting masticatory muscle activity between women of different ages.

## **MATERIALS AND METHODS**

75 women were invited to the study. All participants were clinically tested on the basis of the bi-axial diagnostic system of the TMD with the RDC-TMD form [13]. The research was carried out in accordance with the recommendations of the Helsinki Declaration and with the consent of the Bioethics Committee of the Medical University of Lublin (KE-0254/73/2017). The respondents were informed about the objectives of the study and were aware of the possibility of abandoning them at any time. All women surveyed gave written permission for the above research.

The following exclusion criteria were applied: pregnancy, trauma of facial functional disorders of the masticatory motor system, and neurological disorders.

After applying the above criteria from 75 people, 27 women were qualified for the study (mean age 22 years  $\pm$  2 years). Qualified women were divided into three groups depending on

their age: 1st group - 20-year-olds, the 2nd group - twenty-two-year-olds and 3rd group - twenty-four-year-olds.

The sEMG examination was conducted in accordance with the SENIAM guidelines [14]. Two electrodes were placed on one muscle flank, symmetrical on both sides, according to the course of the fibers of the frontal part of temporal muscle (TA) and the superficial part of the masseter muscle (MM). The reference electrode was placed on the forehead [15]. The study involved an 8-channel BioEMG III<sup>TM</sup> surface electromyography apparatus with BioPak Measurement System measurement software (BioResearch Associates, Inc. Milwaukee, WI, USA). Patients were asked to close their eyes and not to swallow saliva, during which time muscle activity (TA, MM) was recorded [16]. In order to reduce the daily bioelectric variability of the muscles, the study was conducted in the morning hours. Before the test, a disturbance test was carried out to check the reliability of the sEMG signal.

The comparison of data was developed statistically and performed using IBM SPSS STATISTICS 21. Due to small groups of respondents, the non-parametric U Mann-Whitney test was used. Differences were considered statistically significant if the test probability level was lower than the assumed level of significance of 5%.

## **RESULTS**

An increase in the bioelectric tension of the temporal muscle (TA) and a decrease in the bioelectric tension of the masseter muscle depending on age was noted as shown in Table 1. Differences in the bioelectric tensions of temporal muscles and masseter muscles between groups were not statistically significant ( $p > 0.05$ ) as presented in Table 2.

**Table 1. Collective representation of the bioelectrical ( $\mu\text{V}$ ) results of temporal muscles (TA) and masseter muscles (MM) between three groups.**

Group	Age	n	Average resting activity ( $\mu\text{V}$ )			
			TA	SD	MM	SD
1	20	9	1,82	0,83	1,93	0,79
2	22	9	1,97	0,94	1,64	0,29
3	24	9	2,23	0,84	1,55	0,56

**Table 2. Comparison of resting activity of temporal (TA) and masseter (MM) muscles between three groups.**

Comparison between groups	Muscle			
	TA		MM	
	p	Z	p	Z
1 vs. 2	0,825	-0,221	0,895	-0,132
1 vs. 3	0,31	-1,015	0,251	-1,149
2 vs. 3	0,402	-0,839	0,453	-0,751

## **DISCUSSION**

Age is one of the most important factors affecting the differences in muscle activity and should be taken into account when assessing the results of electromyography [6]. Despite this, the current electromyographic examination of masticatory muscle muscles is largely based on people aged 20-30 years or children.

In the author's studies, the mean resting activity of the temporal muscles increased while the age of the subjects increased, whereas the masseter decreased. These results partly coincide with the literature review of recent years. In the study of Woźniak et al., the control group consisted of 54 women and 46 men between 19.5 and 28.7 years of age (mean = 21.42 SD = 1.06) without malocclusion and subjective symptoms of temporomandibular disorders [17].

The average resting tension of women was  $4.07\mu\text{V}$  ( $\text{SD} = 2.02$ ) for the temporal muscle and  $2.12\mu\text{V}$  ( $\text{SD} = 0.89$ ) for the masseter muscles. In the work of Campillo et al., despite the research group with a similar mean age of  $22.8 (\pm 3.9)$ , we observe much lower voltage than in the Woźniak study:  $1.78\mu\text{V}$  R-AT,  $1.07\mu\text{V}$  for L-AT,  $0.77\mu\text{V}$  R - MA,  $0.86\mu\text{V}$  for L-MA [18]. The difference in the results of both studies, however, can be explained by the more restrictive exclusion criteria at Campillo's work. Melo et al. in their research on a group of 43 adults of both sexes aged from 18 to 37 years (mean 24.2) determined resting values at  $2.81\mu\text{V}$  for R-TA ( $\text{SD} = 1.74$ ),  $2.94\mu\text{V}$  for L-TA ( $\text{SD} = 1.98$ ),  $1.87\mu\text{V}$  for R-MA ( $\text{SD} = 0.66$ ) and  $1.95\mu\text{V}$  for L-MA ( $\text{SD} = 0.75$ ) [19]. Similar results can be observed in Zieliński's et al. study in which the control group consisted of 6 women aged  $23 \pm 1$  [20]. The similarity can be noticed in the tension of the masseter muscles (Zieliński's study  $1,814\mu\text{V}$ ). The difference in temporal muscle tension (in Zieliński  $2.414\mu\text{V}$ ) can be explained by the higher upper age threshold and the lack of gender specificity in the study group in Melo et al. research, and a small control group ( $n = 6$ ) in Zieliński's paper.

The research focused on people under 18 years of age show lower resting muscle activity compared to adults. Work Lauriti et al., in which the control group consisted of 11 people aged from 14 to 18 years (mean = 15.64) determined resting tension at the level of  $0.88\mu\text{V}$  for R-TA,  $0.95\mu\text{V}$  for L-TA,  $0.8\mu\text{V}$  for R-MA and  $0.76\mu\text{V}$  for L-MA [21]. In Díaz-Serrano et al. studies, which focused on even younger children (mean age 8.8) in the control group ( $n = 10$ ), lower resting tension values were found in relation to Lauriti's research: RM- $0.18\mu\text{V}$ , LM -  $0.13\mu\text{V}$ , RT- $0.18\mu\text{V}$ , LT- $0.2\mu\text{V}$  [22]. This study does not distinguish the sex of children. However, the results of the Lenguas et al. study indicate that in people aged 6-10 sex does not affect the differences in the results of resting masticatory muscle tension [23].

## CONCLUSIONS

The results suggest that there are no significant relationships between age and masticatory muscle activity among healthy young women. However, due to the small research group, we recommend further research in this direction.

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