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RESEARCH ARTICLE

MULTIPLE SCLEROSIS AND MASTICTION: AN ELECTROMYOGRAPHY STUDY

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ABSTRACT

Purpose: Aim of the study is to determine the activity of masseter muscle formed by mastication of different foods in individuals with multiple sclerosis (MS).
Material and Methods: 12 women with MS and 12 healthy women were included in the study. 3 grams of hazelnut and chewing gum were given to individuals 20 separate times. Activities of the left and the right masseter muscles during mastication were recorded by using surface electromyography (EMG) device.
Results: Values obtained from healthy women were higher than those obtained from patients with MS for both foods and both sides.
Conclusion: The changes in the central and peripheral nervous systems of the patients affect chewing function.

Keywords: masseter, electromyography, multiple sclerosis

INTRODUCTION

Multiple sclerosis (MS) is a chronic disease that frequently occurs in young adults and is characterized pathologically by multiple areas of white matter inflammation, demyelination, and glial scarring (sclerosis). MS usually develops stepwise, in recurrent phases of progression and remission (1).

Despite being studied for many years, the main etiology of MS remains unknown. Many hypotheses have been put forward, including immune deficiency, and viral infections. High levels of antibodies against certain viruses, including measles have been found in previous case reports. Genetic and environmental factors also could be etiologic elements (2,3).

As a result of demyelination, delays may occur in neural transmission, degradation of muscle metabolism functions, and changes in cross-bridge mechanisms to muscle failure and exhaustion are emphasized in the literature (4,5).

Altered peripheral muscle function in MS includes the slowing of muscle contractile properties, decreased muscle oxidative capacity, possibly impaired excitation-contraction coupling, and an altered muscle metabolic response to exercise. The correlation between the severity of the alterations in muscle function and the functional capacity of the individual still is not lightened. Patients with MS have muscle failure and exhaustion. These symptoms affect patients' daily activities (6).

Many studies associated with MS and problems in food consumption have studied swallowing problems (7-9).

Mastication is an elementary function after the eruption of the teeth and is a combination of neuromuscular activities such as jaw movements, control of the tongue, lip, cheek, food mass, and salivation. It is known that the neuromuscular system

works more efficiently with the synergy of components of the system such as temporomandibular articulation, muscles, teeth, periodontal ligaments, tongue, lip, and cheek. There is no adequate information about the efficiency of the masseter muscle playing role in mastication function in individuals with MS (10-12).

Foods with different textures and stiffness have found to require different mastication activities in previous studies (13-15).

In the light of this knowledge, present study aims to determine the change of masseter muscle activity during mastication function of the individuals with MS while eating different test foods using an Electromyography (EMG) device.

MATERIAL AND METHODS

Patients with MS who were recently diagnosed by neurologists did not have any additive systemic diseases and their treatment for MS had not started yet. The mean age of the individuals in the MS group was 36.1±3.38 while in the control group it was 35.3±3.59.

Patients in the control and the MS group had no initial disturbance in the masseteric region and no missing teeth.

Mastication of 3 grams of hazelnut and 3 grams of chewing gum separately specified the activities of the masseter muscle.

The EMG records were measured using the Keypoint device (Dantec, Skovlunde, Denmark) which consisted of a screen used for observing action potentials and an amplifier, recording 1 decibel in the range of 20Hz-10 kHz to watch the data on the monitor and paper.

EMG records of the individuals in the present study were taken from the left and the right masseter muscles of the patients simultaneously. The activities of both muscles were examined by using surface electrodes in a rectangular shape coated with silver chloride. Before taking records, jaw movements to be done were explained to the patients. During this process, the patients sat down without any support and their heads were straight. An earth electrode joined to the wrist was used for localizing the sensitivity (Figures 1-2).

Patients were requested to close their jaws for placing the surface electrodes on the masseter muscle parallel to the ventral section of the muscle that can be felt by palpation.

The reference electrode was at the ventral side of the muscle and the active electrode was 1 cm below the reference electrode.

Before application patients' faces were cleaned by alcohol and electrode gel was used for increasing the contact between the electrode and the skin. All electrodes were fixed to the skin surface by sticking

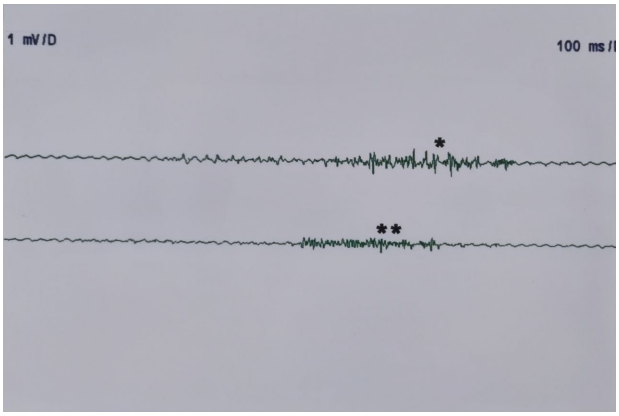

Figure 1. EMG pictures of right masseter of a healthy individual during mastication of hazelnut (*) and chewing gum (**)

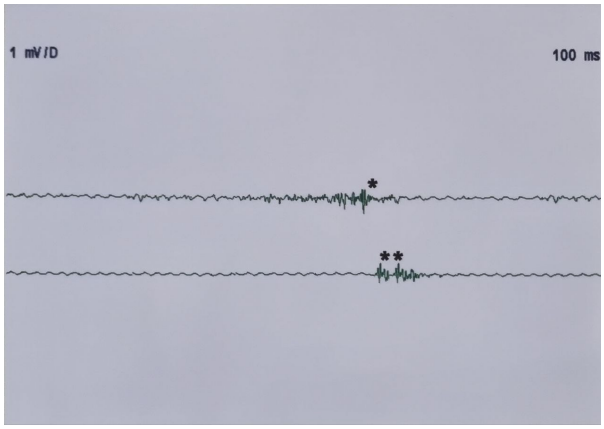

Figure 2. EMG pictures of right masseter of a patient with MS during mastication of hazelnut (*) and chewing gum

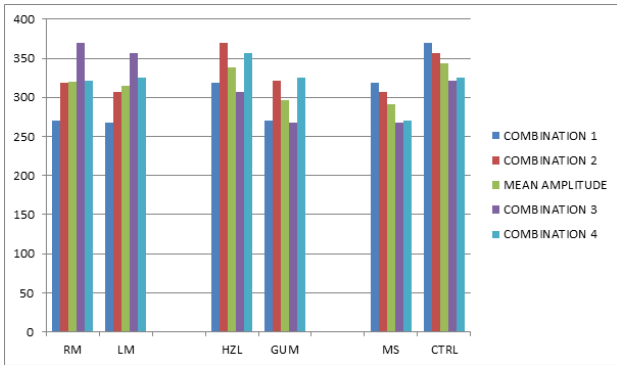

Figure 3. Average EMG magnitudes of masseter muscles in different parameters

plasters. After the electrodes were placed, patients are requested to masticate 3 grams of hazelnut and 3 grams of chewing gum 20 times separately.
Ethical approval of the present study is recieved from Yüzüncü Yıl University's Faculty of Medicine in 18.12.2015 with decision number 02.

Statistical Analysis
In sample size calculation, G*Power (Dusseldorf-Germany) software is used. For 0.5 effect size and 0.8 power, independent t test required 34 of total sample size which for the present study was 48 for 2 regions of 24 indivuals. Achieved power of the study was 0.92.
To minimize the Standard deviation, measurements were done for each function of each individual and the mean values were used in statistical evaluation. For the statistical comparison of data from individuals with multiple sclerosis and the data of the control group, an independent t-Test has been applied.

RESULTS
Data of patients with MS were found to be lower than healthy individuals (p=0.000). Another finding was that the masseter activity during mastication of hazelnut was higher than of chewing gum (p=0.000). Patients were not categorized as being right or left-handed and although the activity of the right masseter was found to be higher than the left; this finding was not statistically significant (p=0.315) (Table 2).
The amplitude data obtained from left and right masseter muscles of the individuals with multiple sclerosis and healthy individuals both during mastication of hazelnut and chewing gum are saved. Values of healthy people compared with MS and mastication of hazelnut compared with chewing gum are higher in a general view (Table 1, Figure 3).

DISCUSSION
In the present study, the activity of masseter muscles of individuals with or without MS during the mastication of different test foods is observed.
Previous studies by Winnberg and Panchers (16) and Kibana et al. (17) have described that the head posture affected all the EMG parameters and more homogenous results were obtained by providing standardization of environmental factors such as light, temperature, sound, and recording hour. To review the muscle activity of present test subjects during mastication function objectively, it is paid attention to perform the measurements at the same hours of the day (between 1.30-3.30 pm) at the same sitting position and standard environmental factors.
Reports of previous studies have stated the moving risk of needle electrodes in the muscle and false EMG measurements could be achieved. To prevent this drawback, in the present study surface electrodes are used (18-20).
Localization of the electrodes is important in obtaining the EMG data. Since the ventral side of the masseter muscle is described as the best region, surface electrodes were placed parallel to the muscle fibrils on ventral side of the muscle which are determined by palpation (21,22).
Carrol et al. have stated a decrease in muscle function in individuals with MS depends upon the types of muscle fibers, and the change formed on the myosin heavy chain (23).
NG et al. have studied the contraction of the ankle dorsiflexion muscles in healthy individuals and MS patients. They have found lower data in MS patients as the present study and the reason is described as the changes in central motor activity (24).
Kent-Braun et al. have found both an increase and decrease in different muscle activity in MS patients. They have shown a decrease in the activity of succinic dehydrogenase enzyme and have stated that anaerobic structuring is more active in individuals with MS while aerobic oxidative supported structuring of the muscles is more active in healthy individuals (25).
Kohyama et al. have evaluated mastication activity of individuals while eating apples with 7 different preparations like raw, half cooked, cooked, peeled, cut and have reported that cooked apples that had relatively less stiffness than non-cooked counterparts have had significantly lower EMG amplitude and masseteric activity, and no difference in swallowing (15).
Kapur and Garret have stated that muscle effort changes with the food tested on individuals with full teeth (26).
Supporting literature knowledge, the present study demonstrates lower masseter activity in individuals with MS than in healthy ones. Determining higher activity during mastication of hazelnut than chewing gum showed that harder foods require higher muscle strength.
Limitations of the present study are limited sample size and limited EMG localizations like peripheral components of the masseter muscle and temporal left-handed or right-handed.

Table 1. Average EMG magnitudes of masseter muscles in different parameters

Variable	MS / Hazelnut	Control/Hazelnut	MS/Gum	Control/Gum
Right Masseter	318.68	369.58	270.50	320.87
Left Masseter	307.13	356.75	267.29	325.70

Table 2. According to average EMG magnitudes and differences between groups

Variable	Group	N	Mean	Std Deviation	Std Error	Sig.
Side	Right Masseter	24	319.91	40.47	4.13	0.315
	Left Masseter	24	314.22	37.81	3.86	
Food	Hazelnut	24	338.04	33.72	3.44	0.000*
	Chewing Gum	24	296.09	32.52	3.32	
Condition	MS	24	290.90	30.35	3.10	0.000*
	Control	24	343.23	27.91	2.85	

Independent t test
* p<0.05

CONCLUSION

In conclusion, the present study has shown a decrease in the activity of masseter muscle formed by mastication of different foods in individuals with multiple sclerosis. Moreover different types of food require and cause different mastication activities.

The changes in the central and peripheral nervous systems of the patients may affect chewing function. For further investigations, more studies with a larger sample size and EMG localizations will be beneficial.

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REFERENCES

1. Ponichtera-Mulcare JA. Exercise and multiple sclerosis. Med Sci Sports Exerc 1993;25(4):451-465.
2. Matthews WB. Symptoms and signs. In: Mc Alpine's multiple sclerosis. 2nd edition, New York: Churchill Livingstone; 1991.p.43-79.
3. Chan A, Heck CS. Mobility in Multiple Sclerosis: More than just a Physical Problem. International Journal of MS Care 2000;2(1): 51-61.
4. Kent-Braun JA, Sharma KR, Weiner MW, Miller RG. Effects of exercise on muscle activation and metabolism in multiple sclerosis. Muscle Nerve 1994;17(10):1162-1169.
5. Garner DJP, Widrick JJ. Cross-bridge mechanisms of muscle weakness in multiple sclerosis. Muscle and Nerve 2003;17:1162-1169.
6. Sharma KR, Kent-Braun J, Mynhier MA, Weiner MW, Miller RG. Evidence of an abnormal intramuscular component of fatigue in multiple sclerosis. Muscle Nerve 1995;18(12):1403-1411.
7. Dos Santos VA, De Carvalho Vleria AC, Da Silva HJ. Electrical activity of the masseter and supra hyoid muscles during swallowing of patients with multiple sclerosis. CoDAS 2019;31(6):1-8.
8. Maden T, Usgu G, Tuncer A. Myotonometric comparison of sternocleidomastoideus and masseter muscles in multiple sclerosis patients with swallowing problem and healthy individuals. Multiple Sclerosis and Related Disorders 2022;57:1-6.
9. Aghaz A, Alidad A & Hemmati E, Jadidi H, Ghelichi L. Prevalence of Dysphagia in Multiple Sclerosis and Its Related Factors: a systematic review and meta-analysis. Iranian Journal of Neurology. 2018;17(4):180-188.
10. Karkazis HC. EMG activity of the masseter muscle in implant supported overdenture wearers during chewing of hard and soft food. Journal of Oral Rehabilitation 2002;29:986–991.
11. Brown WE. Method to investigate differences in chewing behaviour in humans: I. Use of electromyography in measuring chewing. Journal of Texture Studies. 2007;25:1-16.
12. Jack F, Piggott J, Paterson A. Relationships between Electromyography, Sensory and Instrumental Measures of Cheddar Cheese

Texture. Journal of Food Science. 1993;58: 1313-1317.
13. Tomonari H, Seong C, Kwon S, Miyawaki S. Electromyographic activity of superficial masseter and anterior temporal muscles during unilateral mastication of artificial test foods with different textures in healthy subjects. Clinical Oral Investigations. 2019;23(2):1-11.
14. Kemsley E, Defernez M. Relating Surface Electromyograms of the Facial Muscles During Mastication to the Mechanical and Sensory Properties of Foodstuffs. In Applications of EMG in Clinical and Sports Medicine, Rijeka:InTech; 2012.p.329-358.
15. Kohyama K, Nakayama Y, Watanabe H, Sasaki T. Electromyography of Eating Apples: Influences of Cooking, Cutting, and Peeling. Journal of Food Science. 2005;70:257-261.
16. Winnberg A, Pancherz H. Head posture and masticatory muscle function: An EMG investigation. European Journal of Orthodontics 1983;5:209-214.
17. Kibana Y, Ishijima T, Hirai T. Occlusal support and head posture. J Oral Rehab 2002;29:58-63.
18. Wood WW, Takara K, Hannam AG. The electromyographic activity of the inferior part of the human lateral pterygoid muscle during clenching and chewing. Archives of Oral Biology 1986;31:245-253.
19. Fontijn-Tekamp F, Slagter AD, Bilt VDA, Hof MA, Kalk W, Jansen, JA. Biting and chewing with mandibular implant-retained overdentures compared with other states of artificial and natural dentition. J Dent Res. 2000;79:1519-1524.
20. Jonsson B, Bagge UE. Displacement, deformation and fracture of wire electrodes for electromyography. Electromyography. 1968;8(4):329-347.
21. Berry DC, Singh BP. Effect of electromyographic biofeedback therapy on occlusal contacts. J Prosthet Dent. 1984;51(3):397-403.
22. Maarit A.M. Salonen, Aune M. Raustia & Jan A. Huggare (1994) Changes in Head and Cervical-Spine Postures and EMG Activities of Masticatory Muscles Following Treatment with Complete Upper and Partial Lower Denture, CRANIO®, 12:4, 222-226.
23. Carroll CC, Gallagher PM, Seidle ME, Trappe SW. Skeletal muscle characteristics of people with multiple sclerosis. Arch Phys Med Rehabil 2005;86:224-229.
24. Ng AV, Miller RG, Gelinas PM, Kent-Braun JA. Functional relationships of central and peripheral muscle alterations in multiple sclerosis. Muscle & nerve 2004;29:843-852.
25. Kent-Braun J, Ng A, Castro M, Weiner M, Gelinas D, Dudley G, Miller R. Strength, skeletal muscle composition, and enzyme activity in multiple sclerosis. Journal of applied physiology 1997;83(6):1998-2004.
26. Kapur KK, Garret NR. Studies of biologic parameters for denture design. Part II: Comparison of masseter muscle activity, masticatory performance, and salivary secretion rates between denture and natural dentition groups, The Journal of Prosthetic Dentistry 1986;52(3):408-413.