

Analysis of the Prevalence of Dental Complications in Patients with Masticatory Muscle Spasm

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Abstract

Early diagnosis and treatment of masticatory muscle hypertonicity is one of the pressing challenges of today's dentistry. Its importance is highlighted by the fact that masticatory muscle spasm gives rise to a number of dental complications caused by limited mouth opening. An incompetent dentist may recommend and provide treatments, which do not only have a positive effect but may also aggravate the condition of the oral cavity making its course persistent, long-lasting and flaccid.

The present article analyzes the prevalence of dental complications provoked by masticatory muscle spasm. The investigation was conducted in two stages and involved 68 patients. At the first stage a clinical examination was performed. The second stage involved the functional investigation of local blood flow in masticatory muscles both extraorally and intraorally based on laser Doppler flowmetry.

Early diagnosis, expedient correction of the impairments revealed, and prevention of dental complications are the priorities of dental examination of patients with masticatory muscle spasm.

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Introduction

Masticatory muscle spasm alongside with diseases of oral mucosa and periodontal membrane is one of the most frequent causes of the majority of maxillofacial defects¹. According to the statistics, this pathology is found in 85.6% of adult population². Female patients prevalently show a long-lasting, persistent, and excessive hypertonicity of dentomaxillofacial muscles.

Such patients complain of a pain in muscles, which may even cause difficulty in

opening their mouth³. Objectively, bruxism manifestations are observed⁴. The American Academy of Orofacial Pain defines bruxism as total parafunctional daily or nightly activity that manifests itself as grinding, clenching of the teeth and takes place in the absence of subjective consciousness. It does not aim to accomplish any physiological goals. Neither it is controlled by the proprioceptive system. Bruxism manifests itself as involuntary contraction of masticatory muscles while sleeping, on exertion, in time of mental or emotional strain. Muscle contractions occur as a result of exposure to psychoneurological stress and act as unconscious attempts of the body to restore impaired centric occlusion due to abnormal occlusal contact. These contractions are isometric, long-lasting (without pauses) and highly intensive^{5,6}.

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Predictive factors of the development of masticatory muscle spasm are numerous. However, no comprehensive approach to treating this pathology is known⁷. The predisposing factors include psychoemotional stress, occlusal abnormalities, poor quality dental fillings, and pathological conditions associated with locomotor system. The local predisposing factors comprise inflammatory processes of bone and periosteal tissue, injuries, mandibular dislocation, harmful habits, pathologies of the temporomandibular joint⁸.

Currently, the etiology of masticatory muscle spasm remains controversial. There are several theories such as the theories of occlusal imbalance and stress management⁹, sleep-related movement disorders (International Classification of Sleep Disorders 3rd ed.), somatoform disorder (F45.8. Other somatoform disorders according to the International Classification of Diseases, 10th Revision, class V), autonomic dysfunction, parafunctions. In addition, systemic pathologies such as intestinal parasites (especially seatworms, excreting toxic substances irritating the nervous system), endocrine diseases and some allergic reactions may cause masticatory muscle spasm¹⁰.

However, the discussion of bruxism etiology is still centred round the two main points¹¹. The former is related to the minimal mechanical factors occurring in patients with not ideal alignment of teeth in dental arches, namely, in people, whose dental arch elements are displaced and function otherwise than when they are physiologically positioned. The latter deals with the psychological aspect: bruxism is regarded as a manifestation of one of nervous twitch types consisting in night teeth grinding due to the stress experienced in the daytime¹².

The so-called occlusal interferences have proved to be a powerful bruxism trigger in patients exposed to stress. They also act as a trigger for many patients, who do not experience intensive stress. It has been proved that even insignificant teeth interference may provoke a high level of muscular activity, which returns to normal as soon as the occlusal interference is removed.

The following clinical forms of masticatory muscle parafunctions are recognized depending on the leading symptom, course and severity of the disease¹³:

1. Teeth clenching causing a disturbance of

mandibular relative rest due to tonic contractions of the muscles lifting it. Unconscious clenching of teeth occurs when they are occluded in the central or alternately in the right or left buccal areas. The intensity of teeth clenching depends on the level of psychological load or stressors and other external irritants. Contractions of masticatory muscles proper are frequently accompanied by formation of indurated areas or knots in them.

2. Chewing without food in the mouth is characterized by mandibular lateral movements of small amplitude. As a rule, the teeth are occluded at that. Normally, this habit is typical of elderly people and may be associated with the improper fixation of removable dentures. By clenching teeth they try to fix their removable denture to the prosthetic bed tissues. At first, chewing without food in the mouth is practiced only at rest in the evening, but later the harmful habit progresses and is also observed in the daytime.

3. Teeth-grinding involves lateral mandibular movements with dental arches occluded. It is accompanied by a characteristic sound¹³.

It should be emphasized that when muscles are well-balanced, their spasm can be easily eliminated¹⁴. Prosthodontic and orthodontic treatment will have a positive effect. If masticatory muscles are not well-balanced, their hypertonicity may progress, which can result in the emergence of various imbalance conditions. In their turn, the latter, if long-lasting, can induce various dental diseases¹⁵.

The purpose of the study: To analyze the prevalence rate of dental complications in patients with masticatory muscle spasm.

Materials and methods

The study of the prevalence of dental complications in patients with masticatory muscle spasm involved the examination of 68 patients. It was conducted in two stages. At the first stage a comprehensive clinical examination was performed. A special emphasis was placed on taking a patient's social history and the past history of the pathology development.

A patient's history comprised the information on the presence/absence of the primary and concomitant pathologies – diabetes mellitus, hypertensive disease, cardiovascular diseases, gastrointestinal, hepatic and biliary

diseases, thyroid pathologies. The history of allergies was also collected. All the patients were carefully interviewed. They reported that at night they grind and clench their teeth intensively, which is proved by a pain in their masticatory muscles upon awakening.

The dental examination included the assessment of the patients' periodontal condition and functional parameters. A special emphasis was put on the condition of facial skin, oral mucosa, teeth (radiology findings were also considered), periodontal membrane (panoramic radiography findings were used), functional parameters, restored teeth, and other revealed pathologies.

Diagnosis involved the examination of facial and trunk skin (as far as a dental visit can afford it). Subsequently, we performed the palpation of submandibular and cervical lymph nodes, the examination of the vermilion border of lips, oral vestibule and oral cavity proper, revealed local traumatic factors such as cusps, fillings, poor quality crowns, dentures and dental arch defects. When periodontal tissues were inspected, we searched for the signs of stippling, gum bleeding, hypertrophy, edema, purulent discharge, the presence of supra- and subgingival dental calculus, soft dental plaque, teeth mobility (degrees I, II, III), the presence of periodontal and periapical fistulas. A volumetric probe was used to assess the condition of dentogingival junction, the correlation between marginal and alveolar gingival areas (1:5 and 1:4 – normal, 1:3 and 1:2 – insufficient area of the junction of alveolar gingiva, 1:1 and 1:0 – alveolar gingiva is absent). The objective examination helped to reveal the bite type: orthognathia, neutral bite, straight bite, overbite, underbite, deep bite, open bite, crossbite, the presence/absence of hyperemia, the presence/absence of teeth indentations on the buccal mucous membrane. The investigation employed the standardized approach to the comprehensive assessment of the condition of teeth, periodontal membrane and restorations. When assessing the condition of teeth, implants and adjacent tissues we registered caries lesions, abrasive defects, and improper fitting of dentures. Palpation of masticatory muscles was also performed.

Depending on the group of teeth, which bear the maximum load when they are clenched or ground, dental abrasion either localized or generalized was assessed. When patients

showed no signs of physiological abrasion of hard tooth tissues, masticatory muscle parafunctions gave rise to traumatic articulation and periodontitis development. Furthermore, in case of night time parafunctions the highest extent of pathological teeth mobility was observed in the morning. Transitory morning fatigue or pain in masticatory muscles and/or temporal headache, and/or clenched jaws upon awakening were also registered.

A semi-quantification scale was used to assess the severity of muscular pain, headache, glossalgia/stomalgia, the presence or absence of vertigo, entotic sound, intensity of muscle spasm. To objectively assess the masticatory muscle hypertonicity, the distance between the cutting edges of central incisors and the extent of mouth opening were measured. We used the Hosley-Bergmann pain index to evaluate the severity of pain. Pain was assessed on a scale of 0-4 points before and after treatment: no pain – 0 points, mild pain – 1 point, moderate pain – 2 points, severe pain – 3 points, intolerable pain – 4 points.

Panoramic radiography, three-dimension computed tomography, and dental spot radiography were performed to evaluate the radiological parameters. The study employed a Hyperion X9 dental digital scanner (MyRay, France). The exposure mode was 60-75kW, 70-10 mA, the duration of the system movement was 10-12 seconds.



Figure 1. LAKK-OP device appearance.

The second stage involved laser Doppler flowmetry to perform a functional examination – assessment of the basal blood flow followed by the registration of an LDF-gram. Laser Doppler flowmetry was conducted in the dental chair in the sitting position using a LAKK-OP device, a laser analyzer of capillary blood flow, series-

produced by the LASMA research and production enterprise (fig.1).

It should be emphasized that mean indicators of blood flow may differ due to a number of anatomical and physiological parameters¹⁶. Therefore, we made reference measurements of LDF-grams in the same area of the oral cavity in the group of healthy individuals of similar mean age (aged 31-59) (control group).

The investigation of basal blood flow in masticatory muscles was conducted both intraorally and extraorally on the facial surface (fig. 2,3).

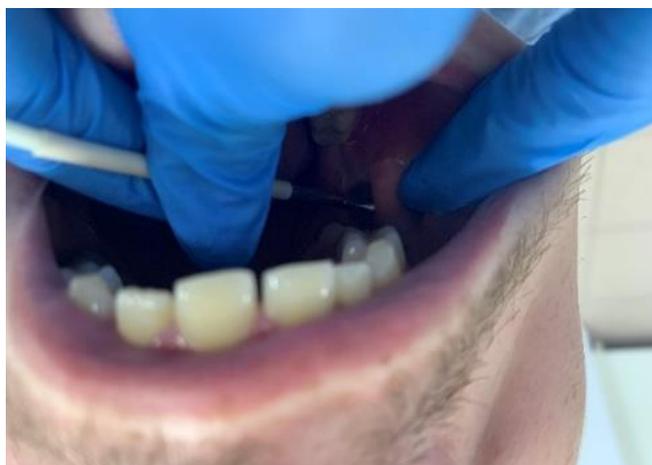


Figure 2. Laser Doppler flowmetry of the masticatory muscle performed intraorally.



Figure 3. Registration of basal blood flow extrabuccally.

Statistical mean values of the tissue perfusion with blood were determined:

M – arithmetic mean of the microcirculation indicator. It characterizes the mean erythrocyte flow in a unit of tissue volume in the probed area within the time interval of registration; it is measured in perfusion units.

δ – mean standard deviation (MSD), range

of blood flow fluctuations compared to the arithmetic mean (M). It characterizes temporary variability of microcirculation (“flux”). It is measured in perfusion units.

Kv – the intergral index of variation, whose calculated parameters make it possible to perform an overall assessment of hemomicrocirculation: $Kv = \sigma / M \cdot 100\%$.

To analyze and process the results of the study, we used the mathematical statistics method, which employed a personal computer, Microsoft Excel and MS Windows XP /Microsoft Corporation (USA) software as well as Stat Soft Statistica v6.0. package in accordance with the generally accepted methods of medical statistics. Descriptive statistics was used for data analysis. For each parameter the following values were calculated: arithmetic means (M), mean error ($\pm m$). The statistically significant differences between the groups (p) were estimated using Student’s t-Test (t). The differences were considered statistically significant when $p < 0,05$ and $p < 0,01$; $t \geq 2$.

Results

Patients appear to find out that they experience masticatory muscle spasm by chance, when their partner can hear tooth-grinding at night and informs them about it. Sometimes other clinical symptoms and complications arise (limited mouth opening, pain, strain or fatigue of masticatory muscles after sleep, TMJ dysfunction, hypertrophy of masticatory muscles, hypertrophy of mandibular angles, periodontal pathologies, pathological teeth abrasion, teeth hypersensitivity, facial pains and headaches, speech disturbances, esthetic problems (“square face”)), when the patient has to seek for the neurologist’s, dentist’s or cosmetologist’s help and undergo treatment.

When conducting the investigation we placed a special emphasis on the patient’s behaviour. All the 68 patients recruited reported a severe and sometimes unbearable pain in the muscles. The Hosley-Bergmann pain index was 3.4 ± 0.3 points. 66 patients (97.1%) complained of severe headaches and dizziness. 63 patients (92.6%) reported discomfort episodes, a burning sensation in the oral cavity, which abated during meals. The presented complaints are typical of glossalgia and burning mouth syndrome. The joint clicking was observed in 100% of cases.

When temporal, lateral, pterygoid and masticatory muscles were palpated, the patients complained of a sharp pain, which was likely to be caused by excessive activity of these muscles. When the temporomandibular joint was examined, patients reported about pain and discomfort, which proves that the primary signs of the joint dysfunction are associated with masticatory muscle spasm.

Oral cavity examination involved the assessment of teeth abrasion, the extent of destruction, tooth cracks and fractures, the presence of chipped teeth and restorations.

Teeth abrasion is the most significant diagnostic sign as when teeth occlude in the maximum intercuspation position, occlusal contacts are found on the abrasion facets. In case of progressing abrasion, the area of the contact surface and facets is increasing. So cracks on the vestibular surface of masticatory teeth were observed in 10 patients (6.8%), pathological abrasion was registered in 98.5%, gum recession in 91.2% of cases. Non-carious lesions arising after teeth eruption (wedge-shaped defects) were seen in 86.7% of patients.

Comprehensive oral examination was quite problematic as mouth opening was limited. The distance between the cutting edges of the central incisors was $33 \pm 1,3$ mm. The patients were unable to open their mouth wide due to tenderness of masticatory muscles.

The functional condition of blood supply to the muscles of mastication was assessed by means of laser Doppler flowmetry.

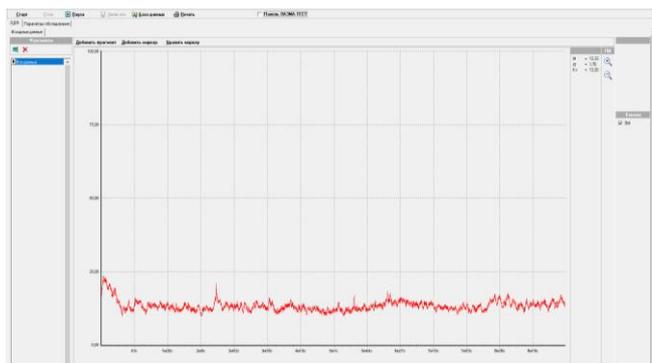


Figure 4. Laser Doppler flowmetry findings in the group of healthy individuals.

When basal blood flow parameters were evaluated in the healthy individuals the following values were registered: M parameter was 28.04 ± 1.2 perfusion units, the mean standard

deviation was 2.07 ± 0.3 perfusion units, the variation index was $7.38 \pm 0.6\%$. The above listed values were obtained when the investigation was performed on the external facial surface of the muscle. On the internal muscle surface the local blood flow values were – M- 13.33 ± 1.1 perfusion units, δ – 1.76 ± 0.2 perfusion units and the variation index – $13.2 \pm 0.8\%$ (fig.4).

When similar parameters were assessed in patients with masticatory muscle spasm, the microcirculation value measured intraorally was 21.85 ± 1.2 perfusion units, δ – 8.18 ± 0.5 perfusion units, the variation index – $37.43 \pm 2.1\%$ (fig.5).

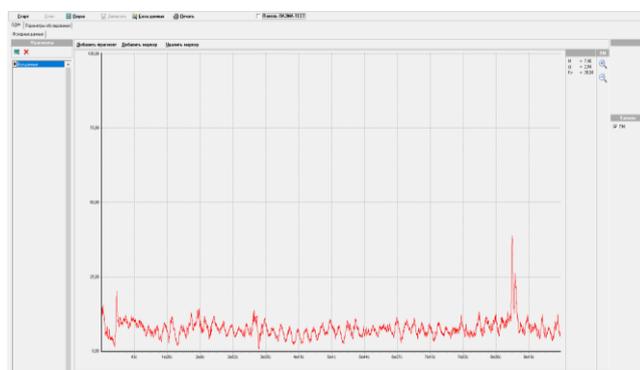


Figure 5. Laser Doppler flowmetry findings in patients with masticatory muscle spasm.

The variation index is the basic parameter demonstrating microcirculatory changes and disturbances. In patients with masticatory muscle spasm it is 2.8 times as high as compared to the control group.

Local blood flow indices in the comparison group were as follows: M – $27.7 \pm 1,3$ perfusion units, δ – 3.16 ± 0.4 perfusion units and Kv – $11.41 \pm 1.1\%$. Their vasomotor activity was 1.5 times as high as that in the control group.

The fact that masticatory muscles are constantly excited and activated, thereby continuously modulating the vasomotor activity of vessels, is likely to account for an increase in local blood flow velocity.

Therefore, the patients with masticatory muscle spasm showed such dental complications as pains in muscles, headaches even causing dizziness, entotic sound, glossalgia and joint clicking. However, no changes in the temporomandibular joint were registered radiographically. The findings of the functional examination revealed that the muscles are in the state of continuous excitation, which accounts for high vasomotor activity of vessels.

Discussion

Masticatory muscle spasm is considered to be a 21st century disease. As the range of diagnostic manipulations has increased, when performing a comprehensive dental examination the dentist has to do it holistically taking into account all the smallest details. Special emphasis should be placed on the patient's behaviour and stressors he/she is exposed to¹⁷.

Improper examination may result in incorrect diagnosis and, subsequently, in inadequate choice of a treatment regimen and the disorder management. This will provoke a long-lasting, chronic, persistent course of the pathology as the received therapy will have no positive effect. A great number of dental complications arising in the oral cavity will be also the evidence of the treatment failure¹⁸. The treatment of masticatory muscle spasm is a challenging task as it is difficult for the dentist to choose a specific method of therapy. The reason for that is that to date there is no universal regimen of pathogenetic management of such dental patients. The suggested treatment methods can be not only ineffective, but also result in complications, which are not merely dental.

Conclusions

There is a wide range of manifestations of masticatory muscle spasm in the oral cavity, which makes its comprehensive diagnostics complicated. A treatment regimen should be chosen on the basis of etiopathogenetic factors and aim to eliminate the cause but not the consequences and manifestations of the pathology. As masticatory muscles tend to be in the state of permanent excitation, myorelaxation therapy should be provided. This technique is promising; however, its further study and careful follow-up are required. Only after masticatory muscle spasm goes away, the dentist can start treating its consequences. In this case dental treatment will be sufficiently effective and rewarding. The pathogenetic approach to the therapy of masticatory muscle spasm will promote higher effectiveness of dental treatment.

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Declaration of Interest

The authors report no conflicts of interest pertaining to any of the products or companies discussed in this article.

References

1. Ella B., Ghorayeb I., Burbaud P., Guehl D. Bruxism in movement disorders: a comprehensive review // *J Prosthodont* 2017;26(7):599–605. DOI: 10.1111/jopr.12479. PMID: 27077925.
2. Orlova O.R., Konovalova Z.N., Alekseeva A.Yu. et al. Interrelation of bruxism and painful temporomandibular joint disorder // *Neuromuscular DISEASES Journal* 2017;25(24):1760–3. (In Russ.)
3. Castrillon E.E., Ou K.L., Wang K. et al. Sleep bruxism: an updated review of an old problem // *Acta Odontol Scand* 2016;74(5): 328–34. DOI: 10.3109/00016357.2015.1125943. PMID: 26758348.
4. Cruz-Fierro N., Martínez-Fierro M., Cerda-Flores R.M. et al. The phenotype, psychotype and genotype of bruxism // *Biomedical Rep* 2018;8(3):264–8. DOI: 10.3892/br.2018.1041.
5. Raphael K.G., Santiago V., Lobbezoo F. Is bruxism a disorder or a behaviour? Rethinking the international consensus on defining and grading of bruxism // *J Oral Rehabil* 2016;43(10):791–8. DOI: 10.1111/joor.12413. PMID: 27283599.
6. Guaita M., Högl B. Current treatments of bruxism // *Curr Treat Options Neurol* 2016;18(2):10. DOI: 10.1007/s11940-016-0396-3. PMID: 26897026
7. Castroroffio T., Bargellini A., Rossini G. et al. Sleep bruxism and related risk factors in adults: a systematic literature review // *Arch Oral Biol* 2017;83:25–32. DOI: 10.1016/j.archoralbio.2017.07.002. PMID: 28692828.
8. Palinkas M., De Luca Canto G., Rodrigues L.A. et al. Comparative capabilities of clinical assessment, diagnostic criteria, and polysomnography in detecting sleep bruxism // *J Clin Sleep Med* 2015;11(11):1319–25. DOI: 10.5664/jcsm.5196. PMID: 26235152.
9. Zucconi M., Ferri R. Assessment of sleep disorders and diagnostic procedures. Sleep medicine textbook chapter B1 // *European Sleep Research Society*, 2014. Pp. 95–109.
10. Stuginski-Barbosa J., Porporatti A.L., Costa Y.M. et al. Agreement of the International Classification of Sleep Disorders Criteria with polysomnography for sleep bruxism diagnosis: a preliminary study // *J Prosthet Dent* 2017;117(1):61–6. DOI: 10.1016/j.prosdent.2016.01.035. PMID: 27460312.
11. Lee S.J., McCall W.D. Jr, Kim Y.K. et al. Effect of botulinum toxin injection on nocturnal bruxism: a randomized controlled trial // *Am J Phys Med Rehabil* 2010;89(1):16–23. DOI: 10.1097/PHM.0b013e3181bc0c78. PMID: 19855255.
12. Paesani D.A., Lobbezoo F., Gelos C. et al. Correlation between self-reported and clinically based diagnoses of bruxism in temporomandibular disorders patients // *J Oral Rehabil* 2013;40(11):803–9. DOI: 10.1111/joor.12101. PMID: 24112029.
13. Stuginski-Barbosa J., Porporatti A.L., Costa Y.M. et al. Agreement of the International Classification of Sleep Disorders Criteria with polysomnography for sleep bruxism diagnosis: a preliminary study // *J Prosthet Dent* 2017;117(1):61–6. DOI: 10.1016/j.prosdent.2016.01.035. PMID: 27460312.
14. Pattara Sukhumanphaibun, Supaporn Sangouam Oral Health Status and Oral Dryness of Elderly Dementia Patients / *Journal of International Dental and Medical Research*. 2020; 13(3): 1059-1064
15. Saptadi A, Lilies DS, Menik P, Benny S. Latief Evaluation of Impacted Mandibular Third Molar Position in Relation to Mandibular Canal on Panoramic Radiography compared to Cone-Beam Computed Tomography / *Journal of International Dental and Medical Research*. 2019; 12(2):591-596.

16. Naumova V. N., Mikhailchenko D. V., Makedonova Ju. A., Kolesova T. V., Denisenko L. N. Interdisciplinary collaboration: screening of systemic blood flow at a dental appointment // Journal of International Dental and Medical Research. 2020;13 (1):216-222.
17. Mikhailchenko D.V., Makedonova Yu.A., Poroytsky S.V. Stress kak factor-predictor razvitiya periimplantita (obzor) [Text] / D.V. Mikhailchenko, Yu.A. Makedonova, S.V. Poroytsky [in Russian] // Georgian medical news. 2019; 9 (294): 46-50.
18. Sri Tjahajawati, Irna Sufiawati, Anggun Rafisa The Correlation between Salivary Volume, Salivary pH and CD4 in ARV and Non-ARV HIV Patients / Journal of International Dental and Medical Research. 2020; 13(3): 1140-1146.