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## The usage of botulinum in the treatment of masticatory muscles hyperactivity

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### ABSTRACT

**Introduction and purpose:** Masticatory muscles hyperactivity is currently a very common problem among adult population. The ignorance of the symptoms and the lack or unsuccessful treatment may lead to serious health complications, which lead to major focus on improvement of the standard therapy for bruxism. The aim of the study was to provide a broad review on the promising treatment of bruxism symptoms with botulinum neurotoxin injections.

**Material and method:** The review was conducted based on an available literature on PubMed database, searching the following phrases: bruxism, botulinum neurotoxin.

**Results:** As bruxism has a very complex etiology, the treatment can not be narrowed down to one therapy system. Despite the fact that botulinum neurotoxin injections can not solve the primary reason of bruxism occurrence, it has shown excellent results in treatment of symptoms, since the substance has an ability to induce muscle relaxation. Therefore, such pain relief substance has shown a much better performance and long lasting results in comparison to drug therapy or behavioral treatment.

**Conclusions:** The research confirmed that the usage of botulinum in the treatment of masticatory muscles hyperactivity is safe, well-tolerated by the patients and shows satisfying results. Conducted studies have proven that the most effective way of bruxism treatment is a therapy, which tackles both complex etiology of the disorder and its symptoms.

**Key words:** Botulinum neurotoxin, bruxism

Bruxism is a masticatory muscles disorder which typically affects from 8% to 31% of adult population [1,2]. It is characterized by teeth grinding and jaw clenching as a result of rhythmic masticatory muscles activity (RMMA) [2,3]. Bruxism is recognized as a pathological manifestation of RMMA, which is considered as physiological during sleep, rather than as a sleep or movement disorder [4]. The phenomenon of bruxism can be divided into two subtypes, depending on the time of the occurrence of symptoms: awake bruxism, if pathology occurs during wakefulness, and sleep bruxism, if such jaw-muscle hyperactivity happens when patient is asleep [1,5]. A prevalence of both types of bruxism individually is difficult to estimate, since approximately up to 80% of bruxers are unconcerned about their subconscious habit [6]. However, studies have shown that awake bruxism occurs more often among women and sleep bruxism affects both genders equally. Although it is reported that such hyperactivity of masticatory muscles varies in etiology, the prevalence of both types of bruxism significantly decreases with age [6]. A study among young college students demonstrated that 37.9% of them struggle with awake bruxism and 31.8% of them also deal with sleep bruxism [7].

The precise etiology of bruxism still remains unknown, however, studies have shown that masticatory muscles hyperactivity is often related to multiple factors. Originally, morphological factors, such as malocclusion, interferences of occlusion, condylar asymmetry, anomalies of dental arch or facial morphology and contacts within the balancing side were linked as focal causes of this pathology. Such belief led to a common overuse of occlusal therapy as a treatment method, which did not show satisfying results. Current state of knowledge focuses on central factors as a main cause of bruxism. These include pathophysiological factors, such as arousals or sleep anomalies, distorted brain chemistry, usage of certain drugs or medication, smoking, allergies, overconsumption of alcohol or coffee, genetic factors and deficiencies of magnesium and calcium. Various studies have also shown significant correlation between high level of stress, depression, anxiety, poor social support or hostility and the occurrence of sleep and awake bruxism [6].

Morphological factors	Physiological factors	Pathophysiological factors
<ul style="list-style-type: none"> <li>• Malocclusion</li> <li>• Interferences of occlusion</li> <li>• Condylar asymmetry</li> </ul>	<ul style="list-style-type: none"> <li>• High level of stress</li> <li>• Depression</li> <li>• Anxiety</li> <li>• Poor social support</li> <li>• Hostility</li> </ul>	<ul style="list-style-type: none"> <li>• Usage of certain drugs and medication</li> <li>• Smoking</li> <li>• Allergy</li> <li>• Overconsumption of alcohol and coffee</li> <li>• Genetic factors</li> <li>• Deficiencies of magnesium and calcium</li> <li>• Distorted brain chemistry</li> <li>• Arousals</li> <li>• Sleep anomalies</li> </ul>

Table 1. Factors, which significantly increase risk of bruxism occurrence [6].

## SYMPTOMS

Both types of bruxism are characterized by hyperactivity of masticatory muscles. However, the physiology of muscle activity significantly differs within both types of bruxism. During awake bruxism patients experience repetitive thrusting and bracing of the mandible, which results in sustained contact of the teeth. However, when it comes to sleep bruxism, patients can experience both tonic (non-rhythmic) and phasic (rhythmic) masticatory muscle activity.

Patients can also experience mixed episodes of bruxism, which combine symptoms of both awake and sleep bruxism. Although we can identify two types of this disorder, which vary in symptoms, craniofacial pain is a common sign for both awake and sleep bruxism [8]. However, it is difficult to evaluate on the subject of chronic pain when it comes this specific medical condition, since the nature of pain cannot be particularized in such case. Patients with sleep bruxism often experience morning headaches, discomfort and sensibility within masticatory muscles and pain which radiates to the muscles of temporal region [9].

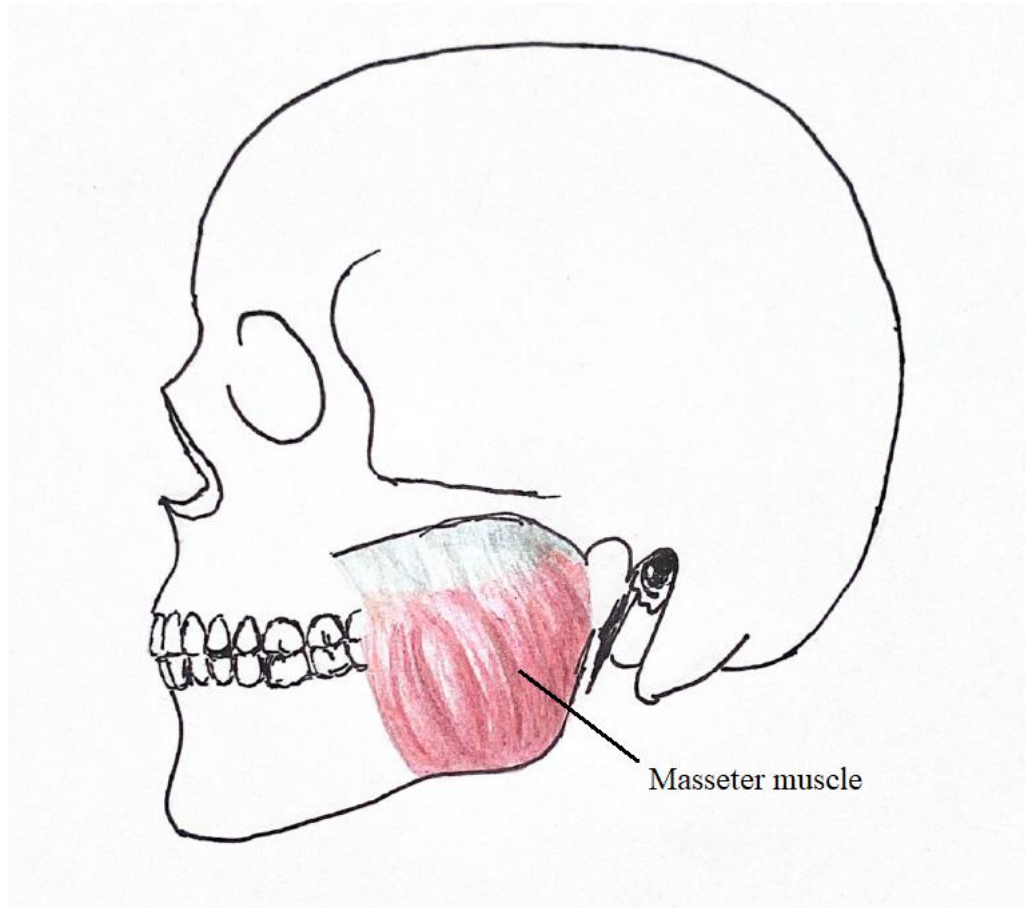


Figure 1. Location of masseter muscle. [16]

In a recent study, a problem of mere occurrence of bruxism symptoms was evoked. It has been argued whether such situation should be considered as a pathology or as a potential risk factor of other diseases, in case when it affects generally healthy individuals. Surprisingly, it has been proven that the mere occurrence of bruxism symptoms can also bring positive side effects in certain medical conditions. For example, patient with gastro-esophageal reflux will have a significantly decreased risk of teeth wear due to an increased salivation caused by bruxism [7].

Potential consequences of bruxism are: hypersensitivity; hypercementosis; damage within the periodontal tissue; hypermobility; problems within the pulp, such as inflammation or necrosis; cheek, tongue or lip damage caused by biting or indentation; discomfort or pain related to masticatory hyperactivity, pain or headaches related to temporomandibular joint disorders or disc displacement within the mentioned joint. Rhythmic hyperactivity of masticatory muscles also leads to physical outcomes of increased pressure on tissues within the tooth, such as fractures of the tooth and its restorations, abfraction cavities, tooth wear and failure of implant treatment. These factors altogether may result in aesthetical changes within the patient's face,

such as significantly reduced vertical facial dimension or characteristic appearance of square jaw which is related to hypertrophy of masticatory muscles [6].

## DIAGNOSIS

A diagnosis of bruxism is a complex process, which involves both subjective observations by the patient and clinical evaluation of the current state of the patient followed by an examination of their medical history, as well as electromyography (EMG), polysomnography (PSG) and investigation with mandibular advancement devices. The criteria for bruxism diagnosis consist of jaw clenching or tooth grinding while asleep and sounds related to such activity, abnormal tooth wear and discomfort, pain and fatigue of masticatory muscles, also clinically manifested as a headache or intensification of muscle symptoms in the morning. Although, all of the following symptoms are considered as symptoms of bruxism, diagnosis based only on observation of dental tissue is invalid. As of today, the golden standard of masticatory muscle hyperactivity diagnosis remains PSG, which measures the hyperactivity of muscles and anomalies, such as teeth grinding, including video and audio recordings registered while patient is asleep. However, due to high cost of such examination, diagnosis with the usage of PSG isn't common [10].

Subjective observation of symptoms			
<p>The presence of:</p> <ul style="list-style-type: none"> <li>• jaw clenching or tooth grinding while asleep and sounds related to such activity,</li> <li>• abnormal tooth wear and discomfort,</li> <li>• pain and fatigue of masticatory muscles</li> <li>• headache or intensification of muscle symptoms in the morning.</li> </ul>	Electromyography (EMG)	Polysomnography (PSG)	Investigation with mandibular advancement devices

Table 2. Diagnosis of bruxism [10].

## TREATMENT

As of today, there is no established therapy which is able to lead to a full recovery of a patient dealing with bruxism. Most commonly used treatment focuses on preventing the consequences of the disease and managing any risk factors, which may indicate hyperactivity within the masticatory muscles. Such behavioral strategy includes reducing smoking habit or caffeine, drug and alcohol consumption, as well as psychological therapy mostly focused on relaxation techniques, cognitive behavioral therapy (CBT) and control of habits, such as clenching teeth during the state of wakefulness [11]. Treatment also involves muscle relaxation, as a focal point of relieving the patients' discomfort. Currently, a suggested method of muscle relaxation consist of an oral appliance with utensils that enable a larger mandibular advancement. The most common pharmacological substances used for such purpose are clonazepam and botulinum neurotoxin which have been proven to significantly improve patients' well-being. Studies on electrical stimulation of masticatory muscles have also been conducted, with an approach of a potential new way of bruxism treatment. Although electrical stimulation has been proven to be an effective method of pain relief, not enough evidence were provided for such system to be established as a standard treatment of bruxism.

When it comes to drug therapy, studies have been conducted on the usage of levodopa, clonidine, bromocriptine, amitriptyline and propranolol in bruxism therapy. However, the following substances did not show any difference in results compared to placebo group. The risk of drug dependence and various side effects specific to each medical drug, as well as no positive results in conducted research made drug therapy uncommon in bruxism treatment [9].

Botulinum neurotoxin (BoNT) is a biological toxin which throughout the years has been proven to be an extremely effective in the treatment of several medical conditions and for cosmetic purposes [12,13]. The popularity of BoNT has significantly increased over time due to the general safety of the injection procedure and minimally invasive nature of the treatment [13]. It is very well tolerated among patients, with the most common side effect being the fatigue of affected muscles [14].

This toxin is naturally produced by anaerobic bacteria *Clostridium botulinum* and was discovered in the 19th century. However, until the discovery of neuromuscular transmission blockage by the above-mentioned toxin, the usage of BoNT in the treatment of medical conditions was not investigated. The successfulness of the treatment with BoNT underlays in its ability to inhibit the release of acetylcholine within the neuromuscular junction in both parasympathetic and sympathetic neurons [14]. Such interference within the emission of the principal neurotransmitter significantly weakens muscles with high overactivity, which also leads to atrophy or paralysis of the muscles within the injected area [14,15]. The acetylcholine transmission within nerve terminals, which were affected by the botulinum toxin, is irreversibly blocked. However, the synapses do not degenerate. Although the neuromuscular junctions of the impacted muscle have neurotransmitter blockage, the function of the muscle isn't permanently damaged. The function of injected muscle is usually restored after two or three months, when enough new synaptic contact develop to restore the mobility of the muscular tissue [14]. This aspect is extremely important to note, since it plays a crucial role when it comes to therapeutic aspects of botulinum neurotoxin usage [9].

Local injections of BoNT were also proven to control the hypersecretion within glands, which are supplied by cholinergic system. Treatment with botulinum toxin is also effective in multiple disorders characterized by ocular motility [14].

Botulinum toxin type A has already been established as an effective treatment for illnesses, such as: primary and secondary exotropia, Duane's syndrome, movement disorders, ophthalmological disorders, idiopathic focal dystonia, writer's cramp, concomitant misalignment, myogenic strabismus, paralytic strabismus, restrictive strabismus, non-concomitant misalignment, tardive dystonia, hemifacial spasm and craniocervical dystonias, such as laryngeal dystonia, oromandibular dystonia, torticollis, lingual dystonia, isolated head tremor and blepharospasm. Treatment with botulinum toxin type A has also been tried in other disorders, including upper eyelid retraction as a result of thyroid disease; tic disorders, such as dystonic tics, simple tics or Tourette's syndrome; ocular motility disorders, such as oscillopsia or nystagmus; Parkinson's disease and muscle stiffness; cramps; spasms; myofascial pain; disorders related to throat, ear and nose; migraine; cervicogenic headache and headache related to tension; stuttering with glottal blocks; pharyngeal and laryngeal disorders and oromandibular conditions, such as masseter hypertrophy and temporomandibular joint dysfunction [14].

Conducted studies on botulinum neurotoxin type A (BTX-A) injections in the treatment of bruxism have shown a significant improvement in the patients' well-being. They were proven to be more effective than placebo as a way to reduce patients pain, even after 3 and 6 months. They also performed better than conventional treatment in the same aspect of pain relief, also

after a 6 and 12 month follow up. However, the treatment with BTX-A has a palliative character and does not solve the primary cause of bruxism [9]. Conducted research has proven that therapy with botulinum neurotoxin lessens the intensity of the rhythmic contractions of masticatory muscles, but does not affect the number of contractions that the patient is experiencing [4]. While choosing a treatment with BoNT, we need to take into consideration side effects of constant reapplication of this substance and the consequences within the function and structure of masticatory muscles [9].

In conclusion, the available literature proves that botulinum neurotoxin treatment combined with muscle massage is an effective way for pain relief among patients who suffer from bruxism [9]. Considering the benefits coming from BoNT injections, as well as the risk that comes along with this procedure, therapy with the following substance is considered as safe, well tolerated by patients and minimally invasive, which makes further investigation on the botulinum neurotoxin treatment very promising [9,13,14].

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