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Efficacy of botulinum toxin in treatment of bruxism and temporomandibular disorders. Systematic review

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ABSTRACT

The medical use of botulinum toxin nowadays is widespread. Recent years show that use of botulinum toxin is not only used to control the muscular overactivity in bruxism, tension in temporomandibular disorders but also it can be applied for cosmetic reasons. The objective of this study was to view recent discoveries in this subject by conducting a systemic review of clinical trials published in the research works.

Recent studies present efficacy in releasing pain in both: bruxism and temporomandibular disorders by minimizing symptoms and reducing the intensity of muscle contractions. The scientific works cited confirm a noticeable improvement in most symptoms occurring in the states mentioned above.

Key words: *botulinum injections, bruxism, temporomandibular disorder*

INTRODUCTION

Temporomandibular disorders

Temporomandibular disorders (TMD) are described as a group of musculoskeletal and neuromuscular conditions that involve the temporomandibular joints, the masticatory muscles, and all associated tissues.¹ People struggling with this condition deal with chronic facial pain. The etiology may be varied; from biopsychosocial factors, including genetics and psychological characteristics, as well as parafunction and trauma. The term “temporomandibular disorder” was first coined in the medical literature in the 1930s. The disorder was first described by Dr. Costen, an American Otolaryngologist in 1934. Temporomandibular joint disorders can have negative impact on people for many reasons

1. Pain: TMD can cause pain and discomfort in the jaw, face, and neck. It can also cause headaches and earaches²
2. Difficulty in opening and closing the mouth: TMD can cause difficulty in opening and closing the mouth, as well as problems with biting and chewing
3. Limited jaw movement: TMD can cause limited jaw movement, leading to difficulty in speaking, eating, and swallowing
4. Difficulty sleeping: TMD can cause sleep disturbances and discomfort while sleeping, leading to fatigue, irritability, and difficulty concentrating³
5. Psychological distress: TMD can cause anxiety and stress, as well as low self-esteem and embarrassment due to the appearance of the face or difficulty speaking or eating
6. Economic impact: TMD can lead to significant medical costs, due to the need for medical treatment such as psychological therapy, medication, and in some cases, surgery

Bruxism

Bruxism is described as a repetitive jaw- muscle activity characterized by the clenching or grinding of the teeth or by bracing or thrusting of the mandible. Bruxism can occur during wakefulness (indicated as awake bruxism) or during sleep (indicated as sleep bruxism)⁴. It is a common condition with an adult prevalence ranging between 8 and 31%.⁵ The pathophysiology is still unclear, although it seems to have multifactorial origin mediated by central and autonomous nervous systems⁶. The term “bruxism” was coined in the late 19th century by a French dentist, Guillaume Duchenne, who was one of the first to describe and study the condition. Bruxism can have negative impact on people for several reasons⁷

1. Oral health: Bruxism can cause excessive wear and damage to the teeth, leading to tooth sensitivity, tooth loss and damage to dental restorations. It can also lead to temporomandibular joint disorders⁸, which can cause pain and discomfort in the jaw and face
2. Sleep disturbances: Bruxism can occur during sleep and can cause disruptions in sleep, leading to fatigue, and difficulty concentrating
3. Headaches and facial pain: Bruxism can cause headaches and facial pain⁵, especially in the morning
4. Psychological distress: Bruxism can cause anxiety and stress, as well as low self-esteem and embarrassment due to the appearance of the teeth.
5. Economic impact: Bruxism can lead to significant dental costs due to the need for dental treatment such as fillings, crowns, and in severe cases, jaw surgery

Botulinum toxin type A

In recent years it has been more common the use of botulinum toxin in both described above disorders. The commercial name for botulinum toxin is Botox. It is produced by the bacterium *Clostridium botulinum*. The toxin exists in seven structurally similar, but immunologically distinct serotypes indicated by the letters A, B, C, D, E, F, and G; of which the most widely used is type A⁹. Botulinum toxin was first discovered in 1895 by a German scientist named Dr. Justinus Kerner. He observed that there was a toxin present in a batch of spoiled sausage that was causing paralysis in those who ate it. He named the toxin „botulism” after Latin word for sausage, „botulus”. It wasn’t until 1970s that scientist began to study the toxin as a potential treatment for muscle spasms and other medical conditions. In 1980, Dr. Alan Scott, an ophthalmologist, used botulinum toxin to treat patient with a muscle disorder of the eye and found that it successfully paralyzed the muscle, leading to the start of the development of Botox as we know it today

The therapeutic effect of botulinum toxin is due to its action on neuromuscular junction. It induces flaccid paralysis by inhibiting acetylcholine release. Mechanism of action consists of three stages: binding, internalization (energy-dependent receptor-mediated endocytosis), and flaccid paralysis through inhibition of releasing neuro- transmitter. This therapeutic effect continues for 3–6 months; within that period, botulinum toxin corrects the patterns of muscle exercises, decreases facial wrinkles or square jaw, and alleviates pain by changing the patient’s lifestyle¹⁰. In addition, BTX is shown to block the release of inflammatory mediators, such as substance P and glutamate, creating an antinociceptive effect¹¹.

Interest in research and clinical usage of botulinum toxin increased exponentially past few decades. The purpose of this study was to explore the efficacy of Botox on the treatment of the bruxism and TMD based on primary outcomes in research.

MATERIALS AND METHODS

Electronical databases such as PubMed and Web of Science were searched by applying key terms relating to botulinum toxin and its efficacy in treatment bruxism and temporomandibular disorders.

RESULTS

Effectiveness of Botulinum Toxin in TMD¹²

According to studies shown in the article “Botulinum Toxin Type A in Dental Medicine” (Muñoz Lora VRM, Del Bel Cury AA, Jabbari B, Lacković Z) there were 3 published controlled clinical trials- 1 class III (Kurtoglu et al. 2008), 1 class II (Ernberg et al. 2011), and 1 class I (Patel et al. 2017)- on the subject of Botulinum Toxin treatment in TMD’s Kurtoglu et al. (2008) reported a significant reduction of activity of the masseter and temporalis muscles after BoNT-A injections. Twenty-one days after injections into both muscles, patients cleared that the pain was approximately lower and they also reported improvement of their psychological status. Contrary to above showed studies, a randomized placebo-controlled crossover multicenter study in 21 patients with myogenous TMD (Ernberg et al. 2011) addressed no pain relief after injection of Botulinum Toxin into the masseter muscles. However, patients treated with the toxin presented a clinically reduction of pain after 1-mo evaluation as compared with the control group. Authors wrapped it up that findings regarding pain reduction on some participants was not adequate to say that BoNT-A is an effective treatment for TMD’s In studies shown in Patel et al. 2017 there was a significant release in pain after injecting Botulinum Toxin A. It was a class I double placebo-controlled study Based on studied presented above, Botulinum Toxin A injection into the temporalis and masseter is probably effective in TMD

Effectiveness of Botulinum Toxin in Bruxism^{7,13}

According to studies shown in the article “Treating severe bruxism with botulinum toxin”⁷ BTX-A has an effective impact on people caused by this condition. In the article they presented 2 case reports. First case was about 79-years old women experiencing severe tooth grinding. They injected 60 MU of botulinum toxin type A in each of both masseter muscles as well as 10 Mu of BTX in the submentalis muscle because of a mild spasm in this muscle. After the injection she reported improvement of her grinding within few days. Her jaw pain also resolved, and she was able to swallow without problems Second case showed 19-year-old women with abnormal muscle spasm in her face and neck. They injected 50 MU of BTX in each of both masseter muscles, as well as 30 MUs of BTX in her eyelid and brow muscles. Her parents reported that her grinding improvement by at least 75 percent within a day of the injection. The improvement had lasted for four months⁷.

According to studies shown in the article “Sleep bruxism possibly triggered by multiple sclerosis attacks and treated successfully with botulinum toxin”¹⁸ Botulinum toxin type A has a great effect when it comes to treating this condition. In the article they mentioned about 3 patients. I patient- 37-year-old male, II patient- 40-year-old women, III-patient- 36-year-old women. They all reported relief of symptoms after BTX-A.

Two articles 1.” botulinum toxin-A injections for sleep bruxism: A double-blind, placebo-controlled study”²¹ 2.” Effect of botulinum toxin injection on nocturnal bruxism: a randomized controlled trial” performer subjective evaluation for the recovery of the bruxism. A total of 34 participants were included with 19 in the BTX-A group and 15 in the placebo group. Lee et al. used the bruxism questionnaire (Scale, 0-5) to measure SA via patients, and Ondo et al. used the VAS (Scale, 0-10 cm). The pooled outcomes showed that the recovery of bruxism was more effective in BTX-A than in the placebo group (SMD, 0.80; 95%CI, 0.09 to 1.52; P=0.03; Figure 6), with low heterogeneity ($I^2=0\%$, P=0.62)²³⁽¹⁴⁾

DISCUSSION

Over the past few decades BoNT-A was widely used in not only dental medicine but also in other fields. In the begging the purpose of its use was mostly to reduce the pain but later, studies discovered the approximately efficacy also in cosmetic procedures, treating spasticity and hypersecretory disorders.

Discussing using Botox as a treatment for bruxism mental health factors are significant factor in this case. This is evident in the study by Zhang et, al¹⁵ which found that the maximum biting force was reduces in both the group receiving BTX-A treatment and the groups receiving a placebo or no treatment. This reduction in the placebo and control groups suggest that psychological approaches can have significant impact in the treatment of bruxism.

It has been speculated that in some cases, bruxism may be a part of dystonia and share a similar pathopsychology¹⁶

Research has shown a strong link between psychological stress and excessive jaw movement, indicating a possible connection between temporomandibular disorder and certain mental health conditions like PTSD- post traumatic stress disorder. Studies support the theory that chronic pain and PTSD share similar neural mechanism^{17,18}.

Scientists do not fully understand how the central nervous system causes or respond to pain, whether it is psychical or emotional. Studies have shown that there are changes in the brain structure and function in people with a condition called temporomandibular disorder, which causes pain in the jaw and face. More research is needed to understand how these changes in the brain lead to pain. Similarly, while there has been progress in understanding the brain changes in people with PTSD, there is still much to learn about the specific brain changes that happen and their effect¹⁹.

CONCLUSIONS

A single Botulinum Toxin A injection cannot reduce the genesis of bruxism and TMD's. However, it can be an effective management option for these conditions by reducing the intensity of the muscles.

Bruxism

Using BTX-A can effectively reduce the number of bruxism episodes and decrease the pain associated with it, leading to an improvement in the patient's quality of life^{20,21}. Furthermore, it is safe treatment option with minimal risks of side effects when used in doses less than 100UL. Compared to traditional methods such as oral splints, medication and cognitive-behavioral therapy, Botulinum toxin type A is a more effective treatment for bruxism and therefore can be justified for use in clinical practice, particularly for patients with severe bruxism⁴. It's important to note that Botox treatment for bruxism is not a permanent solution and will need to be repeated every 3-6 months. Also, Botox should be used in combination with other treatments such as behavioral therapy and oral splints, as well as addressing the underlying causes of bruxism.

Although BTX-A is an effective treatment for bruxism, it is also costly. It should mostly be considered for those who have severe or debilitating bruxism that has not responded to other medical or dental treatments. The treatment should only be administered by healthcare professionals who are knowledgeable about the drug's pharmacology and the anatomy of the areas being injected. Using proper injection techniques and having experience can reduce the risk of complications.

Temporomandibular disorders

Research on the effectiveness of Botox for TMD is limited²², but some studies have shown that it can be helpful in reducing pain and improving jaw function. However, it is important to note that temporomandibular disorders can have many different causes. It is also a temporary solution and will need to be repeated every 3-6 months. A comprehensive treatment plan that addresses the underlying causes of temporomandibular disorders, such as dental issues, stress, and muscle imbalances should be considered in addition to Botox injections. Additionally, TMD's often overlap with other common head and neck pains, which requires further investigation. Botulinum toxin is proving to be powerful and valuable tool for diagnosing and treating temporomandibular disorders. Its success calls for a reevaluation for our understanding of TMD's, their causes, and their connection to other head and neck pains and myofascial conditions. Clinical trials are ongoing to provide scientific evidence for the use of botulinum toxin in TMDs. As seen with other conditions, the advancement of the science will likely precede a full understanding and regulatory approval.

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