

Relationship between Botulinum Toxin and Temporomandibular Dysfunction: a Literature Review

Relação Entre Toxina Botulínica e Disfunção Temporomandibular: uma Revisão Bibliográfica

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Abstract

Temporomandibular dysfunction (TMD) encompasses several conditions affecting the temporomandibular joint and jaw muscles, leading to orofacial pain and other symptoms. Botulinum toxin is a potential therapy for relieving pain, improving jaw function, and reducing the use of analgesics. This study aims to systematically illustrate the application of botulinum toxin in the therapeutic context of TMD. This study took the form of a literature review, in which an analysis of knowledge repositories was conducted, including Medline (U.S. National Library of Medicine), accessed via PubMed, as well as Lilacs (Latin American and Caribbean Literature in Health Sciences), Scielo (Scientific Electronic Library Online), and Google Scholar. The selection involved the inclusion of studies published from 2015 to 2023. The literature review identified botulinum toxin as an effective and safe therapeutic alternative for TMD patients. The manifestation of side effects, when reported, was predominantly mild and transient in nature, granting botulinum toxin the prospect of establishing itself as a promising therapeutic option in refractory cases to conventional approaches. However, it is important to emphasize the need for further studies and clinical trials to further consolidate the efficacy and safety associated with the use of botulinum toxin as a treatment for TMD.

Keywords: Temporomandibular Dysfunction. Masticatory Muscles. Botulinum Toxin.

Resumo

A disfunção temporomandibular (DTM) engloba várias condições que acometem a articulação e os músculos da mandíbula, causando dor orofacial e outros sintomas. A toxina botulínica é uma potencial terapia para aliviar a dor, melhorar a função mandibular e reduzir o uso de analgésicos. Este estudo visa ilustrar de forma sistemática a aplicação da toxina botulínica no contexto terapêutico da DTM. Este estudo assumiu a forma de uma revisão bibliográfica, na qual foi realizado uma análise de repositórios de conhecimento, incluindo o Medline (Biblioteca Nacional de Medicina dos Estados Unidos), acessado por meio do PubMed, assim como o Lilacs (Literatura Latino-Americana e do Caribe em Ciências da Saúde), o SciELO (Scientific Electronic Library Online) e o Google Scholar. A seleção envolveu a inclusão de estudos publicados no período de 2015 a 2023. A revisão bibliográfica identificou a toxina botulínica como uma alternativa terapêutica eficaz e segura para pacientes com DTM. A manifestação de efeitos colaterais, quando relatados, revelou-se predominantemente de natureza branda e transitória, outorgando à toxina botulínica a perspectiva de se consagrar como um recurso terapêutico promissor em situações refratárias às abordagens convencionais. No entanto, é importante enfatizar a necessidade de estudos prévios e ensaios clínicos para uma maior consolidação da eficácia e segurança associadas à utilização da toxina botulínica como tratamento para a DTM.

Palavras-chave: Disfunção Temporomandibular. Músculos Mastigatórios. Toxina Botulínica.

1 Introduction

Temporomandibular dysfunction (TMD), among its categories, can be essentially classified, although not exclusively, into muscular disorders, disc dysfunctions, and other joint conditions. The latter includes degenerative pathologies affecting the involved joints¹. TMD encompasses a set of conditions that affect the temporomandibular joint (TMJ) and the masticatory muscles, including the temporalis, masseter, medial pterygoid, lateral pterygoid muscles, and associated structures. This dysfunction is considered a primary cause of non-dental pains in the orofacial region, leading to symptoms such as headaches, earaches, limited mouth opening, joint noise (clicking), and difficulty during chewing. Epidemiological studies show that TMD is a

common condition that mainly affects adults, with a higher prevalence in women. It is between the ages of 20 to 40 years old that patients report the most symptoms of TMD²⁻⁴.

The therapeutic approach to TMD presents clinical challenges due to its multifactorial causes, which encompass triggers of biological, environmental, social, and emotional origins³. Traditional treatment options include non-invasive pharmacological therapy, minimally invasive therapies with muscle and joint injections, physical therapy, the use of occlusal splints, and in more severe cases, surgery. However, these alternatives are not always effective for all patients and may result in undesirable side effects⁶.

A peripheral approach involves the use of botulinum toxin, which reduces muscle contraction by blocking the release of acetylcholine. This leads to flaccid paralysis of

skeletal muscles and a decrease in the activity of sympathetic and parasympathetic cholinergic synapses. The inhibition provided by the toxin typically lasts from a few weeks to three or four months, with functional recovery dependent on nerve terminal proliferation^{7,8}.

The first description of the use of botulinum toxin in the treatment of TMD dates back to 1999 when Freund conducted injections into the masseter and temporal muscles. In recent years, there has been a significant increase in interest in employing botulinum toxin as a therapeutic alternative for TMD⁹. The application of botulinum toxin in the treatment of TMD is based on the theory that temporary paralysis of the chewing muscles can attenuate muscle overload and alleviate painful sensations. Additionally, recent studies have shown that botulinum toxin can inhibit peripheral sensitization of nociceptive fibers, thus reducing central sensitization by inhibiting the release of glutamate and substance P¹⁰.

Additionally, this substance can influence central sensitization, reducing the nervous system's reaction to pain. Therefore, the present study conducted a literature review to deepen the understanding of the relevance of botulinum toxin in the therapeutic scope of TMD.

2 Development

2.1 Methodology

In this literature review, available scientific evidence regarding the use of botulinum toxin in the treatment of TMD was gathered. To achieve this objective, renowned scientific databases such as Medline (National Library of Medicine, United States), accessed through PubMed, as well as Lilacs (Latin American and Caribbean Literature in Health Sciences), SciELO (Scientific Electronic Library Online), and Google Scholar were explored.

For study selection, inclusion criteria were established, encompassing literature written in Portuguese, as well as articles fully published in Portuguese and English, from the period between 2015 and 2023. Thirty-seven studies were required to present relevant methodological approaches to the research core theme. Exclusion criteria were implemented, covering articles, theses, dissertations, and course completion works that did not comprehensively address the topic under analysis. Literature search involved the use of keywords, combining terms such as “temporomandibular dysfunction,” “masticatory muscles,” and “botulinum toxin.”

2.2 Results and discussion

The literature review highlights botulinum toxin as a highly effective therapeutic option in the treatment of patients with TMD. However, it is important to consider that, until August 2016, research conducted by the Brazilian Society of Temporomandibular Dysfunction and Orofacial Pain (SBDOF) did not recommend the use of botulinum toxin to treat TMD subtypes: myalgia, disc disorders, and

degenerative diseases. This was due to the lack of rigorous studies evaluating its effectiveness, efficacy, and safety for these specific cases¹.

In addition to the remarkable reduction in pain associated with TMD, a significant improvement in patients' quality of life was observed. These findings support the growing adoption of botulinum toxin as a valuable resource in managing complications related to this condition^{12,13}.

In the treatment of TMD, the pursuit of pain relief takes center stage, and it is in this scenario that botulinum toxin has stood out for its remarkable effectiveness¹⁴. In-depth research has shown that the precise application of botulinum toxin to specific points in the masticatory muscles leads to a significant reduction in pain intensity among patients dealing with chronic and recurrent TMD¹⁵.

An especially relevant aspect is that botulinum toxin demonstrates the ability not only to reduce pain intensity but also to decrease the frequency and duration of recurrent painful episodes, thus providing sustained and prolonged relief for patients¹⁶. These findings emphasize the positive influence of botulinum toxin as a broad and long-reaching therapeutic approach in managing the complexities associated with TMD¹⁷.

Another crucial aspect to consider is the notable increase in pain threshold observed in patients undergoing botulinum toxin treatment. This phenomenon, which implies an elevation in the ability to withstand pain, translates into greater tolerance to nociceptive stimuli¹⁸. Consequently, patients exhibit reduced sensitivity to painful stimuli, which not only contributes to better adaptation to daily demands but also correlates with a significant decrease in the discomfort associated with TMD¹⁹.

This synergistic effect between botulinum toxin and the increased pain threshold highlights the therapeutic approach as a central element in optimizing the quality of life of patients facing this debilitating condition.

In addition to pain relief, the application of botulinum toxin has been shown to be effective in improving mandibular function²⁰. Patients treated with botulinum toxin reported increased ability to open and close the mouth, chew, and speak properly. This increase in functionality is essential for the quality of life of patients, as it allows them to resume their daily activities more comfortably and without limitations

Another important benefit is the reduction in the use of analgesic drugs in patients undergoing treatment for TMD with botulinum toxin. The decrease in the need for analgesic medications is beneficial not only to avoid unwanted side effects but also to reduce long-term drug dependence and minimize the risks associated with their excessive use²¹⁻²³.

The importance of proper patient selection for treatment with botulinum toxin is evident. Although botulinum toxin has been shown to be effective for most patients, not all of them exhibit the same positive response to treatment. Therefore,

it is crucial to conduct a thorough evaluation of each case, taking into account the severity of TMD, the patient's medical history, and other relevant factors. This approach enables the attainment of the best possible therapeutic outcome²⁴.

Additionally, in the study by De La Torre Canales²³ it was demonstrated that the use of botulinum toxin can be advantageous in cases of patients who do not respond to conventional treatments. However, due to the potential unwanted effects associated with the administered quantity, it is essential to conduct a thorough assessment of the effectiveness of this procedure.

In this context, conventional treatments should be considered the primary therapeutic alternative, highlighting the importance of traditional approaches in the management of TMD. These include physiotherapy, occlusal therapy, medications, and other conservative interventions²⁵. Although botulinum toxin has demonstrated efficacy, its application should be carefully considered, especially in cases of less severe TMD.

The frequency of botulinum toxin application varies across different therapeutic protocols, with studies proposing quarterly or more spaced intervals, such as semi-annual, reflecting the diversity in approach²⁶. This variation is influenced by the individual characteristics of each patient, the severity of TMD, and the unique response to therapy. Considering the individuality of each case is essential in determining the frequency of application, making periodic patient evaluation crucial for adjustments in the treatment plan.

The indication of botulinum toxin in relation to TMD should be considered in specific situations, such as cases refractory to conventional treatments or when these cause significant side effects. It is recommended that botulinum toxin be reserved for patients who do not respond adequately to conventional therapies or have contraindications to these approaches. A careful assessment of the clinical history, severity of symptoms, and previous response to other interventions is essential to determine the appropriate time for the introduction of botulinum toxin²⁸.

In the review of studies, a crucial aspect highlighted is the highly satisfactory safety profile of botulinum toxin in the context of clinical treatment of TMDs²⁹. Most patients undergoing botulinum toxin injection reported mild and short-lived side effects, including pain at the injection site, warmth sensation, redness, bruising, and mild flu-like symptoms, as well as muscle weakness^{4,30}. It is important to note that more serious adverse events were considered rare and, to date, have not been widely documented in the studies analyzed³¹.

The finding of a low rate of serious adverse events is particularly relevant, considering that traditional treatment for TMD often involves prolonged use of analgesics and other medications³². These medications, while they may provide temporary pain relief, are often associated with unwanted side effects such as drowsiness, nausea, constipation, and

the risk of dependence. By reducing the need for analgesic medications through treatment with botulinum toxin, it is possible to significantly minimize the potential side effects and risks associated with the chronic use of these substances.

Another relevant point is that botulinum toxin has demonstrated a satisfactory safety profile even when used long-term, as long as it is administered by a specialized professional and following appropriate dosage and application interval guidelines³³. Studies that followed patients undergoing multiple applications of botulinum toxin over time did not report significant occurrences of serious adverse events. The most frequently reported side effect was muscle weakness at the injection site, which is usually transient and does not compromise patients' daily activities¹⁶.

However, it is important to emphasize that while botulinum toxin is considered safe in the vast majority of cases, proper patient selection is essential to ensure the safety and efficacy of the treatment. Each patient should be carefully evaluated for medical history, allergies, and other relevant factors for the safe application of botulinum toxin³⁴. This personalized approach allows healthcare professionals to identify and minimize any potential risks associated with the treatment, thus ensuring more satisfactory results³⁵.

The reviewed studies emphasized the favorable safety profile of botulinum toxin in the treatment of TMD. The occurrence of mild and short-lived side effects, along with the reduction in the need for analgesic medications, makes botulinum toxin a promising and well-tolerated therapeutic option. However, it is crucial that the treatment be conducted by a specialized professional and patient selection be meticulous to ensure maximum safety and effectiveness of the procedure³⁶.

It is essential to recognize that botulinum toxin offers temporary relief of TMD symptoms without directly addressing the underlying cause. Although it manages acute symptoms and improves the patient's quality of life, the need for periodic reapplication highlights the palliative nature of the treatment. Thus, it is essential to integrate botulinum toxin as a component of a comprehensive plan for TMD treatment, which may include interventions aimed at addressing the underlying causes³⁷.

3 Conclusion

This study highlights the promising potential of botulinum toxin as a therapy for TMD. However, its application requires careful patient selection and combination with additional therapeutic approaches to optimize clinical outcomes. Although side effects are mild and temporary, further research is needed to consolidate its efficacy and safety as a reliable alternative in TMD.

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