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ARTICLE REVIEW

Use of botulinum toxin type A as a treatment for the gummy smile

Uso de la toxina botulínica tipo A como tratamiento en la sonrisa gingival

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ABSTRACT

Botulinum toxin is a deadly toxin produced by the gram-positive bacterium Clostridium botulinum. In dentistry, it is considered a substantial treatment for muscular hyperactivity that results in an unsightly characteristic such as the "gummy smile" in the patient. The present study was carried out with the aim of describing the use of botulinum toxin type A as a treatment for the aforementioned gummy smile. For this purpose, a search for information was carried out in the Scopus, ProQuest Health and Web of Science databases. The guidelines of the PRISMA declaration were used for its elaboration. It was concluded that the application of BoNTA reduces the contraction of the muscles responsible for elevating the upper lip, reducing gingival exposure, this being the least invasive, most effective, quickest and safest treatment for the patient, giving the patient a harmonious and visibly esthetic smile.

Keywords: Clostridium Botulinum; Botulinum Toxins, Type A; Esthetics; Muscles; Dentistry.

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RESUMEN

La toxina botulínica es una toxina mortal producida por la bacteria grampositiva *Clostridium botulinum*. En odontología, se considera un tratamiento sustancial en la hiperactividad muscular que trae como consecuencia una característica antiestética como lo es la "sonrisa gingival" en el paciente. El presente estudio se realizó con el objetivo de describir el uso de la toxina botulínica tipo A como tratamiento en la ya mencionada sonrisa gingival. Para ello se realizó una búsqueda de información en las bases de datos *Scopus*, *ProQuest* Salud y *Web of Science*. Para su elaboración se utilizaron las directrices de la declaración PRISMA. Se concluyó que la aplicación de BoNTA reduce la contracción de los músculos encargados de elevar el labio superior, disminuyendo la exposición gingival, siendo este el tratamiento menos invasivo, más eficaz rápido y seguro para el paciente devolviendo al paciente una sonrisa armónica y visiblemente estética.

Palabras clave: Clostridium Botulinum; Toxinas Botulínicas Tipo A; Estética; Músculos; Odontología.

INTRODUCTION

Botulinum toxin is a lethal toxin produced by the gram-positive bacterium Clostridium botulinum. Bacteria produce seven antigenically distinct toxins, labeled A to G. However, the most studied toxin is type A.[1,2]

Botulinum toxin is a deadly substance of natural origin that can be used as an effective and potent drug. It has a long history of medical use, evolving from a toxic agent to a versatile clinical tool.[3] The mechanism of action begins when the toxin is taken up by nerve fibers, altering the acetylcholine vesicle release process in nerve endings (motor neurons, alpha and gamma) and blocking neuromuscular junctions.[4,5]

This type of treatment has not been considered ideal for excessive gingival exposure because there are different etiologies that can contribute, such as excessive vertical maxilla, passive dental eruption, or excessive and/or hypertrophic gingival tissue. Therefore, in a patient with a surgical indication, this injection cannot be recommended since botulinum toxin injection may be only a temporary solution and not a definitive treatment for the patient.[6]

The use of botulinum toxin is considered a first-line treatment when the origin is muscular hyperactivity because it is an effective, quick, safe, and more conservative alternative to surgical intervention. It is also recognized as a competent and minimally invasive treatment.[6,7]

Today, Botox is increasingly used in the dental field, being applied in various procedures such as temporomandibular joint issues, bruxism, oromandibular dystonia, mandibular spasm, dental surgery and implants, gummy smile, and masseter hypertrophy.[7,8]

There is a growing demand from patients who want to aesthetically improve their smiles, as it enhances supreme confidence, high self-esteem, and is crucial for socialization, conveying a sense of joy through facial expressions.[8,9]

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In a pleasant smile, the upper lip border should be symmetrically positioned over up to 3 mm of gums, and the gingival line should follow the contour of the upper lip exposure. Showing more than 3 mm of gums when smiling is called "gummy smile," and it negatively affects smile aesthetics. The aesthetic and functional evaluation of the patient in these cases should include extraoral, dental, and periodontal examinations. The smile is determined by the grouping of three components: teeth, gums, and lips, which must be arranged in proper harmony.[6,9,10]

Numerous perioral muscles are involved in the contraction of the upper lip, such as the levator labii superioris and alaeque nasi, major and minor zygomatic, depressor nasalis, and risorius muscles. All these muscles interact with each other and, in turn, with the orbicularis oris to create a smile. If there is increased contraction of one of them due to hypermobility, a greater amount of gum tissue is exposed, resulting in an unaesthetic smile.[7]

This may be the result of factors such as passive or altered dental eruption, skeletal dysplasia or maxillary overgrowth, or in some cases, a combination of these factors, in addition to considering factors such as a short or hyperactive upper lip when smiling. Only after a correct diagnosis and considering the etiological factor in each case can an appropriate treatment plan be proposed.[9,10]

The normal translational movement of the lip from rest is around 6 to 8 mm and up to 10 mm in a situation of hypermobility of the lip. If a patient is suspected to have a hypomobile lip, the clinician should consider lip repositioning surgery or Botox injections.[11] This latter intramuscular injection causes a temporary paralysis of the levator labii superioris muscle and the consequent increase in the relative length of the upper lip.[2]

The present research aims to describe the use of botulinum toxin type A as a treatment for gummy smile.

METHODOLOGY

A search for information was conducted in the Scopus, ProQuest, and Web of Science databases on the use of botulinum toxin type A as a treatment for gummy smile in patients over 18 years old. The PRISMA guidelines were used for its development.[12]

For the information search, a search strategy was employed with the terms "botulinum," "toxin," "gummy smile." Spanish and English languages were selected as filters, and the period 2014-2023 was chosen.

Table 1. PRISMA Methodology

Section	**Ítem**
Eligibility criteria	Inclusion and exclusion criteria
Information sources	Scopus, ProQuest Salud, Web of Science
Search formula	(botulinum) AND (toxin) AND (gummy smile)
Selection process	Omission of duplicate articles. Review of abstracts. The most important information and data will be chosen after a thorough review of the articles.
Data collection process	An Excel matrix was used for data classification from scientific databases
Synthesis methods	The results obtained from the research and systematic review are presented in tables for better understanding

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RESULTS

Fourteen articles were selected for the development of this research. Table 2 shows the authors, year of publication, objective, methodology, and main conclusions of the selected studies.

Table 2. Main Characteristics of the Studies.

Autores	Año	Objective	Methodology	Conclusions
Azam et al.[1]	2015	Describe the fundamentals of botulinum toxin and some of its uses in dentistry.	Internet search on botulinum toxin used in dentistry, selection of all relevant articles and studies, extraction, and summarization of articles related to dentistry.	Botulinum toxin chemodenervation is useful in many dental conditions. Controlled use of this therapy is more important than radical use.
Ser Yun et al.[2]	2019	Summarize the treatment modalities for gummy smile, their applications, improvement of skills and techniques, and possible complications.	This article reviews treatment modalities focused on the etiology of gummy smile, their applications, improvement of skills and techniques, as well as possible complications and solutions.	Three categories of treatment modalities exist: corrective, adjunct, and palliative. Due to the difficulty in finding treatments for gummy smile and effectively demonstrating the efficacy of a specific technique, the clinician and patient must agree on treatment procedures before active treatment begins.
Lino Brancini et al.[3]	2021	Address the importance of using botulinum toxin to correct gummy smile, demonstrating patient satisfaction, even though the effect is temporary.	Literature review in PubMed, LILACS, and Bireme databases with inclusion criteria of literature review of clinical cases of patients with gummy smile published between 2015 and May 2019.	Dental aesthetic treatment with botulinum toxin significantly contributes to obtaining pleasant and harmonious results in gummy smile treatment, provided it is well indicated. Although its effect is temporary, it has become a safe, less invasive, and effective procedure that should be used when the clinician has specific training and does not exceed recommended doses.
Gregnanin Pedron et al.[4]	2017	Present a case of a patient with gummy smile treated with botulinum toxin, avoiding respective surgical procedures.	Systematic review and presentation of a clinical case.	Botulinum toxin type A is a minimally invasive, quick, safe, and effective therapeutic option that produces harmonious results. It should be considered by dentists as an alternative in correction, completion, or complementation of aesthetic procedures, increasing the quality of life and self-esteem of patients.

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Cengiz et al.[6]	2020	Investigate the efficacy of botulinum toxin applied to different muscles in patients with excessive gingival display and evaluate the return to baseline gingival exposure value.	Ethical committee approval obtained for 28 patients with over 2mm gummy smile, randomly divided into 2 groups. Equal botulinum toxin was administered to the left and right sides of the levator labii superioris in group 1 and orbicularis oris in group 2. Photos and measurements were taken before injection and at 3 days, 15 days, 1 month, 4 months, 5 months, and 6 months after injection. Visual analog scale used to assess satisfaction level.	For gummy smile correction, botulinum toxin injection is considered an alternative method because it is effective, conservative, and highly satisfying for patients.
Álvarez Romero et al.[7]	2018	Evaluate the effectiveness and stability of botulinum toxin as a treatment for gummy smile.	Initial search yielded 34 publications, reduced to 7 after applying exclusion and inclusion criteria and conducting a thorough analysis of articles.	Botox application for gummy smile treatment continues to be studied. However, the effectiveness of botulinum toxin treatment as a safe, stable, and minimally invasive alternative can be demonstrated, despite its transient effect, making it one of the most sought-after therapeutic options by patients.
Nunes et al.[9]	2014	Present, through a case, the use of BTX as a treatment alternative for gummy smile in a patient with muscular hyperactivity.	BTX-A treatment can be presented as a treatment option for gummy smile patients if performed by a trained professional. The patient should be evaluated after 15 days of application, and a follow-up visit after 3 or 4 months is necessary for further assessment and potential reapplication.	Botulinum toxin application is a less invasive, quicker, safer, and effective alternative. It produces harmonious and pleasing results when applied to target muscles, respecting the appropriate dose and type of smile. Therefore, the technique is a useful complement in improving smile aesthetics and provides better results when combined with respective gingival surgery.
Pedron et al.[10]	2018	Present a case of a patient with dentogingival discrepancy and gummy smile		Botulinum toxin application is a less invasive, quicker, safer, and effective alternative. It produces harmonious and pleasing

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		treated with respective gingival surgery and botulinum toxin application, optimizing smile harmony and improving self-esteem and quality of life.		results when applied to target muscles, respecting the appropriate dose and type of smile. Therefore, the technique is a useful complement in improving smile aesthetics and provides better results when combined with respective gingival surgery.
Diaspro et al.[13]	2018	Present a treatment option aimed at correcting gummy smile by injecting hyaluronic acid and review published techniques and anatomy of involved facial muscles.	Treatment performed by infiltration in the paranasal area, at the most cranial location of the nasojugal fold, about 3mm lateral to the ala of the alar cartilage, according to a vector perpendicular to the skin plane, to gently compress the lateral fibers of the levator labii superioris without invading it. All treatments used Vycross® technology filler.	This new, less invasive and safer technique for correcting excessive dynamic gum display has proven to be feasible and safe, with lasting results. This treatment could be an innovative and effective option for experienced injectors to address aesthetic facial imperfections.
Figuereido Chagas et al.[14]	2018	Determine the duration of the efficacy of botulinum toxin type A in gummy smile.	Systematic search using Medline (PubMed), Scopus, and Web of Science electronic databases from 1970 to March 2017 without language restrictions; studies evaluating adults with excessive gingival display treated with botulinum toxin and followed for at least 3 months were included. OpenGrey and Clinical Trial Registry were also consulted.	A significant treatment effect tends to be stable for at least 8 weeks of follow-up, and gingival exposure may not return to baseline until 12 weeks. However, well-designed clinical trials with reasonable follow-up are needed to strengthen this observation.
Myung et al.[15]	2021	Review previous studies on predictors of indication and effects of gummy smile treatment by botulinum toxin injection.	This review included all studies related to gummy smile treatment with BoNT injection. The search period extends from 1966 to August 2020. Online literature review conducted through PubMed/MEDLINE, Scopus, and Web of Science on September 1, 2020. All prospective	Gummy smile is not solely caused by the action of the LLSAN muscle but by the interaction of various muscles such as LLS, ZM, Zmi, DSN, and OO. Additionally, injection at the "Yonsei point" is reproducible, easily applied by non-experts, and a

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			studies, retrospective studies, case series, case reports, and available expert reviews were considered. Twelve keywords were used.	relatively simple and safe form. Both low and high doses of BoNT showed an improvement in gummy smile. Since high doses of botulinum injection could induce adverse effects, it is appropriate to adopt a safe approach method by first injecting a dose of 2 U to 3 U.
Machado et al.[16]	2021	This case series describes the clinical indications and application technique of botulinum toxin type A (BoNTA) to correct a gummy smile and evaluates the results and satisfaction levels of 3 patients.	The results suggest that BoNTA use for gummy smile correction is an effective, safe, and well-accepted treatment by patients. However, for successful treatment, clinicians must have correct diagnosis and mastery of both facial topographic anatomy and the technique to be used.	
Mostafa[17]	2018	Highlight the combined treatment capacity of gingivectomy and Botox injection in severe gummy smile treatment. Discuss techniques, advantages, disadvantages, indications, and contraindications of botulinum toxin (BT).	A 24-year-old patient with severe gummy smile was referred for treatment. Clinical examination revealed a 11-12 mm gummy smile, indicating orthognathic surgery. Gummy smile was treated by gingivectomy to increase the clinical crowns of upper anterior teeth and the use of Botox injections. Remarkable and satisfying results were achieved instead of extensive surgery.	It is essential to assess the patient's aesthetic expectations and present possible therapeutic solutions that suit them. BT is considered one of the minimally invasive, quick, and affordable modalities that can replace extensive surgical procedures for severe gummy smile corrections.
Muñoz et al.[18]	2019	Understand the mechanism of action of BoNT and evaluate its effectiveness in dental applications.	This article presents current knowledge on the mechanism of action of BoNT and evaluates its effectiveness in dentistry. Using criteria from the American Academy of Neurology, the uses of BoNT in oral medicine were critically reviewed, finding it effective for trigeminal neuralgia (category A) and probably effective for temporomandibular disorders and bruxism.	

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DISCUSSION

A proper smile is created when there is appropriate interaction between muscles. Excessive gingival exposure occurs when excessive muscular capacity is applied to lift the upper lip.[15]

Myung et al.,[15] mention that the method to improve gummy smile through muscular hyperactivity can be broadly divided into surgical and non-surgical methods. Several methods have been introduced previously; surgical methods have certain limitations such as discomfort and side effects following surgery, as well as relapses and others. However, regarding the non-surgical method, in 2005, the scientific introduction of injecting BoNT into the muscle around the lip was first introduced. This has many advantages, including less discomfort and fewer side effects after treatment.[19]

The literature states that in gummy smiles caused by muscular hyperactivity, botulinum toxin should be indicated. This is because it is defined as the treatment of choice due to the ease and safety of applications. Additionally, it has a rapid effect and a more conservative approach.[20]

Machado et al.,[16] in their study affirm that the use of BoNTA may be indicated when a gummy smile has a muscular origin, attributing that smile activity is determined by various facial muscles, including the levators of the upper lip and nasal wings, major and minor zygomatic, angle of the mouth, orbicularis, and risorius.

Physicians with good knowledge of the topographical anatomy of this region can palpate the muscles to identify the appropriate application point relatively easily. When injected in the right places, BoNTA reduces the contraction of muscles responsible for lifting the upper lip, reducing gingival exposure.[16,17,18]

CONCLUSIONS

The application of BoNTA reduces the contraction of muscles responsible for lifting the upper lip, decreasing gingival exposure. This is the least invasive, most effective, rapid, and safe treatment for the patient, restoring a harmonious and visibly aesthetic smile.

Conflict of Interest
The authors declare that there is no conflict of interest.

Authors' Contribution
All authors participated in conceptualization, formal analysis, project administration, writing - original draft, writing – review, editing, and approval of the final manuscript.

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