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BOTULINUM TOXIN IN DENTISTRY - BOON OR BANE : A REVIEW

Dental Science

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ABSTRACT

We, here, discuss the history, materials, current indications, recent advances and other important considerations for successful treatment with botulinum toxin. The inclusion criteria includes researches that contain dentofacial applications of botulinum toxin injections as in TMJ disorders, bruxism, oromandibular dystonia, muscle spasm, clenching, oral surgery and implant dentistry, gummy smile, hypertrophy in masseter muscle. Exclusion criteria are the researches that contain applications of botulinum toxin shots other than dentofacial ones.

KEYWORDS

Botox; dentofacial; macroesthetics; myofacial pain; technique sensitive

INTRODUCTION

"Esthetics" is a term which comes from the Greek word "aesthesia", meaning sensation or sensibility. In dentistry this term is differentiated from the word "cosmetic", which is again derived from the Greek word "kosmos", meaning adornment. The term esthetic dentistry specifically implies an improved relationship rather than a superficial one.[1]

The true understanding of comprehensive esthetic/cosmetic dentistry and the integration of the philosophical triad of "health, function and beauty" will help the dentist in providing optimal dental care.[2] Recent developments in dentistry have changed the emergency visits to want-based treatment.[3] Patients today demand enhancements not only to their dental (micro/anything within the oral cavity) esthetics but also to their overall facial (macro/anything outside the oral cavity) esthetics. Regardless of the education or social status, most patients have little knowledge of the advancements in dental technology or the treatment techniques available. In addition, they are exposed to media concepts of what is "beautiful". Hence it is the dentist's responsibility to educate patients about the various techniques available today in esthetic dentistry, the recent materials, and the minimally invasive treatments which conservatively enhance and strengthen the health and function of a patient.

Botulinum toxin overview

Botulinum toxin is a neurotoxic protein produced by the Gram-positive, rod-shaped, spore-forming, and strictly anaerobic bacterium Clostridium botulinum and, rarely, by Clostridium butyricum and Clostridium baratii, commonly found on plants and in soil, water, and animal intestinal tracts.[5] The bacteria produces seven antigenically distinct toxins that are lettered A through G. Toxin A, however, has been the most extensively studied. Following forms are available commercially for various cosmetic and medical procedures:Botox (the eponym)-Aboboulinumtoxin A (Dysport), lncobotulinumoxin A (Xeomin), Onabotulinumtoxin A (Botox, Botox cosmetic) and Rimabotulinmtoxin B (Myobloc).[6]

History

Before the advent of Botox and other subsequent neurotoxins used for therapeutic purposes, botulinum toxin was exclusively known as the causative agent in botulism poisoning. The earliest searched accounts of poisoning from this microbe date back to 1793, when an outbreak affected around 15 people in Wildbad, Germany. The source was determined to be a contaminated batch of Blutwurst, or blood sausage. That's how the name “botulism” came up after the Latin word for sausage, botulus which was coined by John Muller. A larger outbreak in Belgium nearly a century later allowed Emile Van Ermengem to identify toxins produced by C botulism as the cause of botulism poisoning.[7]

Type A strain was experimentally used in monkeys and later was approved by the US Food and Drug Administration (FDA) in 1989 under the trade name Botox for treating strabismus, blepharospasm and hemifacial spasm in patients younger than 12 years old.[8] Since then, the benefits of botox have been recognized, reviewed and documented in that it's an area that dentists can definitely work in and deliver without a problem, given our background and training.

Drug pharmacology & mechanism of action

Botulinum toxin inhibits the release of acetylcholine at neuromuscular junction which in turn leads to the paralysis of muscles through various steps. Firstly, the toxin is internalized in the nerve after binding to it. The degradation byproducts of the toxin formed after breakdown by internal proteolytic enzymes then interfere with the normal process of vesicle fusion to the plasma membrane. Eventually it leads to the inhibition of exocytosis of acetylcholine resulting in the neuromuscular blocking effect.[9]

Botulinum toxin is prepared by culturing the bacteria *C. botulinum. A*fter liberation, ammonium sulfate is added to harvest, purify, crystallize the toxin, and is diluted with human serum albumin, lyophilized, bottled in vials, and sealed for single use. Vials should be stored in a freezer at or below −5°C. Maximal pH of the solution varies between 4.2 and 6.8. Just before use, preparations are reconstituted with 1-5 ml of saline. It is advised that the reconstitution should be gentle as bubbling can lead to surface denaturation of the toxin. The reconstituted solution should be stored at 2-8°C and used within 4 h. The preferred syringe for injection is a 1.0 ml tuberculin syringe with a gauge of 26-30.[10]

Adverse reactions

Botox is generally safe. The therapeutic margin (LD50/ED50) is in the order of 15:1 meaning that the systemic toxicity of Botox does not occur until doses reach 15 times the effective therapeutic dose.[11] Allergic reactions could range from a rash, itching, headache, neck/back pain, muscle stiffness, difficulty swallowing, shortness of breath to nausea, vomiting, sore throat. It may spread to distant site (Black box warning) and also cause ptosis.[6]

Dental applications of botox

Excessive gingival display

Botox has a role in treating a high smile line resulting from a hyperfunctional upper lip and the primary contributor to excessive display of maxillary gingiva in such a case is the levator labii superioris alaeque nasi muscle, which participates in the last few millimeters of upper lip elevation. This muscle along with the levator anguli oris, leavator labii superioris, and zygomaticus muscles cause elevation of the upper lip.This is an extremely technique-sensitive treatment, as overtreatment results in transverse elongation and dysfunctional animation of the upper lip. It is therefore advisable to give multiple low-dose treatments over several weeks rather than in a single appointment. The dose required could be anywhere from 1 to 5 units of Botox may be needed for each side.

Intramuscular injection of the Botox is given at the Yonsei Point. Yonsei point is located at the centre of the triangle formed by levator labii superioris, levator labii superioris alaeque nasi and zygomaticus minor. The effect of botox is visible within 5 - 10 days and lasts for around 6

months, ranging between 4-8 months.[12]

Lipstick lines

Vertical rhytids in the upper lip, commonly referred to as lipstick lines or smoker's lines, may often be observed in aging patients, especially smokers and those with a history of excessive sun exposure. Frequent puckering action activates the orbicularis oris muscle and contributes to the development of these wrinkles. Botox injection to treat the vertical rhytids of the upper lip is best performed by having the patient pucker his or her lips and placing 1 to 2 units in the deepest folds seen resulting in 2-4 injection sites.[7]

Masseter Treatments

Hypertrophic masseter muscles can be treated using botox to reduce their strength and also to treat myofascial pain or temporomandibular joint dysfunction arising secondary to bruxism. The muscle atrophy that is induced will necessitate less frequent redosing than needed for other muscles. A recall appointment every 4 to 6 months is sufficient. Because of its increased bulk compared to other facial muscles, treating the masseter requires a much higher dose of botox. The most prominent areas of hypertrophy are identified by having the patient clench his or her teeth, and are treated first. Multiple sites of injection per side are typical, with 5 to 10 units per site being a good starting dose, although some patients may require as much as 100 units for bilateral treatment.[1]

Temporo-mandibular disorder

TMD is a broad term which describes a number of diseases affecting masticatory function. This may include true pathology of the temporomandibular joint as well as masticatory muscle dysfunction. TMD manifests with facial pain, joint sounds, headache, periauricular pain, neck pain, or reduced joint excursions. Etiologic factors of TMD can range from periodontal and occlusal diseases causing dysfunction of masticatory musculature to muscular spasticity occurring secondary to bruxism, external stresses, oromandibular dystonia, and psychomotor behaviors. In patients where the conventional treatment approaches have failed, application of botox injections has been found to provide relief of intractable symptoms.

Bilateral injections of 7.5 U are injected into the anterior vertical fibers of each temporalis muscle, to begin with. Additional 2.5 U are given into the middle and posterior fibers of the temporalis muscles in more severe cases. Pain in the masseter component in TMD is treated with 5 U of botox injected into the belly of the masseter below an imaginary line joining the tragus of the ear and the corner of the mouth.[14]

Trigeminal neuralgia

Botox type A acts by inhibiting the exocytosis of ACh and other neurotransmitters. This action could produce analgesia if it prevents the release of neuropeptides from nociceptive nerve endings. Botox A inhibits the release of norepinephrine and ATP from postganglionic sympathetic nerve endings, providing an analgesic effect and reducing central and peripheral sensitization. The required dose for treating trigeminal neuralgia is 20–50 U, injected at the trigger zones in the muscle.[15]

Sialorrhea

Many neurologic disorders involve excessive salivation, presenting the patient with difficulties in oral motor control. Anticholinergic drugs are used as first line of treatment but may cause some adverse effects, including urine retention and headache. Surgical approach, which is removal of one of the salivary glands, is a possibility in some. But then it exposes the patient to the risks of general anesthesia. Application of botox as a palliative treatment for neurodegenerative diseases has a role to play here. The catch being that the patient should not have used Botox in other sites in the previous 6 months. Recommended dose is up to 30U in the parotid glands and 10U in the submandibular glands.[16]

Complete denture wearers

Jaw muscles are amenable to change as per the changing functional demands. Botox may be used in patients who are struggling to get used to a new set of dentures due to irregular and uncoordinated muscle activity, especially those who have been edentulous for a long period of time. It relaxes the muscles and helps patient in adapting to the prosthesis.[17]

Adjunct to oral surgery

It has been reported that botox injections can facilitate healing by weakening the muscles adjacent to the surgical site and preventing their inappropriate movement which may even lead to bone displacement. Also, overloading of the muscles of mastication can be checked after immediate or delayed loading with implants, thus helping in osseointegration of the same.[18] [19]

Orthodontic considerations

Orthodontic patients who are bruxers or clenchers, generate excessive forces on the periodontium leading to gingival recession and bone loss, and may even progress to TMDs. Botox has been found useful in such patients. It can also prevent relapse of orthodontic treatment in patients with hyperactive mentalis muscle as it reduces the intensity of the muscle post treatment and enables muscle training.

Contraindications

Patients having hypersensitivity to any botulinum toxin preparation, egg protein allergy (albumin in drug has cross-reactivity) should not be administered the same. If there's an infection at the proposed injection site, the treatment should be deferred. In pregnant and lactating females, it should be avoided. There are drugs that can interact and may potentiate the affect of Botox like aminoglycosides, anticholinergic drugs and those affecting neuromuscular transmission. Also, some neuromuscular diseases contraindicate the use of botox e.g myasthenia gravis, guillian-barre syndrome, amyotrophic lateral sclerosis. Botox should not be administered to psychologically unstable patients.[6] [20]

CONCLUSION

Botox is a safe, conservative, non surgical, reversible, minimally invasive treatment therapy which can achieve therapeutic and cosmetic results. Botox injections weaken and even paralyse the injected muscle, leaving other muscles unaffected. They block the extra muscular contractions but still leave enough strength for normal use. Intra muscular injections re-establish the balance between masticatory elevator and depressor muscles relieving muscular pain, improving masseteric hypertrophy with consequent improvement in facial outline, and also restoring normal kinetics of TMJ. Botox therapy is appropriate for patients in whom other preventive modalities are either poorly tolerated or contraindicated, patients who do not respond to other treatments, special cases, and simply those who have a preference for this treatment.

It is pretty evident that Botulinum toxin in the field of dentistry has a great potential. It has indeed broadened our horizon and is persuading dentists all over the world to bring it into their practice.

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We that the manuscript has been read and approved by all the authors, that the requirements for authorship as stated earlier in this document have been met, and that each author believes that the manuscript represents honest work

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