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Botox in Orthodontics

A Project Submitted to The College of Dentistry, University of Baghdad, Department of Orthodontics in Partial Fulfillment for The Requirement of Bachelor Degree of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled "**Botox in Orthodontics"** was prepared by **Zainab Ameer Shamil** under my supervision at the College of Dentistry/University of Baghdad in partial fulfillment of the graduation requirements for the Bachelor degree in dentistry.

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2023

Dedication

I would like to dedicate my humble effort to my **supportive Father and Mother**. Their affection, love, encouragement and prays at day and night made me able to succeed with honor.

Zainab Ameer

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Firstly, all gratefulness and faithfulness to **ALLAH** for providing me the patience, perseverance, and the ability to undertake and complete this research.

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Abbreviations	Meaning
Ach	Acetylcholine
BT	Botulinum toxin
BTA	Botulinum toxin type A
BTB	Botulinum toxin type B
CNS	Central nervous system
Fig.	Figure
LLS	Levator labii superioris
LLSAN	Levator labii superioris alaque nasi
PNS	Peripheral nervous system
TMD	Tempromandibular joint disorder
U	Unit
ZMj	Zygomaticus major
ZMi	Zygomaticus minor

Introduction

There has been renewed interest in the field of Orthodontics /Orthognathic surgery to enhance the facial features. Correction of the hard tissues can alter the way the adjacent soft tissues look and feel but it may not be sufficient alone to give the perfect desired change. Many times it has to be accompanied by procedures done on the soft tissues to enhance the final outcome **(Donofrio, 2000).**

As society becomes more esthetically conscious orthodontists are more challenged to produce not only outstanding occlusions but also outstanding esthetics. Every minute, detail is becoming more important in separating the good from the great orthodontist. Recent studies have indicated that the amount of gingival display on smiling is very important to smile attractiveness**(Ker *et al*, 2008).**

The soft tissue procedures sometimes only can achieve reasonably good results. The basic knowledge of the soft tissue surrounding the perioral structures is essential for a successful outcome. The soft tissue varies according to gender and age. Both play an important role in planning for the patient. Female tend to have finer and delicate features. Men on the other hand rely mostly on masculine aspects of beauty for enhanced features **(Zimbler *et al*, 2001; Donath *et al*, 2007).**

Correction of skeletal or dental deformities alone may not achieve appreciable results unless a focus is made on the correction of soft tissue deformities during the treatment planning. Soft tissue deformities that exist with the skeletal or dental deformities may be self-corrected by Orthognathic surgery/Orthodontics or combination of both. But in many situations adjuvant procedures to the perioral

structures may need to be performed to get the optimal overall results. This can be accomplished Botulinum Toxin injections **(Kahn and Shaw, 2010).**

Furthermore, it is the first-choice treatment for wrinkles located on the upper third of the face, BT is also widely used in the prevention and correction of changes caused by muscle contraction in the middle and lower thirds of the face and neck, including a gummy smile. Enhancing a dynamic facial esthetics has been improved by leaps and bounds ever since the concept of the cosmetic use of botulinum toxin was discovered. With the promising results obtained since the past two decades in the facial esthetics, Botox is recognized by the dentists and introduced into clinical dentistry **(Nayyar *et al,* 2014).**

Aim of the study

This study review is showing the true therapeutic uses of this deadly neurotoxin “Botox”, specifically in treating dental problems and to evolve a modernized review that identifies the uses of botulinum toxin in orthodontic patient during and after treatment, the types of treatment available and the benefits of those treatments.

Chapter One: Review of Literature

1.1. Botulinum Toxin in Orthodontic

Botulism is life threatening disease first described by Kerner in 1817. It is caused by Botulinum toxin (BT) also known as botulinum neurotoxin produced under anaerobic conditions synthesized by the anaerobic Gram-positive Clostridium Botulinum bacterium, BTX, a natural protein, is one of the most potent biological substances known. The toxin inhibits the release of acetylcholine (Ach), a neurotransmitter responsible for the activation of muscle contraction and glandular secretion. Administration of the toxin results in a reduction of tone in the injected muscle **(Polo, 2005).**

Botulinum toxin has eight serological types that include A, B, C1, C2, D, E, F, and G. All eight serotypes have corresponding molecular structures and functions; however, only A, B, and E are deleterious to the human system, causing botulism. BTA has the strongest toxicity to human. The spores of BTA and BTB are heat tolerant; however, the neurotoxin is not. The toxin thrives in acidic conditions as it is acid-resistant, but it is intolerant in an alkaline-medium **(Park *et al*, 2016).**

Botox is one of the commercially available forms of botulinum toxin type A is the lyophilized form of the strain. It is a purified protein used to temporarily relax facial muscles that cause lines and wrinkles. It is also used in the treatment of muscle spasm and excessive sweating. It relaxes the underlying muscle and allows the skin to flatten out. It works on wrinkles that are caused by muscle movement (dynamic wrinkles) and do not work on wrinkles caused by sagging or loss of plumpness in the face (static wrinkles). It is given intramuscularly to weaken muscles in the face. Botulinum toxin type A is used on the forehead lines, lines of the throat, lines across the bridge of the nose, frown lines between the eyebrows, and the wrinkles extending from the outside corners of the eyes. The wrinkle-smoothing effect may last for up to 6 months **(Nigam, 2010).**

Botulinum toxin is used in the treatment of muscular overactivity such as dystonia because of its ability to induce weakness of striated muscles by inhibition of alpha motor neurons at the neuromuscular junction. Inhibition of transmission of alpha motor neurons in muscle spindles may alter reflex overactivity. It inhibits the release of Ach in all parasympathetic and cholinergic postganglionic sympathetic neurons; this mechanism is utilized in treating overactive smooth muscles (achalasia) or abnormal activity glands (hyperhidrosis) **(Münchau and Bhatia, 2000)**.

1.2. Mechanism of action

Botulinum toxin produces a transient dose-dependent weakening of muscle activity. All the serotypes of botulinum toxin interfere with neural transmission by blocking the release of acetylcholine (Ach) although have different specific toxicities, duration of persistence in nerve cells, and different potencies **(Majid , 2009).**

Acetylcholine is the main neurotransmitter at the neuromuscular junction. Upon intramuscular administration of botulinum toxin at the neuromuscular junction, muscle paralysis occurs by inhibition of the release of acetylcholine from the presynaptic motor neurons as show in **(Fig 1).** Botulinum toxins act at four sites of the body:

1. Neuromuscular junction
2. Autonomic ganglia
3. Postganglionic parasympathetic nerve endings
4. Postganglionic sympathetic nerve endings **(Nigam, 2010).**

Botulinum toxin acts at the level of the neuromuscular junction (motor endplate) blocking the release and effects of acetylcholine, an ester of acetic acid and choline, responsible for neurotransmission both at the central nervous system (CNS) level and at the peripheral nervous system (SNP) level. The enzyme acetylcholineesterase, present in the presynaptic nerve endings, continuously hydrolyses the acetylcholine which is then

immediately resynthesized and stored through an active transport mechanism by means of a specific carrier protein, within synaptic cholinergic vesicles of storage. Within these cytosolic vesicles, acetylcholine is transported to the presynaptic region of the neuron (synaptic button) where it waits for the ionic signal (calcium ions) to release its role as a neurotransmitter **(Rossetto *et al*, 2014).**

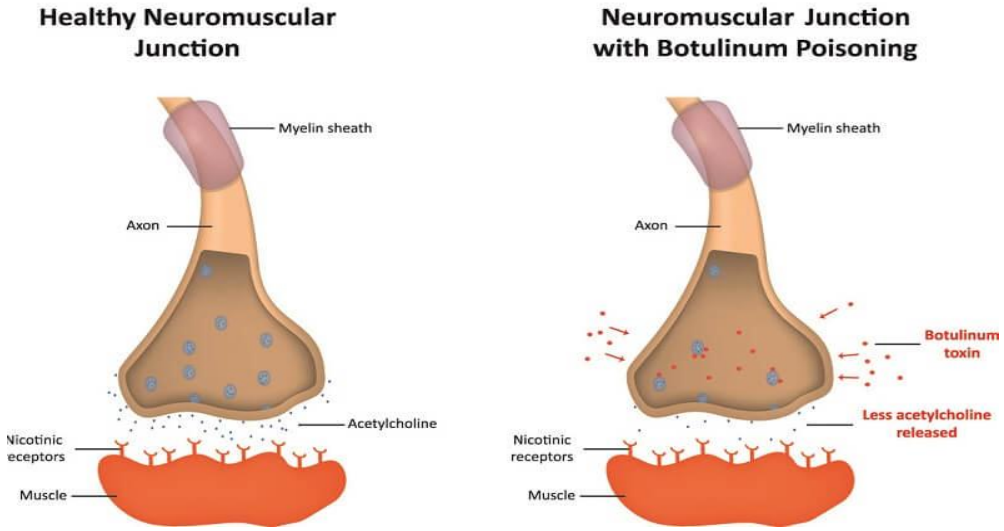

Fig. 1: How botulinum toxin works (https://biologydictionary.net/botulinum-toxin/ ,2020)

Acetylcholine is normally released into the synaptic space trough a potential action that, by following the axon of the neuron at the last termination level of the final arborization of the axon, determines the opening of voltage-dependent ion channels: the channels of calcium. The calcium ions, present in the synaptic space, penetrate inside the synaptic button and start the realizing process of Ach into the synaptic space where it acts on specific receptors (Ach receptors). Ach receptors are located on the postsynaptic cell membrane of the muscle fibrocell, which are of two types: nicotinic and muscarinic. Interacting with Ach receptors, the neurotransmitter achieves its effects by determining, at the postsynaptic level, the opening of sodium-potassium ion channels through which the sodium ions penetrate into the muscle which, thus, initiate muscle contraction.

Immediately afterward, Ach is hydrolyzed by acetylcholinesterase. By inhibiting the release of acetylcholine, botulinum toxin interferes with the nervous impulse and causes a flaccid paralysis of the muscles. Botulinum toxin is in fact a real muscle relaxant **(Pirazzini *et al*, 2017).**

The effect of paralysis occurs within 3–7 days after intramuscular administration, while the maximum effect is seen after 1–2 weeks, then tapers down to a moderate plateau until full nerve recovery within 3–6 months **(Sadick and Matarasso, 2004).**

1.3. Preparation and injection

Doses of BT used for the treatment of a particular condition depend on the particular brand/preparation as the unit of one product is not the same as the other. Instances of botulism have been reported in patients treated with intramuscular injections at therapeutic doses **(Coban *et al*, 2010**).

The two most commonly available types of BTA are Botox and Dysport . About 20–25 units of Botox are equipotent to 80 units of Dysport . Botox is marketed as single-use, sterile 100 Units or 200 Units vacuum-dried powder for reconstitution only with sterile, preservative-free 0.9% sodium chloride injection USP prior to injection **(Allergan, 2015).**

It is recommended that the reconstitution should be gentle as froth arising out of vigorous shaking can lead to surface denaturation of the toxin. BT is stored in a frozen vial (2–4°C) until it is ready to use. Adding 4 ml of 0.9% preservative-free normal saline solution makes injections, and the preparation should be used within 4 hours **(Rao *et al*, 2011).**

It is dispensed in small vials containing 100 U or 500 U. Conditions for stability of the toxin in solution include pH 4.2-6.8 and temperature <20°C. The large molecule is very fragile and is inactivated easily in solution by shaking. The preferred syringe is a

calibrated 1.0 ml tuberculin syringe with a gauge preference of 26-30 **(Tan and Jankovic, 2000; Nayyar *et al*, 2014).**

The injections are usually delivered while the patient reclining at approximately 25–30° angle from the vertically upright position. The targeted muscle should be undergone examination by inspection and palpation, while the patient applying facial expressions or during clenching to locate the exact area of injection. The injection site should be sterilized using Betadine. Then, topical anesthesia and ice should be applied prior to injection to reduce and control the pain and bleeding at the injection site. The Botox is then injected into specified areas as required according to the type of the indication, injected muscle, and the gender (as male muscle has a larger volume than female, thus requiring more units of Botox to achieve the same results as female patients). In case of bleeding, pressure should be applied to the injection site. After finishing, the patient should be in an upright position for 2–5 min to ensure wellness. Post-operative instructions should be given to the patient, which include avoidance of laying down for 4 h, avoidance of excessive physical activity for 1 day to reduce the risk of bruising. In the case of patients complain of pain or headache, non-steroidal anti-inflammatory drugs should be prescribed. Furthermore, to bleeding and edema, it is advisable to recommend the use of ice packs **(Mazzuco and Hexsel, 2010).**

1.4. Potency

The lethal dose of BT in humans is not known, although it has been estimated to be about 3000U. The usual maximum total recommended dose at an injection session in the dental office is about 80-100U. This means that the injector will have to inject 30 vials before a potentially lethal outcome. There is such a huge disproportion between the clinical dose and the lethal dose that a fatal overdose is almost impossible **(Scoff, 1980).**

1.5. Applications in Orthodontics

1. Adjunct to orthodontic treatment and prevent relapse:

In some cases, relapse following an orthodontic correction may occur in patients with strong muscles activity such as that of mentalis muscle (irregularity of the teeth). BT can be used during treatment to reduce the intensity of muscle contractions and muscles can be slowly and gradually trained posttreatment to a more physiologic movement **(Nayyar *et al,* 2014).**

The open-bite can be frequently found in bilateral mandibular angle fractures and the chin is depressed by the contracture of the digastric muscles **(Fig 2).** Most patients can be corrected by open reduction and intermaxillary fixation. When patients do not receive the open reduction in time, reduced segments might be unstable due to the tensional force of the digastric muscles. When the patient is in the state of open-bite, the anterior belly of the digastric muscle receives the tensional force according to the counterclockwise rotation of the mandible in the course of treatment. Accordingly, the mandible has a tendency of clockwise rotation after reduction, and this mechanism will contribute to relapse after treatment. Botox injection into the anterior belly of the digastric muscle has been shown to be successful, and there has been no relapse after injection **(Seok *et al,* 2013).**

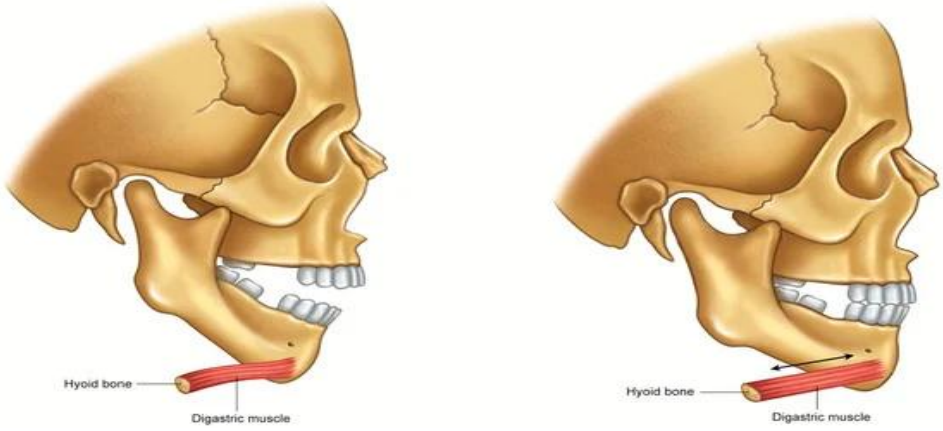

Fig. 2: Relapse mechanism after open-bite correction **(Seok *et al,* 3013).**

"Deep bite" is the opposite of open-bite. The status of malocclusion has been frequently found in mandibular retrognathism. For the surgical correction of this malocclusion, the position of the mandible usually moves downward and the myohyoid muscle receives tension. Accordingly, relapse after treatment occurs at a high frequency, regardless of treatment protocol. Botox has been given to the myohyoid muscle to reduce tension after surgery **(Fig3) (Mucke *et al*. 2016).**

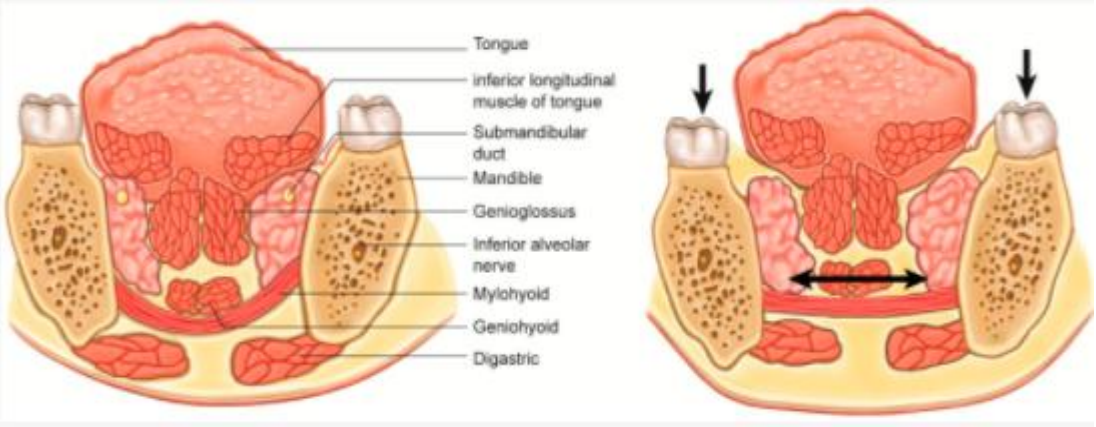

Fig. 3: relapse mechanism after deep bite correction **(Danz et al,2012).**

2. Dentofacial esthetics and gummy smile

An excessive display of the maxillary gingiva while smiling can cause the "Gummy Smile" which is actually an esthetic concern for most of the patients. It is due to the hyperfunctional upper lip and on smiling or over-contraction of the muscles of the upper lip. The appearance of the lip framework is determined by the activity of various facial muscles such as the levator labii superioris (LLS), levator labii superioris alaque nasi (LLSAN), Zygomaticus major (ZMj) and minor muscles (ZMi), of which LLS,LLSAN and ZMi determine the amount of lip elevation during smiling **(Patel *et al*,2013).**

In moderate gummy smile, the LLSAN elevates and everts the upper lip, while the depressor septi nasi muscle pulls the nasal tip down. In severe gummy smile, the LLS and to a lesser extent the zygomaticus minor (ZMi) also raise the upper lip. A single point

injection of a 2 U on each side, 1cm lateral to the nostril ala, also known as Yonsei point, can target these three muscles **(Fig4) (Hwang *et al*, 2009).**

Fig. 4: Patient with gummy smile before and after botox injection **(Vivek *et al*, 2013).**

3. Drooping of corners of mouth:

Hyperactivity of depressor anguli oris can lead to drooping of the corner of the mouth. Injection of BT has shown to have positive results in such cases. The site of injection is on trajectory of nasolabial fold to the jaw line. Bilateral injections in doses of about 2-5U is the norm **(Choi *et al*, 2014).**

4. Temporomandibular disorders (TMD)

Temporomandibular joint disorder (TMD) includes diseases affecting masticatory function which may be pathologic or due to masticatory muscle dysfunction, further manifesting in headache, facial pain, neck and peri-auricular pain, headache, TMJ sounds or decreased jaw excursion **(Nayyar *et al*, 2014).**

The toxin relieves pain caused by hyperactivity in TMD as well as the pain in the masticatory muscles. It is administered intramuscularly into the adjacent muscles (masseter and temporalis), causing relaxation and improving muscle inflammation which in turn leads to improved mouth opening. This has helped in the improved parafunction such as clenching as well as bruxism (grinding of the teeth) and TMD symptoms **(Freund and Schwartz, 2003).**

Bentsianov *et al* (2004) The diverse group of TMDs those are likely to be benefited by injection of BT includes the following:

- Bruxism and clenching
- OMDs
- Myofascial Pain
- Trismus
- Hypermobility
- Masseter and temporalis hypertrophy
- Headaches

Injection Technique:

The involved muscles here are the masseter and temporalis muscles which express direct muscle pain. To determine the injection site, the patient is requested to clench his/her teeth to make the injection site clear and easily detected. The Botox injection applied bilaterally to limit these muscles contraction. The starting dose of Botox 10–25 U for a temporalis muscle, 25–50 U to a masseter muscle. It is preferred to give an injection in multiple sites with low doses to avoid incomplete effect and to reduce the unwanted diffusion to the undesired adjacent areas, with possible causing of brow ptosis, diplopia in temporalis muscle injections, and asymmetry in the case of masseter muscle. As well mouth dryness may occur in case that Botox was accidentally injected into the parotid gland **(Bentsianoy *et al*, 2004).**

5. Bruxism

This is the act of severe clenching or grinding of teeth and is usually associated with attrition, headache, muscular pains, and TMJ dysfunction symptoms. Botulinum toxin is effective in the treatment of bruxism **(Tan and jankovic, 2000).**

Several causes are being reported for bruxism, and from an etiological point of view, psychological factor, emotional stress, and malocclusion are suspected as possible causes, but the exact cause remains unknown **(Attanasio R, 1997).**

Persistent contraction activity of masticatory muscles results in ischemia within the muscle cells, and this ischemia in turn promotes release of serotonin or pain-inducing substances from the surrounding tissues, and this pain mediator transmits pain from brain cortex to nerve endings. Feedback phenomenon transmitted to cerebral cortex leads to contraction of muscle and due to this vicious circle, it causes diseases such as spasm of muscles and myositis at the same time induces referred pain which results in the occurrence of series of symptoms such as migraine, stiffness in the cervical spine, and hypersensitivity of teeth. Also, it becomes the cause of persistent temporomandibular joint pain **(Freud *et al*, 1999).**

Botulinum toxin plays a role in breaking off this vicious circle resulting from persistent muscular contraction. It breaks off the feedback phenomenon by reducing the muscular contraction through flaccid paralysis, relaxing the muscles, and supplying blood to muscular tissue cells **(Ivanhoe *et al*, 1997).**

Injection areas are identified by palpation during clenching, then bilateral injections of Botox are injected in three sites in the thickest parts of the masseter muscles with a dose range of 25–100 U/side **(Jaspers *et al*, 2011).**

6. Trismus

Patients with TMD often have diffeclty opening their mouths; BTA relaxes the neighboring masticatory muscles and reduces muscle inflammation, allowing the patients to open their mouths more easily. Injections of BTA into muscles of mastication had positive therapeutic consequences **(Bhat *et al,* 2018).**

7. Prevention of post-operative open bite in class II malocclusions

A skeletal class II malocclusion patients with hyperdivergent facial types are characterized by short mandibular body lengths and anterior open bite. Accordingly, the treatment for a skeletal class II malocclusion is a lengthening of the mandibular body via ramus osteotomy. If patients have anterior open bites due to hyperdivergent facial skeletal types, a counterclockwise rotation of the mandible is also required. These types of patients have shown high rates of post-operative relapse and reduced overbite **(Proffit *et al,* 2000).**

In case of open-bite correction, 20 units of BTA was injected into the anterior belly of the digastric muscle. The effect of BTA injection occurs immediately as a decrease in muscle activity. Then the muscle volume decreases; this usually lasts for 6 months after BTA is injected into the masseter muscle **(Park *et al,* 2016).**

The greatest amount of post-operative relapse after orthognathic surgery appears within 6 months post-operatively. A single injection of BTA into the target muscle at the time of surgery may be sufficient to prevent post-operative relapse **(Tabrizi *et al,* 2017).**

8. Increased the posterior width of the maxillary arch in developing rats

Botulinum toxin(BT) injection into the anterior belly of the digastric muscle in growing rats showed an increased width of maxillary posterior arch and a decreased width of mandibular condyles. Maxillofacial bony growth is affected by the surrounding soft tissue and muscular activity. The hypofunction of the masticatory muscle affects the bone shape and morphology, and it reduces the growth of the maxillofacial bone **(Fig5) (Ulgen *et al*, 1997).**

When BT is administered into a masticatory muscle, such as the masseter or temporalis muscle, of growing animals, decreased growth of the maxillofacial bone is observed and the size of bone is significantly reduced **(Tsai *et al*, 2009).**

The cause of the increased bony width in the experimental group can be explained by the change of balance among the masticatory muscles due to the decreased muscle power of the anterior belly of the digastric muscle. The digastric muscle's role in opening the mouth is shared with other mouth-opening muscles, such as the lateral pterygoid muscle **(Seok *et al*, 2013).**

The hypofunction of a specific masticatory muscle influences the other masticatory muscle's power, thus acting synergistically with the weakened muscle. This weakness can lead to the increase of synergistic muscle activity to compensate for the muscle weakness. Based on this fact, the hypofunction of the anterior belly of the digastric muscle could affect the activity of the lateral pterygoid muscle that acts synergistically during jaw opening **(Huang *et al*, 1993).**

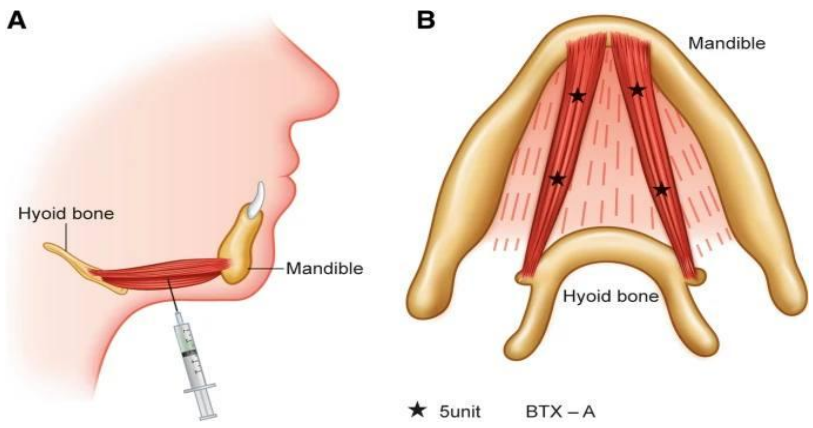

Fig. 5: Injection into the anterior belly of the digastric muscle by submental approach, each point received 5 units of BTX **(Yei-jin Kang *et al*, 2019).**

1.6. Guidelines for Administration

There are necessary guidelines to be followed when administering the botulinum toxin. They include:

1. The preparation should be used within the first 4 h.

2. A lower dose of the toxin should be used as a start dose.

3. The muscles should not be paralyzed completely.

4. The site or area of injection should be covered with a topical anesthetic cream or can be anesthetized with ice.

5. Males generally require a higher dose due to larger muscle masses **(Srivastava *et al*, 2015).**

1.7. Contraindications

Patients should not be treated or treated with extreme caution who are **(Moriarty, 2006)**:

1. Psychologically unstable or who have questionable motives and unrealistic expectations.

2. Dependent on intact facial movements and expressions for their livelihood (e.g. actors, singers, musicians, and other media personalities).

3. Afflicted with a neuromuscular disorder (e.g. myasthenia gravis and Eaton-Lambert syndrome).

4. Allergic to any of the components of BTA or BTB (i.e., BT, human albumin, saline, lactose, and sodium succinate).

5. Taking certain medications that can interfere with neuromuscular impulse transmission and potentiate the effects of BT (e.g. aminoglycosides, penicillamine, quinine, and calcium blockers).

6. Pregnant or lactating.

1.8. Adverse effects

In general, adverse reactions are uncommon and localized. Side effects of Botox include allergic reactions,rash, itching, headache, neck or back pain, muscle stiffness, difficulty in swallowing and shortness of breath. This can also have accomplished by nausea, diarrhea, stomach pain, loss of appetite, injection site reactions, sore throat, runny nose, ringing in ears and increased sweating in areas other than the underarms **(Dressler and Benecke, 2003**).

In some cases, BT effects may be observed at sites beyond the site of local application, known as the "spread of toxin effect". The symptoms of such presentation are consistent with the actions of BT and include generalized muscle weakness manifesting as diplopia, dysphagia, dysphonia, ptosis, and urinary incontinence or even breathing difficulties. The probability of this spread of toxin effect is even more in the face as well as head and neck region due to facial planes and spaces. BT is not advised to use in pregnancy and in nursing mothers is also not recommended routinely. Use of BT in pediatric age groups should also be restrained, and FDA guidelines for its use were followed **(Naumann and Jankovic, 2004).**

Chapter Two: Disscusion

Botulinum toxin is a catalyst protein, produced by a Gram positive anaerobic bacterium, Clostridium botulinum. This substance acts on nerve endings, blocking calcium channels, decreasing the release of acetylcholine, which is responsible for the response of muscle contraction and movement. The inhibition of acetylcholine produces a temporary and reversible dose-dependent weakening of muscle activity, without systemic effects. The effect of BTA has an average duration of 6 months and can vary from 4 to 8 months.

The usual maximum dose recommended for dental applications at an injection session is about 80-100 U. It means that 30 vials of Botox will have to be injected before a potentially lethal outcome. There is such a huge disproportion between the clinical dose and the lethal dose that a fatal overdose is almost impossible. Before injecting Botox into the muscle and/or joint and/or skin, the skin has to be cleaned with an alcohol/betadine/chlorhexidine swab. Botox is injected using 1 ml tuberculin syringe and 0.30 gauge half inch needle.

The main advantages of the treatment using botulinum toxin type A are: easiness of the technique, high tolerability by the patient, low rate of complications and the almost immediate and natural effect. Its main disadvantage is the maintenance of the result for a short period of time.

The use of BT is particularly effective in managing cases of excessive gingival display due to excessive contraction of upper lip muscles; primarily levator labii superioris alaque nosi and drooping the corner of the mouth due to hyperactivity of depresser anguli oris muscle and not give a volume. In addition to many condition can have great benefit from these therapies like temporomandibular joint disorders, bruxism, mandibular spasm, pathologic clenching, dental implant and surgery and masseteric hypertrophy can be

treated with BT easily compared with more sophisticated procedure such as surgical procedures. Current therapies for bruxism are not entirely effective. Botulinum toxin type A has emerged as an alternative to this problem. Clinical studies have shown that applications of botulinum toxin can decrease pain levels, the frequency of bruxism events, in addition to not causing major adverse effects.

An important number of patients who present masseter muscle hypertrophy do not respond to conventional treatments, which shows yet another indication for treatment with Botulinum Toxin type A. Botox represents a therapeutic alternative for patients with painful temporomandibular joint syndrome. It promotes relaxation of the masticatory muscles, reducing pain and enabling an appropriate mandibular function. Side effects are rare and, even if they exist, they are temporary, avoiding major problems for patients with TMD. Most treatments for gingival smiles are based on invasive procedures, such as surgical corrections, which end up causing greater morbidity for patients, unlike botulinum toxin, which is simpler and less invasive for the treatment of gingival smiles caused by hyperactivity of the upper lip.

Simple BTA injection may speed up overall treatment and minimize the post-treatment relapse, long-standing post-traumatic open bite could be corrected successfully by BTA injection into the anterior belly of the digastric muscle without any complication and injection into mylohyoid muscle also prevents the deep bite of teeth and postoperative relapse after orthognathic surgery.

Chapter Three: Conclusions and Suggestions

3.1. Conclusions

1. Botulinum toxin is a successful treatment for many facial and oral musculature dysfunctions because it provide an overall conservative, quick and painless approach.

The mechanism of action of botulinum toxin occurs at nerve endings, blocking calcium channels and thus decreasing the release of acetylcholine, responsible for the muscle contraction response.

2. BT from deadly poison to a remarkably resourceful therapeutic agent. Relatively safe, non-invasive and recovery period is low. Several disorders in orthodontics also being treated with the help of BT. many people are still apprehensive about BT because they feel that when a BT goes wrong, it can give expressionless face. But these risks can be easily avoided if the procedure is done by an experienced dentist.

3. Botulinum toxin can be used in aesthetic and therapeutic procedures. Its main indications are: softening of expression lines, gingival smile, asymmetrical smile, bruxism, temporomandibular dysfunction (TMD), masseter hypertrophy, relapse after orthodontic correction, drooping of corner of the mouth and prevention of post operative openbite.

4. the paralysis of masticatory muscle by BT has an effect on maintaining mandible stability and preventing changes in dental occlusion after orthognathic and mandible fracture surgery. BT injection in digastric muscle reduces the tensional force of mandible and prevents the counterclockwise rotation of mandible and open-bite of teeth. The BT injection in mylohyoid muscle also prevents the deep bite of teeth and postoperative relapse after orthognathic surgery.

3.2. Suggestions

The use of BT continues to steadily expand and multiply. New indications of clinical use of BT are continuously emerging in medical therapy and further applications will be developed in the future. BT find varied applications in head and neck region, they include removal of facial wrinkles, drooping corners of mouth, temporalis and masseter muscle hypertrophy, dental occlusion, tooth eruption and cosmetic use. Therapeutic uses include treating facial pain, salivary secretory problems, muscle movement disorders, and nerve palsies.

Its use Adverse events occur more frequently after the clinical use of the toxin, but may also disclose after its esthetic use. The safe utilization of BT requires knowledge of its indications and pharmacology, anatomy of the treated muscles to avoid serious complications.

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