Clinical uses of botulinum toxin A in smile aesthetic modification

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Key points

- Provides information regarding a drug that is increasingly used by dental practitioners worldwide.
- Provides education on alternative options for correction or camouflage of dentofacial aesthetics of the lower face.
- Summarises the available case reports and research articles on use of botulinum toxin for lower facial and smile aesthetics, a major component of modern dental practice.

In this article we review the pharmacodynamics of commercially available preparations of botulinum toxin type A, and discuss the potential uses of the drug in smile modification. A major emphasis is placed on applications relevant to modern dental practice, and to the complications arising from its use. Botulinum toxin A, when applied correctly, is a safe and effective means of achieving aesthetic smile modification, with limited data on any demonstrable long-term adverse effects.

Introduction

The smile is arguably one of the most influential human emotional expressions in interpersonal relationships. An aesthetic smile is dependent on the proportions and relationships of the structures that comprise the lower face: the teeth, the vermillion and soft tissues of the lips, and the gingiva. Given that the smile represents a functional exercise, the muscles of facial expression carry an important role in the dynamic changes that occur between these structures while smiling.

The chief complaint of an unaesthetic smile has become an area of expertise for the dentist, and is commonly addressed with a focus on dental modification, including orthodontic and orthognathic correction, and periodontal surgery for gingival or soft tissue alteration. Less emphasis has been placed on the muscular and functional components of smiling in the treatment planning phase of smile modification.

Botulinum neurotoxin A (BT-A) is a commercially available preparation of the neurotoxin produced by the bacterium Clostridium botulinum. Upon injection into muscle tissue, BT-A induces a semi-permanent inhibition of muscle fibre contraction. Commercial preparations of BT-A were initially approved for a number of medical indications; more recently, the effect of the drug has been harnessed for cosmetic applications in the upper face, in the reduction of age-associated rhytids, and is well-established as a safe and effective clinic-based treatment.[1,2]

Common indications for BT-A administration by the dentist include a reduction in hypertrophic masseters, as an adjunct treatment option for bruxism, and for excessive gingival display. In most western countries (including the US, the UK and Australia), use of BT-A has been accepted within the scope of practice of the dental practitioner for use in the oral and perioral tissues only. However, in many cases, use of the drug by any suitable health professional is not formally regulated by any governing body; one notable exception is the UK, where injectable treatment providers are regulated and monitored by a national practitioner registration scheme.[3] Regardless of the formal professional qualification preceding use of BT-A, the practitioner should feel comfortable with the pharmacology and safe use of the drug, and carry indemnity insurance to cover their practice, before provision of cosmetic medical services. Use of BT-A should follow site- and country-specific guidelines pertaining to the individual health professional.

Dental practitioners are well versed in the anatomy and physiology of the musculature of the face, and its contribution to the smile. This provides a sound foundation for understanding the clinical applications and the appropriate use of BT-A in the orofacial region. The aim of this paper is to review the pharmacology and characteristics of BT-A preparations based on current scientific knowledge. This will be applied to its use clinically where different applications of BT-A in the orofacial region will be demonstrated together with the short and long-term management of such cases in addition to potential complications/pitfalls.

Methods

A narrative review of the recent literature regarding use of BT-A in aesthetic smile modification was carried out by three independent authors. PubMed and Google Scholar database searches were performed using the following keywords, alone or in combination: smile, aesthetics, botulinum toxin, Botox, Dysport, modification, gummy smile, asymmetry, orbicularis oris, mentalis, excessive gingival display, dental, safety, pharmacology, vertical maxillary excess, smokers lines, perioral, hyperactive upper lip, muscle relaxation, levator labii superioris, alaeque nasi, zygomaticus, minor, major, risorius, mentalis.

Articles were excluded if they were not written in the English language, if studies were not performed on humans, and if the articles

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were not relevant to botulinium toxin use for smile modification or facial aesthetics. The literature search resulted in a combination of case reports, literature reviews, and primary research articles which were selected for inclusion in the article.

Pharmacologic aspects of botulinum toxin A

The BT-A molecule exerts a potent semi-permanent muscle relaxation effect through cleavage of the synaptosomal-associated protein (SNAP-25) from the soluble N-ethylmaleimide sensitive factor attachment protein receptor (SNARE) complexes, involved in presynaptic mobilisation and release of acetylcholine neurotransmitters into the neuromuscular junction.[4,5] Paresis of the muscle generally occurs after 3–4 days post-injection, and is clinically evident for approximately 2–3 months, after which there is gradual return of muscle function.[6,7]

BT-A is currently commercially available in Australia in two main forms, onabotulinum A (Botox, Allergan) and abobotulinum A (Dysport, Galderma). Other available preparations include incobotulinumtoxin A (Xeomin, Merz Pharmaceuticals), a formulation which has undergone a biologic process of protein removal.

From a cosmetic perspective, Botox is currently FDA approved for the treatment of upper face mild to moderate glabellar, forehead and periorbital rhytids; Dysport has FDA approval for glabellar lines only. However, both are widely used 'off-label' for lower face cosmetic purposes/modification, and have other non-cosmetic indications including migraines and hyperhidrosis. The two formulations differ in potency and functional unit measure, and the conversion factor in dosing between the two products is a topic of contention in the literature.[8] Further, diffusion characteristics regarding each formulation are currently not well understood; studies by Almeida *et al.* have suggested that Botox has a lower total diffusion than Dysport, but this conclusion was limited by inconsistencies in differential dose ratios, variation in dilution and injection protocols in the literature, and insufficient data regarding the incidence of complications related to toxin spread.[9,10] For the purposes of consistency, in this paper, reference to unit doses or 'BT-A' from this point forward will be referring exclusively to 'Botox' or 'Allergan' units; in this instance, based upon potency studies which utilise a mouse LD_{50} test.

Botox is most commonly supplied in vacuum-dried form, and one vial can contains 50, 100 and 200 units (u). Reconstitution of the vial is necessary before administration. Manufacturer recommendations for the 100 units involve reconstitution of the entire vial with 2.5 ml of sterile 0.9% sodium chloride solution for injection, to produce a concentration of 4u/0.1 ml.[11] The reconstituted solution should be used within 24 hours of opening; during this time, the reconstituted vial must be stored at a temperature of two to eight degrees Celsius. The drug is administered using a tuberculin syringe with small-gauge needle, or other equivalent equipment.

Applications of botulinum toxin A in smile aesthetics

Thin upper lip

A short clinical lip length or thin upper vermillion may be a presenting complaint, or a consequence of orthodontic/orthognathic treatment.[12] A functional loss of lip length may occur as a result of the resting contraction of the innermost portion of orbicularis oris, causing an inversion of the lips.

Small, concentrated doses of BT-A have been injected superficially along the vermillion border of the upper and lower lip to increase vermillion show.[13] Care should be taken to avoid injections within the philtrum region, as this may flatten the aesthetic Cupid's bow appearance of the lips. Additionally, excessive lip lengthening reduces tooth show and may produce an 'aged' appearance, and so in patients naive to BT-A treatment, low doses should be administered to avoid adverse aesthetic changes. Doses of up to 2 u, across four injection points across the vermillion border, have been reported to provide a significant pseudo-eversion and increase in lip length (Fig. 1).[13]

Perioral 'smoker's' lines

Perioral rhytids, known colloquially as 'smoker's lines', are a result of contraction of the lips to maintain a closed posture. These present as superficial skin wrinkles radiating outward from the vermillion border. Smokers lines tend to occur in patients where active lip pursing is required (for example, musicians or chronic smokers), or where lips are pursed in the resting state. Abnormal incisor inclination or position may theoretically produce this requirement of muscle contraction for lip competence, and this requires diagnosis before BT-A injection to avoid potentially incompetent lips.[14]

The orbicularis oris muscle can be easily identified by palpation, while asking the patient to purse the lips. Injections should be placed peri-orally, approximately 5 mm concentric to the vermillion border, at a depth midway between the outer surface and inner mucosa of the lip (Fig. 2). A similar distribution of injections and dose of BT-A is utilised as for lip lengthening. The philtrum and commissural areas should be approached with caution, to avoid flattening of the Cupid's bow or spread of toxin into the risorius muscle.

Protrusive or dimpled chin

The chin represents an important yet often overlooked part of facial aesthetics, particularly its activity during smiling. Chin shape and symmetry can have a marked effect on overall facial harmony, and is a major determinant of facial shape. An aesthetic, youthful chin in women is small and narrow, with a single point of light reflection.[15,16] From a lateral profile, the female chin should contribute relatively less to the total soft tissue profile than in men, contributing to a convex mean facial profile.[17] The aesthetic male chin is broad, large, can be dimpled, and relatively more protrusive, contributing to a straighter facial profile.[17,18]

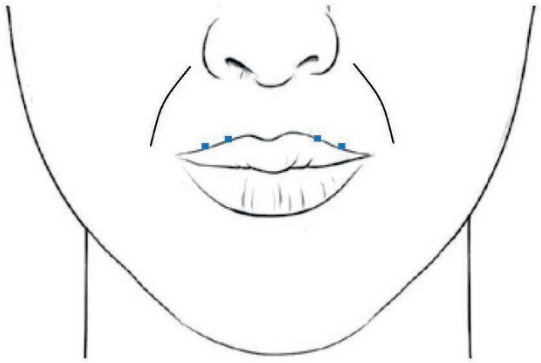

Fig. 1 Injection points for lip lengthening

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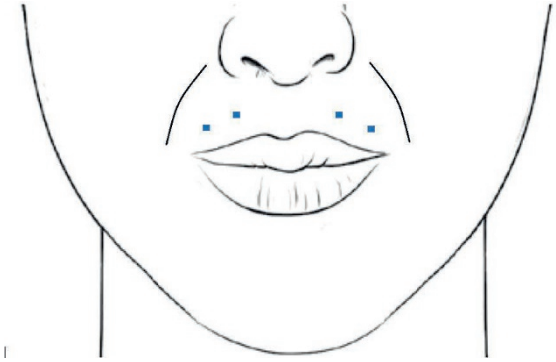

Fig. 2 Injection points for perioral 'smoker's' lines

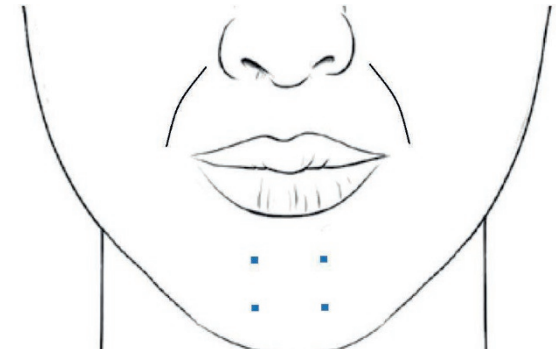

Fig. 3 Injection points for protrusive/dimpled chin

A complete assessment of chin aesthetics should involve evaluation of the skeletal, dental, and soft tissue contributions to lower face morphology or dysmorphology. A comprehensive assessment is necessary, to predict both the impact and success of soft tissue modification with BT-A. Class I dentofacial patients are generally suitable for BT-A treatment of mentalis; class II or III patients are better served with a comprehensive orthodontic or surgical approach.[16]

While the clinical approach is similar, three indications exist for injection of BT-A into the broad, thick mentalis muscle:

1. Deep labiomental fold due to soft tissue relationships. The labiomental fold refers to the visible depression that exists between the lower lip and the chin, and is best observed on profile view. Labiomental fold depth is highly dependent on occlusal vertical dimension[19] and lower face height, and is normally 4 mm in men and 6 mm in women.[20] A prominent chin or lower lip can alter the labiomental fold and this can be a presenting complaint of the patient
2. Excessive muscular soft tissue prominence of the chin. Presence of a strong mentalis muscle can produce a broad, prominent, masculine chin, and is associated with an unaesthetic, aged appearance in women
3. Presence of mentalis rhytids, or 'Peau D'Orange' chin.[21]

For a reduction in soft tissue prominence or deep labiomental folds, a high dose (5–10u) is recommended, to produce a slow atrophy of the muscle. Injections placed deep into the muscle, near the origin of the muscle at the anterior mandible, may reduce risk of inadvertently injecting into more superficial muscles of expression (Fig. 3). Carruthers *et al.* suggest post injection massage, to promote spread of toxin throughout the large muscle.[22] As the overall goal of these injections is to reduce the size of mentalis, the patient should be informed that it may take one to two months before the desired effect is noted. For removal of rhytids, total doses reported have varied from 3–6 u[22,23] and methods described are single, more superficial injections in each band of the mentalis. The muscle should be palpated before injection and injection points should be aimed toward the lowest portion of the muscle. This is to prevent toxin spread to the orbicularis oris, which can result in lower lip incompetence. Injecting too laterally may cause inadvertent paralysis of the depressor anguli oris muscle, and potentially create facial asymmetry.

Downturned commissures/smile curvature

The bilateral depressor anguli oris (DAO) muscles are responsible for lowering the corners of the mouth, contributing to the 'mouth frown' facial expression. The presence of hyperfunctional DAO muscles can cause an unaesthetic lowering of the corners of the mouth, and secondary rhytids in the area can produce an aged appearance. Some individuals activate the DAO muscles while smiling, which can flatten the upper and lower lips.

Frush and Fisher describe the concept of the 'consonant' smile, where the arc of the upper incisors parallels the arc of the lower lip.[24] The aesthetic maxillary arch should form a convex shape, with the central incisors at the lowest point in the arc, with progressive elevation of the incisal edges of the lateral incisors followed by the canines. An aesthetic lower lip should match this arc. Successful soft tissue modification to produce a more consonant smile is therefore dependent on having correctly positioned maxillary incisors. Sarver theorised that patients with a brachyfacial pattern may not be able to achieve a consonant smile, due to a relatively flat maxillary plane.[25] This should be noted in the preoperative assessment to determine patient suitability for smile modification with BT-A.

To identify the DAO muscles, instruct the patient to pull the corners of the mouth downward. The muscle will be palpable inferior and lateral to the oral commissures. Particular care should be taken to identify this muscle, to avoid accidental injection into the orbicularis oris, buccinator, or mentalis muscles. As with all toxin injections, but of particular importance to DAO treatment, palpation and correct identification of the muscle and its anatomy is essential before commencing injections. Branches of the facial vein can be easily perforated in this region, causing significant haematoma of the lower face. Spread of toxin to surrounding muscles can lead to marked asymmetry and loss of oral function, and so care should be taken when approaching this area. If the DAO muscles are overparalysed, patients may experience obvious difficulties with mastication and food packing in the lower vestibule, despite a good cosmetic result. A dose of 2–5 u BT-A is suitable for this area, at moderate depth, injected in two points diagonally along the direction of muscle fibres (Fig. 4).[6]

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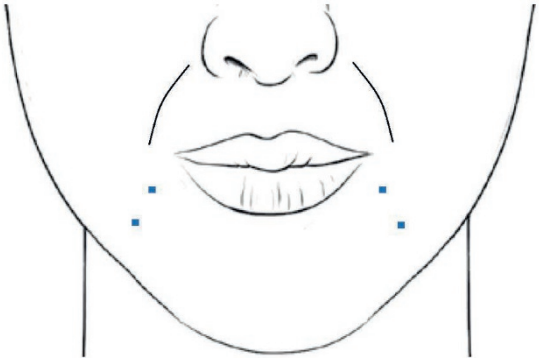

Fig. 4 Injection points for downturned commissure

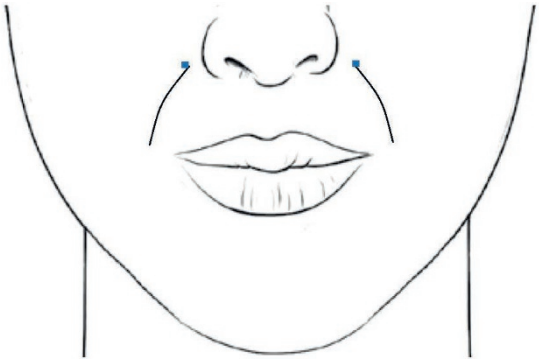

Fig. 5 Injection points for anterior excessive gingival display

Excessive gingival display and dental camouflage

Excessive gingival display, or 'gummy smile' has been previously defined as an exposure of greater than 3 mm of gingiva on smiling.[26] Excessive display of the gingiva on smiling appears to be of greater predominance in women than men, who tend to have a lower smile line.[27] A number of anatomic factors can influence the gummy smile appearance, including lip length, crown length, vertical maxillary excess, and oral muscular behaviour.[26,28] Use of BT-A for gummy smile correction is indicated when perioral muscle hyperfunction is responsible for the gingival display, but may be used to mask other causes of gummy smile. Techniques used for reduction of excessive gingival display can also be used to camouflage defective temporary or permanent prosthodontic restorative margins, irregularities in the gingival contours, and gingival black triangles in the maxillary arch.

Common practice in the management of gummy smile with BT-A has been a single injection into the 'Yonsei point', a surface landmark area lateral to the ala where the levator labii superioris, levator labii superioris alaeque nasi, and zygomaticus minor converge. Generally, a dose of 2–5 u at this point has been sufficient to cause improvement in the appearance of a gummy smile.[29,30]

A case series by Mazzuco and Hexsel subdivided gummy smiles into four classifications, based on the area of gingival exposure. These are: anterior, where the excessive (>3 mm) exposure was limited to the anterior segment between the canines; posterior, where the excessive (>3 mm) exposure was limited to the posterior segment distal to the canines; mixed, with excessive gum exposure in both the anterior and posterior regions; and asymmetric, where excessive gingival exposure was limited to one side only.[31]

Anterior gummy smile

The primary muscles involved in elevation of the central upper lip are the bilateral levator labii superioris alaeque nasi (LLSAN). LLSAN originates from the frontal process of the maxilla and inserts into the soft tissue in the central part of the lip, and less importantly, the alar cartilage of the nose. This muscle can be identified clinically by palpation in the superior part of the nasolabial folds, lateral to the nares, during function. Previous authors have suggested a surface landmark point for the LLSAN 1 cm below and lateral to the nasal ala.[31] Our clinical experience suggests a distance closer to 0.5 cm below and lateral to the nasal ala, as demonstrated in Figure 5, is a more anatomically accurate surface landmark point. Palpation of the muscle in function before injection accounts for individual variability in the location of the LLSAN. A dose of 2–5 u has been successful in reducing the height of an anterior exposure.[31–33]

Posterior gummy smile

Posterior gummy smile is related to hyperfunction of the paired zygomaticus major and zygomaticus minor, whose roles are to retract the upper lip and commissures towards the zygomatic process of the zygomatic bone. The zygomaticus muscles both originate from the zygomatic bone, and travel inferomedially, whereby the zygomaticus major attaches to the corner of mouth and lateral part of upper lip respectively.

Clinical identification of these fine muscles can be difficult, and depth of injection is also variable, particularly in patients with significant facial adiposity. However, absolute clinical certainty is required before injection, to avoid serious clinical complications due to accidental injection of other facial muscles, which can cause significant loss of function and poor aesthetics of the oral commissure. Posterior gummy smile may be safely corrected with no greater than two injection points of 2.5 u BT-A per side, along the palpable path of the zygomaticus muscles (Fig. 6).[31]

Mixed/asymmetric gummy smile

Mixed and asymmetric gummy smiles can include a combination of LLSAN and zygomaticus hyperfunction. Treatment strategies should be targeted against the contributing muscles in each individual case, tailored to the presenting complaint of the patient.

In the patient new to BT-A treatment, it is clinically appropriate to start on the lower end of the dosing spectrum, to avoid over-treating the gummy smile. It is worthwhile to consider that a complete lack of gingival display is less aesthetic than some gingival display and considered a poor outcome – doses should be estimated on a case-by-case basis, based on muscle strength, type, and contributing factors to the gummy smile appearance.[34]

Long-term management and safety

Procedures involving BT-A for smile modification require a comprehensive understanding of regional anatomy of the lower face. BT-A is

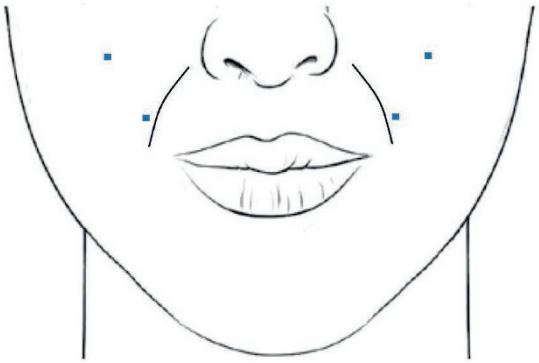

Fig. 6 Injection points for posterior excessive gingival display

technique sensitive and is associated with several complications and adverse outcomes. It is difficult to achieve a perfect result and managing patient expectations is a key component of the cosmetic practitioner. However, when used for cosmetic rather than therapeutic purposes, complications are generally mild and short-lived. Common adverse outcomes include asymmetry, over-correction, under-correction and perioral droop. More commonly, patients may be satisfied with the results at rest but dynamic results may be less satisfactory because of the secondary functional consequences of peri-oral muscle paralysis. There also exists the potential for more serious functional deficits involving the airway and processes of mastication and swallowing, when incorrectly applied to the orofacial region.[35]

Repeated use of BT-A for cosmetic purposes, even in cases of varying dosages, shows no increase in adverse outcomes, with no changes in safety profile.[36] Appropriate administration by well-trained practitioners of BT-A should result in few undesirable side effects, and in the case of an adverse outcome these are usually mild.[6]

Careful case selection should be exercised when using BT-A for smile modification. Consideration should be given to the mental well-being of the patient, including their psychological stability, their expectations and fears of the treatment.[35] It is important to assess muscle dynamism, balance, and symmetry before injection and when deciding on dosage site and depth, and postoperative review at two weeks it is essential to assess and appraise results of the treatment.

The dental practitioner should be aware of the broader implications of BT-A practised under the scope of dentistry. A comprehensive analysis of the medico-legal implications of BT-A within dentistry is beyond the scope of this article. The General Dental Council (GDC) recognises that dental registrants may prescribe Botox, however, its use is not considered to be representative of the practice of dentistry. Due to the inherent ambiguity, the authors recommend guidance from relevant dental boards and indemnity providers.

Conclusion

This review summarises key indications for use of BT-A for aesthetic modification of the smile. For effective and low-risk delivery of BT-A into the lower face, identification of anatomic landmarks and individual muscles is paramount. Doses should be commenced low until the dose-response of each patient can be approximated. This is of particular importance as overdose or improper injection technique can result in significant aesthetic or functional complications.

1. Carruthers J A, Lowe N J, Menter M A *et al.* A multicentre, double-blind, randomized, placebo-controlled study of the efficacy and safety of botulinum toxin type A in the treatment of glabellar lines. *J Am Acad Dermatol* 2002; **46:** 840–849.
2. Gadhia K, Walmsley A D. Facial aesthetics: is botulinum toxin treatment effective and safe? A systematic review of randomised controlled trials. *Br Dent J* 2009; **207:** E9; discussion 216–217.
3. Journal B D. Safeguards introuced for provision of injectable cosmetic treatments. *Br Dent J* 2010; **208:** 279.
4. Blasi J, Chapman E R, Link E *et al.* Botulinum neurotoxin A selectively cleaves the synaptic protein SNAP-25. *Nature* 1993; **365:** 160–163.
5. Kao I, Drachman D B, Price D L. Botulinum toxin: mechanism of presynaptic blockade. *Science* 1976; **193:** 1256–1258.
6. Dressler D, Saberi F A, Barbosa E R. Botulinum toxin: mechanisms of action. *Arq Neuropsiquiatr* 2005; **63:** 180–185.
7. Klein A. Complications and Adverse Reactions With the Use of Botulinum Toxin. *Dis Mon* 2002; **48:** 336–356.
8. Karsai S, Raulin C. Botox and Dysport: is there a dose conversion ratio in dermatology and aesthetic medicine? *J Am Acad Dermatol* 2010; **62:** 346–347.
9. de Almeida A T, De Boulle K. Diffusion characteristics of botulinum neurotoxin products and their clinical significance in cosmetic applications. *J Cosmet Laser Ther* 2007; **9 (Suppl 1):** 17–22.
10. Trindade de Almeida A R, Marques E, de Almeida J, Cunha T, Boraso R. Pilot study comparing the diffusion of two formulations of botulinum toxin type A in patients with forehead hyperhidrosis. *Dermatol Surg* 2007; **33:** S37–S43.
11. Allergan. Botox Cosmetic-botulinim toxin type A injection powder, lypophilized for solution. 2015.
12. Yogosawa F. Predicting soft tissue profile changes concurrent with orthodontic treatment. *Angle Orthod* 1990; **60:** 199–206.
13. Carruthers J, Carruthers A. Special feature: Botox treatment for expressive facial lines and wrinkles. *Curr Opin Otolaryngol Head Neck Surg* 2000; **8:** 357–361.
14. Gustafsson M, Ahlgren J. Mentalis and orbicularis activity in children with incompetent lips: an electromyographic and cephalometric study. *Act Odontologica* 1975; **33:** 355–363.
15. Cunningham M. Measuring the physical in physical attractiveness: quasi-experiments on the sociobiology of female facial beauty. *J Pers Soc Psychol* 1986; **50:** 925.
16. Guyuron B. MOC-PS(SM) CME article: genioplasty. *Plst Reconstr Surg* 2008; **121:** 1–7.
17. Skinazi G L, Lindauer S J, Isaacson R J. Chin, nose, and lips. Normal ratios in young men and women. *Am J Orthod Dentofacial Orthop* 1994; **106:** 518–523.
18. Cunningham M B, Barbee A P, Pike C L. What do women want? Facialmetric assessment of multiple motives in the perception of male physical attractiveness. *J Pers Soc Psychol* 1990; **59:** 61–72.
19. Rosen H M. Aesthetic refinements in genioplasty: the role of the labiomental fold. *Plast Reconstr Surg* 1991; **88:** 760–767.
20. Zide B M, Boutros S. Chin surgery III: revelations. *Plast Reconstr Surg* 2003; **111:** 1542–1550.
21. Beer K, Yohn M, Closter J. A double-blinded, placebo-controlled study of Botox for the treatment of subjects with chin rhytids. *J Drugs Dermatol* 2005; **4:** 417–422.
22. Carruthers J, Carruthers A. Aesthetic botulinum A toxin in the mid and lower face and neck. *Dermatol Surg* 2003; **29:** 468–476.
23. Lowe N J, Yamauchi P. Cosmetic uses of botulinum toxins for lower aspects of the face and neck. *Clin Dermatol* 2004; **22:** 18–22.
24. Frush J F, Fisher R D. The dynesthetic interpretation of the dentogenic concept. *J Prosth Dent* 1958; **8:** 558–581.
25. Sarver D M. The importance of incisor positioning in the esthetic smile: the smile arc. *Am J Orthod Dentofacial Orthop* 2001; **120:** 98–111.
26. Garber D A, Salama M A. The aesthetic smile: diagnosis and treatment. *Periodontol 2000* 1996; **11:** 18–28.
27. Tjan A H, Miller G D, The J G. Some esthetic factors in a smile. *J Prosthet Dent* 1984; **51:** 24–28.
28. Robbins J W. Differential diagnosis and treatment of excess gingival display. *Pract Periodontics Aesthet Dent* 1999; **11:** 265–272.
29. Garcia A, Fulton J E, Jr. Cosmetic denervation of the muscles of facial expression with botulinum toxin. A dose-response study. *Dermatol Surg* 1996; **22:** 39–43.
30. Kane M A. The effect of botulinum toxin injections on the nasolabial fold. *Plast Reconstr Surg* 2003; **112(5 Suppl):** 66S-72S; discussion 3S-4S.
31. Mazzuco R, Hexsel D. Gummy smile and botulinum toxin: a new approach based on the gingival exposure area. *J Am Acad Dermatol* 2010; **63:** 1042–1051.
32. Indra A S, Biswas P P, Vineet V T, Yeshaswini T. Botox as an adjunct to orthognathic surgery for a case of severe vertical maxillary excess. *J Maxillofac Oral Surg* 2011; **10:** 266–270.
33. Polo M. Botulinum toxin type A (Botox) for the neuromuscular correction of excessive gingival display on smiling (gummy smile). *Am J Orthod Dentofacial Orthop* 2008; **133:** 195–203.
34. Dickens SS, D. Proffit W. The dynamics of the maxillary incisor and the upper lip: a cross-sectional study of resting and smile hard tissue characteristics. *World J Orthod* 2002; **3:** 313–320.
35. Emer J, Waldorf H. Injectable neurotoxins and fillers: There is no free lunch. *Clin Dermatol* 2011; **29:** 678–690.
36. Cohen J, Slessinger J. Cox S E, Lin X, Reloxin Investigational Group. An Analysis of the Long-Term Safety Data of Repeat Administrations of Botulinum Neurotoxin Type A-ABO for th Treatment of Glabellar Lines. *Aesthet Surg J* 2009; **29:** 43–49.

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