was employed (Fig. 13). The procedure was performed without filler metal and took 2 minutes, and the irradiation time was 20 s (Fig. 14). After the reparation, the therapy was continued, turning the screw until the required space was achieved (Fig. 15).

**Conclusion**

The ability to weld broken orthodontic appliances directly in the office represents for the dentist a new prospect, allowing the restoration of appliances extremely quickly without additional costs (the welding appliance is the same used for dental therapies). Being able to maintain the integrity of plastic, acrylic and ceramic parts close to the welding zone and the ability to make the reparation while the patient is sitting in the chair and in one visit only are, in our opinion, the great advantages in terms of costs, marketing, patient satisfaction and efficiency of the office. Moreover, as shown in the clinical cases presented, the welding process may also be performed intra-orally without risks and discomfort to the patient. The period of learning for dentists is very short, owing to the simple and fast procedure, because the parameters are standard and it is not necessary to change or adapt them to different clinical situations. We think that this technique represents a valid aid in our daily practice and, simultaneously, opens a new chapter in laser dentistry, bringing new possibilities we intend to analyse and test in further research.

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**Fig. 12:** The Veltri appliance with a broken arm. **Fig. 13:** Intra-oral laser welding. **Fig. 14:** The wire of the appliance repaired. **Fig. 15:** The appliance reactivated after welding of the wire.

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Surgical crown lengthening and botulinum toxin in the management of the orthodontic patient with gummy smile

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Introduction

The demand for cosmetic procedures has grown exponentially. Dental procedures, as well as medical ones, besides working to obtain the principle of health promotion, seek to achieve smile aesthetics, as the smile is a form of communication and social expression of many feelings.1–3

Facial aesthetic harmony correlates directly with the smile and this, in turn, is formed by the union of three components: teeth, gingivae and lips.1–4 The smile becomes aesthetically pleasing when these elements are disposed in suitable proportion and exposure of the gingival tissue is limited to 3 mm. When the gingival exposure is greater than 3 mm, it characterises the unaesthetic condition called gummy smile, which affects some patients psychologically.1, 3, 5–8

Several therapeutic modalities have been proposed for the correction of gummy smile, among them gingivectomy or gingivoplasty,1–3, 5, 6, 8 myectomy6, 8 and orthognathic surgery.6, 8, 9 The last two procedures are more invasive and associated with high morbidity.7 In contrast, the use of botulinum toxin can be considered a therapeutic alternative to surgery, because it is a more conservative method, more effective, faster and safer than surgical procedures.5, 10

Botulinum toxin is synthesised by the Gram-positive anaerobic bacterium Clostridium botulinum and inhibits the release of acetylcholine at the neuromuscular junction, preventing muscle contraction.1, 6, 8, 9. There are seven distinct serotypes of toxins, A, B, C1, D, E, F and G. However, the subtype A is the most frequently used clinically and the most powerful.2, 6

Botulinum toxin has been shown to be effective in the treatment of gummy smile in patients with hyperfunction of the muscles involved in smiling, as well as in patients with other disorders, such as temporomandibular disorders (hypertrophy of the masseter muscle, bruxism, clenching) and myofascial pain.2, 6, 9 The purpose of this article is to report on a case of a patient who presented with gummy smile and was treated with a combination of surgical crown lengthening (gingivoplasty) and application of botulinum toxin.

Case report

A 27-year-old African-descendant female patient attended the clinic with the complaint of gummy smile (Fig. 1). Clinically, the patient had an anatomical discrepancy between the length of the anterior teeth and evident gingival exposure greater than 3 mm, characterising gummy smile (Fig. 2a). Chu’s Proportion Gauge (Hu-Friedy, Chicago, US) was used to measure the length of the teeth (Fig. 2b).

Surgical crown lengthening (gingivoplasty) was proposed and later, after the presentation of the results, the application of botulinum toxin for the correction of gummy smile. However, the patient was informed about the recurrence of gingival smile six months after application, because of its temporary result. Under local infiltrative anaesthesia, bleeding points were determined with the aid of a millimetre probe and the union of these points was performed with electrocautery.2 The length of the teeth was increased, characterising the dental zenith. Subsequently, the scraping was performed, resembling the technique of external bevel gingivectomy, in order to enhance tissue healing. There was no need for the use of surgical cement, given that wound healing would occur by secondary intention. The patient reported no complaints or complications after surgery.

At the subsequent consultation 30 days later, the orthodontic appliance was removed and satisfactory tissue repair was observed (Fig. 3), and no changes or complaints were reported by the patient. However,
the persistence of the complaint of gummy smile was reported by the patient (Fig. 4). At the same consultation, botulinum toxin was applied. Prior to application of the botulinum toxin, the surface of the skin was disinfected with 70% ethyl alcohol and the oils from the area were removed, in order to avoid local infection. The points of application were marked beside each nostril. Then, local anaesthetic (EMLA, AstraZeneca) was applied with the aim of promoting comfort during the procedure. Botulinum toxin A (BOTOX 200, Allergan) was diluted in 2 ml of saline, according to the manufacturer’s instructions, and two units injected into the predetermined sites, lateral to each nostril. After application, the patient was advised not to bend her head forwards for the first 4 hours and not to engage in physical activity for the first 24 hours after the procedure.

After ten days, the patient was examined. She presented with a uniform dehiscence of the upper lip (Fig. 5). No side-effects or complaints were reported.

Discussion

Gummy smile is characterised by the exposure of more than 3 mm of gingival tissue during smiling, and it is often seen in women. The predominance among women can be explained by the fact that men present with a lower smile line, and several aetiologies for gummy smile have been suggested, including vertical maxillary excess, delayed passive eruption, hyperfunction of the muscles involved in smiling, and reduced length of the clinical crown of the teeth. These can occur separately or together, and determine the type of treatment to be used.

In gummy smile caused by overactive muscles, botulinum toxin is indicated. It is the treatment of choice for ease and safety of application, and its rapid effect, besides being a more conservative approach when compared with surgical procedures (myectomy or Le Fort I osteotomy). The clinical effects appear within two to ten days after the injection, and the most visible effect occurs 14 days after the injection. This effect lasts about three to six months.

The action of smiling is determined by several facial muscles, such as the elevator of the upper lip, the elevator of the upper lip and wing of the nose, the zygomaticus major and minor muscles, the muscle of the angle of the mouth, and the orbicularis oris and risorius muscles. Among them, the first three have a greater influence and determine the amount of lip elevation and, therefore, should be the muscles targeted by the injection of botulinum toxin. The fibres of these muscles converge at the same area, forming a triangle, and it is here that the three muscles can be targeted with a single injection. The injected toxin can spread over an area of 10–30 mm and this is its effective extent.
is lateral to the wing of the nose. After being injected into the predetermined locations, the toxin decreases the contraction of the muscles responsible for the elevation of the upper lip, and this reduces gingival exposure.

Each muscle involved in the elevation of the upper lip has a function during the action of smiling. The points of the injections are determined by the contraction of specific muscle groups that results in different areas of gingival display. Several classifications have been proposed for gummy smile: anterior, posterior, mixed and asymmetric, depending on the muscle groups involved.

The anterior gummy smile should be treated with the conventional technique, with the applications lateral to the wing of the nose. In patients with posterior gummy smile, the application of the toxin must involve the zygomaticus major and minor muscles, with the injection of the toxin at two different points: the point of greatest contraction of nasolabial folds during the action of smiling and the second point 2 cm lateral to the first, at the level of the ala-tragal line. In the case of patients who have mixed gummy smile, the application of the toxin should be performed at all the points mentioned above. However, the dose should be reduced to 50% at the point lateral to the wing of the nose. In cases of labial asymmetry, which occurs owing to differences in muscle activity, patients receive injections of different doses on either side of the face.

Botulinum toxin A is a hydrophilic powder, stored under vacuum, that is sterile and stable. The reconstitution occurs with the smooth injection of the diluent (0.9% sodium chloride) into the bottle. The solution should be stored at 2–8 °C and used within 4–8 hours in order to ensure its effectiveness.

At the beginning of the treatment, extra-oral photographs, including a close-up of the smile, were taken. Several authors note the importance of recording the smile before and after the application of the toxin.

It has been suggested that the photographing of the smile should be performed with the muscles individually stimulated with electrical current in order to ensure that the muscle contraction is controlled, precise and repeatable, as a spontaneous smile is extremely difficult to replicate. Patients know that the treatment is carried out to produce a different smile, so from this perspective, unconsciously, there is a tendency to smile differently in photographs after the treatment.

The injection of botulinum toxin, despite being a simple and safe procedure, may be associated with some adverse events, such as pain at the injection site, bruising, infection, oedema, dysphonia, dysphagia, ptosis or lengthening of the upper lip and asymmetry of the smile.

The dentist should be attentive to dosage, precision of technique and location of the injection sites. In this case, no complaints or changes arising from the application were reported. Contra-indications to the use of botulinum toxin are pregnancy, lactation, hypersensitivity (allergy) to botulinum toxin, lactose and albumin, muscle and neurodegenerative diseases (myasthenia gravis and Charcot-Marie-Tooth disease), and concurrent use of aminoglycoside antibiotic, which enhances the action of the toxin.

In this case, the result was satisfactory regarding the harmony of the smile of the patient by the combination of treatments, resective gingival surgery and application of botulinum toxin A. The use of isolated treatments would not have achieved the excellence of the results obtained. Initially, the creation of the new dental zenith during the course of resective gingival surgery promoted the new dental architecture, favouring gingival-dental-facial harmony for the patient. Subsequently, the application of botulinum toxin A softened the gummy smile, by the uniform dehiscence of the upper lip, promoting smoothness of the facial lines of the smile, as can be seen in the nasolabial folds adjacent to the nostrils by comparing Figures 1 and 5.

Conclusion

In summary, the application of botulinum toxin is an alternative treatment that is less invasive, faster, safer and more effective, and it produces harmonious and pleasing results when applied to target muscles, respecting the appropriate dose and type of smile. Therefore, it is a useful adjunct in the aesthetic improvement of the smile and provides better results when combined with resective gingival surgery.

Editorial note: A list of references is available from the publisher.