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Case Report

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Muscle Function Recovery Following Botulinum Toxin Type A Facial Injections: A Case Managed With Photobiomodulation Therapy

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Abstract

Introduction: Aesthetic applications of botulinum toxin type A (BoNT-A) may lead to some complications, including unwanted muscle paralysis. Moreover, BoNT-A effects may last several months, and there is no medical intervention so far to accelerate muscle function recovery.

Case Report: A female patient with a movement disorder of the mimic muscles resulting from BoNT-A injections received daily sessions of photobiomodulation therapy (PBMT). A fast improvement in both facial asymmetry and muscle function was noted within a few weeks. After nine weeks, almost complete recovery was achieved.

Conclusion: According to the current case, PMBT seems to be an effective intervention to accelerate muscle function recovery following BoNT-A use.

Keywords: Botulinum toxin A; Photobiomodulation therapy; Facial muscles.

Introduction

Botulinum toxin is a potent neurotoxin presenting 7 known serotypes (A-G) and naturally produced by *Clostridium botulinum*, a gram-positive aerobic bacterium.[1] Botulinum toxin type A (BoNT-A), the most potent serotype,[2] is a blocker of acetylcholine release from presynaptic terminals[3] widely used for treating blepharospasm, hemifacial spasm, strabismus, and other neurological conditions.[4,5] It has also been proposed for the management of neuropathic pain due to its antinociceptive effect not related to muscle activity,[3] but the cosmetic use of BoNT-A has made it actually popular.[5]

Aesthetic applications of BoNT-A may lead to some complications, including unwanted muscle paralysis. Although pain, swelling, headache, and nausea may occasionally be present,[6] eyelid/brow ptosis resulting from its application in the upper face[5,7,8] is the most common complication.

Given that the BoNT-A effects may last several months[9] and there is no medical intervention so far to accelerate muscle function recovery,[5] the present study hypothesized that the use of photobiomodulation therapy (PBMT), a conservative, safe,[10] painless,[11] and low-cost[12] treatment option that modulates some events of the inflammatory response, mitigates pain, and promotes healing,[13,14] could reduce muscle paralysis or even result in fully recovery of muscle function after BoNT-A injections. For that, we reported herein a clinical case in which a unilateral movement disorder of the mimic muscles resulting from BoNT-A injections was managed with PBMT.

Case Report

A 31-year-old Caucasian woman was referred to an oral and maxillofacial surgeon because of unpredictable attacks of shock-like pain on the left side of her face. The episodes were abrupt in the onset and termination, presented extremely variable duration (a few seconds to about 25 minutes), and affected the upper, middle, and lower face simultaneously. The patient had a medical history of refractory trigeminal neuralgia (TN) on the right side, which was managed with microvascular decompression a year ago.

The diagnosis of TN was made based on clinical signs and symptoms, and high-resolution 3D MR imaging did not demonstrate vascular compression. Clinical management was, therefore, performed using gabapentin, baclofen, and amitriptyline. After a month, with no success, BoNT-A facial injections (Dysport®, Galderma Brasil

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Ltda, Hortolândia, SP, Brasil) were proposed as follows: 3 intradermal points around the supraorbital foramen (2U in each point), 3 around the infraorbital foramen (2U in each point), and 3 points around the mental foramen (2U in each point) (Figure 1A). Furthermore, for aesthetic purposes (glabellar frown lines, periorbital wrinkles, and horizontal forehead lines), 16 intramuscular applications on the upper and middle face were performed bilaterally (1 to 3 U in each point) (Figure 1B). Unfortunately, she reported no improvement in the TN episodes, and a marked facial asymmetry developed from impairment of the left mimic muscles (Figure 2A).

As the TN episodes have become more frequent and painful, the patient was then admitted to a hospital and underwent percutaneous balloon compression, also without success. Pregabalin, gabapentin, chlorpromazine, baclofen, and amitriptyline were prescribed, but they provided a very limited effect. Another MR imagining was requested, and it revealed the left superior cerebellar artery in contact with the superior aspect

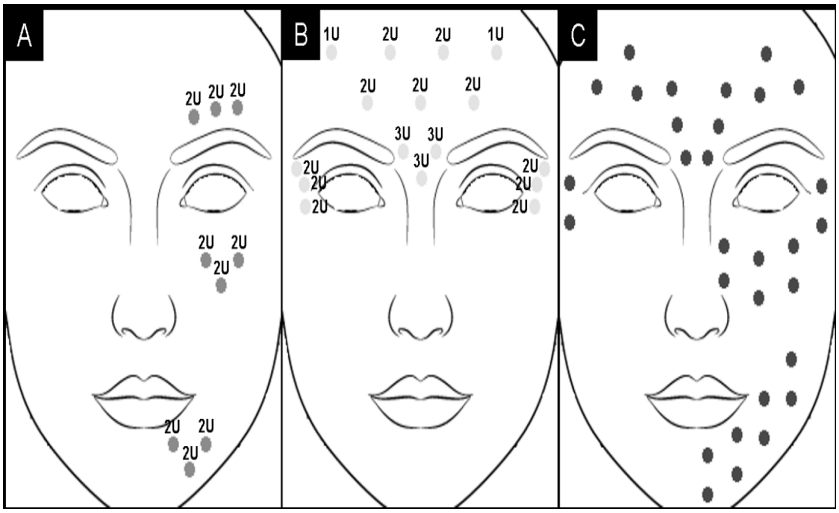

Figure 1. BoNT-A and PBMT points. (A) BoNT-A: Injection points and dose (U) for trigeminal neuralgia. (B) BoNT-A: Injection points and dose (U) for aesthetic purposes. (C) PBMT: Illumination points for muscle function recovery

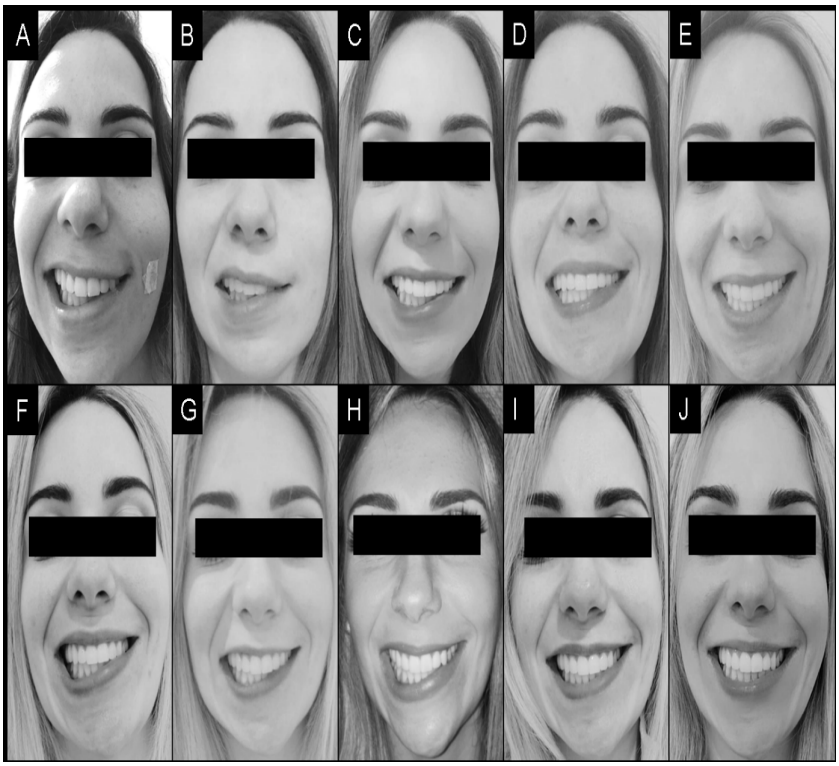

Figure 2. Clinical Course. (A) Initial clinical presentation (two days after BoNT-A injections). (B) 1 week of PBMT. (C) 2 weeks of PBMT. (D) 3 weeks of PBMT. (E) 4 weeks of PBMT. (F) 5 weeks of PBMT. (G) 6 weeks of PBMT. (H) 7 weeks of PBMT. (I) 8 weeks of PBMT. (J) 9 weeks of PBMT

of the cisternal segment of the left trigeminal nerve, approximately 6.0 mm from its origin on the brainstem. Given the clinically intractable condition and the RM findings, the neurosurgery team proposed microvascular decompression; however, because of the BoNT-A effects, intraoperative neurophysiological monitoring could not be performed properly at that moment. So, the surgery was contraindicated temporarily by the neurophysiology team.

After the patient was discharged from the hospital (about a week after the BoNT-A injections) and in order to achieve faster recovery from the motor muscle impairment, daily PBMT sessions using a continuous wave InGaAlP diode laser device (Table 1) were proposed as follows: 808 nm, 75 J/cm², 100 mW, 3 J, 30 seconds by each point, totaling 30 facial points (Table 2). The illumination points were distributed accordingly to the BoNT-A injection areas (Figure 1C), holding the handpiece perpendicular to the skin surface and in contact mode. A fast improvement in both facial asymmetry and muscle function was noted within a few weeks (Figure 2B-I). In the 9th week of PBMT, the patient showed almost complete recovery (Figure 2J).

After some days, the patient underwent microvascular decompression and intraoperative neurophysiological monitoring was performed with success. At present, she is under follow-up with the neurology team and the episodes of facial pain are no longer present.

Table 1. Device Information

Specifications	Information
Manufacturer	MMOptics® Ltda
Model identifier	Twin Flex III Evolution
Number of emitters	One emitter
Emitter type	InGaAlP
Spatial distribution of emitters	-
Beam delivery system	Fiberoptic

Table 2. Irradiation and Treatment Parameters

Specifications	Unit
Type of laser	Diode
Operation mode	Continuous
Center wavelength	808 nm
Exposure duration	30 s
Delivery system	Optical fiber
Energy density	75 J/cm²
Energy per Point	3 J
Number of points irradiated	30 points
Total radiant energy	90 J
Peak radiant power	100 mW
Average radiant power	100 mW
Focus spot area	0.04 cm²
Focus-to-tissue	In contact
Beam spot size at target	0.04 cm²
Irradiance at target	2.5 W/cm²
Application technique	Skin contact
Number and frequency of treatment sessions	9 weeks, daily sessions
Beam divergence	No
Water irrigation	No
Air and aspirating airflow	No

Discussion

It is reported that aesthetic applications of BoNT-A last approximately 3 months but often as many as 4 to 5 months, depending on the facial area involved and the dose and formulation used.[9] Thus, the present paper reported a case in which daily PBMT was effective in muscle function recovery after BoNT-A facial injections for TN within a shorter period. To the best of the authors' knowledge, there is no similar paper addressing this subject.

The rationale for using PBMT was based on the successful management of bilateral eyelid ptosis as a complication of the BoNT-A use with a GaAs laser.[5] Curiously, however, some authors advocate performing pretreatment of movement-associated rhytides with botulinum toxin before laser resurfacing in order to achieve a prolonged improvement in many areas of the upper face,[15] and others suggest that patients may be treated with non-ablative lasers, intense pulsed light, or radiofrequency devices immediately after botulinum toxin injection on glabellar or crow's-feet areas without loss of efficacy or any other apparent untoward effect.[16]

Although this case report is encouraging, the underlying biological mechanisms are obscure. A plausible explanation relies on the biostimulant effects of PBMT, which may have accelerated the washout of the BoNT-A from the neuromuscular junctions, but there has been neither clinical nor laboratory evidence to support this statement yet.[5] Another hypothesis based on both *in vitro* and *in vivo* studies is that PBMT could promote reinnervation of the affected muscles as laser light is believed to promote activation, growth, migration, and sprouting of nerve cells or their components due to alteration of mitochondrial oxidative metabolism, interaction with cytoplasmic proteins, enhancement of actin polymerization at the leading axon edge, and upregulation of several neurotrophic growth factors and extracellular matrix proteins.[17]

Conclusion

According to the current case, PMBT seems to be an effective intervention to accelerate muscle function recovery following BoNT-A use.

Acknowledgments

The findings and conclusions of this case report are the responsibility of the authors.

Conflict of Interests
No potential conflict of interest was reported by the authors.

Consent to Participate
Written informed consent was obtained from the patient.

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Nothing to declare.

References
1. Castillo-Álvarez F, Hernando de la Bárcena I, Marzo-Sola ME. Botulinum toxin in trigeminal neuralgia. Med Clin (Engl Ed). 2017;148(1):28-32. doi: 10.1016/j.medcle.2017.01.005.
2. Nigam PK, Nigam A. Botulinum toxin. Indian J Dermatol. 2010;55(1):8-14. doi: 10.4103/0019-5154.60343.
3. Shackleton T, Ram S, Black M, Ryder J, Clark GT, Enciso R. The efficacy of botulinum toxin for the treatment of trigeminal and postherpetic neuralgia: a systematic review with meta-analyses. Oral Surg Oral Med Oral Pathol Oral Radiol. 2016;122(1):61-71. doi: 10.1016/j.oooo.2016.03.003.
4. Nestor MS, Han H, Gade A, Fischer D, Saban Y, Polselli R. Botulinum toxin-induced blepharoptosis: anatomy, etiology, prevention, and therapeutic options. J Cosmet Dermatol. 2021;20(10):3133-46. doi: 10.1111/jocd.14361.
5. Majlesi G. GaAs laser treatment of bilateral eyelid ptosis due to complication of botulinum toxin type A injection. Photomed Laser Surg. 2008;26(5):507-9. doi: 10.1089/pho.2007.2114.
6. Pena MA, Alam M, Yoo SS. Complications with the use of botulinum toxin type A for cosmetic applications and hyperhidrosis. Semin Cutan Med Surg. 2007;26(1):29-33. doi: 10.1016/j.sder.2006.12.004.
7. Steinsapir KD, Groth MJ, Boxrud CA. Persistence of upper blepharoptosis after cosmetic botulinum toxin type A. Dermatol Surg. 2015;41(7):833-40. doi: 10.1097/dss.0000000000000386.
8. Lee KC, Pascal AB, Halepas S, Koch A. What are the most commonly reported complications with cosmetic botulinum toxin type A treatments? J Oral Maxillofac Surg. 2020;78(7):1190.e1-1190.e9. doi: 10.1016/j.joms.2020.02.016.
9. Flynn TC. Botulinum toxin: examining duration of effect in facial aesthetic applications. Am J Clin Dermatol. 2010;11(3):183-99. doi: 10.2165/11530110-000000000-00000.
10. Kazemikhoo N, Hashemi Pour S, Nilforoushzadeh MA, Mokmeli S, Dahmardehei M. The efficacy of carbone dioxide laser debridement along with low-level laser therapy in treatment of a grade 3 necrotic burn ulcer in a paraplegic patient (a case report). J Lasers Med Sci. 2019;10(4):338-41. doi: 10.15171/jlms.2019.54.
11. Vahdatinia F, Gholami L, Karkehabadi H, Fekrazad R. Photobiomodulation in endodontic, restorative, and prosthetic dentistry: a review of the literature. Photobiomodul Photomed Laser Surg. 2019;37(12):869-86. doi: 10.1089/photob.2019.4707.
12. Brassolatti P, de Andrade ALM, Bossini PS, Otterço AN, Parizotto NA. Evaluation of the low-level laser therapy application parameters for skin burn treatment in experimental model: a systematic review. Lasers Med Sci. 2018;33(5):1159-69. doi: 10.1007/s10103-018-2526-5.
13. Berlingieri G, Alvares CMA, Serrano RV, Palma LF, Campos L. Phototherapies for COVID-19-associated opportunistic oral infections. Photodiagnosis Photodyn Ther. 2022;37:102678. doi: 10.1016/j.pdpdt.2021.102678.
14. Rezende SB, Campos L, Palma LF, Tateno RY, Simões A, Macedo MC, et al. Antimicrobial photodynamic therapy for recurrent herpes labialis in chronic graft-versus-host disease: a case report. Photodermatol Photoimmunol Photomed. 2021;37(4):321-3. doi: 10.1111/phpp.12655.
15. Zimbler MS, Holds JB, Kokoska MS, Glaser DA, Prendiville S, Hollenbeak CS, et al. Effect of botulinum toxin pretreatment on laser resurfacing results: a prospective, randomized, blinded trial. Arch Facial Plast Surg. 2001;3(3):165-9. doi: 10.1001/archfaci.3.3.165.
16. Semchyshyn NL, Kilmer SL. Does laser inactivate botulinum toxin? Dermatol Surg. 2005;31(4):399-404. doi: 10.1111/j.1524-4725.2005.31105.
17. Rochkind S, Geuna S, Shainberg A. Chapter 25: Phototherapy in peripheral nerve injury: effects on muscle preservation and nerve regeneration. Int Rev Neurobiol. 2009;87:445-64. doi: 10.1016/s0074-7742(09)87025-6.