Laser Physics Letters

Astro Ltd.

LETTER

Treatment of facial nerve palsies with laser and endermotherapy: a report of two cases

To cite this article: Vitor Hugo Panhóca *et al* 2021 *Laser Phys. Lett.* **18** 015601

IOP Publishing | Astro Ltd Laser Physics Letters
Laser Phys. Lett. **18** (2021) 015601 (4pp) https://doi.org/10.1088/1612-202X/abcbf8

Letter

Treatment of facial nerve palsies with laser and endermotherapy: a report of two cases

Vitor Hugo Panhóca[1], Marcelo Saito Nogueira[2,3] and Vanderlei Salvador Bagnato[3]

[1] Biophotonics Laboratory, Institute of Physics of São Carlos—University of São Paulo (USP), São Carlos, São Paulo, Brazil
[2] Present address: Tyndall National Institute—University College Cork (UCC), Cork, Ireland
[3] Institute of Physics of São Carlos—University of São Paulo (USP), São Carlos, São Paulo, Brazil

E-mail: vhpanhoca@ifsc.usp.br

Received 8 November 2020
Accepted for publication 13 November 2020
Published 7 December 2020

Abstract

Facial nerve palsy involves paralysis of unknown origin caused by trauma, infectious disease or metabolic disorders. The aim of this study was to employ low-level laser therapy (LLLT) in the recovery of two patients with facial nerve palsies due to trauma and Bell's palsy (BP), respectively. LLLT was used with a gallium aluminum arsenide laser (780 nm) in the first case and in the second case LLLT (660 nm and 808 nm) was used synergistically with a vacuum therapy device. No medication was administered during laser treatment and vacuum therapy. The treatments resulted in complete recovery and normal facial expression in both patients including improved facial movement and facial symmetry at rest. With this result in mind, we believe LLLT and combined vacuum therapy may be an alternative treatment to decrease the recovery time of facial expression in normal patients with facial nerve palsies and BP.

Keywords: low-level laser therapy, vacuum therapy, facial nerve palsies

(Some figures may appear in color only in the online journal)

1. Introduction

Facial nerve injuries may occur after fracture of the temporal bone, which can cause trauma to the peripheral facial nerve. The diagnosis of this type of fracture can be made with computed tomography. Lesions associated with this trauma can lead to rupture of the ossicular chain, or hematotympanum, with leakage of cerebrospinal fluid in patients with otorhinoliquorrhea and even causing changes in the temporomandibular joint. The diagnosis of facial nerve palsies is complex, especially because it requires the exclusion of all other possible causes, including neurological diseases. However, this diagnosis is important for proper treatment to be indicated for effective results.

Currently, facial nerve injury diagnosed as idiopathic peripheral facial palsy or Bell's palsy (BP) has the characteristic of presenting total involvement of the affected hemiface, differing from central facial paralysis, which affects only the lower portion of the face. In BP, the eyelid and eye are affected, preventing eyelid obliteration and lubrication of the eye, and leading to dryness of the eyeball. BP is a fairly common type that occurs predominantly in adults and affects the facial nerve (VII cranial nerve) [1]. The motor branch of the facial nerve controls the facial muscles, facial mimicry, release of tears and saliva. This nerve also controls taste perception in the anterior two-thirds of the tongue through the sensory branch.

BP is an acute peripheral paralysis of the facial nerve with sudden onset and of unknown origin. Primary infection or reactivation of the herpes simplex virus (HSV) is suggested as a possible cause of BP in some but not all patients. Studies in patients who developed BP had urine collected which showed the presence of the human HSV virus (HSV 1 and 2).

BP is diagnosed through the exclusion of all other causes; in particular, other neurological diseases need to be excluded, as well as schwannomas. Steroid use is the most indicated therapy to date, and recovery rates are close to 90%. In addition, patients with BP may benefit from additional antiviral drugs [2].

Physiotherapy modalities are used to treat BP, which include electrotherapy, massage, facial exercises, electrical stimulation and thermal shock. Facial exercises may help to improve facial function and may shorten the recovery time of BP, although evidence for this is low [3]. Electrotherapy can also be used to treat BP to increase muscle and nerve function, while thermal methods and massage aim to reduce edema, increase blood flow and increase oxygenation of affected tissues [4]. However, all these physiotherapy methods related to BP have questionable efficacy [5].

A study by Anders *et al*, in 1993, has shown that low-level laser therapy (LLLT) at well-defined parameters increased the rate of rat facial nerve regeneration following crush injury [6]. A clinical study conducted in Japan by Yamada *et al* in 1995 suggested that LLLT would be an appropriate alternative treatment for peripheral facial paralysis patients not responding to corticosteroids. In addition, the same study indicated that LLLT would be an ideal adjunctive treatment for patients with peripheral facial paralysis not manageable by corticosteroid therapy [7]. Recent studies have shown that LLLT has significantly benefited the recovery of patients with BP [5, 8]. LLLT has been shown to be an accelerator of neural regeneration and has been reported as a valuable clinical work tool in the treatment of a variety of neural diseases, such as trigeminal neuralgia, paraesthesia, dental hypersensitivity and postherpetic pain [9].

LLLT of peripheral facial nerve palsies can also be performed with a device that combines low-level laser and vacuum therapy. Vacuum therapy, also known as endermotherapy, is a non-invasive mechanical therapy consisting of sucking the skin and subcutaneous tissue through negative pressure to increase local blood flow and stimulation of lymphatic drainage [10]. As a result, vacuum therapy increases the blood circulation and oxygenation of connective tissue and is used for esthetic treatments such as those for cellulite [10] and redistribution of the subcutaneous adipose tissue [10]. Then, vacuum therapy may treat BP by restoring facial movements with the activation of suction circulation through suction cups, which improves the circulatory system, promotes the anti-inflammatory effect, increases muscle tone and stimulates nerve regeneration.

In this study, we present clinical cases of patients with facial nerve palsies who were treated with LLLT and endermotherapy presenting positive clinical results to obtain functional neuromuscular restoration of their face.

2. Materials and methods

All the experiments were conducted upon approval of the ethics committee for studies in human beings of Irmandade da Santa Casa de Misericordia de São Carlos, decision number 3.244.307. Informed consent was obtained from all the participants of this study according to the guidelines of the local clinical research ethics committee. Both clinical cases involved facial nerve palsies, where the patient of clinical case 1 had an idiopathic injury (BP) and the patient of clinical case 2 had post-traumatic injury.

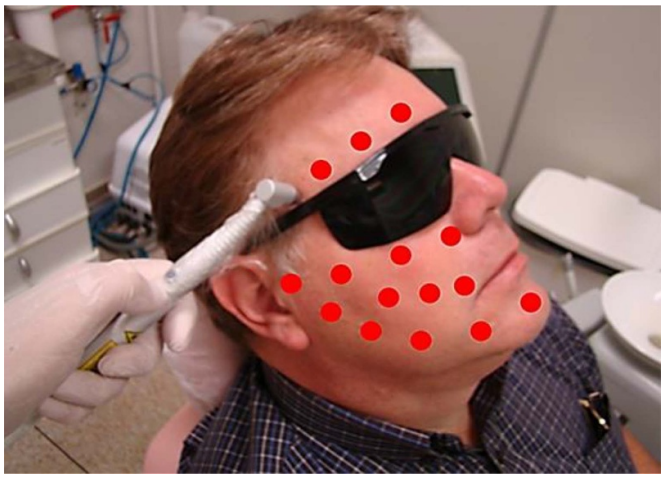

Figure 1. Showing the points of spot application of the laser beam with the active tip of the device in contact with the skin. Application lines were made with spaces of 1 mm at each point making trajectories in the forehead, maxilla and mandible region on the patient's face.

2.1. Clinical case 1

The clinical case report below was a 50-year-old Caucasian male, presenting with right facial paralysis (BP) after a hypertensive peak event, who was treated with LLLT. The total treatment lasted 2 months with the application of LLLT with infrared wavelength (780 nm), device with power around 70 mW for 60 s, dose of 105 J cm^{-2}, 4.2 J of total energy per point and the diameter of the laser application tip measuring 0.04 cm^2 (table 1). There were two sessions per week. The application points on the face can be seen in figure 1. We can also see the symmetry restoration and facial expression before and after treatment in figure 2.

2.2. Clinical case 2

The following case report involves laser treatment combined with endermotherapy on a 29-year-old Caucasian male patient presenting with a major complaint of right-sided facial paralysis due to trauma after falling, with a medical diagnosis of facial nerve and cochlear vestibular nerve injury. The patient also reported unilateral deafness. The treatment was performed with the Vacumlaser appliance (MMOptics, São Carlos, SP, Brazil) seen in figure 3(a). Total treatment time lasted 3 months. Applications were performed with a medium (60 mm) and small (40 mm) size suction cup combined with irradiation of two low-power laser outputs with wavelength

Table 1. Dosimetry parameters used for treatments.

Device	Power	Wavelength	Time	Application	Energy
Twin laser (MMoptics)	70 mW	780 nm	60 seg/point	In touch	4.2 J per point
Vacumlaser (MMoptics)	600 mW divided into six laser spots around the active tip	660 nm (3[a]) e 808 nm (3[a])	3 min per region	In touch	≤108 J[b] per region

[a](3) active tip—infrared or red.
[b]≤108 J discounting lost energy according to the spot distance from the tissue surface that varies with the size of the suction cup.

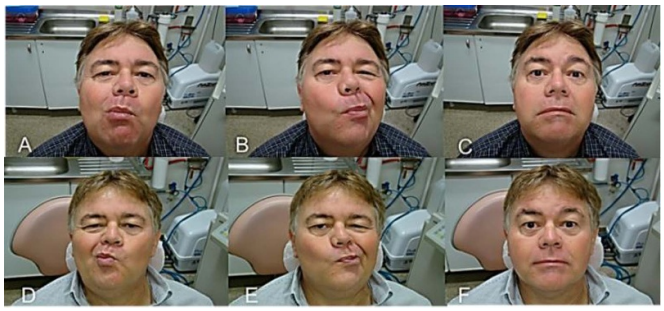

Figure 2. (a) Before treatment showing patient pouting right; (b) before treatment showing patient pouting left; (c) before treatment showing patient's face at rest; (d) after treatment showing patient pouting to the right, movement with greater lateral excursion;(e) after treatment showing patient pouting to the left; (f) after treatment showing patient's face at rest with eyebrow lifting symmetry.

Figure 3. (a) Endermotherapy device combined with LLLT; (b) sliding regions of the suction cups on the patient's face.

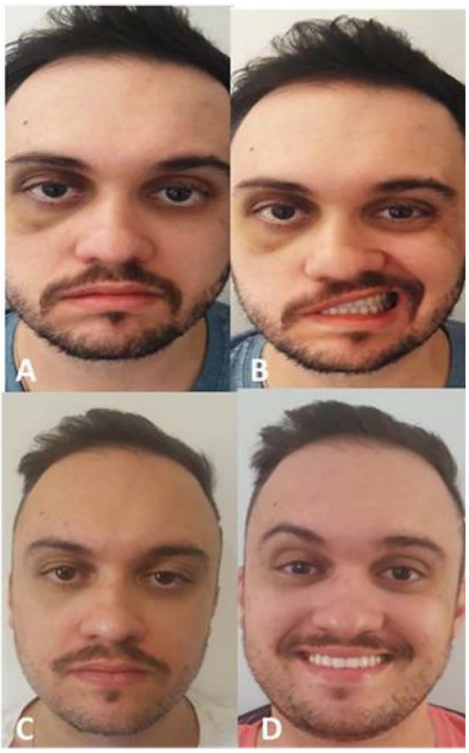

Figure 4. (a) Before treatment showing front of patient's face; (b) before treatment showing patient with asymmetrical smile; (c) after treatment showing front of patient's normal face; and (d) after treatment showing patient with symmetrical smile.

660 nm and 808 nm. For superficial sliding of the suction cup on the skin, vegetable oil was used to avoid damage to the skin. Laser application and vacuum therapy were performed throughout the facial nerve path (frontal, maxillary and mandibular region) for a duration of 3 min per region (table 1) in MP9 mode and with a pressure of approximately 150 mbar (figure 3(b)). We can see the restoration of smile symmetry and facial expression before and after treatment in figure 4.

3. Discussion

In this paper, we present two clinical cases treated with LLLT that show effective results in the treatment of facial nerve palsies. Our findings corroborate the reports of other authors, demonstrating that LLLT can be indicated in the treatment of morbidities that require stimulation of nerve regeneration (trigeminal neuralgia, paraesthesia and BP, among others) [5, 7, 11, 12].

The exact mechanism of photobiomodulation on damaged nervous tissue is not yet well known. One of the most defended hypotheses for cutaneous and subcutaneous nervous/muscle tissue action with LLLT is the increased enzyme activity involved in the mitochondrial respiratory chain, such as cytochrome oxidase and adenosine triphosphatase (ATP), leading to an increase in ATP production in mitochondria [13]. Other hypotheses argue that the synthesis of DNA, pro-collagen and collagen production increases [13]. A clinical study evaluating the effects of LLLT therapy on nerve tissue injuries has shown increased myelin production and nerve function [14].

Our study is the first case study in the literature showing a new system that promotes the synergistic application of laser and endermotherapy in the treatment of facial nerve palsies. The positive results from LLLT and vacuum therapy can be assessed from the photos of clinical cases 1 and 2, showing neuromuscular restoration after treatment. Our clinical results suggest that LLLT and vacuum therapy has a beneficial effect on nerve regeneration, as LLLT produced changes in the facial muscles of patients in order to recover their normal functions. Particularly for clinical case 2, we believe that the use of low-power laser vacuum therapy applied to the patient's pre-auricular region may have increased the peripheral irrigation of the inner ear [15]. Vacuum therapy would bring greater oxygenation of this region to the face, favoring the repair of the labyrinth tissues responsible for the patient's hearing and balance. Based on the discussed results, laser therapy may be a viable approach to nerve regeneration and may have clinical relevance. In order to statistically confirm our findings and the feasibility of LLLT in the treatment of facial nerve palsies, further investigation with larger patient numbers is required. However, LLLT and vacuum therapy are potentials non-invasive therapeutic approaches to treat facial nerve palsies in diabetic or hypertensive patients who cannot be treated with corticosteroids.

4. Conclusion

As we can see from the clinical cases presented, we consider that LLLT associated with endermotherapy can have a beneficial effect on facial nerve palsy treatment, since the results here are presented as facial restoration of facial symmetry after this treatment. Our results corroborate other publications in the literature, indicating that low-power laser therapy has clinical relevance in terms of nerve regeneration.

Acknowledgments

The authors acknowledge the financial support from the Financier of Studies and Projects (FINEP; Grant No. 01.13.0430-00), São Paulo Research Foundation (FAPESP; Grant Nos. 2013/14001-9 and 2013/07276-1; CEPOF—CEPID Program), and the partnership with MMOptics. The author's have confirmed that any identifiable participants in this study have given their consent for publication.

Conflict of interest

The authors declare no conflicts of interest.

References

[1] May M and Klein S R 1991 Differential diagnosis of facial nerve palsy *Otolaryngol. Clin. North Am.* **24** 613–45
[2] Grosheva M, Beutner D, Volk G F, Wittekindt C and Guntinas-Lichius O 2010 Idiopathic facial palsy *HNO* **58** 419
[3] Teixeira L J, Valbuza J S and Prado G F 2011 Physical therapy for Bell's palsy (idiopathic facial paralysis) *Cochrane Database Syst. Rev.* 1–57
[4] Lockhart P, Holland N J, Swan I and Teixeira L J 2011 Interventions for Bell's palsy (idiopathic facial paralysis) *Cochrane Database Syst. Rev.* 1–9
[5] Ordahan B and Yavuz Karahan A 2017 Role of low-level laser therapy added to facial expression exercises in patients with idiopathic facial (Bell's) palsy *Lasers Med. Sci.* **32** 931–6
[6] Anders J J, Borke R C, Woolery S K and Van De Merwe W P 1993 Low power laser irradiation alters the rate of regeneration of the rat facial nerve *Lasers Surg. Med.* **13** 72–82
[7] Yamada H, Yamanaka Y, Orihara H and Ogawa H 1995 A preliminary clinical study comparing the effect of low level laser therapy (LLLT) and corticosteroid therapy in the treatment of facial palsy *Laser Ther.* **7** 157–62
[8] Fontana C R and Bagnato V S 2013 Low-level laser therapy in pediatric Bell's palsy: case report in a three-year-old child *J. Altern. Complement. Med.* **19** 376–82
[9] Kneebone W J 2010 Enhancement of nerve regeneration by therapeutic laser *Pract. Pain Manag.* **10** 70–72
[10] Volpi A A A 2017 Análise da eficácia da vacuoterapia no tratamento do fibro edema gelóide por meio da termografia e da biofotogrametria *Fisioter. Bras.* **11** 70–77
[11] Falaki F, Nejat A H and Dalirsani Z 2014 The effect of low-level laser therapy on trigeminal neuralgia: a review of literature *J. Dent. Res. Dent. Clin. Dent. Prospects* **8** 1
[12] Ozen T, Orhan K, Gorur I and Ozturk A 2006 Efficacy of low level laser therapy on neurosensory recovery after injury to the inferior alveolar nerve *Head Face Med.* **2** 3
[13] Alayat M S M, Elsodany A M and El Fiky A A R 2014 Efficacy of high and low level laser therapy in the treatment of Bell's palsy: a randomized double blind placebo-controlled trial *Lasers Med. Sci.* **29** 335–42
[14] Midamba E D and Haanaes H R 1993 Low reactive-level 830 nm GaAlAs diode laser therapy (LLLT) successfully accelerates regeneration of peripheral nerves in human *Laser Ther.* **5** 125–9
[15] Metelitsa A I and Rao J 2011 Cellulite pathophysiology and treatment *Disord. Fat Cellulite Adv. Diagnosis Treat.* **14** 183