International Journal of Health Sciences
December 2023, Vol. 11, No. 2, pp. 25-31
ISSN: 2372-5060 (Print), 2372-5079 (Online)

Published by American Research Institute for Policy Development
DOI: 10.15640/ijhs. v11n2a3
URL: https://doi.org/10.15640/ijhs.v11n2a3

Clinical Treatment with Photobiomodulation Combined with Vacuum Therapy in Temporomandibular Disorders

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Abstract

Background: Temporomandibular disorder (TMD) may occur in all age groups. Noninvasive and nonpharmacological treatments are desired, mainly, for long-term care. **Objective**: The purpose of the present study was to investigate the synergic effects of photobiomodulation combined with the vacuum therapy on pain, full range of mandibular motion and quality of life in patients with TMD. **Materials and methods**: A clinical trial was performed. Fourteen patients with TMD participated in this study. The device of photobiomodulation and vacuum therapy was used for treatment at 3 regions on face: temporomandibular joint, anterior fibers of the temporal muscle and entire extension of the masseter muscle. The treatment was performed twice a week for 4 weeks, totaling 8 sessions. Measurements of pain intensity and range of mandibular motion during maximum mouth opening were carried out at three moments: T0 = pretreatment, T1 = post-treatment, and T2 = 15 days after termination of the treatment. Oral health-related quality of life measures was performed during T0 and T1. **Results**: The pain intensity was significantly reduced for the right and left side of the masseter and temporal muscles as well as the mouth opening was significantly enhanced after the last session (T1) and 15 days after the last session (T2). In addition, oral health-related quality of life was significantly improved. **Conclusion**: The synergistic treatment of photobiomodulation and vacuum therapy was effective to produce better outcomes in terms of reduced pain, increased mandibular range of motion and improved quality of life in patients with TMD. Moreover, its beneficial effects persisted for at 15 days after the end of treatment.

Keywords: Photobiomodulation; Vacuum Therapy; Temporomandibular Joint Disorders

1. Introduction

Temporomandibular disorder (TMD) is a complex pathology, and its pathogenesis is still not well defined.[1]TMD isa disease of the stomatognathic system and is included in list of musculoskeletal diseases, due to dysfunction of temporomandibular joints (TMJ) and masticatory muscles. In addition, TMD can occasion chronic orofacial pain, characterized as myofascial pain and/or arthralgia.[2]

This disease is usually related to anatomical abnormalities, joint trauma, joint overload, and psychological factors.[3]Several studies have found a correlation between the occurrence and development of TMD with psychological factors, such as anxiety, depression, and stress.[4,5]

TMD may occur in all ages, in this context, the prevalence of TMD among the population, is 31% for adults/elderly and 11% for children/adolescents with a peak occurring at the age of 20 to 40 years.[6,7] In addition, an important aspect to be highlighted is that orthodontic patients show a prevalence of TMD varying from 21.1 to 73.3%.[8]

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Managing TMD includes the analgesic, anti-inflammatory and muscle-relaxant drugs or minimally invasive procedures (e.g., corticosteroids, hyaluronic acid, platelet-rich plasma, and botulinum toxin) for acute pain and/or loss of function[9], but it may be an inappropriate treatment for long-term care. Then, noninvasive and no pharmacological treatments are desired, such as, occlusal splints, therapeutic exercise, massage, acupuncture[2], photobiomodulation, ultrasound therapeutic[10] and copping therapy.[11]

The purpose of the present study was to investigate the synergic effects of photobiomodulation combined with the vacuum therapy on pain, full range of mandibular motion and quality of life in patients with TMD.

2. Materials and Methods

The procedure involving human subjects was approved by a research ethics committee of the São Carlos Hospital in São Carlos city, SP, Brazil (CAAE09096219.0.0000.8148 with approval no.3.244.307). The research was registered on the International Clinical Trial Registry Platform (ICTRP - UTN U1111-1266-6024) and *Registro Brasileiro de Ensaios Clínicos* (REBEC - RBR-4g6dc35) platforms. All subjects signed informed consents documents prior to the study. The inclusion criterions were volunteers of both genders with TMD according to the Research Diagnostic Criteria for Temporomandibular Disorders (DC/TMD). Volunteers undergoing any other type of dental or physical treatment as well as using analgesic, anti-inflammatory or muscle relaxant drugs were excluded. Eighteen voluntaries were enrolled in clinical trials, but four were excluded. Fourteen voluntaries participated in this study.

Treatment

The treatment was carried out with the Vacumlaser® device (MMOptics, São Carlos, SP, Brazil). This device includes3 lasers at wavelengths of 660 nm (red) and 3 lasers at wavelengths 808 nm(infrared). The average power of each laser was 100 mW, which have been applied in non-contact mode. The negative pressure(suction) was applied in pulsed mode (40 pulses per minute) with ranges between-100 and-150 mbar. A suction cup of 40 mm diameter and vegetable oil were used. Photobiomodulation and vacuum therapy were applied at the same time.

The device was performed in the scanning mode at 3 regions on face: temporomandibular joint, anterior fibers of the temporal muscle and entire extension of the masseter muscle. Each region was treated for 120 seconds. The treatment was performed twice a week for 4 weeks, totaling 8 sessions. The laser energy was 72 J per region, 216 J per session and 1728 J per treatment course (**FIGURE 1and 2**). Measurements of pain intensity and range of mandibular motion during maximum mouth opening were carried out at three moments: T0 = pretreatment, T1 = post-treatment, and T2 = 15 days after termination of the treatment. Oral health-related quality of life measures was performed during T0 and T1.

Pain Measurement

According to DC/TMD[10,12,13], visual analogue scale (VAS) was used to assess pain intensity in period in period pre- and post-treatment via manual palpation on the muscles temporal and masseter, and temporomandibular joint. The range for intensity pain was from 0 to 3 (0 for no pain, 1 for mild pain, 2 for moderate pain and 3 for severe pain).

Range of Mandibular Motion

The millimeter-sized ruler was used to measure maximum mouth opening (vertical distance). The ruler was placed between the incisal edge of the maxillary central incisor and the labio-incisal edge of the opposing mandibular incisor.[14]

Oral Health-Related Quality of Life Measurement

Oral Health Impact Profile (OHIP-14) questionnaire was performed in period in period pre- and post-treatment. The questionnaire scores were: 0 for never, 1 for rarely, 2 for sometimes, 3 for often, and 4 for always. The total score is inversely related to the quality of life (lower total score indicates better quality of life).[10,13,15]

2.2*Statistical Analysis*

The data were expressed as mean ± standard deviation (SD). To verify the data normality and the homogeneity of variances, the Shapiro–Wilk and Levene's tests were used. To analyze the effects intervention a two-way analysis of variance (two-way ANOVA) was applied followed by Tukey post hoc test. The significance level was set at 5 % ($p < 0.05$). For the statistical analysis, Statistica for Windows 7 (StatSoft Inc., Tulsa, OK) was used.

3. Results

There was a significant reduction of pain score for the right and left side of the masseter and temporal muscles after the last session (T1) and 15 days after the last session (T2) as well as there was a significant enhance of maximum buccal opening (**TABLE 1**). In addition, there was significant improvement in quality of life, with a lower score indicating a better quality of life (**TABLE 2**).

4. Discussion

The main results of our study were reduced pain, enhanced range of jaw motion and improvement of life quality in patients with TMD treated with combined therapy (photobiomodulation and vacuum therapy). Studies were performed with photobiomodulation therapy[16-20] or copping therapy [21-24] for TMD. Nadershah et al.[18] found reduced pain in patients with TMD that received 5 sessions of infrared laser applied every 48 h for 10 days compared with the sham laser group as evaluated by VAS. Another study performed by Del Vecchioet al.[19] also found reduced pain when infrared laser was applied twice a day for seven consecutive days in patients with TMD compared with placebo group. In the study of Aisaitiet al.[20], infrared laser was applied once a day for 7 consecutive days in patients with TMD, resulting in reduced pain and improvement of the mechanical sensitivity in patients with TMJ arthralgia while there was greater range of jaw movements in patients with masseter myalgia. Differently, Herpich et al.[17] performed intraoral photobiomodulation using a laser cluster with red and infrared wavelength during 6 sessions twice a week, which resulted in reduced pain e enhanced range of jaw motion in patients with TMD compared with sham laser group.

These benefits are related to modulation of inflammation and pain. Ferrara-Jr et al.[16] investigated the effects of red laser on the pain sensitivity and inflammatory process in rats submitted to an experimental model of TMD for 21 days. These authors found decrease of the mechanical sensitivity of rats and reduced inflammatory response evidenced by lesser inflammatory infiltrate in the masseter muscle as well as by a central inhibition of fractalkine in the trigeminal ganglion.[16]

Photobiomodulation is a form of light therapy that utilizes several light sources, such as laser, LED and lamp. However, laser is more advantageous due to special characteristic of light: monochromatic, coherent and collimated. In particular, the coherence favors therapeutic effects due to presence of laser speckles in biological tissue[26,26] and greater penetration.[27] Vacuum therapy is characterized by the application of a cup that generates negative pressure through a vacuum mechanism. Regarding to cupping therapy is an ancient method, characterized by a simple procedure in which negative pressure is applied to the skin through sucking cups.[28] This treatment promotes therapeutic effects, including the anti-inflammatory and analgesic action, as well as lymphatic drainage and myofascial release.[29,30]

Han, Guo and Xia[22] founded that the combination of needle acupuncture, medication and cupping therapy significantly reduced craniomandibular index, dysfunction index, palpation index and intensity of pain. In another study, Serritellaet al.[11] compared different acupuncture methods for TMD treatment, among them body needle acupuncture, electro acupuncture, and needle acupuncture combined with cupping therapy. All methods were effective for reduction of pain and improvement of quality of life. However, these studies focus on the effect of effectiveness of acupuncture.[11,22]

Sajedi et al.[31] conducted a comparative study between the laser puncture (808 nm, continuous mode, 0.5 W, 30 J, 4 J/cm^2, 60 seconds) and cupping therapy carried out in 60 patients with TMD. The therapies were applied on each trigger point on the face during 8 sessions. The authors found that both techniques were equally effective for the treatment of myofascial pain dysfunction syndrome in TMD patients, which showed reduced pain and improved maximum mouth opening.[31] However, only one study of case report was performed with photobiomodulation and vacuum therapy at the same time for feasibility, safety, and preliminary proof of principles in patients with TMD.[32] Moreover, another case report was performed for the treatment of facial nerve palsy. In this study, Panhoca, Nogueira and Bagnato[33] showed the recovery of movements and the return of facial symmetry promoted by synergic application of photobiomodulation and vacuum therapy.

A clinical trial for neurological rehabilitation also was performed with synergic treatment of photobiomodulation and vacuum therapy in patients with Parkinson's disease. In this study, Tamae et al.[34] found reduced pain and improved quality of life. Another study, Lopes et al.[35] applied the same combined therapy for physical rehabilitation of patients with low back pain, shoulder bursitis and hip dysfunction, resulting in reduction of pain, muscle relaxation and enhanced range of movement. Photobiomodulation[16] and vacuum therapy[36] promote effects anti-inflammatory and analgesic. In addition, vacuum therapy is a mechanical stimulus to potentiate laser therapy, leading to synergistic effects.

5. *Conclusion*

The synergistic treatment of photobiomodulation and vacuum therapy was effective to produce better outcomes in terms of reduced pain, increased mandibular range of motion and improved quality of life in patients with TMD. Moreover, its beneficial effects persisted for at 15 days after the end of treatment.

Acknowledgments

We would like to thank the by the Financier of Studies and Projects (FINEP) – Grant no. 01.13.0430-00, the São Paulo Research Foundation (FAPESP) - grant no. 2013/14001-9 and 2013/07276-1 (CEPOF – CEPID Program), the National Council for Scientific and Technological Development (CNPq) - grant no. 465360/2014-9 (INCT Program), and the Productivity Research Scholarship Program (PQ/UEMG) - grant no. 06/2021 and 10/2022.

Conflict of interest statement No competing financial interests exist.

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TABLE 1: Statistical results of the face pain intensity and range of mandibular motion

	Before the first session (T0)		After the last session (T1)		15 days after the last session (T2)	
Pain Score	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**
Masseter Palpation	2.4±0.8	2.2±0.87	0.4±0.66[a]	0.6±0.66[a]	0.5±0.67[a]	0.5±0.67[a]
Temporal Palpation	1.5±0.87	1.8±1.0	0.5±0.92[b]	0.4±0.91 [b]	0.3±0.45[b]	0.6±0.91[b]
Joint Temporomandibular	1.5±1.0	1.3±1.0	0.5±0.67	0.4±0.66	0.4±0.80	0.5±0.80
Range of Motion (mm)						
Maximum Buccal Opening	32.7±4.56		42.6±5.2[c]		43.3±6.75[c]	

[a]versus T0 p<0,001 [b]versus T0 p<0,05; [c]versus T0 p<0,01

TABLE 2: Statistical results of the oral health impact profile.

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	Before the first session (T0)	After the last session (T1)
Functional limitation	1.5±2.12	0.90±1.59
Physical pain	5.1±1.91	3.1±2.47
Psychological discomfort	5.3±1.94	3.4±2.54
Physical limitation	2.9±2.18	1.2±1.55
Psychological limitation	4.4±1.84	2.5±2.32
Social limitation	1.4±2.19	1.5±1.58
Disability	2.1±1.44	1.2±1.47
Total	22.90±8.92	13.90±10.51[a]

[a]versus T0 p<0,001

FIGURE 1. Clinical application with Vacumlaser® on the muscles temporal = TM and masseter = MM, and temporomandibular joint = TMJ.

FIGURE 2. Clinical procedure with Vacumlaser®.