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Phototherapy on the Treatment of Burning Mouth Syndrome: A Prospective Analysis of 20 Cases

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ABSTRACT

The aim of this study was to report the effect of laser phototherapy (LPT) on the treatment of burning mouth syndrome (BMS). This prospective clinical study reports on preliminary outcomes of twenty volunteers diagnosed with BMS who have undergone the conventional treatment prior to laser phototherapy. LPT consisted of weekly sessions of LPT (660 nm), for a period of 10 weeks. The laser protocol consisted of the following parameters: 40 mW, 10 J cm^2 and 0.4 J per point, irradiation time of 10 s. In all sessions, the burning intensity was evaluated with a 10 cm Visual Analogue Scale (VAS). The burning intensity evaluation by VAS was performed immediately before and after each LPT session. Nonparametric test of Wilcoxon was used for statistical analysis, considering a significance level of 5%. All volunteers reported reduced burning intensity in all sessions when compared to the previous one and reduction in VAS scores by up to 49% in the last clinical session when compared to the first session. When only the VAS baseline of the first session was compared with the consecutive sessions, there was a statistically significant reduction in VAS scores in almost all sessions. The LPT may be an alternative treatment for the relief of oral burning symptoms in patients with BMS.

INTRODUCTION

The burning mouth syndrome (BMS) constitutes a distinct clinical entity in which any abnormalities are absent in the oral mucosa, characterized by burning and pain in the affected region (1,2). Some authors tend to use names other than BMS, such as glossodynia, glossopyrosis, stomatopyrosis, estomatodinia and oral dysesthesia (3).

Although there is no study on the prevalence of BMS in the Brazilian population, it is known that the syndrome affects about 5% of Brazilian women, particularly women of middle age (4) in postmenopause (2,5). The most commonly affected area is the tongue, especially in the anterior region, followed by the lips, hard palate, buccal mucosa and oropharynx (6). In most cases, the distribution of the burning sensation is bilateral, although it does not follow anatomical boundaries.

Despite numerous previous studies, the etiology of BMS remains unknown. Among the possible causes of this condition, psychogenic factors, systemic hormones, local irritants, drugs and hyposalivation are cited (2,7–9). Because it consists on an entity of challenging diagnosis, it is of great importance that the professional who has contact with patients reporting BMS performs an appropriate clinical examination and a very careful and detailed record of their medical history to establish the diagnosis and a correct therapeutic (10).

Currently, many studies show that phototherapy with low power lasers can promote analgesia, cell biomodulation, fibroblast proliferation, collagen synthesis and regeneration of bone and nerve tissues, with significant clinical and histological changes on irradiated biological tissues during the inflammatory and healing processes (1,3,10,11). With the use of laser phototherapy on the treatment of BMS, symptoms of burning are reported to decrease, providing pain relief and control of the inflammatory process (12). Recent studies have shown that the therapeutic effects can be reported by the patient immediately after the irradiation (12,13). Also, laser acupuncture (660 nm) has also been reported showing that the technique might be useful in patients with BMS (14).

Therefore, the current study aimed to report a preliminary prospective analysis of 20 cases of BMS where a standardized protocol of laser phototherapy (660 nm) was undertaken for the treatment of BMS symptoms.

PATIENTS AND METHODS

This study was conducted at the School of Dentistry of the Federal University of Pernambuco (UFPE). Ethical approval for the research project was granted by the local Ethics Committee (Protocol CEP/CCS/UFPE # 454/11). All volunteers signed a Consent Form advising them that the data from the clinical procedure were collected by the UFPE and were to be used for research proposes, although patient anonymity was protected.

Study participants were volunteers who, after conducting detailed history and complete medical records, showed symptoms of BMS, but did not show any evidence of oral lesions, their laboratory tests showed no significant changes and they underwent treatment for 21 days with antifungal therapy in order to eliminate the possible presence of fungus. Volunteers 0–17 years of age and patients with Sjögren's syndrome were not included in the study .

Twenty volunteers diagnosed with burning mouth syndrome (BMS), adults of both genders, sorting through the Clinic of Stomatology of the

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School of Dentistry of the Federal University of Pernambuco (UFPE), were considered.

Each volunteer underwent a complete clinical record containing: personal data, main complaint, history of present illness, personal history, family history, salivary flow and laboratory examination (blood count and fasting glucose), and finally, an anamnesis to be analyzed carefully in order to exclude burning sensation associated with systemic diseases such as hematologic diseases, thyroid and diabetes mellitus. It was also observed that vitamin B serum, iron, glucose and thyroid hormones in previous studies have reported their relation to BMS (3,15–18). No systematic abnormalities were observed. The data contained in medical records of volunteers were used to conduct a survey in order to evaluate the prevalence of BMS in volunteers who were considered in this preliminary clinical study. The items considered were: age, gender, duration of the symptomatology and areas affected by the BMS.

In all volunteers, the oral examination revealed healthy oral mucosa, with no clinical signs that could cause symptoms of burning mouth, such as infections, hyposalivation, lichen planus, benign migratory glossitis, allergic reaction, parafunctional habits or inadequate dentures.

Initially, volunteers were submitted to conventional treatment established by the Dental Service of the UFPE, consisting of 21 days of antifungal treatment to rule out the presence of *Candida albicans* (especially in volunteers using prostheses), use of artificial saliva[1] (Compounding Pharmacy of the Federal University of Pernambuco (UFPE), Recife, PE, Brazil), 2% pilocarpine (Allergan, Guarulhos, SP, Brazil – 3 to 5 drops sublingually, three times per day) associated with the use of lip balm (Essential Care, Nivea, São Paulo, SP, Brazil) and 1 mg clonazepam (topically, 3 min in place of stinging, three times per day). Also, instructions for oral hygiene were given. If a significant psychological situation was present, fluoxetine was prescribed 20 mg (01 capsule per day, for 30 days) and subsequent referring to the psychiatrist. All procedures described above occurred in a time interval of approximately two and a half months, with periodic returns every 15 days, to reassess the symptomatology using the Visual Analogue Scale (VAS).

Following conventional treatment without significant improvement on the reduction of sensibility (with an interval of 7–10 days), volunteers were then submitted to laser phototherapy, using a laser device with a wavelength of 660 nm (Laser Hand, MMOptics, São Carlos, SP, Brazil), with the following parameters: spot size of 0.04 mm^2, average power (output) of 40 mW and 0.4 J per irradiation point, energy density of 10 J cm^2, irradiation time of 10 seconds per point and the irradiation points distributed between the locations referred to as the most painful symptomatology (13). The irradiations were performed at intervals of 7 days (1 session per week) until completion of 10 sessions, and in contact with the soft tissue, with a distance of approximately 1 cm between them. Prior to irradiation of each point, the most affected area was cleaned and dried with gauze.

The evaluation of burning mouth symptoms was performed with the aid of a Visual Analogue Scale (VAS) (19), as volunteers were instructed to mark on the scale the degree of pain evaluated in the region (0 – no pain, 10 – severe pain). The assessment of the burning symptoms was done at the volunteer's first visit and after each biweekly periodic return (15, 30, 45, 60 and 75 days), after the use of the proposed treatment (artificial saliva for 15 days, 15 days of pilocarpine, 15 days of clonazepam associated with oral hygiene and final 30 days of fluoxetine). When conducting the laser phototherapy sessions, volunteers were asked again to score on the VAS before and immediately after the irradiation sessions, one per week (recorded as S1, S2, S3, S4, S5, S6, S7, S8, S9 and S10). Evaluations were performed immediately before and after irradiation, during 10 sessions of LPT.

Data obtained from volunteers' records were registered on spreadsheets (Microsoft Office Excel, Microsoft Corporation, Redmond, WA) and analyzed by a single professional. Data were statistically analyzed using the Wilcoxon test (nonparametric) using SPSS (version 13.0) for Windows. It was considered a significance level of 5%.

RESULTS

The clinical data regarding patients' age and gender, duration of the symptomatology (months) and areas affected by the BMS are described in Table 1. The average age of volunteers diagnosed with BMS was 63.2 years (ranging from 48 to 78 years), affecting mostly females (85%). The tongue was the most commonly affected area (85%), followed by the lips, buccal mucosa and hard palate. The mean duration of symptoms was 18.4 months (ranging between 1 and 96 months).

In assessing the symptoms reported by the volunteers undergoing the conventional treatment, the mean pain reduction at day 75 was of 0.3 points, which represents a 4% reduction compared to the initial appointment. All values obtained for the 20 volunteers from their first session until their last day of follow-up are shown in Table 2.

All values obtained using the VAS scale before and after irradiation for each volunteer are shown in Table 3. Considering the mean difference of initial and final values obtained with the VAS at each session, values that represent the percentage of reduction in the symptoms of BMS immediately after laser irradiation was also obtained. The average reduction in symptoms was 28% in session 1 (S1), 27% in S2, 32% in, S3, 30% in S4, 40% in S5, 38% in S6, 34% in S7, 38% in S8, 42% in S9 and 49% in S10. When only the VAS scores obtained before irradiation were considered and the comparison was made between the first session and all the other 9 sessions (W1), a statistically significant improvement was observed in the second session ($P = 0.009$), third session ($P = 0.001$) and the fourth session to the tenth ($P = 0.000$). Comparing sessions with each other (W2), there was a statistically significant pain reduction in S2 ($P = 0.009$) and S3 ($P = 0.001$). In S4 ($P = 0.340$), in S5 (0.554), in S6 ($P = 0.007$), in S7 ($P = 0.207$), in S8 ($P = 0.218$) in S9 ($P = 0.149$) and S10 ($P = 0.176$), there was no statistically significant pain reduction.

The numeric results of the difference between VAS values before each irradiation and immediately after it, in each session, are described in Table 4. A reduction in BMS symptoms that ranged from 1.8 to 2.5 points for each session was obtained that generated a final overall average of 2.0 points. Similarly, as

Table 1. Data collected from medical records of volunteers.

Volunteer	Age (years)	Gender*	Symptomatology (affected area)†	Duration of Symptomatology (months)
1	74	F	L, OM, T	24
2	66	M	L, T	6
3	59	F	T	12
4	78	F	T	24
5	64	F	L, HP	12
6	59	F	T	6
7	78	F	L, OM, T	12
8	53	F	L	6
9	63	F	L, T	4
10	64	F	L, T	12
11	64	F	L, T	24
12	76	M	L, T	18
13	63	F	L, T	1
14	58	F	T	24
15	56	F	L, T	96
16	59	M	T	48
17	71	F	T	3
18	56	F	T, HP	12
19	56	F	T	12
20	48	F	L, T	12

*M, Male; F, Female/†T, Tongue; L, Lip; OM, Oral mucosa; HP, Hard palate.

[1]Composition: sodium chloride 0.67 g, magnesium chloride 0.04 g, potassium phosphate 0.27 g, calcium chloride 0.12 g, Nipagin® 0.01 g, Nipasol® 0.1 g, carboxymethylcellulose 8 g, sorbitol 24 g, purified water q.s. 1000 mL.

Table 2. VAS Scores obtained from volunteers during the conventional treatment, at each clinical return, every 2 weeks.

Treatment						
Volunteer	Initial appointment	Artificial saliva (15 days)	Pilocarpine (30 days)	Clonazepam (45 days)	Fluoxetine (60 days)	Fluoxetine (75 days)
1	8	8	8	9	9	9
2	6	6	5	6	6	6
3	6	6	6	6	6	6
4	9	8	8	8	8	8
5	6	6	6	6	6	5
6	6	6	6	6	6	6
7	10	8	9	8	8	8
8	9	10	10	9	9	9
9	10	10	10	10	10	10
10	10	10	10	10	9	9
11	10	10	9	10	10	10
12	9	9	9	9	9	9
13	8	8	8	7	7	7
14	8	8	7	8	8	8
15	8	8	8	7	8	8
16	5	8	7	7	7	7
17	7	7	7	7	7	7
18	7	7	6	6	6	6
19	8	8	8	7	7	7
20	10	10	10	9	9	9
Mean	8	8.05	7.85	7.75	7.75	7.7
Reduction in VAS scores		−0.05	0.15	0.25	0.25	0.3
Reduction in VAS (%)		−1%	2%	3%	3%	4%

Table 3. Reference values of the VAS scores before (left) and immediately after (right) irradiation with low power laser. Scores obtained for each volunteer during 10 treatment sessions.

	Sessions									
Volunteer	1	2	3	4	5	6	7	8	9	10
1	8-5	7-5	7-4.5	6-5	6-4	6-3	4-3	4-2	3-1	2-0
2	6-5.5	6-4	6-5	6-5	4-3	5-4	3-2	3-2	3-2	3-2
3	6-5	6-5	6-5	6-4	4-3	4-3	3-2	3-2	3-2	2-0
4	8-5	8-4	7-3	7-3	10-3	8-3	7-2	8-1	8-2	9-2
5	6-5	5-4	4-3	3-1.5	5-4	3-2	2-1.5	2-1.5	5-3.5	2-1.5
6	6-4	5-4.5	4-3	4-3	4-3	5-4	4-4	4-3	6-5	6-3
7	8-7	7-6	6-5	10-7	7-5	7-6	7-6	8.5-6	6-5	8-6
8	10-4	10-8	10-8	8-7	7-5	6-4	10-8	10-8	9-6	6-4
9	10-7	9-5	7-5	7-3	7-3	5-3	5-4	5-3	4-1	4-1
10	10-8	10-8	9-7	8-7	8-4	6-3	10-5.5	4-2	4-2	2-1
11	10-8	8-6	5-3	4-2	9-7	8-5	9-7	9-7	7-4	7-3
12	9-5.5	8.5-6	7-4	7-5	10-7.5	10-9	9-6	10-8	6-3.5	8-5.5
13	8-7	6-5	3-2	5-4	8-6	6-5	5-4	4-3	4-3	2-1
14	8-5	8-5	7-5	6-5	6-3	6-4	5-4	4-3	4-3	4-3
15	8-5	8-6	6-4	6-5	6-3	5-3	5-2	4-3	3-1	2-1
16	8-3	3-1	2-1	2-1	2-0	2-0	1.5-1	1.5-1	2-1	2-1
17	7-6	7-6	5-3	5-2	5-1	4-2	4-2	3-1	2-1	2-1
18	7-6	5-2	3-0	3-1	4-2	4-2	4-2	3-1	4-2	4-2
19	8-6	8-7	8-6	7-6	8-6	6-2	5-2	4-2	3-2	2-1
20	10-8	10-8	10-6	9-7	5-2	4-1	4-2	3-1	2-1	2-1
Reduction on Symptoms (%)	28%	27%	32%	30%	40%	38%	34%	38%	42%	49%
W1		0.009*	0.001*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
W2		0.009*	0.001*	0.340	0.554	0.007*	0.207	0.218	0.149	0.176

W1 = comparison of VAS scores before irradiation. Comparison between the first session and the other laser sessions. W2 = comparison between laser sessions. * means significant statistical differences.

described above, comparing these numbers of the first section (S1) with the following sections (W3), there was no statistically significant reduction in the second session S2 ($P = 0.638$), in S3 ($P = 0.336$), in S4 ($P = 0.180$), in S5 ($P = 0.296$), in S6 (0.812) in S7 ($P = 0.253$), in S8 ($P = 0.146$) in S9 ($P = 0.099$) and S10 ($P = 0.369$). When comparing the evaluation at each session

Table 4. Results of the numerical difference between the VAS values of initial (before each irradiation) and immediately after irradiation, in each session.

	Sessions									
Volunteer	1	2	3	4	5	6	7	8	9	10
1	3	2	2.5	1	2	3	1	2	2	2
2	0.5	2	1	1	1	1	1	1	1	1
3	1	2	1	2	1	1	1	1	1	2
4	4	1	4	4	7	5	5	7	6	7
5	1	5	1	1.5	1	1	0.5	0.5	1.5	0.5
6	2	1	1	1	1	1	0	1	1	3
7	2	0.5	1	3	2	1	1	2.5	1	2
8	5	1	2	1	2	2	2	2	3	2
9	3	2	2	4	4	2	1	2	3	3
10	2	4	2	1	4	3	4.5	2	2	1
11	2	2	2	2	2	3	2	2	3	4
12	3.5	2	3	2	2.5	1	3	2	2.5	2.5
13	1	2.5	1	1	2	1	1	1	1	1
14	3	1	2	1	3	2	1	1	1	1
15	3	3	2	1	3	2	3	1	2	1
16	2	2	1	1	2	2	0.5	0.5	1	1
17	1	2	2	3	4	2	2	2	1	1
18	1	1	3	2	2	2	2	2	2	2
19	2	3	2	1	2	4	3	2	1	1
20	2	1	4	2	3	3	2	2	1	1
M.D	2.2	2.0	2.0	1.8	2.5	2.1	1.8	1.8	1.9	2.0
W3		0.638	0.336	0.180	0.296	0.812	0.253	0.146	0.099	0.369
W4		0.638	0.834	0.382	0.010*	0.099	0.297	1.000	0.934	0.564
W5		0.190	0.002*	0.001*	0.003*	0.000*	0.000*	0.000*	0.000*	0.000*

Statistically significant differences. W3 = comparison of VAS scores of the first session (S1) with the following sessions. W4 = comparison between sessions. W5 = comparison between the period of the conventional treatment with the period in which volunteers underwent laser therapy. M.D., mean difference. * means significant statistical differences.

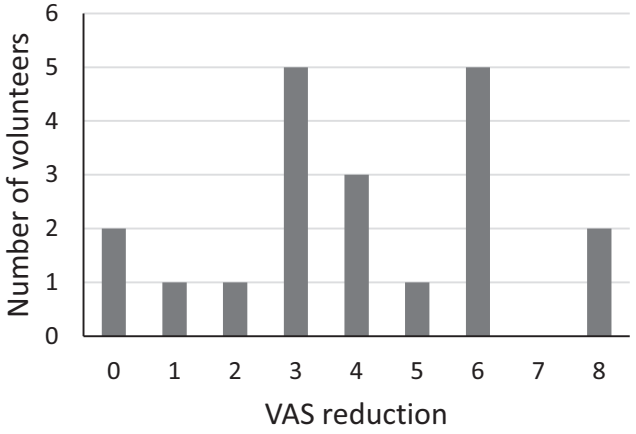

Figure 1. Numerical differences between the VAS scores on the beginning of the experimental phase and before each session of LPT.

with each other (W4), there was a statistically significant improvement in S5 ($P = 0.010$). Comparing the period of the conventional treatment with the period in which volunteers underwent laser phototherapy (W5), there was a statistically significant improvement in S3 ($P = 0.002$) in S4 ($P = 0.001$), S5 ($P = 0.003$), in S6 ($P = 0.000$), in S7 ($P = 0.000$), in S8 ($P = 0.000$) in the S9 ($P = 0.000$) and S10 ($P = 0.000$). Figure 1 depicts the VAS scores obtained from the first irradiation until the last LPT session, for all volunteers.

It was observed that from 20 volunteers, 02 had no reduction in VAS score, 01 reduced 1 point in VAS scale, 01 fell 2 points in VAS, 05 volunteers reduced 03 points in the VAS, 03 volunteers reduced 4 points in the VAS, 01 volunteer reduced VAS score 5, 05 volunteers decreased 06 points in VAS and 02 volunteers decreased 8 points in VAS.

DISCUSSION

The etiology of BMS is doubtful and there is little scientific evidence that supports an effective treatment (10,13). Studies show that the pathogenesis of this condition is complex and, in most cases, seems to involve several factors: local, systemic and psychogenic (2,10). Thus, although some proposed treatment have shown good control of the symptoms, this issue remains inconclusive. In the absence of factors with possible association with the BMS, pharmacologic therapy has been suggested. Drugs used include antifungals, antibiotics, corticosteroids, analgesics, sialagogs, vitamin complexes, benzodiazepines, antidepressants, antihistamines and hormonal replacement therapy (20).

The pathophysiology of BMS includes local environmental factors, salivary gland dysfunction, changes in mucosal blood flow, peripheral nervous system disorder and psychosocials aspects (2). For this reason, in this study, a careful preliminary clinical evaluation was conducted, and a historical survey of the medical and dental history of the volunteers, and no systematic abnormalities were observed.

The findings of this clinical study reinforce the findings of Bergdahl and Anneroth (21) concerning the prevalence of the BMS, wherein volunteers diagnosed with the syndrome were mostly middle-aged women (above 50 years) in postmenopausal stage and with greater involvement on the tongue.

Analyzing the anterior third of the tongue of volunteers with BMS, some authors observed a significant decrease in the

density of epithelial nerve fibres, featuring a small fibre sensory neuropathy of the trigeminal. Furthermore, a decrease in the density of unmyelinated nerve fibers within the epithelium was observed, as well as morphological axonal diffuses (22). Also, BMS volunteers presented a blood flow significantly lower than the healthy volunteers. According to these authors, the laser irradiation on stellate ganglion inhibits sympathetic activity, which probably increases blood flow resulting in pain relief (23). In the cited study, most volunteers complained of burning sensation on the tongue, and while laser phototherapy was associated with the use of lip balm and clonazepam for 21 days, there was no improvement in burning symptoms. The findings of the present study, however, have shown that the average reduction in symptoms in volunteers when undergoing the conventional treatment was lower (4%) than that from the period when they were subjected to irradiation (27–49%) and, comparing the VAS results, there was a significant symptom reduction from the third session of LPT until the last session. It was verified that LPT exceeds the outcomes obtained during the conventional treatment with medication and, therefore, constitutes a promising alternative to control the symptoms of BMS, as some studies have also reported (11,24).

Currently, LPT is considered a safe therapeutic with a range of specific clinical indications (11). The laser effects are confirmed by numerous *in vitro* studies, including increased production of intracellular energy, activation of collagen fibers, fibroblast activation, formation of specific enzymes that help local microcirculation and the lymphatic system (11,25). It was reported that LPT is able to decrease the symptoms of burning, providing pain relief and control of the inflammation (10,11,13).

In the present clinical study, after initiation of the drug treatment (two and a half months) and without satisfactory relief of symptoms (100% of the cases), volunteers were treated with LPT, reaching positive results in controlling symptoms. There was a mean percentage reduction in pain intensity for up to 49%, reported at the tenth session of LPT. The scores assessed before the laser irradiation significantly reduced after the first session of laser phototherapy, showing the potential of LPT to treat the symptoms of BMS. Similarly, some authors found an 80.4% decrease in burning sensation after three sessions of LPT (790 nm, 6 J cm^2, 120 mW) and, despite a partial return of symptoms after 6 weeks, its intensity remained lower than the initial symptoms (26).

A recent study conducted by Santos *et al.* (13) evaluated 10 patients undergoing treatment with low power laser (660 nm), with the same parameters and methodology considered in this study, and obtained positive results in the control of burning mouth symptoms. The authors reported a reduction in 58.2% in the volunteers' symptoms, after ten sessions of LPT. Other studies have also been conducted varying the laser parameters, number of LPT sessions and wavelengths (27,28) and despite the differences between them, the benefits of using the LPT was always reported.

When the success or remission of symptoms are not reached after treating the local and systemic causes, psychogenic factors should be considered and carefully evaluated (29). In this study, two volunteers have reported no pain reduction and this was possibly because one of the volunteers had health problems, and showed signs of cancer phobia, and the other volunteer experienced the death of a member of his family during the period of treatment. Stressful events and social problems of longer duration are commonly reported in the literature as are related to the failure in the treatment of BMS symptoms (30).

Laser phototherapy has been used for over 30 years and more than 90% of the available literature reports positive effects. However, undesirable results may occur due to incorrect use of doses, misdiagnosis, insufficient number of sessions and also the lack of standardization of the frequency of radiation. Thus, successful treatment with the laser light also depends on not only a correct diagnosis, but also the use of correct technical parameters and irradiation (10,13,31).

Finally, it is concluded that laser phototherapy (LPT) consists of an effective alternative for treating the symptoms of burning mouth syndrome. However, further prospective, controlled, double-blinded and randomized clinical trials should be conducted to confirm the benefits of the laser phototherapy for reducing symptoms of BMS.

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