Does Low Intensity Laser Therapy Reduce Pain and Change Orofacial Myofunctional Conditions?

Melissa de Oliveira Melchior, M.S.; Giovana Cherubini Venezian, D.D.S., M.S., Ph.D.; Barbara Cristina Zanandréa Machado, M.S.; Renata Filgueira Borges, D.D.S., M.S.; Marcelo Oliveira Mazzetto, D.D.S., Ph.D.

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Address for correspondence:
Melissa de Oliveira Melchior
Av. do Café s/n,
Monte Alegre
Ribeirão Preto, SP, Brazil
CEP 14040-904
Email:
me_melchior@yahoo.com.br

ABSTRACT: Due to its multifactorial pain aspects, combined therapies are required for the the comprehensive management of temporomandibular joint disorders (TMD). Interdisciplinary forms of therapies, such as laser therapy, and health care or medical professionals, such as speech therapists, have been proposed for this comprehensive management. The aims of this study were the following: 1. verify whether low-intensity laser therapy would promote significant pain remission; 2. evaluate whether this changes orofacial myofunctional conditions in the sample, as tested, using the Orofacial Myofunctional Evaluation with Scores (OMES); and 3. evaluate whether or not the pain improvement would remain stable after a 30-day follow-up for pain conditions. The study included 12 female volunteers diagnosed with myofascial pain and ages ranging from 18 to 60 years old, with or without intra-articular TMD, according to axis I of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). Participants were assessed for pain on palpation, using a visual analogue scale (VAS), before treatment (A1), immediately after 30 days of intervention, i.e, after eight sessions of Low Intensity Laser Therapy (LILT) (A2), and 30 days after the end of the treatment with LILT (A3) (follow-up). Comparing the three evaluation times, it was observed that there was a significant decrease in the values of subjective pain to palpation ($p<0.05$). The initial pain (A1) differed significantly from the A2, but did not differ significantly from A3.

Ms. Melissa de Oliveira Melchior
received an undergraduate degree in speech and language pathology and audiology from the Faculty of Dentistry of Bauru, University of São Paulo in 1998. She subsequently received a Masters in medical science from the Faculty of Medicine of Ribeirão Preto, University of São Paulo, Brazil in 2008. Currently, she is a speech pathologist at the Dental School of Ribeirão Preto, University of São Paulo.

Functions, such as chewing, swallowing, speaking, breathing, and even resting conditions, are performed by structures that compose the stomatognathic system and are modulated by a central pattern generator (CPG) situated in the brainstem. The CPG interacts with peripheral sensory information, such as dental conditions, orofacial structures morphology, pain, physical characteristics of foods and beverages, among others, adjusting its signals to the functional demands of the real world.[1-3] It is known that the stomatognathic system has a high plasticity, or ability to generate adaptive and compensatory behaviors, according to the individual needs and physiological tolerance, to maintain their functional balance. Pain, considered an influential factor on stomatognathic system function, can also be a body's response to the disruption of functional balance.[4,5] Therefore pain, in this case, is a consequence of lost balance, but once the problem sets in, it can induce changes in the functioning of stomatognathic functions, requiring specific intervention to adapt, such as orofacial myofunctional therapy[6] for pain management.

Temporomandibular disorders (TMD) represent a clinical condition involving orofacial signs and symptoms, such as temporomandibular joint (TMJ) noises, mandibular trajectory deviation during jaw movements or limited jaw-opening, mastication muscle dysfunction, and TMJ pain.[7,8]

Although the etiology of TMD is not well-established, it is known to be multifactorial, including the presence of occlusal and traumatic factors, muscle and skeletal disorders, muscle hyperactivity, degenerative problems, habits, stress and emotional problems, which seem to reduce the adaptive capacity of the system, causing dysfunction.[5,9-11]

Due to its multifactorial aspects, interdisciplinary, i.e., combined, therapies are required[4,5] in the comprehensive management of TMD. Different forms of therapies, such as laser therapy, used as a support therapy to treat pain, and orofacial myofunctional therapy (OMT), a modality of exercise therapy, have also been proposed in management of TMD,[6,12-16] in order to equilibrate the orofacial muscles and to favor the proper execution of stomatognathic functions.[6,17] For management of TMD, the authors investigated the use of laser therapy on pain and orofacial myofunctional conditions.

There are many types of lasers with different characteristics, including helium-neon (HeNe) and GaAlAs lasers. LILT is used in the management of TMD for its analgesic and anti-inflammatory effects, increasing pain threshold and biostimulating effects, and alteration of neural stimulation.[18,19]

Recent studies have reported decreased pain with LILT (low intensity laser therapy) in skeletal muscle pain conditions, such as myogenic pain[20-23] and joint pain.[20,21,24] The use of LILT is a nonpharmaceutical and non-invasive intervention. It is quick and safe, and may be beneficial for TMD patients.[25] Although the efficacy of LILT has been dem-onstrated in many clinical studies, there is still a lack of consensus on energy density, and the power and frequency of appropriate application in TMD. Moreover, it is unclear whether the laser effect depends on the wavelength, irradiation points, or dose used.[26]

Due to widespread LILT use in dentistry, the lack of consensus about its mechanism of action in myofas-cial pain, and attempts to contribute to clarify the laser effects in the treatment of TMD, the aims of this study were as follows: 1. verify whether low-intensity laser therapy would promote significant pain remission; 2. evaluate whether this changes orofacial myofunctional conditions in the sample, as tested, using the Orofacial Myofunctional Evaluation Scores (OMES); and 3. evaluate whether or not the pain improvement would remain stable after a 30-day follow-up for pain conditions.

A speech therapist works with the aim of balancing stomatognathic functions, indicating the need for orofacial myofunctional therapy.[12,27] There is then an interest in evaluating the orofacial myofunctional conditions, before and after treatment, since the hypothesis tested in the current study is whether laser therapy is able to promote pain remission, and whether its effect would modify orofacial myofunctional conditions.

Materials and Methods

Sample Selection

The study included 12 female volunteers diagnosed with myofascial pain, with or without intra-articular TMD, according to axis I of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD)[6] and ages ranging from 18 to 60 years of age. All patients signed an informed consent approved by the Research Ethics Committee of Ribeirão Preto College of Dentistry-USP FORP (CAAE: 0011.0.138.000-07). Patients were screened at the Department of Occlusion and Temporomandibular Joint Disorder Service at Ribeirão Preto College of Dentistry, University of São Paulo (SODAT/FORP-USP.

Exclusion Criteria

Subjects were excluded if they were on chronic analgesic, anti-inflammatory, or psychotropic medication or if they had been treated for TMD in the last two years. Patients were instructed to avoid using any analgesic and/or anti-inflammatory medication during the applications and evaluations.

Laser Application

A trained examiner performed the laser applications. The device used was a GaAlAs Low Intensity Laser (780 nm - infrared) (Twin Laser, MM Optics LTDA, São Carlos, Brazil). The applications, with 60.0 J/cm^2 dose (60mW for 40 seconds), were performed in two sessions per week for four consecutive weeks, totaling eight sessions. The energy density, power, and frequency of application in the current study were based on a previous study, which suggested that the dose of 60J/ cm^2 or 2.8J was the most effective for pain management.[19] The laser was applied in direct contact with the patient's skin at the point of greatest tenderness within the upper, medium, and lower thirds of the masseter muscle (three points) and anterior region of the temporalis muscle (one point).

Clinical Evaluation of Pain on Palpation

The participants were assessed using a Visual Analogue Scale (VAS) for pain on palpation on the anterior tem-

poralis and masseter muscles in the upper, medium, and lower portions, before treatment (A1), immediately after eight sessions of LILT (the end of the treatment) (A2), and 30 days after the end of the treatment with LILT (A3).

Orofacial Myofunctional Assessment

One expert researcher conducted the orofacial myofunctional assessments before (A1) and immediately after eight sessions of LILT (A2). Since there were no modifications of orofacial myofunctional conditions from "A1" to "A2," this assessment was not repeated in "A3." For this evaluation, the study used an Orofacial Myofunctional Evaluation with Scores protocol (OMES).[28] OMES has three categories with predetermined scores for level of function, according to the conditions of 1. appearance/posture, 2. mobility of the orofacial structures (first and second categories, respectively), and 3. the functions of swallowing, chewing, and breathing (third category), having previously been validated for use in adults.[29] The scores are assigned according to the orofacial myofunctional conditions, with higher values corresponding to the ideal conditions of normality (expected scores for normality). The evaluation was performed by visual inspection and supplemented by subsequent analysis of recorded video images captured with the use of a camcorder (Panasonic M9000) installed on a tripod, and all images were taken at the same distance. The subjects remained seated in a chair with a backrest. The components of the stomatognathic system were evaluated for 1. appearance/posture, 2. mobility, and 3. breathing, swallowing, and chewing functions.

Statistical Analysis

Pain scores from the anterior temporalis and a mean value of pain scores of upper, medium, and lower thirds of the masseter muscle were used in the statistical analysis. For data, an ordinal level of measurement was used for nonparametric statistics. The Friedman test was used to compare the pain scores between phases. The Wilcoxon test was used for comparison of orofacial myofunctional scores between phases. And, the Mann-Withney test was used to compare the observed and expected scores (according to values defined by Felicio and Ferreira[29]). The significance level was set at 5%.

Results

Comparing the three evaluation times, it was observed that there was a significant decrease in the values of subjective pain to palpation, assessed using a Visual Analogue Scale (VAS) ($p<0.05$) (**Figure 1**). The specific

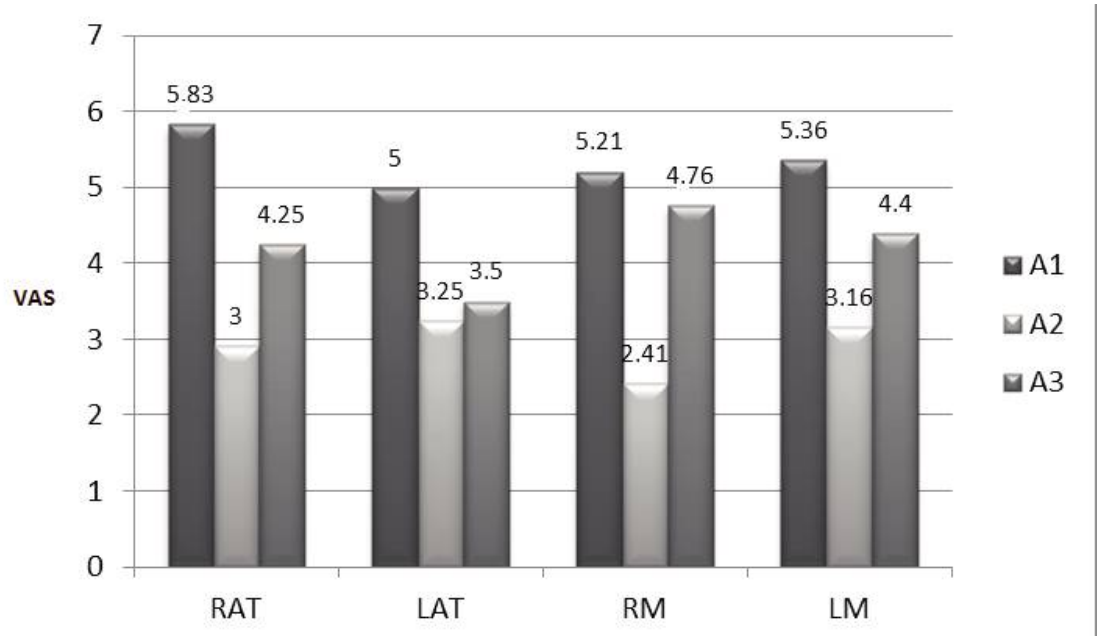

Figure 1
Comparative assessment of pain to palpation values (average of all subjects), before intervention (**A1**), immediately after intervention (**A2**), and 30 days after the end of the laser treatment (**A3**).
VAS: Visual Analog Scale; **RAT**: right anterior temporal; **LAT**: left anterior temporal; **RM**: right masseter (mean value of pain to palpation in the upper, medium, and lower areas); LM: left masseter (mean value of pain to palpation in the upper, medium, and lower areas).

p values were: right anterior temporal p=0.0221, left anterior temporal p=0.0458, right mean masseter p=0.0002, left mean masseter p<0.0001. The initial values of subjective pain to palpation (A1) differed significantly from the completion of the eight sessions (A2), but did not differ from evaluation after 30 days (A3).

According to the OMES protocol, there was no statistically significant difference between the evaluations before (A1) and after (A2) laser therapy (p>0.05) (**Figures 2** and **3**): appearance/posture, p=0.2604; mobility, p=0.4148; breathing, p=0.3613; swallowing, p=0.2076; and chewing, p=0.4990 (**Table 1**). When the scores

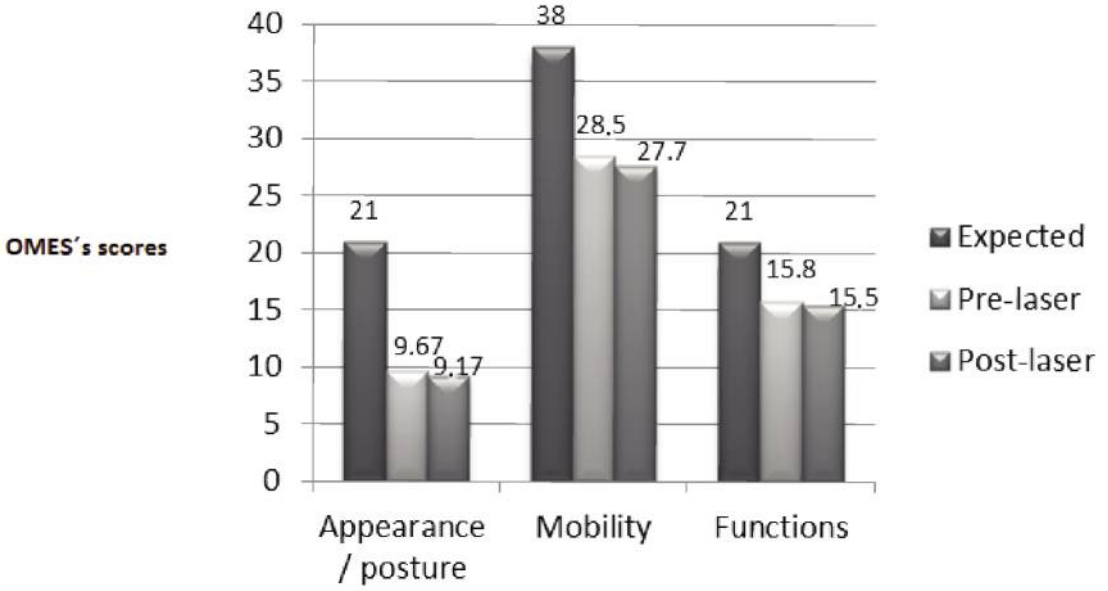

Figure 2
Comparative values of OMES in each category of the protocol.

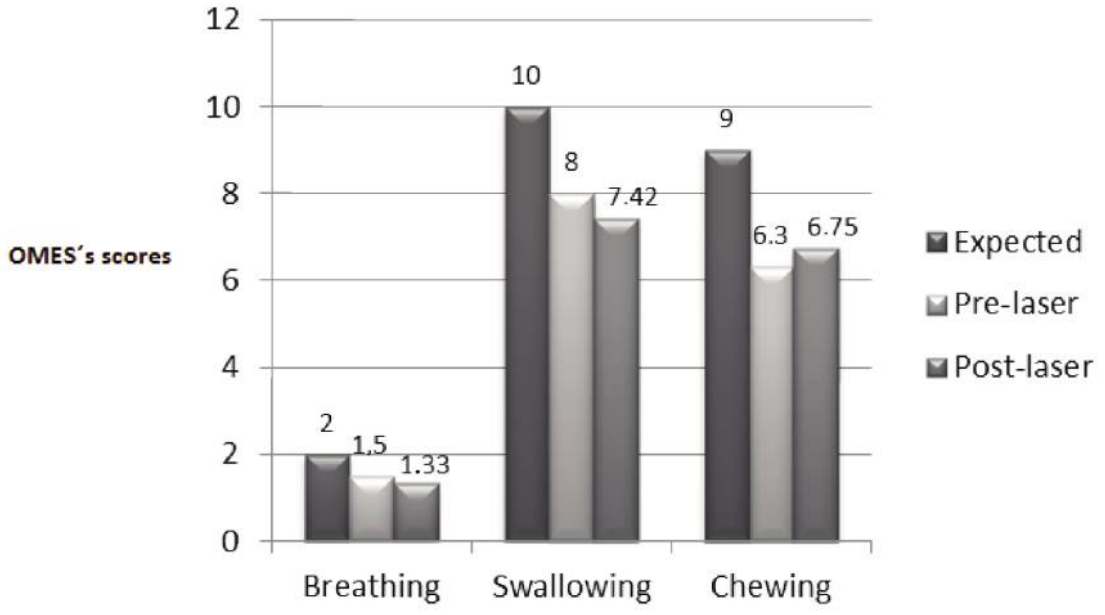

Figure 3
Comparative values of OMES in each item of "Functions" category.

Table 1
Data Collected on Patients Using the OMES Protocol Before (A1) and After (A2) Laser Therapy Compared with Expected Scores (ES) and A1 x A2

	ES	A1	A2	p-values (A1 x E)	p-values (A2 x E)	p-values (A1 x A2)
Appearance/posture						
Lips	3	1.58	1.42	<0.0001	<0.0001	0.1797
Jaw	3	1.08	1.08	<0.0001	<0.0001	1.0000
Cheeks	6	3.00	2.83	<0.0001	<0.0001	0.5002
Facial symmetry	3	1.00	1.08	<0.0001	<0.0001	0.5930
Tongue	3	1.08	1.08	<0.0001	<0.0001	1.0000
Hard palate	3	1.92	1.67	<0.0001	<0.0001	0.1088
Total	21	9.67	9.17	<0.0001	<0.0001	0.2604
Mobility						
Lips	8	6.08	6.25	0.0005	0.0005	0.6744
Tongue	12	7.50	7.17	<0.0001	<0.0001	0.5286
Jaw	10	7.75	7.58	0.0005	0.0005	0.5940
Cheeks	8	7.17	6.67	0.0153	0.0018	0.1097
Total	38	27.67	27.67	<0.0001	<0.0001	0.4148
Functions						
Breathing	2	1.50	1.33	0.0377	0.0056	0.3613
Swallowing	10	8.00	7.42	0.0001	<0.0001	0.2076
Chewing	9	6.30	6.75	0.0001	0.0018	0.4990
Total	21	15.80	15.50	<0.0001	<0.0001	0.7598

ES: expected scores for normality; **A1**: before laser therapy; **A2**: after laser therapy

expected for the ideal conditions of normality were compared to scores obtained in this study, both in A1 and in A2, there was a significant difference ($p<0.001$). **Table 1** shows the comparison between the average scores for each item evaluated, and **Figure 2** shows the comparison between the sums of the items analyzed in each category.

Discussion

Subjects with TMD usually require a multi-professional approach to treatment, due to etiology and associate factors involving the presence of occlusal, neuromuscular, and emotional changes.[5,30] Therefore, it is recommended that the treatment include professionals from different fields, such as dentistry, speech therapy and others.[31]

This study included only females with TMD, due to an increased, demand for this treatment in the female population. There are several hypotheses in the literature about the high prevalence of TMD in females, such as hormonal and bio-behavioral factors.[32,33] Silveira, et al.[34] found the index percentage of females with TMD to be higher than males.

A wide range of etiology and signs/symptoms of TMD may explain the variability of the rates found in the TMD population. This leads to the need for different types of therapies for pain relief, such as acupuncture, laser therapy, transcutaneous nerve electrical stimulation (TENS), ultrasound, massage, pharmacotherapy, psychological treatment, among others, as well as the participation of multiple professionals.

LILT has been the subject of several studies in healthcare, because there is still a disagreement about the energy dose to be applied in different structures, and also about the laser action in different biological tissues and in many diseases.[26,35] In dentistry, its effectiveness as a treatment modality in temporomandibular disorders because it is a non-pharmaceutical, non-invasive, easy to use, safe, and inexpensive method.[25,35]

In the current survey, the population was first treated with LILT, performed by a dentist and accompanied by a speech therapist based on the clinical assessment of

OMES. The therapy effectiveness is controversial in the literature because some studies have reported superior results compared to the placebo effect[22,36] and others have found no differences.[18,25,26] The authors observed, in this study, a significant difference in values of subjective pain to palpation, with a decrease immediately after treatment, but with recurrence 30 days after the end of the treatment. The authors' research suggests positive laser therapy effects on pain due to the anti-inflammatory, analgesic, and modulating actions of cell activity provided[37,38] pre- and post-test with LILT. In the area of dysfunction, there was no change in the OMES scores from A1 to A2. This result indicates that the laser therapy eased the pain but did not effect the orofacial myofunctional conditions.

A speech therapist falls within in the context of TMD treatment because, in many cases, the presence of unbalanced stomatognathic functions and orofacial behaviors may exacerbate and/or perpetuate the dysfunction, and it can act as a recurrence factor of previous treatments.[6,13,39-41] A speech therapist treats the stomatognathic system in order to functionally recover it in a way that is compatible with the dental occlusion.[6,27,28]

As in previous studies in TMD populations,[6,40,42] clinical evaluation of oral functions revealed the presence of orofacial myofunctional disorders (OMDs), which includes specific conditions and behaviors that act negatively on myofunctional balance.[43] With the concomitant presence of TMD and pain, there are two possible hypotheses to the presence of OMDs: 1. it could have been triggered by the TMD in an attempt to save the system,[13,27,40,41] or 2. it could have been present even before the beginning of TMD, acting as a contributing factor.[12,39] It is possible, in some cases, that pain remission can reverse an altered stomatognathic function, e.g., unilateral mastication supported, consciously or unconsciously, to avoid contralateral muscle discomfort, and then after the pain is relieved, it returns to a bilateral pattern spontaneously. However, the resolution of the problem is not always solved by pain remission alone. Even if the OMDs act as etiological factors or are the consequence of TMD, the higher the severity of these OMDs, the harder it is to solve the problem without a specific intervention, such as myofunctional orofacial therapy,[6,12,27] which was observed in the results of this study.

The protocol for orofacial myofunctional assessment used was the OMES (Orofacial Myofunctional Evaluation with Scores),[28] which was implemented at the authors' clinic seven years ago. This protocol allows the examiner to express his/her perception numerically, as to the characteristics and behaviors observed, by assigning predetermined scores to establish relationship with myofunctional orofacial conditions. Initially, OMES was validated to assess children[28] and then recently to assess adults.[29] The OMES application is, therefore, reliable and enables quantitative statistical analysis, as performed in this study. The results of applying OMES in the population studied showed a statistical difference ($p<0.05$) between the scores obtained and those expected for normal conditions, either before or after low-intensity laser therapy treatment (A2). It was illustrated that the pain remission achieved by laser therapy was unable, by itself, to change the functioning of the stomatognathic system. The pain recurrence, after 30 days of the end of LILT (A3), suggests that management should include treatment of the possible etiological factors causing pain. It seems certain that there is a need for sequential orofacial myofunctional therapy, which aims to balance stomatognathic functions, according to the occlusal and morphological conditions of the patient. Thus, treatment falls within the multi-professional sphere in order to stabilize the stomatognathic system by eliminating or minimizing the perpetuating factor of "myofunctional orofacial disorders." Possibly, LILT performed immediately before orofacial myofunctional therapy, when indicated, might facilitate the therapeutic process, promoting pain remission and allowing for more efficient exercises, thereby reducing the therapy time. However, the limits of the current study do not allow an answer to this hypothesis, which requires a further specific study to be tested.

Conclusions

1. The low-intensity laser therapy promoted significant pain remission immediately after the treatment, proving to be an effective modality for immediate relief to the pain symptoms from A1 to A2.

2. Laser therapy has not demonstrated long-term effect, i.e., after 30 days of the end of LILT (A3), recurrence of pain occurred in some degree, without maintaining the significant difference obtained after the last treatment session (A2).

3. The Orofacial Myofunctional Assessment revealed orofacial myofunctional disorder both before and immediately after treatment (A2), showing that the pain remission, by itself, was not able to modify orofacial myofunctional conditions in this population.

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Dr. Giovana Cherubini Venezian *received her D.D.S. degree from the Faculty of Dentistry of Ribeirão Preto University of São Paulo in 2005. She received her Speciality in TMD and orofacial pain in 2008, an M.S. degree in 2009, and a Ph.D. degree in 2012, all from the same university.*

Ms. Barbara Cristina Zanadréa Machado *received an undergraduate degree in speech and language pathology and audiology from the Faculty of Medicine of Ribeirão Preto, University of São Paulo in 2007. She received a Masters in medical science from the same university in 2012, where she is currently a doctoral student.*

Dr. Renata Filgueira Borges *received her D.D.S. degree from the Faculty of Dentistry of the Federal University of Rio Grande do Norte in 2001. She received her Speciality in aesthetics and restorative dentistry from the Brazilian Dental Association in 2004, and a M.S. degree in 2012 from the Faculty of Dentistry of Ribeirão Preto, University of São Paulo. Currently, she is working at the Brazilian Air Force.*

Dr. Marcelo Oliveira Mazzetto *received his D.D.S. degree in 1980 and a Ph.D. degree in 1999. He has served as a titular professor at the Faculty of Dentistry of Ribeirão Preto, University of São Paulo, and is involved in research into temporomandibular disorders.*