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Original Article

Mindfulness-based intervention reduces sensitivity parameters in women with chronic painful TMD*

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Objective: manifestations of allodynia and hyperalgesia are commonly present in chronic painful temporomandibular disorder. Studies point to the benefits of people with chronic pain undergoing mindfulness-based interventions, by demonstrating brain, hormonal, and clinical changes. This study aimed to analyze clinical parameters suggestive of central sensitization (pressure pain threshold, allodynia, and hyperalgesia) in women with chronic painful temporomandibular disorder before and after a mindfulness-based intervention, through a before-and-after intervention study, longitudinal, uncontrolled. Method: the analysis included 11 women chosen at random from a total of 20, aged between 27 and 44 years (36.36 ± 5.61), diagnosed with chronic painful temporomandibular disorder according to the Diagnostic Criteria for Temporomandibular Disorders protocol and who completed the 8-week mindfulness-based intervention program. Hyperalgesia, allodynia, and pressure pain threshold were tested at trigeminal and extra-trigeminal points before and after the intervention as well as the application of the questionnaire to measure the level of mindfulness (Mindful Attention Awareness Scale). The 8-week mindfulness program was offered to the study participants, based on the Mindfulness Trainings International - protocol, in weekly 2-hour sessions and a 4-hour session (immersion). Results: the results pointed to a reduction in allodynia, hyperalgesia and an increase in pressure pain threshold, with significant differences in several tested points ($p < 0.05$). The changes identified were accompanied by a significant increase in the level of mindfulness ($p < 0.05$). Conclusion: healthier indexes in clinical parameters suggestive of central sensitization investigated after the intervention represent a significant improvement in the person's relationship with a chronic illness that generates continuous unpleasant experiences such as temporomandibular disorder. Thus, the practice of mindfulness represents an appropriate and particularly interesting care because it is a low-cost, non-invasive intervention with low evidence of adverse effects.

Descriptors: Mindfulness; Temporomandibular Joint Disorders; Chronic Pain; Hyperalgesia.

* This article refers to the call "Mindfulness and other contemplative practices".

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Intervenção baseada em mindfulness reduz parâmetros de sensibilidade em mulheres com DTM dolorosa crônica

Objetivo: analisar parâmetros clínicos sugestivos de sensibilização central em mulheres com disfunção temporomandibular dolorosa crônica antes e após uma intervenção baseada em *mindfulness*. Método: onze mulheres com idade entre 27 e 44 anos (36,36 ± 5,61), com diagnóstico de disfunções temporomandibulares dolorosa crônica (*Diagnostic Criteria for Temporomandibular Disorders),*participaram do estudo. A hiperalgesia, a alodinia e o limiar de dor à pressão foram avaliados em pontos trigeminais e extra-trigeminais antes e após a intervenção baseada em *mindfulness*, bem como a aplicação do questionário *Mindful Attention Awareness Scale*. O programa de *mindfulness* de 8 semanas foi oferecido às participantes do estudo, com base no protocolo *Mindfulness Trainings International*, em sessões semanais de 2 horas e uma sessão de 4 horas. Resultados: houve redução significativa da alodinia, da hiperalgesia e aumento do limiar de dor à pressão, além de aumento significativo do nível de atenção plena ($p < 0,05$) enquanto marcador de efetividade da intervenção baseada em *mindfulness* oferecida. Conclusão: índices mais saudáveis nos parâmetros clínicos sugestivos de sensibilização central investigados após a intervenção, representam melhora significativa na relação da pessoa com quadro de enfermidade crônica geradora de experiências desagradáveis contínuas como a disfunções temporomandibulares.

Descritores: Atenção Plena; Transtornos da Articulação Temporomandibular; Dor Crônica; Hiperalgesia.

La intervención basada en la atención plena reduce los parámetros de sensibilidad en mujeres con TMD dolorosa crónica

Objetivo: las manifestaciones de alodinia y hiperalgesia y están comúnmente presentes en lo trastorno temporomandibular doloroso crónico. Los estudios señalan los beneficios de las personas con dolor crónico que se someten a intervenciones basadas en la atención plena, al demostrar cambios cerebrales, hormonales y clínicos. El objetivo de este estudio fue analizar parámetros clínicos sugestivos de sensibilización central (umbral de dolor por presión, alodinia e hiperalgesia) en mujeres con trastorno temporomandibular doloroso crónico antes y después de una intervención basada en la atención plena, a través de un estudio de intervención antes y después, longitudinal, sin control. Método: el análisis incluyó a 11 mujeres elegidas al azar de un total de 20, con edades entre 27 y 44 años (36.36 ± 5.61), diagnosticadas con trastorno temporomandibular doloroso crónico de acuerdo con protocolo Criterios de diagnóstico para trastornos temporomandibulares y que completaron el 8- programa de intervención basado en mindfulness de una semana. La hiperalgesia, la alodinia y el umbral de dolor por presión se probaron en los puntos trigémino y extra-trigémino antes y después de la intervención, así como también en la aplicación del cuestionario para medir el nivel de atención plena (Escala de conciencia de atención plena). El programa de atención plena de 8 semanas se ofreció a los participantes del estudio, basado en el protocolo Mindfulness Trainings International, en sesiones semanales de 2 horas y una sesión de 4 horas (inmersión). Resultados**:** los resultados apuntaron a una reducción en la alodinia, hiperalgesia y un aumento en la umbral de dolor por presión, con diferencias significativas en varios puntos probados ($p <0.05$). Los cambios identificados fueron acompañados por un aumento significativo en el nivel de atención plena ($p <0.05$), como un marcador de la efectividad de la capacitación ofrecida para la práctica de la atención plena. Conclusión**:** los índices más saludables en los parámetros clínicos sugestivos de sensibilización central investigados después de la intervención, representan una mejora significativa en la relación de la persona con una enfermedad crónica que genera experiencias continuas desagradables como trastorno temporomandibular doloroso crónico. Por lo tanto, la práctica de la atención plena representa una atención aplicable y particularmente interesante porque es una intervención no invasiva de bajo costo con poca evidencia de efectos adversos.

Descriptores: Atención Plena; Transtornos de la Articulación Temporomandibular; Dolor Crónico; Hiperalgesia.

Introduction

Temporomandibular disorders (TMDs) are understood as a condition of musculoskeletal pain, which can present itself in an acute or chronic form, painful or not and which is more or less intense depending on predisposing, aggravating or perpetuating factors, which reveal in a particular way in each case. Biological, cognitive, emotional, neurobiological, genetic and social factors can be involved in different degrees in the composition of TMD conditions, which exert an influence on the painful perception and generate an unpleasant and distressing experience when there is pain[1-6]. Among these factors, the presence of comorbid health problems, self-reported parafunctions such as onychophagia and dental clenching, for example, anxiety related to pain, depression, and poor quality of sleep and genetic/epigenetic factors[6].

The presence of pain is the main symptom that motivates people with TMD to seek treatment, especially when it becomes chronic and the protagonist of life in any daily situation. The pain modulation process is associated with downward inhibition mechanisms, involving the release of neurotransmitters such as serotonin, dopamine and norepinephrine, which regulate endogenous analgesia. Emotional factors such as the catastrophization of pain and anxiety can influence the expression of this process, increasing nociceptive sensitization and aggravating pain[7-8].

Reduced pain thresholds can occur in stomatognathic structures in the presence of pain, due to functional or dysfunctional overload (as in the case of parafunctional habits and orofacial myofunctional disorders), trauma, and surgical procedures, among others. Local events like these can generate ischemia and inflammation, and increased nociceptive stimuli. The persistence of this type of situation, added to the emotional factors involved, can lead to central sensitization and negatively contribute to the mechanisms for pain downward modulation[9-10]. Anxiety, for example, has been identified as a predictive factor of pain perception, while other factors such as gender, depression, stress, somatosensory amplification, age and weight do not seem to have a direct relationship with the referred levels of pain intensity, but exert an influence on the nociceptive sensitization and pressure pain threshold[7-8,11].

The presence of sensory changes such as allodynia (painful response to a non-harmful stimulus) and hyperalgesia (exacerbated response to a low-intensity harmful stimulus), observed clinically in trigeminal and extra-trigeminal regions, are clinical signs of the central sensitization process that can be occurring in TMD[9-10,12-13], which makes the examination of these characteristics useful for the diagnostic process of chronic pain and its prognosis, even contributing to the evaluation of the proposed treatments[14].

The broader understanding of the various aspects involved in the TMD framework reflects on the perspective of an intervention and treatment that integrates diversified and new practices in addition to the traditional ones, including practices based on *mindfulness* (full attention).

Mindfulness practices constitute an important group of meditative practices that have been gaining attention in several areas, as a tool for reducing stress and anxiety and increasing the well-being. The number of scientific research studies investigating the effects of *mindfulness*-based interventions has grown exponentially in recent years[15-17]. A number of studies point to promising benefits of this meditation tool by demonstrating brain, hormonal and clinical changes such as increased electroencephalographic activity in the left prefrontal area, increased antibody rate, reduced blood pressure, reduced chronic pain, anxiety, stress, and reduction of depressive symptoms[15,18] and, therefore, an approach to be considered for the treatment of chronic painful TMD. The potential benefit of its use for the purpose of self-regulation of chronic pain stems from the development of the ability to discern what is sensation and what is thought and feeling about the sensation, as well as awareness of the impermanence of physical and emotional states[17,19-20].

Pain experiences can be strongly influenced by past memories and negative or positive future expectations, which are evoked by individuals through thoughts in the present experience, and are manifested in catastrophizing behaviors and hyper-vigilance to pain[19-23]. When practicing *mindfulness*, the ability to deal with the direct experience of the present sensation is developed, moment by moment, without judgments or expectations[19-20]. Neurofunctional studies have shown that neural circuits related to pain and contemplative practices, such as meditation, can overlap, suggesting that the regular practice of *mindfulness* can promote pain regulation through the activation of central nervous system structures[2,22]. In addition, higher states of consciousness achieved in *mindfulness* practices have been associated with genetic changes at the transcriptional level. Thus, a study involving a complete analysis of the genome expression of experienced meditators, showed different profiles of gene expression (approximately 1,000 genes) compared to participants who do not practice *mindfulness*[24]. The literature suggests that the role of regular meditation is consistent with influencing the mechanisms of mind-body integration, triggering biological effects that involve

changes at the brain and epigenetic level. Among the practitioners of *mindfulness* it has been proposed that the difference in pain perception would be influenced by the effects of the practice on central mechanisms, such as emotional and cognitive control, whose hypotheses in the epigenetic field point to the modulation of peripheral anti-inflammatory and analgesic molecules, which are involved in the development and maintenance of pain in response to meditation[18].

Studies that demonstrate the effects of *mindfulness* practices are still scarce in people with chronic painful TMD. Thus, the assessment of the manifestation of painful sensitivity before and after the *mindfulness*-based intervention can guide future studies on the effects of this intervention for this specific population.

The aim of the present study was to analyze clinical parameters suggestive of central sensitization (pressure pain threshold, allodynia and hyperalgesia) in women with chronic painful TMD before and after a *mindfulness*-based intervention.

Method

The study design was of a longitudinal and uncontrolled before-and-after intervention. The analysis performed was extracted from partial data from an ongoing study, approved by the Ethics Committee of Research with human beings (CAAE: 98129918.6.0000.5407).

The analysis included 11 women whose medical records were drawn from a total of 20, aged between 27 and 44 years old(36.36±5.61), diagnosed with chronic painful temporomandibular disorder (TMD) according to the DC/TMD (Diagnostic Criteria for Temporomandibular Disorders)[25] and who completed the 8-week *mindfulness*-based intervention program, not necessarily all in the same group. The inclusion criteria were having a history of pain for 6 months or more, age between 18 and 45 years old, and female gender. As non-inclusion criteria, the regular practice of meditation, psychological therapy, physical therapy or speech therapy for painful TMD in progress, and history of trauma or craniofacial surgery in the last year were adopted.

All the participants underwent a clinical diagnostic examination for TMD (DC/TMD), assessment of the pressure pain threshold (PPT), allodynia and hyperalgesia at trigeminal points (temporomandibular joint-TMJ, anterior masseter and temporal muscles, bilaterally) and extra-trigeminal (upper trapezius muscles, lateral epicondyle-elbows- and internal part of the knee, bilaterally) by a trained and qualified professional. Allodynia was assessed by means of mechanical stimulus given by an electric toothbrush (Oral B®,Cross Action Eletric) with vibration maintained for 5 seconds at each point and the intensity of pain was verified using a numerical scale from zero (no pain) to 10 (worst possible pain) reported verbally[13]. The PPT was evaluated using pressure algometry with a portable digital algometer (Model DD-200, measuring 20 kg capacity, Kratos-CAS, Equipamentos Industriais LTDA, São Paulo - Brazil). The algometer was positioned parallel to the evaluated point and a constant and slow pressure (approximately 100 g/second) was applied until the moment when the participant noticed the beginning of a painful sensation. At this moment, when interrupting the pressure exerted, the equipment automatically froze the peak value reached, given in kilogram force (Kgf), which was noted. Hyperalgesia was tested using the same algometer, with a fixed value set at 1.5 kgf of compression for the trigeminal areas and with a value set at 2 Kgf for the extra-trigeminal areas, which can be considered painful stimuli for the chosen regions[26]. At each point, the intensity of pain reported verbally by the participants was verified using a numerical scale from zero (no pain) to 10 (worst possible pain)[13,26].

In addition, the participants answered the "Mindful Attention Awareness Scale" (MAAS) questionnaire which provides a numerical estimate (score) on the level of attention to the present moment (*mindfulness* level), tested for Brazilian Portuguese, showing similar validity and reliability to previous versions, including the original[27-28]. It consists of 15 items with statements that explore awareness about various aspects of well-being and managing daily life (Example: *1-I could experience some emotion and only become aware of it some time later; 2-I break or spill things due to lack of care, lack of attention, or because I am thinking about something else*). Each statement must be scored according to a Likert scale ranging from 1 (almost always) to 6 (almost never), with a maximum of 90 points and a minimum of 15 points. The higher the score achieved, the stronger the *mindfulness* trait in the person's personality, which is related to greater self-esteem and optimism and to less anxiety, depression and neuroticism[27-28].

Clinical examinations of allodynia, PPT and hyperalgesia, as well as the MAAS questionnaire, were applied to the participants before and after the *mindfulness*-based intervention.

As an intervention, the 8-week *mindfulness* program, of an educational nature, was offered to the study participants, based on the *Mindfulness Trainings International - MTI* protocol, whose scope aims to provide training in the practice of *mindfulness* in a secular context[29-30]. It consists of face-to-face meetings

of 2 hours, once a week, and 1 face-to-face meeting of 4 hours (immersion), totaling 9 meetings, in groups of 5 to 10 individuals (the sample of this study was composed of participants from different groups). The meetings took place at the Center of *Mindfulness* and Integrative Therapies of the Ribeirão Preto School of Nursing at the University of São Paulo (*Escola de Enfermagem de Ribeirão Preto da Universidade de São Paulo*, EERP-USP), where there is an environment conducive to this learning (large room with cushions and chairs for people to sit, usually in circles; a quiet environment). This protocol has as a fundamental principle that *mindfulness* is an innate capacity of the human being and that it is natural, simple and easy to develop because it only needs the natural instruments that the living human being has: a body that breathes and a mind that is aware of it. It recommends that, to develop and benefit from it, the training must be systematic and have as its main base the attention consciously directed to breathing, to the body and to the thinking mind, without judgments, moment by moment. Within this context, in each of the 9 meetings, different exercises of attention and focus on breathing, the body, the body movements or the thoughts were proposed, guided by an instructor trained in the MTI method, in order to progressively facilitate the participants' perceptions in relation to their own being in the present moment (physical sensations, habits, patterns of emotions and thoughts, beliefs, etc.), in addition to becoming aware of the changing situations in the body and in daily life.

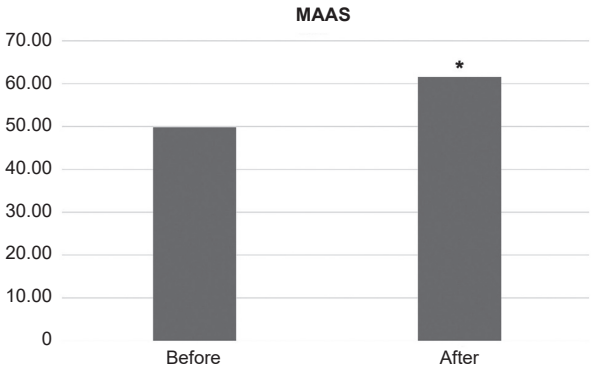
Mindfulness strategies that are used within this protocol involve formal and informal practices, which were taught and trained with the participants during the meetings, so that they could also practice on other days of the week. The formal practices are composed of exercises to intentionally direct attention, consciously and without judgment, developed in 4 basic bodily possibilities: sitting, lying, standing and moving (walking, stretching or flexing body parts). The informal practices are also attention and focus exercises, but they are developed during everyday activities of daily life, such as, for example, consciously directing attention to domestic tasks, such as washing dishes, changing clothes, talking, and walking to the work, among others, allowing for the generalization of *mindfulness* for real life[19-20,30].

To assist the participants in carrying out the formal training of extra-class mindfulness, audio-guides were offered, containing the main practice of each meeting dictated by the instructor's voice. A summary of what was discussed and reflected in each meeting was also sent in writing, by *e-mail* and/or *WhatsApp* to each participant in order to facilitate engagement in the program proposal. Each week, the participants were instructed to train a practice, with the aim of making them independent in their performance at the end of 8 weeks[19]. It is noteworthy that the *mindfulness* instructor was unaware of the results of the clinical examinations and of the participants' answers to the questionnaire before and during the intervention.

For the analysis, the data were tabulated in the Microsoft Excel® program and underwent Shapiro-Wilk's normality statistical treatment prior to the comparisons before and after the intervention. For the results with normal data ($p > 0.05$), the *t-Student* test was applied for paired data, such as the PPT and the MAAS questionnaire. For the results with non-normal data ($p < 0.05$), Wilcoxon's nonparametric test was applied, as for allodynia and hyperalgesia. The significance level was set at $\alpha = 0.05$.

Results

The results of this study show that there was a significant increase in the level of *mindfulness* after the intervention (*t*-Student test for paired data, $p < 0.05$ (Figure 1).



*t-Student test: $p < 0.05$

Figure 1 - Mean of the total score obtained from the MAAS questionnaire - *Mindful Attention Awareness Scale*, before and after the *mindfulness*-based intervention. Ribeirão Preto, SP, Brazil, 2019

Of the total of 9 face-to-face meetings scheduled for the proposed intervention, the total number in which the participants were present varied from 6 to 9 meetings (mean of absolute frequency: 7.73 meetings). Specifically, 2 participants attended 6 meetings, 1 participant attended 7 meetings, 6 participants attended 8 meetings, and 2 participants attended 9 meetings. Even if the participants were absent from face-to-face meetings, the summary of the content covered in the meetings, the guidelines, and audios-guides for the week's practices were made

available by *e-mail* and/or *WhatsApp*, so that they could continue practicing mindfulness.

In the PPT assessment, an increase was observed in all trigeminal (facial) and extra-trigeminal (body) points, with a significant difference ($p < 0.05$) for the pressure pain threshold of the right and left masseter, anterior temporal left, left TMJ, right upper trapezius, right and left epicondyles and left knee muscles (*t*-Student test for paired data).

Before the intervention, 36.4% of the sample reported, using a verbal numeric scale from zero to 10, some painful intensity in the face of the innocuous stimulus (allodynia), being more marked and intense in the trapezius muscles. After the intervention, there was complete remission of allodynia manifested before the intervention, with no statistical difference ($p > 0.05$, Wilcoxon's test).

Regarding the analysis of hyperalgesia, there was a decrease in all the investigated points, both trigeminal and extra-trigeminal, with statistical difference for right trapezius, right epicondyle and left knee ($p < 0.05$, Wilcoxon's test).

Table 1 shows the descriptive statistics (mean and standard deviation) and the statistical result of the comparison of the PPT, allodynia and hyperalgesia at the points tested before and after the intervention.

Table 1 - Mean (Standard Deviation) for the values of PPT*, allodynia and hyperalgesia found in the studied sample. Comparison between the moments before and after the *mindfulness*-based intervention. Ribeirão Preto, SP, Brazil, 2019

	PPT* (t-Student test)		Allodynia (Wilcoxon's test)		Hyperalgesia (Wilcoxon's test)	
	Before	After	Before	After	Before	After
Trapezoid R†	0.96 (±0.8)	1.67 (±0.9)‡	1.36 (±2.6)	0	6.36 (±3.2)	3.91 (±2.8)‡
Trapezoid L§	1.26 (±1.1)	1.55 (±0.9)	1.09 (±2.5)	0	5.00 (±2.7)	4.45 (±2.3)
Epicondyle R†	0.85 (±0.5)	1.45 (±0.7)‡	0.73 (±1.7)	0	6.55 (±3.3)	3.64 (±1.9)‡
Epicondyle L§	0.93 (±0.5)	1.31 (±0.7)	0	0	6.27 (±3.2)	4.55 (±2.2)
Knee R†	1.48 (±0.8)	1.96 (±0.9)	0	0	3.45 (±1.8)	2.82 (±1.4)
Knee L§	1.51 (±0.8)	2.12 (±1.0)‡	0	0	3.27 (±1.6)	1.80 (±0.9)‡
TPR‖	0.71 (±0.3)	0.98 (±0.4)	0.64 (±2.1)	0	7.82 (±4.0)	5.36 (±2.8)
TAL¶	0.51 (±0.3)	0.97 (±0.5)‡	0.55 (±1.8)	0	8.73 (±4.6)	6.09 (±3.1)
Masseter R†	0.56 (±0.4)	0.86 (±0.4)‡	0.73 (±1.8)	0	9.18 (±4.9)	7.82 (±4.0)
Masseter L§	0.50 (±0.3)	0.83 (±0.5)‡	0.73 (±1.6)	0	9.18 (±4.9)	7.82 (±4.0)
TMJ** R†	0.60 (±0.3)	0.93 (±0.5)	0.64 (±2.1)	0	8.18 (±4.3)	6.36 (±3.3)
TMJ** L§	0.56 (±0.2)	0.93 (±0.5)‡	0.82 (±2.1)	0	8.91 (±4.8)	7.45 (±3.8)

*PPT = Pressure Pain Threshold; †R = Right; ‡Significance level: $p < 0.05$; §L = Left; ‖TPR = Temporal Anterior Right; ¶TAL = Temporal Anterior Left; **TMJ = Temporomandibular Joint

Discussion

Based on the definition of pain proposed by the IASP (International Association for the Study of Pain), "Pain is a distressing/stressful experience with present or potential damage, associated with sensory, emotional, cognitive and social components"[5]; it is clear that this somatovisceral sensitivity is a multidimensional phenomenon that is commonly associated with human suffering. And so, the characterization of pain occurs through the understanding of its various facets, within the biopsychosocial model. The *mindfulness*-based intervention, chosen for this research, contemplates this model when integrating practices with strategies of conscious attention, body and mental self-knowledge and, consequently, for promoting emotional and cognitive self-regulation of those who practice it[17-22,27].

The challenge of measuring pain is precisely to find instruments that can translate individual subjective perceptions, which can be influenced by affective-emotional states and by previous experiences. The MAAS questionnaire contributed to the evaluation of the present sample by highlighting the levels of attention/distraction on activities of daily living, as well as on physical and mental states. The increase in the mindfulness levels suggests a greater capacity for emotional self-regulation and for being in the present moment with fewer judgments or expectations[27], which seems to favor the results on the painful sensitivity of the studied sample. To confirm causality, further studies are needed, especially in the area of orofacial pain, whose relationship has not been investigated.

Central sensitization and psychological variables such as anxiety, catastrophization and depression have been suggested as particularly relevant to explain the experience of pain in patients with chronic TMD[6-7]. Parameters such as a reduced pressure pain threshold, and generalized allodynia and hyperalgesia are clinical

signs of central sensitization[9-10,2-13]. Verifying these characteristics confirms the need for treatment approaches of central action, and not only of peripheral action, for chronic painful TMD[13-14], which validated the choice of he *mindfulness*-based intervention proposed in this study.

The pressure pain threshold (PPT), defined as the lowest stimulus intensity capable of initiating painful sensations, has been used as an objective parameter of pain perception. People with painful TMD tend to have lower pressure pain thresholds than healthy individuals, as they are susceptible to changes in the central processing of external stimuli over the trigeminal region[13,31-32]. In general, the studied sample presented a very low PPT not only in the trigeminal region, but also in body points, confirming the knowledge found in the literature about centrally mediated pain[9-10,33-34]. After the proposed intervention, there was an increase in the PPT in all trigeminal (facial) and extra-trigeminal (body) points, with a significant difference ($p < 0.05$) found in several investigated points, on the upward sensory inhibition of pain by the thalamic pathway[22].

The test to investigate the PPT includes the explanation that women must be attentive and warn about the moment of onset of the painful sensation. It is known that the expectation of the arrival of pain can trigger painful perceptions even before the stimulus is given, a fact that was demonstrated by functional magnetic resonance imaging with activation of specific neural areas in the face of pain anticipation[2,22]. It was interesting to notice the increase in the PPT after the intervention, as this result allows thinking about how the mental training offered can contribute to the modulation of the beginning of painful perceptions. The main guidance given during *mindfulness* training is to consciously live the present experience as it is presented, with acceptance and without judgments or expectations. Regardless of the object for the attention-related focus, the training of these guidelines stimulates brain areas responsible for cognitive and emotional regulation of pain. The reduction of anticipation and expectation was considered as one of the mechanisms of action of pain relief based on *mindfulness*[2,35-36]. Perhaps this process may have reflected a decrease in the pain-related anticipatory behavior in the women participating in this study, allowing for higher pressure pain thresholds.

Manifestations such as tactile allodynia and pressure or puncture hyperalgesia are clinical characteristics that point to a possible phenomenon of central sensitization, whose presence and maintenance are strong contributors to the pain phenotype in subjects with chronic painful TMD, among other painful syndromes[9-10,12-13]. Not all the participants presented allodynia (only 36.4%), which justifies mean values below 1 for pain intensity, associated with high values of standard deviation. After the intervention, there was remission of this manifestation in all the participants who reported it at the beginning of the study. In the same sense, there was a reduction in hyperalgesia in all the points, with a significant difference ($p < 0.05$) in several of them. Such results suggest that the *mindfulness*-based intervention was able to mobilize the participants to carry out the proposed practices, with consequences at the central level of pain modulation. The increase in the levels of full attention, demonstrated by the increase in the scores of the MAAS questionnaire, reinforce that there was adherence of the participants to the proposed practices, even though they missed some face-to-face sessions. It is believed that the virtual monitoring provided by *e-mail* and/or *WhatsApp* has strongly contributed to the adherence process, but its real effect has not been tested.

Recently, this type of intervention has shown painful attenuation related to mechanisms of emotional and cognitive regulation, with increased activation of brain areas such as the anterior cingulate cortex and the ventromedial prefrontal cortex. This favors changes in the contextual perspective of sensory events, achieved by the cultivation of attitudes such as acceptance and non-judgment, directed to the eminent stimuli[2,36], aspects addressed and trained during the *mindfulness* intervention period.

The generalization of the results of this study to populations at extended scales requires further investigation and analysis of chronic pain phenotypes for women with painful TMD, related to behavioral, cognitive and emotional aspects.

Conclusion

The results confirmed the hypothesis of the present study, that is, after a *mindfulness*-based intervention applied for 8 weeks, the participants with chronic painful TMD showed changes in their clinical parameters suggestive of central sensitization (pressure pain threshold, allodynia and hyperalgesia).

The changes identified were accompanied by an increase in the mindfulness level, as a marker of the effectiveness of the training for the practice of *mindfulness*.

Continuing scientific research on the effects of *mindfulness*-based interventions is recommended as a care practice for people with painful TMD, seeking to expand the clinical parameters evidenced in this study.

After the intervention, healthier indexes in the clinical parameters suggestive of central sensitization investigated (pressure pain threshold, allodynia and hyperalgesia), represent a significant improvement in the relationship of the person with a chronic illness

that generates continuous unpleasant experiences such as TMD. Thus, the practice of *mindfulness* represents applicable and particularly interesting care because it is a low-cost and non-invasive practice with low evidence on adverse effects.

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