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THE USE OF LASERPUNCTURE IN THE TREATMENT OF CHRONIC MUSCULAR TEMPOROMANDIBULAR DISORDERS: A PILOT STUDY[1]

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ABSTRACT

BACKGROUND: Temporomandibular disorder (TMD) is a prevalent musculoskeletal condition commonly treated conservatively. Auricular acupuncture (AA) and low-level laser therapy (LLLT) effectively reduce pain in orofacial conditions. However, their combined use, auricular laserpuncture, remains unexplored in TMD. **AIM**: This study aims to evaluate, in a pilot study, the effects of auricular laserpuncture in patients with chronic myogenous TMD. **METHODOLOGY**: In a randomized, double-blind, controlled pilot trial, 18 participants (18–45 years) diagnosed with chronic myalgia by RDC/TMD were assigned to three groups: 1.9 J/cm^2 (Group 1), 6.4 J/cm^2 (Group 2), and 0J/cm^2 (Group 3). The laser was applied to standardized auriculotherapy points. Ten sessions over five weeks were performed, with standardized self-care instructions. Pain (VAS) and mandibular range of motion were assessed at baseline,after the fifth session and post-treatment. ANOVA and non-parametric tests were used ($\alpha = 0.05$). **RESULTS**: Significant improvements in VAS scores were observed over time ($p = 0.006$), with a significant reduction specifically in Group 1 after ten sessions. Statistically significant differences between groups were found for VAS ($p = 0.001$; $p = 0.006$), protrusion ($p = 0.04$), and range of laterality movements ($p = 0.04$). No significant differences were detected for maximum mouth opening. No significant group-by-time interaction was found. **CONCLUSION**: Through this pilot study, we observed that auricular laserpuncture at 780 nm with 1.9 J/cm^2, applied in 10 sessions twice weekly, reduced pain and improved some mandibular movements in chronic myogenous TMD.

Keywords: Auriculotherapy. Laser Theraphy. Photobiomodulation. Acupuncture. Temporomandibular Disorders.

INTRODUCTION

Temporomandibular disorder (TMD) is a multifactorial musculoskeletal condition characterized by pain and/or limited jaw function, with masticatory muscle pain as the most common symptom (Slade et al., 2016). It affects 30–50% of the population, predominantly women aged 20–40 (Alrizqi; Aleissa, 2023) and is associated with reduced quality of life and increased healthcare burden (Januzzi et al, 2023).

Conservative treatments, preferred over invasive procedures, are effective for mild to moderate TMD and benefit most patients (75% to 90%). These include

pharmacological therapy, physiotherapy, occlusal splints, self-management strategies, and cognitive-behavioral interventions (Gil-Martínez et al, 2018).

Acupuncture is a millenary Chinese Traditional Medicine, recognized for its effectiveness in restoring systemic balance through peripheral and central neuromodulation, promoting the release of endogenous substances with analgesic and anti-inflammatory action (Fernandes et al, 2017; Li et al, 2017). Evidence demonstrates that acupuncture is beneficial in the management a variety of painful conditions including myofascial pain (Fernandes et al, 2016; Li et al, 2017), fibromyalgia (Valera-Calero et al, 2022) e TMD (La Touche et al, 2010).

Auricular acupuncture (AA) is a modality of acupuncture that was developed in the 1950s (Hou et al, 2015). It's a low-cost technique that is well accepted by patients and relies on the stimulation of the auricular microsystem, whereby activation of specific auricular points (acupoints) can produce therapeutic effects at a distance (Hou et al, 2015; Ferreira et al, 2015). These stimuli can be carried out using needles, mustard seeds, electric current, laser, pressure, cauterization, moxibustion or bloodletting (Lee et al, 2011). Its effects are due to the involvement of the autonomic and endocrine systems, as well as the activation of the neuroimmunomodulatory system (Lee et al, 2011, Murakami et al, 2017; Ferreira et al, 2015; Aroca et al, 2022) and studies show that it has positive effects on pain control in chronic musculoskeletal conditions, such as TMD (Ferreira et al, 2015; Iunes et al, 2015; Aroca et al, 2022).

Another effective adjunctive therapeutic option in the management of TMD is low-intensity laser technology (LLLT), which has the potential to reduce painful symptoms (Jing et al, 2021). Its non-invasive nature, easy application, short duration of treatment and low incidence of contraindications contribute to growing adoption in clinical settings (Ahmad 2021). A systematic review reported that wavelengths around 780 nm promote muscle relaxation, improving local circulation and contributing to pain control (Jing et al, 2021; Ahmad 2021).

The combination of AA and LLLT stands out for its characteristics such as minimal trauma, low risk of adverse effects and short treatment duration (Chon 2019, Yang 2020). This approach has been shown to be effective in the treatment of chronic musculoskeletal pain, particularly chronic low back pain, resulting in improvements in pain intensity, physical functioning, quality of life and self-efficacy for dealing with chronic pain (Andrade 2025). Moreover, it has also proven to be an effective strategy in the management of TMD, resulting in improvements in pain symptoms, mandibular

functionality (Rodrigues et al, 2019) and reduced discomfort associated with emotional symptoms (Fernandes et al, 2020).

Although AA has been shown to reduce orofacial myofascial pain and the combination of AA and LLLT has been explored in conditions with overlying mechanisms similar to chronic TMD, evidence regarding this combined approach specifically in chronic myogenous TMD remains limited. This study aims to evaluate, in a pilot study, the effects of Auricular Laserpuncture (AL) in patients with chronic myogenous TMD.

METHODS

Study Design and Ethical Aspects

This is a pilot, randomized, double-blind, controlled clinical trial. It was approved by the Research Ethics Committee (COMEPE) under protocol number 019/11. All participants read and signed the informed consent form before taking part in the study.

Participants

This was a convenience sample composed of 18 patients of both sexes, aged between 18 and 45 years, recruited between 2011 and 2012 from individuals seeking treatment for temporomandibular disorders at a dental school clinic and from the general population through social media, printed materials, and public advertisements in the city of Fortaleza, Brazil.

Eligibility criteria required that participants had a primary complaint of chronic myogenic TMD with symptoms lasting more than six months, confirmed by the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD; the Diagnostic Criteria for TMD [DC/TMD] was not yet available at the time). Exclusion criteria included the presence of neoplastic conditions, recent history of trauma, acute infection, use of a pacemaker, prior treatment for TMD, or pregnancy. Participants who missed any of the programmed treatment sessions were withdrawn from the study.

Outcome Variables and Examiners

The primary outcome was self-reported pain intensity, assessed using the Visual Analogue Scale (VAS), ranging from 0 (no pain) to 10 (worst imaginable pain). Pain was assessed at three time points: baseline, after the 5th session, and after the

10th session of the intervention. The secondary outcome was mandibular range of motion, measured through maximum mouth opening, lateral excursions, and protrusive movement. All clinical assessments were performed according to RDC/TMD.

Three trained researchers participated in the assessments. Researcher #L.M.S.P.F. triaged the participants, confirmed eligibility according to the RDC/TMD and collected baseline sociodemographic data. Researcher #A.G.R. was responsible for the laser application and clinical assessments, including palpation and motion analysis, without knowing the group allocation and dosimetry. To ensure allocation occultation, the dosimetry parameters were predefined and managed by Researcher #K.M.F.P., who was not involved in the treatment sessions or data collection.

Intervention Groups

Participants were randomly allocated into three groups. Groups 1 and 2 received active auricular laser stimulation at predefined acupoints with doses of 1.9 J/cm^2 and 6.4 J/cm^2, respectively. Group 3 underwent a sham procedure, involving the same handling at the acupoints but without laser activation (0 J/cm^2). The assessor responsible for outcome measurements was blinded to group allocation.

Laser Equipment and Parameters

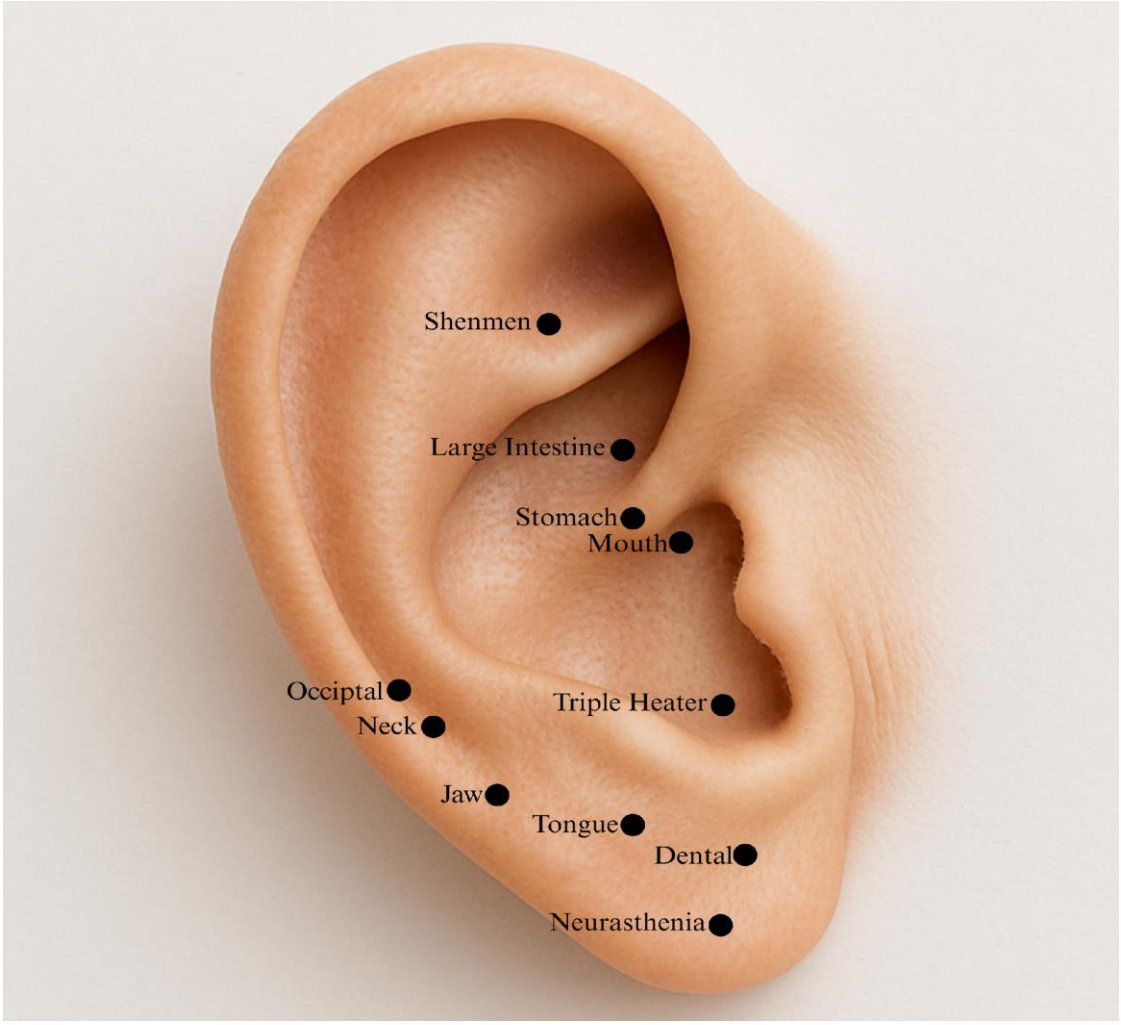
The intervention was delivered using a LLLT device (Twin Laser, MMOptics, São Carlos, SP, Brazil) with a wavelength of 780 nm. A specific probe designed for laser acupuncture was used, with a beam area of 0.0078 cm^2. The laser was applied with direct contact at a 90° angle to the skin surface, following standardized safety and hygiene protocols. Dosage variations followed the study design, with energy densities adjusted according to group assignment.

Auricular Points and Application Protocol

The auricular acupuncture protocol was standardized across all participants. The selected points included: Shen Men (analgesic and sedative effects), Large Intestine (modulation of endogenous pain pathways), Mouth (indicated for orofacial conditions), Stomach (stress control and muscle relaxation), Triple Heater (pain regulation), Neck and Occipital (both related to cervical pain modulation), Dental (analgesic), Tongue (analgesics), Jaw (for pain and tmd) and Neurasthenia (emotional disorders). These points were bilaterally located and identified according to anatomical references from auricular acupuncture charts (Wang et al., 2016). The

selection was based on prior evidence supporting their effects in orofacial pain management and neuromodulation (Boscaine et al., 2019; Wang et al., 2016; Ferreira et al., 2015 (Figure 1).

Figure 1: Auricular Points.



Source: Author's own elaboration.

Intervention Framework and Evaluation Timeline

All participants attended two treatment sessions a week, with a 48-hour break between, totaling ten sessions during the intervention. At the first session, all participants received self-care instructions from researcher #A.G.R.

The self-care guidelines provided were aimed at promoting the reduction of functional and muscular overload in the temporomandibular joints that could be incorporated into the participants' daily lives. The recommendations included dietary adjustments such as avoiding caffeine, hard foods, or excessive chewing; application of thermal compresses (hot or cold); mandibular relaxation techniques; guidelines for improving sleep quality; and encouragement to engage in physical activity. All of this

was done with the aim of complementing the study's therapy through conservative, evidence-based interventions.

Clinical assessments were conducted at three time points: baseline (prior to the first session), mild-treatment (after the fifth session), and post-treatment (after the tenth session). The muscles evaluated included the temporalis, masseter, sternocleidomastoid, cervical, trapezius, lateral pterygoid (via activation and intraoral palpation), medial pterygoid, and digastric muscles. Pain was quantified using the Visual Analogue Scale (VAS). Mandibular movements were assessed for protrusion, lateral excursions and maximum opening, along with joint sounds.

Statistical Analysis

Based on the observed mean difference and standard deviation in VAS scores between the initial and final sessions in Group 1, the effect size (Cohen's $d \approx 2.23$) was considered large. A power analysis using G*Power 3.1 indicated that a minimum sample size of six participants per group would be required to achieve 95% power in a two-tailed test with $\alpha = 0.05$.

Data were tabulated using Microsoft Excel and analyzed using SigmaStat version 5.0 (Systat Software Inc., San José, CA, USA). The Shapiro–Wilk test was applied to assess the normality of the data. For parametric variables such as VAS, maximum mouth opening, a two-way ANOVA followed by Tukey's post hoc test was performed. For non-parametric variables, including range of laterality movements and protrusion, the Friedman test followed by the Wilcoxon signed-rank test was used for intragroup (within-subject) comparisons across time points, while the Kruskal–Wallis test was applied for intergroup comparisons at each time point. Statistical significance was set at $p < 0.05$.

RESULTS

VAS scores (Table 1) showed significant differences both between groups across time points ($p = 0.001$) and within group 1 over time ($p = 0.006$). Maximum protrusion (Table 2) exhibited significant differences within groups over time ($p = 0.04$), but not between groups at each time point ($p = 0.58$). Similarly, maximum laterality (Table 3) showed significant differences within groups over time ($p = 0.713$), but not between groups at each time point ($p = 0.25$). In contrast, no statistically significant differences were found between groups across time points for maximal mouth opening (Table 4; $p = 0.589$), showed significant differences within

groups over time (p = 0.04). Importantly, no statistically significant interaction between group and time was detected for any Variable (Tables 1–4).

Table 1: VAS values of the different groups, presented as mean ± standard deviation.

VAS						
Group	**1st session**		**5th session**		**10th session**	
1.9 J/cm²	5.78 ± 2.19	Aa	4.06 ± 1.42	Aab	1.8 ± 1.25	**Ab**
6,4 cm²	5.26 ± 1.23	Aa	3.61 ± 2.11	Aa	2.85 ± 2.79	ABa
0 J/cm²	6.61 ± 1.86	Aa	5.48 ± 1.83	Aa	5.26 ± 2.27	**Ba**

Different uppercase letters within a column and different lowercase letters within a row indicate statistically significant differences (ANOVA Two-way, Tukey's post hoc test, $p < 0.05$). **Source:** Authors' own data.

Table 2: Maximum protrusion values for the different groups, presented as mean and standard deviation.

Maximum Protrusion						
Group	**1st session**		**5th session**		**10th session**	
1.9J/cm²	3.667 ± 2.066	Aa	5.667 ± 2.503	Aab	7.167 ± 1.835	**Ab**
6.4J/cm²	6.333 ± 1.751	Aa	7.000 ± 3.033	Aa	7.000 ± 4.195	Aa
0J/cm²	6.167 ± 3.189	Aa	5.833 ± 2.927	Aa	7.167 ±1.602	Aa

Different uppercase letters within a column indicate statistically significant differences between groups at each time point (Kruskal–Wallis test). Different lowercase letters within a row indicate statistically significant differences over time within the same group (Friedman test followed by Wilcoxon signed-rank test). $p < 0.05$. **Source:** Authors' own data.

Table 3: Range of lateral movements values for the different groups, presented as mean and standard deviation.

Range of lateral movements						
Group	**1st session**		**5th session**		**10th session**	
1.9J/cm²	6.33 ± 0.816	Aa	7.667 ± 0.683	Aa	8.83 ± 1.57	**Ab**
6.4J/cm²	8.666 ± 3.43	Aa	8.83 ± 3.473	Aa	9.25 ± 3.012	Aa
0J/cm²	7.333 ± 2.250	Aa	7.166 ± 1.160	Aa	7.4167 ±1.393	Aa

Different uppercase letters within a column indicate statistically significant differences between groups at each time point (Kruskal–Wallis test). Different

lowercase letters within a row indicate statistically significant differences over time within the same group (Friedman test followed by Wilcoxon signed-rank test). $p < 0.05$. **Source:** Authors' own data.

Table 4: Maximal mouth opening values for different groups, presented as mean ± standard deviation

	Maximal Mouth Opening					
Group	**1st session**		**5th session**		**10th session**	
1.9J/cm²	35.17 ± 6.853	Aa	36.33 ± 5.465	Aa	39.00 ± 6.033	Aa
6.4J/cm²	38.33 ± 6.282	Aa	38.00 ± 7.823	Aa	39.50 ± 6.253	Aa
0J/cm²	35.67 ± 4.227	Aa	35.33 ± 5.125	Aa	36.17 ± 3.764	Aa

Different uppercase letters within a column and different lowercase letters within a row indicate statistically significant differences (ANOVA Two-way, Tukey's post hoc test, $p < 0.05$). **Source:** Authors' own data.

DISCUSSION

This pilot study aimed to evaluate the clinical effects of two different dosimetry parameters of AL in the management of chronic myogenous TMD. Since conservative therapies such as interocclusal splints, manual therapy, and counseling/self-care are well-established for managing TMD, improving pain, quality of life, and psychosocial aspects (Resende et al, 2019), all participants had previously received self-management guidelines. Within this context, the study investigated the adjunctive effect of a therapeutic approach that has been little explored, assessing its potential additional benefit in TMD treatment.

Although LLLT is increasingly used as an adjunct treatment for TMD, it still faces considerable challenges in terms of standardization, with marked heterogeneity in parameters such as wavelength, power, and treatment frequency, factors that hinder the establishment of a consensus on the most effective protocol (Jing et al, 2021; Ahmad et al, 2021; Karic & Penny, 2025). Quantitative analyses of clinical trials suggest that fluences below 10 J/cm^2 are associated with a statistically significant reduction in pain during the initial treatment of TMD (Jing et al, 2021). Although the number of sessions ranged from 6 to 12 in the RCTs evaluated, most studies adopted an 8-session protocol. Regarding frequency, short application intervals, generally 2 to 3 times per week, appear sufficient to achieve the expected clinical effect (Jing et al, 2021).

In the present study, different dosimetries (6.4 J/cm^2 and 1.9 J/cm^2) were tested within the recommended fluence range (<10 J/cm^2) and at different time points (5th and 10th sessions) to identify the most effective protocol for AL stimulation. For improvements in VAS, as well as in mandibular laterality and protrusion, the most effective protocol involved LLLT at 780 nm with 1.9 J/cm^2 of energy density, applied twice a week for 10 sessions. The superior outcomes observed with the lower dose can be explained by the biphasic dose–response effect, whereby lower doses stimulate tissue repair and analgesia, whereas higher doses may lead to inhibitory or neutral effects (Jing et al, 2021; Ahmad et al, 2021).

To date, only two other studies have investigated AL for TMD (Rodrigues et al., 2019; Fernandes et al., 2020). The first compared AL with the use of an occlusal splint. The laser (904 nm, 50 mW, 4 J/cm^2, once weekly for 8 sessions) was applied to specific auricular points. Outcomes included depressive symptoms, VAS, and jaw function. The results showed that AL produced comparable improvements to the occlusal splint in reducing pain and depressive symptoms and in enhancing mandibular function. The second study compared AL (808 nm, 100 mW, 10 sessions, once weekly) to a no-treatment control group, applying to auricular points. Outcomes assessed included anxiety symptoms, sleep disturbances, and perceived TMD pain. This protocol was effective only in reducing anxiety symptoms.

Together, the findings of this pilot study and the two previous investigations highlight the heterogeneity in laser therapy protocols for TMD, regarding both technical parameters and outcome measures. While the present study focused on mandibular function and pain intensity, the others assessed psychosocial factors including anxiety, depression, and sleep quality, elements inherently linked to the multifactorial nature of TMD. These differences emphasize the need to incorporate multidimensional outcomes in future research. In addition to differences in outcome domains, this study was unique in comparing two dosimetries within the same intervention protocol. The findings suggest that the lower fluence (1.9 J/cm^2) showed more favorable results in both pain reduction and functional improvement, which may reflect a dose–response effect relevant for clinical decision-making.

Auricular acupuncture (AA) is a promising non-invasive approach that modulates pain by stimulating cranial and spinal nerves via the somatotopic representation of body regions on the external ear. This mechanism promotes endogenous opioid release and neurovegetative regulation. AA has accumulating evidence supporting its efficacy in managing musculoskeletal and orofacial pain, including TMD (Iunes et al, 2015; Ferreira et al, 2015; Aroca et al, 2022). Similar to

the challenges encountered in defining optimal LLLT protocols, auriculotherapy also lacks a standardized approach for pain management. This lack of standardization stems from heterogeneity across studies in terms of auricular point selection, stimulation methods, treatment indications, and session frequency. Such variability often reflects the range of clinical profiles and therapeutic objectives investigated, making it difficult to establish consistent clinical guidelines (Murakami, 2016). The present study helps address this gap by offering preliminary data that may guide future investigations and contribute to more standardized clinical applications.

Building upon these considerations, some studies have investigated AL, a technique that integrates auriculotherapy with LLLT stimulation of auricular points. This combined approach may improve therapeutic outcomes, as preliminary evidence suggests it can provide pain relief and muscle relaxation in TMD patients (Mira et al, 2024; Rodrigues et al, 2019). It is well established that applying LLLT to AA produces effects similar to those achieved by needle stimulation. AL has been shown to modulate central nervous system activity in a manner comparable to needle acupuncture (Mira et al, 2024). Considering the involvement of central mechanisms in chronic pain, the neuromodulatory effects of auricular acupuncture may represent a relevant therapeutic pathway in this context.

Although this study focused on individuals with myogenous temporomandibular disorder as their primary complaint, it is well established that even studies designed to assess either muscular or articular TMD subtypes in isolation often find diagnostic overlaps, as many patients meet the criteria for both categories (Svensson, Exposto, Costa, 2025). This clinical variability likely reflects the coexistence of different neurobiological mechanisms underlying pain (Asquini et al, 2025). Such diagnostic overlap was also observed in our sample. In this context, the selection of auricular points with therapeutic action targeting the temporomandibular joint (Jaw Point) in combination with points aimed at modulating muscular function, may have contributed to the observed improvements in lateral and protrusive mandibular movements. This integrative approach likely addressed both articular and muscular components of the disorder, enhancing the clinical response.

This pilot study has some limitations. While the sample size was sufficient to detect the observed effect on pain intensity, its small scale restricts the generalizability of results and limits detection of subtler effects. The short follow-up period prevents assessment of long-term outcomes, and pain intensity was measured

only by a subjective scale (VAS), without complementary objective or functional measures.

Furthermore, heterogeneity in laser therapy protocols extends beyond technical parameters to include a wide range of outcome measures, from functional assessments to psychosocial variables. Given the multifactorial nature of TMD and the important influence of psychosocial factors on pain perception and treatment response, future studies should adopt multidimensional outcome measures. RCTs comparing traditional auricular acupuncture, auricular laserpuncture, and combined protocols are needed to clarify whether integrative protocols offer greater clinical benefits.

CONCLUSION

AL at 780 nm and 1.9 J/cm^2, applied in 10 sessions twice weekly over five weeks, reduced pain and improved mandibular function in patients with chronic TMD. These preliminary results encourage further investigation through adequately powered randomized controlled trials to confirm efficacy and clarify underlying mechanisms.

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