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Effects of acupuncture and related techniques in temporomandibular disorders (TMD): A systematic review

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Abstract: Acupuncture has shown promise as a therapeutic option in temporomandibular disorders (TMD). Its benefits include pain relief, reduction of muscle tension and improvement of jaw function. Several alternative approaches, including dry needling and laser acupuncture, were also reported to improve TMD symptoms. This review aims to summarise the most recent studies available on these alternative therapies for TMD. An electronic literature search was conducted in 3 databases, PubMed, Web of Science, and Scopus, in order to identify articles on acupuncture, dry needling, or laser acupuncture. Search development, process, and two-step article selection were conducted by independent researchers. Data was extracted regarding study characteristics, population characteristics, acupuncture points or techniques used, and assessment methods for diagnosis and effects. Out of 431 identified results, 20 were selected for inclusion. We identified 11 studies on acupuncture, 3 studies on laser acupuncture and 6 studies on dry needling. Most studies showed improvement of TMD symptoms post-intervention, assessed by pain scales and maximum mouth opening. Overall, most studies showed promising results for acupuncture as an alternative, minimally invasive treatment method for TMD. When compared to controls or placebo, acupuncture, and related techniques result in significant relief of TMD symptoms.

Keywords: laser acupuncture, acupuncture, dry needling, temporomandibular joint dysfunction, TMD

1. Introduction

TMD represents a group of pathologies affecting masticatory muscles and/or temporomandibular joints and associated structures. It is recognized by both dentists and other healthcare providers as the most common chronic orofacial pain condition, excluding odontogenic causes [1]. Common symptoms include joint pain, muscle tenderness, headaches, restricted range of motion and articular sounds, which can be easily exacerbated by mastication or speech, leading to an impaired function of the orofacial system and affecting daily life [2]. Quality of life is affected in patients suffering from TMD; one of the main determinants of this is chronic pain and the poor quality of sleep derived from matinal feelings of tiredness and jaw soreness [3]. TMDs were reported to affect up to 31% of the adult population and 11% for children and adolescents [4]. Women are two times more likely to develop TMD, tend to show more signs and symptoms of TMD, but are also more likely to seek treatment [5]. Treatments for TMD usu-

ally follow a multidisciplinary approach, dictated by the various aetiologies and manifestations of disorders, patient preferences and effectiveness related to treatment costs and time. Standard treatment methods for TMD include non-surgical and surgical approaches. Non-surgical approaches include treatments such as occlusal splint (OS) therapy, physiotherapy, pharmacotherapy, and counselling [6]. Non-conventional, minimally invasive approaches such as laser therapy, transcutaneous electrical nerve stimulation (TENS), botulinum toxin A injections and acupuncture are also available. These approaches focus on educating patients, improving quality of life and minimizing the risks and costs associated with more complex, invasive interventions [7,8].

Acupuncture is a traditional Chinese medicine (TCM) practice that involves inserting very fine needles into specific points on the body, called acupuncture points, to promote healing, alleviate pain, and restore balance to the body's energy, or "qi". The theory behind body acupuncture is that the body has a network of energy pathways, or meridians, through which qi flows. When this energy flow is disrupted or blocked, it can cause pain, illness, or other health issues. Acupuncture aims to correct these imbalances by stimulating specific points along the meridians, which helps restore the flow of energy, improve circulation, reduce inflammation and promote the body's natural healing processes [9]. This method has shown promising results for patients with temporomandibular disorder (TMD). Reported benefits include pain relief, reduction of muscle tension, improvement of jaw function, reduction of inflammation and stress reduction [10,11].

Several alternative acupuncture techniques and complementary therapies are available in TMD management. These approaches aim to enhance the therapeutic effects by targeting TMD aetiologies, such as muscle tension, inflammation, stress. Specific alternatives and complementary approaches to consider are laser acupuncture, dry needling, electroacupuncture, pharmacopuncture, auricular acupuncture, scalp acupuncture, acupressure, moxibustion, cupping therapy, herbal medicine, stress-reduction techniques (mindfulness and meditation, breathing exercises) [12–18]. Among the aforementioned, dry needling and laser acupuncture are used in practice with increased frequency, to alleviate TMD-related pain symptoms. Laser acupuncture removes the need for needle insertions, low-light laser light being used instead to stimulate traditional acupuncture points. This method is considered simple, painless and safe, but its effectivity is still unclear [19]. Dry needling is a method that uses acupuncture needles inserted to various depths into muscle trigger points (hypersensitive or irritable points located within taut bands of skeletal muscles). These trigger points are considered a major source of musculoskeletal pain, and often accompany chronic musculoskeletal disorders such as TMD. Palpation of a trigger point will manifest in a local or referred pain response and a local twitch [20]. Dry needling was reported to increase jaw range of motion and improve pressure pain threshold (PPT) in patients with myofascial TMD, thus recommending it as a minimally invasive, simple and relatively safe procedure [21].

The aim of this systematic review was to gather and present the most recent studies available in recent literature on acupuncture and two alternative approaches, laser acupuncture and dry needling, thus providing an overview of current knowledge.

2. Results

2.1. Study selection

The search retrieved a total of 431 results. After duplicate removal, 282 articles were screened for title and abstract, of which 27 were selected for retrieval and read in full text form by two independent researchers. Any conflicts regarding studies inclusion or exclusion from study were settled by a third researcher. The level of agreement be-

tween researchers was calculated by the Kappa coefficient (value k= 9.2). Consequently, 20 studies were included in this review. The study selection process is presented in the following PRISMA 2020 flowchart.

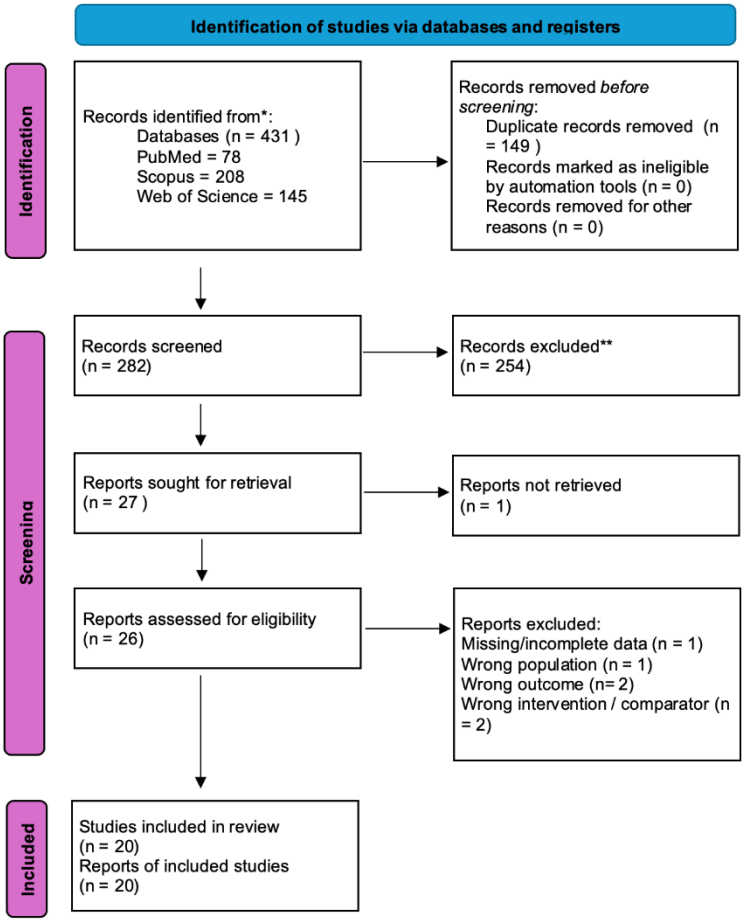

Figure 1: Prisma flowchart of study selection

2.2. Description of included studies

Only studies including adults with TMD were included. Studies on patients with TMD dysfunction, myofascial pain, and myofascial syndrome were included.

From the 20 included studies, 14 are randomised controlled clinical trials (RCCTs). All studies utilised The Research Diagnostic Criteria for Temporomandibular Disorders tools (RDC/TMD or DC/TMD) to diagnose patients with TMD, excepting 2 studies which did not report diagnostic criteria[22,23]. All studies utilised a pain assessment tool (16 studies used the Visual Analogue Scale - VAS, 2 studies used the Verbal Numeric Scale - VNS, 2 studies used other tools). All studies included maximum mouth opening (MMO) or maximum interincisal opening (MIO) or other parameters as specified by RDC/TMD as an additional assessment method.

Included studies are reported based on the main therapeutic approach investigated. Studies investigating multiple treatment methods of TMD, including those of interest to this study, were included if they provided separate group analysis between the investigated therapies and control/placebo groups. Hence, from these studies, only data regarding the study subjects treated with acupuncture, laser acupuncture or DN and control/placebo groups was extracted. Main characteristics of included studies,

along with population, intervention and outcome data are summarised in the subsequent tables. For abbreviations' translations, please consult **"Appendix A -List of abbreviations"** section.

2.2.1. Acupuncture studies

We included 11 studies using acupuncture techniques as interventions. Of these, 8 used body acupuncture interventions, while auricular acupuncture, oral acupuncture and scalp acupuncture were used in 1 study each. 8 studies were RCCTs, 2 were observational retrospective studies and one was a prospective interventional study. 6 studies were conducted in Brazil, 2 studies in Italy, and 1 each in China, Germany and Austria. Sample sizes varied from 28 to 407 participants. Further information is detailed in **Table 1**.

Table 1. Studies on acupuncture

Main author	Year published	Geographic area	Study design	Study population / Groups	Age/gender distribution	Intervention method	Assessment method – TMD diagnosis	Assessment method – outcome	Conclusions	Notes
Aroca et al [24]	2022	Brazil	RCCT	41 Acupuncture group - 16 Sham control group - 16	age mean 26.63, 92.7% F	auricular acupuncture - semipermanent needles on TMJ point 43.3, 0.7 mm depth 1 session/week, 8 weeks	axes I and II of RDC/TMD	VAS, MMO	Improved performance in 9 aspects in the acupuncture group, in an outcome similar to patients treated with an OS	Study comparing auricular acupuncture with OS and control group - data extracted from acupuncture and controls groups
Branco et al [25]	2016	Brazil	prospective interventional study	68 4 groups - all acupuncture interventions	age mean NR, all F	local and distant point acupuncture (points GB20, GV20, TE21, ST6, ST7 and LI4, EX-HN3), 20mm depth 2 sessions/week, 5 weeks	RDC/TMD	ProTMD-Multi, VAS	TMDs involving joint components benefit from local acupuncture, while TMD caused by muscle benefit from distant point acupuncture.	Study comparing local and distant acupuncture interventions
Canales et al[26]	2021	Brazil	RCCT	54 acupuncture group - 18 Control group - 18	mean age 30.3±6.9 years, all F	Acupuncture points GB20, GB21, GB34, BL2, CV23, TE23, LI4, LI11, SI19, LR2 1 session/week, 4 weeks	RDC/TMD (axis I)	VAS, PPT EMG	Self-perceived pain VAS was reduced after 1 month of therapy (P<.001), more than for the control group. There was no significant difference compared to the Botox group.	Study comparing acupuncture with Botox injections and control group - data extracted from acupuncture and controls groups
Zotelli et al. [27]	2017	Brazil	RCCT	40 volunteers: acupuncture group =20, placebo group = 20	Age means 36,5 years, 32 F	Acupuncture points: ST6, ST7, SI18, GV20, GB20, BL10, and LI4	RDC/TMD axes I and II	VAS, MMO	Pain decreased in both groups after four treatment sessions, with no significant difference between groups. Regarding mouth opening limitation, the result was not significant in any of the three open-	

									ing levels studied.	
de Salles-Neto et al [28]	2020	Brazil	RCCT	36 acupuncture group - 18 control - 18	ages 18-60, all F	Acupuncture points LI4, GB34, ST36, SI18, SI19, ST6, ST7, GB20 1 session/week for 5 weeks	RDC/TMD	VAS, SF-MPQ, OHIP-14, MOPDS, MO	Pain intensity reduced after treatment (61% - 1 week and 81% - 1 month) in acupuncture group. Mandibular function and oral-health related quality of life improved significantly in both groups ($p<0.01$). No significant difference was detected between groups for other parameters ($p>0.05$)	
Seritella et al[29]	2023	Italy	Retrospective Observational	28	mean age 49,36 years, 24 F/ 4 M	CV 12, CV10, CV6, CV4, ST24 bilaterally, EX - Ab1 bilaterally, KI17 and KI19 mono or bilaterally, according to pain location	DC/TMD	VNS, MMO, BPI, OBC, PGI-I Scale,	MMO values significantly improved after acupuncture ($p = 0.0002$) and TMD-related pain declined after treatment ($p < 0.001$).	
Şen et al[30]	2020	Germany	RCCT	41 patients: group A: 18 specific acupuncture, group B: 23 non-specific acupuncture	mean age 40, 17. 38 F/3M	Specific acupuncture: BL-2, BL-3, SI-19, ST-7, TE-21, BL-34 and SI-3). Non-specific acupuncture: three nonspecific points bilaterally	DC/TMD	GCPS, MMO, OHRQoL	The level of pain decreased significantly after 4 weeks of treatment in both groups, with no significant difference between them.	Study comparing acupuncture with non-specific acupuncture
Peixoto et al.[31]	2021	Brazil	RCCT	60 acupuncture group - 15 control - 15	18-65 years	Scalp acupuncture - points GV20, GV21, GV22, GV24	RDC/TMD	PSQI, WHOQOL-bref, VAS	Pain level decreased in patients with SA as well as patients with MT and OS. C group has shown no significant improvement of pain reduction. None of the therapies had improved quality of life or sleep.	Study comparing Scalp Acupuncture with Manual Therapy, Occlusal Splint and Controls - data extracted from SA and C groups
Liu et al [32]	2024	China	RCCT	60 acupuncture group - 30 control - 30	age mean 42.3, 26F/4M	bilateral LI4 and GB34; affected-side SI19, ST6 and ST7	DC/TMD	VAS, MMO, GCPS, JFLS-20, DASS-21, PSQI, PPT, EMG	The acupuncture group showed significantly reduced pain intensity ($p<0.001$) and showed improved parameters compared to the control group (jaw opening and movement, GCPS, JFLS-20,	

									DASS-21 and PSQI)	
Serritella et al [33]	2021	Italy	RCCT	60 patients: BA group - 20 EA group - 20	average age: 46,93 years	ST6, ST7, GB20, BL10, LI4, ST36, SP6, LR3	DC/TMD	VNS, PGI-I, BPI	Body Acupuncture is effective in reducing pain and improve the health status of the subject (mood, sleep, quality of life)	Study comparing body acupuncture with electric acupuncture and acupuncture cupping
Simma et al. [34]	2018	Austria	Retrospective clinical study	407 patients,	age 18-75 years, mean age 45 years 315 F	C0/1, CV17-21, LI4-SI3, Area A, intraorally in vestibular and retromolar regions for lower and upper jaw	RDC/TMD	Likert pain scale	After treatment the pain ratings significantly decreased (P<0.001);	Oral acupuncture study

2.2.2 Laser acupuncture studies

We included 3 studies using laser acupuncture as intervention. All studies used low-energy diode laser on acupuncture points. One study was of retrospective observational design, one study had a prospective interventional design, and one study was a RCCT. 2 studies were conducted in Taiwan and one in Iran. Sample sizes varied from 20 to 45 patients. Further information is detailed in **Table 2**.

Table 2. Studies on laser acupuncture

Main author	**Year published**	**Geographic area**	**Study design**	**Study population / Groups**	**Age/gender distribution**	**Intervention method**	**Assessment method – TMD diagnosis**	**Assessment method – outcome**	**Conclusions**	**Notes**
Hu et al [22]	2014	Taiwan	retrospective observational	29	age range 17-67, 25F/4 M	Handy laser Trion (GaAlAs laser diode, 810 nm, 150 mW, pulsed waves) on points ST6, ST7, LI4, Ashi points 3 sessions/wee, 4 weeks	NR	VAS, MMO	VAS score on palpation decreased significantly for patients with acute TMD (p=0.005) and chronic TMD (p<0.001). MMO also increased significantly in patients with acute or chronic TMD (p=0.008; p<0.001)	Study on patients with treatment-resistant TMD
Huang et al [23]	2014	Taiwan	prospective interventional	20 control group - 6	NA for whole sample	low-level energy diode laser - 800 nm, on points ST6, ST7, Ashi, and LI4 1 session/week, min 3 weeks	NR	VAS, MMO	Significant pain relief (p=0.003) post-treatment was achieved in 85% of patients.	
Madani et al [35]	2019	Iran	RCCT	45 Laser acupuncture - 15 controls - 15	33F/12 M, age mean 38 ± 15.3 years	810-nm diode laser used bilaterally on acupuncture points ST6, ST7, LI4	RDC/TMD	MMO, VAS	No significant difference in MMO was observed, but both LLLT and laser acupuncture were effective in pain reduction ($p < 0.05$), and increasing protrusive and excursive mandibular movements.	Study comparing laser acupuncture with LLT and controls - data extracted from laser acupuncture and control group

2.2.3 Dry needling studies

We included 6 studies using dry needling (DN) as therapeutic interventions. 2 studies performed DN on masseter and temporal muscles, 3 on masseter muscles and 1 on lateral pterygoid muscles. 5 studies were RCCTs, while one was prospective interventional. 3 studies were conducted in Spain, 2 in Turkey and 1 in Brazil. Sample sizes varied from 17 to 90 participants. Further information is detailed in **Table 3**.

Table 3. Studies on dry needling

Main author	Year published	Geographic area	Study design	Study population / Groups	Age/gender distribution	Intervention method	Assessment method – TMD diagnosis	Assessment method – outcome	Conclusions	Notes
Blasco-Bonora et al [40]	2017	Spain	prospective interventional	17	age mean 38, 6M/11F	Myofascial trigger points of masseter and temporalis muscles DN, 15-25 mm depth 1 session	RDC/TMD	PPT, VAS, MO	Pain scores (VAS) and MO showed a significant improvement immediately after and at 1 week post-intervention (p<0.001)	
Dib-Zakkour et al [41]	2022	Spain	RCCT	36 dry needling group -16 control - 16	18-40 years, NA	bilateral DDN on masseter muscles trigger points 1 session	RDC/TMD	VAS, T-scan, EMG	Facial pain and muscle activity were significantly reduced and mouth opening range was increased post-procedure.	
Ferreira et al[42]	2024	Brazil	RCCT	60 DN group - 20 controls - 20	18-40 years, age mean 31.3 (DN group)	bilateral DDN on masseter muscles trigger points, 1 session/week, 4 weeks	DC/TMD	VAS, MMO	Significant increasing of mouth opening (p=0.005) and protrusion (p=0.007) was noted, along with pain decrease in both DN and manual therapy groups (p<0.001).	Study comparing DN with manual therapy and controls - data extracted from DN and controls groups
Lopez-Martos et al [43]	2018	Spain	RCCT	60 DDN group - 20 control group - 20 percutaneous needle electrolysis (PNE) - 30	median age 39, 52F/8M	DDN on lateral pterygoid muscle trigger points 1 session/week, 3 weeks	RDC/TMD,	VAS, maximal interincisal opening (MIO)	Statistically significant differences in pain reduction at rest, during chewing, and for maximum interincisal opening (p <0.01) were measured for the PNE and DDN.	Study comparing DN with percutaneous electrolysis and controls - data extracted from DN and controls groups
Ozmen et al [44]	2024	Turkey	RCCT	90 dry needling - 30 control group - 30	18-60 years	DN on masseter and temporal muscles,	DC/TMD	VAS, PSQI, MMO	Dry needling significantly reduces pain, improve quality of life and sleep.	study comparing DN, face yoga and controls - data extracted from DN and controls group
Özden et al. [45]	2020	Turkey	RCCT	60 SDN - 20 DDN - 20 controls 20	18-65 years, 31F/29M	superficial and deep dry needling on masseter muscle trigger points	RDC-TMD	VAS, MMO, PPT	Pain levels was significantly reduced in patients receiving SDN therapy for masseter-related MTMD in comparison with those obtained using DDN therapy	study comparing superficial and deep dry needling interventions with controls

2.3. Risk of bias/quality assessment of studies

We identified 5 studies with an overall low risk of bias, 7 studies with moderate risk of bias and 8 studies with high risk of bias. The studies are presented collectively, but in the same order they were summarised in **Tables 1, 2 and 3.** Therefore, from the acupuncture studies we identified 4 studies with low risk[28,30,32,33], 4 studies with moderate risk [26,27,29,31] and 3 studies with high risk of bias [24,25,34]. From the laser acupuncture studies, we identified 2 studies with high risk of bias[22,23] and 1 study with moderate risk of bias [35]. From the dry needling studies, we identified 1 study with low risk of bias [36], 2 studies with moderate risk of bias [38,41] and 3 studies with high risk of bias [37,39,40].

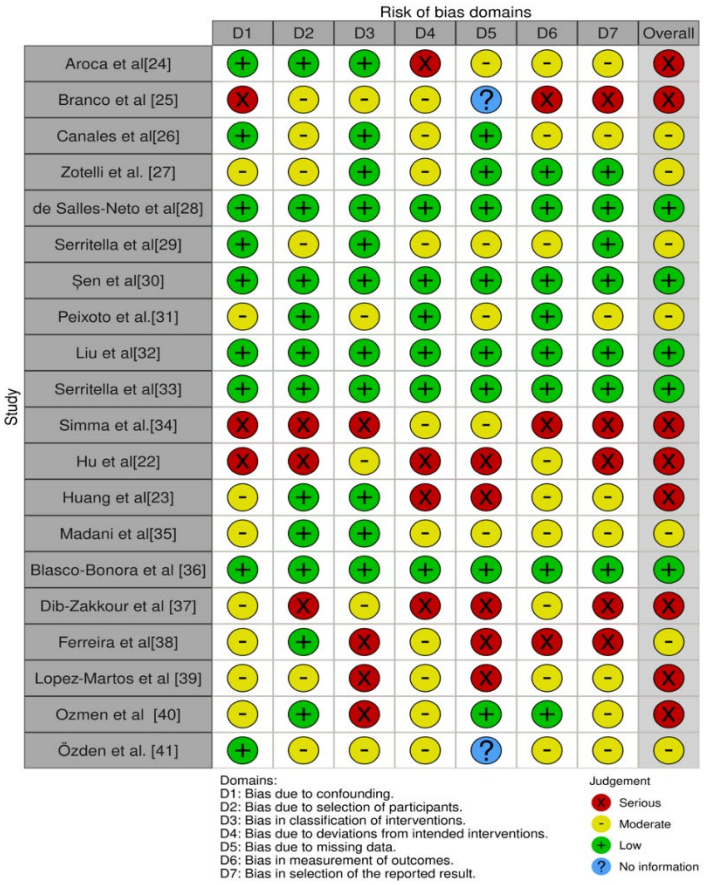

Figure 2. Results of the risk of bias/quality assessment (ROBINS-I)

3. Discussion

This review examined the scientific evidence to assess the effectiveness of traditional acupuncture, laser acupuncture and dry needling in reducing symptoms associated with TMD. It included the most recent studies available on the subject, which all but 2 studies [22,23] used RDC/TMD or DC/TMD as diagnostic tools, thus ensuring diagnostic correctitude and accuracy. All studies used a form of pain assessment scale or form, this being the main outcome evaluated. While most studies showed increased maximum oral opening in the intervention groups, some did not evaluate this outcome [25,26,29,31,34,37]. This leads to difficulty in quantifying the real effect of the interventions. The included studies were also heterogenous regarding acupuncture procedures, acupoints locations, number of points used, and the duration and frequency of treatment received by patients.

Short-term pain reduction was observed in all intervention groups that received acupuncture therapy [24,26–28,30–33]. Moreover, acupuncture demonstrated similar effectiveness to occlusal splint therapy in reducing pain intensity and increasing mouth opening [24,31]. Additionally, acupuncture was found to be more effective than a placebo in reducing pain and functional impairment in TMD patients [24,26,28,31,32]. However, 2 studies [27,30] reported that while pain levels decreased after interventions, there was no significant difference between the acupuncture and the sham-acupuncture (control) groups. Recently, some studies have examined patients' expectations and beliefs as pre-existing mental and brain states that can impact the experience of pain. They found that patients with higher expectations of outcomes or with higher hope for a better outcome, experienced greater improvements. Therefore, it seems possible that both real acupuncture and placebo can effectively alleviate pain in many patients [42–45]. This aligns with the findings of the randomized clinical trial conducted by Assef et al. [46], which did not show a superior analgesic effect between acupuncture and three different acupuncture treatments: acupuncture for an unrelated condition, needle insertion in non-specific sites, or non-invasive sham acupuncture. Several other studies also indicate that genuine acupuncture and placebo or sham acupuncture may both exhibit clinical effectiveness, being each more effective than no intervention at all [47–50]. Overall, evidence seems to indicate that while sham acupuncture might be effective too, true acupuncture can have statistically significant effects on pain relief, thus validating acupuncture as a treatment option in chronic pain conditions [51]. The review conducted by La Touche et al. [52] , when assessing the effects of acupuncture on TMD-associated pain symptoms, concluded that acupuncture is a reasonable adjunct treatment option in TMD patients, producing a short-term pain relief effect. However, due to the significant bias noted in the included studies and the short follow-up period in the studies, the effectiveness of acupuncture for TMD in the long term could not be accurately assessed. A systematic review by Fernandes et al[10] concluded that acupuncture showed results similar to those observed in groups treated with occlusal splints, for patients suffering of myofascial pain. This conclusion should be interpreted with caution, due to the small number of studies involved in this review. Another systematic review by Mohamad et al. [53] investigated the effects of different kinds of acupuncture on patients with orofacial pain. Meta-analysis revealed that acupuncture interventions had statistically significant effects on pain reduction, pterygoid muscles tenderness reduction and jaw dysfunction when compared to sham-acupuncture or lack of treatment on patients suffering from myofascial TMD. However, the overall evidence grade was deemed very low, deeming the results of the study to be interpreted cautiously. These results confirm our own findings regarding the various levels of risk of bias present in current literature on acupuncture, as well as our findings on acupuncture effects on pain.

The effectiveness of laser acupuncture was investigated in three studies [22,23,35] and all studies used low-energy diode laser on acupuncture points. 2 studies concluded in significantly pain relief and increasing MMO [22,23], with one study that showed no difference before and after laser treatment in MMO but cited statistically significant pain relief [35]. In a study by Ferreira et al. [54], laser acupuncture was applied in conjunction with an OS and was compared with a sham-laser acupuncture and OS group, in the treatment of TMD. Both treatments were effective, but the group receiving laser acupuncture had a higher number of patients with symptom remission. This suggests that combining these two therapies may produce better results than using a placebo with occlusal splint alone, thus acknowledging the effect of laser acupuncture. A systematic review and meta-analysis by da Silva Mira et al [55] analysed the effects of laser acupuncture on TMD symptoms, measured in pain and mouth opening levels. The findings mentioned the potential beneficial role of low-level laser therapy (LLLT) in TMD treatment, as both instantaneous pain levels and instantaneous

mouth opening parameters were improved. Low certainty of evidence was cited, however, due to lack of uniformity in the includes studies protocols and the small number of studies included. Another review by Oliveira et al [56] concluded that while the effects of laser acupuncture seem to be beneficial to myofascial pain and temporomandibular disfunction, there are still few studies with high variances in protocols, in terms of laser wavelengths being used, acupoints irradiated, dosages, frequency of treatment, outcome measures and others. However, a recent systematic review by Di Francesco et al. [19] concluded that laser acupuncture was more efficient in treating TMD-related symptoms than placebo interventions. In a study by Bochiș et al, laser was used as an aid in TMD therapy, due to its biotrophic and biostimulent effects. [57].Therefore, due to its pain-relieving properties and conservative therapeutic nature, non-invasiveness and lack of negative effects, laser acupuncture could be indicated in TMD treatment.

Six studies about dry needling that were included in this review showed immediate and long-term pain relief, improvement in jaw function and reduction in muscle tenderness, in comparison with control groups [36–41]. A systematic review and meta-analysis by Vier et al. [58] reached similar conclusions, when investigating the effects of dry needling on TMD-related orofacial pain. While no statistically significant differences were found on MMO when comparing DN with sham therapy, significant differences were found between DN and sham therapy when comparing PPT. DN was also demonstrated to be more efficient in the treatment of myofascial pain than other interventions such as lidocaine injections or paracetamol therapy. DN was found to be as effective in pain reduction as manual therapy, in a systematic review and meta-analysis by Menendez-Torre et al. [59]. While manual therapy was considered most likely to reduce pain, deep DN showed promising results as well. In a study by Sirikaku et al, DN reduced pain intensity in TMD patients, and 84.6% of the study group also maintained reduced pain levels at 90 days, when compared to control group. DN significantly reduced tinnitus intensity and discomfort when compared to control group (sham-DN) [60]. This is significant, considering that in a study by Manziuc et al. 53.8% of TMD patients showed tinnitus and articular noises as symptoms [61]. Although our study cannot replicate these conclusions, due to a short follow-up period in all included studies, the conclusions of the mentioned studies on the efficacity of DN in short-term pain reduction confirm our own, thus validating DN as a treatment method for TMD, to be used by itself or in conjunction with other methods.

The results of our study could serve as evidence for acupuncture and DN being a beneficial alternative treatment for TMD in patients who have limitations with conventional therapies such as pharmacotherapy and physical therapy, or who wish for alternative, minimally invasive methods. The study also verified the effectiveness of acupuncture as a standalone treatment or when used alongside traditional clinical therapies, and indicated that acupuncture combined with other forms of treatment could aid in TMD symptoms relief. Further well-designed, large-scale Randomized Controlled Trials (RCTs) are required to improve the existing evidence on the effectiveness of acupuncture, DN and laser acupuncture in treating TMD.

This study some limitations, most derived from the high heterogeneity of included studies, regarding both treatment methods and study designs and protocols. When evaluating studies on the effects of acupuncture on TMD, the following are typically observed across various studies: small sample sizes, short follow-up periods, lack of standardization, potential for placebo effect, heterogeneity in patient populations, cultural and practitioner differences, limited reporting on adverse effects. While acupuncture is generally considered safe, comprehensive reporting on adverse effects is crucial for evaluating the risk-benefit ratio. All considered, meta-analysis was not available. Included studies presented variations in therapeutic protocols. The small sample sizes

and lack of proper follow-up periods decrease both representability on larger scale and predictability of long-term effects.

This study presents some several notable strengths. Firstly, it adheres to the PRISMA protocols, ensuring a transparent approach to the process of reviewing. Secondly, the comprehensive and broad search strategy ensured the identification of a high number of the most recent studies on the subject. These results were summarised in detail, and discussed based on treatment methods, thus transforming this study in a valuable insight on the subject. Studies were assessed for risk of bias, for further transparency. Furthermore, all studies used the same criteria for TMD diagnosis, and most studies used the same assessment methods, ensuring uniformity and reproducibility of results. The meticulous approach of this study meant that it reached its objectives, providing an extended overview and a basis for further research in this field.

4. Materials and Methods

This study adhered to the PRISMA 2020 guidelines for systematic reviews [60].

This review was designed to answer the following question:

In patients with temporomandibular disorders, are acupuncture and related techniques (laser acupuncture, deep needling) effective in relieving related symptoms, compared to placebo or non-active interventions?

4.1 Inclusion criteria

The inclusion criteria of this systematic review were organized according to the PICOS strategy criteria.

P (population) = human patients suffering from TMD

I (intervention) = acupuncture, laser acupuncture or dry needling as treatment methods for TMD

C (control) = placebo or non-active interventions such as sham acupuncture or sham laser acupuncture, verbal counselling

O (type of outcome measures) = measurable difference in treatment effectivity before and after treatment, based on pain measurement indicators (VAS), maximum mouth opening (MMO), RDC/TMD criteria

S (type of studies) = original studies on humans, observational design, interventional design, both retrospective and prospective design

Additional inclusion criteria: Studies published in the last 10 years before search conclusion

4.2 Exclusion criteria

The following exclusion criteria were applied:

Studies targeting paediatric populations

Animal model studies, cadaver studies, in vitro studies

Studies targeting populations suffering from musculo-skeletal pathologies, cranio-facial traumatisms, or other pathologies or injuries that could interfere with TMD treatment

Studies investigating the effects of investigated interventions in simultaneity with other treatment methods, applied to the same population sample

Study designs: literature reviews and/or meta-analyses, case reports, case series, study protocols, editorials, conference abstracts

Studies not available full-text, or which presented missing/incomplete data regarding X parameters, or retracted studies

Studies published in other languages than English.

4.3 Search strategy

An electronic literature search strategy was developed by CA and PA. This strategy included: identifying relevant search terminology, keyword-related term branching, keyword-oriented search terms grouping, exploratory literature searches and database-controlled vocabulary translation, as well as accommodating searching particularities of each database considered. The electronic literature search was conducted in the following databases: PubMed, Scopus, Web of Science. The electronic literature search for relevant articles was conducted by two independent researchers (CA and PA) until 21.08.2024. The search consisted of keywords (such as Medical Subject Headings or MeSH) for temporomandibular disorders, acupuncture, laser acupuncture and dry needling combined with Boolean operators "AND" and "OR", as well as keyword searching of title, abstract and text words. Date restrictions were applied: from 2014 to 21.08.2024 (the last date of search). Restrictions regarding language (English) and species (humans) were applied. The exact search terminology used in PubMed was:

("acupuncture"[MeSH Terms] OR "acupuncture therapy"[MeSH Terms] OR "dry needling" [MeSH Terms] OR „acupuncture*" or „acupuncture therapy" OR („acupuncture" AND „therap*") OR „laser acupuncture"[tw] OR „dry needling" OR („laser" AND „acupuncture") OR („dry" AND „needl*")) AND ("temporomandibular joint disorders"[MeSH Terms] OR "temporomandibular joint"[MeSH Terms] OR ("temporomandibular"[All Fields] AND "joint*"[All Fields] AND "disorder*"[All Fields]) OR "temporomandibular joint disorders"[All Fields] OR "temporomandibular disorder*" OR "tmd" OR ("temporomandibular" AND "disorder*") OR "temporomandibular disfunction" OR ("temporomandibular" AND "disfunction*") OR "tmj disorder*" OR ("tmj" AND "disorder*")) Filters: **Humans, English, from 2014/8/21 - 2024/8/21**

4.4 Study selection process

The results of the electronic literature searches were exported form each database in library form and were subsequently imported in a reference manager (Mendeley Version 2.116.0). The duplicates were identified and removed using the same software, and a second de-duplication tool (Rayyan) was used to confirm de-duplication results [61]. Remaining articles were screened by title and/or abstract by two independent contributors to the article (CA and PA) and selected based on inclusion and exclusion criteria. Studies considered relevant to this study were manually retrieved full-text and read by 2 independent researchers. The inclusion and exclusion criteria were subsequently applied to select a final number of studies to be included.

4.5 Data extraction

The following data was extracted from the included studies:

General data about the studies (title, main author, country of origin, year of publication, study design)

Population (number of subjects, age/gender distribution)

Exposure and controls (assessment method, type of therapy, groups)

Outcome (assessment method, conclusions)

4.6 Risk of bias and quality assessment

The risk of bias was quantified and assessed by two independent researchers. If any disagreement occurred, a third researcher was asked to intervene. The tool used was the ROBINS-I [62] and the tool used for the visualisation of the assessment was robvis [63] .

5. Conclusions

Based on our research, acupuncture, laser acupuncture and dry needling offer valuable alternatives to conventional treatments in multifactorial pathologies like TMDs. Acupuncture was reported to lower pain thresholds and increase maximum mouth opening when compared to sham acupuncture or other non-active interventions. Laser acupuncture is a viable non-invasive treatment, but its effectivity is yet to be validated by further studies, while dry needling is effective in releasing MTPs and reducing myofascial pain in patients with TMD. Further randomised clinical trials developed with similar protocols on larger samples could validate current findings.

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Appendix A - LIST OF ABBREVIATIONS

BA = body acupuncture
BPI = brief pain inventory
C = counselling
DASS-21 = depression, anxiety and stress scales- 21
DC/TMD =diagnostic criteria for temporomandibular disorders questionnaire by RDC/TMD
DDN= deep dry needling
DN= dry needling
EA = electroacupuncture
EMG= electromyography
GCPS = graded chronic pain scale
JFLS-20 = jaw functional limitations scale-20-item
MMO= maximum mouth opening
MOPDS= Manchester Orofacial Pain Disability Scale
MT = Manual Therapy
MTMD = myofascial temporomandibular disorder
NR= not reported
OBC = Oral Behavior Checklist,
OHIP-14= thee Oral Health Impact Profile
OS = Occlusal Splint
PGI-I Scale = Patients' Global Impression of Improvement scale
PNE = percutaneous needle electrolysis
PPT= pressure pain threshold
ProTMDMulti = protocol for multi-professional centres for the determination of signs and symptoms of temporomandibular disorders
PSQI= Pittsburgh sleep quality index
RCCT = randomised controlled clinical trial
RCT/TMD =The Research Diagnostic Criteria for Temporomandibular Disorders tools
SA = Scalp Acupuncture
SDN = superficial dry needling
SF-MPQ = short version of the McGill pain questionnaire
TENS = transcutaneous electrical nerve stimulation

TMD= temporomandibular disorder
TMJ= temporomandibular joint
VAS = visual analogue scale for pain assessment
VNS= verbal numeric scale for pain assessment
WHOQOL-bref = World Health Organization Quality of Life questionnaire

References

1. Conti PCR, Pinto-Fiamengui LMS, Cunha CO, Conti AC de CF. Orofacial pain and temporomandibular disorders: the impact on oral health and quality of life. Braz Oral Res. 2012;26(spe1):120–3.
2. Trize D de M, Calabria MP, Franzolin S de OB, Cunha CO, Marta SN. Is quality of life affected by temporomandibular disor-ders? Einstein (Sao Paulo). 2018 Nov 29;16(4):eAO4339.
3. Bitiniene D, Zamaliauskiene R, Kubilius R, Leketas M, Gailius T, Smirnovaite K. Quality of life in patients with temporoman-dibular disorders. A systematic review. Stomatologija. 2018;20(1):3–9.
4. Valesan LF, Da-Cas CD, Réus JC, Denardin ACS, Garanhani RR, Bonotto D, et al. Prevalence of temporomandibular joint dis-orders: a systematic review and meta-analysis. Clin Oral Investig. 2021 Feb;25(2):441–53.
5. Bueno CH, Pereira DD, Pattussi MP, Grossi PK, Grossi ML. Gender differences in temporomandibular disorders in adult popu-lational studies: A systematic review and meta‐analysis. J Oral Rehabil. 2018 Sep 15;45(9):720–9.
6. Nandhini J, Ramasamy S, Ramya K, Kaul RN, Felix AJW, Austin RD. Is nonsurgical management effective in temporomandib-ular joint disorders? - A systematic review and meta-analysis. Dent Res J (Isfahan). 2018;15(4):231–41.
7. Alowaimer HA, Al Shutwi SS, Alsaegh MK, Alruwaili OM, Alrashed AR, AlQahtani SH, et al. Comparative Efficacy of Non-Invasive Therapies in Temporomandibular Joint Dysfunction: A Systematic Review. Cureus. 2024 Mar 22;
8. Park EY, Cho JH, Lee SH, Kim KW, Ha IH, Lee YJ. Is acupuncture an effective treatment for temporomandibular disorder?: A systematic review and meta-analysis of randomized controlled trials. Medicine. 2023 Sep 22;102(38):e34950.
9. Wu JY, Zhang C, Xu YP, Yu YY, Peng L, Leng WD, et al. Acupuncture therapy in the management of the clinical outcomes for temporomandibular disorders. Medicine. 2017 Mar;96(9):e6064.
10. Fernandes A, Moura D, Da Silva L, De Almeida E, Barbosa G. Acupuncture in Temporomandibular Disorder Myofascial Pain Treatment: A Systematic Review. J Oral Facial Pain Headache. 2017 Jul;31(3):225–32.
11. Jung A, Shin BC, Lee MS, Sim H, Ernst E. Acupuncture for treating temporomandibular joint disorders: A systematic review and meta-analysis of randomized, sham-controlled trials. J Dent. 2011 May;39(5):341–50.
12. Golanska P, Saczuk K, Domarecka M, Kuć J, Lukomska-Szymanska M. Temporomandibular Myofascial Pain Syndrome—Aetiology and Biopsychosocial Modulation. A Narrative Review. Int J Environ Res Public Health. 2021 Jul 23;18(15):7807.
13. Vier C, Almeida MB de, Neves ML, Santos ARS dos, Bracht MA. The effectiveness of dry needling for patients with orofacial pain associated with temporomandibular dysfunction: a systematic review and meta-analysis. Braz J Phys Ther. 2019 Jan;23(1):3–11
14. Amin LE, Gamily M El. Biological impact of curcumin on the healing of tempromandibular joint in experimentally induced arthritis. J Oral Maxillofac Surg Med Pathol. 2021 May;33(3):260–6.
15. Park KS, Kim ES, Kim KW, Cho JH, Lee YJ, Lee J, et al. Effectiveness and safety of hominis placental pharmacopuncture for chronic temporomandibular disorder: A multi-center randomized controlled trial. Integr Med Res. 2024 Jun;13(2):101044.
16. Deng H, Shen X. The Mechanism of Moxibustion: Ancient Theory and Modern Research. Evidence-Based Complementary and Alternative Medicine. 2013; 2013:1–7.
17. Liu GF, Gao Z, Liu ZN, Yang M, Zhang S, Tan TP. Effects of Warm Needle Acupuncture on Temporomandibular Joint Disor-ders: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Evidence-Based Complementary and Alterna-tive Meicine. 2021 Nov 27;2021:1–10.
18. Baxter GD, Bleakley C, McDonough S. Clinical Effectiveness of Laser Acupuncture: A Systematic Review. J Acupunct Meridian Stud. 2008 Dec;1(2):65–82.

19. Di Francesco F, Minervini G, Siurkel Y, Cicciù M, Lanza A. Efficacy of acupuncture and laser acupuncture in temporomandib-ular disorders: a systematic review and meta-analysis of randomized controlled trials. BMC Oral Health. 2024 Feb 3;24(1):174.
20. Alvarez DJ, Rockwell PG. Trigger points: diagnosis and management. Am Fam Physician. 2002 Feb 15;65(4):653–60.
21. Fernández-Carnero J, La Touche R, Ortega-Santiago R, Galan-del-Rio F, Pesquera J, Ge HY, et al. Short-term effects of dry needling of active myofascial trigger points in the masseter muscle in patients with temporomandibular disorders. J Orofac Pain. 2010;24(1):106–12.
22. Hu WL, Chang CH, Hung YC, Tseng YJ, Hung IL, Hsu SF. Laser acupuncture therapy in patients with treatment-resistant temporomandibular disorders. PLoS One. 2014 Oct 17;9(10).
23. Huang YF, Lin JC, Yang HW, Lee YH, Yu CH. Clinical effectiveness of laser acupuncture in the treatment of temporomandib-ular joint disorder. Journal of the Formosan Medical Association. 2014;113(8):535–9.
24. Aroca JP, Cardoso PM de F, Favarão J, Zanini MM, Camilotti V, Busato MCA, et al. Auricular acupuncture in TMD — A sham-controlled, randomized, clinical trial. Vol. 48, Complementary Therapies in Clinical Practice. Churchill Livingstone; 2022.
25. Branco CA, Fonseca RB, Borges RF, Venezian GC, Magri LV, Mazzetto MO. Perception of the signs and symptoms of tem-poromandibular disorder in females by using the ProTMDMulti protocol and the visual analog scale before and after acupunc-ture treatment. Cranio - Journal of Craniomandibular Practice. 2016 Mar 3;34(2):118–23.
26. De La Torre Canales G, Câmara-Souza MB, Poluha RL, Grillo CM, Conti PCR, de Sousa M da LR, et al. Botulinum toxin type a and acupuncture for masticatory myofascial pain: A randomized clinical trial. Journal of Applied Oral Science. 2021;29.
27. Zotelli VL, Grillo CM, Gil ML, Wada RS, Sato JE, da Luz Rosário de Sousa M. Acupuncture Effect on Pain, Mouth Opening Limitation and on the Energy Meridians in Patients with Temporomandibular Dysfunction: A Randomized Controlled Trial. JAMS Journal of Acupuncture and Meridian Studies. 2017 Oct 1;10(5):351–9.
28. de Salles-Neto FT, de Paula JS, Romero JG de AJ, Almeida-Leite CM. Acupuncture for pain, mandibular function and oral health-related quality of life in patients with masticatory myofascial pain: A randomised controlled trial. J Oral Rehabil. 2020 Oct 1;47(10):1193–201.
29. Serritella E, Galluccio G, Di Paolo C. Abdominal Acupuncture for Non-Responding TMD Patients: a Retrospective Observa-tional Study in General Practice. JAMS Journal of Acupuncture and Meridian Studies. 2023;16(2):56–64.
30. Şen S, Orhan G, Sertel S, Schmitter M, Schindler HJ, Lux CJ, et al. Comparison of acupuncture on specific and non-specific points for the treatment of painful temporomandibular disorders: A randomised controlled trial. J Oral Rehabil. 2020 Jul 1;47(7):783–95.
31. Peixoto KO, Da Silva Bezerra A, Melo RA, De Resende CMBMH, De Almeida EO, Barbosa GAS. Short-Term Effect of Scalp Acupuncture on Pain, Sleep Disorders, and Quality of Life in Patients with Temporomandibular Disorders: A A Randomized Clinical Trial. Pain Medicine (United States). 2021 Apr 1;22(4):905–14.
32. Liu L, Chen Q, Lyu T, Zhao L, Miao Q, Liu Y, et al. Effect of acupuncture for temporomandibular disorders: a randomized clinical trial. QJM: An International Journal of Medicine. 2024 May 6;
33. Serritella E, Galluccio G, Impellizzeri A, Di Giacomo P, Di Paolo C. Comparison of the Effectiveness of Three Different Acu-puncture Methods for TMD-Related Pain: A Randomized Clinical Study. Evidence-based Complementary and Alternative Medi-cine. 2021;2021.
34. Simma I, Simma L, Fleckenstein J. Muscular diagnostics and the feasibility of microsystem acupuncture as a potential adjunct in the treatment of painful temporomandibular disorders: Results of a retrospective cohort study. Acupuncture in Medicine. 2018 Dec 1;36(6):415–21.
35. Madani A, Ahrari F, Fallahrastegar A, Daghestani N. A randomized clinical trial comparing the efficacy of low-level laser therapy (LLLT) and laser acupuncture therapy (LAT) in patients with temporomandibular disorders. Lasers Med Sci. 2020 Feb 1;35(1):181–92.
36. Blasco-Bonora PM, Martín-Pintado-Zugasti A. Effects of myofascial trigger point dry needling in patients with sleep bruxism and temporomandibular disorders: A prospective case series. Vol. 35, Acupuncture in Medicine. BMJ Publishing Group; 2017. p. 69–74.
37. Dib-Zakkour J, Flores-Fraile J, Montero-Martin J, Dib-Zakkour S, Dib-Zaitun I. Evaluation of the Effectiveness of Dry Nee-dling in the Treatment of Myogenous Temporomandibular Joint Disorders. Medicina (Lithuania). 2022 Feb 1;58(2).

38. Ferreira CCQ, Lima KR, Dias-Peixoto MF, Orlando DR, Castelo PM, Pereira LJ, et al. Manual therapy and dry needling im-prove mobility, pain and reduce fear of COVID-19 in temporomandibular disorder patients: Randomized controlled trial. J Bod-yw Mov Ther. 2024 Oct 1;40:620–6.
39. Lopez-Martos R, Gonzalez-Perez LM, Ruiz-Canela-Mendez P, Urresti-Lopez FJ, Gutierrez-Perez JL, Infante-Cossio P. Random-ized, double-blind study comparing percutaneous electrolysis and dry needling for the management of temporomandibular myofascial pain. Med Oral Patol Oral Cir Bucal. 2018;23(4):e454–62.
40. Ozmen EE, Unuvar BS. The effects of dry needling and face yoga on pain, depression, function, and sleep quality in patients with temporomandibular dysfunction. Explore. 2024 Sep 1;
41. Özden MC, Atalay B, Özden AV, Çankaya A, Kolay E, Yıldırım S. Efficacy of dry needling in patients with myofascial tem-poromandibular disorders related to the masseter muscle. Cranio - Journal of Craniomandibular and Sleep Practice. 2020 Sep 2;38(5):305–11.
42. Schafer SM, Geuter S, Wager TD. Mechanisms of placebo analgesia: A dual-process model informed by insights from cross-species comparisons. Prog Neurobiol. 2018 Jan;160:101–22.
43. Caliskan EB, Bingel U, Kunkel A. Translating knowledge on placebo and nocebo effects into clinical practice. Pain Rep. 2024 Apr;9(2):e1142.
44. Vase L, Nørskov KN, Petersen GL, Price DD. Patients' direct experiences as central elements of placebo analgesia. Philosophi-cal Transactions of the Royal Society B: Biological Sciences. 2011 Jun 27;366(1572):1913–21.
45. Rosenkjær S, Lunde SJ, Kirsch I, Vase L. Expectations: How and when do they contribute to placebo analgesia? Front Psychia-try. 2022;13:817179.
46. Assefi NP, Sherman KJ, Jacobsen C, Goldberg J, Smith WR, Buchwald D. A randomized clinical trial of acupuncture compared with sham acupuncture in fibromyalgia. Ann Intern Med. 2005 Jul 5;143(1):10–9.
47. Musial F. Acupuncture for the Treatment of Pain – A Mega-Placebo? Front Neurosci. 2019 Oct 17;13.
48. Moffet HH. Sham Acupuncture May Be as Efficacious as True Acupuncture: A Systematic Review of Clinical Trials. The Jour-nal of Alternative and Complementary Medicine. 2009 Mar;15(3):213–6.
49. Linde K, Niemann K, Meissner K. Are Sham Acupuncture Interventions More Effective than (Other) Placebos? A Re-Analysis of Data from the Cochrane Review on Placebo Effects. Forschende Komplementärmedizin / Research in Complementary Medi-cine. 2010;17(5):1–1.
50. Haake M. German Acupuncture Trials (Gerac) For Chronic Low Back Pain<subtitle>Randomized, Multicenter, Blinded, Parallel-Group Trial With 3 Groups</subtitle> Arch Intern Med. 2007 Sep 24;167(17):1892.
51. Vickers AJ, Vertosick EA, Lewith G, MacPherson H, Foster NE, Sherman KJ, et al. Acupuncture for Chronic Pain: Update of an Individual Patient Data Meta-Analysis. J Pain. 2018 May;19(5):455–74.
52. La Touche R, Angulo-Díaz-Parreño S, de-la-Hoz JL, Fernández-Carnero J, Ge HY, Linares MT, et al. Effectiveness of Acupunc-ture in the Treatment of Temporomandibular Disorders of Muscular Origin: A Systematic Review of the Last Decade. The Journal of Alternative and Complementary Medicine. 2010 Jan;16(1):107–12.
53. Mohamad N, de Oliveira-Souza AIS, de Castro-Carletti EM, Müggenborg F, Dennett L, McNeely ML, et al. The effectiveness of different types of acupuncture to reduce symptoms and disability for patients with orofacial pain. A systematic review and meta-analysis. Disabil Rehabil. 2024 Feb 15;1–17.
54. Ferreira LA, de Oliveira RG, Guimarães JP, Carvalho ACP, De Paula MVQ. Laser acupuncture in patients with temporoman-dibular dysfunction: a randomized controlled trial. Lasers Med Sci. 2013 Nov 5;28(6):1549–58.
55. da Silva Mira PC, Biagini ACSCF, Gomes MG, Galo R, Corona SAM, Borsatto MC. Laser acupuncture to reduce temporoman-dibular disorder (TMD) symptoms: systematic review and meta-analysis. Lasers Med Sci. 2024 Feb 20;39(1):66.
56. de Oliveira RF, da Silva CV, Cersosimo MCP, Borsatto MC, de Freitas PM. Laser therapy on points of acupuncture: Are there benefits in dentistry? J Photochem Photobiol B. 2015 Oct;151:76–82.
57. Bochiș C.F., Pop M.S., Bochiș S.A., Botea M.O., Pop M.G., Nistor-Cseppento C.D., Bungău A.F., Dogaru B.G., Tarce A.G. - Tem-poromandibular joint dysfunction syndrome – a therapeu-tic approach. Balneo and PRM Research Journal 2023, 14(2): 546

58. Vier C, Almeida MB de, Neves ML, Santos ARS dos, Bracht MA. The effectiveness of dry needling for patients with orofacial pain associated with temporomandibular dysfunction: a systematic review and meta-analysis. Braz J Phys Ther. 2019 Jan;23(1):3–1
59. Menéndez-Torre Á, Pintado-Zugasti AM, Zaldivar JNC, García-Bermejo P, Gómez-Costa D, Molina-Álvarez M, et al. Effec-tiveness of deep dry needling versus manual therapy in the treatment of myofascial temporomandibular disorders: a systematic review and network meta-analysis. Chiropr Man Therap. 2023 Nov 3;31(1):46.
60. Sirikaku K, Watinaga GK, de Souza Moraes S, Guimarães TB, Onishi ET. Effect of Dry Needling on the Masseter Muscle in the Tinnitus Perception of Patients with Temporomandibular Disorder. J Maxillofac Oral Surg. 2023 Sep 28;22(3):571–8.
61. Manziuc M.M., Almășan O., Kui A., Negucioiu M., Ispas A., Stupinean M., Varvară B., Buduru S. - Temporomandibular disor-ders, occlusal splints, and treatment options: a survey-based investigation Balneo and PRM Research Journal 2023, 14(4): 608
62. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Syst Rev. 2021 Dec 1;10(1).
63. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Syst Rev. 2016 Dec 5;5(1):210.
64. Sterne JA, Hernán MA, Reeves BC, Savović J, Berkman ND, Viswanathan M, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ. 2016 Oct 12;i4919.
65. McGuinness LA, Higgins JPT. Risk ‐ of ‐ bias VISualization (robvis): An R package and Shiny web app for visualizing risk ‐ of ‐ bias assessments. Res Synth Methods. 2021 Jan 6;12(1):55 ‐ 61.