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REVIEW

Psychological treatments for temporomandibular disorder pain—A systematic review

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Abstract

Objective: Temporomandibular disorders (TMD) are common. They affect abilities for carrying out daily tasks and influence different psychological aspects. In addition to standard treatment, psychological treatments have been suggested. The aim was to investigate the effects of psychological treatments on patients with painful TMD in a short- and long-term perspective.

Materials and Methods: An electronic search was conducted in the databases MEDLINE, CINAHL, EMBASE, the Cochrane Central Registry of Controlled Trials (CENTRAL), and Web of Science for randomized clinical trials (RCTs) reporting psychological interventions for TMD. Registered beforehand in PROSPERO (CRD42022320106). In total, 18 RCTs were included; six RCTs that could be used in the meta-analysis, and all 18 RCTs were used in the narrative synthesis. Risk of bias was assessed by the Cochrane's tool for assessing risk of bias and certainty of evidence by GRADE.

Results: The narrative synthesis indicates that psychological treatment options seem equivalent to standard treatment for painful TMD. The meta-analysis showed that a combination of psychological treatment and standard treatment and manual treatment (very low-quality evidence) are significantly better in pain reduction than just counselling and standard treatments of TMD.

Conclusion: This study indicates that psychological treatments seem to reduce pain intensity in individuals with painful TMD, and that the effect seems to be equally good as standard treatment. However, a combination of psychological treatments and standard treatments seems to have an even better effect. This indicates that psychological treatments are promising as an additional treatment approach for painful TMDs.

KEYWORDS
craniomandibular disorders, anxiety, stress, psychological treatment, systematic review, treatment

1 | INTRODUCTION

The complexity of chronic pains and their multifactorial biopsychosocial aetiology is well known.[1–4] In the orofacial region these pains are clustered under the umbrella term temporomandibular disorders (TMD).[5] TMDs have a prevalence of 5%–12%,[6,7] and are, after low back pain, the second most common musculoskeletal conditions that cause pain.[8] Women are more liable to suffer from TMD than men,[9] two out of three patients with TMD are women.[10] Gold standard for examining TMD patients today is the Diagnostic Criteria for TMD (DC/TMD) that comprises of two axes; DC/TMD Axis I and Axis II. The DC/TMD Axis I protocol includes reliable, strictly specified and valid diagnostic criteria for the most common painful TMDs, and the most common intra-articular conditions.[6] When it comes to DC/TMD Axis II, it includes validated and reliable questionnaires or measures regarding the biopsychosocial perspectives of the patient suffering from TMD, that is, their psychosocial status and pain-related disability,[6] Thus, Axis II can be used to identify any underlying psychosocial factors, such as anxiety, depression or stress, contributing to the TMD symptoms. Finally, according to DC/TMD Axis I, painful TMD conditions can be divided into three subgroups (a) muscle-related pains, that is, myalgia, local myalgia, myofascial pain and myofascial pain with referral; (b) joint-related problems, that is, arthralgia; and (c) headache attributed to TMD.[6]

TMDs are thought to be triggered by several risk factors such as psychosocial, autonomic and genetic factors[11] and are *biopsychosocial* in nature.[12] This means that they reflect the interactions between biological, psychological and social perspectives on pain.[13] While biological aspects of TMD can include genetic factors, physical health, pain modulation, hormonal changes and sex, psychological aspects on TMD can involve individual beliefs, coping abilities, anxiety, fear, depression, sleep disturbance and mood changes. In addition, social aspects of TMD can include relationships, communication and intimacy, culture, socioeconomic status, as well as school or work environments.[14,15] Certainly, TMDs are not just common, they are also known to have significant impacts on the quality of life and on daily activities.[14,16] Besides individual suffering, TMDs cause societal problems, such as increased absence due to illness and health care costs.[17] In relation to the latter, individuals with TMDs will most likely will visit a large number of different care providers, and that both nonmedical and nondental treatment approaches are common, with a moderate degree of treatment satisfaction.[18]

There are several treatment approaches for TMDs, and all these approaches start with providing the individual with information about the condition and causal relationships, as well as counselling with individualized instructions on self-care.[19–21] Physiotherapy is a treatment that enables the individual to improve the function of the temporomandibular region. This treatment is based on the biopsychosocial model where the body and movement interact with cognitive, emotional and social aspects.[22] Additionally, local physiotherapy in the form of jaw exercises has been shown to be effective for pain reduction and involves a low cost for the patient.[23–25] In cases where patients are clenching or grinding their teeth occlusal appliances can be considered, since they have been shown to both reduce pain and protect the teeth.[26–28] When it comes to pharmacological treatments (such as analgesics and anti-inflammatory drugs) it has been suggested that they should be prescribed for a limited period of time,[29] and only as part of a treatment plan. This, because it has been shown that prescription of analgesics often leads to more frequent recurrent TMD pains, reduced effect of the drug and increased risk of drug abuse.[30–32]

Although psychological factors are known to be risk factors for developing TMD the effect of psychological treatments for TMD is still unclear. It has been shown that there is a connection between TMD and psychiatric comorbidity.[33] It has further been suggested that psychiatric comorbidity worsen acute TMD and jeopardize the treatment outcome, consequently predisposing TMD to chronicity.[34] Psychological treatments have been shown to be effective not only for psychiatric conditions but also physical diseases,[35] chronic pain[36] and headache,[37] however, no meta-analysis have yet been made for TMD. Therefore, it is of great importance to investigate the role of psychological treatments for patients suffering from TMD. These treatments could consist of cognitive behavioural treatment (CBT) or cognitive behavioural skills training (CBST), hypnosis, biofeedback, counselling, relaxation treatment or patient education/attention control condition.[38–42] Therefore, the aim of this systematic review and meta-analysis was to investigate the effect of psychological treatments on individuals with TMD in both a long- and short-term perspective.

2 | MATERIALS AND METHODS

2.1 | Protocol

This systematic review, including a meta-analysis (MA), is based on randomized controlled clinical trials (RCTs). The review was registered a priori in the PROSPERO database (the International Prospective Register of Systematic Reviews) with the identification number CRD 42022320106. The MA was performed according to the Preferred Reporting Items for The PRISMA Extension Statement for Reporting of Systematic Reviews Incorporating Network Meta-Analyses of Health Care Interventions (the PRISMA-P checklist)[43] (Appendix S1).

2.2 | Protocol

The research question was formed by using the PICOTS framework. PICOTS is an acronym for P = patients, I = intervention, C = control/comparison, O = outcome, T = time and S = study type and is used to formulate a question that is not too focused, yet not too broad.[44]

Based on PICOTS, the following research question was formulated: In adult individuals with temporomandibular disorders (P)

which effect does psychological treatments have (I) compared to other psychological treatments as well as to other treatments (C) regarding pain and jaw function (O), in short-, intermediate- or long-term (T).

(P) Patients: Adult patients diagnosed with TMD; according to the previous research diagnostic criteria for TMD (RDC/TMD)[45] or the present diagnostic criteria for TMD (DC/TMD)[6] protocols as well as adult patients with a clear clinical diagnosis confirmation by presence signs and symptoms of TMD.

(I) Intervention: The included interventions were (a) cognitive behavioural treatment (CBT); (b) hypnosis; (c) biofeedback; (d) cognitive behavioural skills training (CBST); (e) counselling; (f) education/attention control condition; (g) relaxation; (h) counselling and occlusal appliance; (i) CBT + usual treatment; (j) CBT and/or biofeedback; and (k) behavioural treatment.

(C) Comparator: The included comparators were (a) standard treatment for TMD, such as occlusal appliance, jaw exercises and pharmacological treatments; (b) no treatment; (c) simple verbal instructions ('no treatment' and 'simple verbal instructions' are group as 'control' in the analysis).

(O) Outcome: The outcome variables were pain reduction using a visual analogue scale (VAS 0–100), a numeric rating scale (NRS; 0–10), maximum voluntary mouth opening capacity with pain, maximum voluntary mouth opening capacity without pain and psychological outcomes.

(T) Time: All reported follow-up times, from short-, that is, ≤ 3 months, intermediate- 3-5 months or long-term ≥6 months.

(S) Studies: Only randomized controlled trials (RCT) that reported the outcomes of interest were included.

The inclusion criteria that were applied were as follows: (1) Participants of the age 18 or older; (2) patients with painful TMD diagnosis that underwent one or several psychological treatments and had control groups that either got no treatment, manual treatment, placebo, standard treatment, psychological treatments or a combination of these.

The following exclusion criteria were applied: (1) Studies that cannot be found in another languages other than English; (2) non-randomized clinical trials, case-series, observational studies, editorials letters, legal cases, interviews, cross-sectional studies, case–control studies; as well as cohort studies; (3) review studies; (4) publications using duplicated data; (5) studies with diagnosis other than TMD; (6) study population with ages below 18 years.

2.3 | Search strategy and study selection

The aim of the search strategy was to identify randomized controlled clinical trials that reported data on psychological interventions for adult patients diagnosed with TMD. The search strategy was developed in MEDLINE (Ovid) in collaboration with the librarians Jonas Pettersson (JP) and Narcisa Hannerz (NH). The search strategies were then peer-reviewed by NH before JP performed the searches. Together with the author NC each search concept was identified using the Medical Subject Headings (MeSH-terms) and free text terms. After that, the search was translated, in part using Polyglot Search Translator,[46] into the other databases used in the search. The electronic search was performed June 28th, 2022 and included all relevant RCTs, in any language and with any publication date, from the databases MEDLINE, EMBASE, CINAHL, the Cochrane Central Registry of Controlled Trials (CENTRAL) and Web of Science from the inception of each database to June 28th, 2022. The method presented by Bramer et al. (2016), was used for de-duplication.[47] As a final extra step, comparison of the DOIs was implemented and a search in the reference-lists of the included studies as well as several systematic reviews was performed. However, this did not result in any more full-texts to include, thus there was no grey literature added. The complete search strategies for all databases are available in (Appendix S2).

The tool Rayyan was used to avoid any risk of biasness; in the process of screening.[48] This was done by two of the authors (BZ and NM), that independently and blinded from each other screened each title and abstract. In cases of disagreement regarding potentially eligible studies the authors NC (for TMD related questions and study designs) and RS (for questions regarding psychological treatments) resolved the conflict by discussion, thus having the role of a judge. When all disagreements were resolved the authors (BZ and NM) attempted to retrieve the full-texts of the included and potentially eligible RCTs. All retrieved studies were then reviewed in full-text by the same authors (BZ and MN) to determine whether they aligned with the inclusion criteria or not. Any conflict was, as before, resolved by discussion with the author NC.

2.4 | Data extraction

A data extraction form was designed, developed and pilot-tested independently on three randomly selected studies by the two of the authors (BZ and MN) to ensure consistency in extraction. The extracted data included information on the characteristics of the included studies and study participants, such as the authors, diagnosis/criteria that had been used, mean age of patients, male–female ratio, treatment groups (and their number), duration of the treatments/frequency, timepoints for the follow-ups, risk of bias and outcome measures. Any conflict in the data extracting process was resolved by the author EA, who had the role of a judge.

2.5 | Analysis of risk of bias and certainty of evidence

In this meta-analysis, the risk of bias was determined for all included RCTs using version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB2).[49] Both authors (BZ and NM) evaluated the risk of bias for each study blinded and independently. In cases where conflict arose it was resolved by discussion with the author MC, having the role of a judge. The RoB2 consists of a fixed set

divided into five domains of bias, that evaluates different aspects of the included RCTs, such as design, conduct or reporting. The judgement of the risk of bias is generated by an algorithm and can be either a *low* or a *high* risk of bias, or that the included RCT can express *some concerns*.

For this meta-analysis, the certainty of evidence was assessed by the author EA, using the tool GRADE; an acronym for Grading of Recommendations Assessment, Development and Evaluation.[50] GRADE was implemented to identify the certainty of effect estimates regarding pain intensity, that is, the outcome of interest, in the present meta-analysis. Based on GRADE, there are four levels of quality of evidence for RCTs: (1) *high quality of evidence*, that is when the real effect close to that of the estimated effect; (2) *moderate quality evidence*, that is when the actual effect is likely to be near to the estimated effect, but there is a possibility it is substantially different; (3) *low-quality evidence*, that is when the real effect may be significantly different from the estimated effect; and (4) *very low-quality evidence*, that is when the real effect is likely to be significantly different from the estimate of the effect. When using GRADE, the included RCTs were downgraded based on limitations in the study design (risk of bias), inconsistency, imprecision, indirectness and/or publication bias. Thus, in the assessment all included RCTs begin as having a high-quality level of evidence.

2.6 | Data synthesis

A network-plot was made prior to the MA of this review to evaluate whether the randomized clinical trials had any connections,[51] as shown in Figure 2. The MA connected outcomes, such as post-treatment pain intensity for TMD, maximum mouth opening without pain (MMOwoP) and maximum mouth opening with pain (MMOwP). Since only a minority of the studies had an outcome measure for psychological outcomes there was no possibility to conduct a network meta-analysis, so a plain MA was conducted on pain-related outcomes for ranking of treatments and effect in pain intensity reduction, while a narrative synthesis was performed for the other outcome variables. The data that was of interest for the MA was the pre- and post-treatment values in the form of standardized mean difference (SMD) for each RCT. When the MA was finished it could be seen as an overview for the pre-treatment and post-treatment, that is, for all treatments, controls and nontreatments. The number of patients comprised the statistical unit that was used.

The methodology of this study is one that aligns with previous publications in our group and has previously been described.[52–55] The meta-analysis was constructed, like the previous articles that our research group has been involved in, by using the tool of mvmeta command in the software STATA (StataCorp. 2011. Stata Statistical Software: Release 15. College Station, TX). When it came to reveal any potential of local inconsistency we used the loop-specific approach, and this was performed separately, for all closed loops of the network. When it came to the inconsistency factor, we investigated if there were any differences in direct and indirect estimates, and this was for a defined comparison. The importance in finding inconsistency factors and their 95% confidence intervals (CI) is to enable the authors to detect any inconsistency, for each loop. A common heterogeneity estimate had to be assumed.[56] When analysing the mean of pain reduction, follow-up time and the scale of VAS (0–100) were used. This enabled the authors to assess how and/or if the duration of the follow-up had an impact on the post-treatment pain intensity. As previously mentioned, the studies that had a high risk of bias were excluded from this study. We estimated and ranked the outcome probabilities for each intervention, and this resulted in a hierarchy for treatments. We then evaluated this by surface under the cumulative ranking (SUCRA); both curves and ranks for the mean.[57,58] The surface under the cumulative ranking can be presented in different ways. One way in which it can be presented is in percent of treatments that may be ranked, but in the absence of certainty.[58]

3 | RESULTS

3.1 | Literature search outcome

The entire search before deduplication resulted in 2473 studies from all included databases. After removal of 661 duplicates, a total of 1812 articles were then screened by their title and abstract. The screening resulted in 49 full-texts that were sought for retrieval. Twenty-six full-texts did not meet the inclusion criteria and five did only report data as figures, thus resulting in a total of 18 included RCTs.[38–42,59–71] Data could be extracted from six studies for the meta-analysis, and even though the authors from the other studies were repeatedly (at least three times) contacted, no response was provided so the meta-analysis is based on these six studies.[39,40,59,63,64,68] However, a narrative synthesis of all 18 studies is also presented in the results section. The PRISMA flow diagram including the process of evaluating RCTs for inclusion is shown in Figure 1.

3.2 | Presentation of network geometry

Six interventions (combination of treatments, standard treatment for TMD, counselling, CBT, manual therapy and control group) were included in the network diagrams for the outcome of post-treatment pain intensity via VAS, as shown in Figure 2.

3.3 | Study characteristics, individual data, risk of bias and certainty of evidence

The study characteristics of the included RCTs are reported in Table 1. Thirteen of the studies were shown to have a low risk of bias (green).[38,39,41,42,59,61,62,64,67–71] One had some concerns

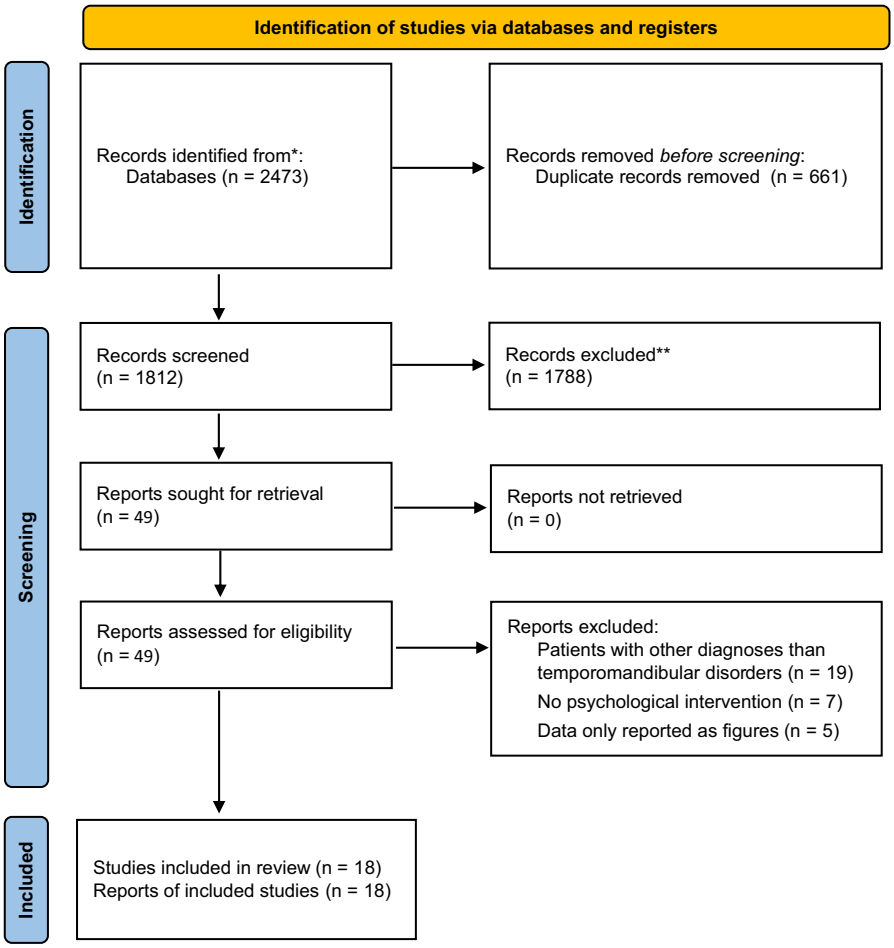

FIGURE 1 The figure illustrates the PRISMA flow chart of the database search strategy.

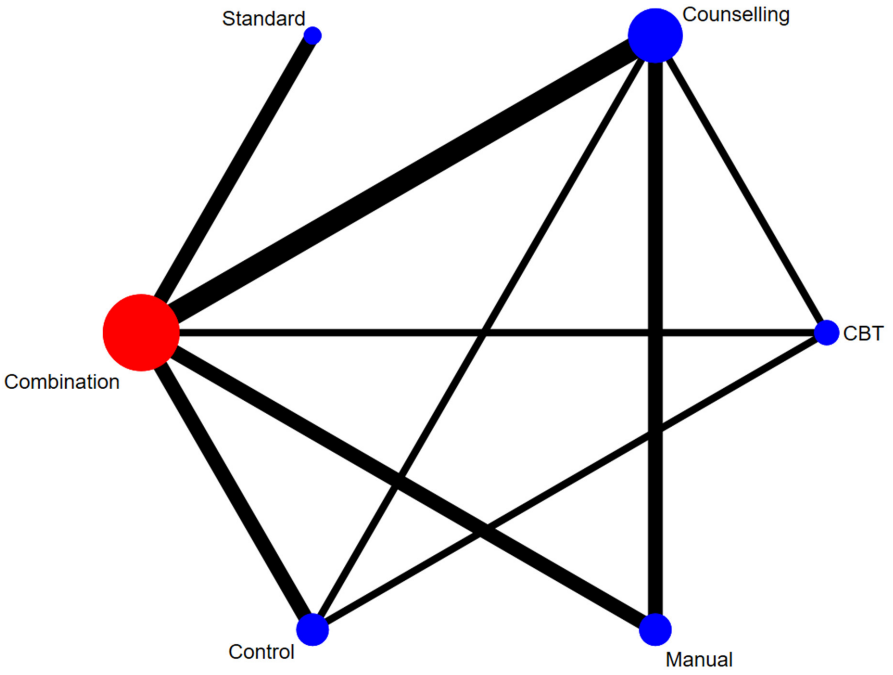

FIGURE 2 The figure illustrates the network geometry for the outcome of post-treatment pain intensity. CBT, cognitive-behavioural treatment.

(orange),[40] while four showed a high risk of bias (red),[60,63,65,66] as shown in Table 2. When it comes to the MA estimates, the certainty of evidence was of very low-quality of evidence for all comparisons (combination of psychological intervention and standard treatment, standard treatment, counselling, CBT, manual therapy and control group).

TABLE 1 The extracted study characteristics of the 18 included randomized controlled trials.

Authors	Study design	Subgroup diagnosis	Criteria used	Age of patients	Male:Female ratio	Treatment groups (n of participants)	Duration of treatments/ frequency	Outcomes measure	Follow-up time	Risk of bias
Abrahamsen et al., 2009	RCT	Myofascial pain	RDC/TMD	G2: 40.9 G3: 38.6	G2: 0:20 G3: 0:20	G2: Hypnosis (20) G3: Relaxation (20)	G2: four 1-hour sessions G3: four 1-hour sessions	Pain VAS MMOwP MMOwoP	Immediately after treatment	Low risk
Abrahamsen et al., 2011	RCT	Myofascial pain	RDC/TMD	G2: 40.9 G3: 38.6	G2: 0:19 G3: 0:20	G2: Hypnosis (19) G3: Relaxation (20)	G2: four 1-hour sessions G3: four 1-hour sessions	Pain VAS MMOwP MMOwoP	1 week after treatment	Low risk
Costa et al., 2015	RCT	Myofascial pain	RDC/TMD	G8: 36.0 G9: 27.5	G8: 1:9 G9: 1:9	G8: counselling (30) G9: counselling + occlusal appliance (30)	G8: one session and repeated twice G9: two sessions and followed up twice	Pain VAS	5 months	High risk
Dura-Ferrandis et al., 2017	RCT	TMD	RDC/TMD	G10: 39,57 ± 13,82 G34: 38,38 ± 16,57	G10: 4:26 G34: 3:26	G10: CBT + standard therapy (41) G34: occlusal splint, jaw exercises, NSAID and/or muscle relaxants medication (31)	G10: six 1-hr sessions distributed over a period of 2.5 months G34: Standard treatment 1–2 visits	Pain VAS MPI BSI-18 Scale—PCS	9 months	Low risk
Dworkin et al., 2002	RCT	TMD	RDC/TMD	G33: 39.3 ± 1.4 G10: 38.6 ± 1.3	G33: 1:5 G10: 1:5	G33: physiotherapy, patient education, medication, occlusal appliance (58) G10: CBT + standard therapy (59)	G33: 4 months G10: 4 months	Pain VAS GCPS	12 months	Low risk
Ferrando et al., 2012	RCT	TMD with muscular diagnosis	RDC/TMD	39 years	7:65	G10: CBT + standard therapy (41) G32: pharmacological pain control, supportive patient education, physical therapy, occlusal splint (31)	G10: six 1-hr sessions distributed over a period of 2.5 months G32: Standard treatment 1–2 visits	Pain VAS MCGill MPI BSI-18	9 months	High risk
Gardea et al., 2001	RCT	TMD	RDC/TMD	G4: 37.4 ± 10.8 G1: 35.1 ± 9.49 G11: 35.1 ± 8.56 G29: 36.5 ± 11.4	G4: 4:21 G1: 3:17 G11: 3:17 G29: 23:77	G4: biofeedback (27) G1: CBT (24) G11: biofeedback + CBST (29) G29: no treatment (28)	12 individual sessions (1–2 h). First 4 weeks, sessions were twice a week. Last four sessions, spread 1 week apart	Pain VAS GCPS	1 year	Some concerns
Gatchel et al., 2006	RCT	TMD/HR acute jaw pain	RDC/TMD	37.76 years	G7: 21,4: 78,6 G29: 17,8: 82,2	G7: (CBST+Biofeedback) (56) G29: no treatment (45)	12 sessions 1, 5–2 h each.	Pain VAS	1 year	Low risk

(Continues)

TABLE 1 (Continued)

Authors	Study design	Subgroup diagnosis	Criteria used	Age of patients	Male:Female ratio	Treatment groups (n of participants)	Duration of treatments/ frequency	Outcomes measure	Follow-up time	Risk of bias
Huttunen et al., 2019	RCT	TMD	RDC/TMD	G28: 43.2 ± 13.3 G12: 44.0 ± 13.1	G28: 7:32 G12: 11:30	G28: masticatory exercises + occlusal splint + counselling (39) G12: counselling + muscle exercises (41)	Stretching fingers for 10–20 seconds; 7–10 times. This had to be done 2–3 times a day	Pain VAS	Follow-up at 1 month, 3 months, 6 months and 12 months	High risk
Kurt et al., 2011	RCT	TMJ	RDC/TMD	G5: 27.16 ± 8.08 G13: 26.9 ± 11.01 G14: 26.55 ± 10.19	G5: 3:29 G13: 5:17 G14: 9:11	G5: occlusal splint (35) G13: behavioural therapy (35) G14: anterior repositioning splint (35)	G5: at night for 6 months G13: NM G14: at night for 6 months	VAS pain GCPS MMOwP MMOwoP	Seven follow-up visits within 6 months	High risk
Litt et al., 2010	RCT	TMD	RDC/TMD	39.4 ± 12.1	16:85	G31: disoccluding splint + non steroidal anti-inflammatory drugs + instruction regarding a soft diet (49) G10: standard therapy + CBST (52)	G31: Treatment 6 sessions once a week G10: Treatment 6 sessions once a week.	VAS pain CESD depression PRSS	6 weeks, 12 weeks, 24 weeks, 36 weeks and 52 weeks	Low risk
Melo et al., 2020	RCT	TMD	RDC/TMD	28 ± 9.34	2:7	G5: occlusal splint (24) G8: counselling (19) G9: occlusal splint + counselling (25) G19: manual therapy (21)	G5: 4 weeks G8: 4 weeks G9: 4 weeks G19: 4 weeks	Pain VAS HADS BAI STAI	Immediately after 4 weeks of treatment	Low risk
Shedden Mora et al., 2013	RCT	TMD	RDC/TMD	G5: 34.3 ± 12.5 G7: 36.3 ± 13,4	G5: 8:19 G7: 1:5	G5: occlusal splint (27) G7: biofeedback + CBT (29)	G6: 8 weeks G8: 8 weekly sessions	Pain VAS	6 months	Low risk
Stam et al., 1984	RCT	TMD (TMPDS)	Clinical examination	25.7 years ±7	2:8	G21: hypnosis + Cognitive coping skills (12) G22: relaxation + cognitive coping skills (15) G29: no treatment (14)	Mean duration 23 months (SD = 26)	Pain VAS	2–4 weeks post-treatment	Low risk
Takeuchi-Sato et al., 2020	RCT	TMD	RDC/TMD	30.7 ± 8.7	G24: 3:7 G23: 5:5 G30: 5:5	G24: simple verbal instructions (10) G23: cbt with sticky note (10) G30: cbt, email based recording (10)	20-day intervention period	Pain VAS	Immediately up to 3 days	Low risk

TABLE 1 (Continued)

Authors	Study design	Subgroup diagnosis	Criteria used	Age of patients	Male:Female ratio	Treatment groups (n of participants)	Duration of treatments/ frequency	Outcomes measure	Follow-up time	Risk of bias
Turner et al., 2005	RCT		TMD	G1: 39.3 ± 11.1 G25: 35.4 ± 10.5	2:10	G1: cbt (61) G25: education/ attention control condition (65)	8 weeks	GCPS	Immediately after 8 weeks of treatment	Low risk
Turner et al., 2006	RCT		TMD	G1: 38,9 ± 11.6 G25: 35.7 ± 10.9	G1: 5:31 G26: 5:33	G1: cbt (79) G25: education/ attention control condition (79)	Four individual biweekly sessions over 8 weeks	GCPS MFIQ 21-BDI CPCI	3, 6 and 12 months	Low risk
Turner et al., 2007	RCT		TMD	NM	2:10	G1: CBT (55) G25: education/ attention control condition (60)	Four individual biweekly sessions over 8 weeks	VAS pain 21-BDI MFIQ SCL-90 PSS SOPA CSQ PCS CPCI 8-item TMD - SES	1 year post-treatment	Low risk

Note: G1: CBT, G2: Hypnosis G3: Relaxation G4: Biofeedback G5: Occlusal splint G6: CBST (Cognitive – behavioural skills training) G7: CBST + biofeedback G8: Counselling G9: Counselling + occlusal splint G10: CBT + usual therapy G11: Cognitive behavioural therapy or/and biofeedback G12: Counselling + masticatory muscle exercise G13: Behavioural therapy G14: Anterior repositioning splints (ARS) G15: Standard therapy + cognitive skills training G16: Jaw movement exercise G17: Jaw movement exercise + psychological intervention G18: Pharmacological therapy G19: Manual therapy G20: Biofeedback based behavioural treatment G21: Hypnosis + cognitive coping skills G22: Relaxation + cognitive coping skills G23: CBT with sticky note G24: Simple verbal instructions G25: Education/attention control condition G26: Cognitive behavioural pain management training G27: counselling for behavioural changes G28: masticatory exercises + occlusal splint + counselling G29: No treatment G30: CBT, email based recording G31: Disoccluding splint + non steroidal anti-inflammatory drugs + instruction regarding a soft diet G32: Pharmacological pain control, supportive patient education, physical therapy, occlusal splint G33: physiotherapy, patient education, medication, occlusal appliance G34: occlusal splint, jaw exercises, NSAID and/or muscle relaxants medication. Our division of all groups: Groups included in the CBT: G1; Groups included in other psychological treatments: G2, G3, G4, G6, G7, G8, G13, G20, G21, G22, G23, G24, G25, G26, G27, G30; Groups included in standard TMD treatment: G5, G9, G32, G12, G14, G16, G18, G28, G31, G32, G33, G34; Combination of treatments: G7, G10, G11, G15, G17, G21, G22; No treatment: G29; Manual therapy: G19.

Abbreviations: DC/TMD, Diagnostic Criteria for Temporomandibular Disorders; MMO, maximal mouth opening; RDC/TMD, Research Diagnostic Criteria for Temporomandibular Disorders; VAS, visual analogue scale.

TABLE 2 Table illustrating the summary of risk of bias assessed by the Revised Cochrane risk-of-bias tool for randomized trials (RoB2).

Authors	Randomization process	Deviation from intended intervention	Missing outcome data	Measurement of the outcome	Selection of reported results	Judgement
Abrahamsen et al., 2009	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Abrahamsen et al., 2011	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Costa et al., 2015	Low risk	Low risk	High risk	High risk	Low risk	High risk
Dura-Ferrandis et al., 2017	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Dworkin et al., 2002	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Ferrando et al., 2012	Low risk	Low risk	High risk	Low risk	Low risk	High risk
Gardea et al., 2001	Some concerns	Some concerns	Low risk	Low risk	Low risk	Some concerns
Gatchel et al., 2006	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Huttunen et al., 2019	Low risk	Low risk	High risk	Low risk	Low risk	High risk
Kurt et al., 2011	Some concerns	Low risk	High risk	Low risk	Low risk	High risk
Litt et al., 2010	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Melo et al., 2020	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Shedden Mora et al., 2013	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Stam et al., 1984	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Takeuchi-Sato et al., 2020	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Turner et al., 2005	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Turner et al., 2006	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Turner et al., 2007	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk

Note: Green shading indicates low risk of bias, orange points out some concerns, while red indicates a high risk of bias.

3.4 | Results of individual studies

The individual characteristics and results of individual studies such as means, standard deviations and sample size for overall post-treatment pain intensity, ranging from immediate to 12 months post-treatment, are presented in Appendix S3.

3.5 | Meta-analysis

The treatments included in this meta-analysis were different types of psychological treatments, such as CBT, biofeedback, hypnosis, counselling, relaxation and education/attention control condition. Also, the different types of standard treatments for TMD, such as occlusal appliances and jaw exercises, and no treatment. Finally, also different combinations of these treatments were included in the MA.

3.5.1 | Pain reduction

As shown in Figure 3, a significant reduction in pain intensity was observed following combination of psychological treatments and standard treatments of TMD (MD = −20.97, CI: −31.31 to −10.82, very low-quality evidence) and manual therapy (MD = −25.77, CI: −36.31 to −15.40, very low-quality evidence) in comparison to counselling therapy. Additionally, notable pain reduction was evident after combination of psychological treatments and standard treatments of TMD (MD = −14.56, CI: −24.96 to −4.16, very low-quality evidence) and manual therapy (MD = −19.35, CI: −34.01 to −4.69, very low-quality evidence) when compared to just standard treatments. However, no statistically significant differences were observed when compared to other interventions.

3.5.2 | Treatment ranking

When it comes to treatment ranking (SUCRA values), manual therapy emerged as the most effective approach in diminishing pain intensity for patients with TMDs, with a success rate of 92.7% (very low-quality evidence). Following closely, a combination of psychological treatments and standard treatments of TMD demonstrated a 78.6% effectiveness (very low-quality evidence), as shown in Figure 4 and Appendix S4.

3.6 | Narrative synthesis of psychological treatment outcomes for TMD

This first part of the narrative synthesis presents the treatment outcomes of psychological treatments to reduce TMD pain, while the second part presents the treatment outcomes of jaw movements.

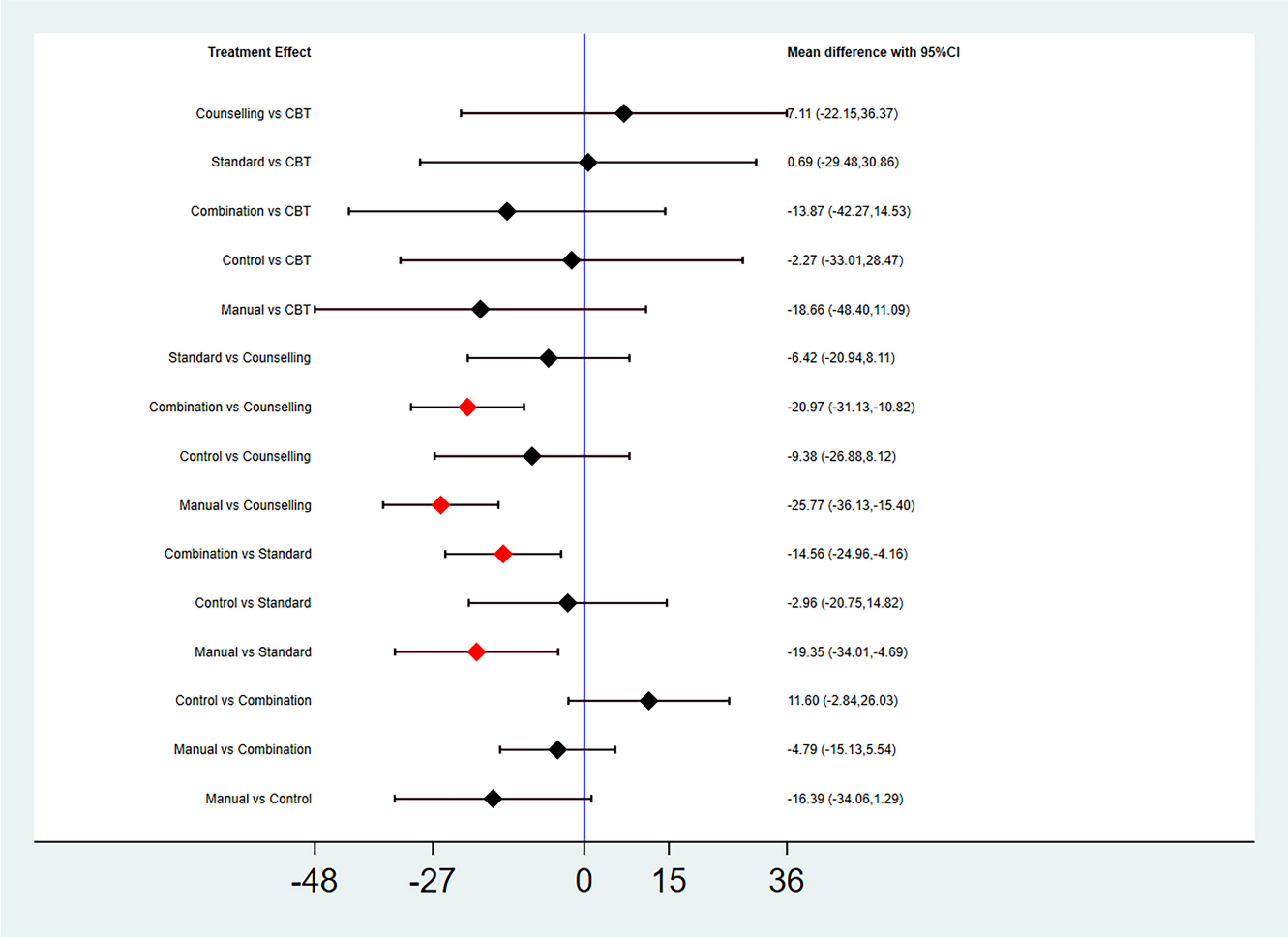

FIGURE 3 Forest plot, showing all possible pairwise comparisons, post-treatment pain intensity. CBT, cognitive-behavioural treatment, CI, confidence interval.

3.6.1 | Counselling

In two studies, counselling was an intervention that had a decreasing effect on pain intensity of approximately 10%–64%.[39,70] In the first study, before counselling treatment was applied on patients, the aetiology for their TMD was investigated. This was followed by a development of guidelines based on their individual needs. As an addition, information about the disease was provided, enabling patients to understand their condition and to be able to manage it. In the last part of the counselling consultation, patients were also provided with a booklet containing guidelines on physical exercises, dietary, posture, instructions on correct mandibular function and more. The following appointment (after 15 days) was set for reinforcing the counselling treatment. A reduction in pain intensity of 12% could be seen in the patients that received this treatment.[39] The second study used a mail-based nonfunctional tooth contact (nFTC) recording and reminding system comprising a host computer, smartphone and specially designed software. This study had two counselling groups, but they named them CBT groups. One group was a cognitive behavioural treatment with an email-based recording and reminding system (e-CBT) for 20 days and the other CBT group received CBT, but with a sticky note reminder (s-CBT). Patients in the e-CBT intervention were reminded to avoid nonfunctional tooth contact by the digitally reminding system and in the s-CBT group patients were told to place more than 10 reminder sticky notes at places they frequently see; for instance televisions and PCs. This was to remind the patients that their maxillary teeth and mandibular teeth should not be in any nonfunctional contact.[70] The CBT with email-based recording reminder decreased the pain intensity with 30%. The CBT treatment with the sticky note reminder showed a decrease of 19% in pain intensity.

3.6.2 | Cognitive behavioural treatment

A total of five studies included CBT as an intervention.[38,40,41,62,71] All of these used a clinical psychologist or equivalent to deliver the intervention. In three study populations the intervention consisted of four visits,[38,41,71] in one population there was six visits,[62] one study had 12 visits.[40] All studies included components described as cognitive restructuring (different ways of challenging

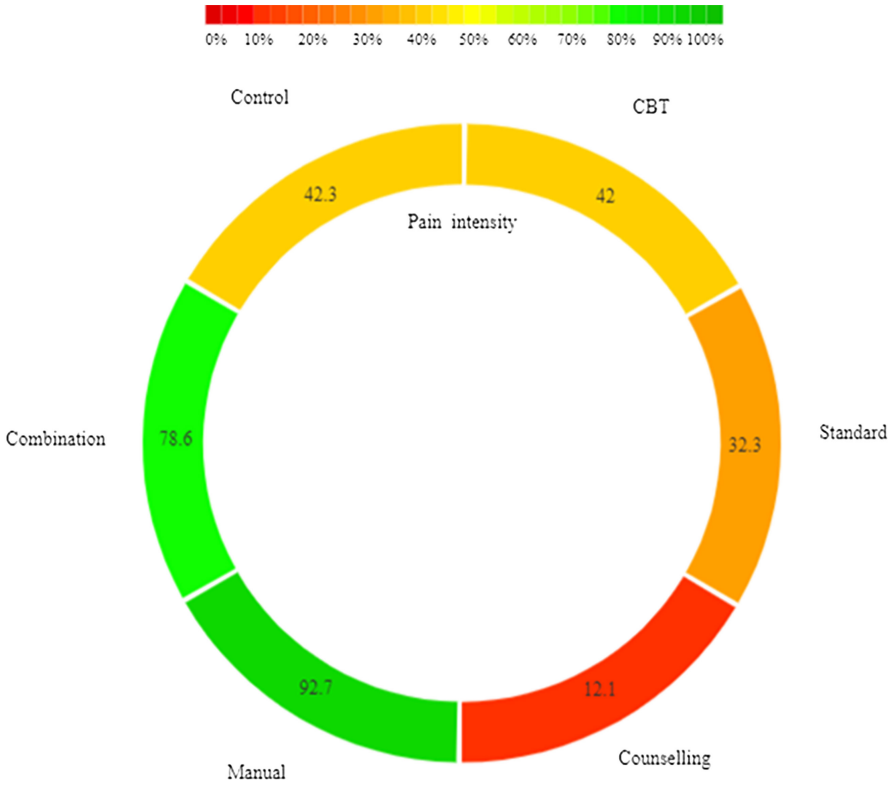

FIGURE 4 Rank-heat plot showing the ranking of treatments from this meta-analysis for all four individual treatments, as well as combination of treatments and control. The scale bar represents the ranking statistic for each intervention, with 0% (red) indicating the worst treatment and 100% (green) indicating the best treatment. The higher the value and the closer to 100%, the higher the likelihood that a treatment is in the top rank or one of the top ranks. The closer to 0 the value, the more likely that treatment is in the bottom rank or one of the bottom ranks. Manual therapy was ranked first with 92.7% followed by a combination of treatments with 78.6%.

or changing negative thoughts or thought patterns), psychoeducation (giving the patients information about their condition and the best way to manage it) and different types of relaxation techniques. Further, four studies described using relapse prevention (identifying and addressing high-risk situations for relapse and assisting individuals in maintaining desired behavioural changes).[38,41,62,71] Three studies had a component of social skills training to improve the use of social support.[40] Two studies reported use of behavioural analysis (to explain and modify behaviours),[40,62] and two reported behavioural activation (engaging in positive and enjoyable activities).[38,41] Finally, one study each reported the use of distraction/imagination techniques, habit reversal training, hypnosis/self-suggestion, problem solving skills and stress management.[38,40,41,62,71]

Four out of five studies with the CBT treatment represented data on pain intensity reduction and varied from a range of 10% to 43%.[40,41,62,71] The study by Turner et al. (2006) showed a 41%–43% decrease in pain intensity, at both follow-ups at 6 and 12 months.[71]

3.6.3 | Biofeedback

There was one study that had biofeedback as an intervention. The treatment consisted of EMG biofeedback (with placement of electrodes superficial to the frontalis muscle), relaxation training and 15 min of temperature; in a total of 12 sessions. At follow-up, the biofeedback treatment had shown a total of 42% decrease in pain intensity.[40]

3.6.4 | Relaxation treatment

Three studies had a control group that was relaxation and in all these studies, the psychological intervention group was hypnosis.[42,59,69] In two of the studies relaxation treatment consisted of four individual 1-hour sessions of relaxation and visualization of a comfortable place. There were no hypnotic pain suggestions provided. The patients also received a compact disc that had relaxation that was made to be used at home. The relaxation treatments contributed to a pain intensity decrease of 4%–7%.[42,59] In the third study, the patients in the relaxation treatment group received four weekly sessions by a blinded therapist. The patients received standard relaxation instructions. This treatment resulted in a 31% decrease in pain intensity.[69]

3.6.5 | Hypnosis

Out of all included studies, three included hypnosis as an intervention.[42,59,69] One of the studies consisted of four weekly sessions of hypnotic intervention. Prior to allocation into one of the clinical treatment groups the participants were assessed regarding their hypnotic susceptibility. The patients that underwent the hypnosis treatment received a hypnotic induction followed by the suggestion model of Carleton University Responsiveness to Suggestion Scale (CURSS). Following the waking procedure, they then assessed their scores in a booklet. The therapist was blind to these scores during the treatment. At follow-up, the hypnosis treatment had resulted of a 30% reduction in pain intensity.[69]

In the two other studies, the patients were randomly assigned into one of two intervention groups. One group was the active treatment group consisting of hypnosis and the other group was an active control group consisting of relaxation treatment. In both studies, the patients were told that they were going to receive a hypnotic intervention and the treatment consisted of four 1-hour sessions. In the hypnosis group, the sessions consisted of hypnotic induction (standardized), progressive relaxation and a procedure guided imaginary instructions based on their individual preferences. Hypnotic suggestions were also a part of the treatment for gaining controlling and changing the perception of pain. This part was tailored for each patient. The purpose was to improve stress, management skills and coping with minor psychological problems for every patient in the hypnosis. The patients were provided with a compact disc that contained hypnotic suggestions and instructions to enable them to practice hypnosis in their homes. At follow-up, the reduction in pain intensity was at 33%–35%.[42,59]

3.6.6 | Patient education/attention control condition

When it comes to education/attention control treatment three studies investigated the effect of this treatment compared to a brief CBT treatment. The patients participated in four biweekly sessions that were carried out by TMD patient educator (bachelor level). The educator was trained and supervised by a licensed clinical psychologist. The sessions focused on a given structured protocol and the participants were not given any specific techniques associated with CBT.[38,41,71] Two of these studies could show a pain reduction of approximately 20%,[41,71] while one could not show any pain reduction.[38] Further, the effect was significantly worse than the effect of CBT.[38,41,71]

Like patient education, one study investigated simple verbal instructions (similar to patient education). In this study, this resulted in a decrease of 34% when it comes to pain intensity.[70]

3.6.7 | Combination of treatments

Nine studies investigate the effect of various combinations of treatments which all resulted in a visible pattern with a reduction in pain intensity. The decrease in pain intensity varied from all combinations of treatments between 21% and 85%.[39,40,61,63–65,67–69]

Two of these studies included standard treatment of TMD in combination with a psychological treatment. In one study, the combination of an occlusal appliance and counselling resulted in a pain reduction of 46%.[39] In the other study, there was a significant pain reduction for the patients treated with a combination of standard treatment of TMD and CBT, however, no data were presented, and no response was received from the authors either.[61] Hence, no comparison to the other groups can be done.

In one of the studies, the combination of treatments consisted of a combination of two standard treatments for TMD, that is, an occlusal appliance and jaw exercises. Together these treatments resulted in a reduction of pain intensity of 55% and pain frequency with 50%.[63]

In three studies, the combination of treatments consisted of two psychological treatments, that is, CBT and biofeedback. This combination resulted in a pain reducing effect of 50%–62%.[40,64,68] Finally, in another study the combination of treatments consisted of two psychological treatments, that is, hypnosis and cognitive coping skills training. This combination resulted in a pain reduction of 27%.[69]

3.7 | Narrative synthesis of psychological treatments for patients with reduced maximum mouth opening capacity without pain

Three studies assessed maximum mouth opening capacity without pain.[59,62,66] In one of the studies, treatment with CBT in combination with standard treatment reached peak increase in mouth opening within 6 months, while standard treatment reached the peak increase in mouth opening after 6 months of treatment. However, there was no difference in increase between standard treatment alone or in combination with CBT.[62]

In the other two studies, the effect on mouth opening capacity was significantly lesser (50% lesser) after treatment with hypnosis or behavioural treatment than for standard treatment of TMD.[59,66]

3.8 | Narrative synthesis of psychological treatments for patients with reduced maximum mouth opening capacity with pain

Four studies assessed the maximal jaw opening.[59,62,66,69] In one of the studies none of the treatments, that is, standard treatment for TMD or combination of standard treatment with psychological treatments affected the maximum assisted or unassisted mouth opening capacity, even though there was a slight increase in both groups.[62] In another study, there was no clinically relevant effect on the mouth opening capacity with either relaxation treatment or hypnosis.[59] On the contrary, a study by Stam et al., (1984) indicates that both relaxation treatment and hypnosis seem to increase maximum mouth opening capacity in patients with pain.[69] When it comes to occlusal appliances, the anterior repositioning appliance was shown to have a significantly larger effect, twice as large as the stabilization appliance and behavioural treatment.[66]

4 | DISCUSSION

The main findings of this systematic review provide some support for psychological treatment for painful TMDs. This is based on the

findings that psychological treatments seem to have an equal effect when compared to standard treatment (such as occlusal appliance, jaw exercises, counselling and pharmacological treatments), and that they in combination with standard treatment seem to have a superior effect.[38,39,41,42,61–65,68,71] Only in one study there was no significant effect on pain intensity after treatment with either hypnosis or relaxation.[69] Due to the limited number of present and included RCTs on psychological treatments alone, or in combination with standard treatment, this study cannot generalize nor rank the psychological treatment options. Nonetheless, this systematic review indicates that psychological treatment approaches are promising for painful TMDs, and especially in combination with standard treatment, which was supported by both the meta-analysis and the narrative synthesis of the results. Given the multifaceted aetiology of painful TMDs, which encompass a variety of complex symptoms and underlying causes, it is essential to conduct an individual assessment before determining a treatment strategy, which may include psychological treatment modalities.

This meta-analysis could only show a significant pain reduction—for the large patient group suffering from painful TMDs[7]—after treatment with manual therapy or a combination of psychological treatments and standard treatments when compared to standard treatment as well as just counselling. Further, manual therapy or a combination of psychological treatments and standard treatments were also ranked in the top two positions. Among the painful TMD there is also the diagnosis headache attributed to TMD.[6] However, the studies assessed the reduction in pain intensity but not the frequency of symptoms. Thus, when it comes to headache attributed to TMD, it is hard to draw any conclusion since we do not know if it was the pain intensity during headache that was affected or if also the frequency was reduced.

Based on the narrative synthesis in this review CBT, hypnosis and relaxation treatment displayed significant and clinically relevant pain reducing effects in the range of 31%–45%.[40–42,59,62,69,71] When it comes to CBT this finding is in line with previous studies on standard treatments of painful TMDs, including occlusal appliances, needling therapies, pharmacological treatments and manual therapy.[52–54,72] Also, this result is in line with previous studies on CBT for low back pain, and on headaches.[60,73] CBT for lower back pain showed a 35% reduction in pain intensity after 3 months,[73] while CBT for headaches showed great effect on the intensity, up to 53% after 3 months.[60] Thus, CBT seems successful as a treatment option for painful states. However, none of the CBT studies in this review[38,40,41,61–64,67,68,71] were based on Acceptance and commitment therapy (ACT). ACT has been shown to have good effects on chronic pain patients, especially for patients with localized pain symptoms like headache.[74,75] Therefore, ACT is currently an unexplored psychological treatment method that could be effective in the treatment of painful TMDs.

In addition to its pain reducing effects, hypnosis also showed improvements of psychological aspects such as diverting attention, praying/hoping, catastrophizing, ignoring sensations, depression, anxiety, hostility and a slight decrease in somatization.[42,59,69] Relaxation, on the other hand, did also show improvements in maximum mouth opening, increased locomotor functions, improvements in the number of awakenings and a decrease in the frequency of sound from the temporomandibular joint.[42,59,69] Based on the close relationship between these factors and painful TMDs,[11–15] as well as the facts that psychiatric comorbidity can worsen TMD and jeopardize the treatment outcomes,[34] treatments such as CBT, hypnosis and relaxation are important in the handling of painful TMDs based on the biopsychosocial model where the body and movement interact with cognitive, emotional and social aspects.[22]

While counselling was not as effective as standard treatment, ranging from 12% to 30%,[39,70] patient education/attention control condition showed a significant effect on pain reduction, of 20%.[41,71] However, one study showed no significant difference in pain reduction,[71] and that the treatment increased catastrophizing and decreased depression.[41,71] An explanation for the effect of these treatments is their target on the cognitive, emotional and social aspects of pain. As previously mentioned, the biopsychosocial nature of TMD means that an improvement of the psychological status of an individual can contribute to an improvement of painful TMDs.[22]

Almost all psychological treatments showed improvements in pain reduction and in different psychological aspects, for instance somatization and depression. However, psychological treatments resulted in a pain reduction akin to the level of pain reduction by standard treatments. To clarify, in an individual with a TMD diagnosis anxiety can result both in a higher load of the orofacial muscles and joints,[76,77] but also increase the tooth wear.[78] While standard treatment with an occlusal appliance protects the teeth and reduces the load of muscles,[54] a psychological treatment prevents the individual from letting the cognitive and emotional factors worsen their TMD and jeopardize the treatment outcomes.[34] This means that both treatments alone can result in a decrease the load of orofacial structures as well as the risk of chronification of painful TMD. Thus, combining treatments, for instance CBT with standard treatment, or CBST with biofeedback, would result in even better outcomes. This was also the result from this meta-analysis that showed a significant decrease in pain intensity, up to 85% when combining treatments.[40,63,64] Also, this combining of treatments showed improvements in anxiety disorders, headache intensity and frequency of headache.[60,64]

When it comes to jaw functioning this could be assessed by maximum mouth opening capacity (MMO). Psychological treatments that showed an improvement in MMO was hypnosis, relaxation,[69] CBT in combination with standard treatment[62] and behavioural treatment.[66] However, the only psychological treatment approach that had greater results than standard treatment was psychological treatment in combination with standard treatment.[62] Thus, when it comes to MMO, psychological treatments alone do not seem to provide clinically relevant effects and should only be considered as a complement to standard treatment, which was also highlighted in one of the studies.[62] This is not surprising since patients with

TMD often have a combination of physiological and psychological symptoms.[69]

Additionally, the health economic aspect is also necessary to consider. This involves costs for the patients, in relation to the frequency of visits, the effect/prognosis of the different treatments, but also the rate of progression. All these factors are important for the patient, and for accepting a treatment plan.[79] For instance, phycological interventions usually require smaller effort for the patients in comparison to standard treatment. The latter often includes recurrent jaw exercises, and/or the daily use of an occlusal appliance.[62] In the studies that included CBT, the number of visits varied from four to 12.[38,40,41,62,71] Thus, this can affect patients economically, and be a decisive factor for the treatment that is finally chosen, despite the recommendation of a more costly treatment, that also offers a better chance of improvement. The professional dentist is therefore central in providing the patient with information on various suitable treatments and costs.

4.1 | Study strengths and limitations

4.1.1 | Strengths

In order to minimize bias, the following measures were taken. First, the literature search was performed in several databases with the help of search experts, that is, the librarians (JN and NH) at the university library, at Karolinska Institutet. During the process of selecting articles both authors (NM and BZ) were blinded from each other to prevent bias, ensuring that each other's decisions whether of including or excluding studies would not be a factor of influence. The two judges were subject experts (NC in TMD and RS in psychology). Further, to improve transparency and minimize bias, all the 18 included RCT studies were assessed for risk of bias, independently and blinded from each other, using the Revised Cochrane risk of bias tool in collaboration with one expert on risk assessment (MC). A pilot-test of the protocol was performed to ensure that both parties were correctly calibrated during data extraction by using a form developed by NC and EA. Out of the 18 included RCTs, 15 had an uneven gender distribution where the majority were women.[38–41,60–69,71] The remaining two studies included only females.[42,59] One study included an even male:female ratio in two groups, and in the third group it had a ratio of 3:7.[70] Thus, the participants were relevant and matching the patient group with painful TMDs regarding gender distribution. Finally, when it comes to the age of the patients the participants mean ages ranged from 25.7 (±7) to 44.0 (±13.1). This is a strength since it enables realistic and clinically results since the participants well match the age and gender distribution of the TMD population.[7]

4.1.2 | Limitations

One limitation in this review is the limited number of included articles, and especially for the meta-analysis. Another was that we were not able to use the PsycInfo database, that might could have increased the included number or studies. Also, the low quality of some the studies included means that the results must be interpreted with caution. Further, we cannot draw any conclusions on whether the pain reducing effect is a result from improvement in their psychosocial status or if it is not dependent of that. In future studies, the Axis II of DC/TMD has also to be followed-up together with reduction of pain and possible improvement in physical functioning. A final limitation was that it is unclear if treatment was performed in general or specialist practice.

4.2 | Clinical implications and generalizability

Psychological treatments seem to have a clinically relevant pain reducing effect for patients suffering from painful TMDs. These are therefore valuable additions to the present selection of treatment approaches for TMD. However, there is no golden standard treatment for TMD. This because, TMD is an umbrella term embracing several different conditions, including a subjective experience, with different multifactorial aetiologies.[5,6] Thus, the treatment plan departs from the patient's individual experience, needs, preconditions and etiology. To fully cover the patients physical and psychological symptoms, this study highlights that standard treatment is best combined with psychological treatment.

4.3 | Future applications

According to the results of this meta-analysis, psychological interventions seem have a positive effect on individuals with painful TMDs. This is based on the findings that psychological treatments seem to have an equal effect when compared to standard treatment, and that they in combination with standard treatment seem to have a superior effect.[38,39,41,42,61–65,68,71] Thus, the use of psychological treatments can be considered relevant. However, due to the limited existing evidence, future, well designed studies, with proper control groups are warranted. One suggestion would be to design a study together with a psychologist, thus ascertain the psychological intervention and clearly describe it. Further, in the follow-ups include both Axis I and Axis II of DC/TMD. This would provide valuable information regarding not just pain reduction, but also if the psychosocial status as well as physiological functioning have improved, in order to be able to analyse what aspects and treatments are beneficial and to understand the mechanisms. Also, there is a need to conduct randomized controlled studies on ACT. A final suggestion for future studies is to include more than one control-group, that is, both a passive control (no treatment/waiting list) and an active control (standard treatment) or an active control and a combination of standard treatment and chosen psychological treatment. Further, there is a need to clarify what is included in the term counselling since this is an important part of the treatment and used in several studies. However, since there is no clear

definition of the term counselling and what this term comprises the results regarding counselling are unreliable.

4.4 | Conclusion

Taken together, this systematic review and meta-analysis indicates that psychological treatments seem to reduce pain intensity in individuals with painful TMDs, and that the pain reducing effect seems to be equally good as for standard treatment. However, a combination of psychological treatments and standard treatments seem to have an even better effect. This indicates that psychological treatments are promising as an additional treatment approach for painful TMD. Therefore, more high-quality research is needed on psychological treatment for TMD patients to fully explore the potential added benefits of this treatment approach.

AUTHOR CONTRIBUTIONS

Essam Ahmed Al-Moraissi and Nikolaos Christidis had the main idea for the article. However, all authors contributed to the study conception and design. Nikolaos Christidis, Maria Christidis and Essam Ahmed Al-Moraissi performed the literature search with help from the university library at Karolinska Institutet. Selection of papers was performed by Natalie Minarji and Bethel Zerfu and double checked by Nikolaos Christidis and Robert Schibbye who is a clinical psychologist. Analysis of risk of bias was performed by Natalie Minarji and Bethel Zerfu. Maria Christidis is a senior lecturer and course responsible for the course 'Scientific theory and methods' and teaches specifically about the different methods existing for risk of bias and certainty of evidence. Further, both Nikolaos Christidis and Essam Al-Moraissi are very experienced on doing systematic reviews and have together with Maria Christidis double checked all parts of the assessment of risk of bias and certainty of evidence. Data were analysed by Essam Al-Moraissi together with Mohammed Sultan Al-Ak'hali. Nikolaos Christidis, Robert Schibbye and Anastasios Grigoriadis, and Maria Christidis drafted the first manuscript that was critically revised by all authors. All authors read and approved the final version manuscript.

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PEER REVIEW

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DATA AVAILABILITY STATEMENT

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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