

Occlusion and temporomandibular joint disorders: a meta-analysis of psychosocial outcomes

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Objective: This meta-analysis aims to evaluate the effects of occlusal therapy, specifically the use of occlusal splints, on psychosocial outcomes in patients with temporomandibular joint disorders (TMDs). While occlusal splints are commonly used to manage TMD symptoms, their impact on psychological and quality-of-life outcomes, such as anxiety, depression, oral health-related quality of life, sleep quality, and overall quality of life remains unclear.

Methods: A systematic search was conducted across databases including PubMed, Google scholar, Scopus, and Web of Science, focusing on studies which assessed the psychosocial impacts of occlusal splint therapy in adult TMD patients. Eligible studies, published between 2000 and 2024, included quantitative measurements of the specified psychosocial outcomes. A total of 17 studies met the inclusion criteria and were subjected to meta-analytic review. Effect sizes were calculated using a random-effects model, with subgroup analyses conducted to explore potential moderators.

Results: The overall findings suggest that occlusal splint therapy does not significantly improve anxiety, overall quality of life, nor sleep quality in patients presenting with temporomandibular joint disorders (TMDs). The significant improvement observed in depression symptoms, while small, could imply a potential mental health benefit of splint therapy. Similarly, the improvement in oral health-related quality of life with occlusal splints indicates a specific benefit for oral health perceptions and related quality of life.

Conclusion: The meta-analysis suggests that occlusal splint therapy has a limited and variable impact on the psychosocial and quality of life outcomes for patients presenting with temporomandibular disorders (TMDs).

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Introduction

Temporomandibular joint disorders (TMDs) represent a spectrum of musculoskeletal conditions which affect the temporomandibular joint, surrounding muscles, and related structures. They are commonly associated with jaw pain, restricted movement, and functional limitations that impair a person's daily activities.¹ TMD affects approximately 5-12% of the general population, with

a higher prevalence affecting females and individuals between 20-40 years of age.² While the physical manifestations of TMDs are widely recognised, recent studies suggest that the disorders also carry significant psychosocial burdens. Individuals with TMDs frequently report elevated levels of anxiety, depression, compromised oral health-related quality of life, poor sleep quality, and reduced general quality of life.³

Temporomandibular joint disorders arise from a combination of musculoskeletal, occlusal, and behavioural factors.³ Common causes include a malocclusion, bruxism, trauma, stress-related muscle tension, and joint inflammatory pathologies. A malocclusion alters the natural occlusal alignment, thereby leading to excessive strain on the temporomandibular joint. Bruxism, often associated with stress and anxiety, exacerbates muscle overuse and joint wear which contributes to inflammation and discomfort. Traumatic injuries, whether from direct impact or repetitive strain, may disrupt joint functions and intensify change over time. Additionally, arthritis-related joint degeneration impairs mobility and causes persistent pain, further complicating TMD symptoms.^{4,5} The consequences of TMDs on quality of life are multifaceted, but encompass physical discomfort, psychological distress, and impaired daily function. Patients frequently report chronic pain, restricted jaw movement, and difficulty in mastication, which can interfere with essential nutritional intake and overall well-being. Psychological burdens, including heightened anxiety and depressive symptoms, are prevalent among individuals with TMDs, and often worsened by persistent pain and functional limitations. Sleep disturbances, commonly associated with bruxism and nocturnal pain, further affect mental and physical health. Additionally, a compromised oral health-related quality of life affects social interactions and self-perception and further contributes to emotional distress and reduced life satisfaction. These findings align with previous research which emphasises the need for a multidisciplinary approach to TMD management that addresses both physical and psychological aspects.⁶

Occlusal splints are a common therapeutic intervention for TMD. These removable oral appliances aim to reduce muscular tension, redistribute occlusal forces and decrease joint loading, potentially alleviating pain and dysfunction.⁷ While occlusal therapy is widely used to manage TMD symptoms, its role in addressing psychosocial outcomes remains under-explored.⁸ Given the link between chronic pain conditions and mental health, understanding the broader effects of occlusal therapy on psychosocial well-being is essential. Additionally, as mental health and quality of life outcomes are increasingly recognised as key treatment metrics, assessing these factors in TMD patients undergoing splint therapy may provide valuable insights for clinical practice.

Although occlusal splints are primarily prescribed to address the physical symptoms of TMD, evidence suggests that improved physical comfort may also positively influence patients' mental health and quality of life. For example, reducing pain through splint therapy may alleviate anxiety and depressive symptoms associated with chronic discomfort. Similarly, improvements in sleep quality, a common issue in TMD patients, may contribute to overall well-being. Despite the potential for psychosocial benefits, existing research on occlusal splint therapy often focuses on physiological rather than psychological outcomes, resulting in limited evidence on how splint wear impacts factors like anxiety, depression, and sleep quality.^{6,8}

This gap in the literature highlights a need for integrative research which examines both the physical and psychosocial impacts of occlusal splints in TMD management. By investigating these factors, clinicians may gain a more comprehensive understanding of the therapeutic value of splints, and lead to better-informed treatment decisions that address both physical symptoms and psychosocial well-being.

The present study aims to evaluate the effect of occlusal splint therapy on psychosocial outcomes in patients with TMD. Specifically, to determine whether occlusal therapy improves levels of anxiety, depression, oral health-related quality of life, sleep quality, and the general quality of life. By conducting a meta-analysis of existing studies, it is aimed to synthesise current evidence on the psychosocial benefits of occlusal splint therapy, thereby providing a more comprehensive view of the therapeutic potential for TMD patients. This research will contribute to the field by offering insights into how a commonly prescribed therapy for TMD might support the mental health and quality of life in affected individuals.

Methodology

Study design

The present meta-analysis was designed following the PRISMA guidelines,⁹ in order to evaluate the psychosocial effects of occlusal splint therapy in patients presenting with temporomandibular disorders. The PROSPERO registration number was CRD 42025648671. The study was structured

based on the PICO framework: Population (patients with TMDs), Intervention (occlusal splint therapy), Comparison (no treatment, placebo, or alternative therapies), and Outcomes (psychosocial measures, including quality of life, anxiety, depression, and sleep quality). The framework ensured a focused approach to assessing the efficacy of occlusal splint therapy in TMD management.¹⁰

To ensure a structured and transparent assessment of evidence, the GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) framework was followed.¹¹ This approach allowed for a systematic evaluation of the certainty of evidence and strength of recommendations by assessing the “risk of bias, inconsistency, indirectness, imprecision, and publication bias” across included studies.

The study was guided by the following PICO question: In patients presenting with TMDs, does occlusal splint therapy, compared to no treatment or other therapeutic interventions, improve psychosocial outcomes related to quality of life, anxiety, depression, and sleep quality? This approach follows established methodological frameworks for evidence synthesis in rehabilitation and pain management research.^{9,10}

Search strategy

A detailed online search was conducted across different data resources including PubMed, Google scholar, Scopus and Web of Science. For an effective literature search, a combination of keywords and Medical Subject Headings (MeSH) terms was used to capture relevant studies on occlusal splint therapy and its psychosocial impact in patients with temporomandibular disorders (TMDs). Keywords included “temporomandibular disorders,” “temporomandibular joint dysfunction,” “TMD,” “TMJ disorders,” “occlusal splint therapy,” “oral splints,” “stabilization splints,” “bruxism treatment,” “malocclusion and TMJ,” “sleep bruxism,” “anxiety in TMD,” “depression and TMJ disorders,” “psychosocial impact of TMD,” “quality of life in TMD patients,” “sleep quality and TMJ dysfunction,” and “multimodal therapy for TMD.” These keywords were complemented by MeSH terms such as “Temporomandibular Joint Disorders,” “Temporomandibular Joint Dysfunction Syndrome,” “Occlusal Splints,” “Bruxism,” “Malocclusion,” “Mouth Protectors,” “Pain Management,” “Cognitive Behavioral Therapy,”

“Quality of Life,” “Sleep Disorders,” “Anxiety Disorders,” “Depressive Disorder,” “Musculoskeletal Pain,” and “Biofeedback, Psychology.” Additional relevant terms included “orofacial pain,” “jaw dysfunction,” “temporomandibular joint pain,” “splint therapy outcomes,” “chronic pain and TMJ,” “oral rehabilitation in TMD,” “behavioral therapy for TMD,” “physiotherapy and TMJ dysfunction,” and “neuromuscular therapy for TMD.”

To ensure a comprehensive and precise literature search, Boolean operators such as “AND,” “OR,” and “NOT” were used to refine search queries. “AND” was applied to combine key concepts, such as “Temporomandibular Joint Disorders” AND “Occlusal Splints” AND “Quality of Life,” ensuring that retrieved studies included all relevant aspects. “OR” was used to expand searches by including synonyms and related terms, such as “Bruxism OR Sleep Bruxism OR Teeth Grinding,” to capture a broader range of studies on TMD-related conditions. “NOT” was selectively used to exclude irrelevant studies, such as “Occlusal Splints NOT Orthodontic Retainers,” to focus specifically on splint therapy rather than general dental appliances.

The search strategy was modified according to the demand of each database to improve the search results. Moreover, the references from included studies were searched manually to add additional relevant data. To align with the GRADE recommendations, studies were screened, not only for methodological rigor, but also for “directness of evidence, consistency in reported outcomes, and precision in effect estimates” to ensure a comprehensive synthesis of high-quality research.

Study selection

To ensure methodological rigor and enhance the reliability of the findings, strict selection criteria were established at both the study and participant levels. The selection process was structured to include only high-quality evidence, prioritised according to GRADE, and evaluating the psychosocial impact of occlusal splint therapy in patients with temporomandibular disorders.

Only randomised controlled trials (RCTs) published in English between 2000 and 2024 were included as they provided the highest level of evidence according to GRADE. Identified studies were required to investigate the role of occlusal splint therapy in the management

of TMDs and include a control group which received either placebo treatment, pharmacological therapy, or an alternative therapeutic intervention. The predefined outcomes for inclusion were psychosocial health-related clinical parameters, including anxiety, depression, oral health-related quality of life, sleep quality, and overall quality of life. Studies were excluded if they were non-RCTs, lacked sufficient data on the predefined outcomes, or did not provide full-text access. Research involving non-human subjects and duplicate publications were also excluded to maintain data integrity and avoid redundancy.

Studies with a “high risk of bias, inconsistency in results, indirect evidence, or serious imprecision” were rated lower in certainty and were either excluded or accounted for in sensitivity analyses. Studies that failed to report psychosocial outcomes with validated measurement tools were excluded to maintain the credibility of pooled results.

Identified studies were required to involve adult patients diagnosed with any type of TMD based on validated diagnostic criteria, such as the Research Diagnostic Criteria for TMD (RDC/TMD) or the Diagnostic Criteria for TMD (DC/TMD). Participants must have been managed with occlusal splint therapy as part of their treatment. Studies focusing on non-painful TMDs or conditions unrelated to TMD, such as neurological disorders, fibromyalgia, or inflammatory joint diseases, were excluded. Additionally, participants with cognitive impairment, severe systemic illnesses including diabetes, cardiovascular disease, malignancies, or psychiatric disorders requiring medication were not considered. Patients using medications that could affect TMD symptoms, such as antidepressants, anticonvulsants, or muscle relaxants, within the last three months were also excluded. Other exclusion criteria included a history of head trauma, intracranial disorders, or previous invasive TMJ treatments such as surgery or arthrocentesis. Furthermore, studies involving participants with severe dental conditions, including periodontal disease, extensive caries, or missing teeth requiring dentures, were omitted.

Outcomes

The primary outcomes to comprehensively assess the psychosocial impact of occlusal splint therapy in patients with temporomandibular disorders included: anxiety, depression, and overall quality of life, as

these factors represent the most clinically significant psychosocial effects of TMD and its management. Anxiety was assessed due to its strong association with psychological distress in TMD patients, aiming to determine whether occlusal splints contributed to emotional regulation and symptom relief. Depression was also a key outcome, given that chronic pain and functional limitations caused by TMDs frequently lead to mood disturbances. By evaluating the impact of occlusal splints on depressive symptoms a further insight into their potential psychological benefits was expected. Additionally, the overall quality of life was measured to assess whether occlusal splints improved broad health and well-being parameters beyond specific symptom relief.

Secondary outcomes were selected to capture additional psychosocial and functional aspects of TMD management, including oral health-related quality of life and sleep quality. Since TMDs directly affect oral function, oral health-related quality of life was examined to measure improvements in jaw discomfort, chewing ability, and oral health satisfaction. Sleep quality was also assessed, as many TMD patients experience bruxism and nocturnal pain, leading to disturbed sleep patterns. Evaluating changes in sleep quality provides further insight into the indirect effects of occlusal splint therapy on overall health and daily functioning.

Data extraction

Relevant data was independently extracted by two researchers through following steps:

1. Searching
2. Removal of duplications by Endnote.
3. Screening of titles and abstracts.
4. Full text reviews.
5. Final enrolment of studies fulfilling the inclusion criteria.
6. Data extraction from the included studies.

Regular meetings and discussions between researchers were planned to resolve any discrepancies. Data was collected on a standard proforma which included the following:

1. Study characteristics (author, year, country, design).
2. Patient demographics (age, gender, baseline characteristics).

3. Intervention details (type, duration, components of the occlusal splint therapy and control group intervention, if any).
4. Outcomes measured (as specified above).
5. GRADE assessment domains (risk of bias, inconsistency, indirectness, imprecision, publication bias).

To enhance transparency, “GRADE evidence profiles” was used in summarising the findings, helping to rank evidence quality for each outcome based on the strength of the available data.

Quality assessment

The Cochrane Risk of bias tool was independently applied by two researchers to evaluate the quality of the selected studies. Six domains of bias, i.e. selection, performance, detection, attrition, reporting and other bias were evaluated for each study. These domains were characterised as having high, low or unclear bias. Depending on the result of the six domains, studies were labelled as high, moderate or low quality. Any disparity in the results of the two researchers was resolved by mutual consensus.

Additionally, following GRADE guidelines, the certainty of evidence was assessed based on the following domains:

1. Risk of Bias: Evaluated using Cochrane’s six domains
2. Inconsistency. Assessed by examining heterogeneity (I^2 statistic) and variability in study results.
3. Indirectness: Considered if studies differed significantly from the research question in population, intervention, or outcome measures.
4. Imprecision: Examined by assessing confidence intervals and sample sizes to determine the robustness of the results.
5. Publication bias

Statistical analysis

Review Manager software (RevMan), version 5.4 (The Cochrane Collaboration, London, UK) was used for statistical analysis. Standardised mean difference was applied to determine the pooled effect size of continuous variables at a 95% confidence interval. The I^2 statistic was used to determine the heterogeneity of the included studies. A value below 25% was considered as low and values above 75% are considered as high heterogeneity. In the case of

low heterogeneity, a fixed effect model was applied and, in the case of high heterogeneity, a random effect model was used. The efficacy of occlusal splint therapy in comparison to a placebo or any other mode of therapy, was analysed by using subgroup analysis. If heterogeneity remained high despite subgroup analysis, the evidence certainty was downgraded according to GRADE. The validity of the results of the meta-analysis was assessed by removing studies with a higher risk of bias and results with fixed and random effect models were compared to determine the effect of the selected model on the pooled effect size. If removal of low-quality studies significantly altered the findings, the GRADE certainty of evidence was downgraded accordingly.

Results

Search results

A detailed online search by two researchers across different databases extracted 1565 relevant studies, of which 765 articles remained after duplicates were removed. The initial screening of titles and abstracts of the 765 articles further removed 705 irrelevant studies. Thereafter, 60 studies were deemed potentially relevant and were selected for a full text review. A detailed review of these studies excluded 43 articles and finally 17 studies fulfilled the selection criteria and were enrolled in the meta-analysis.^{12–28} Steps taken during the selection process are depicted in the flow diagram (Figure 1).

Study characteristics

The majority of the studies were conducted in high income countries. The number of participants varied widely within each study and ranged from 21 to 132 participants. A total 1092 participants were enrolled in the 17 included studies. All participants suffered from a type of TMD and the interventions investigated the effect of occlusal splint therapy. There was considerable variation in the duration of intervention and follow-up (Table I).

Quality assessment and risk of bias

Publication bias was not formally assessed due to the limited number of included studies, as standard methods like funnel plots and Egger’s test are not

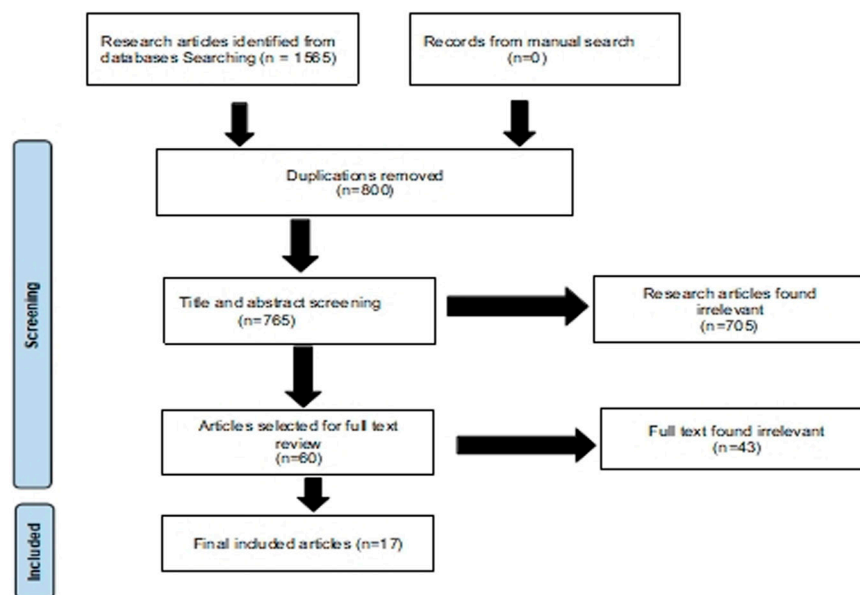


Figure 1. Study selection process.

reliable with small sample sizes. Instead, the potential for publication bias was acknowledged as a limitation, and the results were therefore interpreted cautiously.

The risk of bias assessment revealed that most studies demonstrated a low risk of bias in random sequence generation, outcome blinding, and selective reporting, indicating adherence to robust methodological standards in these areas. However, allocation concealment and blinding of the participants and personnel showed a mix of low and unclear risk, with some studies exhibiting a high risk, and reflected variability in reporting or execution. Incomplete outcome data were generally well-addressed, although a minority of studies had unclear or high risk. Other sources of bias were identified in a significant number of studies, which highlighted potential methodological concerns. The findings suggested variability in study quality, warranting cautious interpretation of the meta-analysis results.

The meta-analysis revealed substantial heterogeneity across outcomes, with I^2 values ranging from 48% to 90%, indicating significant variability in the study results. For anxiety and oral health-related quality of life, heterogeneity was particularly high ($I^2 = 71\text{--}90\%$), complicating the interpretation of non-significant pooled effects. Depression outcomes showed a small significant effect ($\text{SMD} = -0.42$, $P = 0.03$) despite high overall heterogeneity ($I^2 = 70\%$), while stabilisation splints exhibited

the greatest variability ($I^2 = 86\%$). Sleep quality and general quality of life outcomes demonstrated moderate heterogeneity but no significant effects, further highlighting inconsistencies. Measures to address heterogeneity included subgroup analyses to explore potential sources of variability, but tests for subgroup differences showed no statistically significant distinctions (Figures 2 and 3).

Effect on anxiety

The meta-analysis of occlusal splint therapy effect on anxiety outcomes revealed no significant overall effect, with a combined Standardised Mean Difference (SMD) of 0.05 at 95% CI = -0.49 to 0.60; $P = 0.85$. This finding indicates that, overall, splint therapy does not significantly reduce anxiety levels in patients, despite moderate heterogeneity ($I^2 = 74\%$). In the subgroup analysis, occlusal splints demonstrated a small but non-significant effect on anxiety ($\text{SMD} = 0.27$, 95% CI = -0.59 to 1.12; $P = 0.54$ with moderate heterogeneity ($I^2 = 71\%$), while stabilisation splints showed a slight, non-significant effect in the opposite direction ($\text{SMD} = -0.13$, 95% CI = -1.03 to 0.77; $P = 0.78$ with substantial heterogeneity ($I^2 = 83\%$). Furthermore, there was no statistically significant difference in anxiety outcomes between occlusal and stabilisation splints ($P = 0.53$), indicating similar effectiveness across both types (Figure 4).

Table 1. Characteristics of the included studies

Study Characteristics			Population characteristics			Intervention Details			Control Group			
Study ID [reference]	Authors, Year of Publication & Country		Study design & Sample size	Age Mean	Gender distribution	No of participants	Type of intervention	Duration of intervention	No of participants	Type of intervention	Outcomes measured	Tool /Instrument Used
	Aksakali 215 ¹²	Aksakalli S. et al., 2015, Turkey	RCT 40	31 years.	34 (75%) females & 6(25%) males	20	Stabilization splint	3 months	20	Nociceptive trigeminal inhibition–tension suppression system	Pain, Oral health related quality of life & Change in patient complaints	Fonseca’s questionnaire, the Oral Health QoL-UK and visual analog scale.
Alajbeg 2020 ¹³	Alajbeg IZ. Et al., 2020, Croatia	RCT 34	36.1 ± 11.95 years	xxxx	19	Stabilization splint	6 months	15	Placebo splint	Pain variables, Generalized anxiety & Depression,	Graded Chronic Pain Scale, Generalized anxiety disorder- 7 questionnaire, Patient health questionnaire-9	
DeResend 2019 ¹⁴	Machado de Resende CM. et al., 2019, Brazil	RCT, 89	28 ± 9.34 years	72 (80.9%) females & 17 (19.1%) males	24 in occlusal splint & 21 in manual therapy group & 25 in oral splint and counselling group	Occlusal splint	1 month	19	Counselling	Pain, Sleep quality, Quality of life & Oral health related quality of life.	Visual analog scale, Pittsburgh Sleep Quality Index questionnaire, World health organization quality of life questionnaire- BREF, The Oral Health Impact Profile-14	

Table 1. continued

Study ID [reference]	Study Characteristics		Population characteristics			Intervention Details			Control Group		
	Authors, Year of Publication & Country	Study design & Sample size	Age Mean	Gender distribution	No of participants	Type of intervention	Duration of intervention	No of participants	Type of intervention	Outcomes measured	Tool /Instrument Used
Giancarlo 2021 ¹⁵	Canales GD. et al., 2021, Brazil	RCT, 100	36.8 ± 5.6 years	100% females	20 in Oral splint group & 60 in botulinum toxin group	Stabilization splint	6 months	20	Normal saline injection	Pain intensity & Depression	The Graded Chronic Pain Scale, The Symptoms Checklist-9OR (SCL-DEP)
Guadalupe 2016 ¹⁶	Molina-Torres G. et al., 2016 Spain	RCT 58	51 ± 8 years	94% females & 6% males	29	Stabilization splint	12 weeks	29	Laser therapy	Intensity of pain, Severity of symptoms & Sleep quality	Visual analog scale, Symptom Severity Scale, Pittsburgh Sleep Quality Index Questionnaire
Hutela 2020 ¹⁷	Hutela OS. et al. 2020, Finland	RCT 40	26 years,	85% females & 15% males	22	Stabilization splint	12 months	18	Applied relaxation method	Pain, Non-specific physical symptoms & Depression	Visual analog scale, Axis II questionnaire,
Kokkola 2018 ¹⁸	Kokkola O. et al., 2018, Finland	RCT 80	44.4 + 12.6 years	82.5% females & 17.5% males	39	Stabilization splint	12 months	41	Counselling	Oral health related quality of life	The Oral Health Impact Profile-14
Layza 2024 ¹⁹	Opitz LR. et al., 2024, Brazil.	RCT 43	34.8 ± 10.29 years	32 (74.4%) females & 11 (25.6%) males	23	Rigid stabilization splint	12 months	20	Mixed splint	Orofacial pain, Quality of life. Anxiety & Depression	Visual analog scale, World health organization quality of life questionnaire- BREF, Hospital Anxiety and Depression Scale

Marijana 2021 ²⁰	Gikic M. et al., 2021, Croatia	RCT 30	36.44 ± 10.51 years	100% females	10	Stabilization splints	6 months	10	Received thin thermoforming foil (Etkodent 0.5 mm)	Spontaneous pain, Pain intensity, Oral health related quality of life & Anxiety	Visual analog scale, Composite pain index Score, The Oral Health Impact Profile-14, Generalized anxiety disorder-7 questionnaire
Melo 2020 ²¹	Melo RA. et al., 2020, Brazil	RCT, 85	28 ± 9.34 years	82% females & 18% males	25 in oral splint and counselling group, 22 in Occlusal splint & 21 in manual therapy group	Occlusal splint	30 days	17	Counselling	Pain & Anxiety	Visual analog scale, Hospital Anxiety and Depression Scale, The Beck Anxiety Inventory, The State-Trait Anxiety Inventory (STAI) questionnaire
Omer 2022 ²²	Ekici O. et al., 2022, Turkey.	RCT 132	Intervention group 28.58 ± 14.46 years Control group 29.47 ± 10.49 years	31 (23.5%) males & 101 (76.5%) females	34	Occlusal splint	12 weeks	34	No active treatment, Counselling.	Pain, Range of motion of the jaw, Disability & Quality of life	Visual analog scale, The Oral Health Impact Profile-14, Jaw Functional Limitation Scale.
Oz 2010 ²³	Oz S. et al., 2010, Turkey	RCT, 40	32.84 ± 10.70 years	34 (85%) females & 6 (15%) males	20	Occlusal splints	3 months	20	Low dose laser therapy	Pain, Pressure pain threshold & Depression	Visual analog scale, RDC/TMD) Axis II criteria

Table 1. continued

Study ID [reference]	Study Characteristics		Population characteristics			Intervention Details			Control Group		
	Authors, Year of Publication & Country	Study design & Sample size	Age Mean	Gender distribution	No of participants	Type of intervention	Duration of intervention	No of participants	Type of intervention	Outcomes measured	Tool /Instrument Used
Peixoto 2021 ²⁴	Peixoto KO. et al., 2021, Brazil	RCT, 60	18-65 years	xxxx	15 in occlusal splint, 15 in scalp Acupuncture & and 15 in manual therapy group	occlusal splint	30 days	15	Counselling	Pain, Sleep & Quality of life	Visual analog scale, Pittsburgh Sleep Quality Index Questionnaire, World health organization quality of life questionnaire
Rodriguez 2019 ²⁵	Rodriguez MF. et al., 2019 Brazil	RCT, 21	Average age in intervention group 43.63 years & 47.5 years in control group	100% females	11	Occlusal splints	6 months	10	Low-power laser auriculotherapy	Pain, Degree of jaw functioning, Depression & Nonspecific physical symptoms	American Academy of Orofacial Pain questionnaire, Symptoms Checklist-90 (SCL-90) Depression Scale

Rossana 2024 ²⁶	Izzetti R. et al., 2024, Italy	RCT, 120	Intervention group 40.71 ± 15.85 years Control group 42.76 ± 16.94 years	66 (55%) females & 54 (45%) males	60	Stabilization splint & physio-kinesiotherapy	6 months	60	No intervention	Pain, Depression, Anxiety & Oral health related quality of life.	Pressure pain threshold scores, The Oral Health Impact Profile-14, Patient health questionnaire-9, Generalized anxiety disorder-7 questionnaire
Verbanovic 2019 ²⁷	Verbanovic E. et al., 2019 Croatia	RCT, 30	Intervention group 38.89 ± 11.79 years Control group 32.66 ± 11.48 years	100% females	17	Stabilization splint	6 months	13	Placebo splint	Pain & Quality of life	Visual analog scale, The Oral Health Impact Profile-14
Wanman 2020 ²⁸	Wanman A. et al., 2020, Sweden	RCT, 90	39.2 ± 15.2 years	63 (70%) females & 27 (30%) males	30 in Bite splint and 30 in supervised exercise program.	Bite splint	3 months	30	Home exercise therapy	Pain, Neck disability & Somatisation	Jaw function limitation scale-20, Neck Disability Index, Numeric pain rating scale 0-10

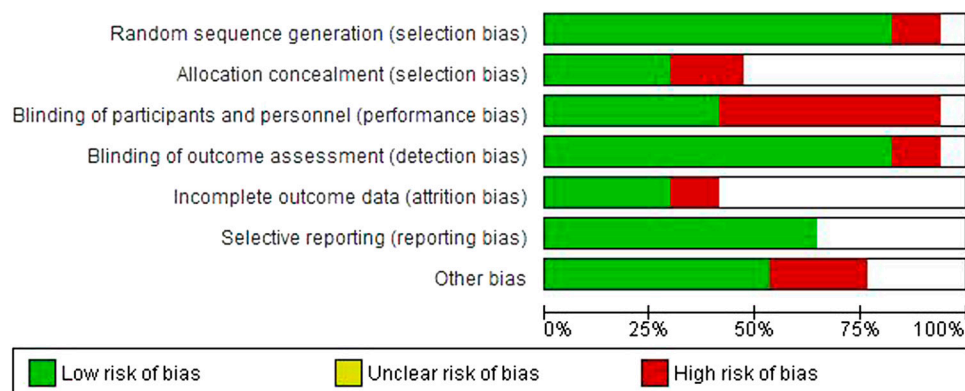


Figure 2. Risk of bias graph.

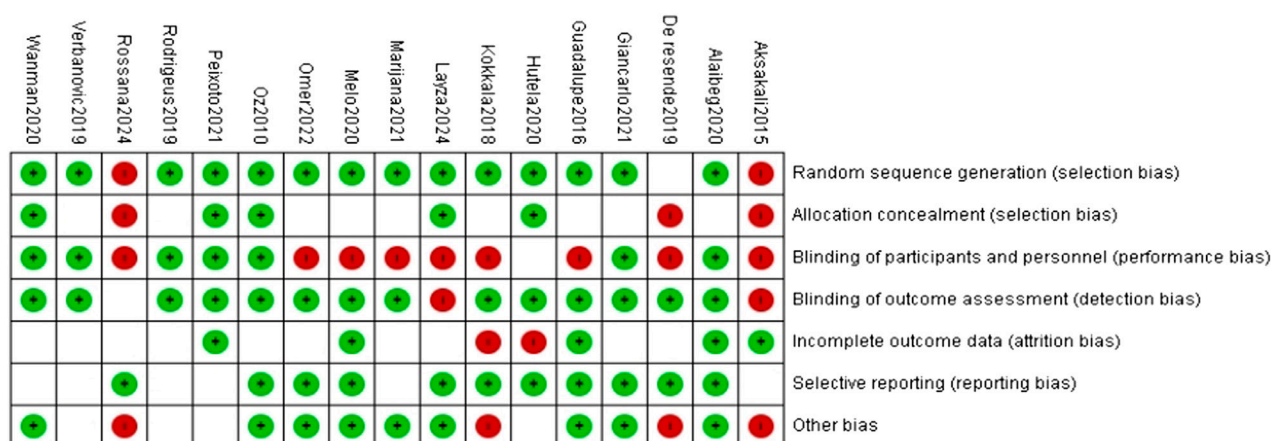


Figure 3. Risk of bias summary.

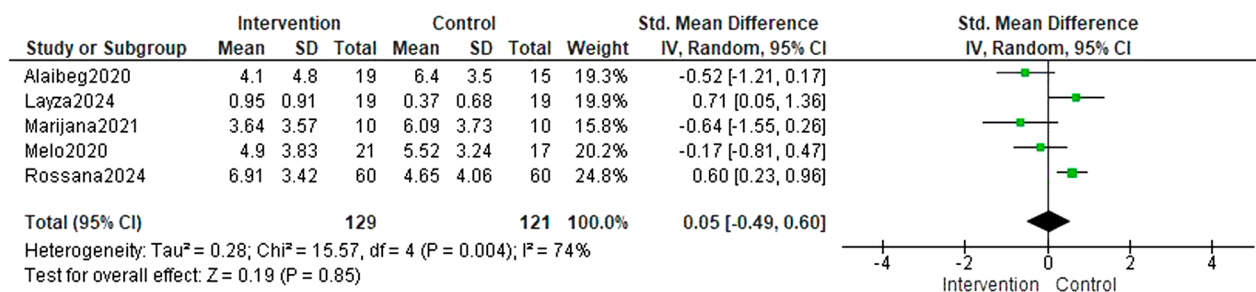


Figure 4. Occlusal splint therapy effect on anxiety.

Effect on depression

The meta-analysis of occlusal splint therapy effect on depression outcomes suggested a small, statistically significant overall reduction in depression symptoms across all splint types, with a combined Standardised Mean Difference (SMD) of -0.42; 95% CI = -0.81 to -0.04; $P = 0.03$. Despite moderate heterogeneity ($I^2 = 70\%$), this indicated a potentially beneficial

effect. Subgroup analyses showed that bite splints have a modest, non-significant effect (SMD = -0.46, $P = 0.08$), occlusal splints have a small effect nearing significance (SMD = -0.38, $P = 0.06$) with minimal heterogeneity ($I^2 = 0\%$), and stabilisation splints showed a moderate but non-significant effect (SMD = -0.50, $P = 0.20$) with high heterogeneity ($I^2 = 86\%$). There were no statistically significant

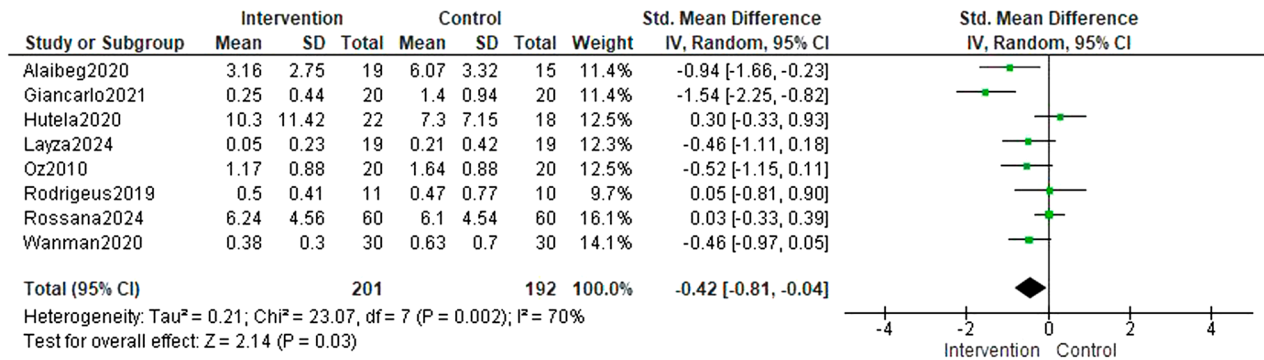


Figure 5. Occlusal splint therapy effect on depression.

differences between the subgroups ($P = 0.95$), indicating similar impacts on depression reduction across splint types (Figure 5).

Oral health-related quality of life

The meta-analysis of occlusal splint therapy effect on oral health-related quality of life showed a small but statistically significant improvement from occlusal splints ($SMD = -0.44$, 95% $CI = -0.82$ to -0.06 ; $P = 0.02$) and no significant variability ($I^2 = 0\%$). Stabilisation splints, however, exhibited no effect on oral health-related quality of life ($SMD = -0.01$, 95% $CI = -0.88$ to 0.86 ; $P = 0.98$) and displayed very high heterogeneity ($I^2 = 90\%$), indicating inconsistent findings across the studies. When combining both splint types, there was no significant overall effect on oral health-related quality of life ($SMD = -0.14$, 95% $CI = -0.78$ to 0.50 ; $P = 0.67$) with substantial heterogeneity ($I^2 = 88\%$). There was also no statistically significant difference in effectiveness between the occlusal and stabilisation splints ($P = 0.37$) (Figure 6).

Sleep quality

The meta-analysis of occlusal splint therapy effect on sleep quality showed a moderate effect size ($SMD = -0.54$, 95% $CI = -1.22$ to 0.14) suggesting a potential benefit, but the effect was statistically non-significant ($P = 0.12$). This trend, though notable, was inconclusive. The high heterogeneity ($I^2 = 71\%$) indicated substantial variability between the studies, likely due to differences in study design or sample characteristics. The overall effect test ($Z = 1.55$, $P = 0.12$) further supported the lack of statistical significance, as the p -value remained above the 0.05 threshold (Figure 7).

Quality of life (QoL)

The meta-analysis of occlusal splint therapy effect on Quality of Life measured by the World Health Organisation (WHO) quality of life questionnaire revealed small, non-significant effects across all domains, indicating that splint therapy does not significantly impact Quality of Life. For the general component, the effect size was near zero

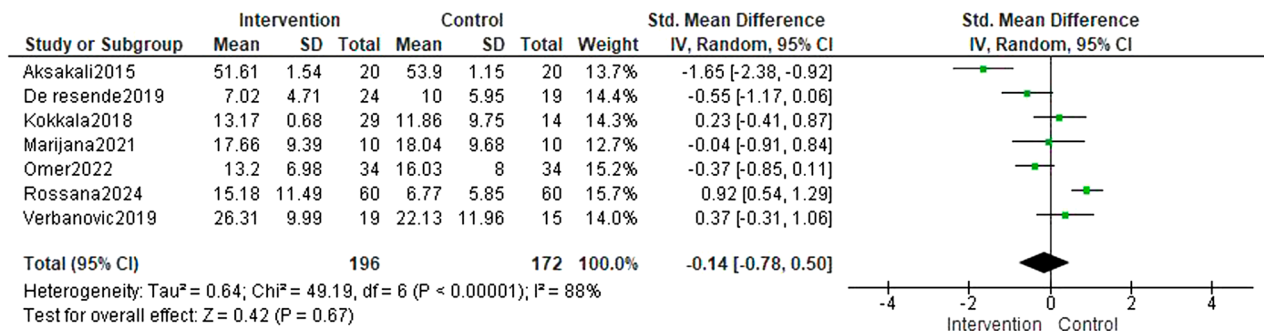


Figure 6. Occlusal splint therapy effect on oral health-related quality of life.

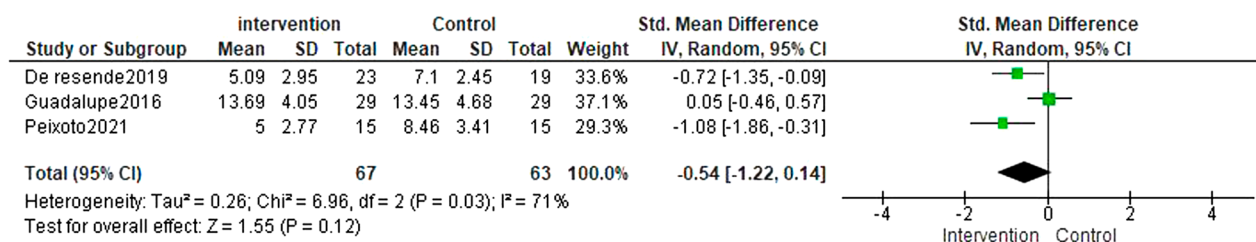


Figure 7. Occlusal splint therapy effect on sleep quality.

(SMD = -0.07, 95% CI = -0.59 to 0.46; $P = 0.80$), with moderate heterogeneity ($I^2 = 48\%$). The physical component showed a small positive trend (SMD = 0.24, $P = 0.20$) and high consistency across the studies ($I^2 = 0\%$). The psychological component had a slightly negative effect size (SMD = -0.18, $P = 0.33$) with no heterogeneity ($I^2 = 0\%$). In the social component, a small positive effect (SMD = 0.16, $P = 0.43$) was observed with low heterogeneity ($I^2 = 10\%$). Finally, the environmental component had an effect size near zero (SMD = -0.05, $P = 0.82$) and moderate heterogeneity ($I^2 = 35\%$). Overall, the consistent lack of statistical significance and generally low heterogeneity across components suggested no meaningful impact on QoL from the interventions studied.

Discussion

The present meta-analysis examined the effects of occlusal splint therapy on psychosocial outcomes in patients with TMD, specifically focusing on anxiety, depression, oral health-related quality of life, sleep quality, and overall quality of life. The findings indicated that, while occlusal splints may provide some benefits in specific domains, their overall psychosocial impact remains limited and highly variable across studies. Given the substantial heterogeneity observed in several outcomes, the results should be interpreted with caution.

The analysis revealed no significant effect of occlusal splint therapy on anxiety levels (SMD = 0.05, 95% CI = -0.49 to 0.60; $P = 0.85$), suggesting that splints alone are unlikely to reduce anxiety symptoms in TMD patients. The high heterogeneity in anxiety outcomes ($I^2 = 74\%$) highlights the variability in study methodologies, patient populations, and baseline psychological conditions. Some studies might have included patients with pre-existing anxiety disorders, whereas others did not assess baseline psychological

status, leading to inconsistencies in treatment response. Furthermore, patient expectations and the placebo effect may play a role, as individuals who sought occlusal splint therapy for pain relief might have experienced transient psychological benefits unrelated to the intervention itself. A sensitivity analysis showed that removing a study with a small sample size slightly reduced heterogeneity but did not alter the overall non-significant result, thereby reinforcing the limited efficacy of splint therapy for anxiety management.

The findings of the present study align with previous studies which suggested mixed or limited psychosocial benefits of occlusal splint therapy in TMD patients. While some studies reported improvements in psychosocial outcomes, the current analysis suggested that these effects were either small or not significant. This is consistent with the findings of Manfredini et al.,⁴ who also reported limited psychological benefits of occlusal splints for TMD patient management and noted that improvements in anxiety were not consistently observed across studies. The moderate to high heterogeneity in the present meta-analysis further highlights variability in treatment responses, which prior research suggested may be attributed to patient-specific factors like baseline anxiety levels or individual differences in TMD pathology.²⁹ Furthermore, while some studies have found that splint therapy can have indirect psychological benefits through pain reduction, these effects on anxiety may be more context-dependent, particularly influenced by patient expectations and adherence to therapy.³⁰ The absence of a significant difference in anxiety outcomes between occlusal and stabilisation splints in the present findings ($P = 0.53$) suggests that splint type is not a primary determinant of anxiety reduction, a notion similarly noted in earlier reviews.⁵

A small but statistically significant reduction in depression symptoms was observed (SMD = -0.42,

95% CI = -0.81 to -0.04; $P = 0.03$), suggesting a potential therapeutic benefit of occlusal splints for mood-related outcomes. The improvement in depressive symptoms may be indirectly mediated by reductions in TMD-related pain and improvements in sleep quality, as prior research suggested that chronic pain is closely linked to mood disturbances.³¹ However, the high heterogeneity observed ($I^2 = 70\%$) raises concerns about the consistency of this effect, which may be influenced by factors such as splint design, patient adherence, and coexisting psychological conditions. The sensitivity analysis revealed that the effect size for depression slightly decreased when studies with unclear allocation concealment were excluded, indicating that methodological quality may have influenced the observed significance. These findings align with previous systematic reviews that suggested that occlusal splints may have a mild but not clinically substantial effect on mood and should not be considered a primary intervention for depression.³²

The current subgroup analysis showed that while bite splints and occlusal splints had non-significant effects nearing significance ($P = 0.08$ and $P = 0.06$, respectively), stabilisation splints exhibited moderate effect sizes with high heterogeneity, in a pattern that suggests inconsistencies in the way stabilisation splints influence mood. The findings mirror previous observations by Yap et al.,³³ who noted that the effect of stabilisation splints on depressive symptoms may vary greatly depending on the frequency of use, patient characteristics, and co-existing psychosocial factors. Overall, the current analysis supports the concept that while splints may offer some reduction in depressive symptoms, they are unlikely to serve as primary interventions for psychological outcomes in TMD patients. This echoes the conclusions from larger systematic reviews by List and Jensen,⁶ which assert that occlusal splint therapy may be beneficial when combined with other treatments, particularly cognitive-behavioural interventions, for comprehensive management of TMD and its associated psychological burden. Existing research also emphasised the importance of addressing psychological co-morbidities through adjunct therapies, as splints alone have limited efficacy in treating anxiety and depression. The relatively high heterogeneity observed in the present findings across both anxiety and depression outcomes may also reflect variability in study protocols, splint designs,

and follow-up periods, consistent with the challenges noted by Manfredini and Lobbezoo in achieving standardisation in splint therapy research.^{34,35}

Occlusal splints demonstrated a modest but significant improvement in oral health-related quality of life (SMD = -0.44, 95% CI = -0.82 to -0.06; $P = 0.02$), while stabilisation splints did not yield a comparable benefit. This suggests that specific splint designs may be more effective in enhancing patients' perceptions of oral health, potentially through pain reduction and improved jaw function. However, the high variability in oral health-related quality of life outcomes ($I^2 = 90\%$) indicates significant inconsistencies across the studies, likely due to differences in study protocols, splint fabrication techniques, and patient compliance. The sensitivity analysis showed that the significant effect of oral health-related quality of life persisted even after excluding studies with unclear blinding procedures, suggesting that the observed benefit was relatively robust. However, the clinical relevance of this effect remains uncertain given the high level of heterogeneity.

A study by Manfredini et al. found that patients using occlusal splints reported improvements in oral health metrics, including reductions in pain and better masticatory function, which are key contributors to perceived Oral Health-Related Quality of Life.³² Alajbeg et al. observed that occlusal splints improved the functional aspects of oral health and led to a subjective increase in patient comfort and satisfaction with oral activities which supported the concept that occlusal splints may target Oral Health-Related Quality of Life more effectively than stabilisation splints.¹³ Additional studies, such as those by Wetselaar et al., also reported mixed results regarding stabilisation splints, thereby reinforcing the need for standardised intervention protocols.³⁶

The present analysis found a moderate but statistically non-significant effect of occlusal splint therapy on sleep quality (SMD = -0.54, 95% CI = -1.22 to 0.14; $P = 0.12$), with substantial heterogeneity ($I^2 = 71\%$). The sensitivity analysis indicated that removing a study with an extreme effect size reduced heterogeneity from 71% to 50% but did not change the overall non-significant result, suggesting that inconsistencies in study populations and adherence rates may be driving variability. These results align with the existing literature showing inconsistent

effects of splints on sleep outcomes, particularly in patients with co-existing sleep disorders, bruxism, or chronic pain syndromes. While some studies suggest that occlusal splints may improve sleep by alleviating nocturnal bruxism and reducing orofacial pain, the variability in individual responses makes it difficult to draw definitive conclusions.³⁷ Similar findings by Raph³⁸ indicated that sleep quality may benefit indirectly from splint therapy through pain reduction, yet the specific impact on sleep remains inconclusive due to the variability in patient responses and splint use. Aarab and colleagues³⁹ emphasised that a 'one-size-fits-all' approach may not be optimal for treating sleep issues in TMD patients, and personalised adjustments in splint design may be necessary to produce more consistent results. The findings highlight the need for future research to incorporate patient-specific factors, such as baseline sleep disturbances and pain severity measures, when assessing the efficacy of splint therapy for sleep quality.

Occlusal splint therapy showed no significant effect on general quality of life across psychological, social, environmental, and physical health domains, aligning with previous studies that reported limited holistic benefits of splint therapy beyond oral health-specific outcomes. The findings further suggested that while occlusal splints may alleviate localised symptoms, the impact on broader QoL indicators remains negligible. It was previously reported that splints improved pain-related QoL aspects but did not significantly influence psychological nor social well-being, reinforcing the notion that a multimodal approach integrating cognitive-behavioral therapy or physical therapy may be necessary for addressing the broader psychosocial impacts of TMD.⁴⁰ The absence of a significant QoL effect in the current meta-analysis suggests that splint therapy alone is insufficient for achieving meaningful improvements in overall patient well-being and should be considered as part of a comprehensive treatment strategy rather than a standalone intervention.⁴⁰

List and Axelsson⁴¹ observed that improvements from occlusal splints were generally restricted to physical well-being, with a limited effect on social or psychological aspects, underscoring the need for a multifaceted approach to TMD management. Smith et al.⁴² advocated occlusal splint therapy with other interventions, such as cognitive-behavioural therapy or physical therapy, to target the psychosocial

impacts of TMD more comprehensively. Their research suggested that while occlusal splints may relieve physical discomfort, additional therapeutic components are essential for achieving significant improvements in overall Quality of Life. This supports the present finding that splint therapy alone does not impact Quality of Life, and that a multidisciplinary treatment model may offer a more effective approach for enhancing QoL outcomes in this patient population.⁴³

Several limitations should be considered when interpreting the present results. The high heterogeneity observed in multiple outcomes limits the generalisability of the findings and suggests that treatment effects may vary based on individual patient characteristics and study designs. The potential publication bias remains a concern, as smaller studies with non-significant findings may be under-represented in the literature, potentially skewing effect estimates. Although sensitivity analyses demonstrated that the main findings remained stable when studies with a high risk of bias were excluded, the small number of included trials reduced the reliability of these assessments. Additionally, most studies focused on short- to medium-term outcomes (3-6 months post-treatment), with limited data on long-term psychosocial effects which is a crucial aspect given that TMD-related symptoms and their psychological impact may evolve over time. Future studies should aim to address these gaps by standardising intervention protocols, ensuring adequate sample sizes, and incorporating long-term follow-up assessments to better understand the sustained impact of occlusal splint therapy on psychosocial well-being.

Clinical implications

The present meta-analysis highlights the value of occlusal splints, not only as a treatment for the physical symptoms of TMD, but also as a potential tool for enhancing psychosocial well-being. Integrating mental health assessments in routine care for TMD patients may help identify those who could most benefit from occlusal therapy, especially in cases in which psychological symptoms exacerbate pain or impair quality of life. Furthermore, the findings suggest that interdisciplinary care, encompassing dental, psychological, and sleep-related support, could offer more holistic benefits for TMD patients.

Table II. Summary of the findings

Sr. No.	Outcome	Effect size	P- value	Heterogeneity	Evidence Certainty (GRADE)
1	Anxiety	0.05 (-0.49 to 0.60)	0.85	74% (Moderate)	Low
2	Depression	-0.42 (-0.81 to -0.04)	0.03	70% (Moderate)	Moderate
3	Oral Health-Related QoL	-0.14 (-0.78 to 0.50)	0.67	88% (High)	Low
4	Sleep Quality	-0.54 (-1.22 to 0.14)	0.12	71% (High)	Low
5	Overall QoL (General Component)	-0.07 (-0.59 to 0.46)	0.80	48% (Moderate)	Moderate
6	Overall QoL (Physical Component)	0.24 (-0.12 to 0.60)	0.20	0% (Low)	Moderate
7	Overall QoL (Psychological Component)	-0.18 (-0.53 to 0.18)	0.33	0% (Low)	Moderate
8	Overall QoL (Social Component)	0.16 (-0.23 to 0.55)	0.43	10% (Low)	Moderate
9	Overall QoL (Environmental Component)	-0.05 (-0.50 to 0.40)	0.82	35% (Moderate)	Moderate

Conclusion

The present meta-analysis provides a comprehensive evaluation of the psychosocial effects of occlusal splint therapy in patients presenting with temporomandibular disorders. The findings suggest that, while occlusal splints may offer some benefits for depression and oral health-related quality of life, their overall impact on anxiety, sleep quality, and general quality of life (QoL) remains limited and inconsistent. Given that TMDs arise from multifactorial causes including malocclusion, bruxism, trauma, and stress-related muscle tension, these diverse aetiological factors likely contribute to the heterogeneity of observed in treatment outcomes. The moderate to high heterogeneity noted across outcomes underscores the need for a cautious interpretation of these results, as variations in study design, sample characteristics, and intervention protocols may have influenced treatment effects.

Despite these insights, the quality of evidence remains a major limitation. Many included studies lacked standardised outcome measures, consistent follow-up durations, and detailed reporting of methodological rigor, which raises concerns about potential biases and the reliability of effect estimates. Future research should adhere to transparent, standardised evidence synthesis frameworks, such as the GRADE approach, to ensure a more robust and clinically meaningful interpretation of findings. Furthermore, a higher standard of methodological

quality is required in TMJ research, with improved reporting of randomisation procedures, blinding methods, and long-term outcome assessments to enhance reproducibility and applicability in clinical practice.

To advance the field, future studies should prioritise well-designed randomised controlled trials with larger sample sizes, uniform outcome definitions, and long-term follow-ups to determine the sustained psychosocial effects of occlusal splint therapy. Additionally, integrating occlusal therapy with multimodal treatment approaches, including cognitive-behavioural therapy and physical therapy, may provide a more comprehensive strategy for addressing the complex interplay between TMD and psychosocial well-being. By ensuring methodological rigor and standardised evidence synthesis, future research can contribute to clearer clinical guidelines and more effective patient-centred treatment strategies for TMD-related psychosocial outcomes Table II.

Conflict of interest

The authors declare that there is no conflict of interest.

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