E-ISSN: 3068-3726
Journal of Orthopaedic Science and Research

ATHENAEUM SCIENTIFIC PUBLISHERS

Review Article

Non-Pharmacological Management of Temporomandibular Disorders: Occlusal Splints, Physical Therapy and Behavioral Strategies: A Narrative Review

Alejandra Patricia Eris[1*], Alina Fonseca Contrera[2], Daniela Valiente Orive[3], Danae Alvarez Reyes[4], Irviana A Molina García[5], Pierina M Calderon Higinio[6]

[1]School of Dentistry, Catholic University of Honduras, San Pedro Sula, Honduras
[2]Masters in Comprehensive General Stomatology, University Specialty Clinic "Manuel de Jesus Cedeno" Granma- Cuba, University of Medical Sciences "Efrain Benitez Popa" Granma-Cuba
[3]University of Medical Sciences of Havana, Havana, Cuba, School of Stomatology "Raul Gonzalez Sanchez", Doctor of Stomatology, Cuba
[4]University of Medical Sciences of Havana, Havana, Cuba. School of Stomatology, Cuba
[5]School of Dentistry, Universidad de Los Andes, Venezuela
[6]School of Dentistry, Inca Garcilaso de la Vega University, Lima, Peru; Enrique Guzman y Valle National University of Education, Lima, Peru
***Correspondence author:** Alejandra Patricia Eris. DDS, School of Dentistry, Catholic University of Honduras, San Pedro Sula, Honduras;
Email: research@idpathwaysllc.com

Citation: Eris AP, et al. Non-Pharmacological Management of Temporomandibular Disorders: Occlusal Splints, Physical Therapy and Behavioral Strategies: A Narrative Review. J Ortho Sci Res. 2026;7(2):1-18.

https://doi.org/10.46889/JOSR.2026.7209

Received Date: 27-05-2026
Accepted Date: 15-06-2026
Published Date: 22-06-2026

Abstract

Temporomandibular Disorders (TMDs) are multifactorial conditions affecting the temporomandibular joint, masticatory muscles and associated structures, commonly resulting in pain, limited jaw function and diminished quality of life. Epidemiological data indicate that signs and symptoms of TMD affect between 33% and 75% of the general population, with a higher prevalence among women and adults aged 20 to 40 years. The biopsychosocial framework underpinning the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) recognizes biological, psychological and social contributors to onset and chronicity. Although pharmacological agents may provide short-term symptom relief, their long-term use is limited by adverse effects and inability to address underlying mechanisms. Accordingly, conservative non-pharmacological strategies including occlusal splint therapy, physical therapy and behavioral interventions have emerged as preferred first-line management approaches. This narrative review synthesizes current evidence on these modalities, discussing their mechanisms, clinical efficacy, limitations and the rationale for individualized, multidisciplinary treatment planning in TMD management.

Keywords: Temporomandibular Disorder; Non-Pharmacological Therapies; Occlusal Splints; Physical Therapy; Behavioral Strategies; Biopsychosocial Model

Introduction

Temporomandibular Disorders (TMDs) encompass a cluster of clinical conditions affecting the masticatory muscles, the Temporomandibular Joint (TMJ) and associated structures. Epidemiological surveys suggest that TMD signs or symptoms are present in 33% to 75% of the general population [1]. Although prevalence is not strictly age-specific, adults between 20 and 40 years of age are most frequently affected and consistent evidence across multiple studies demonstrates that women are more likely than men to report TMD symptoms and to seek clinical care [2]. The clinical burden of TMD extends beyond pain. Patients commonly experience restricted mandibular mobility, headache, earache and difficulties with basic functions such as chewing and speaking. These functional impairments, combined with associated psychological distress, significantly reduce health-related quality of life and generate substantial direct and indirect healthcare costs [1,2].

TMDs are multifactorial conditions, commonly linked to overlapping etiological contributors including trauma, parafunctional activity, peripheral and central sensitization and psychological factors such as stress, anxiety and depression [3]. The anatomical proximity of the TMJ to the cervical musculature has generated evidence suggesting that postural dysfunction may also contribute to TMD pathogenesis and perpetuation [2,3].

The Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) provides a standardized, dual-axis classification framework. Axis I addresses physical diagnoses, categorized as pain-related conditions (myalgia, arthralgia and TMD-related headache) or joint disorders (disc displacement variants, degenerative joint disease and subluxation). Axis II evaluates psychosocial status, encompassing perceived stress, emotional distress, pain-related disability and maladaptive coping behaviors [2,4]. Together, these axes support a comprehensive biopsychosocial understanding of TMD that moves beyond purely structural explanations (Fig. 1).

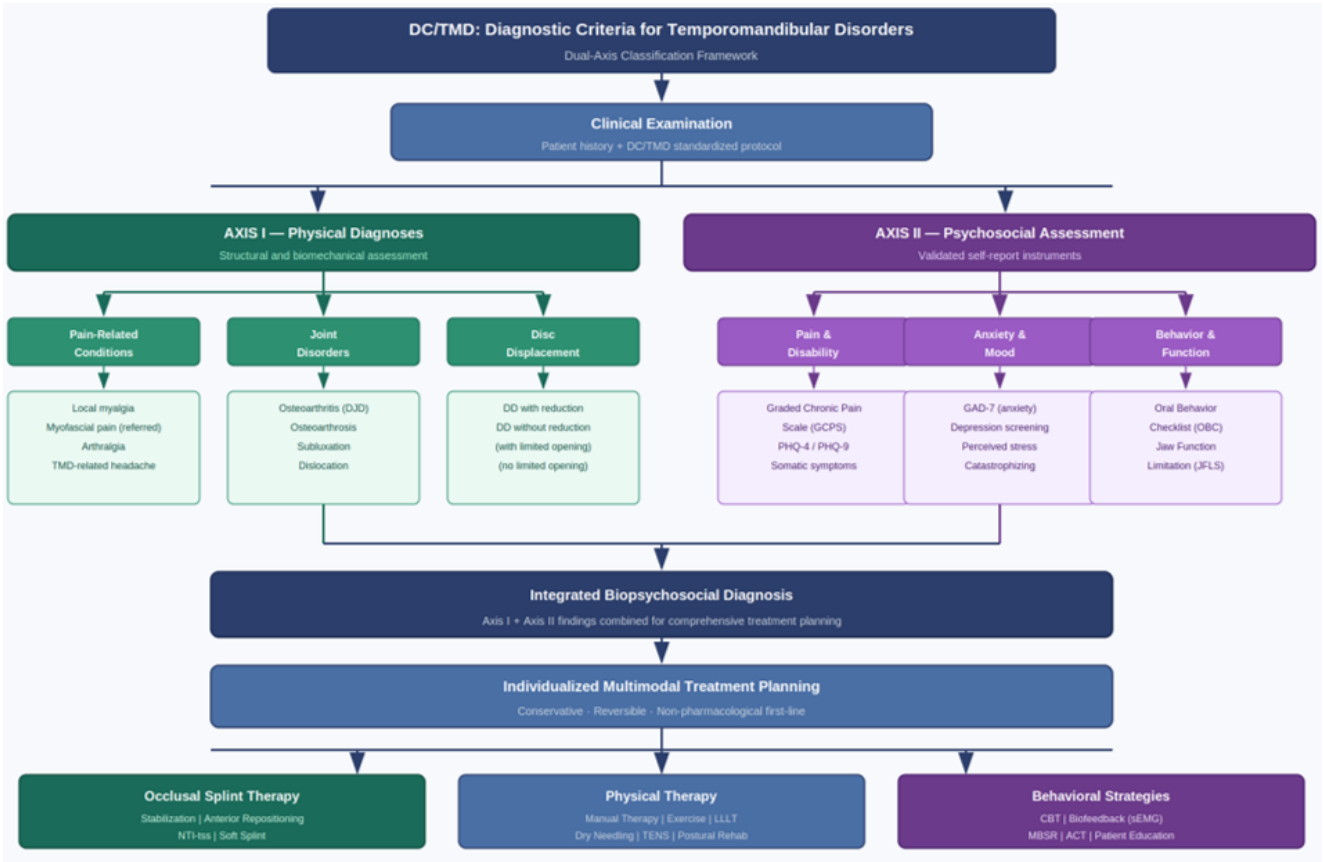

Figure 1: DC/TMD dual-axis classification framework and integrated treatment pathway. Axis I captures physical diagnoses (pain-related conditions and joint disorders) assessed through clinical examination. Axis II evaluates psychosocial status using validated self-report instruments. Findings from both axes are integrated to inform individualized, multimodal, non-pharmacological treatment planning. DD = Disc Displacement; DJD = Degenerative Joint Disease; GCPS = Graded Chronic Pain Scale; GAD-7 = Generalized Anxiety Disorder Scale-7; PHQ = Patient Health Questionnaire; OBC = Oral Behavior Checklist; JFLS = Jaw Functional Limitation Scale; LLLT = low-level laser therapy; DN = dry needling; CBT = cognitive behavioral therapy; MBSR = Mindfulness-Based Stress Reduction; DC/TMD = Diagnostic Criteria for Temporomandibular Disorders [1-3].

Due to the anatomical complexity and multifactorial etiology of TMD, diagnosis and treatment planning remain challenging. The variability in presentation often leads to trial-and-error therapeutic approaches, underscoring the need for individualized, evidence-based management strategies [4,5]. The goal of this narrative review is to provide a broad and integrative overview of non-pharmacological treatments for TMDs, synthesizing current evidence on occlusal splint therapy, physical therapy and behavioral strategies. The review aims to highlight the mechanisms, clinical benefits and limitations of these approaches while emphasizing the importance of individualized, multidisciplinary care.

Management

A narrative literature review was conducted to evaluate current evidence on non-pharmacological approaches for the management of temporomandibular disorders, with a primary focus on occlusal splints, physical therapy and behavioral strategies. Given that TMD is a multifactorial condition influencing both physical and psychological well-being, an interdisciplinary search approach was employed to capture evidence from dental, rehabilitation and behavioral pain management literature [6].

Four electronic databases were searched: PubMed, Cochrane Library, Embase and PsycINFO. These were selected to ensure broad coverage of biomedical, rehabilitation and behavioral research relevant to TMD management [7]. Articles published between 2020 and 2025 were prioritized, with seminal earlier works included where they provided foundational evidence not adequately represented in more recent literature. Reference lists of selected articles were also reviewed to identify additional relevant sources [8].

The search strategy combined Medical Subject Headings (MeSH) and free-text keywords using Boolean operators (AND, OR). Key MeSH terms included "Temporomandibular Joint Disorders," "Occlusal Splints," "Physical Therapy Modalities," "Behavior Therapy," and "Chronic Pain." Free-text terms included "temporomandibular disorders," "TMD," "conservative treatment," "non-pharmacological therapy," "splint therapy," "physiotherapy," and "behavioral strategies." An example search string was: ("Temporomandibular Joint Disorders" OR "TMD") AND ("Occlusal Splints" OR "splint therapy") AND ("Physical Therapy" OR "physiotherapy") AND ("Behavior Therapy" OR "behavioral interventions") [3,9].

Inclusion criteria required studies to be Randomized Controlled Trials (RCTs), systematic reviews, meta-analyses or narrative reviews focused on conservative, non-pharmacological management of TMD [8]. Only studies involving adult patients diagnosed using standardized criteria, specifically the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) or the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD), were eligible. Studies limited exclusively to surgical or pharmacological interventions, investigations involving pediatric populations, case reports, expert opinions and studies lacking standardized diagnostic criteria were excluded [1,9].

A narrative review design was selected because it permits integration of heterogeneous evidence across multiple disciplines and treatment modalities, which is particularly important given the wide variety of outcome measures and therapeutic approaches described in the TMD literature [1]. This design does carry inherent limitations, including the potential for selection bias and the absence of quantitative pooling as used in systematic reviews and meta-analyses. Furthermore, although research on TMD is substantial, published evidence on certain non-pharmacological modalities remains relatively sparse, highlighting the need for further high-quality investigation in this area (Fig. 2) [10].

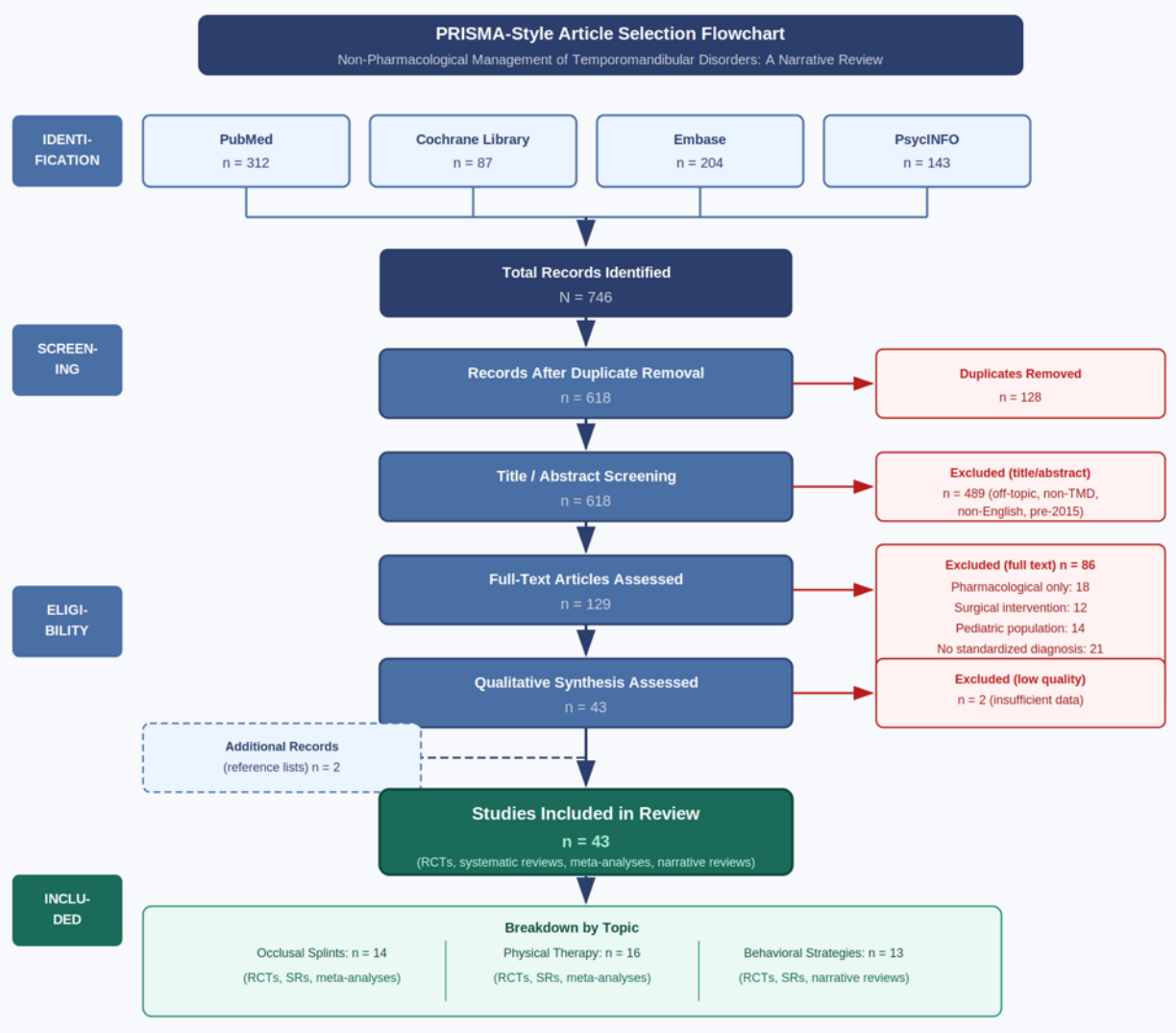

Figure 2: PRISMA-Style article selection flowchart for the narrative review on non-pharmacological management of temporomandibular disorders. Four electronic databases were searched (PubMed, Cochrane Library, Embase, PsycINFO), yielding 746 records. After duplicate removal (n = 128), 618 records underwent title and abstract screening. Full-text assessment was performed for 129 articles; 86 were excluded based on predefined criteria (pharmacological or surgical interventions only, pediatric populations, absence of standardized diagnostic criteria or case reports and expert opinions). Two additional records were identified through reference list screening. A total of 43 studies were included in the final narrative synthesis, distributed across three principal topic areas: occlusal splint therapy (n = 14), physical therapy (n = 16) and behavioral strategies (n = 13). RCT = randomized controlled trial; SR = systematic review; DC/TMD = Diagnostic Criteria for Temporomandibular Disorders; RDC/TMD = Research Diagnostic Criteria for Temporomandibular Disorders. Study counts are approximate and presented for illustrative purposes. Adapted from PRISMA 2020 guidelines.

Occlusal Splints:

Classification of Splint Types

Occlusal splints are among the most widely used conservative interventions for temporomandibular disorders. These removable intraoral appliances are designed to reduce pain, improve jaw function and decrease parafunctional activity such as bruxism and clenching. Splint selection depends on the patient's diagnosis, symptom profile and treatment objectives; evidence consistently supports combining splint therapy with physical therapy, behavioral management and patient education rather than relying on splints as a standalone treatment [10,11].

Several distinct categories of occlusal splints have been described in the literature. Stabilization splints, often referred to as Michigan splints, are full-arch hard acrylic appliances that aim to distribute occlusal forces evenly, reduce masticatory muscle

hyperactivity and promote a more physiologically stable condylar position. Anterior repositioning splints guide the mandible into a slightly protruded position to reduce pressure on the retrodiscal tissues and are primarily indicated for disc displacement conditions. NTI-tss devices are smaller anterior coverage appliances designed to reduce clenching intensity by preventing posterior tooth contact. Soft splints, fabricated from flexible thermoplastic materials, are generally recommended for short-term symptom relief or as a low-cost introductory intervention, particularly in cases of sleep bruxism [11-13].

Proposed Mechanisms of Action

The mechanisms by which occlusal splints improve TMD symptoms remain incompletely understood. Proposed explanations include redistribution of occlusal loading, reduction in muscle hyperactivity, protection of dental structures from attrition and increased proprioceptive awareness of parafunctional habits. It is likely that symptom improvement results from a combination of these mechanisms rather than any single factor and that the therapeutic effect of wearing an appliance includes cognitive and behavioral components that are difficult to isolate in research settings [13,14].

Evidence for Myofascial Pain and Arthralgia

The strongest evidence base for occlusal splint therapy pertains to patients with myofascial pain and arthralgia. Stabilization splints have been shown to reduce pain intensity and improve mandibular range of motion, particularly in patients with muscular TMD presentations characterized by nocturnal clenching and masticatory muscle tenderness. However, the literature is not uniformly positive; some RCTs and systematic reviews report that stabilization splints do not significantly outperform other conservative treatments, including self-care instruction, counseling or physical therapy alone [14,15]. For this reason, many clinical guidelines position occlusal splints as an adjunctive rather than definitive therapy.

Evidence for Disc Displacement

For patients with disc displacement with reduction, anterior repositioning splints may reduce joint pain and clicking by temporarily improving the condyle-disc relationship. Some evidence supports short-term benefit in terms of pain reduction and functional improvement; however, long-term stability after discontinuing the splint remains uncertain and full-time wear carries the risk of posterior open bite development and permanent occlusal changes. Current clinical consensus favors conservative, reversible approaches over irreversible occlusal procedures in these patients [15,16].

Adverse Effects and Limitations

Despite their widespread clinical use, occlusal splints are not without risk. Prolonged use of partial-coverage appliances, in particular, has been associated with unwanted tooth migration, posterior open bite and alterations in the existing occlusal scheme. Patient compliance and individual variation in splint design and fabrication quality further influence outcomes. Long-term randomized trials with standardized protocols are still needed to clarify the true efficacy of different splint types over extended time horizons (Table 1) [16,17].

Splint Type	Coverage	Proposed Mechanism	Primary Indication	Evidence Level	Key Limitations
Stabilization Splint (Michigan / Flat-plane)	Full arch; hard acrylic	Redistributes occlusal forces; reduces masticatory muscle hyperactivity; promotes stable condylar seating.	Myofascial pain; arthralgia; bruxism; generalized TMD.	Moderate–Strong. Multiple RCTs and systematic reviews support pain reduction and improved mouth opening [13,14,16]	Not superior to other conservative therapies in all trials; does not eliminate parafunctional drive.

Anterior Repositioning Splint	Full arch; hard acrylic; mandible protruded	Advances mandible to reduce retrodiscal loading; may improve condyle-disc relationship.	Disc displacement with reduction; joint pain with clicking.	Moderate. Short-term improvement in pain and click reduction reported; long-term stability uncertain [15,16]	Risk of posterior open bite and permanent occlusal change with prolonged use; full-time wear not recommended.
NTI-tss Device	Anterior teeth only; hard acrylic	Prevents posterior tooth contact; reduces clenching force; reflex inhibition of jaw-closing muscles.	Sleep bruxism; clenching-related myofascial pain; headache associated with TMD.	Limited. Small RCTs; FDA-cleared but evidence on safety and occlusal effects is mixed [11,13]	Risk of posterior tooth over-eruption with prolonged use; not suitable for patients with anterior tooth issues.
Soft / Resilient Splint	Full arch; thermoplastic	Cushions occlusal contacts; reduces joint loading; may increase proprioceptive awareness.	Bruxism; short-term symptom relief; low-cost introductory intervention.	Low–Moderate. Evidence weaker than hard splints; some studies report comparable short-term relief [11,13]	May paradoxically increase masticatory muscle activity in some patients; less durable than hard acrylic.

Table 1: Classification of occlusal splint types: mechanisms, indications, evidence and limitations. Source: Synthesized from Albagieh, et al., Manfredini, et al., González-Sánchez, et al., Zhang, et al., Somogyi, et al. and Maejima, et al., [11-16]. Evidence levels reflect the quality and consistency of available literature at the time of this review. RCT = Randomized Controlled Trial; TMD = Temporomandibular Disorder; FDA = Food and Drug Administration.

Clinical Implications for the General Dentist

For the general dentist, the key practical takeaway is that occlusal splints are most effective when prescribed within an accurate diagnosis and when integrated into a broader multimodal treatment plan. Conservative and reversible approaches should remain the priority. Splint therapy appears to provide its greatest benefit when combined with physical therapy, behavioral management and patient education, rather than being used in isolation. Appropriate follow-up and monitoring for adverse occlusal effects are essential components of responsible splint management [14-16].

Physical Therapy

Overview and Anatomical Rationale

Physical therapy is a fundamental component of conservative, non-pharmacological management for temporomandibular disorders, complementing occlusal splint therapy and behavioral interventions within a multidisciplinary framework [18]. The temporomandibular joints are among the most anatomically complex joints in the human body, consisting of bilateral synovial articulations formed by the mandibular condyle, articular tubercle and mandibular fossa of the temporal bone, all separated by a fibrocartilaginous articular disc and supported by a network of capsular ligaments and masticatory muscles [19,20]. This structural complexity, combined with the close biomechanical relationship between the TMJ, cervical musculature and the postural chain, means that dysfunction in one region frequently contributes to pain and limitation in another [18-20].

Manual Therapy

Manual therapy has been established as a safe and effective intervention for TMD, particularly when combined with therapeutic exercise in patients with myogenic presentations [21,22]. Techniques commonly employed include myofascial release, muscle energy techniques, strain-counterstrain and intraoral soft tissue mobilization targeting the masseter and medial pterygoid muscles, which are frequently hypertonic and tender in TMD patients. High-velocity low-amplitude manipulation, while used less commonly in the orofacial region, has also been described in the literature as part of multimodal protocols [23,24]. Although manual therapy consistently demonstrates benefit in reducing pain and improving mandibular opening in the short to medium term, additional high-quality trials with longer follow-up are needed to confirm its long-term effectiveness.

An integrated cervical-temporomandibular rehabilitation program has been associated with greater short-term clinical improvement compared to cervical-focused rehabilitation alone in individuals with chronic non-specific neck pain with TMD co-involvement [22]. This finding reinforces the importance of treating the cervical and mandibular regions as a functionally linked system rather than as independent entities.

Therapeutic Exercise

Jaw-specific therapeutic exercise, used in conjunction with manual therapy, can reduce pain intensity, improve maximum mandibular opening and enhance lateral excursion in TMD patients [23,27]. Exercise programs typically include controlled mouth-opening exercises, coordination training and proprioceptive re-education aimed at normalizing neuromuscular function of the masticatory system. When combined with postural correction exercises targeting the cervical and thoracic spine, these programs address the full musculoskeletal chain relevant to TMD, contributing to more durable functional outcomes [28].

Electrophysical Modalities

A range of electrophysical modalities are employed as supportive therapies within TMD physical therapy protocols. Transcutaneous Electrical Nerve Stimulation (TENS) has demonstrated efficacy in reducing pain and decreasing masticatory muscle hyperactivity. Therapeutic ultrasound has been associated with improved local circulation and muscle relaxation. Low-Level Laser Therapy (LLLT) has shown particularly promising analgesic and anti-inflammatory effects, with a recent systematic review and meta-analysis reporting superior outcomes in pain reduction and mouth opening improvement compared with both TENS and therapeutic ultrasound [27,29]. Dry needling of masticatory trigger points has also gained evidence support; notably, a multi-center RCT found that dry needling combined with upper cervical spinal manipulation provided greater improvement in jaw pain and pain-free mouth opening than a protocol combining splint therapy, medication and joint mobilization (Table 2) [26,30].

Modality	Primary Target	Techniques / Protocol	Clinical Findings	Evidence Level
Manual Therapy	Masticatory muscle tension; joint mobility; cervical dysfunction	Myofascial release; muscle energy techniques; intraoral soft tissue mobilization; High-Velocity Low-Amplitude (HVLA) manipulation; strain-counterstrain.	RCT: significant reduction in pain and improvement in maximum mouth opening. Greater benefit when combined with therapeutic exercise [23,24]	Moderate
Therapeutic Exercise	Mandibular range of motion; neuromuscular coordination; postural alignment	Controlled mouth-opening exercises; lateral excursion training; proprioceptive re-education; cervical and scapular stabilization exercises.	Systematic review and meta-analysis: exercise therapy comparable to splint therapy for pain and mobility; combination of both modalities superior to either alone [23,24]	Moderate–Strong

TENS	Pain modulation; masticatory muscle hyperactivity	Surface electrode placement over masseter and temporalis; typical protocol 20–30 min sessions; frequency and intensity adjusted to patient tolerance.	Demonstrated reduction in muscle hyperactivity and pain. Inferior to LLLT in direct comparisons for pain reduction and mouth opening [26,27]	Moderate
Low-Level Laser Therapy (LLLT)	Analgesia; inflammation; trigger point pain	Infrared or near-infrared laser applied to masticatory trigger points and TMJ capsule; 4–12 sessions common in trials.	Systematic review and meta-analysis: LLLT superior to TENS and therapeutic ultrasound for pain reduction and improvement in mouth opening in TMD patients [26,27]	Moderate–Strong
Therapeutic Ultrasound	Local circulation; muscle relaxation; tissue healing	Continuous or pulsed mode; applied over masseter, TMJ capsule and lateral pterygoid region; 5–10 min per session.	Randomized controlled trial: ultrasound combined with exercise and stabilization splint produced meaningful reduction in myofascial pain and improved jaw function [27,42]	Moderate
Dry Needling	Myofascial trigger points; referred pain; masticatory muscle tension	Intramuscular needle placement at active trigger points in masseter, temporalis and pterygoid muscles; combined with spinal manipulation in recent trials.	Multi-center RCT: dry needling combined with upper cervical spinal manipulation superior to splint therapy plus medication and joint mobilization for jaw pain and pain-free mouth opening [25]	Moderate
Cervical and Postural Rehabilitation	Cervical alignment; craniocervical posture; mandibular mechanics	Cervical joint mobilization; postural correction exercises; integrated cervico-temporomandibular rehabilitation protocols targeting both the cervical spine and jaw simultaneously.	RCT: integrated cervical-TMD rehabilitation produced greater short-term improvement than cervical rehabilitation alone. Derwich, et al., (2022): physiotherapy combined with splint therapy improved both craniovertebral and craniomandibular alignment [22,26,40]	Moderate

Table 2: Physical therapy modalities for TMD: Techniques, clinical evidence and evidence levels. Source: Synthesized from Ferrillo, et al., [18], Gębska, et al., [23], Dunning, et al., [25], Ansari, et al., [26,27], Delceoğlu and Algun [22], Zhang, et al., [41], Salloum, et al., [42] and Derwich, et al., [40]. Evidence levels reflect the volume and methodological quality of available trials. TENS = transcutaneous electrical nerve stimulation; LLLT = Low-Level Laser Therapy; HVLA = High-Velocity Low-Amplitude; RCT = Randomized Controlled Trial; TMD = Temporomandibular Disorder; TMJ = Temporomandibular Joint.

Cervical Spine and Postural Considerations

Cervical spine dysfunction and postural abnormalities are frequently co-present in TMD patients and should be systematically assessed during both examination and treatment planning [21]. Altered head and neck posture, together with cervical muscular tension, can influence mandibular mechanics through shared neuromuscular pathways, contributing to pain amplification and functional restriction. Evidence indicates that combining cervical manual therapy with postural correction exercises yields greater improvement in mouth opening and pain-related disability than postural exercises alone, supporting the value of a genuinely integrated approach [28,31].

Dentist-Physical Therapist Referral Interface

Because TMD is a multifactorial condition with musculoskeletal, functional and psychosocial dimensions, interdisciplinary collaboration between dentists and physical therapists is important for achieving optimal outcomes. Referral to physical therapy should be considered for patients presenting with muscular pain, cervical dysfunction, postural abnormalities or restricted mandibular mobility, especially when symptoms persist after initial conservative dental management. Comprehensive individualized assessment and coordinated treatment planning across disciplines can improve pain management, restore function and reduce reliance on invasive interventions [29].

Behavioral Strategies

DC/TMD Axis II Rationale

The understanding of temporomandibular disorders has progressively evolved from a predominantly structural and biomechanical framework toward a biopsychosocial model that integrates physical, psychological and social contributors to pain and dysfunction [31]. Within this paradigm, the DC/TMD Axis II assessment was developed as a complementary tool to evaluate psychosocial status, emotional distress, maladaptive coping behaviors and pain-related disability in TMD patients [30,31]. Axis II instruments assess perceived stress, anxiety, depressive symptoms, somatic awareness and catastrophizing, all of which have been consistently associated with increased pain intensity, greater functional limitation and poorer treatment outcomes in chronic TMD populations [30,32].

The relationship between psychological distress and TMD is not merely associative. Multiple studies have demonstrated that stress activates the Hypothalamic-Pituitary-Adrenal (HPA) axis, leading to cortisol dysregulation that may contribute to central sensitization and persistent pain amplification [31,33]. Accordingly, DC/TMD Axis II should be viewed not only as a diagnostic classification tool but also as an essential screening instrument that informs comprehensive and interdisciplinary treatment planning [34].

Cognitive Behavioral Therapy (CBT)

Cognitive behavioral therapy is among the most extensively studied and best-supported behavioral interventions for chronic TMD management. CBT targets maladaptive thought patterns, emotional responses and dysfunctional coping behaviors associated with chronic pain [32]. The primary therapeutic goal is not necessarily pain elimination but rather the improvement of coping capacity and functional restoration, outcomes that often translate indirectly into reductions in perceived pain intensity and disability [32,35].

Evidence from systematic reviews confirms that CBT, whether delivered as a standalone intervention or combined with conventional conservative dental treatment, improves pain intensity, jaw function, depression, activity interference and overall quality of life in TMD patients [36,37]. Multi-component behavioral programs integrating pain neuroscience education, CBT, relaxation training and biofeedback have demonstrated clinically meaningful improvements in pain and psychosocial outcomes that are sustained at long-term follow-up [38]. CBT appears especially beneficial in chronic or myofascial TMD patients with substantial psychosocial burden, where addressing maladaptive cognition and catastrophizing is as therapeutically important as managing structural joint abnormalities [32,37].

Biofeedback (sEMG)

Surface Electromyographic (sEMG) biofeedback has emerged as a useful complementary behavioral strategy in TMD management. This technique enables patients to monitor and voluntarily modulate physiological responses, particularly masticatory muscle tension and parafunctional activity, through real-time visual or auditory feedback. It functions as both a self-regulation tool and a form of operant conditioning that promotes heightened awareness of harmful muscular behaviors [32,38]. Clinical practice guidelines for chronic TMD management include biofeedback as a recommended adjunctive therapy, recognizing that psychosocial and behavioral factors are strongly implicated in symptom persistence [33,39]. Although network meta-analyses suggest that biofeedback may not consistently outperform other conservative therapies in reducing pain intensity, it demonstrates comparable efficacy and contributes meaningfully to self-regulation, psychological resilience and reduction in parafunctional habits [40]. It is most appropriately positioned as a complementary educational intervention rather than a standalone treatment, particularly in patients with awake bruxism, stress-related hyperactivity of the masticatory musculature and chronic muscular TMD presentations [32,33].

Mindfulness-Based Interventions

Mindfulness-based approaches, including Mindfulness-Based Stress Reduction (MBSR) and Acceptance and Commitment Therapy (ACT), have gained increasing recognition within the chronic TMD literature [41]. These interventions aim to improve emotional regulation, enhance cognitive flexibility, reduce stress reactivity and foster greater awareness of physiological and psychological responses to chronic pain [34,35].

Recent clinical evidence demonstrates that mindfulness-based interventions can meaningfully reduce stress levels, pain catastrophizing, pain sensitivity and emotional distress in patients with chronic painful TMD. Specifically, these approaches have been associated with reductions in rumination, magnification, hopelessness and the number of active trigger points, while simultaneously improving pain pressure thresholds and emotional regulation capacity [34,42]. Mindfulness-based orofacial pain education programs have also shown promise in promoting self-awareness, patient engagement and a more adaptive biopsychosocial understanding of chronic pain [35]. Although existing evidence is limited by small sample sizes and a predominance of female participants, mindfulness-based interventions represent low-cost, patient-centered adjunctive strategies with meaningful potential for enhancing long-term coping in chronic TMD [43].

Patient Education and Self-Management

Patient education and self-management strategies form the foundation of conservative TMD care and should be integrated into every treatment plan regardless of other modalities selected [43]. Dentists should routinely educate patients regarding habit awareness, jaw relaxation techniques, sleep hygiene, postural correction, soft diet modifications during symptomatic flare-ups and avoidance of parafunctional behaviors such as clenching and gum chewing.

Despite the high prevalence of TMD, considerable variability persists in TMD-related education across dental training programs. Although the Commission on Dental Accreditation (CODA) has established competency standards requiring graduates to manage TMD patients, individual institutions retain wide latitude in how this training is delivered, resulting in persistent gaps in diagnostic confidence and clinical preparedness among dental trainees [36]. Because long-term outcomes in TMD management are strongly tied to patient adherence and behavioral modification, education should extend beyond symptomatic first aid and should actively promote engagement with self-management strategies over time (Table 3).

Intervention	Theoretical Basis	DC/TMD Axis II Target	Clinical Outcomes	Evidence Level
Cognitive Behavioral Therapy (CBT)	Cognitive restructuring; modification of maladaptive pain beliefs, catastrophizing and avoidance behaviors.	Depression; anxiety; pain catastrophizing; activity interference; pain-related disability.	Systematic review: CBT alone or combined with standard care improved pain intensity, jaw function, depression and quality of life. RCT: multimodal CBT program sustained clinically meaningful improvement at long-term follow-up [22,37,38]	Moderate–Strong
Biofeedback (sEMG)	Operant conditioning; real-time feedback of masticatory muscle electromyographic activity to promote voluntary self-regulation.	Parafunctional habits; masticatory muscle hyperactivity; awake bruxism; stress-related clenching.	Network meta-analysis: biofeedback demonstrated comparable efficacy to other conservative therapies for pain; superior benefit for self-regulation of parafunctional habits and behavioral awareness [32,33]	Moderate

Mindfulness-Based Stress Reduction (MBSR)	Mindful awareness; non-judgmental attention to bodily sensations; reduction of pain rumination and emotional reactivity.	Pain catastrophizing (rumination, magnification, hopelessness); perceived stress; emotional distress.	RCT: MBSR reduced pain catastrophizing, pain sensitivity, trigger point count and emotional distress while improving pain pressure thresholds in chronic painful TMD [34,35]	Moderate (limited by sample size)
Acceptance and Commitment Therapy (ACT)	Psychological flexibility; acceptance of chronic pain; value-based behavioral activation; cognitive defusion.	Psychological inflexibility; experiential avoidance; hopelessness; chronic pain-related functional restriction.	Emerging evidence supports ACT as a complement to CBT in chronic pain management; specific TMD trials are limited but data from related orofacial pain populations show improved coping and reduced disability [32,35]	Low–Moderate (emerging)
Patient Education and Self-Management	Behavioral activation; habit awareness; empowerment through knowledge of TMD biopsychosocial mechanisms.	Parafunctional habit modification; sleep hygiene; posture correction; jaw rest behaviors.	Broadly supported across TMD guidelines as a foundational intervention. Fan, et al., identified significant gaps in TMD education in dental training programs, suggesting that dentist-delivered education remains inconsistently applied [6,10,36]	Moderate (guideline-supported)

Table 3: Behavioral strategies for TMD management: Theoretical Basis, DC/TMD Axis II targets and clinical evidence. Source: Synthesized from Wie, et al., [32], González-González, et al., [33], De Oliveira Melchior, et al., [34], Melchior, et al., [35], Fan, et al., [36], Shivakumar, et al., [37] and Vaddamanu, et al., [38]. ACT evidence extrapolated from related chronic orofacial pain literature; dedicated TMD trials remain limited. Note: CBT = Cognitive Behavioral Therapy; sEMG = Surface Electromyography; MBSR = Mindfulness-Based Stress Reduction; ACT = Acceptance and Commitment Therapy; DC/TMD = Diagnostic Criteria for Temporomandibular Disorders.

Oral Clinician Role in Diagnosis and Referral

Oral clinicians are uniquely positioned to identify psychosocial risk factors associated with chronic TMD during routine clinical encounters, for several converging reasons. First, the dental setting affords repeated, longitudinal contact with patients across time, enabling clinicians to observe changes in pain behavior, functional limitation and emotional state that may not be apparent in a single visit. Second, oral clinicians are typically the first point of contact for patients with orofacial pain complaints, placing them at the front line of early detection before chronicity is established. Third, the DC/TMD Axis II instruments including the GCPS, PHQ-4, GAD-7, JFLS and OBC are brief, validated and readily integrated into standard intake workflows without requiring specialist training [30,31]. Together, these factors mean that timely psychosocial screening is both clinically feasible and strategically impactful within the dental setting. Early recognition of anxiety, depression, perceived stress, catastrophizing and pain-related disability facilitates prompt referral to psychologists, behavioral pain specialists, physical therapists or multidisciplinary orofacial pain teams as appropriate (Table 4).

Studies indicate that many dental trainees feel insufficiently prepared to diagnose and manage TMD in a clinically confident manner, emphasizing the ongoing need for strengthened educational exposure and hands-on training in this area [36]. By combining conservative dental management with psychosocial screening, structured patient education and well-coordinated multidisciplinary referrals, oral clinicians can meaningfully improve both physical and psychological outcomes in patients with chronic TMD.

Axis	Category	Subcategory / Diagnosis	Key Clinical Features
I	Pain-Related	Myalgia (local / myofascial / referred)	Bilateral or unilateral masticatory muscle pain; pain provoked by jaw movement or palpation; may radiate to adjacent areas [2,4]
I	Pain-Related	Arthralgia	TMJ pain provoked by jaw movement, function or direct palpation of the joint capsule [2,4]
I	Pain-Related	TMD-Related Headache	Headache in the temple area modified by jaw movement or palpation of masticatory muscles / TMJ [2,4]
I	Joint Disorders	Disc Displacement with Reduction	Reproducible TMJ click or pop on opening / closing; reciprocal click; pain may or may not be present [2,4]
I	Joint Disorders	Disc Displacement without Reduction (with / without limited opening)	No click; restricted or absent opening; jaw deflection toward affected side; joint noise may be crepitus [2,4]
I	Joint Disorders	Degenerative Joint Disease (Osteoarthritis)	Crepitus on jaw movement; radiographic evidence of bone changes; pain and restricted mobility [2,4]
I	Joint Disorders	Subluxation / Dislocation	Condyle locks anterior to articular eminence on wide opening; patient unable to close without manipulation [2,4]
II	Psychosocial Assessment	Pain Intensity and Disability (GCPS)	Graded Chronic Pain Scale evaluates pain intensity and pain-related functional disability [1,30]
II	Psychosocial Assessment	Depression / Somatic Symptoms (PHQ-4, PHQ-9)	Screens for depressive symptoms and somatic amplification; strongly associated with chronic TMD [1,30]
II	Psychosocial Assessment	Anxiety (GAD-7)	Generalized anxiety frequently co-presents with myofascial TMD and predicts poor treatment outcomes [30,31]
II	Psychosocial Assessment	Jaw Functional Limitation (JFLS)	Assesses difficulty with chewing, swallowing, communication and emotional expression [1,30]
II	Psychosocial Assessment	Oral Behavior (OBC)	Identifies parafunctional habits (clenching, bruxism, nail biting) as modifiable behavioral targets [1,30]

Table 4: DC/TMD classification framework: axis I physical diagnoses and axis II psychosocial assessment instruments. This synthesis integrates evidence from Yu, et al., [1], Wan, et al., [2], Garstka, et al., [4] and Ferrillo, et al., [30]. Categorizations align with the dual-axis DC/TMD framework, representing the established clinical standard for diagnostic excellence. Table 4. DC/TMD = Diagnostic Criteria for Temporomandibular Disorders; GCPS = Graded Chronic Pain Scale; PHQ = Patient Health Questionnaire; GAD-7 = Generalized Anxiety Disorder Scale; JFLS = Jaw Functional Limitation Scale; OBC = Oral Behavior Checklist; TMJ = Temporomandibular Joint.

Discussion

Occlusal Splint Therapy

Occlusal splint therapy exerts its clinical effects through several interacting mechanisms: redistribution of occlusal forces across the dental arch, reduction of masticatory muscle hyperactivity, protection of dental structures from attrition and enhancement of proprioceptive awareness of parafunctional behaviors such as nocturnal clenching. The rationale for these effects rests on the premise that altered biomechanical loading at the joint and muscular level contributes directly to pain sensitization and functional restriction in TMD; by modifying these inputs, splint therapy aims to interrupt the cycle of overload and nociception. The evidence base is moderate in strength, supported by multiple RCTs and systematic reviews confirming reductions in pain intensity and improvements in mandibular range of motion, particularly in myofascial and arthralgic presentations [14-16].

However, this evidence also reveals important limitations: stabilization splints do not consistently outperform other conservative approaches, long-term efficacy beyond the active treatment period remains uncertain and partial-coverage appliances carry the risk of unwanted occlusal change with extended use. Patient compliance and variability in fabrication quality further influence outcomes, reinforcing the importance of accurate diagnosis, individualized appliance selection and regular follow-up within any splint therapy protocol.

Physical Therapy

Physical therapy addresses TMD through a mechanistically distinct but complementary pathway. Its primary rationale lies in the close anatomical and neuromuscular interdependence of the temporomandibular joint, masticatory musculature and cervical spine, a relationship that means peripheral musculoskeletal dysfunction in one region routinely amplifies pain and restriction in another. Manual therapy targets hypertonic masticatory muscles and restricted joint mobility directly, while therapeutic exercise programs restore neuromuscular coordination and mandibular range of motion through progressive proprioceptive re-education. The inclusion of cervical and postural rehabilitation addresses the craniocervical contributors to TMD that purely dental interventions cannot reach. The evidence base is moderate to strong, with RCTs and systematic reviews confirming meaningful reductions in pain and improvements in mouth opening, particularly in myogenic presentations with cervical co-involvement [18,22,23]. Limitations include access and cost barriers in many healthcare contexts, heterogeneity in treatment protocols across studies that constrains direct comparison and the requirement for adequately trained practitioners, factors that collectively underscore the need for structured referral pathways and interdisciplinary coordination between oral clinicians and physical therapists.

Behavioral Strategies (CBT, Biofeedback, Mindfulness)

Behavioral strategies address a dimension of TMD pathophysiology that neither occlusal nor physical interventions can adequately target: the psychosocial mechanisms that initiate, perpetuate and amplify chronic pain. The clinical rationale for CBT, biofeedback, mindfulness-based approaches and patient education rests on well-established evidence that psychological distress including anxiety, depression and catastrophizing activates central sensitization pathways, increases parafunctional muscle activity through HPA-axis dysregulation and predicts poor response to conventional dental management [32,33]. By modifying maladaptive pain cognitions, reducing emotional reactivity and fostering voluntary self-regulation of parafunctional behaviors, behavioral interventions target these upstream drivers rather than their downstream structural consequences. The evidence base is moderate overall, with systematic reviews confirming meaningful improvements in pain intensity, jaw function and quality of life when CBT is delivered alone or in combination with standard care; biofeedback contributes comparably in terms of pain outcomes with added benefit for self-regulation of muscle hyperactivity; and mindfulness-based approaches show emerging efficacy for catastrophizing and pain sensitivity [37,38]. Limitations include restricted access to trained behavioral health practitioners in many settings, meaningful variability in CBT delivery protocols across studies and the predominance of small sample sizes in the mindfulness literature, all of which constrain the generalizability of current findings and highlight the need for larger, more standardized trials.

Synthesis of Findings Across the Three Modalities

When the evidence for occlusal splint therapy, physical therapy and behavioral interventions is considered collectively rather than in isolation, a consistent and clinically important pattern emerges: each modality addresses a distinct but overlapping dimension of TMD pathophysiology and the therapeutic ceiling of any single approach is predictably lower than what can be achieved through their coordinated application. This convergence is not incidental; it reflects the fundamentally multidimensional nature of TMD itself. Occlusal splints reduce the peripheral biomechanical drivers of pain by modifying joint loading and suppressing masticatory muscle overactivity, yet they cannot correct the postural dysfunction or cervical muscular tension that perpetuates mandibular restriction. Physical therapy restores mobility, re-establishes neuromuscular coordination and addresses the craniocervical contributors to TMD, yet it cannot independently modify the catastrophizing cognitions or stress-driven parafunctional habits that sustain chronic pain. Behavioral strategies target precisely these upstream psychological and behavioral drivers, yet without concurrent management of the structural and musculoskeletal components, their effects on function remain incomplete. The rationale for multimodal integration, therefore, is not merely additive, it is mechanistically justified by the multifactorial architecture of TMD chronicity [10,18].

Pharmacological interventions play an adjunctive role in pain control for patients with painful TMDs. The most commonly used agents include Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), muscle relaxants, anxiolytics, antidepressants, corticosteroids and anticonvulsants [5]. However, the decision to employ pharmacotherapy should be preceded by a careful benefit-risk analysis, as long-term use of these agents is frequently limited by adverse effects including gastrointestinal complications, sedation and dependency risks [4]. More fundamentally, pharmacological treatments address symptomatic expression rather than the underlying biopsychosocial mechanisms of TMD, often resulting in incomplete or time-limited relief [6].

Non-pharmacological therapies are attracting growing attention for their capacity to address TMD more holistically and over longer time horizons, with fewer systemic adverse effects [5,6]. This category of intervention encompasses occlusal splinting, physical therapy, exercise, low-level laser therapy, cognitive behavioral therapy, mindfulness-based approaches and patient education [7]. These modalities target the muscular, articular, postural and psychosocial dimensions of TMD and are increasingly recognized as the standard first-line approach prior to any escalation toward invasive interventions [6].

This mechanistic rationale is supported by a body of empirical evidence that, while heterogeneous in design, consistently favors combined approaches over monotherapy. Vrbanovic, et al., provided an early signal of the bidirectional relationship between splint therapy and psychosocial outcomes, reporting that three months of occlusal splint use in female TMD patients produced concurrent reductions in perceived stress, pain intensity and salivary oxidative stress markers, suggesting that structural intervention can exert measurable effects on biological stress indicators [39]. Derwich, et al., extended this reasoning by demonstrating that combining physiotherapy with splint therapy improved both craniovertebral and craniomandibular alignment beyond what either intervention achieved independently, providing structural evidence of functional synergy between dental and rehabilitative approaches [40] Zhang, et al., in a systematic review and meta-analysis, reported that exercise therapy and occlusal splint therapy produced statistically comparable effects on pain and mandibular mobility as standalone interventions, but that their combination yielded more comprehensive functional improvement than either alone, directly supporting the clinical value of integration [41]. Salloum, et al., further reinforced this pattern by demonstrating that a multimodal physical therapy protocol incorporating ultrasound, jaw exercises and stabilization splints produced meaningful reductions in masticatory myofascial pain that exceeded what any single component could plausibly achieve in isolation [42]. Taken together, these findings illuminate not merely that combined treatment works, but why: each modality contributes a mechanistically distinct therapeutic input that the others cannot replicate.

Case for Integrated Multimodal Management

The cumulative evidence reviewed in this narrative synthesis makes a compelling case for integrated multimodal management as the clinical standard for TMD, rather than the exception. The underlying rationale is straightforward: because TMD is not a single-mechanism condition, it cannot be resolved by a single-mechanism treatment. Its muscular, articular, postural, neurological and psychosocial dimensions each require a targeted therapeutic response and the failure to address any one of these dimensions reliably limits the durability and completeness of recovery. An oral clinician who prescribes a stabilization splint without addressing the cervical dysfunction driving mandibular restriction or without screening for the anxiety and catastrophizing that will sustain central sensitization after the appliance is removed, has treated part of the problem while leaving its perpetuating factors intact [40]. Integration across disciplines is therefore not an optional enhancement but a clinical necessity for patients with moderate to severe or chronic TMD presentations. From a patient-centered perspective, this model also aligns with what the evidence shows patients value most: a clinician who explains their condition in terms they understand, coordinates their care actively and treats them as a whole person rather than a structural problem to be corrected [43]. Building that experience requires not only technical competence in each individual modality but the organizational infrastructure and interdisciplinary communication to deploy them in a coherent, coordinated fashion.

Evidence Gaps and Limitations of Current Literature

Despite the promising body of evidence supporting non-pharmacological TMD management, important methodological limitations persist. Many studies are characterized by small sample sizes, short follow-up durations and heterogeneous outcome measures that impede direct between-study comparisons [41,42]. Variability in treatment protocols, splint designs, physical therapy techniques and behavioral intervention delivery further weakens the generalizability of individual findings. Most research concentrates on short-term symptom relief rather than long-term functional rehabilitation or prevention of recurrence, leaving fundamental questions about treatment durability unanswered.

Future Research Directions

Future investigations should prioritize adequately powered randomized controlled trials with standardized methodologies, validated outcome measures and extended follow-up periods sufficient to assess durability of treatment effects. There is a particular need for studies exploring the interactions among psychosocial factors, cervical musculoskeletal dysfunction and chronic pain biomarkers in TMD populations. Patient-reported outcome measures, health-related quality of life assessments and cost-effectiveness analyses of multidisciplinary TMD care represent additional research priorities [39,43].

Limitations of This Review

Several limitations of this narrative review warrant explicit acknowledgment. First, the narrative design, while appropriate for integrating heterogeneous evidence across multiple disciplines and treatment modalities, is inherently susceptible to selection bias in article inclusion and does not permit the quantitative pooling of effect sizes achievable through systematic review with meta-analysis [1,8]. Dinsdale, et al., and Argueta-Figueroa, et al., have previously identified similar constraints in narrative syntheses of TMD conservative interventions, noting that the diversity of outcome measures and treatment protocols across the TMD literature makes direct between-study comparison methodologically challenging even within more rigorous review designs [41,42]. Second, the variability among included studies in terms of treatment duration, patient demographics, TMD subtype distribution and outcome measurement instruments limits the strength of conclusions that can be drawn about specific clinical populations or treatment sequences. Zhang, et al., and Salloum, et al., explicitly acknowledged analogous heterogeneity within their own systematic and randomized controlled trial designs, further underscoring that this is a field-wide limitation rather than one specific to the present review [43]. Third, the focus on three principal modalities, occlusal splints, physical therapy and behavioral strategies, while clinically justified by their prevalence in evidence-based guidelines and the scope of this review, means that potentially relevant emerging approaches were not addressed. These include acupuncture, platelet-rich fibrin injection, low-dose naltrexone and combined pharmacological adjuncts, several of which have preliminary evidence supporting their role in refractory or complex TMD presentations [44]. Future narrative and systematic reviews should consider broadening their modality scope to capture the expanding landscape of conservative TMD management [44].

Conclusions

TMD is a multifactorial condition that cannot be resolved by any single intervention. The evidence reviewed in this narrative synthesis consistently supports occlusal splint therapy, physical therapy and behavioral strategies as complementary first-line non-pharmacological approaches, each targeting a distinct dimension of TMD pathophysiology, biomechanical, musculoskeletal and psychosocial, respectively and collectively achieving outcomes that none can reach alone. Oral clinicians are well placed to lead this process. Applying DC/TMD Axis II screening in routine encounters enables early identification of psychosocial risk factors and facilitates timely referral to physical therapy or behavioral health professionals before chronicity is established. Accurate diagnosis, conservative reversible treatment, structured patient education and coordinated multidisciplinary care remain the cornerstones of effective TMD management and the most reliable pathway to durable functional recovery and improved quality of life.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding Statement

This research did not receive any specific grant from funding agencies in the public, commercial or non-profit sectors.

Acknowledgement

The authors have no acknowledgments to declare.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement

Informed consent was obtained from all participants included in the study.

Authors' Contributions

All authors contributed equally to this paper.

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