CURRENT CONCEPTS IN THE DIAGNOSIS AND MANAGEMENT OF TEMPOROMANDIBULAR DISORDERS: A NARRATIVE REVIEW

Rotaru Costin Alice[1], Agop-Forna Doriana[2*], Ramona Elena Constantin[1]

1 DDS, Resident, Faculty of Dental Medicine, University of Medicine and Pharmacy "Grigore T.Popa", Iasi
2"Gr. T. Popa" U.M.Ph. - Iași, Romania, Faculty of Dentistry, Department of Surgery

Corresponding authors: Agop-Forna Doriana , e-mail: drdorianaforna@gmail.com

ABSTRACT

Background: Temporomandibular disorders (TMDs) represent a heterogeneous group of musculoskeletal and neuromuscular conditions affecting the temporomandibular joint, masticatory muscles, and associated craniofacial structures. These disorders are considered one of the most common causes of chronic non-dental orofacial pain and may significantly impair mandibular function, psychosocial well-being, and quality of life. Contemporary evidence supports a multifactorial and biopsychosocial etiology involving structural, behavioral, psychological, and functional factors. **Objective:** The aim of this narrative review is to summarize contemporary knowledge regarding the diagnosis and management of temporomandibular disorders, with particular emphasis on recent developments, clinical implications, and future directions in patient care. **Methods:** A narrative review of the literature was conducted using contemporary scientific publications, systematic reviews, clinical guidelines, and consensus statements retrieved from major medical and dental databases. Priority was given to recent evidence addressing diagnostic criteria, risk factors, conservative management, minimally invasive therapies, and multidisciplinary treatment approaches in temporomandibular disorders. **Results:** Current evidence indicates that TMDs are multifactorial conditions influenced by occlusal, psychological, behavioral, inflammatory, genetic, and systemic factors. The Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) currently represent the gold standard for diagnosis. Conservative and reversible therapies, including patient education, pharmacological management, physiotherapy, occlusal splints, and psychological interventions, remain the cornerstone of treatment. Emerging technologies such as digital diagnostic systems, artificial intelligence, and regenerative therapies may contribute to improved diagnostic precision and personalized management strategies. **Conclusions:** Temporomandibular disorders require a comprehensive and individualized diagnostic and therapeutic approach based on contemporary evidence and multidisciplinary collaboration. Future advances in digital technologies, biologic therapies, and personalized medicine may further improve long-term clinical outcomes and patient quality of life.

Key words: *temporomandibular disorders (TMD), temporomandibular joint (TMJ), orofacial pain, masticatory muscles, diagnosis, conservative management, multidisciplinary treatment.*

1. INTRODUCTION

Temporomandibular disorders (TMDs) comprise a diverse group of musculoskeletal and neuromuscular conditions involving the temporomandibular joint (TMJ), masticatory muscles, and related craniofacial structures, and are recognized as one of the leading causes of non-dental orofacial pain [1], [2].

TMDs comprise a wide spectrum of clinical entities, such as myalgia, arthralgia, disc displacement disorders, degenerative joint diseases, and headache attributed to TMD, all of which may significantly impair mandibular function and patient well-being [2], [3].

In recent years, increasing attention has been directed toward the impact of TMD, as contemporary systematic reviews

suggest that approximately one-third of the global population may experience signs or symptoms associated with these disorders during their lifetime. Furthermore, TMDs appear to affect women more frequently than men and are particularly prevalent among young and middle-aged adults, suggesting the involvement of biological, hormonal, psychosocial, and behavioral factors in disease development and progression [1], [2].

Historically, the etiology of TMD was primarily attributed to occlusal discrepancies and structural abnormalities of the stomatognathic system; however, contemporary evidence now supports a multifactorial biopsychosocial model of the disorder [1], [2], [4].

The clinical presentation of TMD is highly variable and may include pain in the temporomandibular joint or masticatory muscles, joint sounds, restricted mandibular movements, functional limitations, headaches, and reduced oral health-related quality of life [1], [2]. Given the multifaceted nature of these disorders, accurate diagnosis remains challenging and requires a comprehensive evaluation integrating patient history, clinical examination, psychosocial assessment, and, when indicated, advanced imaging techniques. The introduction of the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) has significantly improved diagnostic reliability and has become the internationally accepted framework for both clinical practice and research [1], [3].

Management strategies for TMD have evolved considerably over the last decades, shifting from predominantly irreversible and occlusion-focused interventions toward conservative, evidence-based, and patient-centered approaches [3], [5]. Invasive procedures are generally reserved for selected cases that fail to respond to conservative measures [1], [2].

2. LITERATURE REVIEW

➢ Classification of Temporomandibular Disorders

The classification of temporomandibular disorders (TMDs) has evolved considerably over the past decades, reflecting advances in the understanding of the complex biological, functional, and psychosocial mechanisms involved in these conditions. Early classification systems primarily focused on structural abnormalities of the temporomandibular joint (TMJ) and masticatory muscles; however, contemporary approaches recognize TMDs as a heterogeneous group of musculoskeletal disorders characterized by multifactorial etiologies and variable clinical presentations [6], [7].

A major milestone in the standardization of TMD diagnosis was the introduction of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) in 1992, which provided the first validated framework for clinical and research applications [8]. Although the RDC/TMD significantly improved diagnostic consistency, limitations regarding diagnostic accuracy led to the development of the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), published in 2014 and currently considered the gold standard for TMD classification [3], [9]. The DC/TMD system employs a

dual-axis approach. Axis I focuses on the physical diagnosis of TMD conditions through standardized clinical examination procedures, whereas Axis II evaluates psychosocial factors, pain-related disability, emotional distress, and behavioral characteristics that may influence symptom severity and treatment outcomes [3], [10].

According to the DC/TMD classification, TMDs can be broadly categorized into pain-related disorders and intra-articular disorders. Pain-related disorders include myalgia, local myalgia, myofascial pain with spreading, myofascial pain with referral, arthralgia, and headache attributed to TMD [3], [7]. Myogenous disorders constitute the most prevalent category and are characterized by pain originating from the masticatory muscles, often exacerbated by jaw function or parafunctional activities [11].

Intra-articular disorders primarily involve structural and functional alterations within the temporomandibular joint. These conditions include disc displacement with reduction, disc displacement with reduction accompanied by intermittent locking, disc displacement without reduction with limited opening, disc displacement without reduction and without limited opening, degenerative joint disease, and TMJ subluxation [3], [7]. Disc displacement disorders are among the most frequently diagnosed joint abnormalities and may present with joint noises, restricted mandibular movement, or episodic locking [12].

In addition to the DC/TMD classification, the International Classification of Orofacial Pain (ICOP) recognizes painful temporomandibular disorders as a distinct subgroup of orofacial pain conditions and integrates them within a broader pain taxonomy framework. This classification highlights the close relationship between TMDs and other chronic pain disorders, supporting the concept that temporomandibular pain should be assessed not only from a structural perspective but also within a comprehensive pain management model [13].

Recent studies have emphasized the importance of continuously refining TMD classification systems to improve diagnostic precision, facilitate interdisciplinary communication, and support personalized treatment planning [9], [14].

- **Etiopathogenesis and Risk Factors**

The etiopathogenesis of temporomandibular disorders (TMDs) is complex and multifactorial, involving the interaction of biological, mechanical, psychological, behavioral, and social factors. Contemporary evidence no longer supports a single causative mechanism but rather a biopsychosocial model in which multiple predisposing, initiating, and perpetuating factors contribute to the onset and progression of the disease [1], [15], [16].

Historically, occlusal discrepancies and structural abnormalities of the stomatognathic system were considered the primary etiological factors of TMD [17]. For many decades, malocclusion, loss of posterior support, and occlusal interferences were believed to directly

induce temporomandibular dysfunction. However, more recent studies have demonstrated that the association between occlusion and TMD is relatively weak and inconsistent, suggesting that occlusal factors alone cannot explain the development of these disorders [15], [18]. Although occlusal instability may contribute to functional overload in certain patients, current evidence indicates that irreversible occlusal therapies should not be regarded as first-line treatment solely for TMD management [1], [19].

Parafunctional activities, particularly bruxism, are currently recognized as significant contributing factors in the development and maintenance of TMD symptoms. Bruxism may occur during wakefulness or sleep and is characterized by repetitive jaw-muscle activity involving clenching, grinding, or mandibular bracing. Excessive mechanical loading generated by parafunctional habits can lead to muscle fatigue, microtrauma, joint overload, and exacerbation of pain symptoms [20], [21]. Nevertheless, not all individuals with bruxism develop TMD, emphasizing the importance of individual susceptibility and adaptive capacity [15].

Psychological factors play a central role in the pathogenesis of TMD and are strongly associated with symptom severity, chronicity, and treatment outcomes. Psychological distress may increase muscle tension, alter pain perception, and contribute to central sensitization mechanisms, thereby amplifying chronic pain experiences. In addition, stress-related behaviors such as daytime clenching and poor sleep quality may further aggravate functional overload of the temporomandibular system [1], [22], [23], [24].

Several studies have demonstrated bidirectional relationships between chronic TMD pain and sleep dysfunction, suggesting that each condition may perpetuate the other. Poor sleep quality, insomnia, obstructive sleep apnea, and fragmented sleep patterns may influence pain modulation pathways and increase susceptibility to chronic pain conditions [25], [26].

Trauma represents another important etiological factor and may include macrotrauma, such as direct injury to the jaw or whiplash accidents, as well as repetitive microtrauma associated with parafunctional habits [1], [15]. Mechanical trauma can affect joint structures, induce inflammatory responses, and alter mandibular biomechanics, potentially contributing to disc displacement and degenerative changes [27].

Inflammatory and degenerative mechanisms are particularly relevant in intra-articular disorders of the temporomandibular joint. Degenerative joint disease is characterized by progressive deterioration of articular cartilage, subchondral bone remodeling, and synovial inflammation [28], [29].

Genetic and hormonal influences have also been investigated in recent years. Variations in genes involved in pain modulation, inflammatory pathways, and catecholamine metabolism may contribute to increased susceptibility to TMD. Furthermore, the higher prevalence of TMD among women has led researchers to explore the potential role of estrogen and

other sex hormones in pain perception, joint laxity, and inflammatory responses [30], [31].

Systemic conditions, including rheumatoid arthritis, fibromyalgia, chronic fatigue syndrome, and other chronic pain disorders, are frequently associated with temporomandibular dysfunction. These comorbidities support the concept that TMD may share common pathophysiological pathways with centralized pain disorders and highlight the importance of comprehensive patient assessment [24], [32].

Recent evidence emphasizes that no single etiological factor can fully explain the development of TMD. Instead, the disorder should be understood as the result of dynamic interactions between peripheral tissue alterations, psychosocial influences, behavioral habits, and central pain modulation mechanisms. Consequently, accurate identification of individual risk factors is essential for establishing personalized and effective treatment strategies aimed at reducing pain, improving function, and preventing chronicity [1], [15], [16], [24].

- **Clinical Manifestations**

Temporomandibular disorders (TMDs) are characterized by a broad spectrum of clinical manifestations involving the temporomandibular joint (TMJ), masticatory muscles, and associated craniofacial structures. The severity and combination of symptoms may vary considerably among patients, ranging from mild functional discomfort to chronic debilitating pain significantly affecting daily activities and quality of life [3], [27].

Pain is considered the most common and clinically significant symptom of TMD [27]. It is typically localized in the preauricular region, temporomandibular joint, masticatory muscles, or adjacent craniofacial areas and may present as intermittent or persistent discomfort [33]. Pain intensity often increases during mandibular function, including chewing, speaking, yawning, or parafunctional activities such as clenching and grinding [15]. Muscular pain is frequently described as dull, diffuse, and aching, whereas articular pain may be sharper and more localized to the joint area [3].

Masticatory muscle tenderness is another common clinical finding and may involve the masseter, temporalis, medial pterygoid, and lateral pterygoid muscles [27]. Palpation of these muscles often reproduces the patient's symptoms and may reveal myofascial trigger points associated with referred pain patterns. In chronic cases, sustained muscle hyperactivity and central sensitization mechanisms may contribute to widespread pain and increased pain sensitivity [34], [35].

Joint sounds are frequently reported by patients with intra-articular disorders of the TMJ. Clicking sounds are commonly associated with disc displacement with reduction, while crepitation may indicate degenerative joint disease or osteoarthritic changes. Although joint sounds may occur in asymptomatic individuals, their presence combined with pain or mandibular dysfunction may suggest clinically relevant pathology [3], [17].

Mandibular movement limitation represents another important manifestation of TMD [27]. Patients may experience

reduced mouth opening, deviation during mandibular movements, or episodes of jaw locking. Disc displacement without reduction is frequently associated with restricted mandibular mobility and limited maximal interincisal opening [17], [36]. Functional impairment may interfere with mastication, speech, oral hygiene procedures, and social interactions, thereby negatively affecting quality of life [15].

Headache is commonly associated with temporomandibular disorders and may represent either a secondary manifestation of muscular dysfunction or a headache directly attributed to TMD. Pain is often localized in the temporal region and may resemble tension-type headache or migraine symptoms. The close anatomical and neurophysiological relationship between the trigeminal system and cervical musculature contributes to the frequent coexistence of TMD with other headache disorders [13], [37].

Otologic symptoms are also frequently described in patients with TMD despite the absence of primary ear pathology. These manifestations may include tinnitus, ear fullness, otalgia, dizziness, and hearing disturbances. The proximity between the temporomandibular joint and auditory structures, together with shared neural pathways, may explain the occurrence of these symptoms [38].

In addition to physical manifestations, TMDs are strongly associated with psychosocial disturbances and reduced oral health-related quality of life [35]. Chronic pain, sleep disturbances, anxiety, depression, and emotional stress may significantly affect psychological well-being and social functioning [16], [39].

Clinical manifestations may differ depending on the subtype and chronicity of the disorder. Acute TMD cases are often associated with localized pain and reversible functional disturbances, whereas chronic conditions may involve central sensitization, widespread pain, psychosocial impairment, and greater therapeutic complexity [16], [35].

- **Diagnostic Methods in Temporomandibular Disorders**

Accurate diagnosis of temporomandibular disorders (TMDs) is essential for establishing an appropriate treatment plan and preventing unnecessary or irreversible interventions. Due to the multifactorial nature and variable clinical presentation of TMDs, diagnosis requires a comprehensive and systematic approach integrating patient history, clinical examination, psychosocial assessment, and imaging investigations when indicated [5], [27].

The diagnostic process begins with a detailed medical and dental history focused on the onset, duration, intensity, and characteristics of symptoms [27]. Patients should be questioned regarding pain location, aggravating and relieving factors, joint sounds, episodes of mandibular locking, parafunctional habits, previous trauma, systemic diseases, and psychosocial stressors. Particular attention should also be given to sleep disturbances, headaches, anxiety, depression, and previous treatments, as these factors may significantly influence symptom severity and prognosis [16], [17].

Clinical examination represents the cornerstone of TMD diagnosis and should

include both extraoral and intraoral evaluation [5]. Assessment of mandibular movements includes measurement of maximal mouth opening, lateral excursions, protrusion, mandibular deviations, and functional limitations. Restricted mandibular mobility or asymmetrical movements may indicate muscular dysfunction, disc displacement, or joint pathology [36], [40].

Palpation of the temporomandibular joints and masticatory muscles is essential for identifying pain sources and reproducing patient symptoms [27]. Joint sounds, including clicking or crepitation, should be evaluated during mandibular opening and closing movements [34], [36].

The Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) currently represent the most widely accepted standardized diagnostic system for TMD assessment. The DC/TMD protocol combines validated clinical examination procedures with psychosocial assessment tools and demonstrates high reliability for the diagnosis of common pain-related and intra-articular TMD conditions [3], [33].

Psychosocial assessment has become increasingly important in contemporary TMD diagnosis due to the recognized role of behavioral and emotional factors in chronic pain development. Standardized questionnaires assessing anxiety, depression, stress, somatization, and quality of life are frequently incorporated into diagnostic protocols. Identification of psychosocial risk factors may contribute to improved treatment planning and more predictable long-term outcomes [15], [16].

Imaging investigations are recommended when clinical findings suggest structural abnormalities, trauma, degenerative changes, or persistent dysfunction [27]. Panoramic radiography may provide an initial overview of osseous structures; however, its diagnostic value for soft tissue assessment is limited. Cone-beam computed tomography (CBCT) is currently considered the preferred imaging modality for evaluating bony alterations of the temporomandibular joint, including erosions, osteophytes, condylar remodeling, and degenerative changes [41], [42].

Magnetic resonance imaging (MRI) remains the gold standard for soft tissue evaluation of the temporomandibular joint. MRI allows detailed visualization of the articular disc, retrodiscal tissues, synovial structures, joint effusion, and inflammatory changes. Disc displacement with or without reduction can be accurately diagnosed through MRI examination, making this technique particularly valuable in patients presenting with joint sounds, locking, or persistent pain [43], [44].

Ultrasonography has also gained interest as a non-invasive and cost-effective adjunctive diagnostic method. Although less accurate than MRI, ultrasound may provide useful information regarding joint effusion, disc position, and muscular abnormalities in selected clinical situations [45].

Because TMD symptoms frequently overlap with other craniofacial pain disorders, differential diagnosis is of major importance. Conditions such as dental pain, trigeminal neuralgia, sinusitis, otologic disorders, headaches, salivary gland

pathology, and neuropathic pain syndromes should be carefully excluded before establishing a definitive diagnosis [46].

Recent advances in digital technology have introduced new diagnostic tools for TMD evaluation, including computerized mandibular tracking systems, electromyography, digital occlusal analysis, and artificial intelligence-based diagnostic models. Although these technologies show promising results, their routine clinical application remains controversial due to limited standardization and insufficient evidence regarding long-term clinical benefits [47], [48].

Overall, contemporary diagnosis of temporomandibular disorders requires an evidence-based and multidisciplinary approach integrating clinical findings with psychosocial evaluation and imaging investigations when necessary. Early and accurate diagnosis is essential for improving treatment outcomes, reducing chronicity, and optimizing patient quality of life.

- **Contemporary Therapeutic Strategies**

The management of temporomandibular disorders (TMDs) has evolved significantly over recent decades, shifting from predominantly irreversible occlusal interventions toward conservative, evidence-based, and multidisciplinary treatment approaches. Because TMDs are considered multifactorial conditions with variable clinical presentations, contemporary therapeutic strategies aim not only to reduce pain and improve mandibular function, but also to address psychosocial, behavioral, and functional contributing factors [4], [15], [19].

Current evidence suggests that most patients with TMD can be successfully managed using conservative and reversible therapies. Initial treatment commonly includes patient education and self-management strategies focused on reducing functional overload of the temporomandibular system. Patients are advised to avoid parafunctional habits such as clenching, gum chewing, nail biting, and excessive mandibular movements. Dietary modifications, thermal therapy, sleep hygiene, stress reduction, and behavioral awareness techniques may also contribute to symptom improvement [15], [17], [33].

Pharmacological therapy is frequently used for short-term pain control and management of acute inflammatory symptoms. Nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly prescribed to reduce pain and inflammation, particularly in patients with arthralgia or degenerative joint disease. Muscle relaxants may be indicated in cases involving muscular hyperactivity and myofascial pain, while low-dose antidepressants can be beneficial in chronic pain conditions associated with sleep disturbances, anxiety, or central sensitization. However, pharmacological therapy should generally be considered adjunctive rather than definitive treatment due to the potential risk of adverse effects associated with long-term medication use [15], [49], [50].

Occlusal splint therapy remains one of the most widely used conservative treatment modalities for TMD management. Stabilization splints are

designed to reduce muscular hyperactivity, improve occlusal stability, protect dental structures from parafunctional wear, and decrease temporomandibular joint loading. Several studies have demonstrated that occlusal splints may provide symptomatic relief in patients with myogenous TMD and sleep bruxism [51], [52], [53]. Contemporary evidence also emphasizes that splint therapy should be individualized according to the patient's diagnosis and clinical presentation rather than routinely prescribed for all TMD cases [19].

Physiotherapy plays an important role in the conservative management of TMD and is particularly effective in muscular disorders and functional limitation. Therapeutic exercises, stretching, manual therapy, posture correction, massage, and relaxation techniques may contribute to improved mandibular mobility, muscle coordination, and pain reduction. In recent years, physical rehabilitation protocols have increasingly incorporated multimodal approaches combining exercise therapy with patient education and behavioral modification [54], [55].

Psychological interventions are frequently recommended in patients presenting with chronic pain, anxiety, depression, stress-related symptoms, or significant psychosocial impairment. Cognitive behavioral therapy (CBT), relaxation training, mindfulness-based interventions, and biofeedback techniques have shown beneficial effects in reducing pain intensity and improving coping mechanisms in chronic TMD patients [56], [57].

Minimally invasive procedures may be considered in patients who fail to respond adequately to conservative treatment [15]. Arthrocentesis is a commonly used technique involving lavage of the superior joint space to reduce inflammatory mediators, improve joint mobility, and decrease pain. Arthroscopy allows direct visualization of intra-articular structures and may be combined with lysis of adhesions or lavage procedures [58], [59]. Intra-articular injections, including corticosteroids, hyaluronic acid, platelet-rich plasma (PRP), and botulinum toxin, have also been investigated as adjunctive treatment modalities, although evidence regarding their long-term efficacy remains variable [60], [61].

Surgical intervention is generally reserved for severe structural abnormalities, advanced degenerative joint disease, ankylosis, neoplasms, or persistent dysfunction unresponsive to conservative and minimally invasive therapies [19]. Surgical procedures may include disc repositioning, discectomy, arthroplasty, or total joint replacement in selected cases [62]. Because surgical management carries increased risks and potential complications, careful patient selection and comprehensive preoperative assessment are essential [15].

Multidisciplinary management has become a fundamental principle in contemporary TMD therapy. Collaboration among prosthodontists, oral and maxillofacial surgeons, physiotherapists, psychologists, neurologists and other healthcare professionals may significantly improve treatment outcomes, particularly in chronic and complex cases. Personalized treatment plans based on the patient's clinical presentation, psychosocial profile, and functional limitations are currently

regarded as the most effective approach for achieving long-term symptom control and functional rehabilitation [4], [19], [63].

3. FUTURE PERSPECTIVES

The understanding of temporomandibular disorders (TMDs) has progressed considerably over the last decades; however, important challenges regarding diagnosis, treatment standardization, and long-term management continue to persist. Future perspectives in the field are increasingly focused on precision medicine, digital technologies, minimally invasive therapies, and multidisciplinary patient-centered care [4], [15].

One of the most promising directions in TMD research involves the integration of digital diagnostic technologies into routine clinical practice. Digital occlusal analysis systems, computerized mandibular tracking devices, electromyography, and three-dimensional imaging techniques may improve the accuracy and reproducibility of functional assessment. Cone-beam computed tomography (CBCT) and magnetic resonance imaging (MRI) continue to evolve, allowing increasingly detailed visualization of osseous and soft tissue structures of the temporomandibular joint. In addition, the incorporation of artificial intelligence (AI) into imaging interpretation and diagnostic algorithms may contribute to earlier detection of structural abnormalities and more precise classification of TMD subtypes [10], [47], [48], [64].

Artificial intelligence and machine learning models are also expected to play an important role in the development of personalized treatment protocols [48]. By analyzing large clinical datasets, psychosocial variables, imaging findings, and patient-reported outcomes, AI-based systems may help identify predictors of treatment response and risk factors associated with chronicity [10]. Such approaches could facilitate individualized therapeutic planning and improve long-term prognosis in patients with chronic temporomandibular pain [15].

Another important area of future development is represented by regenerative and biologic therapies targeting degenerative temporomandibular joint disorders. Platelet-rich plasma (PRP), stem cell therapies, growth factors, and tissue engineering strategies have shown promising preliminary results in promoting cartilage regeneration, reducing inflammation, and improving joint function. Although current evidence remains limited and heterogeneous, these biologically based therapies may represent valuable alternatives to invasive surgical procedures in selected patients [65], [66].

Psychosocial assessment and multidisciplinary management are anticipated to become even more integrated into standard TMD care pathways. The growing recognition of central sensitization, chronic pain mechanisms, and psychological comorbidities highlights the necessity of collaboration between dentists, physiotherapists, psychologists, neurologists, pain specialists, and sleep medicine professionals. Comprehensive management strategies addressing both physical and psychosocial dimensions of the disease may improve treatment

predictability and patient quality of life [35], [67].

Digital dentistry and telemedicine may also significantly influence the future management of TMD patients. Remote monitoring systems, mobile health applications, and teleconsultation platforms could facilitate long-term follow-up, improve patient compliance, and increase accessibility to specialized care, particularly in underserved regions. Furthermore, digital workflows may support more accurate fabrication of occlusal appliances and individualized prosthodontic rehabilitation protocols [47], [68].

Ultimately, the future of temporomandibular disorder management will likely depend on the integration of biologic, technological, psychological, and functional perspectives into a comprehensive patient-centered model of care [67]. Continued advances in diagnostic accuracy, personalized medicine, regenerative therapies, and multidisciplinary rehabilitation may contribute to improved clinical outcomes and a better understanding of the complex mechanisms underlying temporomandibular disorders [68].

4. CONCLUSIONS

An accurate diagnosis of TMDs is essential for effective management and should rely on a thorough clinical examination, psychosocial evaluation, and appropriate imaging techniques. The development of the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) has considerably improved diagnostic consistency and enhanced both clinical practice and research standardization.

Contemporary treatment strategies emphasize conservative, minimally invasive, and patient-oriented approaches, while surgical management is generally reserved for carefully selected cases.

Recent progress in digital dentistry, artificial intelligence, regenerative medicine, and individualized therapeutic protocols may further enhance diagnostic accuracy and treatment outcomes. In parallel, increasing awareness of psychosocial contributors and chronic pain mechanisms underlines the importance of multidisciplinary collaboration in the comprehensive management of patients with TMD.

Ultimately, effective management of temporomandibular disorders requires an individualized, evidence-based approach aimed not only at reducing symptoms, but also at restoring mandibular function, improving psychosocial well-being, and enhancing patients' overall quality of life.

REFERENCES

1. D. T. S. Li and Y. Y. Leung, 'Temporomandibular Disorders: Current Concepts and Controversies in Diagnosis and Management', *Diagnostics*, vol. 11, no. 3, p. 459, Mar. 2021, doi: 10.3390/diagnostics11030459.

2. F. P. Kapos, F. G. Exposto, J. F. Oyarzo, and J. Durham, 'Temporomandibular disorders: a review of current concepts in aetiology, diagnosis and management', *Oral Surgery*, vol. 13, no. 4, pp. 321–334, Nov. 2020, doi: 10.1111/ors.12473.
3. E. Schiffman *et al.*, 'Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: Recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group†', *J Oral Facial Pain Headache*, vol. 28, no. 1, pp. 6–27, Jan. 2014, doi: 10.11607/jop.1151.
4. Committee on Temporomandibular Disorders (TMDs): From Research Discoveries to Clinical Treatment, Board on Health Sciences Policy, Board on Health Care Services, Health and Medicine Division, and National Academies of Sciences, Engineering, and Medicine, *Temporomandibular Disorders: Priorities for Research and Care*. Washington, D.C.: National Academies Press, 2020, p. 25652. doi: 10.17226/25652.
5. E. Schiffman and R. Ohrbach, 'Executive summary of the Diagnostic Criteria for Temporomandibular Disorders for clinical and research applications', *The Journal of the American Dental Association*, vol. 147, no. 6, pp. 438–445, Jun. 2016, doi: 10.1016/j.adaj.2016.01.007.
6. [6] M. Osiewicz, B. Ciapała, K. Bolt, P. Kołodziej, M. Więckiewicz, and R. Ohrbach, 'Diagnostic Criteria for Temporomandibular Disorders (DC/TMD): Polish assessment instruments', *Dent. Med. Probl.*, vol. 61, no. 1, pp. 5–8, Jan. 2024, doi: 10.17219/dmp/181149.
7. J. Warzocha, J. Gadomska-Krasny, and J. Mrowiec, 'Etiologic Factors of Temporomandibular Disorders: A Systematic Review of Literature Containing Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) and Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) from 2018 to 2022', *Healthcare (Basel)*, vol. 12, no. 5, p. 575, Feb. 2024, doi: 10.3390/healthcare12050575.
8. S. F. Dworkin and L. LeResche, 'Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique', *J Craniomandib Disord*, vol. 6, no. 4, pp. 301–355, 1992.
9. G. Minervini, M. M. Marrapodi, Y. Siurkel, M. Cicciù, and V. Ronsivalle, 'Accuracy of temporomandibular disorders diagnosis evaluated through the diagnostic criteria for temporomandibular disorder (DC/TDM) Axis II compared to the Axis I evaluations: a systematic review and meta-analysis', *BMC Oral Health*, vol. 24, no. 1, p. 299, Mar. 2024, doi: 10.1186/s12903-024-03983-7.
10. P. Bizzarri *et al.*, 'Temporomandibular Disorders and Orofacial Outcomes in Subjects with Neck Pain and/or Cervicogenic Headache: A Systematic Review with Meta-Analysis', *JCM*, vol. 15, no. 1, p. 266, Dec. 2025, doi: 10.3390/jcm15010266.
11. E. Hatfield, 'An Overview of Diagnosis and Management of Temporomandibular Disorders', *Journal of the California Dental Association*, vol. 52, no. 1, p. 2400419, Dec. 2024, doi: 10.1080/19424396.2024.2400419.
12. S. Reiter, 'Axis I diagnosis profile according to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD): comparison between hospital-based orofacial pain clinic and dental academic-based orofacial pain clinic', *Journal of Oral & Facial Pain and Headache*, 2024, doi: 10.22514/jofph.2024.040.
13. International Classification of Orofacial Pain, 1st edition (ICOP)', *Cephalalgia*, vol. 40, no. 2, pp. 129–221, Feb. 2020, doi: 10.1177/0333102419893823.
14. M. Ardıç, M. Y. Ardıç, B. Kahraman, P. Bozkurt, and C. Üçok, 'RDC/TMD axis II criteria in defining temporomandibular disorders. a cross-sectional study', *BMC Oral Health*, vol. 25, no. 1, p. 1516, Oct. 2025, doi: 10.1186/s12903-025-06814-5.
15. J. Durham, T. R. O. Newton-John, and J. M. Zakrzewska, 'Temporomandibular disorders', *BMJ*, vol. 350, no. mar12 9, pp. h1154–h1154, Mar. 2015, doi: 10.1136/bmj.h1154.
16. R. B. Fillingim *et al.*, 'Psychological Factors Associated With Development of TMD: The OPPERA Prospective Cohort Study', *The Journal of Pain*, vol. 14, no. 12, pp. T75–T90, Dec. 2013, doi: 10.1016/j.jpain.2013.06.009.
17. J. P. Okeson, *Management of temporomandibular disorders and occlusion*, 8th edition. St Louis: Elsevier, 2020.

18. D. Manfredini, L. Lombardo, and G. Siciliani, 'Temporomandibular disorders and dental occlusion. A systematic review of association studies: end of an era?', *J of Oral Rehabilitation*, vol. 44, no. 11, pp. 908–923, Nov. 2017, doi: 10.1111/joor.12531.
19. C. S. Greene, 'Managing the Care of Patients With Temporomandibular Disorders', *The Journal of the American Dental Association*, vol. 141, no. 9, pp. 1086–1088, Sep. 2010, doi: 10.14219/jada.archive.2010.0337.
20. F. Lobbezoo *et al.*, 'International consensus on the assessment of bruxism: Report of a work in progress', *J of Oral Rehabilitation*, vol. 45, no. 11, pp. 837–844, Nov. 2018, doi: 10.1111/joor.12663.
21. D. Manfredini, J. Serra-Negra, F. Carboncini, and F. Lobbezoo, 'Current Concepts of Bruxism', *Int J Prosthodont*, vol. 30, no. 5, pp. 437–438, Sep. 2017, doi: 10.11607/ijp.5210.
22. M. Wieckiewicz *et al.*, 'Prevalence and Correlation between TMD Based on RDC/TMD Diagnoses, Oral Parafunctions and Psychoemotional Stress in Polish University Students', *BioMed Research International*, vol. 2014, pp. 1–7, 2014, doi: 10.1155/2014/472346.
23. G. D. Slade *et al.*, 'Painful Temporomandibular Disorder: Decade of Discovery from OPPERA Studies', *J Dent Res*, vol. 95, no. 10, pp. 1084–1092, Sep. 2016, doi: 10.1177/0022034516653743.
24. C. J. Woolf, 'Central sensitization: Implications for the diagnosis and treatment of pain', *Pain*, vol. 152, no. 3, pp. S2–S15, Mar. 2011, doi: 10.1016/j.pain.2010.09.030.
25. M. T. Smith *et al.*, 'Sleep Disorders and their Association with Laboratory Pain Sensitivity in Temporomandibular Joint Disorder', *Sleep*, vol. 32, no. 6, pp. 779–790, Jun. 2009, doi: 10.1093/sleep/32.6.779.
26. B. Dubrovsky *et al.*, 'Polysomnographic Investigation of Sleep and Respiratory Parameters in Women with Temporomandibular Pain Disorders', *J Clin Sleep Med*, vol. 10, no. 2, pp. 195–201, Feb. 2014, doi: 10.5664/jcsm.3452.
27. R. de Leeuw, G. D. Klasser, and American Academy of Orofacial Pain, Eds, *Orofacial pain: guidelines for assessment, diagnosis, and management*, Sixth edition. Hanover Park, IL: Quintessence Publishing Co, Inc, 2018.
28. E. Tanaka, M. S. Detamore, and L. G. Mercuri, 'Degenerative Disorders of the Temporomandibular Joint: Etiology, Diagnosis, and Treatment', *J Dent Res*, vol. 87, no. 4, pp. 296–307, Apr. 2008, doi: 10.1177/154405910808700406.
29. S. V. Kellesarian *et al.*, 'Cytokine profile in the synovial fluid of patients with temporomandibular joint disorders: A systematic review', *Cytokine*, vol. 77, pp. 98–106, Jan. 2016, doi: 10.1016/j.cyto.2015.11.005.
30. S. B. Smith *et al.*, 'Potential Genetic Risk Factors for Chronic TMD: Genetic Associations from the OPPERA Case Control Study', *The Journal of Pain*, vol. 12, no. 11, pp. T92–T101, Nov. 2011, doi: 10.1016/j.jpain.2011.08.005.
31. M. P. Warren and J. L. Fried, 'Temporomandibular Disorders and Hormones in Women', *Cells Tissues Organs*, vol. 169, no. 3, pp. 187–192, 2001, doi: 10.1159/000047881.
32. B. Häggman-Henrikson *et al.*, 'Increasing gender differences in the prevalence and chronification of orofacial pain in the population', *Pain*, vol. 161, no. 8, pp. 1768–1775, Aug. 2020, doi: 10.1097/j.pain.0000000000001872.
33. R. Ohrbach and S. F. Dworkin, 'The Evolution of TMD Diagnosis: Past, Present, Future', *J Dent Res*, vol. 95, no. 10, pp. 1093–1101, Sep. 2016, doi: 10.1177/0022034516653922.
34. G. Fernandes, A. L. Franco-Micheloni, J. T. T. Siqueira, D. A. G. Gonçalves, and C. M. Camparis, 'Parafunctional habits are associated cumulatively to painful temporomandibular disorders in adolescents', *Brazilian Oral Research*, vol. 30, no. 1, 2016, doi: 10.1590/1807-3107BOR-2016.vol30.0015.
35. D. E. Harper, A. Schrepf, and D. J. Clauw, 'Pain Mechanisms and Centralized Pain in Temporomandibular Disorders', *J Dent Res*, vol. 95, no. 10, pp. 1102–1108, Sep. 2016, doi: 10.1177/0022034516657070.
36. A. Isberg, *Temporomandibular Joint Dysfunction*, 0 edn. CRC Press, 2001. doi: 10.1201/9780203633151.

37. Y. Costa, A. Porporatti, J. Stuginski-Barbosa, L. Bonjardim, J. Speciali, and P. Conti, 'Headache Attributed to Masticatory Myofascial Pain: Clinical Features and Management Outcomes', *J Oral Facial Pain Headache*, vol. 29, no. 4, pp. 323–330, Oct. 2015, doi: 10.11607/ofph.1394.
38. I. Porto De Toledo *et al.*, 'Prevalence of otologic signs and symptoms in adult patients with temporomandibular disorders: a systematic review and meta-analysis', *Clin Oral Invest*, vol. 21, no. 2, pp. 597–605, Mar. 2017, doi: 10.1007/s00784-016-1926-9.
39. L. Dahlström and G. E. Carlsson, 'Temporomandibular disorders and oral health-related quality of life. A systematic review', *Acta Odontologica Scandinavica*, vol. 68, no. 2, pp. 80–85, Mar. 2010, doi: 10.3109/00016350903431118.
40. C. L. P. Ferreira, M. A. M. R. D. Silva, and C. M. D. Felício, 'Sinais e sintomas de desordem temporomandibular em mulheres e homens', *CoDAS*, vol. 28, no. 1, pp. 17–21, Feb. 2016, doi: 10.1590/2317-1782/20162014218.
41. O. B. Honey *et al.*, 'Accuracy of cone-beam computed tomography imaging of the temporomandibular joint: Comparisons with panoramic radiology and linear tomography', *American Journal of Orthodontics and Dentofacial Orthopedics*, vol. 132, no. 4, pp. 429–438, Oct. 2007, doi: 10.1016/j.ajodo.2005.10.032.
42. M. Alkhader *et al.*, 'Diagnostic performance of magnetic resonance imaging for detecting osseous abnormalities of the temporomandibular joint and its correlation with cone beam computed tomography', *Dentomaxillofacial Radiology*, vol. 39, no. 5, pp. 270–276, Jul. 2010, doi: 10.1259/dmfr/25151578.
43. D. Manfredini and L. Guarda-Nardini, 'Ultrasonography of the temporomandibular joint: a literature review', *International Journal of Oral and Maxillofacial Surgery*, vol. 38, no. 12, pp. 1229–1236, Dec. 2009, doi: 10.1016/j.ijom.2009.07.014.
44. T. A. Larheim, P.-L. Westesson, and T. Sano, 'Temporomandibular Joint Disk Displacement: Comparison in Asymptomatic Volunteers and Patients', *Radiology*, vol. 218, no. 2, pp. 428–432, Feb. 2001, doi: 10.1148/radiology.218.2.r01fe11428.
45. R. Emshoff, S. Bertram, A. Rudisch, and R. Gaßner, 'The diagnostic value of ultrasonography to determine the temporomandibular joint disk position', *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, vol. 84, no. 6, pp. 688–696, Dec. 1997, doi: 10.1016/S1079-2104(97)90374-7.
46. J. M. Zakrzewska, 'Differential diagnosis of facial pain and guidelines for management', *British Journal of Anaesthesia*, vol. 111, no. 1, pp. 95–104, Jul. 2013, doi: 10.1093/bja/aet125.
47. M. Wieckiewicz, K. Boening, P. Wiland, Y.-Y. Shiau, and A. Paradowska-Stolarz, 'Reported concepts for the treatment modalities and pain management of temporomandibular disorders', *J Headache Pain*, vol. 16, no. 1, p. 106, Dec. 2015, doi: 10.1186/s10194-015-0586-5.
48. G. Minervini, M. M. Marrapodi, Y. Siurkel, M. Cicciù, and V. Ronsivalle, 'Accuracy of temporomandibular disorders diagnosis evaluated through the diagnostic criteria for temporomandibular disorder (DC/TDM) Axis II compared to the Axis I evaluations: a systematic review and meta-analysis', *BMC Oral Health*, vol. 24, no. 1, p. 299, Mar. 2024, doi: 10.1186/s12903-024-03983-7.
49. T. List and S. Axelsson, 'Management of TMD: evidence from systematic reviews and meta-analyses: MANAGEMENT OF TMD', *Journal of Oral Rehabilitation*, vol. 37, no. 6, pp. 430–451, May 2010, doi: 10.1111/j.1365-2842.2010.02089.x.
50. H. R. Mujakperuo, M. Watson, R. Morrison, and T. V. Macfarlane, 'Pharmacological interventions for pain in patients with temporomandibular disorders', *Cochrane Database of Systematic Reviews*, Oct. 2010, doi: 10.1002/14651858.CD004715.pub2.
51. E. A. Al-Moraissi, R. Farea, K. A. Qasem, M. S. Al-Wadeai, M. E. Al-Sabahi, and G. M. Al-Iryani, 'Effectiveness of occlusal splint therapy in the management of temporomandibular disorders: network meta-analysis of randomized controlled trials', *International Journal of Oral and Maxillofacial Surgery*, vol. 49, no. 8, pp. 1042–1056, Aug. 2020, doi: 10.1016/j.ijom.2020.01.004.
52. J. Kuzmanovic Pficer, S. Dodic, V. Lazic, G. Trajkovic, N. Milic, and B. Milicic, 'Occlusal stabilization splint for patients with temporomandibular disorders: Meta-analysis of short and long

term effects', *PLoS ONE*, vol. 12, no. 2, p. e0171296, Feb. 2017, doi: 10.1371/journal.pone.0171296.
53. D. Manfredini, J. Ahlberg, P. Wetselaar, P. Svensson, and F. Lobbezoo, 'The bruxism construct: From cut-off points to a continuum spectrum', *J of Oral Rehabilitation*, vol. 46, no. 11, pp. 991–997, Nov. 2019, doi: 10.1111/joor.12833.
54. S. Armijo-Olivo, L. Pitance, V. Singh, F. Neto, N. Thie, and A. Michelotti, 'Effectiveness of Manual Therapy and Therapeutic Exercise for Temporomandibular Disorders: Systematic Review and Meta-Analysis', *Phys Ther*, vol. 96, no. 1, pp. 9–25, Jan. 2016, doi: 10.2522/ptj.20140548.
55. M. Paço, B. Peleteiro, J. Duarte, and T. Pinho, 'The Effectiveness of Physiotherapy in the Management of Temporomandibular Disorders: A Systematic Review and Meta-analysis', *J Oral Facial Pain Headache*, vol. 30, no. 3, pp. 210–220, 2016, doi: 10.11607/ofph.1661.
56. V. R. Aggarwal, K. Lovell, S. Peters, H. Javidi, A. Joughin, and J. Goldthorpe, 'Psychosocial interventions for the management of chronic orofacial pain', *Cochrane Database Syst Rev*, no. 11, p. CD008456, Nov. 2011, doi: 10.1002/14651858.CD008456.pub2.
57. S. F. Dworkin *et al.*, 'Brief group cognitive-behavioral intervention for temporomandibular disorders', *Pain*, vol. 59, no. 2, pp. 175–187, Nov. 1994, doi: 10.1016/0304-3959(94)90070-1.
58. L. Guarda-Nardini, 'Arthrocentesis of the Temporomandibular Joint', 2021.
59. J. P. McCain, *Principles and practice of temporomandibular joint arthroscopy*. St. Louis: Mosby-Year Book, 1996.
60. F. S. de Sousa, 'Socioeconomic inequalities and temporomandibular joint disorders in adolescents: contributions from a Maranhão cohort', *Community Dental Health*, vol. 38, no. 3, pp. 192–197, Sep. 2021, doi: 10.1922/CDH_deSousa0028506.
61. M. A. U. Huamani, L. A. Moreira, N. S. D. Araújo, M. H. Napimoga, J. L. C. Junqueira, and M. E. Miranda, 'Use of botulinum toxin type a in temporomandibular disorder', *RGO, Rev. Gaúch. Odontol.*, vol. 65, no. 2, pp. 151–155, Jun. 2017, doi: 10.1590/1981-86372017000200093144.
62. L. G. Mercuri, M. Q. Neto, and R. Pourzal, 'Alloplastic temporomandibular joint replacement: present status and future perspectives of the elements of embodiment', *International Journal of Oral and Maxillofacial Surgery*, vol. 51, no. 12, pp. 1573–1578, Dec. 2022, doi: 10.1016/j.ijom.2022.05.015.
63. R. Ohrbach and S. Sharma, 'Behavioral therapy for temporomandibular disorders', *Front Oral Maxillofac Med*, vol. 3, pp. 37–37, Dec. 2021, doi: 10.21037/fomm-20-65.
64. R. B. Kerstein, 'Current applications of computerized occlusal analysis in dental medicine', *Gen Dent*, vol. 49, no. 5, pp. 521–530, 2001.
65. X. Van Bellinghen *et al.*, 'Temporomandibular Joint Regenerative Medicine', *IJMS*, vol. 19, no. 2, p. 446, Feb. 2018, doi: 10.3390/ijms19020446.
66. S. K. Mathpati, G. Jain, V. Mishra, A. K. Singh, R. Mishra, and B. K. Yadav, 'Platelet-Rich Plasma in the Management of Temporomandibular Joint Pain in Young Adults With Temporomandibular Disorder', *Cureus*, Mar. 2024, doi: 10.7759/cureus.55609.
67. G. B. Rollman and J. M. Gillespie, 'The role of psychosocial factors in temporomandibular disorders', *Current Review of Pain*, vol. 4, no. 1, pp. 71–81, Feb. 2000, doi: 10.1007/s11916-000-0012-8.
68. R. Franco and G. Minervini, 'Digitalization, Technologies, New Approaches, and Telemedicine in Dentistry and Craniofacial/Temporomandibular Disorders', *Applied Sciences*, vol. 14, no. 13, p. 5871, Jul. 2024, doi: 10.3390/app14135871.