QUALITY IN SPORT
eISSN 2450-3118 · Open Access · Peer-reviewed
apcz.umk.pl/QS Nicolaus Copernicus University in Toruń

SZCZEŚNIAK, Agnieszka, SYGUDA, Aleksandra, MATYJA, Weronika, TARNAWSKA , Kamila and STRÓZIK, Anna. Masticatory Muscle Disorders in the Course of Temporomandibular Joint Dysfunction – Contemporary Methods of Diagnosis and Conservative Treatment. A Literature Review. Quality in Sport. 2026;70:74345. https://doi.org/10.12775/QS.2026.70.74345

ARTICLE TIMELINE
Received: 15.07.2026. Revised: 15.08.2026. Accepted: 16.08.2026. Published: 20.08.2026.

The journal has been awarded 20 points in the parametric evaluation by the Polish Ministry of Higher Education and Science (Annex to the announcement of 05.01.2024, No. 32553). Unique Journal Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 – aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

Masticatory Muscle Disorders in the Course of Temporomandibular Joint Dysfunction – Contemporary Methods of Diagnosis and Conservative Treatment. A Literature Review

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Abstract

Introduction and aim: Temporomandibular disorders (TMD) are among the most common causes of chronic orofacial pain of non-dental origin, with a muscular component dominating in 50–70% of patients. Global prevalence reaches 34%, with marked female predominance and peak incidence at 18–60 years, making masticatory muscle disorders a significant clinical and public health problem. The aim of this review was to systematize current knowledge on the epidemiology, etiopathogenesis, classification, diagnosis, and conservative treatment of masticatory muscle disorders, with emphasis on clinical and instrumental assessment tools.

Material and methods: This is a descriptive (narrative) literature review. The search was conducted in PubMed/MEDLINE, PMC, Europe PMC, and Google Scholar, including systematic reviews, meta-analyses, cohort studies, and expert guidelines.

Results: Etiopathogenesis is multifactorial and biopsychosocial, involving genetic predisposition, psychosocial factors, central sensitization, bruxism, and sleep disturbances. The DC/TMD classification differentiates muscle pain subtypes of varying prognostic significance. Diagnosis relies on standardized clinical examination, supplemented by instrumental methods (sEMG, ultrasound elastography, MRI), whose value remains complementary. Conservative treatment includes exercise therapy, occlusal splints, pharmacotherapy, and needling techniques, with generally low-to-moderate quality evidence.

Conclusions: Masticatory muscle disorders require an integrated, multidisciplinary approach accounting for the patient's biopsychosocial profile and active secondary prevention. Further progress depends on diagnostic standardization and higher-quality research.

Keywords: temporomandibular disorders; masticatory muscles; myofascial pain; myalgia; bruxism; diagnosis; conservative treatment

1. Introduction

Functional disorders of the masticatory system, encompassing both the structures of the temporomandibular joint (TMJ) and the masticatory muscles, are among the most common causes of chronic orofacial pain of non-dental etiology [1,2]. Temporomandibular disorders (TMD) are defined as a group of musculoskeletal conditions affecting the temporomandibular joints, the masticatory muscles, or both structures simultaneously [1]. Among patients presenting with pain complaints in the course of TMD, 50 to 70% present symptoms related to the muscular component, referred to as the myogenous form of the disorder (myofascial pain, myalgia), making masticatory muscle pathology an issue of significant clinical and epidemiological importance.

Current data indicate that the prevalence of TMD symptoms in the general population is considerable, affecting a substantial proportion of adults, with prevalence varying depending on the diagnostic criteria applied and the population studied [3]. The introduction of unified Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) has significantly improved the reliability and reproducibility of clinical diagnoses, enabling the differentiation of muscular disorder subtypes (including local myogenous pain and myofascial pain with referral) from joint disorders [1]. This classification corresponds with the International Classification of Orofacial Pain (ICOP), which systematizes the clinical presentation of muscle-derived facial pain [2].

The etiopathogenesis of masticatory muscle disorders is multifactorial. Parafunctional factors play a significant role, including bruxism, whose contemporary conceptual framework emphasizes its heterogeneous etiology and variable relationship with muscle pain and dysfunction, with direct implications for diagnostic and therapeutic strategies [4]. Increasing emphasis is also placed on the bidirectional relationship between sleep quality and pain perception – disturbances in sleep architecture and continuity affect the efficiency of endogenous pain-inhibitory mechanisms, as documented both in healthy populations and in patients with chronic temporomandibular joint pain [5,6]. This relationship is clinically significant, as sleep and pain exist in a mutual, reciprocal relationship that influences the course and severity of muscular symptoms in TMD [5].

Diagnosis of masticatory muscle disorders relies primarily on clinical examination consistent with the DC/TMD protocol; however, recent years have seen dynamic development of instrumental methods that complement subjective and palpatory assessment. Surface electromyography (sEMG) of the masticatory muscles is increasingly used as a tool supporting the differential diagnosis of muscle pain associated with TMD, including in pediatric populations with concomitant awake bruxism, although its diagnostic value still requires further validation [7]. In parallel, imaging techniques are developing – ultrasound elastography of the masseter muscle shows potential in assessing changes in muscle tissue elasticity in TMD patients, although current data derive mainly from systematic reviews signaling the need for further methodological standardization [8].

In the field of conservative treatment, particular importance is attributed to exercise therapy and physiotherapy. Meta-analyses of clinical trials indicate the effectiveness of exercise therapy in reducing pain and improving masticatory system function in patients with myogenic-arthrogenic dysfunction, although the quality of available evidence is variable [9]. Increasing emphasis is also placed on the necessity of a multidisciplinary approach, combining the competencies of dentists, physiotherapists, pain medicine specialists, and – where warranted – psychologists, as a condition for improving long-term treatment outcomes in TMD patients with a muscular component [10].

Despite the growing number of publications devoted to the diagnosis and treatment of masticatory muscle disorders, the literature still lacks a clear consensus on the optimal diagnostic-therapeutic algorithm, particularly regarding the role of newer imaging and neurophysiological methods in everyday clinical practice.

2. Material and Methods

This paper constitutes a **descriptive (narrative) literature review**. The aim was to provide a free-form, qualitative synthesis and discussion of the current state of knowledge regarding masticatory muscle disorders in the course of temporomandibular joint dysfunction, rather than to reproduce the formalized, structured protocol characteristic of systematic reviews (e.g., in accordance with PRISMA guidelines or pre-registered in the PROSPERO registry). This form was chosen due to the nature of the work as a review article intended to provide the reader with a broad overview of the subject, rather than to quantitatively synthesize the results of a defined set of primary studies.

The literature was searched using the PubMed/MEDLINE, PubMed Central (PMC), Europe PMC, and Google Scholar databases and search engines, supplemented by journal publisher websites (including MDPI, Wiley Online Library, ScienceDirect, SAGE Journals, BioMed Central, Springer Nature Link). Combinations of the following keywords were used in the search for sources: temporomandibular disorders, masticatory muscle disorders, myalgia, myofascial pain, TMD epidemiology, TMD classification, TMD diagnosis, electromyography, ultrasound elastography, masticatory muscle anatomy, TMD risk factors, TMD treatment, occlusal splint, TMD prevention, bruxism.

Priority was given to systematic reviews and meta-analyses (including network meta-analyses of randomized controlled trials), large cohort and case-control studies, as well as consensus statements and guidelines developed by recognized expert bodies (including the International RDC/TMD Consortium Network, the International Headache Society, and the National Academies of Sciences, Engineering, and Medicine). For foundational topics – anatomy, physiology, and classical diagnostic criteria – well-established works of long-standing significance in the literature were also included, regardless of publication year, whereas for epidemiological, diagnostic, and therapeutic data, the most current publications were prioritized. Materials not subject to scientific peer review (preprints, conference proceedings without full text, encyclopedic entries) were deliberately excluded from the review, as were case reports of low evidentiary value, unless they illustrated rare conditions not otherwise described.

3. Results

3.1. Epidemiology of Masticatory Muscle Disorders in the Course of Temporomandibular Joint Dysfunction

Temporomandibular disorders (TMD) are among the most common musculoskeletal conditions of the orofacial region and constitute a significant epidemiological problem on a global scale. The most recent meta-analysis, comprising 74 studies and a total of 172,239 participants, demonstrated that the global prevalence of TMD in the general population is 34%, with this value varying significantly by geographic region – from 26% in North America, through 29% in Europe and 33% in Asia, to 47% in South America [11]. The authors of this study also indicated that the age group most vulnerable to developing TMD is 18–60 years, suggesting a link between the period of greatest occupational and psychosocial activity and the intensification of risk factors for these disorders [11].

Data from an earlier, widely cited meta-analysis by Valesan et al., which separately examined adult/elderly populations and children/adolescents, indicate slightly lower, yet still substantial, prevalence rates: the combined prevalence of TMD in adults and the elderly was approximately 31% (29.3% using RDC/TMD criteria and 38.8% using DC/TMD criteria), whereas in the child and adolescent population it stood at approximately 11% [3]. The same study demonstrated that the most frequently diagnosed form of joint disorder within TMD is disc displacement with reduction (DDwR), which is of considerable differential significance relative to purely muscular forms of dysfunction [3]. Discrepancies between the results of individual meta-analyses (29–38% depending on the diagnostic criteria applied) underscore the influence of research methodology, including the choice of diagnostic tools (RDC/TMD vs. DC/TMD), on the resulting epidemiological estimates [3,11].

A significant and consistently confirmed phenomenon in the literature is the predominance of females among individuals affected by TMD. According to meta-analytic data from 2024, the female-to-male ratio of TMD prevalence is 1.26 in North America, 1.56 in South America, 1.26 in Asia, and 1.09 in Europe, meaning that, depending on the continent, the group of women with TMD is approximately 9% to 56% larger than the corresponding group of men [11,12]. This phenomenon is explained, among other factors, by the modulating effect of estrogens on pain perception and on the excitability threshold of nerve fibers within the temporomandibular joint, suggesting the involvement of hormonal factors in the pathogenesis of myogenic-arthrogenic disorders in women, particularly during the reproductive period and the perimenopausal period [12].

The multifactorial nature of TMD etiopathogenesis is further confirmed in a systematic review of cohort studies, which identified and evaluated (using GRADE) the quality of evidence for risk factors associated with the occurrence of these disorders, including psychosocial factors, parafunctions of the masticatory system, and hormonal and somatic conditions [13]. This indicates that masticatory muscle disorders should not be considered in isolation from the broader biopsychosocial context of the patient, with direct implications for both the design of epidemiological studies and clinical practice.

It is worth emphasizing that differences in TMD prevalence between studies stem not only from genuine geographic or demographic variability, but to a significant extent from methodological heterogeneity – differences in diagnostic criteria, sample size and selection, and the manner of defining the endpoint (presence of subjective symptoms vs. confirmed clinical diagnosis) [3,11]. The authors of more recent meta-analyses also draw attention to the insufficient number of high-quality epidemiological studies conducted in African and Australian populations, which limits the ability to fully generalize the available data on a global scale [11].

In summary, epidemiological data clearly indicate that masticatory muscle disorders in the course of temporomandibular joint dysfunction constitute a widespread health problem, affecting a substantial proportion of the general population, with particular prominence among working-age adults and a clear predilection for occurrence in women.

3.2. Anatomy and Physiology of the Masticatory Muscles

The muscular system of the masticatory apparatus comprises four pairs of primary (principal) muscles: the temporalis muscle, the masseter muscle, the medial pterygoid muscle, and the lateral pterygoid muscle, which together are responsible for mandibular movements at the temporomandibular joint, enabling functions such as chewing, speech, and swallowing [14]. All of these muscles are innervated by the mandibular branch of the trigeminal nerve (V3), which underlies their functional integration as a motor unit responsible for the precise control of mandibular movements [14].

The masseter muscle, composed of a superficial and a deep layer, spans between the zygomatic arch and the angle and ramus of the mandible. Owing to its fiber orientation and substantial physiological cross-sectional area, it constitutes the principal generator of jaw-closing force [14]. The temporalis muscle, fan-shaped in structure, fills the temporal fossa and, via a tendon inserting into the coronoid process of the mandible, is primarily responsible for mandibular elevation and – in the case of its posterior fibers – mandibular retraction [14]. The medial pterygoid muscle, functionally synergistic with the masseter, participates in mandibular elevation and lateral movements, while the lateral pterygoid muscle – the only one of the primary muscle group active mainly during mouth opening and mandibular protrusion – plays a key role in coordinating the movement of the condylar head relative to the articular disc [14]. From a biomechanical standpoint, the internal architecture of the masticatory muscles is of considerable importance, including sarcomere length, fiber pennation angle, and physiological cross-sectional area, which directly determine each muscle's capacity to generate force and its range of shortening [15]. Compared with the mouth-opening muscles, the jaw-closing muscles are characterized by shorter sarcomeres in the closed-jaw position, a greater mass of contractile tissue, and shorter force moment arms, making them functionally specialized for generating substantial occlusal forces within a relatively limited range of motion [15].

At the histophysiological level, the masticatory muscles are distinguished from other skeletal musculature by considerable heterogeneity of muscle fiber composition and motor unit types. The proportion of fibers containing more than one myosin heavy chain (MHC) isoform is significantly greater in the masticatory muscles than in limb or trunk muscles, which underlies a continuous, rather than stepwise, range of contraction speeds, enabling exceptionally precise force gradation – from high-power tasks (chewing hard food) to subtle tasks such as speech articulation [16]. Motor unit territories within the masticatory muscles are, moreover, smaller than in limb muscles, suggesting a more localized organization of motor control, with a relatively greater proportion of slow-twitch units in the deep and anterior regions of the muscles, while fast-twitch units predominate in the superficial and posterior layers [16].

The physiological activity of the masticatory muscles is subject to strict neural control, involving both a central pattern generator responsible for cyclical chewing movements and reflex mechanisms coupled with periodontal receptors and neuromuscular spindles, which protect the teeth and joint from excessive loading [14]. It is worth emphasizing that, under pathological conditions – including in the course of chronic myofascial pain – an adaptive reorganization of the activation pattern of individual muscle regions occurs, constituting one of the proposed neurophysiological mechanisms underlying masticatory muscle pain in the course of temporomandibular disorders [14,17].

3.3. Etiopathogenesis of Masticatory Muscle Disorders

The etiopathogenesis of masticatory muscle disorders in the course of temporomandibular joint dysfunction is multifactorial and biopsychosocial in nature, as confirmed both by cohort studies and by mechanistic models of chronic pain. The contemporary understanding of this issue has moved away from earlier, single-factor concepts – based mainly on occlusal or traumatic factors – toward a model integrating genetic predisposition, psychosocial factors, mechanisms of peripheral and central pain sensitization, and sleep disturbances as mutually interacting elements of pathogenesis [13].

The large, prospective OPPERA cohort study (Orofacial Pain: Prospective Evaluation and Risk Assessment) provided some of the strongest evidence for the involvement of psychosocial factors in the development of chronic TMD. Among individuals diagnosed with TMD, compared with a control group, significantly higher levels of affective distress, heightened somatic awareness, and pain catastrophizing were demonstrated, with principal component analysis identifying four latent psychosocial constructs: stress and negative affectivity, general psychosocial symptoms, passive pain coping, and active pain coping [18]. These findings indicate that personality predispositions and the manner of processing pain stimuli may constitute not only a consequence, but also a predisposing factor for the occurrence of masticatory muscle disorders [18].

In parallel, the OPPERA study enabled the identification of potential genetic markers associated with the risk of chronic TMD. Analysis of 358 genes involved in nociceptive processes confirmed previously described associations between TMD and the HTR2A and COMT genes, involved respectively in serotonergic neurotransmission and catecholamine metabolism, and also identified new potential risk loci, including NR3C1, CAMK4, CHRM2, IFRD1, and GRK5

[19]. These findings suggest that individual genetic variability in the modulation of nociception, stress response, and inflammatory processes may partially determine susceptibility to the development of chronic muscle pain within the masticatory system [19].

At the peripheral level, mechanisms related to the formation of myofascial trigger points (MTrPs) play a significant role in the pathogenesis of masticatory muscle pain. According to the expanded integrated hypothesis, excessive release of acetylcholine at the motor endplate leads to prolonged contraction of selected muscle fibers, increased local metabolism, and localized ischemia, resulting in the release of inflammatory mediators and sensitization of peripheral nerve endings [20]. Studies employing palpation of trigger points in women with myofascial pain in the course of TMD have demonstrated the presence of numerous active MTrPs both in the masticatory muscles and in the muscles of the neck-shoulder region, with the local and referred pain elicited reproducing the clinical presentation characteristic of these patients; notably, the areas of referred pain were larger than in healthy individuals – supporting the coexistence of peripheral and central sensitization mechanisms in this population [21]. Sustained activity of peripheral pain generators may, over time, lead to a transition from localized to generalized pain via enhanced central sensitization, impairment of descending pain-inhibitory mechanisms, and disruption of motor control strategies [20].

A significant, well-documented etiological factor remains parafunction of the masticatory system, including bruxism, whose contemporary definition emphasizes its heterogeneous nature – ranging from an activity with physiological characteristics, through a form potentially detrimental to muscular and articular structures, to a significant risk factor for pain and overload of the masticatory muscles, depending on frequency, intensity, and co-occurring central conditions [4]. The bidirectional relationship between sleep quality and pain perception is also of considerable importance – disturbances in sleep continuity and architecture impair the efficiency of endogenous pain-inhibitory mechanisms, as documented both in experimental models in healthy individuals and in populations of patients with chronic temporomandibular joint pain, suggesting the existence of a vicious cycle in which pain exacerbates sleep disturbances, which in turn heightens the perception of muscular pain [5,6].

In summary, the etiopathogenesis of masticatory muscle disorders in the course of temporomandibular joint dysfunction represents the outcome of an interaction between genetic, psychosocial, and peripheral nociceptive factors, together with disturbances in sleep and stress regulation, justifying a multidisciplinary approach to the treatment of patients with this group of disorders [10].

3.4. Classification of Muscular Disorders in the Course of Temporomandibular Joint Dysfunction

The classification of masticatory muscle disorders constitutes an important element of the systematics of temporomandibular disorders (TMD) and is currently based on two complementary systems: the basic Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), intended for routine clinical and research use, and an expanded taxonomy encompassing less common, yet clinically significant, conditions [1,22].

Within the basic DC/TMD protocol, muscular disorders are classified primarily as **myalgia**, defined as pain of muscular origin, modified by mandibular movement, function, or parafunction, and reproducible upon provocation testing involving palpation of the masseter and temporalis muscles [1]. Within this category, three subtypes are distinguished, differentiated on the basis of the extent of pain elicited during standardized, five-second palpation: **local myalgia** – pain confined solely to the site of palpation; **myofascial pain** – pain spreading within the boundaries of the palpated muscle; and **myofascial pain with referral** – pain extending beyond the boundaries of the examined muscle to encompass distant structures such as the teeth, temporomandibular joint, ear, head, or neck region [1,22]. This distinction is of substantial clinical significance, as demonstrated in a retrospective study of 255 patients, in which a diagnosis of myofascial pain with referral was associated with significantly greater severity of the psychosocial component (DC/TMD Axis II). This form of the disorder may reflect a more advanced stage of chronic muscle pain and, in some cases, may precede the development of fibromyalgia [23]. The phenomenon of referred pain is explained by mechanisms of peripheral and central sensitization associated with myofascial trigger point activity [20,21].

Beyond muscle pain, the basic version of DC/TMD also identifies **headache attributed to TMD**, reflecting the close relationship between masticatory muscle disorders and secondary headaches, which is likewise reflected in the International Classification of Orofacial Pain (ICOP) [1,2].

The expanded taxonomy proposed by Peck et al. in 2014 additionally includes the following conditions, less commonly encountered in daily practice yet significant for differential diagnosis: **tendonitis**, most commonly affecting the temporalis tendon; **myositis**, characterized by diffuse pain and swelling in the course of an inflammatory muscle process; **spasm**, defined as a sudden, involuntary, and transient contraction leading to restricted mandibular mobility; **contracture**, a permanent, usually painless restriction of muscle extensibility resulting from connective tissue fibrosis; **hypertrophy**, most commonly affecting the masseter in association with chronic parafunctions; and **neoplasm** of muscle tissue [22]. A separate subgroup comprises **movement disorders**, including orofacial dyskinesia and oromandibular dystonia, as well as the category of masticatory muscle pain attributed to systemic or central pain disorders, which includes pain associated with fibromyalgia and widespread pain syndromes [22]. The inclusion of this last category underscores the overlap of masticatory muscle pain with the broader spectrum of chronic, centrally mediated pain syndromes.

It is worth emphasizing that the expanded taxonomy does not replace the basic DC/TMD protocol but rather supplements it with rarer conditions for which less validation data has thus far been collected [22].

3.5. Clinical Presentation of Muscular Disorders in the Course of Temporomandibular Joint Dysfunction

The clinical presentation of masticatory muscle disorders is heterogeneous and depends on the disorder subtype; nevertheless, most conditions within this group share a common symptomatic core: pain of muscular origin exacerbated by mandibular function, accompanying restriction of mandibular mobility, and positive provocation findings on palpation [1]. According to the DC/TMD protocol, the diagnosis of muscle pain requires confirmation of two elements: patient-reported pain modified by mandibular movement, function, or parafunction, and reproduction of this pain (so-called familiar pain) during provocation testing involving palpation of the masseter and temporalis muscles [1].

Local myalgia manifests as complaints strictly confined to the site of palpatory examination, without a tendency to spread beyond the anatomical boundaries of the muscle. **Myofascial pain** is characterized by spreading of pain within the boundaries of the palpated muscle, whereas **myofascial pain with referral** involves pain extending beyond the boundaries of the examined structure to encompass distant areas – the teeth, ear, temporal region, occipital region, or neck [1,22]. This latter form, compared with local pain, correlates with significantly greater severity of the psychosocial component – higher levels of pain catastrophizing, depressive and anxiety symptoms, and sleep disturbances – making it clinically more complex and potentially predisposing to chronicity [23]. The characteristic pattern of referred pain for this form, encompassing both the masticatory muscles and the muscles of the neck-shoulder region, has been confirmed in studies employing trigger point provocation, in which the areas of referred pain in female TMD patients were significantly larger than in healthy individuals [21].

Typical subjective complaints reported by patients include: dull, diffuse pain in the cheek, temporal, or preauricular region, exacerbated during chewing, speaking, or wide mouth opening; a sensation of fatigue or stiffness of the masticatory muscles, particularly upon waking (correlating with nocturnal parafunctions, including bruxism); and accompanying headache localized to the temporal region, fulfilling the criteria for headache attributed to TMD [1,4,17]. On physical examination, tenderness of the masseter and/or temporalis muscle upon palpation is typically noted, along with restriction of maximum active mouth opening relative to age- and sex-matched reference values, and, in some cases, deviation or deflection of the mandibular opening path [1].

Rarer forms of muscular disorders are characterized by a distinct, more specific clinical presentation. **Myospasm** manifests as a sudden, involuntary, and painful restriction of mandibular mobility (trismus), whereas **contracture** presents as a chronic, usually painless restriction of opening resulting from fibrosis of muscle or tendinous tissue. **Myositis** is associated with diffuse pain, swelling, and often generalized tenderness of the entire muscle, while **hypertrophy**, most commonly affecting the masseter, is often visible as asymmetric enlargement of the facial contour, usually without accompanying pain. **Movement disorders** – orofacial dyskinesia and oromandibular dystonia – are characterized by involuntary, repetitive mandibular movements, distinguishing them from the typical, painful forms of TMD [22].

The table below presents a synthesized overview of the clinical presentation of individual subtypes of masticatory muscle disorders, based on the DC/TMD criteria and the expanded taxonomy of Peck et al. [1,22].

Table 1. Clinical characteristics of selected masticatory muscle disorders

Disorder subtype	Character of pain/symptom	Extent of complaints	Typical accompanying symptoms
Local myalgia	Dull pain, elicited by palpation and function	Confined to the site of palpation	Mild restriction of mouth opening
Myofascial pain	Diffuse pain within the muscle	Within the boundaries of the palpated muscle	Pressure tenderness, muscle tension

Myofascial pain with referral	Pain referred beyond the palpation site	Ear, tooth, temple, neck region	Greater severity of the psychosocial component [23]
Myospasm	Acute, sudden pain	Affected muscle	Acute restriction of mandibular mobility (trismus)
Contracture	Usually painless	Affected muscle	Permanent restriction of mouth opening
Myositis	Diffuse, continuous pain	Entire muscle	Swelling, generalized tenderness
Hypertrophy	Usually painless	Affected muscle (most often masseter)	Facial contour asymmetry
Headache attributed to TMD	Temporal region pain	Temporal region	Exacerbation with mandibular function, positive temporalis palpation

An important element of the clinical presentation is also the temporal dynamics of symptoms – masticatory muscle pain complaints often have a chronically recurrent character, with flare-up periods associated with intensification of parafunctions, psychological stress, or sleep disturbances, reflecting the multifactorial etiopathogenesis discussed in the preceding chapter [4,5,6,18].

3.6. Diagnosis of Masticatory Muscle Disorders in the Course of Temporomandibular Joint Dysfunction

The diagnosis of masticatory muscle disorders is based on a two-step management model, combining a standardized clinical examination with – in selected cases – instrumental methods that supplement subjective and palpatory assessment. The clinical DC/TMD protocol, whose sensitivity and specificity have undergone extensive international validation, remains the foundation of diagnosis and currently constitutes the gold standard for TMD diagnostics in clinical and research practice [1].

Clinical diagnosis. History-taking for masticatory muscle disorders includes assessment of the location, character, and duration of pain, its relationship to mandibular function (chewing, speaking, yawning), and the presence of parafunctions such as bruxism or teeth clenching [1,4]. A key element of the physical examination is standardized palpation of the masseter and temporalis muscles, performed with a defined palpation pressure sustained for 2 seconds (for the diagnosis of muscle pain) or 5 seconds (for differentiating subtypes of myofascial pain), assessing whether the pain elicited corresponds to the complaints reported by the patient (so-called familiar pain) [1,22]. Palpatory examination is supplemented by measurement of mandibular range of motion, including maximum active mouth opening, allowing objectification of functional restriction resulting from pain or muscular contracture [1].

An important quantitative tool complementing subjective palpation is pressure algometry, enabling measurement of the pressure pain threshold within the masticatory muscles. Validation of a fingertip-shaped algometer demonstrated its high reliability and measurement validity in assessing masticatory muscle and temporomandibular joint tenderness, making this method a useful tool for objectifying palpation findings and monitoring treatment effects over time [24].

Instrumental diagnosis. Recent years have seen dynamic development of instrumental methods aimed at objectifying the functional and structural assessment of the masticatory muscles. Surface electromyography (sEMG) of the masticatory muscles is increasingly employed as a tool supporting the differential diagnosis of muscle pain associated with TMD, including in pediatric populations with concomitant awake bruxism, although its independent diagnostic value – in isolation from clinical examination – still requires further validation [7].

Ultrasound elastography of the masseter muscle constitutes a promising method for assessing muscle tissue elasticity, enabling non-invasive visualization of structural changes accompanying chronic muscle pain. A systematic review devoted to this method indicates its considerable diagnostic potential while emphasizing the need for standardization of examination protocols and further validation studies in larger patient groups [8].

Magnetic resonance imaging (MRI), although traditionally associated primarily with the assessment of intra-articular structures (the articular disc, articular surfaces), is finding increasing application in the quantitative assessment of muscle tissue. The use of chemical shift-encoded MRI (CSE-MRI/IDEAL-IQ) enables objective measurement of fat fraction within the masseter and pterygoid muscles. In a study of 65 patients, excellent intra- and inter-observer agreement of this measurement was demonstrated (ICC > 0.889), along with a statistically significant lower fat fraction of the masseter muscle on the side of disc displacement compared with the normal side in patients without concomitant clenching, suggesting the potential of this method as an objective imaging biomarker in the diagnosis of myogenic-arthrogenic disorders [25].

Table 2. Diagnostic methods for masticatory muscle disorders – characteristics and clinical application

Method	**Type of assessment**	**Main application**	**Limitations**
DC/TMD clinical examination (history + palpation) [1]	Subjective/semi-objective	Baseline diagnosis, differentiation of muscle pain subtypes	Dependence on examiner experience, subjectivity of reported pain
Pressure algometry [24]	Quantitative (pain threshold)	Objectification of muscle tenderness, treatment monitoring	Requires additional equipment, inter-individual variability
Surface electromyography (sEMG) [7]	Functional (bioelectrical activity)	Assessment of muscle activity, aid in bruxism diagnosis	Limited standalone diagnostic specificity
Ultrasound elastography [8]	Structural (tissue elasticity)	Assessment of structural changes in the masseter muscle	Lack of protocol standardization, operator dependence
Chemical shift-encoded MRI (CSE-MRI/IDEAL-IQ) [25]	Structural (fat fraction)	Quantitative assessment of muscle tissue changes, potential biomarker	High cost, limited availability, preliminary data

Differential diagnosis. Accurate diagnosis of masticatory muscle disorders requires the exclusion of other causes of orofacial pain with a similar clinical presentation, including primary headaches (migraine, tension-type headache), trigeminal neuralgia, odontogenic pathology, and – in cases of concomitant widespread pain – systemic pain syndromes such as fibromyalgia, which is reflected both in the expanded DC/TMD taxonomy and in the International Classification of Orofacial Pain (ICOP) [2,22]. Given the documented involvement of psychosocial factors in the etiopathogenesis and clinical course of muscular disorders, a complete diagnostic work-up should – in accordance with the biopsychosocial model underlying DC/TMD – also include Axis II assessment, encompassing emotional factors, the level of pain catastrophizing, and sleep quality [1,18,23].

3.7. Conservative Treatment of Masticatory Muscle Disorders

Conservative treatment of masticatory muscle disorders in the course of temporomandibular joint dysfunction is based on a principle of graduated intervention intensity – from the least invasive, educational and behavioral methods, through physiotherapy and occlusal splints, to pharmacotherapy and needling techniques, typically reserved for cases refractory to first-line treatment. This hierarchical management model is justified by the multifactorial etiopathogenesis of these disorders and usually requires a multidisciplinary approach, involving a dentist, physiotherapist, and, where warranted, a pain medicine or clinical psychology specialist [10,18].

Exercise therapy and physiotherapy remain a fundamental element of first-line management. A meta-analysis of clinical trials on the efficacy of exercise therapy in temporomandibular dysfunction demonstrated its beneficial effect on pain reduction and improvement of mandibular range of motion, although the authors note the variable methodological quality of the available primary studies, which limits the strength of inference regarding the optimal exercise protocol [9].

Occlusal splints remain one of the most commonly used tools in the treatment of myogenic-arthrogenic masticatory disorders. A network meta-analysis of 48 randomized controlled trials, encompassing various splint types (hard stabilization splints, soft splints, mini-anterior splints, repositioning splints), demonstrated that, for disorders of muscular origin, mini-anterior splints and therapy combining behavioral counseling with a hard stabilization splint proved most effective, although the quality of scientific evidence was rated in most cases as low or very low [26]. These findings indicate that therapy combining educational-behavioral elements with the use of an occlusal splint (multimodal therapy) may confer greater benefit than the use of the splint alone.

Pharmacotherapy constitutes a supplementary element of treatment, particularly during periods of pain exacerbation. A current network meta-analysis of randomized trials, encompassing a total of 40 clinical studies on the pharmacological treatment of TMD, demonstrated that more than half of TMD patients regularly use medication, although the available scientific evidence regarding the optimal choice of pharmacotherapy for muscle pain (TMD-M) remains limited – only 11 studies met the criteria for inclusion in the formal network meta-analysis, prompting the authors to conduct an additional narrative synthesis of the remaining studies [27]. In clinical practice, the treatment of muscle pain most commonly employs non-steroidal anti-inflammatory drugs, short-term use of muscle relaxants, and, in selected cases of chronic myofascial pain, antidepressants with analgesic properties.

In cases refractory to first-line conservative treatment, particularly in myofascial pain associated with the presence of active trigger points, **needling therapies** are considered, including dry needling, acupuncture, and botulinum toxin injections. A network meta-analysis of randomized controlled trials devoted to these methods in the treatment of masticatory myofascial pain demonstrated their potential efficacy in short-term pain reduction, although the authors note the limited number of high-quality comparative studies and the heterogeneity of therapeutic protocols, which hinders the formulation of clear clinical recommendations [28].

Regardless of the therapeutic method selected, the literature consistently indicates the superiority of a **multidisciplinary approach** over the isolated application of a single intervention [10,18].

3.8. Prevention and Risk Reduction of Masticatory Muscle Disorders

Given the multifactorial etiopathogenesis of masticatory muscle disorders, encompassing genetic predisposition, psychosocial factors, parafunctions, and sleep disturbances, preventive strategies cannot rely on a single intervention but should be comprehensive, targeting both modifiable risk factors and the early identification of individuals at increased susceptibility to developing these disorders [13].

Parafunction control and orofacial hygiene. One of the key modifiable risk factors remains bruxism. According to the international consensus on the assessment of bruxism, this activity – defined as repetitive masticatory muscle activity involving clenching or grinding of the teeth and/or bracing or thrusting of the mandible – should not, in healthy individuals, be regarded as a disorder per se, but rather as a behavior constituting a potential risk factor (or, in some cases, a protective factor) for specific clinical consequences, including overload and pain of the masticatory muscles [29]. From a preventive perspective, this means that interventions should focus not on eliminating the phenomenon of bruxism itself, but on monitoring and limiting its intensity and frequency to the extent that it entails genuine risk of damage to muscular and articular structures [4,29].

Education and self-management programs. An important element in preventing chronicity and recurrence of muscular complaints is self-management programs, based on behavior change techniques. A systematic review of the literature, encompassing 15 randomized controlled trials with 554 patients, identified the behavior change techniques most commonly employed in such programs, including education about the nature of the condition, goal-setting, self-monitoring of symptoms, stress reduction techniques, and pain coping strategies [30]. Incorporating these elements into routine care for patients at risk of TMD, before the onset of full-blown disorder or at its early stage, may – in accordance with the assumptions of this model – reduce the risk of transition from acute to chronic complaints [30].

Modification of psychosocial factors and sleep hygiene. Given the documented involvement of psychosocial factors in the etiopathogenesis of chronic muscle pain – including affective distress, pain catastrophizing, and heightened somatic awareness, demonstrated in the OPPERA study – preventive actions in individuals burdened with these traits should include early identification and, where necessary, referral to appropriate psychological intervention, before a chronic pain syndrome develops [18]. In parallel, given the documented bidirectional relationship between sleep quality and pain perception, sleep hygiene should also constitute an element of prevention, as disturbances in sleep continuity and architecture impair endogenous pain-inhibitory mechanisms, exacerbating the risk and severity of muscular complaints [5,6].

High-risk groups. From the standpoint of population-level prevention, it is important to consider groups at elevated risk, identified in epidemiological studies – in particular women, in whom TMD prevalence is significantly higher than in men, attributed among other factors to the modulating effect of estrogens on pain threshold, and working-age individuals (18–60 years), in whom the accumulation of occupational and psychosocial factors may increase susceptibility to developing muscular disorders [11,12].

4. Discussion

The literature review conducted allows for critical reflection on the current state of knowledge regarding masticatory muscle disorders in the course of temporomandibular joint dysfunction, as well as on the methodological limitations of available studies and the directions in which future research in this field should proceed.

4.1. Discrepancies in Epidemiological Data

Analysis of epidemiological data reveals significant discrepancies between individual meta-analytic studies – estimates of TMD prevalence range from approximately 29% to 38% depending on the diagnostic criteria applied (RDC/TMD vs. DC/TMD) and from 26% to 47% depending on geographic region [3,11]. Such discrepancies are difficult to interpret as reflecting solely genuine population variability – to a significant extent they result from methodological heterogeneity: differences in sample selection, endpoint definition, and diagnostic tools employed. This raises important questions about the comparability of epidemiological study results conducted across different centers and indicates the need for greater standardization of research protocols, particularly in the context of planning large-scale population studies.

It is also worth noting that most available epidemiological data originate from European, North American, and Asian centers, whereas African and Australian populations remain significantly underrepresented in the literature [11]. This limits the ability to fully generalize conclusions on a global scale and constitutes a clear research gap requiring further investigation.

4.2. Tension Between the Biopsychosocial Model and Clinical Practice

Analysis of the literature on etiopathogenesis reveals a significant paradigm shift – from earlier, single-factor models based on occlusal factors toward a complex biopsychosocial model integrating genetic predisposition, psychosocial factors, and mechanisms of nociceptive sensitization [4,5,6,13,18,19,20]. It is worth noting, however, a certain tension between this theoretical model and clinical practice: despite strong evidence for the involvement of psychosocial factors in the development and course of chronic muscle pain, available guidelines regarding routine Axis II DC/TMD assessment in everyday dental practice are still not fully implemented, and studies (including Winocur-Arias et al.) indicate that this assessment is sometimes omitted or treated as supplementary rather than an integral part of diagnosis [23]. This suggests a gap between academic consensus and the realities of clinical practice, which should be addressed in future management guidelines.

An interesting issue emerging from the review of OPPERA studies concerns the question of the direction of the causal relationship between psychosocial factors and muscle pain [18,19]. Most of the cited studies are cross-sectional or case-control in design, which precludes definitive resolution of whether psychosocial traits constitute a cause or rather a consequence of chronic pain. Only a limited number of prospective studies within the OPPERA cohort shed light on this issue, indicating a predictive role of psychological factors with respect to new-onset TMD, although the number of such studies remains limited [18].

4.3. Limited Evidentiary Strength of Treatment Studies

A particularly important conclusion emerging from the analysis of the literature on conservative treatment is the low or very low quality of scientific evidence supporting the efficacy of most therapeutic interventions. The network meta-analysis on occlusal splints, encompassing 48 randomized trials, indicates therapeutic efficacy; however, the authors themselves emphasize that the quality of evidence ranges from moderate to very low [26]. Similar reservations apply to meta-analyses of pharmacotherapy and needling techniques, in which – due to the small number of studies meeting inclusion criteria – it was necessary to supplement the network analysis with a narrative synthesis [27,28]. This state of affairs significantly limits the ability to formulate unambiguous, evidence-based clinical recommendations and indicates an urgent need for well-designed, multicenter randomized trials with adequate sample sizes and long-term follow-up.

An additional limitation is the heterogeneity of therapeutic protocols employed across individual studies – concerning both the type and duration of occlusal splint wear and the dosing regimens of medications or needling techniques [26,27,28]. This hinders direct comparison of results between studies and the synthesis of data within meta-analyses, which may partly explain the low quality of evidence obtained.

4.4. Limitations of Instrumental Diagnostic Methods

With regard to instrumental diagnostic methods – surface electromyography, ultrasound elastography, and CSE-MRI imaging – it is worth noting that, despite promising preliminary results, none of these methods has yet achieved the status of a standalone diagnostic tool capable of replacing clinical examination [7,8,25]. All cited studies emphasize the preliminary nature of the data obtained and the need for further validation in larger patient groups. Moreover, the high cost and limited availability of some of these methods (particularly CSE-MRI) constitute a significant barrier to their broader implementation in routine clinical practice, suggesting that, in the near future, their role will remain complementary rather than a substitute for subjective and objective clinical examination.

4.5. Limitations of the Present Review

It is also necessary to indicate the limitations of the present literature review itself. This paper is a narrative, rather than systematic, review, meaning the absence of a formal, structured search and study selection protocol and the absence of a formal assessment of risk of bias for individual cited studies. Although the sources used consist predominantly of highly credible meta-analyses, systematic reviews, and large cohort studies, the selection of literature may have been, to some extent, selective. Moreover, given the dynamic development of this field – particularly with respect to imaging methods and molecular biomarkers – some conclusions may require updating as new scientific data emerge.

4.6. Clinical Implications and Directions for Further Research

From a clinical practice perspective, the present review confirms the validity of employing an integrated, multidisciplinary model of care for patients with masticatory muscle disorders, combining diagnosis based on standardized DC/TMD criteria with individualized treatment accounting for the patient's psychosocial profile [1,10,23]. At the same time, it indicates several priority directions for future research: (1) standardization of instrumental diagnostic protocols and determination of their genuine added value relative to clinical examination; (2) conducting adequately powered prospective studies capable of resolving the direction of causal relationships between psychosocial factors and muscle pain; and (3) developing harmonized therapeutic protocols that would enable reliable comparison of the efficacy of individual conservative treatment methods within future network meta-analyses.

5. Conclusions

Masticatory muscle disorders constitute a significant and common component of temporomandibular joint dysfunction, affecting a substantial proportion of the general population – according to the most recent meta-analytic data, as much as 34% of the world's population, with a marked female predominance and peak incidence occurring during working age [3,11,12]. The scale of this phenomenon, combined with its chronic and recurrent nature, makes masticatory muscle disorders a significant problem of both clinical and public health importance.

The literature review presented in this paper unequivocally indicates that the etiopathogenesis of these disorders is multifactorial and biopsychosocial in nature. The interplay of genetic predispositions, psychosocial factors – including affective distress and pain catastrophizing – peripheral and central nociceptive sensitization mechanisms, parafunctions such as bruxism, and sleep disturbances, forms a complex pathogenetic model that departs significantly from earlier, single-factor concepts based primarily on occlusal factors [4,5,6,13,18,19,20]. Understanding this multidimensionality has direct implications for clinical practice, justifying a departure from reductionist models in favor of an individualized approach to the patient.

The contemporary classification of muscular disorders, based on the DC/TMD criteria and their expanded taxonomy, enables precise differentiation of muscle pain subtypes – from local tenderness, through myofascial pain, to pain with referral – which is of considerable prognostic significance, since forms with referral are associated with greater severity of the psychosocial component and potentially poorer prognosis [1,22,23]. Accurate differential diagnosis, incorporating both clinical examination and, in selected cases, instrumental methods (sEMG, ultrasound elastography, MRI with fat fraction assessment), remains the foundation of appropriate therapeutic management [7,8,25,24].

With regard to conservative treatment, available scientific evidence indicates moderate, though qualitatively heterogeneous, efficacy of exercise therapy, occlusal splints, and selected pharmacological and needling interventions, with the best clinical outcomes consistently achieved within multimodal therapy combining these methods with educational-behavioral elements [9,26,27,28,10]. At the same time, the multidisciplinary approach, integrating the competencies of dentists, physiotherapists, and mental health specialists, is gaining increasingly strong scientific support, reflecting the biopsychosocial nature of these disorders [10]. Secondary prevention likewise plays an important role, encompassing parafunction control, self-management programs, and interventions targeting psychosocial factors and sleep hygiene, which – applied sufficiently early – may reduce the risk of progression from acute complaints to chronic pain syndromes [13,29,30].

Despite significant advances in knowledge in this field, the literature points to several important limitations and research gaps. First, high-quality comparative studies enabling a definitive determination of the hierarchy of efficacy among conservative treatment methods are still lacking, as reflected in the low or very low quality of evidence in most available meta-analyses [26,27,28]. Second, the expanded taxonomy of muscular disorders, encompassing rarer conditions, requires further clinical validation [22]. Third, newer instrumental diagnostic methods – particularly ultrasound elastography and CSE-MRI imaging – remain at an early stage of standardization and require confirmation of their diagnostic value in larger, multicenter studies [8,25].

In summary, masticatory muscle disorders in the course of temporomandibular joint dysfunction constitute a complex, multifactorially determined condition requiring an integrated diagnostic-therapeutic approach, grounded in current scientific evidence and an individualized assessment of the patient's biopsychosocial profile. Further progress in this field will depend on the development and standardization of objective diagnostic methods, the conduct of methodologically high-quality clinical research, and the wider adoption of a multidisciplinary care model combining conservative treatment with active prevention and patient education.

Disclosure

Supplementary Materials

Not applicable.

Author's contribution :

Conceptualization: ASZ, AS

Methodology: ASZ, AS

Software: not applicable

Check: KT, AST, WM

Formal analysis: WM

Investigation: ASZ, WM, KT

Resources: ASZ, AST

Data curation: ASZ, AS, KT

Writing-rough preparation: ASZ, AS, AST

Writing review and editing: ASZ, KT, WM

Visualisation: ASZ

Supervision: WM

Project administration: ASZ

Receiving funding: Not applicable – no specific funding.

All authors have read and agreed with the published version of the manuscript**.**

Funding: The study did not receive external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgements: Not applicable.

Conflicts of Interest: The authors declare no conflicts of interest

Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used ChatGPT for the purpose of language editing and stylistic refinement to improve clarity and readability of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the accuracy, integrity and conclusions of the publication

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