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MDPI

Protocol

Proposed Protocol for Orofacial Pain Assessment Prior to Orthodontic Treatment: An Expert-Informed Framework

Jumana Jbara [1] and Ziad D. Baghdadi [2,3,4,*]

[1] Gentle Dental of New England, Derry, NH 03038, USA; jumana.jbara@42northdental.com
[2] Centre for Community Oral Health, Gerald Niznick College of Dentistry, University of Manitoba, Winnipeg, MB R3B 0L8, Canada
[3] Department of Preventive Dental Sciences, Division of Pediatric Dentistry, Dr. Gerald Niznick College of Dentistry, University of Manitoba, Winnipeg, MB R3E 0W2, Canada
[4] TopSmiles Pediatric Dentistry and Orthodontics, Winnipeg, MB R2M 3A4, Canada
* Correspondence: ziadeddin.albaghdadi@umanitoba.ca or drziadeddin.albaghdadi@gmail.com

Abstract

Background: Temporomandibular disorders (TMDs) are the most common source of non-dental orofacial pain, with peak prevalence during adolescence and young adulthood—the same age group when orthodontic treatment is typically initiated. Although orthodontics is not a proven cause of TMD, pre-existing dysfunction may be aggravated during treatment, creating clinical and medico-legal risks. Objective: This paper proposes a structured diagnostic questionnaire and scoring framework for pre-orthodontic TMD assessment. The protocol aims to enhance the early recognition of high-risk patients, facilitate interdisciplinary communication, and lay a foundation for systematic validation. Methods: The framework was developed through synthesis of international diagnostic criteria (DC/TMD), a targeted narrative review of the literature, and expert clinical input. Diagnostic categories were selected based on prevalence, impact on orthodontic outcomes, and medico-legal significance. Weighted scoring stratifies patients into three pathways: (1) proceed with orthodontics without concern, (2) proceed with monitoring, or (3) defer orthodontics until TMD is managed. Results: The proposed questionnaire is designed to address inconsistencies in the literature by applying standardized diagnostic items and objective thresholds (e.g., jaw opening < 38 mm) and structured follow-up intervals. Case scenarios illustrate how risk stratification guides decision-making. The questionnaire includes intra-articular and pain-related TMD entities such as disk displacement, degenerative joint disease, myalgia, myofascial pain, arthralgia, headache, and trismus. The framework provides orthodontists with defensible baseline documentation while supporting safe and individualized patient care. Conclusions: Inconsistent diagnostic frameworks, malocclusion classifications, and outcome measures have fragmented the evidence base in orthodontics and TMD. The framework aims to provide orthodontists with structured baseline documentation that may support clinical decision-making and medico-legal risk management. Validation studies are required to establish psychometric reliability and international applicability.

Keywords: temporomandibular disorders; orofacial pain; orthodontics; protocol; patient assessment

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1. Practical Implications

This expert-informed framework provides orthodontists and orofacial pain specialists with a structured tool to assess temporomandibular disorders (TMDs) prior to orthodontic

treatment. By applying standardized diagnostic items and a weighted scoring system, clinicians can:

- Identify patients at low, moderate, or high risk for TMD aggravation.
- Provide transparent counseling and obtain informed consent, documenting baseline findings.
- Incorporate appropriate follow-up intervals or referral pathways for patients at high risk of complications.
- Reduce the likelihood of treatment complications and strengthen medico-legal protection.

For everyday practice, the questionnaire can be completed during the initial examination in under 10 min. It enhances interdisciplinary communication, promotes patient trust, and supports safer decision-making in orthodontics. After validation, adopting this framework could lead to more consistent outcomes, improve patient safety, and mitigate litigation risk in orthodontic care.

2. Introduction

Temporomandibular disorders (TMDs) represent the most common source of chronic non-odontogenic orofacial pain. Epidemiological studies estimate that 10–15% of the general population is affected, with peak prevalence among adolescents and young adults aged 15 to 45 years [1]. TMD encompasses a heterogeneous group of musculoskeletal and neuromuscular conditions involving the temporomandibular joints (TMJ), masticatory muscles, and associated structures. Its multifactorial etiology includes biomechanical, psychosocial, and occlusal components, making diagnosis and treatment inherently complex.

Orthodontic treatment, pursued increasingly for esthetic and functional purposes, also overlaps with this age group. The duration of orthodontic care, typically extending over 18–24 months, creates a prolonged period during which occlusal and functional changes may influence the course of TMD. While orthodontic therapy is not universally accepted as a cause of TMD, clinical experiences and certain studies suggest it can aggravate pre-existing dysfunctions [2–6].

Orthodontic treatment can support the multidisciplinary management of temporomandibular joint (TMJ) disorders, potentially contributing to symptom improvement and functional recovery. For successful outcomes, it is essential that clinicians are well-informed about the clinical signs and symptoms of TMJ dysfunction, possess comprehensive knowledge of all available treatment options, and conduct thorough assessments of TMJ and myofunctional status both before and after orthodontic intervention. When the treatment process is carefully monitored in patients exhibiting TMJ dysfunction, the joint structures can adapt to new functional positions, often leading to improvements in clinical symptoms and surrounding tissue health. Based on both research findings and clinical experience, it is essential to strongly emphasize that TMJ evaluation should be an integral component of pre-orthodontic planning. This ensures better treatment outcomes and helps prevent potential complications that may arise following orthodontic therapy [7].

The proposed protocol is primarily intended for adolescents and young adults, as this population is where orthodontic consultation and treatment most frequently begin. Epidemiological evidence indicates that the prevalence and incidence of temporomandibular disorders (TMD), particularly pain-related TMD, increase during adolescence and peak in young adulthood, coinciding with periods of active orthodontic intervention [1,8,9].

Adolescence and early adulthood are also characterized by biological, behavioral, and psychosocial factors—such as ongoing craniofacial maturation, increased parafunctional activity, psychosocial stressors, and heightened pain sensitivity—that may influence the onset, expression, and progression of TMD symptoms [8,10]. As a result, this age group

represents a clinically relevant population in which pre-existing or emerging TMD may intersect with orthodontic tooth movement [1,4,5].

By focusing on adolescents and young adults, the protocol targets the population most likely to benefit from structured pre-orthodontic TMD screening, while minimizing confounding influences associated with age-related degenerative joint disease and systemic comorbidities more commonly observed in older adults.

2.1. The Orthodontics–TMD Debate

The relationship between orthodontic treatment and TMD has been studied extensively, yet consensus remains elusive. Several longitudinal and randomized controlled studies conclude that orthodontic treatment does not significantly increase the risk of developing TMD [4,5]. On the other hand, clinical reports highlight potential risks, particularly in cases involving premolar extractions and incisor retraction, which may lead to posterior condylar displacement and increased intra-articular loading [11–13]. The heterogeneity of findings underscores the multifactorial nature of TMD, in which orthodontic procedures may serve as either precipitating or aggravating factors, rather than causal ones.

Adding complexity, TMD symptoms often fluctuate spontaneously, with waxing and waning independent of interventions [9]. Thus, distinguishing natural variability from treatment-induced changes is challenging. Nevertheless, even in the absence of proven causality, aggravated symptoms during orthodontic care can undermine patient trust and expose practitioners to medico-legal claims [1].

A meta-analysis study [14] aimed to evaluate the prevalence of temporomandibular disorder (TMD) in patients with malocclusion. The study concluded that temporomandibular disorders (TMD) occurred in 43% of individuals with malocclusion, with increased prevalence in females, adults, and those with malocclusion patterns such as Class II, overjet, open bite, and crossbite. The observed heterogeneity across studies is largely attributed to differences in diagnostic criteria and malocclusion classification systems. These findings underscore the importance of accounting for individual patient characteristics in assessing TMD risk. To enhance the validity and consistency of future research, the adoption of standardized diagnostic frameworks, the use of representative sampling methods, and the implementation of multilingual literature searches are strongly recommended.

2.2. Medico-Legal and Clinical Implications

Litigation involving orthodontic treatment and TMD has been reported (e.g., Pollack's Michigan case) [15]. A well-cited Michigan case resulted in an $850,000 judgment against an orthodontist accused of causing TMD [15]. Despite the absence of comprehensive international litigation data, medico-legal risk related to the disputed causation of TMD symptoms remains a recognized concern in orthodontic practice. While evidence in such cases is often inconclusive, the absence of systematic pre-treatment documentation and patient counseling contributes significantly to orthodontists' vulnerability. From a medico-legal perspective, documenting pre-treatment TMD signs and symptoms is not only clinically prudent but essential for risk management.

2.3. Need for Structured Pre-Treatment Guidelines

Despite decades of research, standardized protocols for TMD assessment before orthodontics are lacking. Many orthodontists perform cursory evaluations, often missing subtle signs of dysfunction. Patients with limited adaptive capacity—such as those with chronic TMD—are particularly vulnerable to occlusal changes. They may be hypersensitive to minor discrepancies and less tolerant of instability introduced during orthodontic adjustment [13]. Without structured guidelines, these patients risk worsening symptoms, while orthodontists face potential disputes.

Several brief protocols for TMD screening have been reported since 1982 [6,8,16,17], yet a questionnaire explicitly tailored for orthodontic patients remains a need. The importance of this screening evaluation for TMD as a part of the initial examination for orthodontic cases is both therapeutic and legal.

2.4. Aim of the Study

This expert-informed framework introduces a structured diagnostic questionnaire and scoring system for orofacial pain specialists to assess patients before orthodontic treatment. The questionnaire may be applied by different dental providers, depending on their training, scope of practice, and clinical context. The objectives are to:

1. Standardize the evaluation of TMD in orthodontic candidates.
2. Provide a risk-stratified framework guiding management decisions.
3. Support interdisciplinary communication between orthodontists and orofacial pain specialists.
4. Minimize the risk of treatment complications and legal claims.

3. Materials and Methods

3.1. Study Design

The protocol focuses on adolescents and young adults, as orthodontic treatment most commonly begins during this period, which also coincides with the highest prevalence of pain-related temporomandibular disorders. This work presents an expert-informed, evidence-based framework derived from the synthesis of established diagnostic criteria (e.g., DC/TMD [8]), a targeted literature review, and clinical expertise. The protocol was not developed through a formally convened consensus process (e.g., Delphi methodology) but reflects alignment with widely accepted diagnostic standards and shared clinical reasoning. A diagnostic questionnaire was developed to capture the most common TMD presentations in orthodontic adolescent candidates. No formal consensus methodology (e.g., Delphi process, predefined consensus thresholds, or a convened expert panel) was used in developing this framework.

3.2. Development of the Questionnaire

A targeted narrative literature review was conducted using PubMed/MEDLINE and Google Scholar, focusing on English-language publications on temporomandibular disorders, orofacial pain, and orthodontic treatment. Search emphasized established diagnostic criteria (e.g., DC/TMD), screening tools, and clinically relevant studies. The review was not intended to be systematic, and articles were selected for relevance to pre-orthodontic assessment rather than exhaustive coverage. The process of questionnaire development followed three stages:

- Identification of diagnostic categories: Based on prevalence, clinical significance, and potential impact on orthodontic outcomes, both intra-articular and pain-related TMD categories were selected.
- Item generation: Diagnostic questions were formulated for each category, designed to be easily applied during clinical interviews and examinations.
- Scoring system creation: Responses were assigned weighted scores reflecting severity and clinical risk.

3.3. Diagnostic Categories

The questionnaire includes the following categories:

- Disk displacement with reduction (DDwR);
- Disk displacement without reduction (DDwoR);

- Degenerative joint disease (DJD);
- Disc displacement with intermittent locking;
- Myalgia;
- Myofascial pain;
- Arthralgia/Capsulitis;
- Headache attributed to TMD;
- Trismus: Masticatory muscle trismus may involve the masseter, pterygoid, and temporalis muscles and is not limited to a single muscle group.

3.4. Scoring and Management Pathways

Scores are grouped into three outcome categories:

1. Low-risk (minimal symptoms): Proceed with orthodontic treatment without concern.
2. Moderate-risk (mild to moderate symptoms): Proceed with orthodontic treatment but with follow-up every 6 months.
3. High-risk (severe symptoms): Manage TMD/orofacial pain before starting orthodontics.

4. Proposed Protocol

This expert-informed framework provides a structured framework for assessing temporomandibular disorders (TMD) in orthodontic candidates. It is designed to be applied during pre-treatment evaluation by orofacial pain specialists, orthodontists, and other dental providers with appropriate training.

4.1. Diagnostic Categories and Sample Questions

The protocol integrates key diagnostic categories from international criteria (e.g., DC/TMD) and expert clinical experience.

These include:

- Disk displacement with reduction (DDwR): "Do you notice clicking or popping in your jaw?"
- Disk displacement without reduction (DDwoR): "Is your jaw opening limited to less than 38 mm?" Patients are asked about perceived limitation of jaw opening, while the clinician records objective maximal interincisal opening (<38 mm) during examination [8].
- Degenerative joint disease (DJD): "Do you have grinding or crepitus noises during jaw movement?"
- Myalgia and myofascial pain: "Do you experience muscle pain on function or referred pain when pressure is applied?" For orthodontic screening, myalgia and myofascial pain are grouped together, as reliable differentiation between these entities requires specialized orofacial pain training and is not routinely feasible in general orthodontic practice.
- Arthralgia/Capsulitis: "Do you have tenderness of the TMJ aggravated by function or following trauma?"
- Headache attributed to TMD: "Do your headaches occur in the temple region and are they triggered by jaw use?"
- Trismus: "Is your jaw opening restricted with pain or muscle guarding?"

Each question is linked to diagnostic indicators and assigned a weighted score that reflects its severity.

4.2. Scoring and Risk-Stratified Pathways

Patient responses are scored and summed, yielding three levels of risk that guide management:

- Low Risk (0–3 points): Orthodontic treatment can proceed without concern.
- Moderate Risk (4–6 points): Orthodontic treatment can proceed, but follow-up every 6 months is recommended.
- High Risk (≥7 points): TMD should be managed before orthodontic treatment is initiated.

This stratification provides clinicians with a simple yet structured approach to decision-making, while also ensuring medico-legal documentation of baseline TMD status.

4.3. Illustrative Case Applications

To demonstrate clinical utility, the following cases illustrate how the scoring system may be applied:

- Case 1 (Low Risk): A 17-year-old reports occasional clicking (DDwR) but no pain. Score = 2. Orthodontics initiated with reassurance; no aggravation observed.
- Case 2 (Moderate Risk): A 19-year-old patient presents with temple headaches and mild tenderness of the masseter muscles. Score = 5. Orthodontic treatment was initiated, with scheduled follow-up appointments every 6 months.
- Case 3 (High Risk): An 18-year-old with restricted jaw opening (DDwoR) and joint pain. Score = 8. Orthodontics postponed; TMD managed with conservative therapy before reassessment.

Additional clinical examples, such as pterygoid muscle trismus after mandibular advancement device (MAD) use or degenerative joint disease with crepitus and open bite, illustrate how the protocol captures complex presentations and stratifies them into appropriate care pathways.

4.4. Clinical Application

4.4.1. Pterygoid Muscle Trismus After Mandibular Advancement Device (MAD) Use in OSA

In this case, a 16-year-old patient developed pterygoid muscle trismus following the use of a mandibular advancement device (MAD) for obstructive sleep apnea (OSA). Trismus involving the lateral pterygoid muscle may present with incomplete posterior tooth contact in centric occlusion, with or without associated pain. Such patients are considered high risk and must be treated before initiating orthodontic therapy, as chronic MAD use can lead to shortening and dysfunction of the lateral pterygoid muscle.

4.4.2. Scoring System

- Pterygoid Muscle Trismus (ICD-10: R25.2)

History of MAD use for OSA

- a. No → Proceed to Section 10
- b. Yes → 1 point

Posterior teeth contact in centric occlusion

- a. Yes → 0 points
- Interpretation of Scores

  0 points: Orthodontic treatment can proceed without concern.
  1–2 points: Pterygoid muscle trismus must be addressed before initiating orthodontic treatment. Ongoing monitoring is required throughout orthodontic therapy.
- b. No → 1 point

4.4.3. Osteoarthritis of the TMJ Presenting with Crepitus, Pain, and Posterior Open Bite in a 19-Year-Old Patient

The patient is 19 years old with a history of osteoarthritis (OA), a degenerative condition affecting the temporomandibular joint (TMJ). Clinical signs may include:

- Audible noises (crunching, crepitus, grinding) during mandibular motion.
- Radiographic changes: flattened condyle, narrowing of the TMJ space, or other signs of bony deterioration (confirmed by panoramic or CBCT imaging).
- Occlusal findings: posterior open bite due to altered condylar morphology.
- Symptoms: preauricular pain aggravated by function, detected by palpation, often accompanied by joint crepitus.

This presentation categorizes the patient as being at high risk for orthodontic treatment.

- Section 4: Degenerative Joint Disease (M26.64)

Does the patient have crepitus/crunching, grinding noises with jaw movement?

- a. No → Go to Section 5
- b. Yes → 1 point

Does the patient have imaging (panoramic or CBCT)?

- a. No
- b. Yes → Are degenerative changes to the condyle/articular eminence present?
- i. No → 0 points
- ii. Yes → 1 point

Is there pain in the preauricular area aggravated by function?

- a. No → 0 points
- b. Yes →
- i. Pain 0–4/10 → 1 point
- ii. Pain 5–10/10 → 2 points

Does the patient have occlusal changes associated with degenerative joint changes?

- a. No → 0 points
- b. Yes → 1 point

Total Score Range: 0–5

- Interpretation
- 0–2 points: Orthodontic treatment can be initiated with no major concern.
- 2–3 points: Orthodontic treatment can proceed with a 6-month follow-up by an Orofacial Pain specialist.
- 3–5 points: Degenerative joint disease must be managed before orthodontic treatment begins.
- Section 5: Arthralgia/Capsulitis (M26.62)

Does the patient have tenderness to palpation of the TMJ?

- a. No → Go to Section 6
- b. Yes → 1 point

Does patient history identify trauma as the cause of capsulitis?

- a. No → 0 points
- b. Yes → 1 point

Total Score Range: 0–2

- Interpretation

- 0 points: Orthodontic treatment can proceed without concern.
- 1–2 points: Arthralgia/capsulitis must be addressed before orthodontic treatment. Ongoing follow-up is recommended during orthodontic care.

5. Discussion

5.1. Summary of Key Findings

This study proposes a structured, expert-opinion-based protocol for evaluating TMD in orthodontic candidates. By standardizing pre-treatment assessment, the questionnaire enables early recognition of high-risk patients, supports tailored treatment planning, and provides medico-legal protection for orthodontists.

5.2. Clinical Relevance

The fluctuating nature of TMD symptoms poses a challenge to both diagnosis and patient management. A structured pre-treatment assessment not only improves diagnostic accuracy but also facilitates shared decision-making with patients and orthodontists. Identifying TMD before orthodontic treatment empowers clinicians to discuss risks transparently, thereby improving patient trust.

Moreover, some patients may be referred to orthodontists specifically for TMD signs and symptoms. The decision whether to initiate orthodontic treatment or refer for TMD treatment is more critical, with both legal and ethical aspects. For instance, initiating orthodontic treatment without addressing TMD symptoms could lead to legal consequences and raise moral questions about providing the best possible care for the patient.

For many experts, TMD evaluation is conducted at presentation, during orthodontic treatment, and after treatment. Although this questionnaire is recommended for use before orthodontic treatment, its application can also be extended to be useful during treatment and during follow-up. It is essential to note that TMD may develop during orthodontic treatment or emerge after the treatment is completed, emphasizing the importance of ongoing vigilance.

Given the multifactorial nature of temporomandibular disorders, effective risk management in orthodontic patients extends beyond single-provider decision-making and requires coordinated interdisciplinary care.

5.2.1. Interdisciplinary Collaboration and Referral Considerations

Temporomandibular disorders (TMD) and orofacial pain are multifactorial conditions that frequently require coordinated management across multiple disciplines [13]. Although the present protocol is designed to support pre-orthodontic assessment and decision-making, it is not intended to replace interdisciplinary care. Instead, it provides a structured framework to facilitate timely referral and communication among relevant healthcare providers when elevated risk is identified.

Orthodontists play a central role in recognizing TMD-related risk factors and integrating risk stratification into treatment planning. Patients identified as moderate or high risk using the proposed scoring system should be referred to an orofacial pain (OFP) specialist for comprehensive evaluation and conservative management before, or concurrent with, orthodontic treatment. General dentists contribute to early screening, baseline documentation, and continuity of care, while oral and maxillofacial surgeons (OMFS) may be required for trauma, advanced degenerative joint disease, significant structural pathology, or when surgical consultation is indicated.

Collaboration beyond dental specialties is often necessary. Primary care physicians (PCPs) should be involved when systemic conditions, such as inflammatory arthritis, connective tissue disorders, chronic pain syndromes, or sleep-related breathing disorders,

may influence temporomandibular health. Behavioral or pain psychologists play an important role in patients with psychosocial risk factors, parafunctional behaviors, anxiety, depression, or features of central sensitization, all of which are known to modulate pain perception and treatment outcomes [9,13]. Referral to physical therapists is recommended for patients presenting with myofascial pain, trismus, postural abnormalities, or cervical–mandibular dysfunction, where musculoskeletal rehabilitation can improve function and symptom control.

Importantly, the proposed scoring system functions not only as a diagnostic aid but also as a referral trigger, guiding interdisciplinary involvement based on patient risk. By embedding referral thresholds within a standardized pre-treatment assessment, this protocol supports coordinated, patient-centered care, improves communication among providers, and enhances both clinical safety and medico-legal defensibility in orthodontic practice.

Accurate diagnosis of temporomandibular disorders requires specific clinical training, and not all orthodontists may have equivalent expertise in comprehensive TMD assessment. Accordingly, this questionnaire is intended as a structured screening and risk stratification tool rather than a substitute for specialist diagnosis. Use of the protocol does not require formal certification; however, identification of moderate- or high-risk findings should prompt referral to an orofacial pain specialist or appropriately trained clinician for definitive evaluation and management.

5.2.2. Consideration of Bruxism Within the Scoring and Risk Stratification Framework

Bruxism is recognized as an essential modifying factor in the assessment of temporomandibular disorder (TMD) risk before orthodontic treatment. Both sleep- and awake-bruxism are associated with increased masticatory muscle activity, elevated temporomandibular joint loading, and a higher prevalence of pain-related and intra-articular TMD conditions [1,10]. As such, bruxism may reduce the adaptive capacity of the stomatognathic system and increase susceptibility to symptom aggravation during orthodontic tooth movement.

Within the proposed protocol, bruxism is not scored as an independent diagnostic category but is incorporated into the interpretation of pain-related and intra-articular findings, particularly myalgia, myofascial pain, arthralgia, headache attributed to TMD, and degenerative joint disease. In patients with a history or clinical indicators of active bruxism (e.g., self-reported clenching or grinding, tooth wear, muscle hypertrophy, morning muscle fatigue), the presence of concurrent TMD signs should be interpreted with heightened clinical caution.

Accordingly, patients with bruxism who fall within the moderate-risk score range may be managed as functionally higher risk, warranting closer monitoring, earlier referral to an orofacial pain specialist, or conservative management before orthodontic initiation. Similarly, in high-risk patients, active bruxism may represent a perpetuating factor that should be addressed as part of comprehensive TMD management before orthodontic treatment is commenced.

Orthodontic treatment itself may influence bruxism activity through transient occlusal instability, discomfort during alignment, and neuromuscular adaptation [1,7]. Therefore, identification and documentation of bruxism as a pre-existing condition are essential for baseline risk assessment, informed consent, and medico-legal documentation. Integrating bruxism as a contextual modifier into the scoring framework strengthens the protocol's ability to reflect real-world clinical complexity while preserving its structured, standardized design.

5.2.3. Psychological Health (Axis II) as a Contextual Modifier in Pre-Orthodontic TMD Assessment

Psychological and psychosocial factors, as defined by Axis II of the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), play a critical role in the onset, persistence, and amplification of TMD-related pain [9]. This is particularly relevant in adolescents and young adults, the primary population undergoing orthodontic treatment, in whom emotional and developmental stressors are everyday and may significantly influence pain perception and capacity to cope.

In this age group, psychosocial stressors such as sibling rivalry, peer pressure, academic demands, home- and school-related difficulties, bullying, and normal developmental transitions can contribute to increased muscle tension, parafunctional behaviors, and central pain sensitization. These factors may not directly cause structural temporomandibular pathology but can substantially modify symptom severity, chronicity, and response to orthodontic and conservative TMD interventions.

Within the proposed protocol, Axis II factors are not scored as independent diagnostic entities but are incorporated as contextual modifiers when interpreting pain-related findings, including myalgia, myofascial pain, headache attributed to TMD, arthralgia, and bruxism-associated symptoms. Patients presenting with disproportionate pain responses, widespread tenderness, fluctuating symptoms, or poor coping mechanisms in the presence of identifiable psychosocial stressors should be regarded as having reduced adaptive capacity.

Accordingly, patients who meet moderate-risk criteria based on somatic findings but also demonstrate significant psychosocial stress may be managed as functionally higher risk, warranting closer follow-up, interdisciplinary referral, or deferral of orthodontic treatment until symptoms are stabilized. In selected cases, referral to behavioral health or pain psychology services is recommended to address stress-related contributors, maladaptive coping strategies, and pain amplification mechanisms.

Recognition and documentation of Axis II factors during pre-orthodontic evaluation support a biopsychosocial approach to care, improve patient counseling and informed consent, and enhance medico-legal defensibility. Incorporating psychological health considerations into risk interpretation strengthens the protocol's ability to reflect real-world clinical complexity while maintaining its structured, standardized design. Modifiers are documented but not yet quantified; to be tested in validation.

5.3. Comparison with Literature

Multiple studies have attempted to elucidate the relationship between orthodontics and temporomandibular disorders (TMDs).

A most recent systematic review [9] in April 2025 aimed to evaluate the impact of malocclusion on the prevalence of pain-related temporomandibular disorders in children and adolescents. The result was that some forms of malocclusion could be linked to a higher risk of TMD-related pain among young people. Due to inconsistencies in current research and questions about its reliability, experts argue that more comprehensive, long-term studies are necessary to draw more precise conclusions.

A scoping Review [18] explores the intricate association between occlusal factors and temporomandibular disorders (TMD). Various occlusal deviations—including malocclusion types, pronounced overjet or overbite, crossbite, and occlusal interferences—have been linked to masticatory discomfort and temporomandibular joint (TMJ) dysfunction. Individuals with Angle Class I occlusion generally exhibit a lower prevalence of TMD symptoms. In contrast, those with Angle Class II or III malocclusions, deep bites, or edentulous regions

show a greater tendency toward manifestations such as mandibular deviation, myofascial pain, and muscle tenderness.

The findings further reinforce the multifactorial etiology of TMD, in which occlusal characteristics interact with parafunctional activities and systemic influences, including age- and sex-related predispositions. However, due to the observational nature of the studies, a direct causal relationship between occlusion and TMD cannot be conclusively established.

This review highlights the importance of early assessment and management of occlusal conditions as a preventive approach to mitigate the risk of developing temporomandibular disorders.

Henrikson and Nilner [4] demonstrated no significant worsening of TMD symptoms in orthodontically treated Class II patients compared with the control group. Conversely, Nielsen et al. [5] reported increased muscle tenderness in orthodontically treated adolescents. McNamara [19] highlighted that orthodontics neither prevents nor cures TMD, but emphasized the importance of a stable occlusal relationship. Together, these studies reinforce the need for systematic pre-treatment assessment to clarify baseline symptoms.

5.4. Medico-Legal Considerations

The medico-legal implications are significant. Without pre-treatment screening, orthodontists may be accused of causing TMD symptoms that were pre-existing but undocumented. By adopting a structured questionnaire, practitioners create a defensible record that mitigates liability. The Michigan case of Pollack [15] underscores the high stakes involved.

Statements regarding reduction in medico-legal risk and improved standardization should be interpreted as potential benefits based on theoretical rationale and alignment with existing diagnostic standards, rather than as empirically demonstrated effects. These outcomes have not been directly measured and require formal validation.

5.5. Validation Considerations

Validation of the proposed framework will require a staged approach. Initial pilot testing should evaluate feasibility, clarity, and inter-examiner reliability when applied by orthodontists and orofacial pain specialists. Criterion validity should then be assessed by comparing protocol outcomes with comprehensive DC/TMD examinations and, where indicated, imaging findings. Finally, prospective multi-center studies are needed to determine predictive validity, specifically whether baseline risk stratification is associated with the development or exacerbation of TMD symptoms during orthodontic treatment. These steps will allow refinement of scoring thresholds and support external validation across different clinical settings.

6. Comparison with Literature—Explaining Divergent Findings and Informing the Framework

Apparent contradictions in the orthodontics–TMD literature largely reflect methodological heterogeneity. First, studies differ in diagnostic criteria—ranging from symptom-only screening to RDC/TMD or DC/TMD-based clinical examination—producing non-comparable case definitions and prevalence estimates [9,14,15]. Because TMD symptoms naturally fluctuate, inconsistent follow-up intervals can confound attribution of symptom changes to orthodontic treatment. The proposed protocol addresses these issues by aligning screening items with DC/TMD-consistent indicators, incorporating objective clinical thresholds (e.g., limited opening), and standardizing documentation and follow-up intervals. This structure is intended to improve comparability across patients and settings and to support subsequent psychometric and predictive validation.

Second, there is substantial variability in malocclusion classification and how occlusal factors are operationalized (e.g., Angle class vs. specific traits, such as overjet, open bite, and crossbite) [9,14,18]. Meta-analytic work shows that reported TMD prevalence differs by sex, age, and malocclusion pattern and that between-study heterogeneity is driven by inconsistent diagnostic and malocclusion taxonomies—precisely the kind of inconsistency this tool intends to mitigate by structuring occlusal/TMD items and weighting them into uniform risk strata.

Third, outcome measures vary (pain vs. function vs. imaging changes), as do follow-up windows. Because TMD symptoms exhibit natural waxing and waning, short or mismatched follow-ups can misattribute spontaneous fluctuation to treatment effects (or lack thereof) [1,12]. The pathway's baseline scoring, combined with scheduled reviews, addresses this by creating a comparable longitudinal record (including thresholds such as limited opening) to distinguish between regression to the mean and actual change.

Fourth, studies frequently conflate patient mix and co-factors (parafunction, trauma history, psychosocial load, sleep devices) with orthodontic mechanics. Reports associating extractions/retractions with risk are likely to reflect selection and measurement bias in subgroups with lower adaptive capacity [7,11,12]. The framework addresses this by risk-stratifying adaptive reserve (e.g., myalgia, arthralgia, disc displacement items) and routing high-risk phenotypes to TMD management before orthodontics, thereby standardizing decisions across heterogeneous populations.

Fifth, measurement methods (e.g., uncalibrated MMO cutoffs, inconsistent imaging use) further fragment the evidence base. This protocol encodes objective clinical thresholds (e.g., <38 mm opening for DDwoR/trismus) and triggers selective imaging for suspected DJD [6,8], promoting cross-study comparability and cleaner medico-legal records.

Finally, many orthodontic cohorts lack systematic pre-treatment TMD screening, which leaves baseline symptoms undocumented and inflates perceived "post-treatment" incidence. The motivation for a standardized, pre-orthodontic screening protocol is therefore both clinical and legal; this tool operationalizes that need with structured items, weighted scoring, and explicit referral thresholds.

How this resolves the literature's inconsistencies: By (i) adopting DC/TMD-consistent items, (ii) normalizing occlusal/TMD constructs into uniform risk bands, (iii) using objective cutoffs (e.g., MMO < 38 mm), and (iv) building in time-anchored follow-ups, the proposed framework converts heterogeneous, non-comparable reports into a standard pre-/post-treatment data structure. This not only improves patient safety and counseling but also creates a standardized dataset suitable for multi-center validation and medico-legal defensibility.

7. Limitations

At present, the proposed benefits related to consistency of assessment and medico-legal risk mitigation are based on theoretical rationale and alignment with existing standards, rather than direct empirical validation. Nonetheless, structured pre-treatment documentation has been widely advocated as a best practice in both clinical risk management and medico-legal contexts.

The questionnaire has not undergone formal pilot testing or systematic evaluation in clinical practice. The clinical examples presented are illustrative and intended to demonstrate the application of the framework rather than to present outcomes from structured real-world use. During development, the protocol was refined informally based on the authors' clinical experience to enhance clarity and feasibility; formal pilot evaluation is planned as part of future validation.

The clinical case examples presented are illustrative and intended solely to demonstrate the application of the proposed framework. They do not constitute a clinical sample, systematic data collection, or statistical analysis, and should not be interpreted as evidence of efficacy or outcome.

At present, no data on sensitivity, specificity, diagnostic accuracy, or reproducibility are available for the proposed scoring system. The framework is intended as a preliminary, expert-informed risk stratification tool, and its performance characteristics require formal evaluation through pilot testing and prospective validation studies.

8. Next Steps: Pathway to Validation

The proposed protocol represents a structured framework intended to guide the pre-orthodontic assessment of TMD. While it offers clinical relevance and medico-legal value, its long-term utility depends on systematic validation. Several steps are recommended to establish its reliability, generalizability, and integration into practice:

8.1. Psychometric Evaluation

Future research should focus on testing the questionnaire's sensitivity, specificity, and predictive validity. This includes:

- Pilot testing in orthodontic and orofacial pain clinics.
- Reliability testing through repeated administration.
- Validation against gold-standard diagnostic methods such as DC/TMD and imaging modalities.

8.2. Prospective and Multi-Center Studies

To ensure broad applicability, prospective studies across diverse populations are essential. Multi-center trials involving orthodontists, orofacial pain specialists, and general dentists will help determine whether the protocol performs consistently in different clinical and cultural settings.

8.3. Integration of Imaging and Digital Tools

Advanced imaging (CBCT, MRI) can be incorporated to strengthen diagnostic accuracy in high-risk cases. Additionally, digital health platforms and artificial intelligence–driven decision-support systems could be leveraged to automate scoring, issue clinical alerts, and facilitate data sharing across specialties.

8.4. Training and Implementation

Successful adoption requires training programs for orthodontists and allied providers. Workshops, continuing education modules, and integration into orthodontic residency curricula could standardize the use of this protocol.

9. Medico-Legal Monitoring

Longitudinal monitoring of medico-legal cases will help assess whether systematic pre-treatment TMD documentation reduces orthodontists' liability. Such evidence would further strengthen the case for widespread adoption.

Summary

By pursuing these steps, the proposed framework can transition from an expert-informed framework to a validated clinical instrument. Its ultimate goal is to improve patient safety, enhance interdisciplinary collaboration, and provide orthodontists with defensible, evidence-based documentation during treatment planning. Because this frame-

work is expert-informed rather than empirically validated, it should be used as a supportive decision aid rather than a prescriptive or definitive tool. Clinical judgment and interdisciplinary consultation remain essential, particularly where protocol outputs may influence treatment timing or referral decisions.

10. Conclusions

Patients with pre-existing TMD are at heightened risk of symptom aggravation during orthodontic treatment. Inconsistent diagnostic criteria, variable malocclusion classifications, non-standardized outcomes, and the absence of systematic pre-treatment screening fragment current literature. This framework addresses these shortcomings by offering a structured diagnostic questionnaire and scoring framework.

Adopting the protocol enables orthodontists to:

- Recognize and stratify TMD risk with standardized criteria;
- Provide transparent counseling and individualized care;
- Facilitate communication with orofacial pain specialists;
- Establish defensible medico-legal documentation.

While empirical validation remains essential, the proposed framework represents an important step toward safer orthodontic practice and more coherent research. Its broader adoption could improve patient safety, foster interdisciplinary collaboration, and reduce litigation risk, making it a valuable tool in modern orthodontic care.

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