



TEMPOROMANDIBULAR JOINT DYSFUNCTION: MODERN SCIENTIFIC FOUNDATIONS OF GNATHOLOGICAL AND ORTHODONTIC APPROACHES

Author: Baratov Faxriddin Shavkatovich

Assistant Lecturer, Tashkent EMU Institute

Department of Otorhinolaryngology and Hospital Dentistry

Gnathological Orthodontist

ABSTRACT

Temporomandibular disorders (TMD) represent one of the most актуал problems in modern dentistry, orthodontics, and gnathology. This article discusses the anatomy, biomechanics, etiology, diagnostics, and treatment principles of temporomandibular joint dysfunction based on contemporary scientific literature. The role of occlusion, muscle activity, psychoemotional factors, parafunctional habits, and skeletal disproportions is scientifically analyzed. Modern diagnostic methods such as MRI, CBCT, cephalometric analysis, and articulator diagnostics are reviewed. The article also explains the importance of individualized orthodontic and gnathological treatment planning in preventing complications and restoring stomatognathic balance.

INTRODUCTION

The temporomandibular joint (TMJ) is one of the most complex joints in the human body. It performs rotational and translational movements simultaneously and is closely connected with the muscles of mastication, occlusion, and the central nervous system. Temporomandibular disorders are increasingly observed in modern clinical practice. According to international studies, clinical manifestations of TMD occur in approximately 40–70% of adults. The disorder negatively affects mastication, speech, swallowing, posture, and quality of life. Modern literature



confirms that TMD has multifactorial etiology involving occlusal disturbances, stress, trauma, bruxism, and skeletal disproportions.

ANATOMY AND BIOMECHANICS OF THE TMJ

The temporomandibular joint is formed by the mandibular condyle and temporal bone. An articular disc divides the joint into upper and lower compartments. The lower compartment mainly performs rotational movement while the upper compartment allows translational movement. The TMJ functions together with the masseter, temporalis, medial pterygoid, and lateral pterygoid muscles. The lateral pterygoid muscle plays a critical role in anterior disc displacement and muscular imbalance. Biomechanical disturbances in the joint may result in muscle hyperactivity, pain, and functional limitations.

ETIOLOGY AND PATHOGENESIS

Scientific evidence demonstrates that TMD develops as a result of several interacting factors. Occlusal discrepancies may overload the joint and muscles. Psychological stress contributes to muscle hypertonicity and parafunctional habits such as clenching and bruxism. Traumatic injuries may alter condylar position and disc relationship. Skeletal disproportions and malocclusion may additionally disturb stomatognathic harmony. The progression of TMD is associated with inflammation, muscle fatigue, disc displacement, and degenerative changes within the joint.

CLINICAL MANIFESTATIONS

Patients with temporomandibular dysfunction commonly complain of pain in the preauricular area, headaches, joint clicking, crepitation, and mandibular deviation during mouth opening. Muscle tenderness and cervical pain are also frequently observed. In advanced cases, limited mouth opening and chronic pain syndromes may occur. Some patients experience tinnitus, dizziness, and facial asymmetry due to muscular imbalance and altered mandibular function.



DIAGNOSTIC PRINCIPLES

Diagnosis of TMD requires comprehensive functional analysis. Clinical examination includes palpation of masticatory muscles, evaluation of mandibular movements, occlusal analysis, and assessment of muscle tone. MRI is considered the gold standard for evaluation of the articular disc and soft tissues. CBCT allows detailed analysis of condylar morphology and osseous structures. Cephalometric analysis and articulator diagnostics are essential in modern orthodontic and gnathological treatment planning.

GNATHOLOGICAL APPROACH

Gnathology evaluates the stomatognathic system as a unified functional complex involving joints, muscles, and occlusion. Discrepancies between centric relation and centric occlusion are considered important etiological factors in TMD. Splint therapy is widely used to reduce muscular hyperactivity and stabilize condylar position. Functional rehabilitation aims to restore neuromuscular balance and eliminate pathological occlusal contacts.

ROLE OF ORTHODONTIC TREATMENT

Orthodontic treatment plays an important role in the management of TMD when properly planned. Incorrect biomechanics may increase joint loading and aggravate symptoms. Modern orthodontics emphasizes individualized diagnosis and stable functional occlusion. Digital diagnostics and cephalometric analysis improve treatment precision and long-term stability.

SCIENTIFIC EVIDENCE

Scientific investigations by Okeson, Dawson, McNeill, and Proffit significantly contributed to understanding TMD pathogenesis and treatment. Okeson emphasized the role of parafunctional habits and muscle dysfunction. Dawson highlighted the importance of stable condylar position and functional occlusion. McNeill demonstrated the influence of psychoemotional stress on muscle hyperactivity and



chronic pain syndromes. Modern evidence-based dentistry recommends multidisciplinary cooperation between orthodontists, gnathologists, neurologists, physiotherapists, and otorhinolaryngologists.

TREATMENT PRINCIPLES

Conservative and multidisciplinary treatment is recommended in most TMD cases. Main therapeutic methods include splint therapy, physiotherapy, orthodontic correction, occlusal equilibration, muscle relaxation, and psychological stabilization. Severe cases may require arthrocentesis or surgical interventions. Long-term success depends on accurate diagnosis and elimination of etiological factors.

DISCUSSION

Temporomandibular disorders cannot be explained by a single etiological factor. The disorder develops through interaction of anatomical, muscular, psychological, and occlusal abnormalities. Modern orthodontic and gnathological concepts focus on restoration of harmony between muscles, joints, and occlusion. Individualized diagnostics and multidisciplinary treatment planning significantly improve clinical outcomes.

CONCLUSION

Temporomandibular joint dysfunction remains one of the most relevant problems in modern dentistry. Early diagnosis and evidence-based treatment provide high clinical effectiveness. MRI, CBCT, cephalometric analysis, and functional diagnostics are essential for successful management of TMD patients. Orthodontic treatment should always be based on comprehensive gnathological evaluation in order to maintain long-term stability and functional balance.



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ADDITIONAL SCIENTIFIC ANALYSIS 1

Recent studies indicate that temporomandibular dysfunction is strongly associated with altered neuromuscular coordination, postural imbalance, airway disturbances, and psychoemotional stress. Modern digital dentistry integrates CBCT imaging, virtual articulators, and 3D occlusal analysis to improve diagnosis and treatment outcomes. Scientific literature also demonstrates that untreated bruxism may lead to progressive condylar remodeling, muscle fatigue, and chronic pain syndromes. Comprehensive rehabilitation therefore requires multidisciplinary cooperation and long-term functional monitoring.

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