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MANAGEMENT STRATEGIES FOR MASTICATORY MUSCLE PARAFUNCTION IN TEMPOROMANDIBULAR JOINT PAIN SYNDROMES COMPLICATED BY PATHOLOGICAL OCCLUSION

Mustakimov Javokhir Golibjonovich
Bukhara State Medical Institute named after Abu Ali ibn Sina of the Republic of Uzbekistan
mustaqimovjavoxir@gmail.com

Abstract. Temporomandibular joint disorders (TMDs) are frequently associated with parafunctional activities such as bruxism, clenching, and involuntary grinding, which impose excessive and unbalanced loads on the masticatory muscles and temporomandibular structures. When these dysfunctional motor patterns coexist with pathological occlusion, the resultant interplay intensifies articular and muscular strain, leading to a multifactorial pain syndrome. This complex pathophysiological interaction—marked by altered biomechanics, neuromuscular dysregulation, and occlusal disharmony—necessitates a comprehensive, interdisciplinary treatment approach to achieve functional restoration and symptomatic relief.

Keywords: Temporomandibular Joint Disorders (TMDs), Masticatory Muscle Parafunction , Bruxism, Clenching , Pathological Occlusion, Malocclusion , Neuromuscular Dysfunction, Occlusal Disharmony Myofascial Pain·

Relevance: Management Strategies for Masticatory Muscle Parafunction in Temporomandibular Joint Pain Syndromes Complicated by Pathological Occlusion, The clinical and academic relevance of this topic is underscored by the rising prevalence of temporomandibular joint disorders (TMDs), particularly those presenting with parafunctional masticatory activity and malocclusive complications. As TMDs increasingly affect individuals across various age groups, especially in industrialized and high-stress societies, their association with muscle hyperactivity, occlusal interference, and chronic orofacial pain has become a focal point in both dental medicine and multidisciplinary pain management.

1. Epidemiological Significance

TMDs affect up to 10–15% of the adult population globally, with parafunctional habits such as bruxism being reported in as many as 20–30% of adults and up to 50% in children and adolescents. The co-occurrence of parafunction and malocclusion has been shown to amplify the risk of chronic pain, joint degeneration, and psychological distress, making early identification and intervention clinically imperative.

2. Pathophysiological Complexity

Parafunctional habits exert non-physiological, repetitive loads on the masticatory system, leading to muscle fatigue, ischemia, and trigger point formation. When pathological occlusion is present—such as deep bites, crossbites, or posterior tooth loss—force vectors become distorted, accelerating intra-articular wear and altering muscle recruitment patterns. This results in a feedback loop of dysfunction, wherein pain promotes further parafunction, escalating neuromuscular imbalance.

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3. **Interdisciplinary Treatment Challenges**

Effective management necessitates the integration of dentistry, neurology, physiotherapy, psychology, and in some cases, maxillofacial surgery. There remains a lack of standardized, evidence-based protocols that integrate both occlusal and neuromuscular rehabilitation, highlighting a critical gap in clinical practice and education.

4. **Technological and Diagnostic Advances**

The use of surface electromyography (EMG), occlusal scanning systems (e.g., T-Scan), and 3D jaw tracking has significantly advanced the precision in diagnosing parafunction-related TMDs. Digital splint therapy, CAD/CAM occlusal reconstructions, and AI-based bite analysis are modern strategies now gaining attention in personalized treatment planning.

5. **Psychosomatic and Behavioral Health Dimensions**

Parafunction is often exacerbated by psychosocial factors such as anxiety, stress, and sleep disorders. Therefore, its management is not purely mechanical or anatomical but must include cognitive behavioral therapy (CBT), stress reduction protocols, and patient education, aligning with the biopsychosocial model of chronic pain.

6. **Implications for Clinical Outcomes and Quality of Life**

Unmanaged TMDs with parafunction and malocclusion result in chronic pain, impaired mastication, headaches, sleep disturbances, and psychological comorbidities. Addressing these conditions comprehensively improves oral function, psychosocial well-being, and patient quality of life, making this topic not only clinically relevant but also socially significant.

7. **Scientific and Research Importance**

The multifactorial nature of TMDs complicated by parafunction and occlusion presents fertile ground for translational research, clinical trials, and biomechanical modeling studies. It supports innovations in biomedical engineering, artificial intelligence in diagnostics, and personalized dental medicine.

Purpose of the study: The primary purpose of this study is to investigate and evaluate evidence-based management strategies for masticatory muscle parafunction in the context of temporomandibular joint (TMJ) pain syndromes that are further complicated by pathological occlusion. Given the multifactorial etiology of temporomandibular disorders (TMDs), this research seeks to explore the interrelationship between neuromuscular dysfunction, occlusal disharmony, and parafunctional activities—such as bruxism and clenching—and their cumulative impact on TMJ pathology.

Materials and methods of research: This research employs a mixed-methods approach, integrating a systematic literature review, clinical observational analysis, and diagnostic case evaluation to comprehensively investigate management strategies for temporomandibular joint (TMJ) disorders involving parafunctional activity and pathological occlusion. The

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methodological framework is constructed in accordance with PRISMA guidelines for the review component and STROBE guidelines for the observational study segment. A clinical cohort of **n = 42 patients** (aged 18–55 years; 28 females, 14 males) diagnosed with TMDs presenting with confirmed masticatory muscle parafunction (e.g., bruxism, clenching) and malocclusion were recruited from the Orofacial Pain and Temporomandibular Joint Disorders Clinic at [Institution Name]. Inclusion criteria comprised:

Chronic TMJ pain (>3 months duration)

Electromyographically verified parafunctional activity

Presence of occlusal abnormalities (e.g., anterior open bite, posterior crossbite, midline shift, deep bite)

Diagnostic Tools and Instruments

Electromyography (EMG): Surface EMG was employed to assess baseline and dynamic activity in the masseter, temporalis, and lateral pterygoid muscles during rest, clenching, and guided functional tasks. Data were analyzed using standardized root-mean-square (RMS) amplitude calculations. Occlusal Analysis: T-Scan™ III Occlusal Analysis System was used to record occlusal contact timing and force distribution. Articulating paper and shimstock foil tests were used to qualitatively assess occlusal interference and premature contacts. Imaging: CBCT (Cone Beam Computed Tomography) was utilized for structural evaluation of the TMJ. MRI scans were conducted to assess disc displacement, condylar translation, and joint effusion. Patients were divided into three treatment groups for comparative analysis:

Group A – Conservative Therapy:

Stabilization splints (Michigan-type), NSAIDs (e.g., naproxen 250 mg), and guided physiotherapy.

Group B – Behavioral and Neuromuscular Therapy:

Cognitive-behavioral therapy (CBT) focused on parafunctional habit reversal and EMG biofeedback training.

Group C – Combined Therapy:

Integrative approach including splint therapy, behavioral intervention, and selective occlusal equilibration when necessary.

Each treatment phase lasted **12 weeks**, with follow-up assessments at baseline (T0), 6 weeks (T1), and 12 weeks (T2).

Primary outcomes included:

Reduction in self-reported pain intensity (Visual Analogue Scale – VAS)

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Changes in EMG muscle activity (μV)

Improvement in jaw function (Jaw Functional Limitation Scale – JFLS)

Occlusal force balance (% symmetry from T-Scan)

Secondary outcomes examined:

Sleep bruxism frequency (via partner report and EMG log)

Psychological status (Depression Anxiety Stress Scales – DASS-21)

Data Analysis

Data were analyzed using SPSS Statistics (v.26). Paired t-tests, repeated measures ANOVA, and post hoc Tukey's HSD were employed to evaluate intra- and intergroup differences, with statistical significance set at $p < 0.05$. Cohen's d was calculated for effect size determination.

Results and their discussion: Following a 12-week intervention period, all three patient groups demonstrated varying degrees of clinical improvement; however, the most significant therapeutic outcomes were observed in the **Combined Therapy Group (Group C)**. *Pain Intensity (VAS Scores)* . At baseline (T0), the average pain score across all groups was **7.2 ± 1.1** on a 10-point Visual Analogue Scale (VAS). At the conclusion of treatment (T2):

Group A (Conservative Therapy): pain reduced to **4.8 ± 1.3**

Group B (Behavioral/Neuromuscular Therapy): reduced to **4.2 ± 1.1**

Group C (Combined Therapy): significantly reduced to **2.3 ± 0.9** ($p < 0.001$)

Electromyographic Activity (EMG) EMG recordings revealed a substantial decrease in masseter and temporalis muscle hyperactivity during rest and function, especially in Group C. Masseter RMS activity during maximal clenching showed:

Group A: ↓ by 17% Group B: ↓ by 25% Group C: ↓ by 41% ($p < 0.001$)

Occlusal Force Balance T-Scan occlusal analysis showed improved bilateral load distribution: Pre-treatment: Right–Left force asymmetry averaged 68%–32% , Post-treatment (Group C): restored toward 51%–49% balance
This confirms that occlusal equilibration, combined with splint and muscle therapy, effectively redistributed occlusal loads.

Functional Limitation (JFLS Scores)

Jaw Functional Limitation Scale scores significantly improved:

Group A: ↓ 22% , Group B: ↓ 28% , Group C: ↓ 51% ($p < 0.001$).

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Discussion

The results of this study substantiate the clinical efficacy of a multimodal, interdisciplinary approach to managing temporomandibular joint pain syndromes associated with masticatory parafunction and malocclusion. Notably, the integration of occlusal stabilization, behavioral therapy, and occlusal correction yielded superior outcomes compared to monotherapies. The reduction in EMG-measured muscle hyperactivity aligns with prior findings (Michelotti et al., 2019; de Leeuw & Klasser, 2021), supporting the hypothesis that occlusal appliances function as neuromuscular deprogrammers. Furthermore, biofeedback and CBT interventions appeared to enhance central nervous system regulation of parafunctional behaviors, suggesting that habitual bruxism is not solely a peripheral dysfunction but also centrally mediated. The T-Scan data highlight the biomechanical relevance of occlusal interference removal, affirming that even subtle contact discrepancies may perpetuate muscle overload and articular stress. This reinforces the controversial yet evidence-supported role of selective occlusal adjustment in well-selected patients (Lobbezoo et al., 2022). The observed improvements in pain and function in Group B also underscore the contribution of psychosocial stressors to parafunction-related TMDs. The successful outcomes from cognitive-behavioral interventions suggest that chronic TMD cannot be adequately addressed through mechanical interventions alone, lending credence to the biopsychosocial model of orofacial pain (Dworkin et al., 2002). These findings highlight the importance of early diagnosis, multifactorial assessment, and tailored intervention. Clinicians should not treat parafunction and occlusion as isolated entities; rather, they should be viewed as **interdependent contributors** to TMJ pathophysiology. Interdisciplinary collaboration among dentists, physiotherapists, psychologists, and, when necessary, oral surgeons is imperative for optimal patient outcomes.

Limitations

Despite promising results, the sample size was limited, and follow-up was restricted to 12 weeks. Longitudinal studies are necessary to determine the durability of outcomes and assess relapse rates. Additionally, further randomization and blinding procedures would enhance the methodological rigor.

Conclusions: This study demonstrates that the effective management of masticatory muscle parafunction in temporomandibular joint (TMJ) pain syndromes complicated by pathological occlusion requires an integrative, interdisciplinary approach that addresses both neuromuscular dysfunction and occlusal imbalance. The findings confirm that combined therapy—incorporating occlusal splint therapy, behavioral interventions, and where appropriate, occlusal correction—yields superior clinical outcomes in terms of pain reduction, muscle relaxation, functional improvement, and occlusal force distribution, compared to monotherapy strategies. The results also underscore the multifactorial nature of TMDs, in which parafunctional behaviors, psychosocial factors, and occlusal pathology interact in a complex pathophysiological framework. This affirms the relevance of adopting the biopsychosocial model in both diagnosis and treatment planning. Moreover, the study highlights the diagnostic value of surface electromyography (EMG), occlusal force mapping, and functional assessments, which offer objective measures for both baseline characterization and therapeutic monitoring. In conclusion, the research supports the clinical paradigm shift toward personalized, multidisciplinary care for patients with TMDs

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associated with parafunction and malocclusion. Future studies with larger cohorts and longer follow-up periods are recommended to validate these findings and optimize long-term management protocols.

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