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Editorial

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Toward Precision Medicine in Temporomandibular Disorders: The Emerging Role of Artificial Intelligence

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Editorial

Temporomandibular disorders (TMD) constitute a highly prevalent and heterogeneous group of conditions with significant functional, psychological, and socioeconomic impacts. Despite decades of research and the introduction of standardized clinical frameworks such as the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), the clinical management of TMD remains marked by diagnostic uncertainty, variable treatment strategies, and variable outcomes. In this context, artificial intelligence (AI) has emerged not merely as a diagnostic tool, but as a potential catalyst for redefining how TMD are understood, classified, and managed across the clinical continuum.

1. The Unresolved Complexity of Temporomandibular Disorders Care

1.1. The Diagnostic Challenge

TMD are not a single disease entity but rather a spectrum of disorders involving the temporomandibular joint, masticatory muscles, and associated neuromuscular and psychosocial systems. Clinical presentation is often discordant with structural findings, and symptom severity correlates poorly with imaging abnormalities [1–3]. As a result, clinicians frequently make therapeutic decisions under challenging conditions.

1.2. The Role of Imaging

Imaging plays a central role in this process. Magnetic Resonance Imaging (MRI) remains the reference standard for evaluating disc position, effusion, and inflammatory changes, while Cone Beam Computed Tomography (CBCT) provides superior assessment of osseous changes [4–6]. However, interpretation is time-consuming and subject to considerable interobserver variability, even among experienced specialists [7, 8].

2. The Transformative Potential of AI in TMD Management

2.1. AI as a Solution to Diagnostic Variability

The diagnostic potential of AI in TMD is increasingly supported by a growing body of evidence. Deep learning models applied to MRI and CBCT have demonstrated near-expert performance in segmenting TMJ structures, detecting disc displacement, and identifying degenerative joint disease [9–11]. Systematic reviews and meta-analyses consistently report diagnostic accuracies approaching or exceeding 90%, although the certainty of evidence remains low due to methodological heterogeneity [12–14].

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Crucially, AI's value lies not in replacing clinicians, but in standardizing interpretation. AI systems provide reproducible outputs, reduce interobserver variability, and generate structured data that can be seamlessly integrated into clinical decision-making. Studies show that clinicians assisted by AI—particularly through segmentation overlays and explainable visualizations—achieve higher diagnostic accuracy than those working independently [10]. This diagnostic capability should be considered a starting point, not the endpoint.

2.2. From Diagnosis to Treatment: AI as a Decision-Support Tool

While most AI research in TMD has focused on diagnostic imaging, its most transformative potential may be in supporting treatment planning. Management of TMD encompasses a broad therapeutic range—from conservative interventions such as physiotherapy and cognitive behavioral therapy to minimally invasive procedures and open surgery. Currently, treatment selection remains largely empirical, often guided by the best scientific evidence and clinical experience, rather than objective predictors of response.

AI models that integrate imaging features with clinical and functional data are beginning to explore predictive analytics and risk stratification [10, 15]. Although current performance is modest, such models illustrate the feasibility of identifying patient subgroups with distinct risk profiles and treatment trajectories. These tools may assist clinicians in distinguishing patients suited for conservative management from those who may require earlier interventions.

More broadly, AI supports a shift from binary diagnoses to phenotype-driven management, aligning with precision medicine principles increasingly adopted across healthcare.

2.3. Monitoring, Workflow Optimization, and Longitudinal Care

AI's role in TMD extends beyond diagnosis and prediction to include workflow efficiency and longitudinal monitoring. Automated segmentation significantly reduces image analysis time—from minutes to seconds—freeing clinicians to focus more on patient-centered care [16]. AI-assisted image reconstruction and denoising techniques have also reduced MRI acquisition times by up to 50%, while improving diagnostic reliability [17, 18].

These innovations have direct clinical implications: faster, more reliable imaging enhances patient comfort, expands access to advanced diagnostics, and enables objective monitoring of disease progression and treatment response. For chronic conditions like TMDs, AI-supported longitudinal evaluation may represent a major leap forward.

2.4. Ethical, Scientific, and Clinical Challenges

Despite its promise, integrating AI into TMD care presents significant challenges. Most existing models are trained on small, single-center datasets, often with class imbalance and limited external validation [12, 13, 19]. Annotation inconsistency—especially in disc segmentation and early degenerative findings—remains a key limitation.

Ethical considerations are equally pressing. Issues of data privacy, algorithmic bias, model explainability, and clinical liability require proactive management. Transparent reporting, explainable AI methodologies, and prospective multicenter trials are vital to building clinician trust and ensuring safe adoption.

Importantly, AI should augment—not replace—clinical judgment. Evidence increasingly supports a collaborative model, in which algorithms reduce cognitive burden and variability, while clinicians maintain responsibility for contextual decision-making and patient communication.

3. A Vision for the Future of TMD Care

Looking forward, the convergence of AI, advanced imaging, and large-scale clinical databases may usher in a new era for TMD management. Integrated AI platforms capable of real-time image interpretation, multimodal data fusion, and explainable reporting may soon become standard in maxillofacial practice.

Such systems have the potential to redefine care standards—enabling earlier diagnosis, personalized therapeutic pathways, and continuous outcome tracking. In doing so, they may also reduce healthcare costs, optimize resources, and lessen the burden of chronic TMD on patients and health systems alike.

The future of TMD care is not one where machines replace clinicians, but where clinicians are empowered by intelligent systems that enhance precision, consistency, and confidence.

4. Conclusion

AI has demonstrated its capacity to improve the diagnostic accuracy and reproducibility in TMD. The next—and more impactful—step is to extend this foundation to support treatment planning, monitoring, and long-term patient management.

Rather than viewing AI as a disruptive force, the oromaxillofacial community should embrace it as an enabling technology—transforming uncertainty into structured insight, and experience-based care into precision-driven management.

The future of TMD care will not be defined by algorithms alone, but by the intelligence with which they are integrated into clinical practice.

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References

[1] Schiffman, E.; et al. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group†. *Journal of Oral Facial Pain and Headache* **2014**, *28*, 6–27. https://doi.org/10.11607/jop.1151.

[2] Ohrbach, R.; Dworkin, S. The Evolution of TMD Diagnosis: Past, Present, Future. *Journal of Dental Research* **2016**, *95*, 1093–1101. https://doi.org/10.1177/0022034516653922.

[3] Reneker, J.; Paz, J.; Petrosino, C.; Cook, C. Diagnostic accuracy of clinical tests and signs of temporomandibular joint disorders: a systematic review of the literature. *Journal of Orthopaedic Sports Physical Therapy* **2011**, *41*, 408–416. https://doi.org/10.2519/jospt.2011.3644.

[4] Zhang, M.; et al. Cone-Beam Computed Tomography and Magnetic Resonance Imaging in Temporomandibular Joint Disorder Diagnosis: A Comparative Study. *Journal of Multidisciplinary Healthcare* **2025**, *18*, 3793–3802. https://doi.org/10.2147/jmdh.S521279.

[5] Tresoldi, M.; et al. Magnetic Resonance Imaging Evaluation of Closed-Mouth TMJ Disc-Condyle Relationship in a Population of Patients Seeking for Temporomandibular Disorders Advice. *Pain Research and Management* **2021**, p. 5565747. https://doi.org/10.1155/2021/5565747.

[6] Wang, Y.; et al. Diagnostic efficacy of CBCT, MRI and CBCT-MRI fused images in determining anterior disc displacement and bone changes of

temporomandibular joint. *Dentomaxillofacial Radiology* **2022**, *51*, 20210286. https://doi.org/10.1259/dmfr.20210286.

[7] Ahmad, M.; et al. Research diagnostic criteria for temporomandibular disorders (RDC/TMD): development of image analysis criteria and examiner reliability for image analysis. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* **2009**, *107*, 844–860. https://doi.org/10.1016/j.tripleo.2009.02.023.

[8] Molinari, F.; et al. Interobserver variability of dynamic MR imaging of the temporomandibular joint. *Radiologia Medica* **2011**, *116*, 1303–1312. https://doi.org/10.1007/s11547-011-0699-0.

[9] Li, M.; et al. Temporomandibular joint segmentation in MRI images using deep learning. *Journal of Dentistry* **2022**, *127*, 104345. https://doi.org/10.1016/j.jdent.2022.104345.

[10] Mao, W.; et al. Automated diagnosis and classification of temporomandibular joint degenerative disease via artificial intelligence using CBCT imaging. *Journal of Dentistry* **2025**, *154*, 105592. https://doi.org/10.1016/j.jdent.2025.105592.

[11] Yoon, K.; et al. Explainable deep learning-based clinical decision support engine for MRI-based automated diagnosis of temporomandibular joint anterior disk displacement. *Computer Methods and Programs in Biomedicine* **2023**, *233*, 107465. https://doi.org/10.1016/j.cmpb.2023.107465.

[12] Sankar, H.; et al. Role of artificial intelligence in magnetic resonance imaging-based detection of temporomandibular joint disorder: a systematic review. *British Journal of Oral and Maxillofacial Surgery* **2025**, *63*, 174–181. https://doi.org/10.1016/j.bjoms.2024.12.004.

[13] Manek, M.; et al. Temporomandibular joint assessment in MRI images using artificial intelligence tools: where are we now? A systematic review. *Dentomaxillofacial Radiology* **2025**, *54*, 1–11. https://doi.org/10.1093/dmfr/twae055.

[14] Jha, N.; Lee, K.; Kim, Y. Diagnosis of temporomandibular disorders using artificial intelligence technologies: A systematic review and meta-analysis. *PLoS ONE* **2022**, *17*, e0272715. https://doi.org/10.1371/journal.pone.0272715.

[15] Farook, T.; Dudley, J. Automation and deep (machine) learning in temporomandibular joint disorder radiomics: A systematic review. *Journal of Oral Rehabilitation* **2023**, *50*, 501–521. https://doi.org/10.1111/joor.13440.

[16] Vinayahalingam, S.; et al. Deep learning for automated segmentation of the temporomandibular joint. *Journal of Dentistry* **2023**, *132*, 104475. https://doi.org/10.1016/j.jdent.2023.104475.

[17] Ye, Z.; et al. Accelerated MRI in temporomandibular joints using AI-assisted compressed sensing technique: a feasibility study. *European Radiology* **2025**, *35*, 8046–8057. https://doi.org/10.1007/s00330-025-11734-7.

[18] Lee, C.; et al. Deep learning image enhancement for confident diagnosis of TMJ osteoarthritis in zero-TE MR imaging. *Dentomaxillofacial Radiology* **2025**, *54*, 302–306. https://doi.org/10.1093/dmfr/twae063.

[19] Mehta, V.; Tripathy, S.; Noor, T.; Mathur, A. Artificial Intelligence in Temporomandibular Joint Disorders: An Umbrella Review. *Clinical and Experimental Dental Research* **2025**, *11*, e70115. https://doi.org/10.1002/cre2.70115.