

Editorial

Artificial intelligence in orthodontics – A double-edged scalpel

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1. Introduction

Artificial Intelligence (AI) is making inroads into nearly every medical specialty, and orthodontics is no exception. From digital treatment planning to personalize patient monitoring, AI is reshaping how orthodontic care is delivered. While the benefits are significant, it's equally important to understand the limitations and challenges to ensure responsible and ethical implementation.

2. Advantages of AI in Orthodontics

1. **Enhanced Diagnostic Accuracy-** AI algorithms can analyze cephalometric radiographs, CBCT scans, and 3D dental models with high precision. These tools reduce human error and help in identifying dental landmarks for diagnosis and treatment planning. Example: Convolutional Neural Networks (CNNs) have demonstrated accuracy in identifying cephalometric points on radiographs comparable to trained orthodontists (Liu et al., 2023).¹⁻³
2. **Efficient Treatment Planning-** AI can simulate tooth movement and predict treatment outcomes based on patient-specific data. This allows orthodontists to develop more precise and individualized treatment plans. Clinical Application: Invisalign's "ClinCheck" system uses AI to model and adjust aligner therapy dynamically.
3. **Predictive Analytics-** By analyzing large datasets from previous cases, AI can forecast treatment duration, risk of relapse, and potential complications.

Benefit: Improved communication with patients about timelines and expected results, boosting satisfaction and compliance.

4. **Remote Monitoring and Compliance -** AI-powered mobile apps like Dental Monitoring allow orthodontists to track patient progress through smartphone photos and send alerts for issues, improving follow-up and patient engagement.
5. **Time and Cost Savings-** Automation of repetitive tasks such as treatment planning, documentation, and appointment scheduling reduces administrative burdens and operational costs.

3. Disadvantages and Challenges of AI in Orthodontics

3.1. Data privacy and security

AI systems require large amounts of patient data. If not securely managed, this raises serious concerns about data privacy and potential breaches.

Concern: HIPAA compliance and data protection laws must be strictly followed.

3.2. Over-reliance on technology

Excessive dependence on AI tools can diminish the clinician's critical thinking and manual diagnostic skills. AI should support, not replace, clinical judgment.

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3.3. Bias and limited generalizability

AI models trained on limited or non-diverse datasets may produce biased results, potentially compromising diagnosis or treatment for underrepresented populations.

Example: A model trained on adult datasets may not be reliable for pediatric orthodontics.

3.4. Lack of standardization

There is currently no universal standard for AI implementation in orthodontics. Differences in software capabilities and interoperability can cause inconsistencies in clinical practice.

3.5. Cost of implementation

While AI can lead to long-term savings, the initial cost of integrating AI technologies—including software, hardware, and staff training—can be prohibitive for small or solo practices.⁴

4. Ethical and Clinical Considerations

Ethics in AI goes beyond data privacy. Clinicians must be transparent with patients about how AI is being used in their care. Additionally, the human aspect of care—empathy, communication, and experience—should never be overshadowed by technological tools.

5. Conclusion

Artificial Intelligence is undeniably transforming orthodontics. It promises improved accuracy, efficiency, and

patient engagement. However, as with any innovation, it comes with caveats. The key to successful integration lies in understanding its limitations, maintaining ethical standards, and using AI to enhance rather than replace the clinical art of orthodontics. As we move forward, a balanced, informed, and patient-centric approach will define the true success of AI in orthodontic care.

6. Conflict of Interest

None.

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