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RESEARCH ARTICLE OPEN ACCESS

AI IN CARIES DETECTION

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ABSTRACT

AI dental caries detection uses computer vision algorithms and deep learning to analyze bitewing and periapical radiographs. It identifies initial demineralization, enamel progression, and dentinal decay with remarkable precision, helping clinicians catch subtle lesions that are easily missed by the human eye.

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INTRODUCTION

How AI Detects Decay

- **Pattern Recognition:** Models scan pixel-level radiographic data to detect anomalies and density changes associated with demineralization.
- **Visual Overlays:** Advanced diagnostic platforms highlight suspected lesions with digital overlays directly on the X-ray, acting as an automated "second reader".
- **Comprehensive Staging:** AI assists in mapping the entire caries process, from initial white-spot enamel lesions to deeper dentinal decay and recurrent decay around restorations.

Top Industry Platforms

Leading dental AI platforms integrate seamlessly into clinical workflows to improve diagnostic accuracy and standardize care:

- **Overjet:** FDA-cleared AI software that analyzes and quantifies decay in real-time on patient radiographs, helping to reduce diagnostic variability between different dentists.
- **Pearl:** Uses deep learning for multi-stage decay detection in both adult and pediatric populations.
- **Denti.AI:** Provides automated diagnostics and reporting to streamline clinical exams and insurance documentation.

Clinical and Patient Benefits

- **Proactive Treatment:** AI enables dentists to pivot to less-invasive, preventative treatments by catching caries in their earliest stages.
- **Objectivity:** It minimizes subjective variability in reading X-rays, ensuring consistent interpretations across multi-doctor practices.
- **Patient Communication:** Visual overlays and highlighted findings can be shown to patients to improve their understanding of required treatments and preventative care.

Objective: This clinical study aimed to evaluate the practical value of integrating an AI diagnostic model into clinical practice for caries detection using intraoral images.

METHODS

In this prospective study, 4,361 teeth from 191 consecutive patients visiting an endodontics clinic were examined using an intraoral camera. The AI model, combining MobileNet-v3 and U-net architectures, was used for caries detection. The diagnostic performance of the AI model was assessed using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy, with the clinical diagnosis by endodontic specialists as the reference standard.

RESULTS

The overall accuracy of the AI-assisted caries detection was 93.40%. The sensitivity and specificity were 81.31% (95% CI 78.22%-84.06%) and 95.65% (95% CI 94.94%-96.26%), respectively. The NPV and PPV were 96.49% (95% CI 95.84%-97.04%) and 77.68% (95% CI 74.49%-80.58%), respectively. The diagnostic accuracy varied depending on tooth position and caries type, with the highest accuracy in anterior teeth (96.04%) and the lowest sensitivity for interproximal caries in anterior teeth and buccal caries in premolars (approximately 10%).

CONCLUSION

The AI-assisted caries detection tool demonstrated potential for clinical application, with high overall accuracy and specificity. However, the sensitivity varied considerably depending on tooth position and caries type, suggesting the need for further improvement. Integration of multimodal data and development of more advanced AI models may enhance the performance of AI-assisted caries detection in clinical practice. My Perspective:Agree that AI assisted tools have potential for clinical application with precision and accuracy. Debatable:Sensitivity is only lowest in inter-proximal anterior and buccal of premolars which might be due to AI not programmed to distinguish between hypo calcifications and incipient caries. Nevertheless ,even with this amount of accuracy patient will be treated early, less painfully, less amount of anesthetics leading to decrease in missed dental appointments. Also, patients on Autism spectrum will benefit the most as early detection can reduce the appointment length resulting in less anxiety.

REFERENCES

Pub med publication on the topic:
Diagnostic accuracy of artificial intelligence-assisted caries detection: a clinical evaluation
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