Research Article

Artificial Intelligence–Assisted Early Detection of Dental Caries Using Intraoral Imaging: A Clinical Observational Study

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Abstract

Early detection of dental caries is essential for preventive care and improved patient outcomes. This study evaluates the effectiveness of artificial intelligence (AI)–assisted intraoral imaging in detecting early dental caries compared with conventional clinical examination. A total of 120 patients aged between 18 and 45 years participated in this observational study. Each patient underwent clinical examination followed by AI-assisted intraoral image analysis. The results showed that AI-assisted detection identified early carious lesions with 92% sensitivity compared to 78% with traditional visual examination.

Keywords: *Artificial Intelligence; Dental Caries; Intraoral Imaging; Early Diagnosis; Digital Dentistry; Preventive Dentistry; Oral Health Technology*

1. Introduction

Dental caries remains one of the most prevalent chronic oral diseases worldwide, affecting individuals across all age groups. Early detection plays a critical role in preventing disease progression and avoiding invasive treatments. Traditional diagnostic methods include visual inspection, tactile examination, and radiographs. However, these methods are sometimes limited in detecting early-stage lesions.

Artificial intelligence has emerged as a promising tool in healthcare diagnostics. AI-based imaging systems can analyze intraoral images and detect subtle changes that may not be visible to the human eye. This technology has the potential to improve diagnostic accuracy, efficiency, and patient outcomes.

The purpose of this study is to evaluate the effectiveness of AI-assisted intraoral imaging in detecting early dental caries and compare its diagnostic performance with conventional clinical examination.

Materials and Methods

Study Design

This was a clinical observational study conducted in a dental teaching hospital.

Study Population

A total of 120 patients aged 18–45 years participated in the study.

Inclusion Criteria

- Patients with suspected early dental caries
- Patients willing to participate

Exclusion Criteria Patients with advanced dental caries Patients with systemic diseases affecting oral health Procedure

Each patient underwent:

- Visual clinical examination
- Intraoral imaging using digital camera
- AI-assisted image analysis

Statistical Analysis

Diagnostic sensitivity and accuracy were calculated and compared between methods. 3. Results

Diagnostic Method	Sensitivity	Accuracy
Clinical Examination	78%	81%
AI-Assisted Detection	92%	94%

AI-assisted imaging showed significantly higher sensitivity and accuracy compared to conventional methods.

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4. Discussion

The findings of this study demonstrate that AI-assisted intraoral imaging significantly improves early caries detection. AI systems can analyze image patterns more precisely and identify early lesions that may be missed during clinical examination.

The use of AI technology can enhance preventive dentistry, reduce treatment costs, and improve patient outcomes. These findings are consistent with previous research highlighting the potential of AI in dental diagnostics.

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5. Clinical Images and Observations

Image 1: AI-detected early enamel lesion
Image 2: Intraoral camera image showing occlusal caries
Image 3: AI analysis highlighting affected tooth region

(Insert intraoral clinical images here as per journal template formatting)

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6. Conclusion

AI-assisted intraoral imaging is a reliable and effective diagnostic tool for early dental caries detection. It enhances diagnostic accuracy and supports preventive dental care. Integration of AI technology into routine dental practice can improve clinical outcomes and patient care.

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Page 2 of 2