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Routine Diagnosis of Dental Caries on RVG Images with Perplexity AI

Saladi. Sai Durga Likitha[1], Dr. M. Srinivasa Raju[2], Namburi Buelah Chelsia[3], Mennem Amechitha[4], Narra Smruthi[5], Maseeha Rabab[6]

[1]Post Graduate Student, Department of Oral Medicine and Radiology, St. Joseph Dental College, Duggirala, Eluru, Andhra Pradesh, India (Corresponding Author)

[2]Professor & HOD, Department of Oral Medicine and Radiology, St. Joseph Dental College, Duggirala, Eluru, Andhra Pradesh, India

[3]Postgraduate Student, Department of Oral Medicine and Radiology, St. Joseph Dental College, Duggirala, Eluru, Andhra Pradesh, India

[4]Intern, St. Joseph Dental College, Duggirala, Eluru, Andhra Pradesh, India

[5]Intern, St. Joseph Dental College, Duggirala, Eluru, Andhra Pradesh, India

[6]Intern, St. Joseph Dental College, Duggirala, Eluru, Andhra Pradesh, India

Corresponding Author: Saladi. Sai Durga Likitha

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KEYWORDS

Artificial Intelligence, Digital Dentistry, Manual Interpretation, Diagnostic Accuracy, Time Efficiency

ABSTRACT:

Background: Artificial intelligence (AI)–based digital interpretation tools are increasingly incorporated into dental practice to enhance efficiency and support clinical decision-making. While these systems provide rapid outputs, their diagnostic accuracy in comparison with conventional manual interpretation remains a subject of debate. AI-based digital interpretation helps in reducing the time required for image analysis and improves workflow efficiency in dental clinics. Manual interpretation allows detailed visual assessment and clinical correlation, which contributes to higher diagnostic accuracy. Digital interpretation provides rapid results, making it useful in busy clinical settings. Accuracy of digital tools may vary depending on image quality, software algorithms, and calibration. Manual interpretation remains the gold standard due to the examiner's experience and ability to detect subtle findings. AI tools may sometimes miss fine details or produce incorrect interpretations in complex cases. Digital interpretation can be helpful as a supporting tool for screening and preliminary diagnosis. Combining AI-based interpretation with clinician expertise may improve overall diagnostic performance. Proper training and validation of AI software are essential before routine clinical use. Further studies with larger sample sizes are required to improve the reliability of AI-based systems. Continuous updates and improvements in AI algorithms may enhance diagnostic accuracy in the future.

Aim: To compare manual interpretation with digital (AI-based) interpretation in dental diagnosis with respect to interpretation time and diagnostic accuracy.

Materials and Methods: A comparative analytical study was conducted using 100 dental samples. Each sample was evaluated using two approaches: manual interpretation performed by a trained dental examiner and digital interpretation using an AI-based tool (Perplexity AI). The time required for interpretation and diagnostic accuracy were recorded for both methods. Results were analyzed descriptively and comparatively.

Results: Manual interpretation demonstrated a diagnostic accuracy of 100%, with an average interpretation time of approximately 1 minute per sample. Digital interpretation significantly reduced interpretation time to approximately 0.5 seconds per sample; however, diagnostic accuracy was limited to 80%. Manual interpretation showed superior accuracy, whereas digital interpretation showed superior time efficiency.

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Conclusion: Although AI-based digital interpretation offers a substantial reduction in interpretation time, it demonstrates lower diagnostic accuracy compared to manual interpretation. Manual assessment remains the gold standard, particularly for the detection of dental caries. Digital AI tools should be considered adjunctive aids rather than replacements for clinician-based diagnosis.

Introduction

The rapid advancement of artificial intelligence (AI) has significantly influenced various domains of healthcare, including dentistry. AI-based digital tools are designed to analyze clinical data, radiographs, and images with the aim of supporting diagnosis, treatment planning, and decision-making. These technologies promise increased efficiency, consistency, and reduced clinician workload. In dentistry, accurate diagnosis is fundamental for successful treatment outcomes. Traditional manual interpretation relies heavily on the clinician's knowledge, experience, and visual assessment skills. Although manual interpretation is time-consuming, it is widely regarded as the most reliable method, particularly for conditions such as dental caries that require detailed clinical judgment. Digital interpretation systems, including AI-based platforms, offer rapid analysis and instant feedback. However, their diagnostic performance may vary depending on the complexity of the condition, quality of input data, and limitations of the underlying algorithms. Discrepancies between AI-generated results and clinical findings raise concerns regarding the sole reliance on these systems. Therefore, this study was undertaken to compare manual interpretation with digital (AI-based) interpretation using Perplexity AI, focusing on two key parameters: time efficiency and diagnostic accuracy. The findings aim to provide clarity on the practical role of AI tools in routine dental diagnostics. The present study was undertaken to compare manual interpretation with digital (AI-based) interpretation using Perplexity AI in dental diagnosis. The comparison was based on two clinically relevant parameters: time taken for interpretation and diagnostic accuracy. By assessing both efficiency and reliability, this study aims to clarify the role of AI as a supportive tool in routine dental practice.

Materials and Methods

Study Design

This study was designed as a comparative analytical study to evaluate and compare manual and digital interpretation methods in dental diagnosis.

Sample Size

A total of 100 dental samples were included in the study. The sample size was selected to provide adequate representation for comparative analysis.

Study Setting

The study was conducted in an academic dental setting using standardized diagnostic criteria

- **Manual interpretation:** Performed by a trained and experienced dental examiner following standard diagnostic guidelines.
- **Digital interpretation:** Conducted using an AI-based digital platform (Perplexity AI).

Parameters Evaluated

1. Time taken for interpretation
2. Diagnostic accuracy

Study Procedure

1. One hundred dental samples were selected based on predefined inclusion criteria.
2. Each sample was initially evaluated manually by the dental examiner. The time taken to reach a diagnostic conclusion was recorded using a stopwatch.
3. The same samples were subsequently analyzed using the digital AI-based system (Perplexity AI). The interpretation time was recorded automatically.
4. The diagnostic outcomes from both methods were compared with the reference standard.

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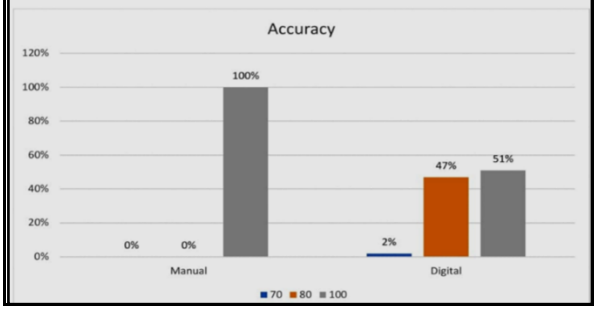
No Accuracy percentages and mean interpretation times were calculated and tabulated.

S.NO	OP.NO	RADIOGRAPH	MANUAL INTERPRETATION	PERPLEXITY AI INTERPRETATION
1	16745/25		Deep Dental caries irt 46 Localized periodontitis irt 46 47	It detects only bone loss irt 46 47
2	16951/25		Deep dentinal caries irt 27 Impacted tooth irt 28	Carious lesion involving tooth irt 27 Impacted tooth irt 28
3	18949/25		Deep dentinal caries irt 46 47 Horizantal impaction irt 48	Impacted tooth irt 48
4	19284/25		Deep dental caries involving pulp irt 17 Localized periodontitis irt 16 17	Boneloss irt 16 17
5	17361/25		Deep dental caries involving pulp irt 28	Impacted tooth irt 28

Statistical Methods

Figure 1 compares the accuracy of manual versus digital methods across three distinct criteria (implied as 70, 80, and 100 on the legend). The manual method achieved 100% accuracy for the final criteria (100), but 0% for the first two categories (70 and 80). Conversely, the digital method showed results across all categories (2%, 47%, and 51%), with the highest accuracy also being for the final criteria.

Figure 1: Comparison of accuracy between Manual and digital methods



Results

The manual interpretation method required an average of approximately 1 minute per sample. All 100 samples

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were correctly diagnosed, resulting in a diagnostic accuracy of 100%. In contrast, digital interpretation using Perplexity AI required an average of only 0.5 seconds per sample, demonstrating a marked reduction in interpretation time. However, only 80 out of the 100 samples were correctly diagnosed, resulting in an overall diagnostic accuracy of 80%. These results indicate that while digital interpretation significantly enhances time efficiency, manual interpretation remains superior in terms of diagnostic accuracy.

Discussion

The present study highlights the trade-off between time efficiency and diagnostic accuracy when comparing manual and AI-based digital interpretation in dentistry. The reduction in interpretation time observed with digital tools underscores their potential value in high-volume clinical settings. However, the reduced accuracy associated with digital interpretation raises concerns regarding its independent use. Manual interpretation achieved 100% accuracy, reinforcing its role as the gold standard in dental diagnosis. The lower accuracy of Perplexity AI may be attributed to limitations in recognizing subtle clinical features, particularly those associated with early dental caries. These findings align with existing literature suggesting that AI tools perform best as supportive systems rather than standalone diagnostic solutions. Human expertise remains essential for contextual judgment and nuanced interpretation. One of the key observations from this study is that speed alone cannot determine the usefulness of a diagnostic method. Although digital interpretation was extremely fast, accuracy remains the most critical factor in dental diagnosis, where incorrect findings may lead to improper treatment decisions. Manual interpretation allows the clinician to consider multiple factors simultaneously, such as tooth anatomy, surrounding tissues, and clinical context. Digital systems analyze data in isolation, which may limit their ability to interpret complex or unclear findings. AI-based tools function based on previously learned data patterns. If certain dental conditions are underrepresented or poorly defined in their training datasets, the system's performance may be compromised, leading to reduced accuracy. The study also indicates that digital interpretation may not be equally effective for all types of dental conditions. While it may perform adequately for simple or obvious findings, it shows limitations in identifying early-stage or subtle changes, especially dental caries. Another important aspect is the need for clinician supervision. AI tools can assist in saving time, but they cannot independently make final clinical decisions. Manual verification is essential to prevent diagnostic errors. In routine clinical practice, a combined approach may be more effective. Using digital interpretation for initial screening followed by manual confirmation could improve efficiency without compromising accuracy. The findings emphasize that AI should be viewed as a supportive technology rather than a replacement for human expertise. Clinical judgment, experience, and reasoning remain irreplaceable components of dental diagnosis.

Limitations

In this study, Perplexity AI was not effective in detecting dental caries accurately.

1. The AI system mainly identified impacted teeth and some periapical changes.
2. It failed to recognize early and subtle carious lesions.
3. This limitation reduced the overall diagnostic accuracy of the digital method.
4. Future studies should focus on improving AI algorithms for better dental caries detection.

Conclusion

Digital AI-based interpretation offers a significant advantage in terms of speed; however, it demonstrates reduced diagnostic accuracy compared with manual interpretation. Manual interpretation remains the most reliable approach, particularly for dental caries detection. AI-based tools should be utilized as adjuncts to, rather than replacements for, clinician-based diagnosis .Even though AI-based digital systems give results very quickly; they are not yet accurate enough to be used alone for clinical diagnosis. Manual interpretation by a dentist is still very important to ensure correct diagnosis and patient safety. AI tools must be carefully tested and verified before they are used regularly in dental practice. When used properly, AI-based interpretation can help reduce the workload of dentists by saving time. Improving AI systems with better data and training is necessary to increase their accuracy in the future.AI should work together with

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dentists, supporting their decisions rather than replacing them. This study confirms that human knowledge and clinical experience remain essential, especially for diagnosing conditions like dental caries and you can collect more images of oral lesions in bigger volume so that it can analyze and give proper results right now we need to give prompts to interpret the accurate diagnosis by AI

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