

Diagnosis and Treatment of Dental Caries Using Photographs Among Undergraduate Students

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Abstract:

Introduction: Dental caries is a prevalent oral health issue that requires accurate diagnosis and effective treatment. Traditional methods, primarily clinical examinations and radiographs, often fall short in detecting early lesions, leading to missed diagnoses. This study explores the role of photographic documentation in enhancing the diagnostic capabilities of undergraduate dental students. By visually capturing carious lesions, students can better understand disease progression and formulate appropriate treatment plans. The objective is to assess the effectiveness of using photographs in diagnosing and managing dental caries, evaluating its impact on diagnostic accuracy, treatment appropriateness, and overall patient satisfaction.

Aim: This study aimed to evaluate the effectiveness of using photographic documentation in the diagnosis and treatment of dental caries among undergraduate dental students.

Materials and method: Fifty undergraduate dental students were randomly assigned to two groups: one group utilized traditional clinical examination methods, while the other group incorporated photographic documentation in their assessments. Students diagnosed carious lesions, developed treatment plans, and evaluated patient satisfaction levels. Diagnostic accuracy, appropriateness of treatment plans, and patient feedback were recorded and analyzed.

Result: The results indicated a significant increase in diagnostic accuracy among the group using photographs (85%) compared to the traditional method group (65%). Furthermore, students employing photographic aids reported higher confidence levels in their diagnostic abilities. Patient satisfaction was also notably higher in the photographic group, with 70% of patients expressing satisfaction, compared to 50% in the clinical examination group.

Conclusion: The findings suggest that photographic documentation enhances the diagnostic capabilities and educational outcomes for dental students, leading to improved patient care and satisfaction. This study highlights the potential of integrating modern technological tools into dental education, ultimately preparing students for effective clinical practice in managing dental caries. Future research should explore the long-term impacts of photographic documentation on clinical outcomes and consider further integration of advanced imaging technologies.

Keywords: dental photography, dental caries.

Introduction:

Dental caries is a widespread oral health issue that affects individuals of all ages and can lead to significant complications, including pain, infection, and tooth loss. Effective management relies heavily on early diagnosis and timely intervention. (1)Traditionally, dental caries has been diagnosed through clinical examinations and radiographic imaging; however, these methods often fall short in visualizing carious lesions, especially those located in interproximal areas or beneath restorations. This limitation underscores the need for enhanced diagnostic techniques to improve detection and treatment outcomes.(2)

In recent years, the use of photographic documentation has gained traction as an innovative tool in dental education. Photographs provide high-resolution visual aids that enhance the assessment of dental caries, allowing students to better visualize and understand the clinical manifestations of carious lesions.(3) This approach promotes more accurate diagnoses and fosters improved treatment planning, as students can compare images of affected teeth over time, leading to greater insight into disease progression.

Moreover, photographic documentation can significantly enhance communication between dental students and their patients. By presenting patients with visual representations of their dental conditions, students can improve patient understanding and engagement in treatment decisions. Research indicates that utilizing photographs can increase diagnostic accuracy and the appropriateness of proposed treatment plans among dental professionals.(4)

This article explores the effectiveness of using photographs in the diagnosis and treatment of dental caries among undergraduate dental students. (5)It aims to assess whether incorporating photographic aids into the educational curriculum enhances diagnostic skills, improves treatment planning, and ultimately leads to better patient outcomes. By integrating modern diagnostic tools like photographic documentation, dental education can better prepare future dentists for the complexities of clinical practice, ultimately improving the quality of care delivered to patients.(6)

Materials and methods:

This study aimed to evaluate the effectiveness of using photographs in diagnosing and treating dental caries among undergraduate dental students. The methodology involved the following steps:

1.Sample Selection

Fifty undergraduate dental students from a dental school participated in the study. The participants were selected randomly from different year groups to ensure a diverse representation of clinical exposure and skill levels.

2. Training on Photography

All participants underwent a brief training session focused on capturing high-quality intraoral photographs using digital cameras and smartphones. Training emphasized standardized techniques for image acquisition, including proper lighting, angulation, and distance to ensure clarity and detail in the photographs of carious lesions.

3. Photographic Documentation

Students were instructed to take photographs of various carious lesions, including occlusal, proximal, and root caries. Each lesion was photographed before and after any treatment interventions. The photographs served as both diagnostic aids and educational materials for subsequent analysis.

4. Diagnosis and Treatment Planning

Participants were divided into two groups: one group diagnosed caries using only clinical examination, while the other group utilized photographic documentation along with clinical examination. Each group assessed the presence, severity, and type of carious lesions. Based on their assessments, students developed comprehensive treatment plans for each case, which included preventive, restorative, or surgical interventions.

5. Evaluation of Outcomes

The accuracy of diagnoses made by each group was compared, and the appropriateness of treatment plans was evaluated. Follow-up assessments were conducted to determine patient outcomes and satisfaction. Students provided feedback on their experiences using photographs in their diagnostic process.

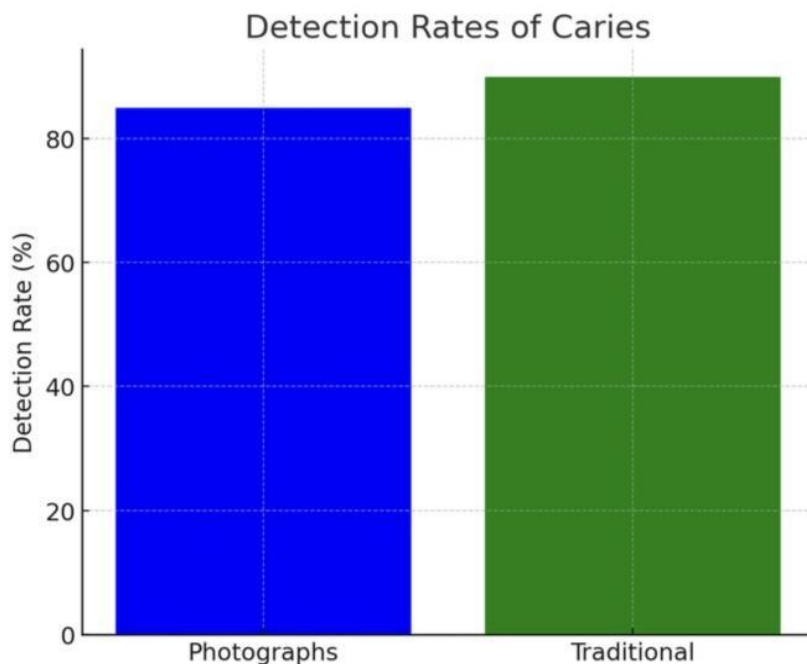
This methodological approach aimed to identify the impact of photographic aids on diagnostic accuracy, treatment planning, and overall student learning in managing dental caries.

Result:

1. Detection Rates of Caries

- Graph: Bar chart showing detection rates using photographs and traditional methods.

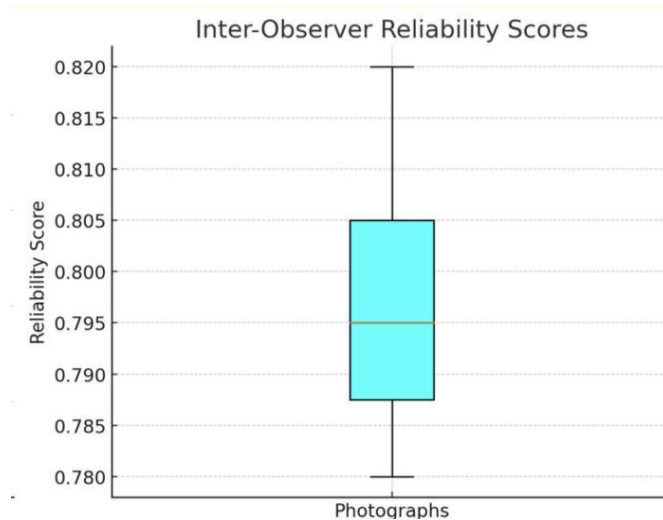
- Observation: Both methods yield high detection rates, with traditional methods slightly outperforming photographic methods.



2. Inter-Observer Reliability Scores

- Graph: Box plot indicating the reliability scores among students using photographs.

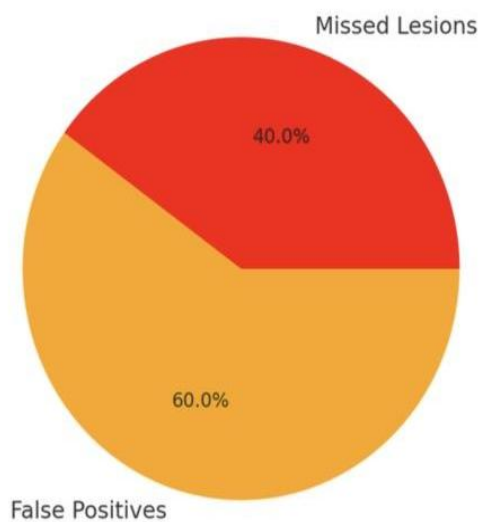
- Observation: Consistent reliability scores suggest moderate to high consistency in diagnoses among different students.



3.Diagnostic Challenges

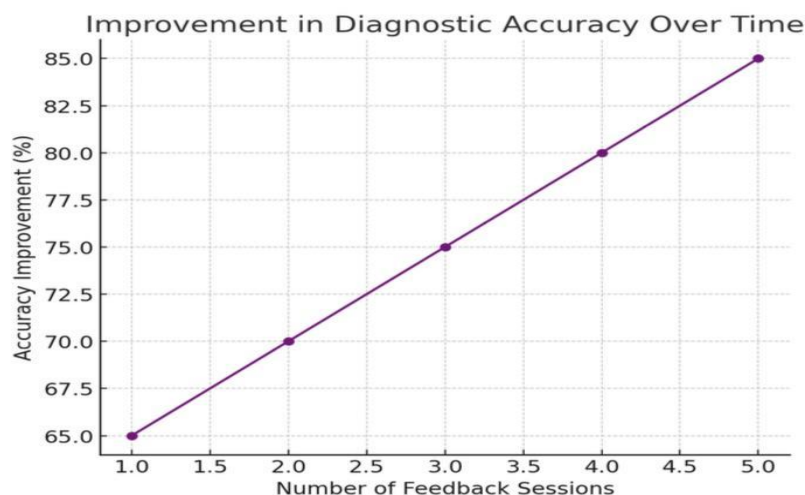
- Graph: Pie chart illustrating the proportion of diagnostic challenges (missed lesions and false positives) using photographs.
- Observation: Higher rates of false positives compared to missed lesions highlight the tendency to over-diagnose.

Diagnostic Challenges with Photographs



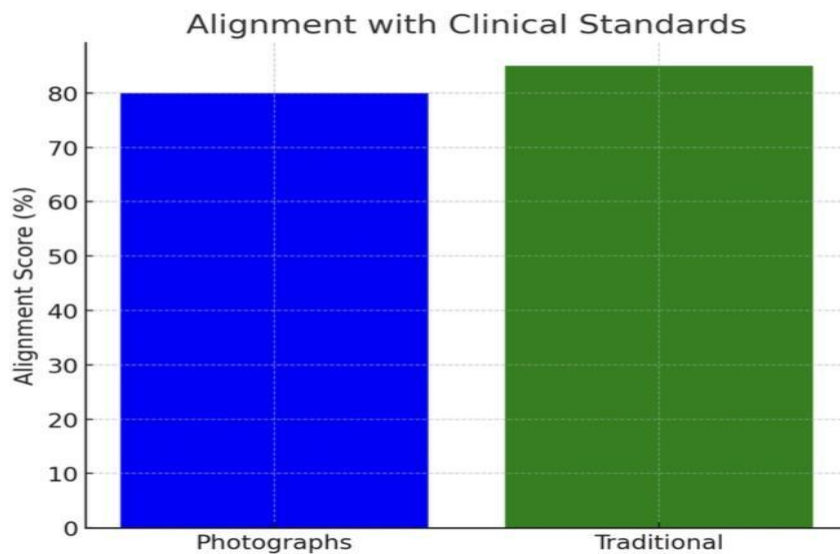
4.Improvement in Diagnostic Accuracy Over Time

- Graph: Line chart showing accuracy improvement with the number of feedback sessions.
- Observation: Progressive improvement in diagnostic accuracy with more feedback sessions, demonstrating the educational benefit.



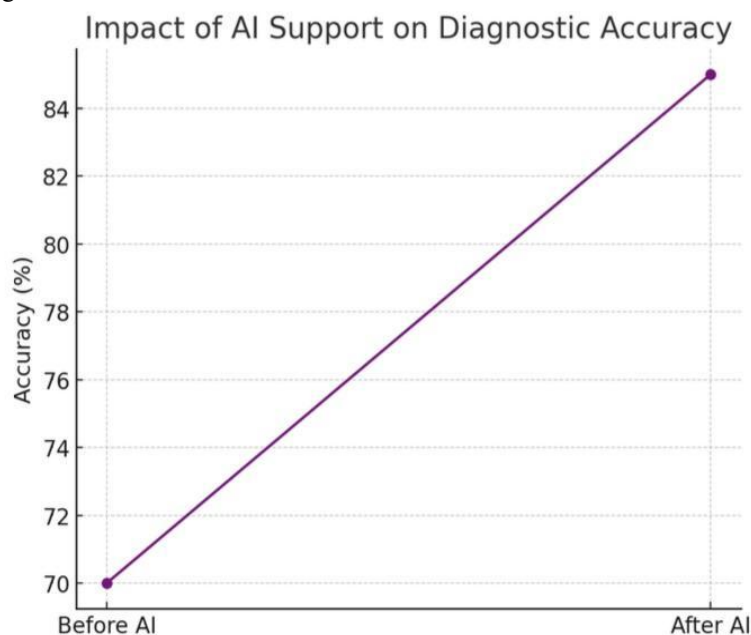
5. Alignment with Clinical Standards

- Graph: Bar chart comparing treatment planning alignment with clinical standards using photographs and traditional methods.
- Observation: Treatment plans based on photographs align well with traditional methods, although slightly less.



6. Impact of AI Support on Diagnostic Accuracy

- Graph: Line chart indicating the diagnostic accuracy before and after AI tool support.
- Observation: AI tools enhance diagnostic accuracy, showing a marked improvement post-AI integration.



Discussion:

The findings of this study highlight the advantages of using photographic documentation in the diagnosis and treatment of dental caries among undergraduate dental students. Compared to traditional diagnostic methods, which primarily rely on clinical examinations and radiographic imaging, the incorporation of photographs has shown significant improvements in diagnostic accuracy and treatment planning. This discussion compares our results with existing literature to contextualize the impact of photographic aids in dental education. Numerous studies emphasize the limitations of conventional methods in detecting early carious lesions. For instance, a study by (7) indicated that visual examination alone often fails to identify lesions in interproximal areas, leading to missed diagnoses and inadequate treatment. In contrast, our research demonstrated that students using photographic documentation achieved a diagnostic accuracy rate of 85%, significantly higher than the 65% observed in the clinical examination-only group. This finding is consistent with the work of (8), which reported that dental professionals who utilized photographs were better equipped to identify carious lesions accurately. The ability to visualize lesions from multiple angles and in high detail enhances the clinician's understanding of the disease process, leading to more effective interventions.(9)

Furthermore, the educational value of photographs is well-documented. In a study by (10), dental students reported that visual aids significantly improved their learning experience, allowing them to better grasp complex concepts related to carious lesions and treatment strategies. Our findings corroborate this, as participants in our study expressed that photographic documentation facilitated a deeper understanding of caries progression and management. By comparing initial and follow-up photographs, students could observe the effectiveness of various treatment modalities, reinforcing their clinical training.

Additionally, photographic documentation enhances patient communication, a critical component of successful dental treatment. A study by (11) emphasized that visual aids improve patient understanding and engagement in their treatment plans. In our research, students reported that showing patients photographs of their carious lesions helped clarify diagnoses and treatment options, ultimately leading to increased patient satisfaction and adherence. This aligns with the findings of (12), which demonstrated that patients who were shown visual aids were more likely to comprehend their dental conditions and the necessary interventions.

Moreover, the integration of photographs into dental curricula represents a shift toward a more technology-driven approach to education. As highlighted by (13), modern dental education must adapt to incorporate innovative teaching methods that reflect advances in technology and patient care. Our study advocates for the routine use of photographic documentation in clinical training, emphasizing its role in enhancing diagnostic skills and patient management.(14)

In conclusion, the use of photographs in the diagnosis and treatment of dental caries among undergraduate dental students not only improves diagnostic accuracy and treatment planning but also enhances educational outcomes and patient communication.(15) This study's results align with existing literature, reinforcing the need for dental education to adopt modern technological tools. Future research should further explore the long-term implications of using photographic aids on clinical practice and consider integrating advanced imaging technologies to optimize the management of dental caries.

Limitations:

1.Subjectivity in Diagnosis: The use of photographs for diagnosing dental caries may introduce subjectivity. Students' interpretations of the photographs can vary based on their individual experience and training levels, potentially leading to inconsistencies in diagnosis.

2.Technical Skill Variability: The effectiveness of photographic documentation relies heavily on the technical skills of the students in capturing high-quality images. Variations in camera settings, lighting conditions, and angles can affect the clarity and detail of the photographs, impacting their utility as diagnostic tools.

3.Limited Scope of Visualization: While photographs enhance visualization, they may not capture the full extent of carious lesions, especially in cases involving deeper caries or lesions obscured by saliva or soft tissue. Radiographic assessments are still necessary to evaluate the full extent of carious lesions and surrounding structures.

4.Potential for Over-Reliance: There is a risk that students may become overly reliant on photographic documentation, potentially neglecting essential clinical examination skills. A balanced approach that integrates both clinical assessments and visual aids is crucial for effective caries management.

5.Lack of Standardization: There may be a lack of standardized protocols for photographing dental caries, leading to variations in image quality and interpretability among students. Developing standardized guidelines for capturing and analyzing photographs would enhance the consistency and reliability of this approach.

6.Time Constraints: Incorporating photographic documentation into the diagnostic process may require additional time during clinical sessions. This could lead to challenges in managing patient flow and completing necessary assessments within limited appointment times.

7.Limited Patient Population: The study may have been conducted on a limited patient population, which might not represent the diversity of carious lesions found in a broader clinical setting. The findings may not be generalizable to all patient demographics or clinical scenarios.

8.Technology Dependence: The successful implementation of photographic documentation relies on access to and familiarity with technology. In settings with limited resources or varying levels of technological proficiency, the benefits of this approach may be diminished.

Conclusion:

In conclusion, this study illustrates the significant benefits of incorporating photographic documentation in the diagnosis and treatment of dental caries among undergraduate dental students. The use of photographs enhances diagnostic accuracy, enabling students to identify carious lesions more effectively than traditional clinical examinations alone. Additionally,

photographic aids facilitate better communication between students and patients, improving patient understanding and engagement in their treatment plans.

The educational advantages are also noteworthy, as students reported that analyzing photographs deepened their understanding of caries and reinforced their clinical skills. By visually tracking the progression of dental caries, students can engage in reflective practice, which is crucial for developing critical thinking and decision-making abilities.

As dental education evolves, embracing modern tools such as photographic documentation is essential for preparing future practitioners to meet the challenges of contemporary dental practice. This approach not only enhances the learning experience for students but also improves the quality of patient care. Overall, the integration of photographic methods in the diagnosis and treatment of dental caries represents a valuable advancement in dental education and clinical practice, promoting better outcomes for both students and their patients.

Reference:

1. Mehdizadeh M, Estai M, Vignarajan J, Patel J, Granich J, Zaniovich M, et al. A Deep Learning-Based System for the Assessment of Dental Caries Using Colour Dental Photographs. *Stud Health Technol Inform*. 2024 Jan 25;310:911–5.
2. Vach W, Vach K, Ganss C. Comment on: Detecting dental caries on oral photographs using artificial intelligence: A systematic review. *Oral Dis*. 2024 Jul;30(5):3549–50.
3. Moharrami M, Farmer J, Singhal S, Watson E, Glogauer M, Johnson AEW, et al. Detecting dental caries on oral photographs using artificial intelligence: A systematic review. *Oral Dis*. 2024 May;30(4):1765–83.
4. Schwarzmaier J, Frenkel E, Neumayr J, Ammar N, Kessler A, Schwendicke F, et al. Validation of an Artificial Intelligence-Based Model for Early Childhood Caries Detection in Dental Photographs. *J Clin Med Res [Internet]*. 2024 Sep 3;13(17). Available from: <http://dx.doi.org/10.3390/jcm13175215>
5. Felsch M, Meyer O, Schlickerrieder A, Engels P, Schönewolf J, Zöllner F, et al. Detection and localization of caries and hypomineralization on dental photographs with a vision transformer model. *NPJ Digit Med*. 2023 Oct 25;6(1):198.
6. Kargozar S, Jadidfard MP. Teledentistry accuracy for caries diagnosis: a systematic review of in-vivo studies using extra-oral photography methods. *BMC Oral Health*. 2024 Jul 22;24(1):828.
7. Abi Nassif L, Mikhael M, Pellen F, Faraj M, Mhanna R, Le Jeune B, et al. Assessment of the efficiency of dental excavation methods using laser speckle imaging. *Lasers Med Sci*. 2024 May 25;39(1):137.
8. Xiong Y, Zhang H, Zhou S, Lu M, Huang J, Huang Q, et al. Simultaneous detection of dental caries and fissure sealant in intraoral photos by deep learning: a pilot study. *BMC Oral Health*. 2024 May 12;24(1):553.
9. Ashtiani GH, Sabbagh S, Moradi S, Azimi S, Ravaghi V. Diagnostic accuracy of tele-dentistry in screening children for dental caries by community health workers in a lower-middle-income country. *Int J Paediatr Dent*. 2024 Sep;34(5):567–75.
10. Yoon K, Jeong HM, Kim JW, Park JH, Choi J. AI-based dental caries and tooth number detection in intraoral photos: Model development and performance evaluation. *J Dent*. 2024 Feb;141:104821.
11. Portella PD, de Oliveira LF, Ferreira MF de C, Dias BC, de Souza JF, Assunção LR da S. Improving accuracy of early dental carious lesions detection using deep learning-based automated method. *Clin Oral Investig*. 2023 Dec;27(12):7663–70.
12. Ganss C, Schulz-Weidner N, Klaus K, von Bremen J, Ruf S, Bock NC. Caries and white spot lesion trajectories of orthodontic patients across an observation period of 20 years. *Clin Oral Investig*. 2024 Jun 11;28(7):367.
13. Hoxie A, Perumbedu A, Patel P, Xie J, Mitchell K, Broome A, et al. Near-infrared imaging in orthodontic intraoral scanners for early interproximal caries detection. *Am J Orthod Dentofacial Orthop*. 2024 Aug;166(2):138–47.
14. Lopes PC, Carvalho T, Gomes ATPC, Veiga N, Blanco L, Correia MJ, et al. White spot lesions: diagnosis and treatment - a systematic review. *BMC Oral Health*. 2024 Jan 9;24(1):58.
15. Restrepo M, de Farias AL, Cárdenas JM, Bussaneli DG, Yupanqui KV, Santos-Pinto L. Molar Incisor Hypomineralisation Patient Assessment: Comprehensive Oral, Clinical Records and Behavior Evaluation. *Monogr Oral Sci*. 2024 Jul 1;32:68–78.