

Level of agreement among dental students and general dentists on the diagnosis of periodontitis using the new classification of periodontal diseases

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ABSTRACT

The new classification system of periodontal diseases, introduced in 2017, aims to provide more precise diagnostic criteria for identifying and classifying periodontitis. It defines periodontal disease based on staging, grading and extent, facilitating a more accurate approach for general dentists and periodontists. **Aim:** The aim of this study was to establish the inter-observer agreement and diagnostic accuracy among three groups with different levels of education and experience in dentistry in assigning stages, grades and extent of periodontitis using the 2017 AAP-EFP classification system. **Materials and Method:** The study involved 32 participants divided into three groups: Group 1-dental students (n=12), Group 2-dentists with up to 3 years' experience (n=10), and Group 3-general dentists with more than 4 years' clinical experience (n=10). Twelve periodontitis cases were evaluated by all participants, who classified each case by stage, grade and extent. The evaluations were compared with the gold standard provided by a panel of expert periodontists. Statistical analysis, including Fleiss' kappa and chi-square tests, was performed to assess agreement and diagnostic accuracy. **Results:** Significant differences were observed in stage classification, with students and recent graduates more likely to underestimate the severity of the disease, while experienced dentists tended to overestimate it. No significant differences were found in grade and extent classifications. Diagnostic accuracy was comparable across all groups, but students showed slightly higher agreement with the gold standard compared to other groups. **Conclusions:** The 2017 AAP-EFP classification system can be applied by both general dentists and dental students, but further clinical practice is needed to improve diagnostic accuracy. Misclassification tendencies, such as over- or underestimation of disease severity, highlight the need for additional training and familiarity with the system.

Keywords: periodontitis - diagnosis - sensitivity and specificity - dental students - dental education - reproducibility of results

Nivel de concordancia en el diagnóstico de periodontitis utilizando la nueva clasificación de las enfermedades periodontales entre estudiantes de odontología y odontólogos generales

RESUMEN

La nueva clasificación de las enfermedades periodontales, introducida en 2017, ofrece criterios diagnósticos más precisos para identificar y clasificar la periodontitis. Este sistema clasifica la enfermedad periodontal en función de un estadio, grado y extensión, permitiendo un abordaje diagnóstico más objetivo tanto para odontólogos generales como para periodoncistas. **Objetivo:** Establecer el grado de concordancia interobservador y la precisión diagnóstica en la asignación de estadios, grados y extensión de la periodontitis utilizando la clasificación AAP-EFP 2017, entre tres grupos con distintos niveles de formación y experiencia en odontología. **Materiales y Método:** Se reclutaron 32 participantes, distribuidos en tres grupos: Grupo 1-estudiantes de odontología (n=12), Grupo 2-odontólogos con hasta 3 años de experiencia clínica (n=10) y Grupo 3-odontólogos generales con más de 4 años de práctica clínica (n=10). Los participantes evaluaron 12 casos clínicos de periodontitis, asignando estadio, grado y extensión a cada uno. Estas evaluaciones fueron comparadas con el estándar de referencia establecidos por un panel de expertos en periodoncia. Se utilizó el coeficiente kappa de Fleiss y la prueba de chi-cuadrado para determinar la concordancia y precisión diagnóstica. **Resultados:** Se observaron diferencias estadísticamente significativas en la clasificación del estadio de la periodontitis, con una tendencia a la subestimación de la severidad de la enfermedad en los estudiantes y recién graduados, frente a una tendencia a la sobreestimación en los odontólogos con mayor experiencia clínica. No se encontraron diferencias significativas en la clasificación del grado y la extensión de la enfermedad entre los grupos. La precisión diagnóstica fue comparable entre todos los grupos, observándose una mayor concordancia del grupo de los estudiantes con el gold standard. **Conclusiones:** El sistema de clasificación de 2017 de la AAP-EFP puede ser utilizado tanto por odontólogos generales como por estudiantes, sin embargo se requiere mayor práctica clínica para mejorar la precisión diagnóstica. Las tendencias a clasificar erróneamente la severidad de la enfermedad, ya sea por sobreestimación o subestimación, subrayan la necesidad de entrenamiento adicional y familiarización con el sistema para mejorar los resultados clínicos y la planificación de los tratamientos.

Palabras clave: periodontitis - diagnóstico - sensibilidad y especificidad - estudiantes de odontología - educación en odontología - reproducibilidad de los resultados

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INTRODUCTION

At the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions¹, a new system for classifying periodontal diseases was established. This system defined a periodontitis case and introduced the assignment of stages, grades and extent to describe the severity, progression rate, treatment response and number of teeth involved in the diagnosis. This new classification system aims to provide a more precise diagnosis and is intended for implementation in clinical practice by both specialists and general practitioners. It is designed to be dynamic, enabling updates over time.

The need for a new classification was based on the deficiencies of the previous system (1999), which had imprecise criteria for determining the diagnosis, severity and complexities of periodontitis. The 1999 American Academy of Periodontology (AAP) Workshop established a classification system based on the scientific evidence available at the time, while the European Federation of Periodontology (EFP) did the same a year later².

The 2017 Workshop was a joint effort by the AAP and the EFP, with contributions from various working groups that analyzed the current evidence and reached a consensus in their publication^{3,4}.

A significant difference in this new system was the establishment of a clear definition of a periodontitis case, characterized by interproximal attachment loss in at least two non-adjacent teeth^{5,6}.

Stages determine the severity of the disease, treatment complexity and percentage of affected teeth, while the grade provides information on the biological characteristics of the disease, including its progression rate, risk of further progression, and potential treatment response.

Stage is determined based on a complete series of radiographs of both arches, a full periodontal chart, and a detailed patient history. Grade is defined according to clinical periodontal records (periodontal chart) and full radiographs of both arches, which may be adjusted based on the presence of modifying risk factors such as smoking and diabetes⁷. Extent is determined by the percentage of affected teeth.

The definition of stages, grades and extent in cases of periodontitis using the new classification system requires a learning curve, not only for general practitioners but also for specialists in periodontics. Diagnostic accuracy is evaluated by comparing the

stage, grade and extent assignments between the examiner groups and an expert panel (gold standard). Identifying the level of diagnostic accuracy among study participants will provide valuable information to improve the implementation of this system across all groups of practitioners⁸. The dissemination within the dental community of this tool for making precise diagnoses will lead to appropriate treatment planning and follow-up for patients with periodontal disease⁹. Several studies have assessed the reliability and accuracy of the 2017 AAP-EFP classification system for periodontitis across different professional backgrounds and levels of expertise. Ravidà et al. analyzed the degree of agreement among international periodontal experts, and found notable variability even within this highly trained group⁸. Oh et al. reported significant discrepancies in periodontitis classification among dental practitioners with varying educational backgrounds, suggesting that training plays a critical role in diagnostic consistency¹⁰. Abrahamian et al. evaluated both intra- and inter-examiner reliability in applying the new classification, emphasizing the challenges of standardizing diagnosis across clinicians¹¹. Similarly, Marini et al. compared the consistency and accuracy of staging and grading among periodontal specialists, general dentists and undergraduate students, revealing substantial differences between groups¹².

To date, no study in Argentina has analyzed the diagnostic accuracy of periodontitis among dentists using the new classification system. The ability to distinguish between less severe (Stage I and II) and more severe cases (Stage III and IV) is crucial for both general practitioners and undergraduate trainees.

The aim of this research was to establish the inter-observer agreement and diagnostic accuracy in assigning stages, grades and extent of periodontitis using the 2017 AAP-EFP classification system among three groups with different levels of education and experience in dentistry.

MATERIALS AND METHOD

Study Design

This is an observational study on inter-observer agreement. The main objective was to evaluate the diagnostic accuracy and agreement level among dental students, general dentists with up to

3 years' clinical experience, and general dentists with more than 4 years' experience in classifying cases of periodontitis using the 2017 Classification of Periodontal Diseases. The evaluations were compared to those made by a panel of periodontal experts as the gold standard. The study was conducted according to the Guidelines for Reporting Reliability and Agreement Studies¹³.

Population

The study included 32 examiners, divided into three groups:

- Group 1: dental students from 5th and 6th year at the Instituto Universitario Italiano de Rosario (IUNIR) (n= 12).
- Group 2: general dentists who recently graduated from IUNIR, with up to 3 years' clinical experience (n=10).
- Group 3: general dentists recruited from the teaching staff at IUNIR, with more than 4 years' clinical experience, without advanced training in periodontics (n=10).

All examiners signed informed consent prior to participation. Data collection was performed in April 2023.

Inclusion Criteria

Group 1: Undergraduate dental students in their final years of study.

Group 2: General dentists with up to 3 years' clinical experience.

Group 3: General dentists with more than 4 years' clinical experience.

Exclusion Criteria

Dentists with specialization or advanced postgraduate training in periodontics.

Elimination Criteria

Examiners who did not complete all the required evaluations.

Clinical Cases

Twelve representative cases of different stages and grades of periodontitis were selected from the patient database of the Periodontology Clinic at IUNIR. These cases were chosen by the Principal Investigator (FH) and a certified periodontics specialist. Cases of necrotizing periodontitis or

those with underlying systemic conditions were not included.

Each clinical case included the following information:

- a) Patient's age and gender.
- b) Relevant dental and medical history, including systemic diseases and risk factors such as diabetes (HbA1c values) and smoking.
- c) Intraoral photographs.
- d) Complete periodontal chart.
- e) Full series of radiographs.

Expert Panel (Gold Standard)

The expert panel consisted of the Principal Investigator (FH) and another specialist in periodontics, who evaluated the 12 clinical cases using the 2017 New Classification. The consensus diagnosis for stage, grade and extent of each case was considered the gold standard for comparison to the assessments made by the examiners.

Training Procedure

Prior to evaluating the cases, the examiners participated in a 3-hour training seminar on the 2017 New Classification of Periodontal Diseases. During the seminar, three clinical cases not included in the study were discussed, and relevant literature was provided. Examiners were able to clarify any questions regarding the classification before starting the formal evaluation of the 12 cases.

Case Evaluation

Each examiner was granted access to a virtual classroom created for the project, where they were presented with the complete documentation of the 12 clinical cases. The examiners classified each case in terms of stage, grade, and extent using a standardized questionnaire based on the study by Oh et al., which included questions about their training, prior knowledge of the classification system, and its use in clinical practice¹⁰.

Overall agreement was defined as the global diagnostic consistency between each examiner group and the gold standard across the three classification domains—stage, grade and extent—considered collectively. This composite measure reflects the extent to which participants' overall diagnostic assessments matched those of the expert panel, providing a summary index of diagnostic accuracy beyond individual category agreement.

Description of Periodontitis Case Characteristics

Twelve cases of periodontitis were evaluated, with patient ages ranging from 22 to 64 years (mean age: 42 years). Of the 12 cases, 4 were male patients and 8 were female. Five patients reported a family history of periodontal disease. Regarding smoking habits, 7 patients were non-smokers, 3 patients smoked fewer than 10 cigarettes per day, and 2 patients smoked more than 10 cigarettes per day. In terms of glycemic status, 10 patients were normoglycemic/non-diabetic, 1 patient was diabetic with HbA1c < 7%, and 1 patient was diabetic with HbA1c > 7%. One patient reported being a hepatitis C carrier, and 2 patients were HIV-positive.

Statistical Analysis

Inter-observer agreement was evaluated using Fleiss' kappa statistics to measure the consistency in the classification of stage, grade and extent among the three groups of examiners.

Diagnostic accuracy was determined by comparing the examiners' classifications with the gold standard diagnosis, calculating the weighted quadratic kappa for each pairwise comparison. Frequencies and percentages of overall agreement were also calculated. A sub-analysis was performed to investigate the effect of variables such as stage, grade and modifying factors (smoking, diabetes) on diagnostic accuracy¹⁴. Differences in diagnostic accuracy among examiner groups were evaluated using the chi-square test, with a significance level of 0.05. Statistical analysis was conducted using IBM SPSS Statistics version 25.

Ethical Considerations

This study was approved by the IUNIR Ethics and Bioethics Committee (CEB Res. 45/22). All participants signed informed consent before participating in the study. Patient confidentiality was safeguarded by removing all identifying information from the clinical cases presented to the examiners.

RESULTS

Stage Classification

Statistically significant differences between groups were observed in the stage assignment (p -value < 0.05), showing a general trend toward underestimation. Examiners tended to underestimate the stage of periodontitis more frequently than overestimate it (Fig. 1).

The Quadratic Weighted Kappa (QWK) values for stage classification showed moderate agreement across all examiner group comparisons: κ = 0.561 (Group 2 vs. Group 1), κ = 0.451 (Group 3 vs. Group 2), and κ = 0.376 (Group 3 vs. Group 1), with all p -values < 0.0001 (Table 1).

Grade Classification

In the assessment of grade, no statistically significant differences were observed between the groups in terms of frequency distributions (Fig. 2). However, dentists with more than four years' experience (Group 3) tended to underestimate the disease grade more often, although the difference was not statistically significant.

QWK values indicated fair to moderate agreement: κ = 0.387 (Group 3 vs. Group 2), κ = 0.338 (Group

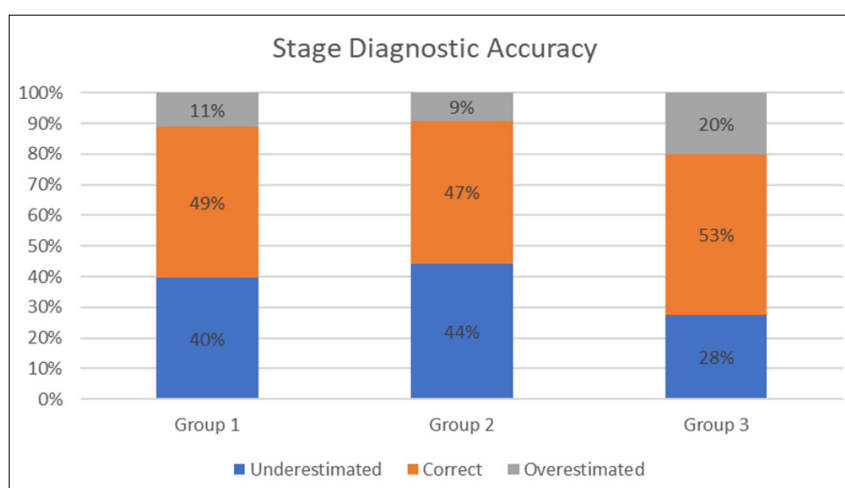


Fig. 1: Stage classification accuracy. Distribution of responses by group according to periodontitis stage classification (p < 0.05).

Table 1. Fleiss' kappa Statistics

Periodontitis	Index	Dentist vs. Student	Professor vs. Student	Professor vs. Dentist
Stage	Kappa	0.2857	-0.0693	0.0199
	p-value	0.0016	0.4475	0.826
Grade	Kappa	0.2688	0.0917	0.1657
	p-value	0.0019	0.2936	0.066
Extent	Kappa	0.4449	0.2953	0.25
	p-value	0.0001	0.0011	0.006
Overall	Kappa	0.3219	0.1268	0.1795
	p-value	0.0001	0.0152	0.0007

2 vs. Group 1), and $\kappa = 0.313$ (Group 3 vs. Group 1), all statistically significant ($p < 0.0001$).

Extent Classification

Regarding the classification of disease extent (localized vs. generalized), no significant differences were found among examiner groups ($p > 0.05$) (Fig. 3).

Agreement levels, as measured by QWK, showed moderate consistency across all group comparisons: $\kappa = 0.552$ (Group 2 vs. Group 1), $\kappa = 0.436$ (Group 3 vs. Group 1), and $\kappa = 0.415$ (Group 3 vs. Group 2), with all p-values < 0.0001 .

Diagnostic Accuracy

Comparison of the examiners' diagnostic accuracy to the gold standard (expert panel) showed no statistically significant differences overall (p-value = 0.4967). However, the highest agreement with the gold standard was observed in the student group

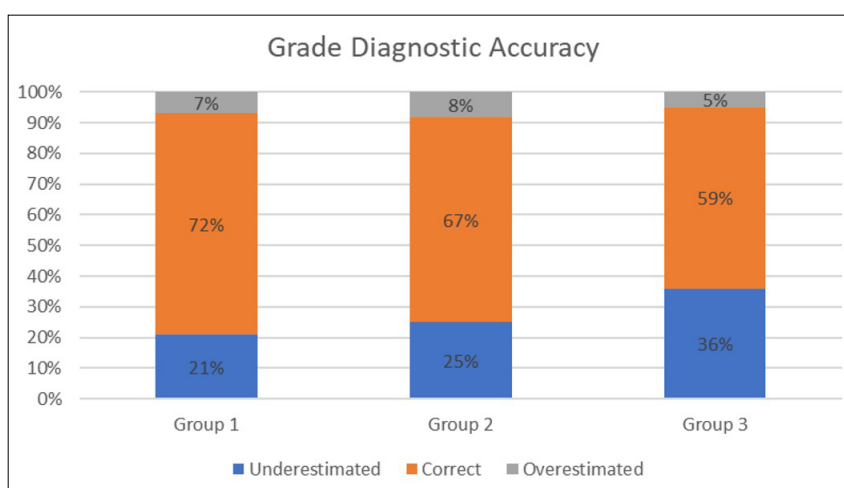


Fig. 2: Grade classification accuracy. Grade assignment by examiner group. No significant differences ($p > 0.05$).

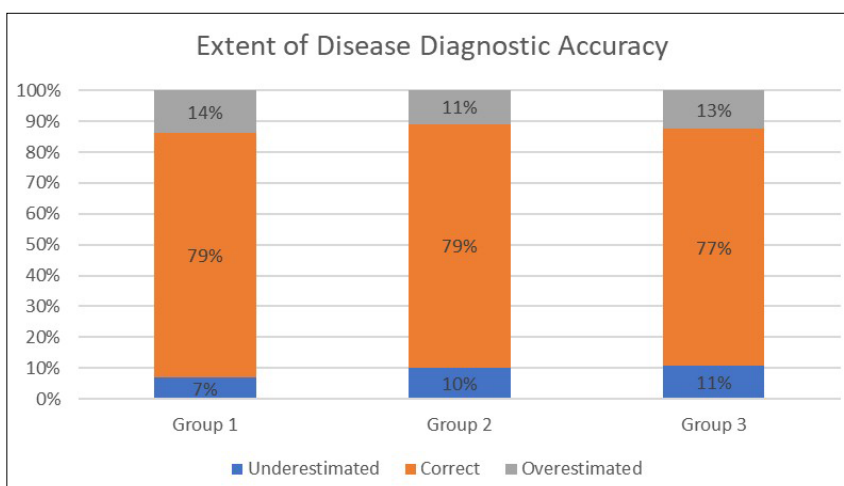


Fig. 3: Extent classification accuracy. Classification of disease extent among examiner groups ($p > 0.05$).

(Group 1), followed by the dentists with less than 3 years' experience (Group 2). The dentists with more than 4 years' experience (Group 3) had the lowest concordance percentage (Fig. 4). In the classification of stage, students and less experienced dentists exhibited a greater tendency toward underestimation, while more experienced dentists showed a tendency to overestimate. Regarding grade, accuracy was similar for students and recently graduated dentists, while experienced dentists more frequently underestimated disease severity. For the extent of disease, no significant differences were observed among the examiner groups.

The overall QWK values indicated moderate agreement between groups, with the highest agreement observed between Group 2 and Group 1 ($\kappa = 0.552$), and the lowest in the grading between Group 3 and Group 1 ($\kappa = 0.383$). All kappa values were statistically significant ($p < 0.0001$), reflecting systematic, though moderate, consistency in the application of the classification criteria across groups.

DISCUSSION

The new classification system for periodontal diseases was introduced by the AAP and EFP in the 2017 Workshop and published in 2018. Its aim is to improve the identification and diagnosis of periodontitis and gingivitis by providing clear clinical and radiographic parameters and identifying significant risk factors. It can be used by both periodontists and general dentists^{1, 7}.

This study was designed to analyze how dental

students and general dentists interpret and apply this new classification system. The examiners were divided into three groups: dental students, general dentists with up to three years' experience, and general dentists with more than four years' experience. Their assessments were compared against a gold standard established by an expert panel that diagnosed the clinical cases used in this study¹⁰.

The classification, which includes stage, grade and extent, enables more precise evaluation of the severity, progression and distribution of periodontal disease¹⁵. Although students had the advantage of recent training on the new classification, their diagnostic accuracy did not differ significantly from that of the other groups. Regarding stage evaluation, all groups agreed with the gold standard in approximately half the cases. However, students and newly graduated dentists tended to underestimate the stage, whereas dentists with greater clinical experience tended to overestimate it. This discrepancy may be due to a misinterpretation of clinical and radiographic parameters or a lack of familiarity with the new classification system. Marini et al. showed that overall, the consistency with the gold standard of general dentists was significantly lower than that of the other two groups¹². In another study, Ravidà et al. reported agreement between raters and the gold-standard panel in terms of staging (76.6%), grading (82%) and extent (84.8%)⁸.

Periodontitis grade, which determines its progression rate, was estimated better by students and recently graduated dentists. In contrast, dentists

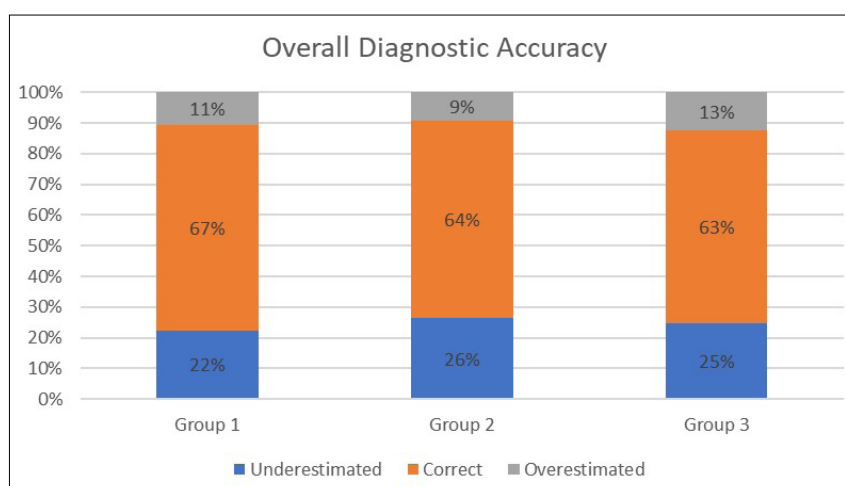


Fig. 4: Overall diagnostic agreement with the gold standard. Percentage of overall agreement by group across stage, grade and extent ($p = 0.4967$).

with more than four years' experience had a higher error rate in their estimations. This discrepancy may be attributed to incorrect interpretation of indirect evidence, such as the relationship between radiographic bone loss and patient age. It is also possible that more experienced dentists did not fully consider modifying factors such as diabetes or smoking when estimating disease grade^{16, 17}.

Winkler et al. concluded that smoking was a modifying factor in grade estimation¹⁷, which is consistent with the results of the current study. Oh et al. reported that the identification of risk factors for periodontal disease is also difficult, regardless of educational background, as indicated by the low level of accuracy and the lack of any significant difference in the recognition of risk factors¹⁰.

For periodontitis extent, all groups demonstrated similar levels of accuracy in classifying the disease as localized or generalized, making this the category with the least difficulty in interpretation.

The diagnosis of furcation lesions is crucial for determining periodontal disease staging. Our Exploring Furcation Involvement Diagnosis and Treatment Practices survey, published in 2023, identified a low percentage of furcation lesion detection among general dentists¹⁸. This finding is significant, as furcation involvement plays a key role in staging periodontitis within the new classification system, which is designed not only for specialists but also for general practitioners.

Finally, when analyzing the overall concordance between the groups and the gold standard across stage, grade and extent, no significant differences were observed. This suggests that, despite variations in interpretation, the overall diagnostic accuracy

is comparable between students and experienced dentists^{8, 11}.

Previous studies, such as Marini et al., have shown that concordance with the gold standard is higher among students and specialists than among general dentists¹². Similarly, Oh et al. reported that periodontists demonstrate superior diagnostic performance relative to general dentists¹⁰.

Study Limitations

The main limitation of this study is the relatively short time since the implementation of the new classification system, which may explain the lack of familiarity among some participants, particularly more experienced dentists. Additionally, the use of clinical photographs instead of in-person evaluations may have limited the examiners' ability to make more precise diagnoses.

Future studies should include larger sample sizes and incorporate periodontal specialists as a separate analysis group to obtain more conclusive results.

CONCLUSION

The findings of this study demonstrate that the 2017 AAP-EFP classification system for periodontitis can be applied with moderate consistency by dental students and general dentists with varying levels of clinical experience.

Although this study found an acceptable level of diagnostic accuracy, continued clinical practice and familiarity with the system will likely improve its interpretation and application. Incorporating structured educational interventions and case-based exercises may help reduce variability and improve diagnostic precision in clinical practice.

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CONFLICT OF INTERESTS

The authors declare no conflicts of interest with respect to the research, authorship and/or publication of this article.

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