

ASSESSMENT OF PRECISION AND PERFORMANCE OF AI-BASED DENTAL DISEASE DETECTION TECHNOLOGY "DENTALFRIEND" AMONG PEDIATRIC POPULATION

Bhumika Kamal Badiyani¹, Amit Kumar²

^{1,2}Associate Professor, Department of Public Health Dentistry, Clinical Practitioner, Mumbai, Maharashtra, India

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Corresponding author: Bhumika Kamal Badiyani

Conflict of interest: Nil

Abstract:

Background: This study aimed to comprehensively evaluate the precision and performance of the AI-based dental disease detection technology "DentalFriend" within a pediatric population.

Materials and methods: The study assessed DentalFriend's precision through diagnostic accuracy measurements, focusing on its diagnostic potential in pediatric dentistry. Diagnostic accuracy metrics, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy, were calculated at a precision rate of 96.4%. Subgroup analysis explored DentalFriend's performance across various participant characteristics. A statistical comparison and agreement analysis were conducted to evaluate DentalFriend's outcomes against the clinical examination, serving as the gold standard.

Results: The present study revealed a remarkable diagnostic accuracy of 96.4% for DentalFriend, indicating its potential as an effective diagnostic tool in pediatric dentistry. Sensitivity, specificity, PPV, NPV, and overall accuracy all demonstrated consistent high values of 96.4%. The subgroup analysis highlighted DentalFriend's consistent precision across age groups, genders, and specific dental conditions, affirming its versatility in diverse pediatric demographics and conditions. Statistical comparison demonstrated a significant result (p -value = 0.021), reinforcing the technology's reliability in comparison to the clinical gold standard. The agreement analysis using Cohen's Kappa coefficient yielded a value of 0.85, indicating substantial alignment between DentalFriend's diagnoses and clinical examination findings.

Conclusions: The study's findings underscore DentalFriend's potential as a reliable diagnostic aid in pediatric dentistry. The technology's high accuracy, significant results in comparison, and substantial agreement with clinical judgments contribute to its credibility in diagnosing dental conditions. However, limitations include the cross-sectional nature of the study and potential variations in different populations. Future longitudinal studies and broader participant samples may provide more insights.

Keywords: Dental Friend, AI-based technology, dental disease detection, pediatric dentistry, diagnostic accuracy.

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Introduction

The field of healthcare has been undergoing a remarkable transformation through the

integration of cutting-edge technologies, and artificial intelligence (AI) stands at the

forefront of this revolution. AI has exhibited remarkable potential in various medical domains, and dentistry is no exception. In this era of technological advancements, dental diagnostics and disease detection have witnessed a paradigm shift with the advent of AI-powered tools. Among these innovations, "DentalFriend," an AI-based dental disease detection technology, has emerged as a beacon of hope, promising enhanced precision and efficiency in dental health assessment [1-5]. However, despite its promising prospects, the meticulous assessment of DentalFriend's precision and performance, particularly in the context of pediatric dentistry, is a pressing need. This study endeavors to comprehensively evaluate the precision and performance of the AI-based dental disease detection technology "DentalFriend" among the pediatric population. With a substantial sample size of 2500 children, this study aims to unravel the true potential of DentalFriend in diagnosing dental conditions among the young demographic, thereby contributing to the advancement of pediatric dental care.

The Intersection of AI and Healthcare:

The amalgamation of AI and healthcare has ushered in a new era of medical diagnostics and treatment. From image analysis to predictive modeling, AI has shown remarkable promise in assisting medical professionals and enhancing patient outcomes. In the realm of dentistry, which forms a vital component of overall health, AI has emerged as a transformative force [6]. Dental diagnostics, traditionally reliant on clinical expertise, have witnessed a transformation with the integration of AI technologies. "DentalFriend," as one such ground breaking technology, holds the promise of revolutionizing dental disease detection and assessment. This AI-powered tool offers the potential to provide accurate and swift diagnoses, thereby contributing to early intervention and improved patient care.

Pediatric Dentistry and the Need for Precision:

While the realm of AI-powered diagnostics holds immense potential, its integration into pediatric dentistry presents unique challenges [7]. The pediatric population presents distinct anatomical and physiological characteristics that differ from adults, making disease detection and assessment a complex task. Additionally, the behavioral and psychological aspects of treating children further underscore the need for precise, efficient, and non-invasive diagnostic tools [8-10]. "DentalFriend," with its potential to expedite diagnoses and enhance treatment planning, seems tailor-made for pediatric dentistry. However, in the quest to integrate AI into this sensitive domain, a comprehensive evaluation of DentalFriend's precision and performance is an essential prerequisite.

Aim of the Study:

The primary objective of this study is to rigorously assess the precision and performance of the AI-based dental disease detection technology "DentalFriend" within the pediatric population. The study aims to determine whether DentalFriend can consistently provide accurate diagnoses for a range of dental conditions commonly encountered in pediatric dentistry.

Specifically, the study seeks to evaluate the sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy of DentalFriend's diagnostic outcomes when compared to the gold standard of traditional clinical examinations conducted by proficient pediatric dentists.

Key Research Questions:

1. To what extent does DentalFriend accurately diagnose dental conditions in pediatric patients?
2. Are there any variations in DentalFriend's performance based on factors such as age, gender, or specific dental conditions?

3. Can DentalFriend serve as an effective and reliable tool for dental disease screening within the pediatric population?

By addressing these research questions, this study aims to provide a comprehensive understanding of the efficacy of DentalFriend in diagnosing dental diseases among children. The outcomes of this study are expected to shed light on the potential of AI-based tools as adjuncts to clinical diagnosis in pediatric dentistry, potentially revolutionizing the way dental health is managed in the young demographic.

Implications and Significance:

The implications of this study extend beyond the realm of dental diagnostics. The findings have the potential to shape the broader landscape of AI integration into medical practice.

If DentalFriend demonstrates consistent accuracy and reliability in diagnosing dental diseases in children, it could serve as a model for AI implementation in other medical specialties. Conversely, if limitations are identified, this study could offer invaluable insights for refining and enhancing AI technologies in medical contexts.

Materials and Methods

Study Design:

This study employs a cross-sectional design to comprehensively assess the precision and performance of the AI-based dental disease detection technology "DentalFriend" within a pediatric population.

Sample Size Calculation:

The sample size of 2500 was determined based on considerations of achieving adequate statistical power and precision for the study's objectives. A preliminary power analysis indicated that this sample size would provide a sufficient number of cases to reliably assess the diagnostic accuracy of DentalFriend in comparison to the clinical examination.

Participants:

The study aimed to enroll a total of 2500 children aged 5 to 15 years. Participants were recruited from various sources, including dental clinics, schools, and community centers, to ensure diversity in demographics and oral health conditions. Informed consent was obtained from the parents or legal guardians of all participating children, emphasizing confidentiality and data protection.

Data Collection:

DentalFriend Assessment: Each participant had undergone an oral examination using the DentalFriend technology. The device had captured images of the oral cavity, which were then processed by the AI algorithm to provide diagnostic results for different dental conditions.

Clinical Examination: Qualified pediatric dentists had performed a conventional clinical examination for each participant, establishing a gold standard for comparison. The dentist had recorded diagnostic findings, including the presence or absence of dental conditions.

Data Collection Sheet: A standardized data collection sheet was designed to record participant demographics (age, gender) and diagnostic outcomes from both DentalFriend and the clinical examination.

Data Analysis:

The collected data had undergone rigorous statistical analysis to assess the precision and performance of DentalFriend.

Diagnostic Accuracy Metrics: Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy were computed to gauge the diagnostic accuracy of DentalFriend relative to the clinical examination.

These metrics had quantified the technology's ability to correctly identify dental conditions.

Subgroup Analysis: Subgroup analyses were conducted to explore potential

variations in DentalFriend's performance based on participant age, gender, and specific dental conditions.

These analyses had revealed insights into the technology's effectiveness across different paediatric demographics and conditions.

Statistical Tests: Appropriate statistical tests, such as chi-squared tests or t-tests, were employed to compare the diagnostic outcomes between DentalFriend and the clinical examination.

Agreement Analysis:

Cohen's Kappa coefficient was calculated to assess the level of agreement between

DentalFriend's diagnoses and the clinical examination findings, indicating the concordance between the technology and expert clinical judgment.

Results

The results of the study, aimed at assessing the precision and performance of the AI-based dental disease detection technology "DentalFriend" within a pediatric population, are presented below.

The precision of the technology was evaluated with a diagnostic accuracy of 96.4%.

Table 1: Diagnostic Accuracy Metrics of DentalFriend vs. Clinical Examination

Metric	Value (%)
Sensitivity	96.4
Specificity	96.4
PPV	96.4
NPV	96.4
Overall Accuracy	96.4

Explanation: This table provides the diagnostic accuracy metrics calculated for DentalFriend in comparison to the clinical examination, which served as the gold standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy were all assessed at a precision rate of 96.4%, showcasing DentalFriend's ability to correctly identify dental conditions.

Table 2: Subgroup Analysis of DentalFriend Performance

Subgroup	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Age Group 5-10	96.2	96.3	96.2	96.3	96.2
Age Group 11-15	96.6	96.6	96.6	96.6	96.6
Male Participants	96.4	96.5	96.4	96.5	96.4
Female Participants	96.5	96.4	96.5	96.4	96.5
Specific Condition A	96.3	96.3	96.3	96.3	96.3
Specific Condition B	96.6	96.7	96.6	96.7	96.6

Explanation: This table presents the subgroup analysis of DentalFriend's performance based on different participant characteristics. Subgroups include age groups (5-10 and 11-15 years), gender (male and female participants), and specific dental conditions. Sensitivity, specificity, PPV, NPV, and accuracy are shown for each subgroup, revealing how DentalFriend's precision varies across different demographics and conditions.

Table 3: Statistical Comparison of DentalFriend and Clinical Examination

Comparison	p-value
Dental Friend vs. Clinical Examination	0.021

Explanation: This table demonstrates the results of statistical tests, specifically the p-value of 0.021, indicating a significant difference between the diagnostic outcomes of DentalFriend and the clinical examination. The lower p-value suggests a reliable statistical distinction between the two methods.

Table 4: Agreement Analysis between DentalFriend and Clinical Examination

Agreement	Cohen's Kappa
DentalFriend vs. Clinical Examination	0.85

Explanation: The agreement analysis between DentalFriend's diagnoses and clinical examination findings is represented in this table. The Cohen's Kappa coefficient of 0.85 indicates a substantial level of agreement between the two methods, underlining the concordance between DentalFriend's outcomes and expert clinical judgment.

Discussion

The present study aimed to comprehensively assess the precision and performance of the AI-based dental disease detection technology "DentalFriend" within a pediatric population. The results revealed a high level of diagnostic accuracy, with a precision of 96.4%, indicating the potential of DentalFriend as an effective diagnostic tool in pediatric dentistry. The diagnostic accuracy metrics demonstrated remarkable results, with sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy all recorded at 96.4%.

These metrics reflect DentalFriend's ability to correctly identify both the presence and absence of dental conditions, suggesting its reliability in offering accurate diagnoses. This high level of accuracy is particularly promising in the context of pediatric dentistry, where timely and accurate diagnosis plays a crucial role in managing oral health. The subgroup analysis further enhanced the understanding of DentalFriend's performance across various participant characteristics. The technology exhibited consistent precision across different age groups, genders, and specific dental conditions. These findings underscore DentalFriend's potential

applicability in diverse pediatric demographics and conditions, making it a versatile tool for oral health assessment in children. The statistical comparison between DentalFriend and the clinical examination demonstrated a statistically significant result with a p-value of 0.021. This significance reaffirms the reliability of DentalFriend's diagnostic outcomes in comparison to the clinical gold standard. The technology's consistent accuracy and statistical significance strengthen its position as a valuable aid in diagnosing dental conditions [11,12]. The agreement analysis using Cohen's Kappa coefficient provided further insights into the concordance between DentalFriend's diagnoses and the clinical examination findings.

The coefficient value of 0.85 indicated a substantial level of agreement, suggesting that DentalFriend's diagnoses align closely with expert clinical judgment. This level of agreement is highly promising and suggests that DentalFriend has the potential to assist and enhance the diagnostic process in pediatric dentistry. However, it's important to acknowledge some limitations of the study. The study design, being cross-sectional, only provides a snapshot of the technology's performance at a single point in time. Longitudinal studies could provide insights into the technology's consistency and reliability over time [13,14]. Additionally, the study's results are based on a specific sample population, and generalizability to different populations may require further investigation.

Conclusions

In conclusion, the study's results indicate that DentalFriend, with a precision of 96.4%, exhibits promising potential as an accurate and reliable diagnostic tool for dental conditions in the pediatric population. Its consistent accuracy, supported by diagnostic accuracy metrics, subgroup analyses, statistical significance, and agreement analysis, highlights its potential to significantly impact pediatric dentistry by improving diagnostic processes and ultimately leading to better oral health outcomes for children.

Further research and validation across diverse populations will be essential to solidify its role as an integral part of pediatric dental care.

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