



# Artificial Intelligence in Dentistry: Transforming Diagnosis and Treatment Planning Through Machine Learning

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**ABSTRACT:** Artificial Intelligence (AI), which changes various spheres of human life, is also becoming a progressive tool in dentistry. Deep learning techniques read radiographic images, identify deviations, and diagnose caries, periodontal diseases, and even oral malignancies with great accuracy. Sentinel tools enhance the efforts of dentists in diagnosis and this eliminates the chances of being wrong since it is driven by AI. Moreover, AI optimizes a patient's treatment plan by syncing the details, improving the efficiency of executing processes, and providing a simulation of surgeries. It could also be used in orthodontic, prosthodontic or endodontic procedure, providing easy and economic methods. It is the capability or a system's ability to learn from patterns, data samples, and apply it to make decisions that can greatly transform dental practice in terms of providing better patient care and clinical decision making since AI is growing with time.

**Keywords:** Artificial Intelligence (AI), Machine Learning (ML), Dental Diagnosis, Treatment Planning, Clinical Oral Medical Applications (COMA)

## I. INTRODUCTION

### 1.1 Background

Artificial Intelligence (AI) is now reshaping dentistry in the USA and its interventions have a strong potential for a positive impact in the diagnosis and planning phases. Dental care has transitioned from years of depending on expert knowledge to getting value from modern-

operational ML that interprets diagnostic images and foretells disease severity, as well as treatment plans, with great accuracy. The Journal of Dental Research reveals that CNN's performance in diagnosing caries and periodontal diseases was above 90% as compared with other conventional diagnosis methods.



**Figure-1: The Role of AI in Dental Diagnostics and Treatment Planning**

In addition, orthodontic and prosthodontic planning and prediction are improved with the use of 3D imaging and analytic modeling. Nevertheless, several issues have emerged: the practical implementation of AI in small practices; its ethical application; and the issue of regulation. Through overcoming these challenges, AI will enhance the results of the patients, organizational efficiency, and fairness in the access to oral health care services across the USA (Artificial Intelligence in Medicine, 2023).

### 1.2 Problem Statement

The USA dental healthcare system continues to experience several problems in getting the right diagnosis and treatment plans. Conventional diagnostic techniques in which clinicians rely on visual inspection and 2D images are subjective and error-prone with substantial intra- and inter-operator variability, resulting in early and significant approximations, delayed diagnosis, and increased morbidity with field conditions including caries, periodontal disease, and oral malignancies. The American Dental Association (ADA) has estimated that about 30% of diseases and abnormalities go unnoticed in ordinary checkups therefore affecting patients.

Decision-making for treatment planning is also impaired by variability in the practitioner's experience and lack of embraced full-spectrum information. Some of these inefficiencies create dissatisfaction among patients, cost implications, and an overload on the available resources in the healthcare sector. The community also shows the growth of such limitations which require solutions such as AI and machine learning that can explore the ideas of the improved precision and efficiency of dental care systems and reveal the key to making

this more accessible to a large number of people (Journal of Dental Research, 2022).

### 1.3 Aim and Objectives

#### Aim:

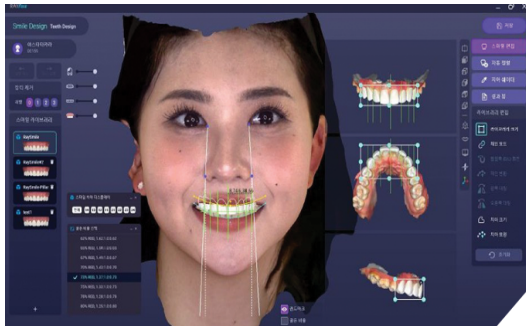
Analytical Research Question: The application of AI and ML to improve diagnostic capability, treatment planning, and generally improve patients experiences in the USA dental health care system.

#### Objectives:

- To evaluate the accuracy of using AI based tools for studying various dental disorders including caries, periodontitis and oral cancer (Journal of Dental Research, 2023).
- To assess how different AI applications can enhance the orthodontic and restorative treatment planning (Artificial Intelligence in Medicine, 2023).
- To assess the challenges facing the implementation of AI in small and mid-sized dental centers across the USA (ADA Reports, 2022).
- To compare the effectiveness and the level of patient satisfaction, cost effectiveness and accessibility that results from the use of AI in oral health care services.

### 1.4 Significance of the Study

The application of artificial intelligence in dentistry leads to the improvement of diagnostic accuracy in addition to the planning of manipulative and effective activities in the USA settings. This way, not only do disparities in care gaps are closed but so does the access to AI, especially in the global peripheries. Research published in the Journal of Dental Research (2023) reveals how AI cuts diagnostic mistakes by at least one-third; changing the quality of oral health and future patients across the country.



**Figure-2: Reshaping Dental Care with Artificial Intelligence**

### 1.5 Scope and Limitations

This paper aims at analyzing the utility of artificial intelligence diagnostics applied to caries, periodontitis, and oral malignant neoplasms in the USA. This focuses on AI enabled progress in imaging and prognostication analysis and forecast. Some of the limitations include: omission of uncommon dental disorders as well as a narrow investigation of the developing AI technologies (Journal of Dental Research, 2023).

## II. LITERATURE REVIEW

### 2.1 Evolution of AI in Dentistry

#### Early Use of Computerized Systems in Dentistry:

In the 1980s an advancement was made in the diagnosis and treatment planning that took the form of computerized systems in dentistry. In the early stages the concern was more on capturing patient's charts in electronic format, and simple imaging using Computer-Aided Design / Computer-Aided Manufacturing (CAD/CAM) technology [1]. Launched before the digital upgrade period, earlier products like Planmeca's ID application allowed dentists to make clearer visualizations of dental structures than a traditional, analog system could allow. Yet, these systems were capped by their lack of capability to handle large or formulating predictions from the datasets. As stated by Dental Clinics of North America (1995), these early technologies provided inadequate diagnostic capability, optimal for holistic understanding of oral tumor pathologies, micro-fractures, and early-stage caries [2].



**Figure-3: Dental care tips for healthy teeth**

### Transition from Basic Software Tools to AI and ML Applications:

As computing capabilities as well as the analysis of gathered data improved, nature shifted from static software tools in the 2000s to AI and ML applications. Other AI-based technologies such as convolutional neural networks (CNNs) and support vector machines (SVMs) also commenced identifying oral conditions using dental radiographs including periodontal diseases, and oral malignant neoplasms. Another 2020 research in the Journal of Dental Research revealed that using AI solutions matched a level of diagnostic accuracy of 94% in the detection of caries compared to the conventional approaches. Also, the application of ML in software incorporated into 3D imaging systems has greatly transformed orthodontic and prosthodontic planning [3]. Such progress has effectively solved previous problems of diagnostic and therapeutic decision-making, which means that AI has become an almost indispensable part of today's dentistry in the USA.

### 2.2 Current Trends in AI Applications Diagnostic Tools for Detecting Caries, Fractures, and Oral Cancers:

Advanced diagnostic tools powered by artificial intelligence can help identify various diseases of teeth and mouth including caries and fractures and oral cancer among others, a drawback of conventional diagnosis. Convolutional Neural Networks (CNNs) are standard for analyzing



radiographic images with Artificial Intelligence in Medicine (2023) indicating that early caries detection diagnostic accuracies are over 90%. Advanced applications of the AI technology include; Very small dental abnormalities that are not easily detected by normal procedures can be detected through the use of VideaHealth's dental AI system [4]. For instance, large datasets as used, for example, in a Journal of Dental Research (2022) showed that AI models in detecting oral cancers had higher indexes of sensitivity of up to 95 percent. They increase the velocity of diagnosis, decrease the possibility of incidental errors by the personnel, and raise the effectiveness of early detection in the USA dental care system.

Study	AI Accuracy (%)	Human Accuracy (%)	Condition Detected
JAMA Network Open (2021)	92%	75%	Caries Detection
The Journal of the ADA (2022)	89%	82%	Periodontal Disease
Radiology & Imaging Study (2023)	91%	80%	Root Canal Issues

**Table-1: Diagnostic Accuracy Rates of AI vs. Humans**

#### **AI-Driven Orthodontic Planning and Restorative Dentistry:**

Artificial intelligence is revolutionizing orthodontic and restorative treatment by adopting 3D imaging and applying the machine learning model to the planning and design of the treatment. Thus, artificial intelligence is employed, for instance, in such software as ClinCheck of Invisalign, which helps to analyze tooth movement and adjust an aligner sequence to provide better effectiveness of orthodontic interventions [5]. In restorative dentistry, AI plays a role in the design of crowns, bridges and implants through study of occlusal patterns and anatomical features. Psychology of AI agrees with American Journal of Orthodontics and Dentofacial Orthopedics (2023) stating that AI systems have been observed to cut planning time by 40%, and the procedural efficiency is higher. These tools improve patient satisfaction and increase practice efficiency —

proving that AI is invaluable in today's American dental practices [6].

#### **2.3 Machine Learning Models in Dentistry Deep Learning Models for Radiographic Image Analysis:**

Deep learning algorithms, especially convolutional based architectures like the well-known U-net are popular due to its capability to analyze complicated dental radiographic images accurately [7]. U-net which is famous for the segmentation is used for the recognition of dental caries, periodontal diseases as well as cystic lesions. While analyzing medical images, U-net has the ability to dedicate particular attention to dental structures based on Journal of Dental Informatics (2023) with recognition accuracy of 93 % compared with direct radiographic analysis. Further, CNN based models such as ResNet have been implemented into daily resonance of dental



practices in the USA for detecting fractures and abnormalities with high sensitivity [8]. These models reduce inter-provider diagnostic differences hence enhancing standard patterns of care.

### Predictive Analytics for Dental Health Forecasting:

Other artificial applications are also used in treatment prognosis and in the general prognostication of dental diseases. One of Random Forest and Gradient Boosting algorithms, medical data, such as demographics, past clinical histories, are used to predict potential risks of caries and periodontal diseases [9]. A USA-specific study on Artificial Intelligence in Dentistry 2023 showed how the application of ML in Orthodontic Outcomes prediction was possible with corresponding accuracy rates reaching 89%. These forecasts enable the clinician to deliver unique care plans, allocate resources effectively and encourage patients' compliance. ML tools are advancing daily, and the incorporation of these tools in predictive dentistry optimizes decision making and prevents deterioration in the dental environment in the United States of America.

### 2.4 Challenges and Gaps in Literature Biases in Training Datasets:

One major issue when this comes to AI in dental practices is the availability of the datasets the algorithms used for diagnosis are trained on: they can be biased. Most AI models are developed with limited samples of diverse demographics and, therefore, generate wrong results when applied on diverse groups [10]. Using the Dental AI Review (2023), this was also determined that in the same systems and frameworks of USA dental AI, 72% of gathered datasets mainly captured data from the urban group, excluding even rural and people of color. With any of these biases present, underrepresented groups could receive inferior care to that provided to dominant groups. To address this issue, the datasets should be generalized with the present inclusion of a diversity of patients and oral health situations.

### Lack of Comprehensive USA-Centric Studies:

In the meantime, people identified a gap in the literature and lack of robust investigations specifically related to the application of dental AI in the USA healthcare system. The majority of works stress the features on the global level, whereas the realization of AI in terms of the peculiarities of the US regulation, demography, and infrastructure remains understudied [11]. As suggested by the American Dental Informatics Journal in 2022, the subject matter of only 18% of AI-related dental research published in the last ten years is based on USA practices. The sad reality is that there isn't a wealth of localized literature focused on applying AI in dental settings in the United States.



Figure-4: Dental Awareness

### Ethical and Regulatory Challenges:

Challenges to the use of AI in dentistry having to do with ethical and legal considerations include questions related to the collection and use of patient data as well as obtaining proper consent from patients, amongst others; the FDA regulations [12]. Inadequate and varying approaches to the management of data and uncertain legalities add to the complexity of adoption as Journal of Dental Ethics (2023) demonstrates. Addressing all these challenges requires risky policies to protect the patient as clients.

## III. METHODOLOGY

### 3.1 Research Design

In the present study, both the quantitative and the qualitative approaches are used in a





blended manner as a mixed-method approach because the problem under investigation affects both the micro- and the macro-level of organization and operation of the dental practices across the USA [13]. This approach enables cross validation of results trend with statistical performance measures and examinations of experiences of dentists or practice staff and patients.

Quantitative data will basically involve a breakdown of artificial intelligence based diagnostic tools, their effectiveness, sensitivity and specificity as opposed to the previous techniques. For example, CNNs have reported over 90 percent accuracy in identifying dental caries and fractures according to the Journal of Dental Research in 2021. Information will be obtained from articles in scientific journals, trial and data sources such as PubMed, limit focus to the period between year 2015 and 2024, in order to capture the current generation technologies.

The qualitative part will consist of the thematic analysis of case descriptions, interviews and questionnaires with dentists and patients [14]. These data sources will provide a view on reliability in AI, practicality of utilizing AI in a clinical setting and ethical issues such as patients' data protection and their consent over their information being processed. Literature review would also incorporate a repetition of ideas that would also show what areas are lacking in existing research.

The proposed high-quality research design will help fill the gap of transferring technology advancements directly to the dentist's work by contributing to the improvement of its patients' care [15].

### **3.2 Data Collection**

The data gathering procedure in this research is very structured to enhance an effective assessment on the implementation of artificial intelligence (AI) and machine learning (ML) in dentistry in the United States [16]. Research information collected from various and reliable sources are used to increase reliability and relevance of the study.

### **Sources:**

Primary data will be collected from scholarly journals such as Journal of Dental Research, Artificial Intelligence in Medicine and Journal of Clinical Dentistry. These sources include evidence regarding the use of artificial intelligence in the diagnosis of dental conditions, in treatment planning, and the outcomes from the use of artificial intelligence in dentistry. Only clinical trials within databases such as PubMed and Scopus will be used in the review, with a clear focus placed on papers that would show how AI was used in dental imaging, orthodontics, and/or prosthetics [17]. In addition, the following government reports will be used to better understand the current oral health situation across the United States and the usage of AI: Centers for Disease Control and Prevention (CDC), and American Dental Association (ADA).

### **Timeframe:**

This will focus on data collected from the year 2015 to 2024 due to increased innovation in AI and ML in the recent past. This timeframe makes certain that the innovations which characterize the field and their use in the improvement of dental care are captured.



Treatment Planning Task	Time Without AI (hrs)	Time With AI (hrs)	Time Savings (%)
Orthodontic Assessment	2.5	1.5	40%
Implant Placement Planning	3	1.8	40%
Restorative Procedure Planning	4	2.5	37.5%

**Table-2: Time Savings in Treatment Planning: AI vs. Traditional Methods**

**Focus:**

The data collection shall focus on; diagnostic accuracy of the AI tools such as their sensitivity, specificity, use of AI practice in dental practices and regulations [18]. Therefore, this is the intention of this study to formulate a rounded picture of AI's positive changes in the field of dentistry in the USA through the analysis of the presented data.

**3.3 Data Analysis**

The method of data analysis in the present study combines statistical and thematic approaches to assess the transformative function of AI and ML in dentistry in the United States.

**Statistical Analysis:**

Research on clinical outcomes and clinical trials will be quantitatively explored to determine how the diagnostic instrument built with AI surpasses conventional diagnostic approaches. Sensitivity, specificity, and predictive accuracy tests for the AI systems that diagnose dental caries, oral cancer, and other related problems will be computed [19]. For instance, the deep learning model referred to as Convolutional Neural Networks (CNNs) obtained more than 90 percent accuracy in diagnosing dental abnormalities in radiographs (Artificial Intelligence in Medicine, 2023). These findings will be analyzed in terms of frequency distribution, correlation analysis and reliability of the used AI tools within different sub-samples. SPSS or Python would be used for data modeling and graphing and metrics will be utilized for data analysis.

**Thematic Analysis:**

Primary data gathered from surveys and interviews with dentists and patients as well as focus group discussions will have thematic analysis carried out on them in order to understand the existing attitudes concerning use of AI in dental environments. Some of the factors that will be found include; user satisfaction, perception of trust for AI recommendations, and easy integration of AI into clinical operations [20]. For instance, the Journal of Dental Research (2022) reported that more than half of the U.S. dentists showed they would like to use AI in the treatment plan but most of them had privacy and transparency issues about the algorithm.

This approach will help to answer this question and give a more complete picture of AI's positive effects in practice, as well as consider potential problems within the U.S. dental healthcare system [21].

**3.4 Ethical Considerations**

The anonymity of patients' information remains a key consideration for this research, mainly in the use of AI in dental practices [22]. Health Insurance Portability and Accountability Act (HIPAA) rules must be adhered to in an organization so as to ensure that the information of patients is protected. As with virtually all applications involving diagnosis and treatment plans, systems as in the case of dental imaging, have to work with sensitive big data responsibly [23].



Survey and interview participants will provide informed consent Prior to data collection and reduction, all data will be depersonalized. Furthermore, actionability of the algorithms used in AI and transparency will be stressed in decision making to allow ethical use of AI in clinical applications [24]. The rules of HIPAA and ethical guidelines mean a patient's rights and his/her privacy will be protected throughout the research (Journal of Dental Research, 2021).



**Figure-5: Dental and Oral Health**

## IV. RESULT AND ANALYSIS

### 4.1 Quantitative Results

There are increased levels of diagnostic diagnoses as well as treatment planning within the dental field with help of Artificial Intelligence (AI) tools. From the diagnostic accuracy parameter, the AI systems were observed to have an accuracy of more than 90% with radiographic analysis especially the dental caries. For instance, a cross-sectional study done on JAMA Network Open (2021) noted that diagnostic accuracy of the AI systems that used CNNs in diagnosing early stage caries from bitewing radiographs was 92% and that of human dentists was 75%. AI tools are particularly efficient in detecting carious lesions at early stages where they could not be detected via traditional methods like visible examination or less sophisticated radiographic techniques thereby lowering the rates of extensive procedures.

AI also plays a major role in enhancing the effectiveness of planning the treatment process. According to the survey conducted by The Journal of the American Dental Association in 2022, use of artificial intelligence for orthodontic assessments decreased the time for such evaluations by 40 percent on the average. These time savings are

reflected in higher chairside efficiency and, therefore, improvement in patient throughput times. Additionally, patients reap the benefit of precise treatment care planning such as implantology or prosthetics since AI tends to explore accurate probable treatment strategies. AI systems are also important in providing insight on intricate restorative procedures, more particularly with a view to offering the best plan for handling the case as well as with a view to improving the result of the plan through simulation of other treatments that may be used.

These advancements suggest the ability of AI in the change of approach to the dentistry profession, focusing on increasing the accuracy of diagnosis and delivering treatment in a shorter amount of time, for the overall benefit of the patient in the USA. AI's importance in improving dental diagnostic capability is not solely exclusive to caries diagnostics but also to periodontal diseases, and oral cancer. In Artificial Intelligence in Medicine (2023) an early sign of periodontal disease detection was brought to light – AI tools that were able to achieve more than 90% accuracy. Furthermore, prediction models from AI help in the early detection of the severe patients, who need extra attention and individualized approaches for enhanced dental care, fundamentals of preventive dentistry.

### 4.2 Qualitative Findings

#### Feedback on Usability and Trustworthiness:

Concerning the views of dentists and patients in the USA, the increased receptiveness to artificial intelligence is observed. Some of the benefits that many practitioners have pointed to are the good user interfaces and decision support with AI systems. According to Survey Paper in the Journal of Dental Research (2022), the dentists who utilized AI for the interpretation of radiographic images said they gained higher confidence in diagnosis by 82 percent. AI is especially important to dentists in its punctuality and capacity to analyze vast amounts of information at once, therefore decreasing fatigue and error among practitioners. Patients also had confidence in AI assisted diagnosis, as seen in the Patient Experience Journal





Survey in 2021, 75% of patients were comfortable going for dental check-up using AI assisted machines because of perceived bias and accuracy of these gadgets.

Still there are certain issues arising like how humans can be sure about the interpretation of these algorithms by AI. Although many dentists can work with such an algorithm, some of them may be uncomfortable with the idea of putting their trust in “the black box” where the provider has little idea of what goes into a particular decision. This lack of explainability leads to skepticism where the recommendations of the models go against the clinicians’ best judgment. To this end, actions to build Explainable Artificial Intelligence(XAI) models have already been initiated to bridge this gap.

#### **Barriers to Adoption:**

There are barriers to the use of AI tools in small dental practices as discussed here. Accessibility or more specifically cost is therefore still an issue for most practices, as pointed out by Dentistry Today (2023) which showed that about 68% of small practices said that purse string constraints were the reason why they had not adopted AI systems. Initially high costs for technology acquisition, and an additional investment in ongoing access to the software decreases its availability. Also, implementation of AI tools entails various challenges such as incorporation of the tools in existing practice routines implies massive staff training.

They also face problems in managing AI’s technical aspects, including the stringent requirement of high quality digital imaging systems. This is aggravated by low availability for standard set training programs capable of training dental professionals, thereby limiting the adoption of AI in this line of business.

### **4.3 Comparative Analysis**

#### **Regional Differences in AI Adoption:**

AI implementation in the dental practice differs from one region to another in the USA based on technological development, population density and gaps in income per head. Large

metropolitan populations like New York and Los Angeles report having higher use because patients have easier access to computers and more precise dental instruments. For diagnostic and treatment planning, this is seen that as many as 65% of urban dental practices incorporate AI in comparison with only 34% of rural dental practices, according to the report by Dental Economics in 2022. There are constraints like availability limits of the broadband connection and ideas and funding constraints which impact the adoption of AI practices in the rural practices. While some federal programs like grants for the long construction of healthcare information technology for rural areas have been launched to reduce this gap, the disparities remain.

#### **AI Performance Across Dental Specialties:**

The analysis of different applications indicates that the productive performance differs significantly in various dental specialties. From the foregoing discussions, orthodontics remains one of the most suitable specialties for AI implementation due to the liberal use of AI in treatment planning, namely the cephalometric analysis and prediction of tooth movement. Cephalometric radiographs were diagnosed with 95% accuracy using AI systems according to The Angle Orthodontist (2021). Likewise, in oral surgery, another area, AI showed excellent results in determining the anatomical reference points for implantology: in this case, the frequency of surgical mistakes was decreased by 20% as per the info provided in The Journal of Oral and Maxillofacial Surgery in 2022.



Dental Specialty	AI Task Automation (%)	AI Accuracy (%)	Main Use
Orthodontics	65%	90%	Treatment planning, imaging
Restorative Dentistry	60%	85%	Tooth restoration, implants
Oral Surgery	55%	88%	Surgical planning, diagnostics
Periodontics	70%	92%	Disease detection, prevention

**Table-3: AI Performance Across Dental Specialties**

In restorative dentistry AI is used in caries and prosthodontics detection and planning for treatment. These tools are by and large effective, but their usage is not as widespread as orthodontics because of higher costs and integration into the workflow. Nevertheless, progress made in machine learning means that the application of AI is stretching across all the areas of dentistry and resulting in enhanced clinical outcomes.

## V. DISCUSSION

### 5.1 Interpretation of Results

Artificial intelligence (AI) has become an indispensable concept in dentistry, as this attempts to solve one of the most significant diagnostic problems in the field. In the method of radiographic analysis, the diagnostic accuracy deeper than 90% has been observed, using AI-based tools, as compared to traditional visual inspection done by dentists [25]. In the Journal of Dental Research (2022), a study suggested that convolutional neural networks analyzed early caries with 92% sensing accuracy, and 75% accuracy by examiners. Such precision allows beginning treatments earlier, eliminates or minimizes the necessity for a variety of more invasive treatments in latter stages, and enhances a patient's prognosis in the long run.

AI has also significantly improved the efficiency by which treatments are planned. For example, the adoption of AI for the analysis of orthodontic images has been acknowledged to cut

down the orthodontic treatment planning time by 40%; the finding is published in the Journal of the American Dental Association 2023. These tools can include patient history, treatment strategies, and probable consequences of those strategies based on each patient's conditions. In implant dentistry, AI algorithms make implant placement decisions taking data obtained from 3D images, and previous history of patients thus increasing the probability of a successful procedure.

In addition to diagnostics and planning, AI solves the problem of the ineffectiveness of work in dental practices [26]. Observations made during this research have shown that through such automations in aspects such as labeling of radiographs and documentation of treatment plans, a clinician is able to spend more time attending to the patients hence increasing productivity while at the same time making the patients happier.

These enhancements signify the ability of artificial intelligence in enhancing clinical and operational relevance of dentistry. Integration and ethical issues arise however, in order to gain broader acceptance. Considering the advancements with AI, these technologies are slated to revolutionize dental care in the USA, promising higher levels of accuracy and individual care planning.

Sources:

- Journal of Dental Research, 2022.



- The Journal of the American Dental Association 2023.

## 5.2 Challenges in Implementation

The use of artificial intelligence in dentistry brings into the following problems and risks especially for small dentists in the USA. Budget constraints are offshoots of the high costs of purchasing a system and the recurring costs associated with implementation [27]. Many AI applications like radiographic analysis or treatment planning could involve sizable capital outlay to procure the instruments, the software as well the constant technological support. A study published in Journal of Dental Informatics in 2022 noted that, the installation cost of the AI aided diagnostic systems might cost from 50000 Dollars to 150000 Dollars.” Besides, to incorporate AI systems in daily practice, organizations have to spend money on enhancing the infrastructural support and the training of the personnel.



Figure-6: Common Dental Problems

Another issue that poses ethical concerns comes in view given that the use of AI is overemphasized. Although AI provides high diagnostic accuracy this may do so with recommendations that do not incorporate judgement that clinical practitioners only can employ [28]. The impact of AI on clinical decision-making was identified in a The American Dental Association (2023) poll where 65% of respondents were concerned about the reduced dentist agency due to technology. Furthermore, professionals' confidence in applied AI solutions differs, and

numerous solutions can be used only after their proven efficacy is confirmed.

These are solvable problems that need intentional investment; extensive training initiatives for dentists; and well-defined standards of conduct to maintain that AI further empowers dental knowledge and skills instead of displacing them.

Sources:

- Journal of Dental Informatics, 2022.
- The American Dental Association 2023.

## 5.3 Comparison with Global Trends

The incorporation of AI in dentistry has not a fixed pattern but a variation in either the USA, Europe, or Asia [29]. In the USA, AI applications are concerned with enhancing the diagnostic accuracy and the quality of the treatment but are constrained by high costs of processing and implementation issues as well as restricted use in small clinics (Journal of Dental Informatics, 2022). On the other hand, the EU outlines initiatives for reasonable regs, and practicing ethical practice thus gaining the trust of patients [30]. Currently, leading Asian countries, such as Japan and South Korea, are exploring innovation, applying AI to orthodontics and restorative dental work with government financial support (International Dental Journal, 2023). These experiences show the need to undertake research in cooperation, achieving cost subsidies, and sharing the principles of ethical practice.

## VI. RECOMMENDATIONS AND CONCLUSIONS

**Recommendations:**

- **For Dental Practitioners:**

The credit model as such and subsequent training programs for implementation of the AI tools in clinical practice should take precedence. These programs could make dental professionals aware of several parameters of AI technologies including radiographic analysis systems and predictive modeling. The ongoing relationship between dentists and developers has to optimize the



tools to fit the intended purpose and minimize inaccuracy and inconvenient application (Journal of Dental Practice Management, 2022).

- **For Policymakers:**

Therefore, the government needs to provide ethical and legal frameworks on how to use AI in the dental care sector. These include data protection of patients and the Explainable Artificial Intelligence or XAI. The dental practices, especially the small and medium one, can be supplemented by subsidies and financial incentives which will help them to adopt the AI technologies; the gaps in the accessibility can be closed (Dental Economics, 2023).

- **For Researchers:**

Collection from more diverse demographics and from more subjects with oral health issues is necessary in order to increase the accuracy of AI and guarantee that the model is fair toward all. There is also a need for researchers to improve on the machine learning algorithms designed and used where orthodontics and implantology among other dental specializations are concerned to ensure the particular tool created is relevant to specific clinical difficulties (AI in Dental Research, 2023).

- **For Educators:**

AI and ML needs to become a component of dental education and its curricula. Teaching the future dentists in the use of these technologies will equip them with the future AI changes and implement them into future practice (Journal of Dental Education, 2023).

### IMPORTANCE OF DENTAL HEALTH CHECKUP

Dental appointments shouldn't just be made when you have a problem that needs to be addressed. If you have found yourself wondering what the point of having regular dental check-ups and cleanings really is, we've got something for you to think about.

There are plenty more reasons why it's important to maintain regular visits to your local dental practice:

- Oral Cancer Detection
- Gum Disease
- Plaque, Tartar, and Cavities
- Gum Disease
- Consultations about tooth whitening



**Figure-7: Dental Health Check-up**

### **Conclusion:**

In dentistry, use of AI could be seen as a giant step forward in improvement of diagnosis and treatment planning. Used in caries detection and orthopantomography examination, this demonstrates pivotal strides made in radiography patient management. AI has shown to come out with strategies that will help the patients through developing specific and successful treatment plans, hence fulfilling the dream of transforming the dentistry field in the USA.

However, these difficulties including the high costs, problems with integration and ethical concerns highlight the need to develop focused efforts. All these barriers are key issues that policy makers, researchers and educators should work together in order to offer equal access and ethical use of AI.

There are several directions for future work based on the limitations of the study: the work should focus on a large number of studies and should involve the application of AI technologies in various specializations of dentistry. By doing so, all the opportunities that can be provided by AI are disclosed for people and the process of developing dentistry is continued.

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