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Artificial intelligence in oral medicine

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ABSTRACT

Artificial intelligence (AI) is a technology which is quickly advancing and has captivated the minds of researchers across the globe. The adoption of artificial intelligence (AI) in healthcare is developing while profoundly changing the face of healthcare delivery. There is a marked increase in the evolution of AI from the last decade, which has been showing tremendous improvement and dentistry is no exception. AI has its importance in dentistry, especially in oral medicine , which includes patient diagnosis, storage of patient data, and the assessment of radiographic information which will provide improved healthcare for patients. Regardless of many improvements and advances, AI is still in its teething stage, but its potential is boundless. This technology is tremendously utilized for easy and early diagnosis, proper treatment of lesions of oral cavity, advanced breakthroughs in image recognition techniques, of suspicious premalignant, and malignant changes of oral cavity with satisfying outcome. A thorough knowledge regarding the adaptation of technology will not only help in better and precise patient care but also reducing the work burden of the clinician.

Keywords: *Artificial intelligence, Oral medicine , Machine learning, Artificial neural network.*

1. INTRODUCTION

Artificial intelligence (AI) has witnessed remarkable advancements in recent years, transforming various healthcare sectors.[1] One area that has benefitted significantly from AI integration is oral medicine. AI techniques, including machine learning and deep learning algorithms, have revolutionized diagnosing and treating oral diseases, enhancing accuracy, efficiency, and patient outcomes. [1,2] This paper aims to explore the role of AI in oral medicine, highlighting its potential, challenges, and future directions. Artificial Intelligence (AI) has made significant advancements in various fields, and oral medicine is no exception.[2.3] The integration of AI technologies in oral medicine has brought about a paradigm shift, revolutionizing the way oral health is diagnosed, treated, and managed. From improving accuracy in diagnosis to enhancing patient care, AI is reshaping the landscape of oral medicine. [2]

The term AI is primarily associated with robotics, denoting the use of technology to create software that mimics human intelligence, undertaking specific tasks [3]. The inception of artificial intelligence dates back to 1956 with Dartmouth, marking a significant milestone in research, including neural networks and other computer theories [4]. Fig.1

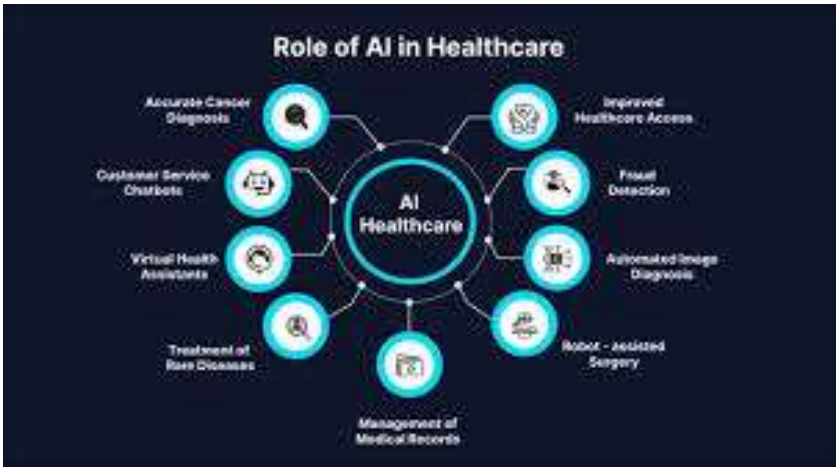


Fig.1. The role od AI in heathcare

However, AI faced initial challenges, such as high expectations and limitations like data accessibility. Today, AI broadly refers to any technology that can simulate human cognitive abilities [5].

Artificial intelligence is characterized by the ability of technology to exhibit a form of its own intelligence, with the goal of developing machines capable of learning from data to solve problems. Presently, several resources in AI include Machine Learning, Deep Learning, and Natural Language Processing [7-15]]. Machine learning employs algorithms to predict outcomes based on datasets, facilitating machine learning from data to solve problems without human intervention [8,10]. Neural networks, algorithms calculating signals through artificial neurons, seek to emulate the human brain [9,11,12].

In dentistry, AI can improve preventive approaches, enabling early diagnosis for better treatment outcomes. Integration of software with AI facilitates quick analysis, storage, and comparison of data [15-21]. The technology aims to minimize errors in dental treatments, streamline work processes, and support clinical decision-making, ultimately enhancing the role of dental surgeons [16-25]. The present narrative review article's goal is to explore various AI applications in oral medicine and different specialties, while also examining how AI approaches human expertise levels in diverse dental contexts.[20-25]

2. AI APPLICATIONS IN ORAL MEDICINE

The use of AI in medicine is a more recent phenomenon, and it has been developing very quickly; nowadays, it is the focus of interest of many scientists in the field of computer use and applications of robotics in medicine. The following references present the latest advancements and available achievements in the field.

Azarkhish et al. [26], investigating alternative options of determination of iron in serum, have shown that by way of analysis of other standard laboratory data, such as mean carpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular Hb concentration (MCHC), Hb/ red blood cell (RBC), using the system of artificial neural network (ANN) and adaptive neuro-fuzzy inference system (ANFIS), the level of iron in serum can be predicted with an acceptable degree of precision. This analysis illustrated how an AI system, based on peripheral laboratory results, drew conclusions and guided physicians regarding the possible presence of anemia as the consequence of iron deficiency. Qidwai et al. [27] have proposed a new strategy to be of use to neurologists, neurosurgeons, and orthopedic surgeons, aiming to predict the recovery and health status of a patient after surgery of the spinal column, based on the analysis of preoperative data by the Standard Fuzzy Inference System. The results suggested a high precision rate of predictions (of about 88%) in the population of 501 patients. The system was thus able to contribute to quality decision-making regarding whether to administer or not surgical treatment, especially for benign lesions, where surgery could be avoided. Tsuchihashi [28] has found the accuracy of 95% in automatized diagnosis of prostate cancer by an AI system and automatized marking of cancerous regions. Syed et al. [29] have proposed and evaluated a system of fully automatic nonparametric learning and drawing conclusions using the AI method, supported by support vector machines (SVMs) on large datasets, in order to calculate the probability of risk for perioperative patient complications, morbidity, and mortality. The system translated individual Current Procedural Terminology (CPT) codes into procedural risk values, and analyzed the robust risk model producing more reliable assumptions compared to the National Surgical Quality Improvement Program (NSQIP) – traditional, individual programme created by the American College of Surgeons (ACS).

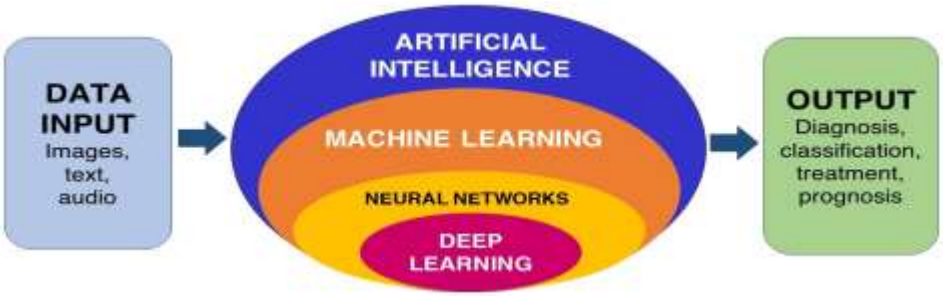


Fig.2. Artificial Intelligence in the Diagnosis of Oral Diseases

Uzuner et al. [30] have observed the relationships of medical complaints of patients in the context of semantic relation (SR) and cross-interference of diagnoses, tests, and therapies. These were classified according to the Unified Medical Language System (UMLS) and organized according to their meaning [31]. Each medical complaint in a patient was represented as a disease or a symptom, creating a unique SR relation for the classification and processing of medical records. In this way, a significant help in drawing inferences was provided to AI systems, and the consequences were new scientific insights and discoveries. Roberts et al. [32] have demonstrated that it is possible to extract meaning from medical texts in patient records and set meaningful relations in order to use the algorithms of machine learning (ML). Large datasets could thus be analyzed in order to identify patterns of interest. This study was performed on the Clinical E-Science Framework (CLEF) system for

storing, integration, and presentation of clinical information for research purposes. The study utilized clinical data from 20,000 patients of the Royal Marsden Hospital (Great Britain). Zolnoori et al. [33] have created an extensive classification of AI applications in asthmalike diseases. They looked into the use of AI in the techniques of diagnosis and work-up of patients with asthma, but also in the automated production of new knowledge and prediction of major events and exacerbations in such patients. Kim et al. [34], using an AI system based on the neural network model, have been able to predict toothache in 80% of the examined cases. Nieri et al. [35] using the Bayesian network analysis, have been able to successfuly identify several substrates with direct effect on the final outcome of treatment of impacted maxillary canines. Xie et al. [36] assisted by the ANN, have been able to use a decision-making expert system in order to identify the factors of prevailing influence in decision-making, evaluating the need for tooth extraction before orthodontic treatment of patients with malocclusion. They were able to reach a decision with the success rate of 80% whether a treatment with tooth extraction should be preferred to a treatment without it in a given situation.

Fig. 3. Evaluation of the Diagnostic and Prognostic Accuracy of Artificial Intelligence in

Kitporntheranunt and Wiriyasuttiwong [37] created a software medical expert system of assistance in diagnosing ectopic pregnancy. Using an interactive backward chaining inference algorithm, the system analyzed patient medical records and the available information, successfully detecting ectopic pregnancy in 31 out of 32 cases, while recognizing all cases of normal pregnancy. Tamaki et al. [38] formed a data mining tool to identify associations, anomalies, and statistically significant patterns in large datasets, using a system of AI. The system successfully identified a high level of Streptococcus mutans and Lactobacillus as the factors of high risk for caries development in school children. Sakai et al. [39] studied the possibility of prediction of acute inflammation of the appendix using a Bayesian model. Based on the data about conditions preceding the disease in patient medical records, the AI system created a model and evaluated probability of the disease in new cases. Käkilehto et al.[40], using the data mining AI technique, analyzed a large set of patient electronic dental records in order to obtain scientifically acceptable conclusions about the duration of dental restorations. The results showed that the life span of dental amalgams and composite fillings was over 15 years, while 60% of silicate dental cement restorations were replaced as early as 5 years after the initial placement, and more than 50% of glass ionomer cement restorations were replaced after 7 years. Korhonen et al. [41], using the data mining technique, have established that dentists more successfully detect caries in their new patients, compared to their old patients. The study was done using an AI system with the data obtained at general physical examinations. Kawaguchi et al. [42] used the data mining technique in order to find complex interactions between the risk factors and clinical evidence of non-hepatitis B virus/non-hepatitis C dependent hepatocellular carcinoma (NBNC-HCC). Since the disease is usually diagnosed in more advanced stages, in order to identify the risk factors, in a cohort of 663 patients with the diagnosis of NBNC-HCC, the Milan criterion was used and artificial analysis was done using the decision tree algorithm. Six factors were identified: date of diagnosis of hepatocellular carcinoma, the diagnosis of cirrhosis of the liver, values of serum aspartate transaminase, alanin aminotransferase, α-fetoprotein, and the level of des-γ-carboxy prothrombin. Miladinović et al. [4] demonstrated that the use of AI enabled successful collection, triage, sorting, numbering, and analysis of raw electronic data related to tooth extraction samples, and that the applied AI algorithms were able to execute nonparametric evaluation of impact of possible non-dental attributes, drawing scientifically acceptable conclusions. In this way, an AI system was able to “understand” and communicate the reasons for tooth extraction, i.e. to indicate the principal substrates that may have influence on such an outcome. Miladinović et al. [43] have also assessed possible use of medical data usage for research purposes and analysis using the AI methods. They suggested a design model of a huge medical data base of collected medical information which would make possible subsequent precise analysis using AI algorithms. In his PhD Thesis, Miladinović [44] presented an AI model of automatization of numerous scientific processes using an AI system,

suggesting that AI systems can be of significant diagnostic help in oral surgery, identification of potentially successful measures of disease prevention, and giving new insights into the diseases and health in oral surgery Stanley et al. [45] presented their model of automated search and ordering of clinically obtained diagnostic images (histograms, x-rays, etc.) with an image data base for known diseases. In this way, independent computer search is performed, someting similar to fingerprint identification, facilitating the job of a clinician in diagnosis and confirmation of a disease. Korhonen et al. [46] have created and tested a data mining system able to determine independently the life-long mean index of carious teeth, extracted teeth, and/or filled permanent teeth. They found the method feasible, but not suitable for persons below 20 years of age. De Bruijn et al. [47] investigated the applicability of ANN in their analysis of speech nasalization in patients treated for oral or oropharyngeal cancer in order to evaluate hypernasalization in their speech. After the speech sound samples were recorded from 51 patients, using 18 control sounds, they evaluated hypernasalization, articulation, intelligibility, etc. The

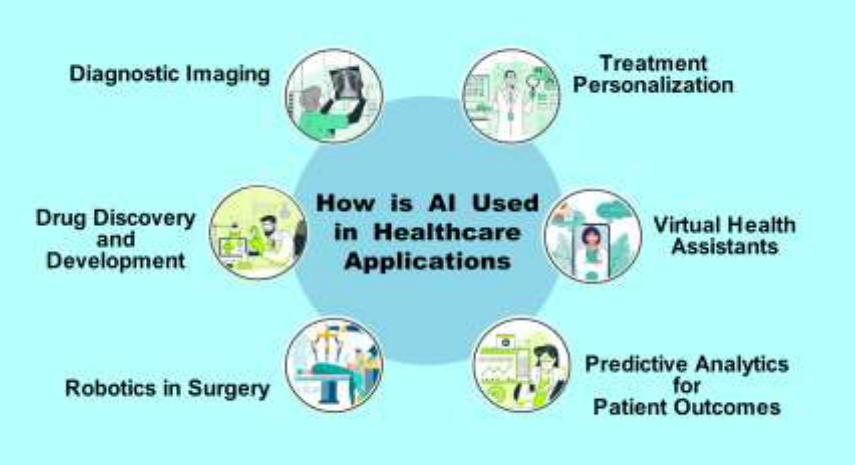


Fig.4. How.is.ai.used.in.healthcare.applications

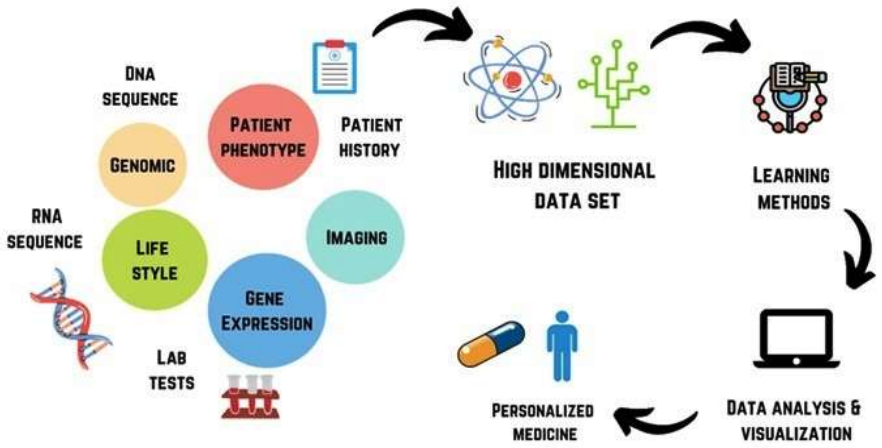
analysis of nasalization properties was done in the whole speech range, and based on their final results the study was considered feasible, while parameter prediction was graded as medium to poor. Bas et al. [48] have used ANN to predict two subgroups of internal disturbances of the temporomandibular joint and normal joint using characteristical clinical signs and symptoms of disease. Clinical symptoms and diagnoses of 161 patients with temporomandibular joint disorders were set as a gold standard and used for learning by the neural network. After the learning process, AI was presented for analysis with the results from 58 new patients for proper diagnosis to be made. The experiment was successfully finished in about 90% of cases, with the conclusion that ANN application in the diagnosis of subtypes of the disease can be a valuable diagnostic tool especially to dentists. Cilia et al. [49] obtained some promising results in the prediction of viral mutations. They used machine learning methods on the experience of existing viral resistencies developed against the present drugs. Wright et al.[50], using the Constrained Sequential Pattern Discovery using Equivalent Class (CSPADE) algorithm with 90% success rate, have made predictions as to which would be the next drug in the treatment of diabetic patients, based on the patterns observed for present drugs. Wu et al. [51], evaluating computer-aided diagnosis of early knee osteoarthritis from magnetic resonance imaging (MRI) findings, have concluded that AI methods alone were able to make the accurate diagnosis in 75% of cases.

3. ORAL DISEASE DETECTION AND DIAGNOSIS

AI algorithms, particularly machine learning and deep learning models have demonstrated remarkable capabilities in detecting and diagnosing various oral diseases. These models are trained using large datasets comprising clinical images, radiographs, and patient records. By analyzing these data, AI algorithms can accurately identify and classify oral pathologies, including dental caries, periodontal diseases, and oral cancers. The use of AI in oral disease detection enables early intervention, leading to improved patient outcomes and reduced treatment costs. **[52,53]**

-Treatment Planning and Predictive Modeling

AI techniques support treatment planning by analyzing patient data, including medical history, clinical features, and imaging results. Machine learning algorithms can generate personalized treatment plans, while predictive modelling helps clinicians forecast treatment outcomes and assess intervention effectiveness. This assists in optimizing treatment strategies and improving success rates. [54]



5. AI-in-Medicine

-Image Analysis and Radiographic Interpretation

AI algorithms excel in image analysis and radiographic interpretation, enhancing the efficiency and accuracy of oral medicine. By leveraging deep learning techniques, AI systems can automatically detect and analyze abnormalities in oral images and radiographs. They can identify dental caries, bone **loss,** and other pathological conditions, aiding in early detection and timely intervention. AIpowered image analysis tools reduce the workload for oral radiologists and enable faster diagnoses. [56]

-Artificial Intelligence in the Early Detection of Oral Cancer

Earlydetection of oral cancer is the key to successful treatment. In OMR, a routine should be established which is a full mouth examination to identify changes in the oral cavity that lead to early detection of oral lesions. There is research stating that professionals and students are not confident enough in their diagnoses. This led to an opportunity to develop an ancillary device for diagnostic purposes based on AI in identifying early changes in the oral mucosa. AI has the ability to detect changes that the untrained human eye cannot detect, thereby detecting early changes in the oral cavity. [56]

-Artificial Intelligence in the Detection of Dental Caries

Dental caries is considered as one of the most common dental diseases globally, and AI mainly DL and neural ML networks are increasingly utilized in this field. Many studies are conducted using clinical photographs and radiologic images to build AI algorithms which that as given superior results

-Artificial Intelligence in the Diagnosis of Temporomandibular Joint Disorders

Temporomandibular joint (TMJ) disorderis diagnosed by elicitinga medical history, clinical examination and radiographic evaluation. These TMJ disorders clinically show characteristic signs of limited movement of the lower jaw due to pain, crepitus, and local paraspinal tenderness in a joint promotion. These disorders can be confirmed when a radiographic examination shows a structural bone change.[18]

-Artificial Intelligence in the Diagnosis of Fractures

Fractures are one of the most common injuries seen in the oral and maxillofacial regions. The mandible is the most common site.These fractures occur as a result of an assault, vehicle accident, fall or fight among others. Radiologists mostly diagnose mandibular fractures using CBCT and panoramic radiography. Artificial intelligence and deep learning are progressing and expanding rapidly in this field, and have shown promising applications for the detection of fractures in recent years.[32]

-Artificial Intelligence in the Diagnosis of Cysts and Tumors.

Tumours and cysts of the jawbone are generally asymptomatic unless they become large enough to cause expansion leading to pathologic fracture and impinging nerve canals. Although in rare cases a malignant transformation of lesions for benign jaw has also been described. Surgery that is radical in last stage involves reconstruction, and free flaps, and ablation graft of bone, affects the lives drastically causes facial deformity, subsequent emotional and social incompetence. Early diagnosis is the only option to ensure healthy years of life.[26]

-Artificial Intelligence in Forensic Odontology

Forensic odontology involvesthe evaluation, examination, management and dental evidence presentation for civil and

criminal proceedings, all in favour of justice interest. This field has the ability to bring justice where dental remains are the only available evidence. Technology of Artificial intelligence has proven to become breakthrough for providing information that is reliable in in forensic sciences for decision-making.[36]

4. DISCUSSION

Fig.6. Top-10-Use-Cases-for-AI-in-Healthcare

Artificial Intelligence (AI) has the potential to revolutionize oral medicine by enhancing diagnostic accuracy, improving treatment outcomes, and streamlining clinical workflows. This discussion explores the applications of AI in oral medicine, its potential benefits, challenges, and the implications for dental professionals and patients. One of the key areas where AI can significantly impact oral medicine is in diagnosis. AI algorithms can analyze large datasets of patient records, images, and clinical data to identify patterns and markers that may be indicative of oral diseases, such as oral cancer, periodontal diseases, and caries. By utilizing machine learning techniques, AI systems can learn from these datasets and develop predictive models that aid in early detection and accurate diagnosis. This can potentially lead to improved patient outcomes and reduced healthcare costs.

Another area where AI can make a difference is in treatment planning and decision-making. AI algorithms can analyze patient data, including radiographic images, medical histories, and treatment records, to assist dentists in developing personalized treatment plans. AI can provide valuable insights and recommendations based on evidence-based guidelines and clinical expertise. This can help dentists make more informed decisions and improve treatment outcomes. AI can also contribute to the development of virtual models and simulations, enabling dentists to visualize treatment outcomes and predict the long-term effects of various interventions. This can aid in patient communication and facilitate shared decision-making, as patients can have a better understanding of the potential outcomes and implications of different treatment options.

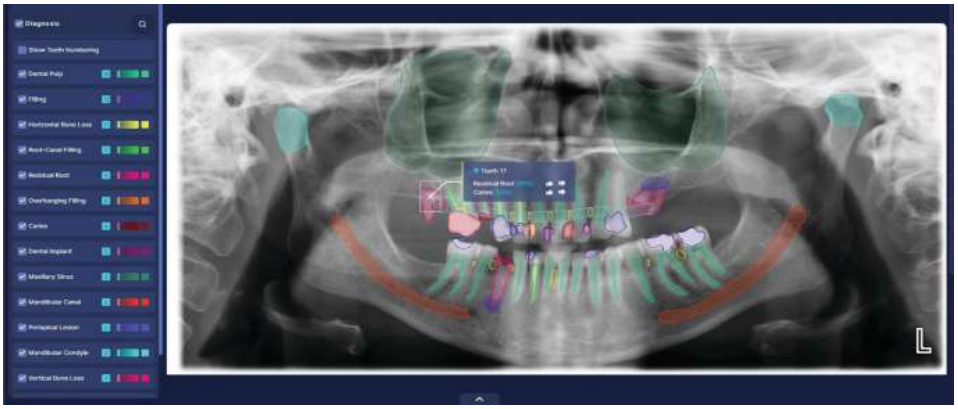


Fig.7. Applications of Artificial Intelligence in Dentistry

\While the integration of AI in oral medicine offers promising benefits, there are challenges that need to be addressed. Data security and privacy are paramount concerns when dealing with patient information and sensitive medical data. Robust data protection measures and compliance with privacy regulations are essential to ensure the confidentiality and integrity of patient information. Another challenge is the need for proper training and education for dental professionals. Dentists must be equipped with the necessary knowledge and skills to effectively utilize AI technologies in their practice. Continuous professional development programs should focus on familiarizing dentists with AI concepts, training them in using AI tools,

and fostering a culture of innovation and adaptability. Ethical considerations also arise with the use of AI in oral medicine. The decisions made by AI algorithms should be transparent, explainable, and accountable. Dentists must maintain their professional judgment and oversight when utilizing AI-driven solutions. It is crucial to strike a balance between the potential benefits of AI and the preservation of the dentist-patient relationship and human touch in oral healthcare.

The primary limitations to AI are insufficient data and inaccurate data. This means that clinicians today should focus on collecting the data now to be able to fully use it in thefuture. If we can do that, we can continue to provide greater care to our patients.

Fig. 8. Artificial intelligence (AI) in dental diagnostics - Diagnocat

\systems have been often regarded as black boxes, which do not provide any feedbackwhy and how they arrive at their predictions. In the last few years, there have been enormous developments in the field of explainable AI. Various methods have been developed to visualize, interpret and explain what AI systems are doing. Further, medical AI research needs standards. Dental researchers are called to action to participate in the development of such standards, for example, relating to;

1) concepts and terminology

2) data principles

3) sample size estimation

4) metrics

5) performance testing and methodology

6) risk management.[45]

In future, the cutting edge technologies will serve as a great assistant to the dentist by preserving their valuable time, giving them streamlined workflow and increasing their precision. AI has less bias and better judging probabilility, making it a great assistant to the dentist in analysis of the diseases, diagnosing them and providing an optimal treatment plan based on collected evidence. However a clinician still retains the responsibility of making the final decision.

The use of dental insurance for AI could be beneficial in future. Uploading radiographs and CT scans will give insurance companies more transparency and faster claim of insurance by the patient thus increasing patient benefits and reducing practitioner's loss [21].

Newer innovations would help clinicians master treatment plans. Nanotechnologies are expected to bring more wonders in the field of dentistry using robots and nanobots to provide an extra hand to dentists instead of replacing them. The catalytic antimicrobial robots (CARS) will enhance the oral hygiene maintenance. The trend of 3D printers are revolutionaries in the field of prosthetics and surgery by providing desired biocompatible parts in a very less period of time and making the procedure cost effective as well

Radiomics and imaging biobanks are the future of AI systems. The algorithms developed by these would help extract distinctive features from radiographic images of tumors by MRI and CT of the head and neck. Oncologists can, thus, use radiomics in anticipating the tumor activities and their response to the treatment.

Based on the findings and discussion presented in this research, the following recommendations are proposed for the

integration of Artificial Intelligence (AI) in oral medicine:

• Continuous Professional Development:

Dental professionals should engage in continuous education and training programs to stay updated with the latest advancements in AI technologies and their applications in oral medicine. This will enhance their knowledge and skills, enabling them to effectively leverage AI tools and algorithms in their practice.

• Collaboration and Interdisciplinary Research:

Collaboration between dental professionals, AI experts, and researchers from related fields is crucial for the successful integration of AI in oral medicine. Interdisciplinary research initiatives can promote the development of innovative AI solutions, address complex challenges, and ensure the integration aligns with the specific needs of oral healthcare.

• Ethical Guidelines and Standards:

The development and adoption of ethical guidelines and standards for AI in oral medicine are essential. These guidelines should address issues such as transparency, explainability, fairness, and accountability of AI algorithms. Dentists should adhere to these guidelines to maintain the ethical use of AI technologies and safeguard the dentist-patient relationship.

• Research and Development:

Continued investment in research and development is necessary to advance AI technologies in oral medicine. Funding agencies and institutions should prioritize research projects that explore novel AI applications, evaluate their effectiveness, and investigate the long-term impact on oral healthcare.

• Collaborative AI Platforms:

Collaboration among dental institutions, researchers, and AI technology developers can lead to the creation of collaborative AI platforms. These platforms can provide access to shared datasets, AI algorithms, and resources, fostering innovation and advancing AI integration in oral medicine. Dental professionals can benefit from these platforms by leveraging shared knowledge and experiences.

• Patient Education and Engagement:

Educating patients about the benefits and limitations of AI technologies in oral medicine is essential for building trust and ensuring informed decision-making. Dental professionals should engage in effective communication with patients, explaining how AI technologies can enhance their care, while emphasizing the continued importance of personalized, human-centric dental practices.

Applications of AI in everyday life are growing by leaps and bounds. Dentists have always been at the forefront of implementing technology. Hence, understanding the various concepts and the techniques involved will have a clear advantage in the future when it is time to adapt to the change with redefined roles for a rewarding practice.

The advantages and disadvantages of Artificial Intelligence are;

- Advantages of Artificial Intelligence;

a. Management ofAbundance Data:

Huge data is generated when the patient encounters each stepof a treatment cycle. Data like booking an appointment, patient medical and habit history, impression taking of patient's teeth, or taking the routine IOPA X-rays. And it is not just during the patient's treatment-cycle data can be generated outside the dental setup. Exemplifications include, marketing dentist practice, monitoring reviews of patients on social media sites etc. When there is a large complex of datasets available, there is always an occasionfor AI to carry out tasks. These data can be given to generate AI Algorithms in numerous formats example: natural text, tables, digital images/videos, and audio. AI can not only perform data analytics but can also carry out routine tasks and functions to help dentists reduce their overall workload.

b. Diagnostic accuracy:

Exploration in the field of AI in Radiology has found that duly trained AI models can clearly read an x-ray better and identify conditions that were frequently misread or missed through the human eye. The accuracy of AI in diagnosis can save time, and wealth and lead to better dental health among patients.

c. Time-saving tool:

With the use of AI technology, there are numerous administrative tasks in dentistry that can be sped up and made further cost-effective. Using AI technology will free up further time to concentrate on more important matters and ameliorate job performance as well. One primary use of AI is virtual consultations. This saves patients time when they come in as the clinician formerly knows what the next steps in their treatment will be.[44]

Disadvantages of Artificial Intelligence;

a.Distributional shift:

Due to a change in terrain or circumstances, there can be a mismatch in data which can lead to incorrect prognostications. As per example, patterns of disease can change leads to a discrepancy between the data set's testing and training. Insensitivity to impact: Still AI hasn't the capacity to take the positive or, false negative into the account.

Decision-making of Black box:

Prognostication isn't unlocked to interpretation or, examination with the use of AI. As per example, training data problem can produce X-ray analysis that is inaccurate and the system of AI unable to factor it.

c.Unsafe failure mode:

Diagnosis of cases can occurred through the models of AI, dissimilar to a doctor without having prognostication confidence, particularly during the work with data that is inadequate

d.Automation complacency:

AI tools may blindly trust by the clinicians assuming that every prognostications are collected and they fail to consider alternatives or, to cross check it.

e. Reinforcement of outmoded practice:

Acclimatization cannot perform by AI during the changes or, developments of enforced medical polices with the utilization of historical data in the trained system.

f. Self-fulfilling prediction:

In order to identify particular illness, an AI model is trained that is designed to get better outcome for identification.

g. Reward hacking:

Intended objectives related to the proxies are served as the rewards for AI and these models are able to find loopholes an hacks to receive rewards that are unearned, without fulfilling objective actually. **H.Unsafe exploration:**

A system of AI may start to learn new strategies for getting end result in a way that is unsafe The field of artificial intelligence is rapidly evolving to fill an ever-expanding niche in medicine. Most AI research is still in its nascent stage. Increased availability of patient data can accelerate research into artificial intelligence, machine learning, and neural networks. Today, there are few real-time AI applications integrated into the internal operational process of dental clinics. Research has shown that data-driven AI is reliable, transparent, and in certain cases, better than humans in diagnosis. AI can replicate human functions of reasoning, planning, and problem-solving. Its application can save time and storage, reduce manpower and eliminate human errors in diagnosis.

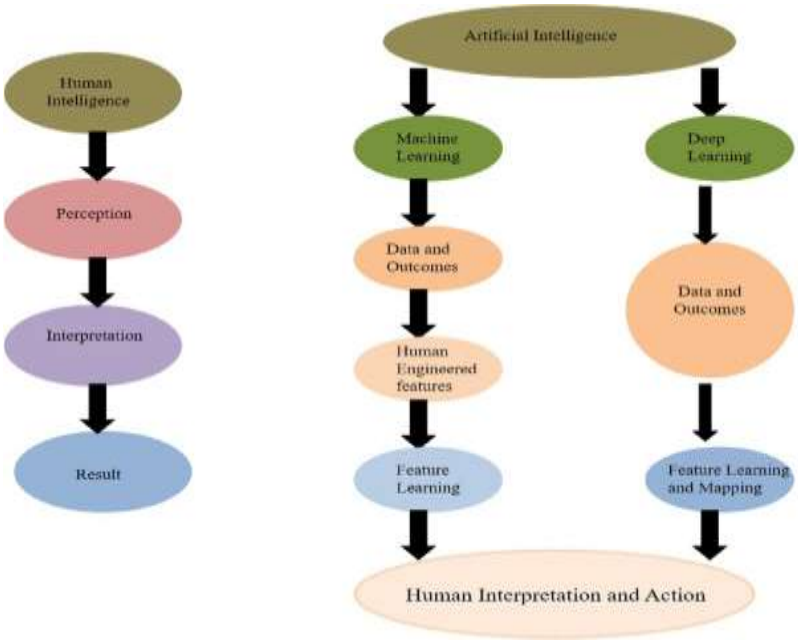


Fig.9. Present and future of artificial intelligence in dentistry

Integration of artificial intelligence eases the radiologist's job rather than taking it away. Oral and maxillofacial radiologists, as professionals who understand the basic principles and characteristics of radiographic imaging and have the ability to read radiographs and interpret them in terms of various diseases, continue to play an important role in artificial intelligencerelated research. If artificial intelligence becomes adept at screening for diseases in images, it could screen populations faster than radiologists and at a fraction of cost. The radiologist should ensure that images are of sufficient quality and that artificial intelligence is yielding neither too many false-positive nor too many false negative results.

In conclusion, the integration of AI in oral medicine has the potential to revolutionize the field by enhancing diagnostic accuracy, improving treatment planning, and streamlining clinical workflows. The findings of this research highlight the importance of continuous education and training for dental professionals to effectively harness the benefits of AI. It is essential for dentists to navigate the ethical considerations and address the challenges associated with data security and privacy. By embracing AI technologies responsibly and ensuring proper implementation, oral medicine can advance towards a future where AIpowered solutions enhance patient care, improve outcomes, and contribute to the overall well-being of patients in the dental field.

5. CONCLUSIONS;

With the advent of AI, the branch of oral medicine and radiology has been upgraded. From the use of AI in clinical diagnosis and detection of oral cancer to its applications in oral radiology for fast and accurate interpretation, it has revolutionized this field. With ongoing research of applications of AI, the future of oral medicine and radiology looks bright with improved patient care, prompt and accurate radiological diagnosis, and early detection of oral cancer.

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Conflicts of interest There are no conflicts of interest.

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