CURRENT AND FUTURE TRENDS OF ARTIFICIAL INTELLIGENCE IN ORAL MEDICINE & RADIOLOGY

Abstract

Introduction: Artificial Intelligence (AI) is referred as a branch of computer science which is customized to build up computer algorithms to do the works which are basically based on intelligence of human beings, like capability to understand and manage the tasks. Word "AI" is being utilized when computer manages to do some analytical tasks like "problem-solving and learning", that generally a man usually connect with brains of other human beings. This branch helps in planning diagnosis, decisions for projection, treatment and prognosis. AI is shown to uplift the efficiency, accuracy and precision similar to medical practitioners, but comparatively more fast and affordably.

Materials and Method: The sources were searched from a database of PubMed library and Google Scholar for published literature from 2017 to 2023 (last 6 years). The inclusion criteria included key words of AI, recent trends in dentistry, applications of AI,

Results: The 17 articles that met the selection criteria (most of them were review article and some observational studies) were included for this chapter.

Conclusion: AI has become a promising tool by its various applications in dentistry. Although it cannot replace the role of dentists in health care system, but it can prove as a valuable adjunct by assisting in diagnosis and treatment planning in a fast and precise way. Still there is the need to understand the models and concepts of AI clearly in order to get proper benefits of this

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technology. To establish AI databases, dentists should also provide authenticated information, so that accurate results can be received from AI. The challenges should be managed in such a way that dentists can have a long-term reliability on AI models.

I. INTRODUCTION

Artificial Intelligence (AI) is referred as a branch of computer science which is customized to build up computer algorithms to do the works which are basically based on intelligence of human beings, like capability to understand and manage thetasks.[1]Word "AI" is being utilized when computer manages to do some analytical tasks like "problem-solving and learning", that generally a man usually connect with brains of other human beings. This branch helps in planning diagnosis, decisions for projection, treatment and prognosis. AI is shown to uplift the efficiency, accuracy and precision similar to medical practitioners, but comparatively more fast and affordably.[2]

II. HISTORY

Mimicking human brain remained a challenge for scientists. Since many years, scientists are trying their best to make advancements in "artificial intelligence" (AI). In year 1956, McCarthy J was the one who introduced artificial intelligence as the branch of applied computer science, which is also called machine intelligence or fourth industrial revolution.[2-3]AI uses computer technology to reproducethe capability of making decisions, thinking critically, and showing intelligent behaviourwhich is same as of humans.[3]

III. AI IN HUMAN LIFE

Now-a-days, there are numerous applications of AI, which are impacting our routine lives like software used in officesfor practice management. A recent application is Alexa, Siri and other devices which are controlled by voice command. These applications have established an intelligent interface through conversation with user.[4]

IV. AI IN MEDICINE

Recently in the field of medicine two branches of AI; machine learning[5] and deep learning are being used. 'Machine learning' (ML) gives methods which helps in resolving complex relations that cannot be solvedeasily. Physical (robotics) and virtual types of AI are being used in the health care system. The main areas of work of virtual AI are calculating drug dosage, checking drug interactions, making diagnosis, scheduling appointments, determining prognosis of treatment, making health records, and imaging. The areas of work of physical AI arerobotics in surgical intervention, tele presence, rehabilitation, and robots as companions for elderly care.[5] AI usually do important tasks, but still it is limited to leave the main responsibility for managing patients with human doctor. An important part of algorithms of DL is the artificial neural network (ANN). It is a structure which is made up of various small communicating units known as neurons being lined up in layers. Convolutional neural network (CNN) is one of the most commonly used ANN subclasses in the field of medicine and dentistry.

V. APPLICATION OF ARTIFICIAL INTELLIGENCE IN ORAL MEDICINE AND RADIOLOGY

Utilization of AI in field of dentistry is evolving with time. Various applications being used are diagnosing carious lesions, imaging, radiology, pathology, record keeping, robotic

assistance, etc. AI holds special place in branch of Oral Medicine and Radiology (OMR), by keeping electronic records, helping in diagnosis by radiographic assessment. Thus AI is being considered a 'game-changing' device now-a-days.[1]Besides diagnosis, AI is also helpful in treatment planning. AI helps to diagnose, differentiate, and classify pre-maliganant from malignant lesions. Radiology holds a special place in AI applications because diagnostic images which are digitally coded are translated into computer language easily. These images are used to develop AI algorithms for detecting pathologies, diagnosing diseases and estimating risk of disease.[6-8]

1. **Diagnosing Dental Caries and Periapical Lesions:** For diagnosing any dental ailment, Artificial neural networks (ANNs) are used to assist dental professionals for assessing risks and doing timely treatment. Diagnosis is based on assessing reoccurrence of previous dental conditions, thus minimizing errors caused by humans. For dental carious lesions, neural Machine Learning (ML) and Deep Learning (DL) is mainly used. Various studies are done to establish. AI algorithms with the help of clinical and radiological images for obtaining better results.

   For detecting periapical lesions, features of alveolar bone resorption and periapical radiolucency helps in creating models of Artificial Intelligence.[6]For fast diagnosis, data of patient is made available for ANN through digital scans, Intraoral Periapical Radiograph (IOPA) X-ray, etc. This helps in identifying risk groups who are more prone to oral cancers.[9]

2. **Early Oral Cancer Detection:** Routine full mouth examination is required to become a practice in field of OMDR. It helps in timely detection of oral lesions and oral cancers. As young dental professionals are not that confident in detecting such lesions, thus there arose a need to develop an adjunct for identifying such lesions at earliest. AI holds such capability for detecting oral mucosal changes that can be missed by untrained dental professionals.[10]CT, cytology, and fluorescent images are obtained and utilized as assessment tools in AI for diagnosing oral cancer precisely. Studies have reported success in diagnosing oral cancer cases by using AI models at the earliest.[9]

3. **Detecting Cysts and Tumors:** Cysts and tumours affecting jawbones are usually asymptomatic in nature, till they get increase in size causing symptoms due to impinging of nerve canalsand leading to pathological fractures. Some benign lesions may also show malignant transformation. In last stage, surgical management is generally radical and it consists of reconstruction by bone grafting and free flaps. Such lesions affect emotional well being of patients by creatingfacial deformity. It is important to diagnose such lesions at the earliest to ensure a healthy quality of life. AI applications can help in early detection of cysts and tumors affecting the maxillofacial areas, thus helping in timely management.[10]

4. **Diagnosing Temporomandibular Joint Disorders:** A thorough medical history, clinical and radiographic assessment helps to diagnose various Temporomandibular joint (TMJ) disorders. Such disorders reveal restricted jaw movements because of crepitus, pain, and tenderness in paraspinalarea. AI has been investigated as an adjunct technology for diagnosing such disorders.[12]

5. **Diagnosing Fractures:** In the oral and maxillofacial regions, traumatic fractures are one of the most prevalent injuries. Trauma to mandible is observed to be the most common one, which may be due to motor vehicle accident, fight, fall, assault, etc. Generally panoramic radiography and CBCT is used by radiologists to diagnose mandibular fractures. But now-a-days, applications of artificial intelligence and deep learning are evolving, thus showing promising results in detecting fractures.[13]

6. **Application of AI in Forensic Odontology:** Forensic odontology is the branch of dentistry that deals with examination, assessment, management and collection of dental evidence for the purpose of criminal and civil proceedings in judiciary. Applications of Artificial intelligence have merged in a promising way by giving required information necessary for decision-making in forensics.[14]

7. **Artificial Intelligence in Patient Management:** Dental based virtual assistants of AI can manage various tasks with less manpower, great obstinacy, and minimum mistakes as compared to human beings. AI is being used for various purposes like keeping records, diagnosis, treatment planning, scheduling appointments, managing paper works, checking insurance records etc. During unavailability of practitioner, AI can even help patients by giving Tele assistance. Thus virtual database of AI has made life of patients easy by providing better ways of treatment.[15]

8. **Future of AI applications in Oral Medicine and Radiology:** We have already discussed numerous applications of AI in field of Oral medicine and radiology. Various applications of AI helps to make and check records for better patient handling. AI helps in diagnosing various kinds of lesions as AI models are provided with enormous data to identify correct match. Data of diagnostic images in AI record helps in diagnosing the pathology in patient by matching the investigation images of dental IOPA, bitewing, OPG, MRIs, CT scans, and CBCT scans, with speed, and precision.

   In coming 5yrs, AI will grow in healthcare system. Tools detecting carious lesions, bone loss, periodontal diseases are now commercially available, with more speedy increase in coming years. CBCT images that require an expertise of radiologist to interpret, can now be managed through applications of AI. In coming years, AI will be utilized extensively for diagnosis, imaging, interpretation and practice management in the field of Oral medicine and radiology.[16]Some limitations are being addressed in utilising AI in dentistry. These limitations are: complex system, bias in data snooping, lack of proper training and understanding of AI algorithms and expensive setup. Sometimes, the results of AI models are not clinically applicable. There is a need to establish a beneficial relationship between dentists and AI, which should be cost-effective and less complex.[17]

VI. CHALLENGES OF AI

The major challenge of application of AI in health care systems is sharing and managing of clinical data. For maintaining and keeping records, patient data is added in AI algorithms, but issue arise when this data is shared between institutions and even beyond national boundaries. Thus it is required to make such applications that could protect the privacy and confidentiality of patient records.[8]

VII. CONCLUSION

AI has become a promising tool by its various applications in dentistry. Although it cannot replace the role of dentists in health care system, but it can prove as a valuable adjunct by assisting in diagnosis and treatment planning in a fast and precise way. Still there is the need to understand the models and concepts of AI clearly in order to get proper benefits of this technology. To establish AI databases, dentists should also provide authenticated information, so that accurate results can be received from AI. The challenges should be managed in such a way that dentists can have a long-term reliability on AI models.

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