Review Article

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Artificial Intelligence in Oral Medicine and Radiology: A Critical Overview

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Abstract

In the last many years, dentistry has advanced rapidly. Conventional dental care is about to undergo a revolution because to new technological advancements and diagnostic tools. One such innovation whose promise has now been realised is "artificial intelligence," a highly developed technology that can replicate how the human brain functions. Artificial intelligence technology could be used in dentistry applications to cut down on expenses, time, human mistake, and human expertise. AI is being used in the dental sciences for a variety of purposes, such as diagnosis, differential diagnosis, imaging, and treatment of head and neck conditions, dental emergencies, and other dental specialisations. Although artificial intelligence will never completely replace the work of a dentist, it is crucial to understand how this technology may be used in the future. The purpose of this AI overview is to give readers a better understanding of the different methods and uses of AI in radiology and oral health.

Keywords : Advantages, artificial intelligence, disadvantages, oral medicine, oral radiology, utilization

Introduction

Artificial intelligence (AI) is the scientific field that focuses on training computers to possess intelligence similar to that of humans, enabling them to do certain activities and so decrease the amount of work and time required by humans.(Sur et al., 2020). The initial characterization of the term "Artificial intelligence" occurred in 1956.(McCarthy et al., 2006).

Artificial intelligence (AI) is involved in various daily tasks, including social media, surveillance, intelligent vehicles, and travel. The utilisation of deep learning techniques in the processing of dental and medical images has significantly transformed the reporting process for radiologists. It has alleviated the burden on radiologists, hence enhancing the efficiency and accuracy of diagnosis. The future of artificial intelligence (AI) in diagnostic radiology is promising due to the progress made in data mining, language processing, and research in robotic systems. (Heo et al., 2021).

Oral medicine and radiology encompass the skills of diagnosing, arranging treatments, and interpreting radiographic images. Radiologists specialising in oral and maxillofacial medicine are renowned for their precise analysis and interpretation of radiographic images captured within the maxillofacial area. The process of interpreting images is intricate and requires a significant amount of time, as it necessitates a comprehensive understanding of anatomy and a keen ability to identify abnormalities in several multiplanar images. (Ramesh et al., 2004: Tang et al., 2018) .The objective of the present review article was to provide an overview of the recent utilisation of artificial intelligence (AI) in the fields of oral medicine and radiography.

Techniques Of Ai Applied In Oral Medicine And Radiology

- **Artificial Neural Networks:** AI technology, specifically ANN, has been effective in assessing cancer aggressiveness and predicting disease progression and prognosis, leading to potential treatment options. The structure and function of ANN closely resemble the brain. It is made up of perceptrons that behave like neurons. The ANN concept involves creating a decision-making unit with interconnected perceptron units for nonlinear analysis. Most often used ANN forms are multilayer perceptron (MLP). The MLP is a reliable tool for assessing oral cancer biomarker prediction potential.(Sherbet et al., 2018).
- **Clinical Decision Support System (CDSS):** CDSS are interactive computer programmes that aid health professionals in decision-making. A CDSS consists of a dynamic knowledge base and an inferencing mechanism, built through medical logic modules using Arden syntax. Clinical expertise is utilised in these systems to analyse patient data and make recommendations for diagnosing, preventing, and treating orofacial illnesses. CDSS software can work alone or in conjunction with other technologies including electronic dental records, order entry systems,

and radiography systems (Khanna, 2010).

- **Principal Component Analysis (PCA):** Laser-induced fluorescence (LIF) spectroscopy and imaging are noninvasive diagnostic tools for identifying oral cancers. It involves illumination of tissue with monochromatic light, recording the fluorescence spectrum, and classifying using PCA and artificial neural networks. (Kamath & Mahato, 2007).
- **Data Mining Technique:** This computational approach identifies patterns in massive data sets. It turns data into a format that may be used for further analysis. KDD is the analysis step of the "knowledge discovery in databases" process. The process includes anomaly detection, association rule mining, clustering, classification, regression, and summarization. Used to develop a new oral cancer detection and prognostic approach. The genetic ID3 algorithm is the simplest method for cancer diagnosis and prognosis. (Kesavaraj & Sukumaran, 2013).
- **Genetic Algorithms (GA):** In GP, the process of addressing issues is reformed by searching for a highly fit programme among a population of candidate programmes. The search space includes relevant functions and terminals for the problem domain. GP identifies the most fit persons within the programme. Through the use of Darwinian principles and genetic operations such as mutation and crossover, GP generate populations of hundreds or thousands of computer programmes. In general, GP addresses issues arising from natural selection and genetic operations. Used to evaluate oral cancer prognosis. (Sharma & Om, 2015).
- **Deep Learning (DL):** DLS Learns to extract and classify image features without operator input. Images are fed into the top layer, which transmits information through layers to learn the proper categorization. The model outputs the proposed classification in the final layer. This will significantly reduce the workload of radiologists and physicians in domains like molecular imaging for early cancer diagnosis. Assess cervical lymph node metastases from oral malignancies.(Bur et al.,2019)
- **Machine Learning (ML):** Machine learning is a subtype of AI that allows computers to learn from past data, gain insights, and predict new data using learnt information. Be highly accurate and precise. Statistics focuses on inference and describes the relationships between components. A study found that tumour depth of invasion>4mm was linked to an odds ratio of 8.3 for nodal metastasis. In contrast, machine learning employs massive patient data sets to anticipate unknown variables based on past experiences. (Yaji, 2019).

Applications of AI in Oral Medicine and Radiology

1. Analysis of radiographic abnormalities and standardised analysis of dental radiographs
2. By utilising the radiologist's work as data, artificial intelligence (AI) can facilitate the identification of specific aspects of individual radiologists' practice patterns and classify them in order to generate an advanced radiology report card.
3. The Logicon Caries Detector™ programme has been specifically developed to aid dentists in the identification and analysis of proximal caries.
4. Detection of vertical root fractures on CBCT images of teeth that have undergone endodontic treatment and are still intact.
5. To determine the stage of tooth development.
6. Digitised subtraction imaging using computer technology.
7. Utilising computer-assisted image processing proves to be advantageous in the direct visualisation and evaluation of bone architecture from dental panoramic radiographs.
8. Utilising patient models and OPGs for the visualisation of orthodontics in three dimensions.
9. Utilising OPGs for bone density assessment to forecast osteoporosis.
10. Segmentation of the mandibular canal using automated methods.
11. Forensic dental imaging system that utilises dental panoramic radiographs and employs a metaheuristic algorithm for personal identification.
12. In the field of dental biometrics. (Suganya & David, 2020).

Advantages and Disadvantages of AI

Advantages	Disadvantages
Accurate diagnosis	Expensive system
Standardized procedure	Complex procedure
Time saving	

Conclusion

The uses of AI in daily life are expanding exponentially. Surgeons who specialise in dentistry have always been at the forefront of integrating technology. Understanding a variety of concepts and the associated procedures will be very beneficial in the future when it comes to quickly adapting to changes in jobs and pursuing fulfilling careers. Artificial intelligence has already had a significant impact on the field of medicine and is predicted to have more in the future, especially given the increasing pressure on healthcare facilities to offer high-quality, reasonably priced care to a growing number of patients. While there is no denying the rise of AI in dentistry, it will never be able to fully replace a dentist's function in clinical practice, which involves not just diagnosis but also correlation with clinical results and the provision of individualised patient care.

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