

Is Artificial Intelligence the future of Dental Radiology?

Abhishek Kumar

Corresponding Author: Abhishek Kumar, College of Dental Surgery, BP Koirala Institute of Health Sciences, Dharan, Nepal

DOI: 10.71168/NDO.01.01.107

Received Date: November 01- 2024**Publication Date:** November 15- 2024

Abstract: The integration of AI is anticipated to bring a major transformation to the quality, value, and impact of radiology on patient care and population health, as well as radiologists' workflows, over the next decade. AI technologies are already being applied across various dental specialties, including orthodontics. There are various applications of AI in Oral and Maxillofacial Radiology. AI is expected to ease the daily workload of physicians and reduce the incidence of misdiagnosis or underdiagnosis in dental practice. Although AI systems are a valuable resource in both dentistry and dental education, it's crucial to recognize that these technological advancements stem from human innovation and discovery.

Introduction

The ability of a machine to mimic intelligent human behaviors to perform complicated tasks like problem-solving, object and word recognition, and decision-making is known as artificial intelligence or AI [1,2]. AI has gained popularity recently in several areas, including dentistry, where its uses in oral and maxillofacial imaging show significant promise. Because radiology creates digitally coded images, integrating AI into medical procedures is much simpler [3].

Convolutional neural networks, which are capable of handling tasks including image categorization, detection, segmentation, registration, creation, and refinement, are the main focus of recent studies in oral and maxillofacial radiology [4]. In this field, artificial intelligence systems have been developed for image analysis, forensic dentistry, radiography diagnosis, and picture quality enhancement [4]. However, obtaining useful results necessitates large data sets, and oral and maxillofacial radiologists play a critical role in creating reliable and consistent datasets, which can take a lot of time.

The use of AI is expected to bring about a dramatic revolution in the next ten years regarding the workflows of radiologists and the impact of radiology on population health and patient care. Dentists need to use their skills to evaluate patients, choose the best course of treatment, and make clinically sound prognostic judgments. They might, however, occasionally lack the expertise needed to act swiftly and decisively in clinical decisions. Applications of AI can be useful tools for improving performance and decision-making. AI is already being used in several dental specializations, such as orthodontics. The majority of current research focuses on artificial intelligence (AI) models that use artificial neural networks (ANNs) and convolutional neural networks (CNNs) [5]. AI developments are anticipated to lessen the everyday burden on healthcare professionals and lower the number of dental misdiagnoses and underdiagnoses. Radiological image research encompasses tasks such as segmenting and classifying teeth, automatically labeling anatomical structures, performing cephalometric analysis, detecting early dental diseases and periodontal conditions, and using jaw radiographs to diagnose specific diseases like osteoporosis [6].

Current State of Dental Radiology

In dental radiology, conventional methods are essential for both diagnosing and treating dental disorders. Dental radiology employs a number of main procedures, including Intraoral X-rays, Panoramic Radiography, Cone-Beam Computed Tomography (CBCT), Lateral Cephalograms, etc.

Getting, reading, and evaluating radiographic pictures can be time-consuming procedures. Delays can impede prompt diagnosis and treatment, which can have an impact on patient outcomes. The knowledge of the radiologist is crucial in the interpretation of radiographic pictures. Misinterpretations can have a major negative influence on patient care by resulting in missing diseases, needless therapies, or inaccurate diagnoses. Access to skilled oral and maxillofacial radiologists is restricted in several areas. Due to shortage, expert evaluations may take longer to complete and less experienced practitioners may be used, which could compromise the accuracy of the diagnosis. These difficulties highlight the need for accessibility and technological developments to raise the effectiveness and consistency of diagnosis in oral and maxillofacial radiography.

Because of several important considerations, including proficiency in interpretation, comprehension of imaging techniques, integration with clinical context, ongoing education, quality assurance, etc., dental radiology significantly depends on qualified radiologists for accurate diagnosis.

Different uses of AI in Oral and Maxillofacial Radiology

There are various uses of AI in Oral and Maxillofacial Radiology. Some of them are listed below [6]:

- Interpretation of radiographic lesions and automated interpretation of dental radiographs.
- Caries detection: Logicon Caries Detector™ is designed to assist dentists in the detection and characterization of proximal caries.
- Diagnosis of vertical root fractures on CBCT images of endodontically treated and intact teeth.
- To stage tooth development.
- Automatic detection and classification of dental restorations in panoramic radiography.
- Computer-based digital subtraction imaging.
- Computer-assisted image analysis is useful to visualize and evaluate the bone architecture directly from the dental panoramic radiograph.
- 3-dimensional orthodontics visualization using patient models and OPGs.
- Bone density evaluation to predict osteoporosis using OPGs.
- Forensic dental imaging

Current Scenario and Future Prospects

By improving diagnostic speed and accuracy, artificial intelligence is transforming oral and maxillofacial radiology. Radiography images are analyzed and anomalies are precisely detected using deep learning techniques. Although AI speeds up treatment planning and decreases errors in radiologists' jobs, human monitoring is still essential.

AI has a bright future in oral and maxillofacial radiology, with the potential to advance personalized treatment, real-time image analysis, and diagnostics. These technologies have the ability to reduce errors and streamline processes. To guarantee precision, dependability, and moral application, however, further research and collaboration with medical professionals will be necessary.

Ethical Considerations

There are important ethical questions raised by the use of AI in oral and maxillofacial radiology. Careful consideration must be given to issues like patient consent, data privacy, and the possibility of bias in AI systems. Concerns have also been raised over the depersonalization of care, since a reliance on AI too much may lessen the significance of professional judgment [7]. Furthermore, it is critical to retain accountability in the event of errors and to guarantee transparency in the decision-making process of AI systems. For AI to be used responsibly in clinical practice, a balance between these ethical problems and the technology's advantages must be struck.

Conclusion

In many respects, artificial intelligence has significantly advanced the domains of dentistry and medicine. Even though the human body is complicated, artificial intelligence (AI) has been shown to be a useful tool for dental practice and teaching. But it's crucial to remember that human creativity and discovery are the source of these technological advancements. Artificial intelligence (AI) is meant to support healthcare professionals in carrying out their duties more effectively; it is not meant to replace human expertise, knowledge, or treatment planning. Nevertheless, further research into AI has the potential to advance oral and maxillofacial radiology in a big way.

References

1. Wong SH, Al-Hasani H, Alam Z, Alam A. Artificial intelligence in radiology: how will we be affected?. *European radiology*. 2019 Jan;29:141-3.
2. Hashimoto DA, Rosman G, Rus D, Meireles OR. Artificial intelligence in surgery: promises and perils. *Annals of surgery*. 2018 Jul 1;268(1):70-6.
3. Thrall JH, Li X, Li Q, Cruz C, Do S, Dreyer K, Brink J. Artificial intelligence and machine learning in radiology: opportunities, challenges, pitfalls, and criteria for success. *Journal of the American College of Radiology*. 2018 Mar 1;15(3):504-8.
4. Heo MS, Kim JE, Hwang JJ, Han SS, Kim JS, Yi WJ, Park IW. Artificial intelligence in oral and maxillofacial radiology: what is currently possible?. *Dentomaxillofacial Radiology*. 2021 Mar 1;50(3):20200375.
5. Pauwels R. A brief introduction to concepts and applications of artificial intelligence in dental imaging. *Oral radiology*. 2021 Jan;37(1):153-60.
6. Yaji A, Prasad S, Pai A. Artificial intelligence in dento-maxillofacial radiology. *Acta Sci Dent Sci*. 2019;3(1):116-21.
7. Maart RD, Mulder R. Ethical considerations for artificial intelligence in dentistry. *South African Dental Journal*. 2024 Jun 1;79(5):260-2.