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Artificial Intelligence in Orthodontics

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Abstract:- This review article's goal was to document the scope and effectiveness of AI-based models that are frequently used for orthodontic assessment, treatment planning, and prognosis prediction. A comprehensive search was done in electronic databases like Pubmed, Medline, Cochrane, Google scholar, Scopus, and Web of science to find and choose the literature for this work. Orthodontic applications of AI and ML offer promising tools that can enhance clinical practice.

Keywords:- *Artificial Intelligence ,Dentistry; Machine Learning, Orthodontics, Cephalometric Landmarks, Orthognathic Surgery*

I. INTRODUCTION

Orthodontics, one of the nine dental specialties, is concerned with identifying malocclusions and treating and preventing them. Its primary goal is the craniofacial skeleton, which is achieved mostly by altering the dentoalveolar region rather than other regions. [1] Dentistry has undergone significant change in the last few decades. Numerous applications, such Siri and Alexa, have been made possible by the exponential advancement of science and technology. These programmes are located at the very top of the elements of artificial intelligence (AI).

Artificial intelligence (AI) is the ability of a system to simulate human intelligence or defined as choosing wisely and effectively in accordance with a gold standard.[2] The phrase "artificial intelligence" was first used by mathematician John McCarthy in 1955.[3] McCarthy is usually regarded as the originator of the field. He used this phrase to describe how machines have the ability to undertake activities that can are considered to be "intelligent" pursuits. Several AI subfields, primarily machine learning (ML), artificial neural networks (ANNs), convolutional neural networks (CNNs), and deep learning (DL), have been widely applied in a variety of domains, most notably biological and medical diagnostics.[4]

Artificial intelligence (AI) has mostly been utilised in dentistry to improve diagnosis, which is crucial for attaining the greatest outcomes from treatments and providing top-notch patient care.

To assess patients and select the most appropriate course of treatment, dentists must draw on all of their knowledge. Furthermore, they must make accurate clinical decisions when predicting the prognosis[5]. Dentists occasionally lack the expertise necessary to make the best clinical choice in a short amount of time, though. They can use AI programmes as their guides to help them make better decisions and perform better.

The purpose of this review article was to record the extent and performance of artificial intelligence-based models that have been widely employed in orthodontic evaluation, treatment planning, and prognosis prediction.

II. MATERIALS AND METHODS

The literature for this paper was identified and selected by conducting a thorough search in electronic databases such as Pubmed, Medline, Cochrane, Google scholar, Scopus, Web of science, and Saudi digital library using keywords such as artificial intelligence in dentistry, deep learning, machine learning, artificial neural networks, convolutional neural networks, and computer-aided design.

III. APPLICATION OF ARTIFICIAL INTELLIGENCE IN ORTHODONTICS

A. Need for Orthodontic Extraction

For orthodontic therapy to be successful, accurate diagnosis, treatment planning, and prognosis prediction are essential. One of the most significant and important decisions that affects the treatment's outcome is whether to have an orthodontic extraction.[2] Given that the extraction process is irreversible, it is regarded as essential. One of the most significant and important decisions that affects the treatment's outcome is whether to have an orthodontic extraction. Artificial neural network (ANN) model was used in a study by Xie et al.[6] to determine whether extractions are required using lateral cephalometric radiographs. The outcomes seemed quite encouraging. Using lateral cephalometric radiographs, Jung et al.'s [7] AI expert system demonstrated 92% accuracy in making permanent tooth extraction decisions.

The findings of both trials imply that the AI modes were accurate and successful at foretelling the necessity for extraction.

B. Identifying Cephalometric Landmarks

Cephalometric analysis is a crucial technique that has been utilized for both diagnosis and therapy planning..[8] Automated models are being used for cephalometric analysis which based on AI. A cellular neural network study examined how well cephalometric landmarks could be identified on cephalometric radiographs. The study's findings were encouraging, and the model functioned effectively.9The study's findings were quite positive, and the model's performance was comparable to that of an expert. These results were in line with those of another study that examined cephalometric factors for orthodontic diagnosis using a paraconsistent artificial neural network (PANN).[10] The effectiveness and precision of the updated deep-learning algorithms for the automatic detection of cephalometric landmarks using cephalometric radiographs were compared by Park et al[11]. The outcomes showed that the system's computation of the landmarks was incredibly accurate. These research' findings imply that these AI-based automated systems may be utilized as a supplement to human decision-making in orthodontics and are a good choice when repeated identification is necessary.

C. Estimate Facial Beauty During Orthognathic Surgery

Analyzing the patient's facial features is essential for gauging the effectiveness of the treatment. According to a study, AI-based technology has been used for this employed a model based on ANNs to forecast post-orthognathic surgery photograph, the subject showed encouraging outcomes. These results were comparable to those of another AI-based study, which had predictions that were more than 80% accurater[13]. Describing how orthognathic procedures affect attractiveness of the face. These AI-based automated systems' outcomes can be used to healthcare decision-making , Planning for therapy and suggestion to the writers who claim that these systems still require improvement more predictability.[14] According to Arnet et al.,[15] if the diagnosis of an orthodontic patient is made incorrectly, the patient's esthetics may continue to deteriorate, which might pose a serious issue. [16]This implies that accurate diagnosis is a crucial component of the dentist's ability to assess the patient's issues. The goal of AI technology is to make the work of dentists significantly more exact and precise. According to Choi et al[17].lateral cephalometric radiographs were used to determine whether or not surgery should be performed. He demonstrated how the system had a 96% success rate in diagnosing patients that required surgery vs those that did not.

This model has produced encouraging results and can be used to diagnose instances requiring orthognathic surgery.

D. Determining the Growth and Development by Cervical Vertebrae Stages

According to a study, the ANNs-based model was able to identify the stages of cervical vertebrae growth and development with a mean accuracy of 77.02%[18]. AI-based technology has been utilized to identify the cervical vertebrae's growth and development phases.[19-20] These results are consistent with another study in which the AI-based model performed better. The results of this study imply that AI-based automated systems can be relied upon to anticipate the stages of growth and development of the cervical vertebrae with accuracy, and that orthodontists may find greater utility in using them.

IV. CONCLUSION

Artificial Intelligence shown to be quite effective at completing the objectives for which they were intended. For clinical decision-making in the field of orthodontics, the doctor mostly uses diagnostic techniques. The use of AI in dentistry has been effective in helping dentists make more accurate diagnoses and clinical decisions. Orthodontic applications of AI and ML offer promising tools that can enhance clinical practice. These clinical decision support tools can make orthodontists' work more productive, less variable, and subjectivity-free. The majority of systems' accuracy Currently available is rated good to outstanding with a range of roughly 64% to 97%.

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