

Revolution of Artificial Intelligence: A Review Article

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Abstract:

The use of information technology (IT) in the dental field has increased significantly over the past 25 years and has helped reduce cost, time, dependence on human expertise and medical errors. AI allows examination, organization, representation and cataloguing of medical information. In 2019, Morgan Stanley estimated that global market for AI in health care could surge from \$1.3 billion to \$10 billion by 2024, growing at an annual compound rate of 40%. There are 2 main categories of AI, Symbolic AI and Machine Learning (ML). ML is a term first phrased by Arthur Samuel in 1952, is the current paradigm. Current orthodontic literature is replete with studies that have documented various applications of AI and ML. The objective of this review article is to summarize recently developed techniques with regards to applications of AI.

Keywords: Artificial intelligence, orthodontics.

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INTRODUCTION:

The human brain is one of the most complicated calculators. Unveiling its intricate structure reflects the process of understanding ourselves.¹

The use of information technology (IT) in the dental field has increased significantly over the past 25 years and it has helped reduce cost, time dependence on human expertise and medical errors. As it is a subfield of computer science, AI encompasses both hardware and software that can perceive its environment and take action that maximizes its chances of success in attaining its goals.²

Currently, AI based algorithms are involved in everyday technology and are being extensively used in search engines of internet, online assistance and face recognition in various social media platforms. In general, artificial intelligence is described as “computers mimicking human intelligence”.

It deals with a variety of information representation schemes, intelligent search methods

for solving uncertainty of data and knowledge, different ideas for automated machine.³ Because of its precise methodologies have immense capability to detect and diagnose the lesions of oral cavity which may be unnoticed by the human eye.⁴

AI is a problem-solving tool which can help and support a orthodontist to provide more better standards of care. It can even assist orthodontists to choose the best mechanotherapy to move a tooth or group of teeth.⁵

McCarthy in 1956 brought forward the concept of Artificial Intelligence, basically AI is a branch of computer science which deals with developing specialized computers and programs that have the ability to perceive information and reason, and ultimately, convert that information into intelligent actions.⁶

In 2016, a study by Takada et al stated that AI expert systems with neural network ML could be useful in Artificial intelligence and machine learning is the next new paradigm in our future orthodontics practice which will improve

Orthodontic practice with help of proper input data selection, appropriately organized modelling, & preferable generalization.⁷

This article aims to provide an insight into applications of AI related to orthodontic diagnosis and treatment planning.

APPLICATIONS OF AI IN ORTHODONTICS

Enormous changes have occurred in orthodontic speciality. There is an increase in newer the advances in treatment modalities, patient awareness and usage of digital appliances. All this has given a new dimension in field of orthodontics. A complete conventional method is not feasible in the future. Artificial intelligence-based software systems are showing notable and refined role in the field of orthodontics and are considered as the future of orthodontic applications.

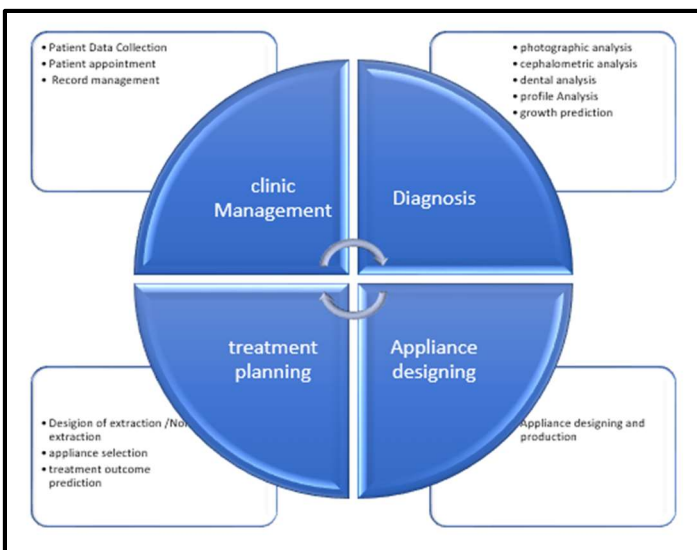


Fig. 1 How AI helps in Orthodontics

1. In management of patient: virtual dental assistants are based on Artificial Intelligence technology are available in the market, these software act as virtual assistants which performs all tasks with high precision and less errors reducing need of manpower in orthodontic clinics.

2. In records : According to Murata et al., 2017 For a clinician, the patient evaluation and taking records are time-consuming steps, AI with automation of diagnosis and imaging increase the speed and accuracy of the evaluation.⁸

3. In cephalometric analysis: Lee et al. (2020) researched using deep convolutional neural network-based analysis for automated cephalometric tracing& found that the developed software showed high success rate (over 90%) in differential diagnosis of cephalometric landmarks.⁹

4. In planning orthognathic surgery: Great investment has been made in research and development of digital orthodontics and 3D simulation of orthognathic surgery. ¹⁰ According to Bouletreau P, et al, 2019 all the digital tools based on artificial intelligence are able to put marked impact on orthognathic-surgical treatment plans rite from the initial diagnosis to follow-up treatment.¹¹

5. In designing and fabrication of appliances: AI based laboratory designing software will be able to design and fabricate the appliance by maintaining hygiene and precision. ¹²

6. In prediction of force: Kazem et al. did a study on constructed artificial neural network to evaluate the force system of T - retraction springs where they found that neural network was effective in prediction of force system.¹³

7. Decision regarding extraction: Jung et al.2016 also constructed neural network model combined with back propagation algorism. The study intended to construct an AI expert system for deciding extraction therapy and extraction pattern. He constructed model showed 93% match for the diagnosis of extraction or non-extraction therapy and 84% for the selection of extraction pattern.¹⁴

8. In evaluating the outcome of treatment: in a study did by Nanda SB et al (2015) ahowed that the ANN model analysis was more accurate for the prediction of lip curvature change following extraction and non-extraction orthodontic

treatment as compared to the conventional statistical regression analysis.¹⁵

9. Segmentation and landmark identification: Image segmentation is the process where we isolate the targeted organ or lesion from CBCT, X-rays or MRIs.¹⁶ Wang et al. developed a method for automated segmentation of both maxilla and mandible by using a CBCT.¹⁷ Several studies were conducted for looking into automated landmark identification of lateral cephalometric.

Arik first applied CNNs for automated lateral cephalometric landmark identification.¹⁸ Nishimoto used CNNs with personal computer and lateral cephalometric X-rays gathered through the internet and still get the result without significant difference between AI and hand traced cephalometric landmarks.¹⁹

10. Predicting growth: Timing is one of the crucial factor which is considered during any treatment planning, especially for young growing patients. Several methods have been proposed for growth prediction such as chronological age, bone age menarche and change in height and voice. The gold standard for assessing bone age is by hand-wrist radiographs.²⁰ Spampinato used deep learning approaches to assess bone age through hand-wrist radiographs.²¹

11. Cleft related studies: Zhang collected blood samples from non-syndromic cleft lip and palate infants and healthy infants to validate the diagnostic effectiveness of 43 single nucleotide polymorphisms (SNPs) using genome-wide association.²² Different machine learning algorithms were used to build predictive models with SNPs. The results showed logistic regression was best in risk assessment.

12. TMD Classification: Shoukri et al. applied neural network to stage condylar morphology in temporomandibular joint osteoarthritis (TMJOA). The result of his study suggest that TMJOA can be comprehensively classified by AI.²³

CONCLUSION

AI is a human made magnificent tool in the field of Orthodontics. AI has strongly proven its efficient performance with accuracy and precision. It is proved to be a reliable and time saving tool in many aspects

AI based simulations for diagnosis and treatment planning has turned out most reliable and time saving.

Refinement with more clinical and theoretical information so digitalization of records in day-to-day clinical practice should be strongly promoted. AI technology coupled with conventional methods should be promoted to make it more accurate and precise.

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