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Artificial Intelligence in Endodontics

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Scientists and researchers have always been fascinated by the brain, one of the most interesting organs in the human body. The scientific community has never figured out how to perfectly replicate the human brain in a model. For many years, scientists have been working assiduously toward improving the concept of "artificial intelligence" (AI). Artificial intelligence, a branch of applied computer science, was first described by John McCarthy in 1956. It is sometimes referred to as artificial intelligence. The "fourth industrial revolution," also known as artificial intelligence, makes use of computer technology to mimic human-like reasoning, judgment, and intelligent behaviour.

AI research is the study of an intelligent medium or any machine that comprehends its environment and behaves in a way that maximizes its odds of successfully achieving its goals.

When a computer mimics analytical skills that people usually connect with other human brains, such as "learning and problem-solving," the term "AI" is employed. There has been a lot of experimentation with AI techniques as clinical trial tools, specifically to help in decision-making for prognosis and projection, as well as each phase of diagnosis and subsequent therapy, as a result of their excellent capabilities and capacities in recognizing significant data patterns. AI has been shown to improve precision, accuracy, and efficiency to the same level as medical specialists more quickly and economically.

Our everyday lives are already being touched by technology because of various office and practice management software. A few applications that have used artificial intelligence to create intelligent conversational user interfaces for any device, application language, or environment include Siri, Alexa, and other voice command devices. Both physical (robotics) and virtual AI have applications in the healthcare industry. The primary domain of the virtual type is the mathematical formulae for dose of medications, diagnosis and prognosis, appointment scheduling, drug interactions, electronic health records, and imaging. The physical component includes telepresence, robotic surgery support, rehabilitation, and companion robots for senior care.

HOW ARE MODELS OF ARTIFICIAL INTELLIGENCE CONSTRUCTED?

Artificial intelligence (AI) functions in two phases: "training" in the first phase and "testing" in the second. The training data determines the parameters of the model set. Retrospectively, the model uses information from earlier examples, such as patient information or information from data sets with a variety of examples. After that, the test sets are subjected to these settings.

ENDODONTIC APPLICATIONS OF ARTIFICIAL INTELLIGENCE:

Artificial intelligence is becoming more relevant in the field of endodontics. Its importance in planning endodontic therapy and disease diagnosis is continuously expanding. AI-based networks can detect even minute changes at the level of a single pixel that the human eye could miss.

Following is a detailed list of some of its endodontic applications:

- Locating minor apical foramen
- Dental caries
- Periapical lesions
- Root Fractures
- Root canal system anatomy
- Root caries
- Stem cell viability
- Working Length
- Difficulty level
- Success of retreatment

- Locating minor apical foramen

DIAGNOSIS:

Identifying a diagnosis and a course of therapy for teeth exhibiting periapical lesions and/or accompanying symptoms can be challenging for clinicians. Apical periodontitis, a common disease, is to blame for about 75% of cases with radiolucent jaw lesions. Early diagnosis could improve the effectiveness of treatment, stop it from spreading to other tissues, and lessen future difficulties. The two 2-dimensional diagnostic techniques that are most frequently used in routine clinical practice to identify apical periodontitis are IOPA and OPG. On radiographs, periapical lesions frequently appear as radiolucencies. However, the data obtained from these periapical radiographs is unreliable since the genuine 3-D anatomy is reduced into a 2-D image.

For precisely identifying periapical lesions and determining their position and extent, the 3D imaging technique CBCT imaging was created. The periapical lesions had accuracy scores of 0.96, 0.73, and 0.72 for CBCT imaging, traditional IOPA, and digital IOPA, respectively, according to a meta-analysis [20]. CBCT imaging demonstrated a lower degree of accuracy when identifying apical periodontitis in teeth with filled roots.

DETECTION OF ROOT FRACTURES:

Vertical root fractures (VRF), which account for 2% to 5% of crown/root fractures, are a serious consequence that may need root resection or tooth extraction. A Vertical Root Fracture, which may be difficult to diagnose, is identified using cone beam computed tomography (CBCT) imaging and radiographs. Additionally, a delayed diagnosis could result in unnecessary surgery or tooth extraction. The low sensitivity and clinical presentation of conventional radiography in the detection of vertical root fractures typically restrict a clinician's diagnostic options.

CNN may be an effective method for locating VRFs on panoramic radiographs, according to a study by Fukuda et al. A neural network was developed in a previous study to recognize VRFs in teeth that were both intact and root-filled using periapical radiographs and CBCT images. They discovered that fracture detection of roots on CBCT images is more sensitive, accurate, and specific when compared to images from 2-D radiography. In order to examine second molar fractures using synthetic data, Shah et al. created second molar fractures. These mathematical processes enable the machine learning technique's ability to retrieve weak signals from noisy environments. Steerable wavelets were successfully applied to high-resolution CBCT images, despite the small sample size, to identify fractures.

ESTABLISHING WORKING LENGTH:

For root canal treatments to be successful, the WL must be determined correctly. Radiography is one technique used to evaluate working length. Other techniques include CBCT imaging, electronic apex locators, digital tactile sensation, and the patient's response to a paper or file point inserted into the root canal system. Radiography and electronic apex locators are two routine procedures used by clinical dentistry. Digital radiography's image clarity is crucial for a correct evaluation of the architecture of the root canal system. However, a number of additional factors influence radiographic readings, which could result in misdiagnosis.

As a result, it becomes vital to apply computer-based solutions to deliver consistently accurate working lengths. Some authors claim that using ANNs as a second opinion to locate the radiographic apical foramen can increase the accuracy of the working length measurement. In a related study, the accuracy of WL assessment by an artificial neural network was determined using a model of a human corpse to simulate a clinical environment.

They found no change in the root length measurements when they compared an artificial neural network with the actual measurement following extraction. They also pointed out that the ANN fared significantly better at around 96% than an endodontist at 76% when using periapical radiographs to identify mild anatomic restriction.

THE ROOT AND ROOT CANAL MORPHOLOGY:

The efficiency of nonsurgical root canal therapy depends critically on an understanding of the various types of roots and root canal systems. This has frequently been accomplished using periapical radiography and cone-beam computed tomography imaging. Cone beam computed tomography imaging has been demonstrated to be more accurate in detecting root and root canal geometries when compared to radiography. However, due to radiation issues, it cannot be recommended in routine clinical practice. According to some scientists, a deep learning algorithm that utilized panoramic radiographs was able to distinguish between the distal roots of the mandibular first molars (radix entomolaris). An automatic, three-dimensional tooth segmentation using the CNN method was demonstrated by another author.

RETREATMENT PROGNOSIS:

A case-based reasoning paradigm was developed, according to a report, for the prediction of the outcome of nonsurgical retreatment of the root canal with risks and benefits. The algorithm essentially gave advice on whether to retreat or not. The system included data on statistical performance, probability, and recall. The system's ability to accurately predict how the retreatment would play out is one of its finest features. The limitation was that the system's precision could only equal the data's information. Case-based reasoning is the process of developing answers to problems based on prior experiences with

similar problems. Important knowledge and information may be absorbed by locating analogous scenarios. Heterogeneity in this system may result from the issue of variability and the popularity of alternative methods. Future papers ought to take the human method's variability into account and perhaps expand the sample size in order to improve accuracy, sensitivity, and specificity.

DENTISTRY EDUCATION:

Since its inception in the 1980s, the field of intelligent tutoring systems has made major advancements. AI is commonly used in the field of dental education to create scenarios that mimic clinical work on patients and reduce all the risks associated with training on a live patient. As a result, the students' preclinical virtual patient feedback has improved dramatically.

Professionals may help their patients receive top-notch dental care with the aid of AI technologies. AI systems can be used by dentists as an additional tool to increase the accuracy of diagnosis, treatment planning, and treatment result prediction. General dentists can receive diagnostic support from deep learning technologies. Automated technology can quicken healthcare procedures and increase physician output. By utilizing these methods for supplementary perspectives, the diagnosis' accuracy can be improved.

CONCLUSION:

Endodontics has made extensive use of artificial intelligence technology. The neural networks performed similarly to the dental specialists with more accuracy and precision, according to a study on the use of AI in endodontics. In several studies, artificial intelligence models have surpassed the expertise of the experts. The results suggest that these might serve novices and non-specialists as an expert opinion more effectively.